



MEMORANDUM

To: MCWD Board of Managers
From: Becky Christopher
Date: June 22, 2017
Re: Distribution of Draft Comprehensive Plan

Purpose:

At the June 22, 2017 Board Meeting, staff will request Board authorization to distribute the draft Comprehensive Water Resources Management Plan (Plan) for 60-day review and comment.

Background:

The draft Plan has been distributed in sections for preliminary Board and Citizen Advisory Committee (CAC) review and comment. The draft Plan and proposed schedule for public review was reviewed and discussed with the Managers at the June 8, 2017 Planning and Policy Committee (PPC) meeting. At that meeting, the Managers indicated they would be comfortable with the Plan being brought forward at the June 22, 2017 meeting for authorization to distribute.

Next Steps:

A few sections have not yet been incorporated into layout and will be sent to the Board in an updated version on Wednesday, June 21. These include sections 3.7: Evaluation and Reporting, 3.9.4: Lake Minnetonka Subwatershed Plan (Implementation Plan section), 3.10: Implementation Tables, and the Appendix: Public Process. Other text and layout edits have also been compiled based on staff, Board, and CAC feedback and will be incorporated into the final draft prior to distribution.

If there are questions in advance of the meeting, please contact Becky Christopher at 952-641-4512 or bchristopher@minnehahacreek.org.

We collaborate with public and private partners to protect and improve land and water for current and future generations.

MEETING DATE: June 22, 2017

TITLE: Authorization to Distribute Draft Comprehensive Plan for Review and Comment

RESOLUTION NUMBER: 17-043

PREPARED BY: Becky Christopher

E-MAIL: bchristopher@minnehahacreek.org

TELEPHONE: 952-641-4512

REVIEWED BY: Administrator Counsel Program Mgr. (Name): _____
 Board Committee Engineer Other

WORKSHOP ACTION:

<input type="checkbox"/> Advance to Board mtg. Consent Agenda.	<input type="checkbox"/> Advance to Board meeting for discussion prior to action.
<input type="checkbox"/> Refer to a future workshop (date): _____	<input type="checkbox"/> Refer to taskforce or committee (date): _____
<input type="checkbox"/> Return to staff for additional work.	<input type="checkbox"/> No further action requested.
<input checked="" type="checkbox"/> Other (specify): <u>Requesting approval at June 22, 2017 Board meeting</u>	

PURPOSE or ACTION REQUESTED:

Authorization to distribute the draft 2017 MCWD Comprehensive Water Resources Management Plan for 60-day review and comment

PROJECT TIMELINE:

- June 22 - Board authorization to distribute Plan for 60-day review and comment
- June 29 – Plan distribution
- August 28 – end of 60-day comment period
- September 28 – Board review and authorization of comment responses
- October 12 – public hearing
- October 25 – submit Plan to state agencies for final review and approval
- December 28 – anticipated date of Plan adoption

PAST BOARD ACTION:

- July 31, 2014 Board Meeting– Resolution 14-059: Adoption of a framework for the 2017 Comprehensive Plan update
- May 28, 2015 Board Meeting – Resolution 15-050: Appointment of Comprehensive Plan Advisory Committee Members
- October 8, 2015 Board Workshop – Resolution 15-085: Approval of process to evaluate and align District programs using strategic framework
- January 28, 2016 Board Meeting – Approval of revised Mission, Vision, Goals, and Guiding Principles
- September 8, 2016 Board Workshop – Resolution 16-076: Authorization for Plan extension

- February 9, 2017 Board Workshop – Resolution 17-007: Approval of MCWD's Strategic Direction and Adoption of 2017 Strategic Alignment Report
- June 8, 2017 Policy and Planning Committee Meeting – Review and discussion of draft Plan (no action)

SUMMARY:

For the past two years, the District has been working to develop its next generation Comprehensive Water Resources Management Plan (Plan). This work has involved an extensive stakeholder process, including a series of meetings with technical, policy, and citizen advisory committees to discuss and vet the District's approach; subwatershed meetings to discuss local priorities and plans; and other targeted outreach efforts to local policymakers and technical staff.

The development of the Plan has also involved an extensive internal strategic planning process with staff and the Board to establish a clear and focused mission, vision, goals, and guiding principles; evaluate District programs; and establish clear and focused priorities for each program and the District as a whole.

The primary focus for the Plan update is on improving the District's implementation model following the direction established in the Board's *Balanced Urban Ecology* policy which aims to integrate the District's work with the built environment using the guiding principles of partnership, focus, and flexibility.

The draft Plan consists of three volumes. The first volume acts as an executive summary of the Plan, outlining the District's new mission and a high-level framework of how the District will achieve that mission. The second volume contains a synthesis of all pertinent data used in identifying specific resource issues and acts as the District library of all studies and data collected. The third volume expands on the District's implementation framework; defines issues, drivers, and management strategies for each of the District's 11 subwatersheds; and establishes priorities based on resource needs and opportunities created through integration with land use planning.

Per MN Statutes 103B.231, the District is required to "submit the draft plan for a 60-day review and comment period to all counties, the Metropolitan Council, the state review agencies, the Board of Water and Soil Resources, soil and water conservation districts, towns, and statutory and home rule charter cities having territory within the watershed".

The Board reviewed and discussed the draft Plan and proposed timeline for the public review process at its June 8, 2017 Policy and Planning Committee meeting. A final round of edits has been compiled based on staff, Board, and CAC feedback and will be incorporated prior to distribution. Staff is requesting authorization to distribute the draft Plan for 60-day review and comment to the above entities and other interested parties following incorporation of final edits.

RESOLUTION

RESOLUTION NUMBER: 17-043

TITLE: **Authorization to Distribute Draft Comprehensive Plan for Review and Comment**

WHEREAS, the District's next generation Comprehensive Water Resources Management Plan (Plan) is due for adoption by December 31, 2017, per extension from the MN Board of Waters and Soil Resources; and

WHEREAS, on July 31, 2014, the Board approved a framework for updating the Plan that identified the primary focus of improving the District's implementation model following the direction established in the Board policy, *In Pursuit of a Balanced Urban Ecology in the Minnehaha Creek Watershed*; and

WHEREAS, development of the Plan has involved an extensive stakeholder process, including a series of meetings with technical, policy, and citizen advisory committees to discuss and vet the District's approach; subwatershed meetings to discuss local priorities and plans; and other targeted outreach efforts to local policymakers and technical staff; and

WHEREAS, development of the Plan has also involved an extensive internal strategic planning process with staff and the Board to establish a clear and focused mission, vision, goals, and guiding principles; evaluate District programs; and establish clear and focused priorities for each program and the District as a whole; and

WHEREAS, per MN Statutes 103B.231, the District is required to "submit the draft plan for a 60-day review and comment period to all counties, the Metropolitan Council, the state review agencies, the Board of Water and Soil Resources, soil and water conservation districts, towns, and statutory and home rule charter cities having territory within the watershed"; and

WHEREAS, the Board reviewed and discussed the draft Plan and proposed timeline for the public review process at its June 8, 2017 Policy and Planning Committee meeting; and

WHEREAS, a final round of edits has been compiled based on staff, Board, and CAC feedback and will be incorporated prior to distribution;

NOW, THEREFORE, BE IT RESOLVED that the Minnehaha Creek Watershed District Board of Managers authorizes staff to distribute the Draft 2017 MCWD Comprehensive Plan for 60-day review and comment, following the incorporation of final edits.

Resolution Number 17-043 was moved by Manager _____, seconded by Manager _____.
Motion to adopt the resolution ___ ayes, ___ nays, ___ abstentions. Date: _____.

Secretary Date: _____

MINNEHAHA CREEK WATERSHED DISTRICT

COMPREHENSIVE PLAN 2017

June 21, 2017



MINNEHAHA CREEK
WATERSHED DISTRICT

ACKNOWLEDGMENTS

The development of the Minnehaha Creek Watershed District's 2017 Comprehensive Water Resources Management Plan relied on the valuable input of many policymakers, city and agency staff, and community members. Listed below are the formal groups the District regularly conferred with, all of which were crucial to the production of the District's 2017 Comprehensive Plan. For a summary of the full public input process, please see the Appendix.



MINNEHAHA CREEK
WATERSHED DISTRICT

MINNEHAHA CREEK WATERSHED DISTRICT BOARD OF MANAGERS

Name	Seat
Brian Shekleton	Vice President
James Calkins	Former Manager
Jeff Casale	Former Manager
Jessica Loftus	Manager
Kurt Rogness	Secretary
Pamela Blixt	Former Manager
Richard Miller	Treasurer
Sherry Davis White	President
William Becker	Manager
William Olson	Manager

POLICY ADVISORY COMMITTEE

Name	Organization
Councilor Bob Stewart	City of Edina
Mayor Marvin Johnson	City of Independence
Administrator Scott Johnson	City of Medina
Councilor Linea Palmisano	City of Minneapolis
Councilor Patty Acomb	City of Minnetonka
Mayor Lisa Whalen	City of Minnetrista
Mayor Lili McMillan	City of Orono
Mayor Scott Zerby	City of Shorewood
Mayor Tom O'Conner	City of Victoria
Councilor Sliv Carlson	City of Woodland
Central Region Manager Terri Yearwood	Department of Natural Resources
Commissioner Stephanie Musich	Minneapolis Park & Recreation Board
Commissioner Gene Kay	Three Rivers Park District

TECHNICAL ADVISORY COMMITTEE

Name	Organization
Terry Jeffery	City of Chanhassen
Ross Bintner, Jessica Wilson	City of Edina
Nate Stanley	City of Hopkins
Lois Eberhart	City of Minneapolis
Liz Stout	City of Minnetonka
Bob Bean	Cities of Deephaven, Greenwood, Orono, Mound, St. Bonifacius, and Woodland
Derek Asche	City of Plymouth
Erick Francis	City of St. Louis Park
Cara Geheren	City of Victoria
Mike Kelly	City of Wayzata
Kristin Larson	Carver County
Randy Anhorn	Hennepin County Environmental Services
Steve Christopher	Board of Water and Soil Resources
Kate Drewry	Department of Natural Resources
Karen Jensen	Metropolitan Council
Rachael Crabb, Deb Pilger	Minneapolis Park & Recreation Board
Rich Brasch, John Barten	Three Rivers Park District

CITIZEN ADVISORY COMMITTEE

Name	City of Residence	Terms Served
Bradley Coulthart	Minneapolis	2017
Brian Girard	Orono; Deephaven	2015, 2016, 2017
Cassandra Ordway	Long Lake	2017
Chris Dovolis	Minnetonka Beach	2015, 2016

ACKNOWLEDGEMENTS

Colin Cox	St. Louis Park	2015, 2016, 2017
Craig Wilson	Hopkins	2017
Cristina Palmisano	Minneapolis	2015
David Oltmans	Minneapolis	2015, 2016, 2017
Elizabeth Crow	Minneapolis	2017
Gerald Ciardelli	St. Louis Park	2015, 2016, 2017
Jacqueline Di Giacomo	Tonka Bay	2015, 2016, 2017
John Grams	Minnetonka	2017
Joseph Lofgren	Minneapolis	2015, 2016
Joseph Lutz	Minnetonka	2016
Linda Jahnke	St. Louis Park	2017
Marc Rosenberg	Minnetonka	2015, 2016, 2017
Neil Weber	Long Lake	2015, 2016, 2017
Peter Rechelbacher	Wayzata	2015, 2016, 2017
Richard Manser	Edina	2015, 2016, 2017
Richard Nyquist	Edina; Minneapolis	2016, 2017
Sliv Carlson	Woodland	2015, 2016, 2017
Steve Mohn	Eden Prairie	2015, 2016, 2017
Valerie McGruder	Minnetonka	2016
William Bushnell	Minnetrista	2015, 2016, 2017

SIX MILE-HALSTED BAY ADVISORY COMMITTEE

Name	Organization
Thomas Funk	City of Victoria
Cara Geheren	City of Victoria
Sean Ruotsinoja	City of St. Bonifacius
Robert Bean	City of St. Bonifacius
Lisa Whalen	City of Minnetrista
David Abel	City of Minnetrista
Lane Braaten	City of Waconia
Mike Klingelhutz	Laketown Township
Angela Smith	Three Rivers Park District
Richard Brasch	Three Rivers Park District
Kristin Larson	Carver County
Mike Wanous	Carver County Soil and Water Conservation District
Randy Anhorn	Hennepin County

TABLE OF CONTENTS

1	EXECUTIVE SUMMARY	
	1.1 INTRODUCTION	12
	1.2 MCWD OVERVIEW	14
	1.2.1 MCWD PURPOSE	14
	1.2.2 DISTRICT BOUNDARIES	16
	1.2.3 ORGANIZATIONAL HISTORY	16
	1.3 MCWD APPROACH	20
	1.3.1 DISTRICT PHILOSOPHY	20
	1.3.2 DISTRICT GOALS	21
	1.3.3 IMPLEMENTATION MODEL	21
	1.4 IMPLEMENTATION PLAN SUMMARY	22
	1.4.1 PRIMARY ISSUES	22
	1.4.2 IMPLEMENTATION PRIORITIES	24
	1.4.3 RESPONSIBILITIES OF LOCAL GOVERNMENTS	29
2	LAND AND NATURAL RESOURCES INVENTORY	
	INTRODUCTION	33
	WATERSHED OVERVIEW	33
	SUBWATERSHED INVENTORY	33
	INVENTORY OF STUDIES	33

3	IMPLEMENTATION PLAN	
	3.1 INTRODUCTION:	270
	3.2 DISTRICT PHILOSOPHY:	270
	3.3 DISTRICT GOALS	274
	3.4 IMPLEMENTATION MODEL:	274
	3.4.1 UNDERSTANDING RESOURCE NEEDS	275
	3.4.2 UNDERSTANDING LAND USE PLANS	278
	3.4.3 INTEGRATION AND PRIORITIZATION	279
	3.4.4 PROGRAM IMPLEMENTATION	280
	3.5 MCWD PROGRAMS	283
	3.5.1 PLANNING	283
	3.5.2 RESEARCH AND MONITORING	284
	3.5.3 PERMITTING	285
	3.5.4 EDUCATION AND COMMUNICATIONS	287
	3.5.5 CAPITAL IMPROVEMENT PROJECTS	288
	3.5.6 LAND CONSERVATION	292
	3.5.7 PROJECT MAINTENANCE AND LAND MANAGEMENT (PMLM)	299
	3.5.8 GRANTS	300
	3.6 REVIEW OF LOCAL WATER PLANS AND MUNICIPAL COORDINATION	304
	3.6.1 STATUTORY REQUIREMENTS FOR LOCAL WATER PLANS	304
	3.6.2 A SHIFT IN THE DISTRICT’S APPROACH TO LOCAL WATER PLANNING	306

3.6.3 THE ROLE OF THE LOCAL WATER PLAN IN ACHIEVING REGIONAL LAND AND WATER GOALS	307
3.6.4 LOCAL WATER PLAN CONTENT REQUIREMENTS	311
3.6.5 DISTRICT REVIEW AND APPROVAL OF LOCAL WATER PLANS	322
3.7 EVALUATION AND REPORTING	325
3.8 PLAN AMENDMENTS	325
3.9 SUBWATERSHED PLANS	327
3.10 IMPLEMENTATION TABLES	327

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VOLUME 1 EXECUTIVE SUMMARY

1.1 INTRODUCTION	12
1.2 MCWD OVERVIEW	14
1.3 MCWD APPROACH	20
1.4 IMPLEMENTATION PLAN SUMMARY	22

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1.1 INTRODUCTION

This watershed management plan (“Plan”) has been prepared pursuant to Minnesota Statutes §103B.231 and Minnesota Rules 8410. It describes how the Minnehaha Creek Watershed District (District or MCWD) will fulfill its responsibilities under the Metropolitan Surface Water Management Act (Minnesota Statutes §§103B.201 to 103B.255) over the ten-year planning period of 2017-26.

The Plan consists of three volumes.

The first volume is this **Executive Summary**. This volume briefly reviews the purpose, structure and history of the MCWD; its philosophy and approach to fulfill its water resource management responsibilities; the primary issues within its eleven subwatersheds; the programs and projects by which it will address these issues; and what it will ask of its cities and townships in order to achieve water resource goals for the watershed.

The second volume is the **Land and Natural Resources Inventory**. Chapter 8410 requires the Plan to inventory watershed data on topography, soils, geology, precipitation, surface water resources, water quality and quantity trends, groundwater resources, hydraulic systems to convey stormwater, regulated pollutant sources, habitat, rare and endangered species, recreation areas, existing land uses and trends, and wetland preservation and restoration priority areas. The MCWD has a substantial data base from many years of careful monitoring and data acquisition. It provides in this volume a description of its data, reference to data locations, and a discussion of the data support for the MCWD’s identified water resource issues, goals and strategies.

In addition, this volume describes the MCWD’s Ecosystem Evaluation Program, or “E-Grade,” a rubric that uses multiple parameters to characterize the health and function of the watershed. The purpose of E-Grade is to capture the condition of resources within the watershed in a way that is useful to the public and provides a uniform metric to set priorities and make resource investment decisions.

The third volume is the **Implementation Plan**. This volume is the roadmap from planning to implementation. More specifically, it describes the planning path from issue identification to identifying the causes of issues, setting objectives and goals and, finally, defining management strategies to achieve identified goals. Management strategies fall into program and project categories that include planning, research and monitoring, capital improvements, land acquisition and conservation, incentive

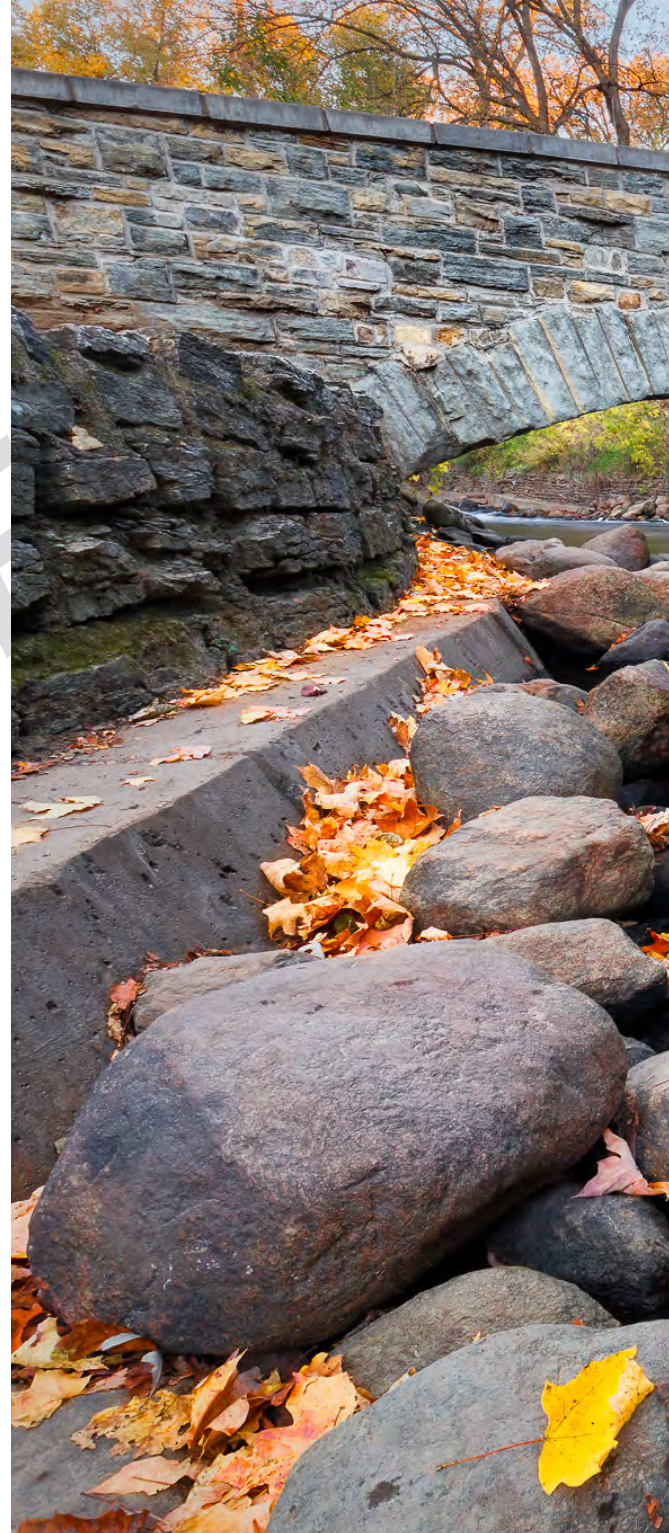



Figure 1.3 Minnehaha Creek below the falls, Ernesto Ruiz



The MCWD is responsible for 177 square miles that drain into the Minnehaha Creek and ultimately the Mississippi River.

programs, project maintenance, land disturbance permitting and public communication/education. The volume describes each of these programs and the procedures that the MCWD will use to identify, fund and implement them.

Objectives and management strategies rest on the MCWD's *Balanced Urban Ecology* approach to water resource planning and implementation. This approach recognizes the environmental, social and economic value created when built and natural systems work in harmony. It is described in this volume.

Finally, the Implementation Plan features a subplan for each of the MCWD's eleven subwatersheds. Each subwatershed plan follows the same sequence outlined - from issues to identification of causes, objectives and goals, and management strategies. The implementation program for each subwatershed will identify specific projects and initiatives but also allow for specific projects and initiatives to arise from planning, collaborative processes and opportunities. Subwatershed plans are intended to be largely self-standing so they are efficient resources for LGUs and other stakeholders within a given subwatershed.

1.2 MCWD OVERVIEW

1.2.1 MCWD PURPOSE

Clean water and a healthy natural environment are essential to create and sustain vibrant communities. The lakes, streams, wetlands and green space that make up our landscape create a sense of place that provides a local identity, adds economic value and increases well-being.

As a political subdivision created under state law, the MCWD exists to pursue water resource management purposes set forth at Minnesota Statutes §§103B.201 and 103D.201. The listed purposes are many, but may be summarized as "secur[ing] the ... benefits associated with the proper management of surface and ground water." Minn. Stat. §103B.201(8). The MCWD assumes a further mandate for water resource protection as a permittee under the federal National Pollutant Discharge Elimination System (NPDES) program for municipal separate storm sewer systems (MS4s).

Traditionally, the MCWD has pursued its purposes through several standard roles: gathering and assessing data; planning, constructing and maintaining capital projects; regulating land use disturbances to limit water resource impacts; supporting others' actions through grant or cost-share programs and technical assistance; conducting non-capital programs such as rough

The MCWD's approach to water resource planning recognizes the environmental, social, and economic value created when built and natural systems work in harmony."



Figure 1.4 Looking westward over Lake Wassermann

fish management and lake treatment for invasive aquatic species; and engaging in public communication and education.

In general, these remain the means by which the MCWD acts. This planning cycle, however, reflects an evolution from an independent program of action toward one that derives from a more careful and active consideration of the MCWD's role and the roles of other public and private interests in the realm of water resource protection. As such, the MCWD sees its purposes not only as securing water resource benefits for the public, but as serving the roles that facilitate similar efforts by other interests.

The MCWD's particular role includes, then:

- » Acquiring, assessing and maintaining watershed-wide water resource data.
- » Performing special studies, and developing assessments and metrics, to provide for consistent resource evaluation and priority-setting across the watershed.
- » Linking local units of government to statewide water programs, mandates and funding.
- » Leading or facilitating multi-partner water resource actions that cross local government boundaries within the watershed.
- » Serving as a conduit of best practices, and other specialized knowledge and resources, to its general purpose units of government.
- » Coordinating with local units of government to integrate water resource protection at site and regional scales into land subdivision and development.

Clean water and a healthy natural environment are essential to create and sustain vibrant communities. The lakes, streams, wetlands and green space that make up our landscape create a sense of place that provides a local identity, adds economic value and increases well-being.

- » Working with public and private partners to integrate public water resource goals with other public and private goals in land and infrastructure development.

1.2.2 DISTRICT BOUNDARIES

The MCWD encompasses about 177 square miles within the western Twin Cities metropolitan area. Of this area, about 148 square miles lies within Hennepin County and about 29 square miles lies within Carver County.

The watershed comprises two distinct hydrologic basins. The “Upper Watershed” drains through 104 square miles of agricultural and suburban land to Lake Minnetonka, a 22-square-mile lake that is Minnesota’s tenth largest waterbody. Lake Minnetonka outlets through a structure controlled by the MCWD into Minnehaha Creek, which flows for about 23 miles and discharges into the Mississippi River in Minneapolis. About 52 square miles, constituting the “Lower Watershed,” drain into Minnehaha Creek through the Minneapolis Chain of Lakes or directly by means of stormsewer or overland flow.

Twenty-seven cities and two townships lie in whole or part within the watershed as shown in Figure 1.1. Table 1.1 lists the MCWD’s cities and townships. Two regional park authorities exist within the MCWD: the Minneapolis Park and Recreation Board and the Three Rivers Park District.

1.2.3 ORGANIZATIONAL HISTORY

On April 12, 1966, the Hennepin County Board of Commissioners petitioned the Minnesota Water Resources Board under authority of Minnesota Statutes Chapter 112 (now 103D) to establish the MCWD. The cited purposes for the MCWD were to conserve the watershed’s waters and natural resources; improve lakes, marshes and channels for water storage, drainage, recreation and other public purposes; reduce flooding; keep silt from streams; control land erosion; reclaim wetlands; control stormwater, and preserve water quality in lakes and streams. The MCWD was established on March 9, 1967.

The MCWD has implemented numerous policies, programs and projects to advance its goals. It first adopted rules to regulate development in 1967. Since that time, it has exercised oversight of development to limit water resource impacts from erosion, stormwater flows, floodplain alteration, wetland disturbance, shoreline and streambank alterations, dredging and other causes. In 1972, the MCWD accepted authority over eight county and judicial drainage systems located within the watershed. The MCWD developed watershed management plans in 1969, 1997 and 2007. This Plan represents the MCWD’s fourth cycle of water resource planning and implementation.

The MCWD’s 1997 plan featured a traditional emphasis on identified capital projects to address legacy water quality or flooding issues and, separately,

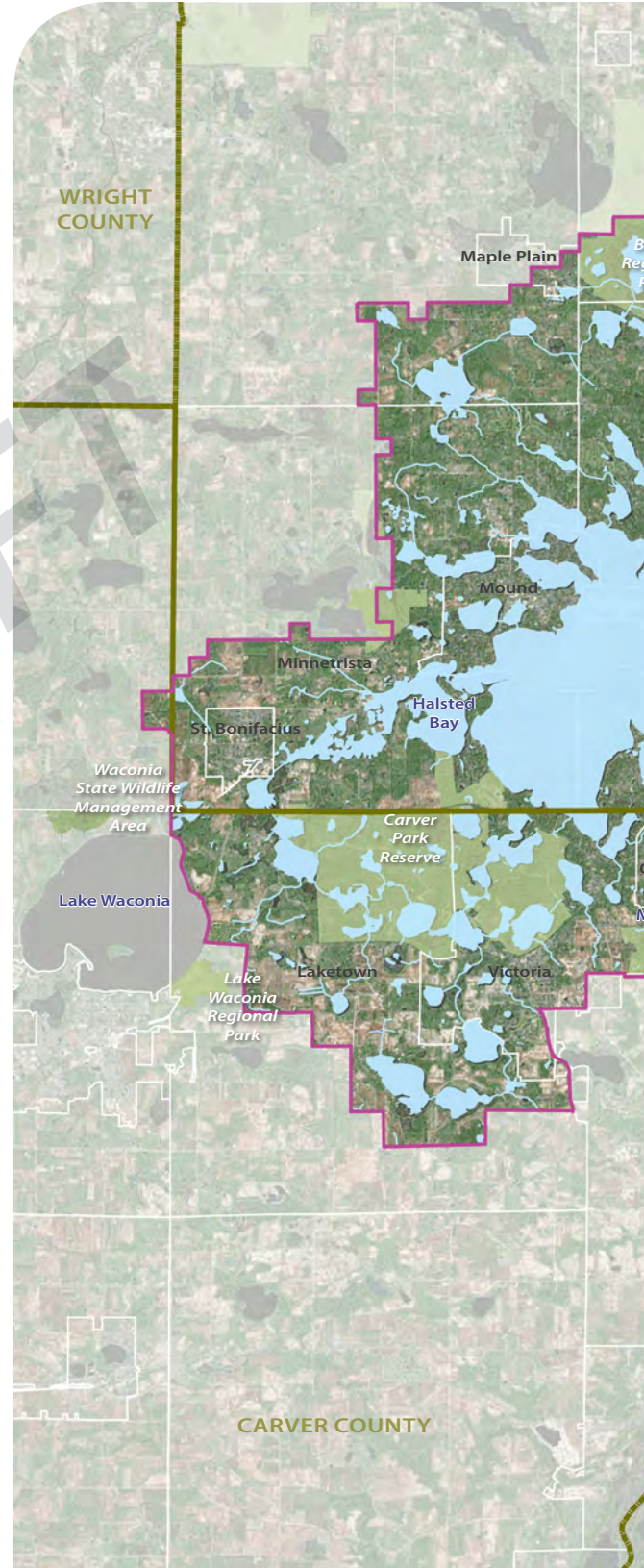
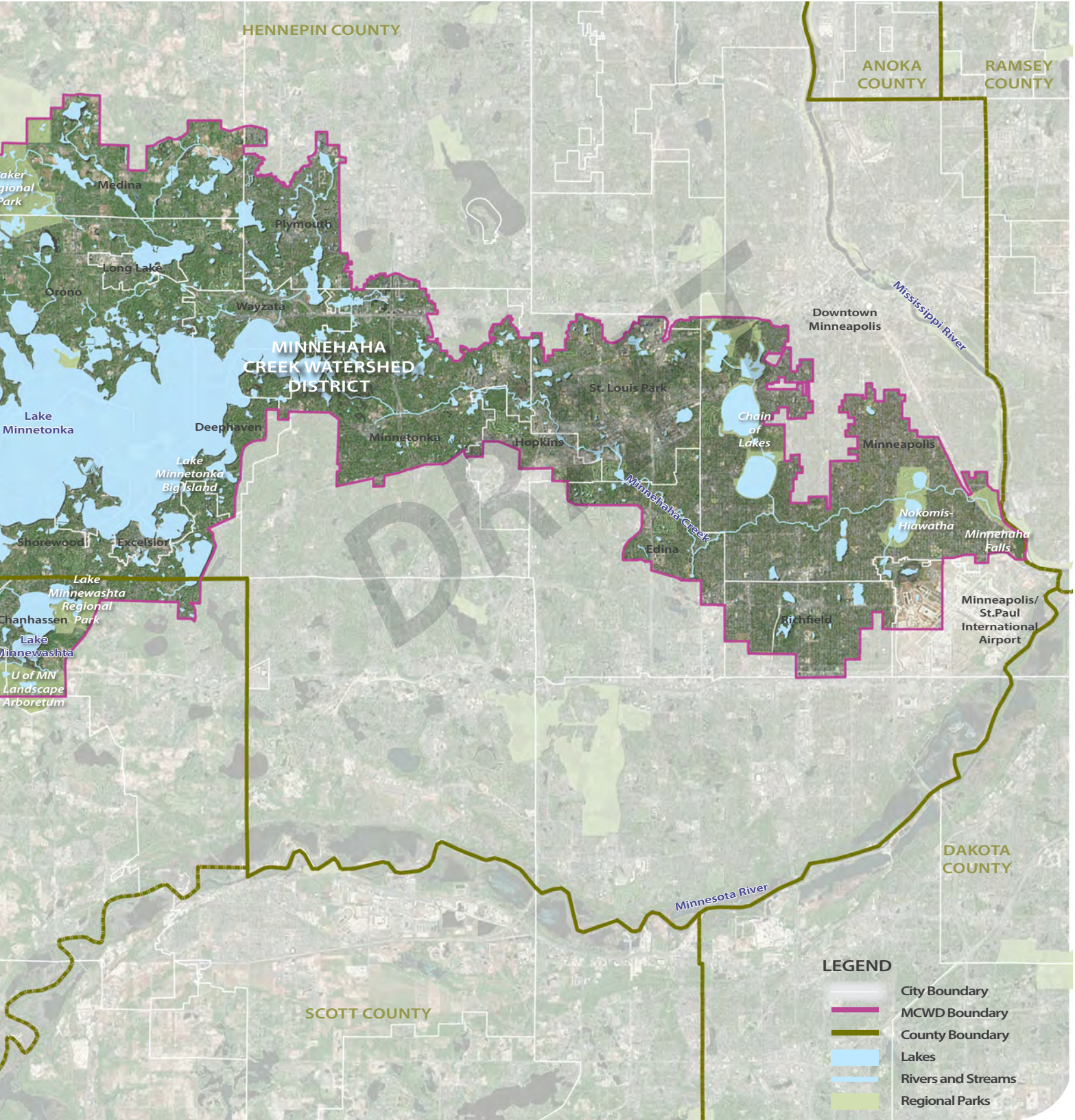


Figure 1.5 Minnehaha Creek Watershed District extents



HENNEPIN COUNTY	
Deephaven	Minnetrista
Edina	Mound*
Excelsior*	Orono*
Golden Valley	Plymouth
Greenwood*	Richfield
Hopkins	St. Bonifacius*
Independence	St. Louis Park
Long Lake*	Shorewood
Maple Plain	Spring Park*
Medina	Tonka Bay*
Minneapolis	Wayzata*
Minnetonka	Woodland*
Minnetonka Beach*	
CARVER COUNTY	
Chanhassen	Victoria*
Laketown Township	Watertown Township

*Entirely in District

Figure 1.9 Figure title



Figure 1.6 Cottageville Park Expansion



Figure 1.7 Streambank restoration at Cottageville Park



Figure 1.8 Cottageville Park

regulation of new development to minimize new impacts. The 2007 plan began to move toward a more flexible framework, with water quality standards set for the MCWD’s lakes and streams, and targets set for the reduction of phosphorus loads to identified receiving waters in each of the MCWD’s subwatersheds. The MCWD assumed responsibility for a part of these reductions and mandated that the local water plans of its LGUs program “housekeeping” (such as management of LGU properties and street sweeping) and capital projects to achieve reductions.

The plan, though, was static in several respects. It identified a specific list of MCWD projects, it directed LGUs to independently act, and it separated capital project work from regulation of development. As the MCWD implemented the plan, however, the approach evolved to a more flexible framework in which its LGUs, developers and other public and private parties have become partners in opportunity-based work that serves multiple goals. In 2014, the MCWD Board of Managers articulated and adopted this approach as its *Balanced Urban Ecology* (BUE) policy. The BUE policy prioritizes partnership with the land use community to integrate

policy, planning and implementation in order to leverage the value created when built and natural systems are in harmony.

The BUE policy emerged as the MCWD reflected on its collaborative work along the urbanized Minnehaha Creek corridor within the Cities of St. Louis Park and Hopkins, now referred to as the Minnehaha Creek Greenway. There, over the course of several years, the MCWD worked with public and private partners - including a hospital, a large industrial employer, property owners, and the Cities of Hopkins and St. Louis Park - in a succession of projects to achieve mutual goals.

The hospital created a healing environment through connection with a restored natural setting and enhanced flood protection for a sensitive part of its facilities. The industrial employer gained footprint, stormwater management and local land use approval for a large expansion.

An apartment complex property owner achieved trail access for its residents, while an industrial property owner was connected to city stormsewer improvements to address site flooding. Hopkins turned a hidden, troubled pocket park into an open community space; gained regional stormwater treatment for redevelopment; and positioned a large industrial site for a shift in use consistent with the area redevelopment plan. St. Louis Park gained natural and recreational amenities and an expanded tax and employment base.

For the MCWD, outcomes of this partnered work included restoration of a substantial length of creek sinuosity, riparian wetland and floodplain; treatment of runoff from several hundred fully developed acres of urban land that previously discharged untreated to the creek; and the creation of both passive and active recreational sites connected to the water environment and integrated with public education about the natural environment. Further, the public cost of the stormwater infrastructure work was reduced by working with Metropolitan Council Environmental Services to incorporate the work into concurrent sanitary sewer construction.

The MCWD realized that if it builds sound relationships with local partners; remains aware of partners' land use activities and goals; is mindful of subwatershed priorities; and is watchful and flexible, opportunities will present themselves to advance water resource goals cost-effectively and consistent with other local public and private goals. This Plan takes the next step in the evolution of the MCWD's philosophy and approach by adopting the BUE policy as its underlying organizational strategy.

1.3 MCWD APPROACH

1.3.1 DISTRICT PHILOSOPHY

The natural environment is an integral component of vibrant communities. It creates a sense of place, provides vital connections, and enhances social and economic value. The MCWD vision is a landscape of vibrant communities where the natural and built environments in balance create value and enjoyment.

This vision stems from the MCWD’s 2014 adoption of the Balanced Urban Ecology (BUE) policy, which now serves as the MCWD’s underlying organizational strategy. It prioritizes partnership with the land use community to integrate policy, planning and implementation. BUE developed from a series of policy analyses that identified the governance gap between land use and water resource planning. It responded to state, county and non-profit assessments calling for increased integration with land use to improve the watershed management model in Minnesota, and for treating land development and water resource protection as complementary rather than competing interests.

The BUE policy states:

Rather than viewing the natural and built environments as a clash of opposing forces, we recognize the interrelated and interdependent character of modern life; communities cannot thrive without healthy natural areas, and healthy natural areas become irrelevant without the interplay of human activity. This is the integrated setting in which we live. Indeed, our quality of life and our economic wellbeing are inextricably linked. Any notion that land development and environmental protection are locked in a winner-take-all battle is sadly outdated.

Successful, sustainable, livable communities are built on a foundation of integrated planning – planning that recognizes communities as living organisms and takes into consideration all components of the urban ecology.

Our work will be strengthened through these collaborative efforts. Not only will they offer greater community impact, they will produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits. Going it alone is no longer the best path forward.

The BUE policy rests on the following three principles:

- » Intensifying and maintaining focus on high-priority projects;
- » Partnering with others to pursue watershed management goals;



Figure 1.10 District philosophy



Figure 1.11 Great Blue Heron

- » Being flexible and creative in adapting to the needs of partners.

Too often, watershed district ten-year implementation plans have been pursued independent of community planning and, as a result, have not been aligned with land use changes, new public infrastructure and private development. This has led to independent public expenditure to address existing problems and a reliance on regulation to limit impacts from new development. The opportunity to partner with other public and private actors to achieve better water resource outcomes and increased public value has been missed. By working to understand the goals of others; applying sound science to creative solutions; and aligning investments, technical expertise, streamlined permitting, collaborative planning and educational resources, the MCWD will seek to bring added value to partner initiatives across the watershed and cost-effectively achieve complementary public and private goals.

1.3.2 DISTRICT GOALS

The District has established four strategic goals:

- » **Water Quantity** - To manage the volume and flow of stormwater runoff to minimize the impacts of land use change on surface and groundwater.
- » **Water Quality** - To preserve and improve the quality of surface and groundwater.
- » **Ecological Integrity** - To restore, maintain and improve the health of ecological systems.
- » **Thriving Communities** - To promote and enhance the value of water resources in creating successful, sustainable communities.

For purposes of Plan organization, all MCWD water resource issues nest within the three strategic goal areas of Water Quality, Water Quantity and Ecological Integrity. Example issues include excess nutrients (water quality), flooding (water quantity), and degraded habitat (ecological integrity). No issues are outlined under the Thriving Communities goal. This goal is an overarching organizing element to guide the MCWD in implementing its mission: the MCWD will implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities.

1.3.3 IMPLEMENTATION MODEL

The BUE policy requires awareness, adaptation and the capacity to pursue opportunities as they arise. The implementation model to support this approach is ongoing and iterative, with several elements.

The first element is to understand water resource needs on a subwatershed

basis. Each subwatershed plan within this Plan follows an issues, drivers and strategies sequence. Issues are the specific needs to be addressed - where conditions fall short of strategic goals for the subwatershed. Drivers are the causes or contributing factors of these conditions. Strategies are the means by which the issues may be addressed. Strategies are not defined programs or projects, but rather the different modes of action, approaches and techniques that the MCWD may use within a described area to achieve a desired water quantity, water quality or ecological integrity outcome.

The second element is to understand the land use setting. The MCWD maintains current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity. Under this Plan, the MCWD will establish with each LGU a coordination protocol so that the MCWD and the LGU are aware of each other's planning activities, of pending development activity and of applications received for regulatory review.

The third element is prioritization. By means of diagnostic data-gathering, the MCWD forms and adjusts implementation priorities to achieve MCWD goals, and coalesces project concepts, on a subwatershed basis. It performs feasibility scanning in consultation with regulatory and other resource agencies. At the same time, the MCWD integrates its water resource priorities with the current land use context to look for the intersection of MCWD and partner interests, develop feasible and potentially cost-effective project concepts, and initiate project planning and coordination with public and private partners.

The last element is implementation. This involves formalizing public and private partner agreements that identify project roles and responsibilities, arranging necessary land rights, following required procedures to establish project funding and financing, and moving forward to implement. A project may involve capital construction, or may involve one or more other modes of MCWD action including data collection/diagnosis, technical or planning assistance, permitting assistance, facilitation and grants. After project completion, the MCWD assesses project performance with respect to desired outcomes of the MCWD and of partners.

1.4 IMPLEMENTATION PLAN SUMMARY

1.4.1 PRIMARY ISSUES

Water Quality

Within the watershed, pollutant discharge is primarily from non-point sources, carried to lakes, streams and wetlands by snowmelt or rainfall that runs across the landscape. Sediment, nutrient (particularly phosphorus) and



Figure 1.12 Planning layers diagram

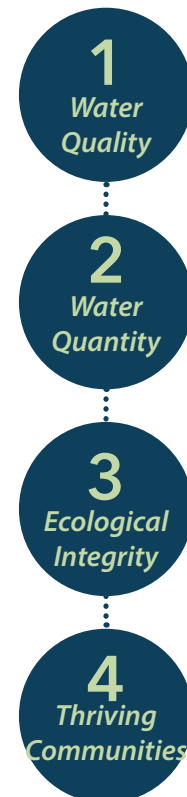


Figure 1.13 Four subwatershed goals

other pollutant load in runoff exceeds what lakes, streams and wetlands would receive in an undeveloped watershed.

Within freshwater systems, excess nutrient content promoting eutrophication is the most common problem. Phosphorus affects algal and plant productivity, water clarity, fish habitat and aesthetics. Other pollutants stress freshwater systems, but phosphorus is used as standard indicator of system health.

The U.S. Environmental Protection Agency (EPA) and the Minnesota Pollution Control Agency (MPCA) define acceptable water quality as that which supports the designated use of the waterbody (e.g. fishable, swimmable, drinkable). The Plan defines good water quality as when the physical, chemical, biological and aesthetic characteristics of a waterbody support its designated use. Because water quality is largely regulated by total phosphorus concentration, the water quality emphasis of this Plan is on reducing phosphorus loads to lakes to achieve standards set by the state.

Water Quantity

As land use alters a watershed, the flow of water across the landscape changes. In an undeveloped watershed, rainfall largely infiltrates into the ground. As the watershed begins to include built components, channels are straightened, wetlands are filled, drainageways are piped, natural vegetation is removed and hard surface is installed. These reduce water infiltration and storage. Larger volumes of water drain through the system faster.



Figure 1.14 Heavy rains flooded Lake Hiawatha in 2014

Flooding occurs when a watershed is overwhelmed with rainfall that cannot infiltrate into the ground or be appropriately stored on the landscape. Flooding can occur across a watershed on major lakes and streams, or more locally in ponds and street systems that cannot adequately store or convey the water being received during and after storm events.

Water quantity also is an issue when there is not enough water. Water is essential for aquatic life and the health of aquatic systems. In an undeveloped watershed condition, water is stored in wetlands or infiltrated into the ground. It is slowly released to the stream channel, promoting long periods of stable water flow. In urban watersheds with extensive hard surface, water moves through the system quickly after rainfall events. This results in intermittent channel flow and periods where the channel is dry. This “flashy” stream behavior directly affects the ecological health of the stream, stressing fish, macroinvertebrates, plants and other aquatic life.

The Plan focuses on water quantity issues that stress the regional system. The MCWD will work with its partners to plan and implement solutions that return surface flow behavior as much as possible to natural behavior, and that create a more resilient system to handle high and low flow behavior.

Ecological Integrity

The three primary elements of an ecological system are its structure, composition and function. Structure is all of the living and non-living physical components that make up an ecosystem. Composition is the variety of living things within the ecosystem. Function is the assemblage of natural processes that occur within the ecosystem.

Ecological integrity exists when ecosystem composition and function are unimpaired by stress from human activity. It exists when natural ecological processes are intact, naturally evolving and self-sustaining.

Within this Plan, ecological integrity seeks balance between the built and natural environments, with ecosystems providing the highest possible measure of structure, composition and function relative to the level of human impact within the system. The implementation plan seeks to improve structure, composition and function at an individual resource level, and connectivity between aquatic and terrestrial ecosystems at a regional landscape scale.

1.4.2 IMPLEMENTATION PRIORITIES

One of the guiding principles of the District’s Balanced Urban Ecology policy is “intensifying and maintaining focus on high-priority projects”. Through its work in the Minnehaha Creek Greenway, the District has found



Figure 1.16 Great egret



Figure 1.15 Staff and volunteers monitor water quality across the watershed

Through sustained focus, the District is able to develop a thorough understanding of a system's issues and drivers, build relationships, identify opportunities, and coordinate plans and investments with its partners for maximum natural resource and community benefit.



Figure 1.17 A boardwalk at the Minnehaha Creek Preserve

that it can more effectively achieve its mandate to manage and improve water resources, not when it seeks to apply its resources evenly across the watershed at all times, but rather when it coordinates its programs and capital investments so as to focus on specific areas of high need and opportunity.

Through sustained focus, the District is able to develop a thorough understanding of a system's issues and drivers, build relationships, identify opportunities, and coordinate plans and investments with its partners for maximum natural resource and community benefit.

This focused approach is best suited in areas where there are significant resource needs and a level of complexity that require sustained effort and coordination across multiple public and private partners. The other factors that drive the District to focus in a particular geography are the opportunities that exist, such as land use changes, partner efforts, or funding sources.

The District has identified three priority subwatersheds in which to focus its implementation efforts for the 2017-26 plan cycle – Minnehaha Creek, Six Mile-Halsted Bay, and Painter Creek. These three subwatersheds have been prioritized based on a combination of resource needs and opportunities, as summarized below.

Minnehaha Creek

As described in Section 1.2.4, the District's focused approach originated in the Minnehaha Creek Greenway, and has produced significant natural resource and community benefits.

The Board identified this section of the Creek through Hopkins and St. Louis Park as a priority focus area because of its resource needs – Minnehaha Creek and downstream Lake Hiawatha are impaired, and this stretch of creek was identified as contributing the highest pollutant loads; and its opportunities – the area is undergoing significant land use planning and redevelopment due to the planned light rail transit system.

The District will continue its efforts in the Minnehaha Creek Subwatershed under this Plan, completing projects that are underway in the Greenway, and extending its stream restoration and stormwater management work downstream through partnerships with the cities of Edina and Minneapolis and the Minneapolis Park and Recreation Board.

Six Mile-Halsted Bay

The Six Mile-Halsted Bay focal geography is a complex system that spans four communities, two counties, and a significant portion of Three Rivers

Park District land. It is resource-rich with 18 lakes, including Halsted Bay of Lake Minnetonka, and over 6,000 acres of wetlands. Six of these lakes are classified as impaired under Minnesota Pollution Control Agency standards with Halsted Bay requiring the largest load reduction of any waterbody in the District. The subwatershed is experiencing significant growth and development activity that creates opportunities, and an urgency, for integrated land use and water resource planning.

In 2016, the District formed the Six Mile-Halsted Bay Subwatershed Partnership to coordinate implementation activities with the communities and other subwatershed partners. From 2016-2017, the Subwatershed Partnership has established shared priorities for the geography and a framework for ongoing coordination to realize its goals around clean water and abundant natural resources integrated with the built environment.

The principal implementation strategies within the Six Mile-Halsted Bay subwatershed include carp management to restore lake ecology, restoration of degraded wetlands, and the use of aluminum sulfate, or alum, to address internal phosphorus release. Given the geography's scale and complexity, priority implementation activities will be established in coordination with the Subwatershed Partnership on an ongoing basis based on an individual project's natural resource benefit, opportunity to leverage external investment, community support and urgency.

Painter Creek

The Painter Creek Subwatershed contains a number of large wetlands, many of which have been ditched or otherwise altered, that are connected by Painter Creek. The system delivers high phosphorus loads to Jennings Bay on Lake Minnetonka, which is listed as impaired and requires the second largest load reduction in the District. Painter Creek is also impaired by excess *E. coli* bacteria. *The subwatershed includes areas of high quality wetland and upland, including several regionally significant ecological areas.*

The MCWD has previously established a partnership with the United States Army Corps of Engineers (USACE), which identified the potential restoration of four of the major wetland marsh systems under the Federal Section 206 Program. Management strategies within the Painter Creek subwatershed will focus on restoring wetland and stream systems in ways that reduce nutrient loading downstream to Jennings Bay, while improving ecological integrity and corridor connectivity within the subwatershed. Before this work is advanced, MCWD will develop a specific systems plan for this subwatershed in partnership with local municipalities and landowners.







Figure 1.18 A boardwalk connects Park Nicollet Methodist Hospital to a restored section of Minnehaha Creek.



Watershed-wide

In addition to these focused implementation efforts, the District's approach watershed-wide is to remain responsive to opportunities created by land use change or partner initiatives. The Plan creates a coordination framework through which the District will maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined in the subwatershed plans in Section 3.7 and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

The District anticipates that the most likely capital project opportunities to arise through this approach will be in the area of stormwater management. For this reason, the capital improvement program (CIP) includes stormwater management projects for all subwatersheds, with the exception of Christmas Lake which has high water quality. The CIP also includes wetland restoration and internal load management in the Long Lake Creek Subwatershed as well as carp assessment and management in the Dutch Lake, Painter Creek, Lake Minnetonka, and Long Lake Creek subwatersheds. Over the course of the 2017-26 plan cycle, new opportunities and priorities may be identified that are beyond the scope of this CIP in which case the District would pursue a plan amendment.

1.4.3 RESPONSIBILITIES OF LOCAL GOVERNMENTS

After the Plan is approved or amended, each local government unit (LGU) within the MCWD with land use planning and regulatory responsibility must prepare a local water management plan, capital improvement program, and official controls as prescribed in the Plan. An MCWD-approved local water plan is a required element of the LGU comprehensive land use management plan mandated by Minnesota Statutes §473.864.

This planning framework shows the link that the legislature has recognized between land use and water resource planning. As the regional water resource authority, the MCWD is responsible to understand hydrologic systems on a watershed basis. In its review of local water plans, the MCWD seeks to engage its LGUs as partners in incorporating this basis of knowledge and understanding into the exercise of land use planning, regulatory, capital, infrastructure maintenance and related local authorities.

Although the watershed planning law gives watershed districts the authority to mandate LGU actions toward district-identified water resource goals, the MCWD’s approach under this Plan relies to a limited extent on mandates and much more on support for a partnership approach. Between the water resource program capacity that LGUs have developed since the MCWD’s 2007 plan, the capacity the MCWD has developed since that time to discern and facilitate projects and initiatives that serve the complementary goals of public and private interests, and the broader concept of hydrologic function and beneficial public use reflected by the MCWD’s development of the E-Grade metric for measuring water resource health, the MCWD is judging that a collaborative approach will better achieve its water resource goals. The benefit of a local water plan that is more full with local data, that expresses an LGU’s more careful assessment of its issues and potential strategies, and that makes a stronger commitment to coordination, will be a greater MCWD interest in collaboration and higher priority access to MCWD technical and financial resources.

Targeted areas of collaboration include:

- » Land use policy development and its implementation through planning activities including long-range land use and infrastructure plans, area-wide plans, and recreation and open-space plans.
- » Capital improvement feasibility planning for public infrastructure including roads, sewer, drinking water and localized power generation.
- » Land use and development regulation, from initial development feasibility through ongoing inspection and facility maintenance functions.
- » LGU operations and facility maintenance.

The District is prepared to program staff capacity to track planning, development, public infrastructure and program activity within interested LGUs, so as to position the District to work with public and private interests within those LGUs in pursuit of the shared and compatible goals of each.

A chief element of the local plan is a proposed plan for LGU/MCWD coordination. The goal of the coordination plan is to maintain mutual awareness of needs and opportunities to foster programs and projects that: (i) develop out of coordinated, subwatershed-based planning; (ii) reflect the cooperation of other public and private partners; (iii) align investments; and (iv) secure a combined set of District, LGU and partner goals. The coordination plan provides for ongoing and periodic communications as to land use planning, infrastructure programming, and development regulation.



Figure 1.19 Park Nicollet overlooks a restored wetland & boardwalk



Figure 1.20 Cottageville Park Figure title



Figure 1.21 District staff and partners co-develop plans

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Table of Contents

1.0	Introduction	1-42
2.0	Watershed Overview.....	2-47
	Cities:.....	2-47
	Climate:	2-48
	Topography, Soils, and Drainage:.....	2-48
	Water Resources:	2-49
	Potential Environmental Hazards:	2-51
3.0	Subwatershed Inventory	3-57
3.1	Christmas Lake Subwatershed	3-57
	Watershed Description and Hydrology.....	3-57
	Water Quality:.....	3-61
	Water Quantity:.....	3-67
	Ecological Integrity:.....	3-68
	Thriving Communities:.....	3-71
	Studies and Assessments:.....	3-75
3.2	Dutch Lake Subwatershed	3-75
	Watershed Description and Hydrology:.....	3-76
	Water Quality:.....	3-80
	Water Quantity:.....	3-86
	Ecological Integrity:.....	3-86
	Thriving Communities:.....	3-89
	Studies and Assessments:.....	3-93
3.3	Gleason Lake Subwatershed	3-94
	Watershed Description and Hydrology:.....	3-94
	Water Quality:.....	3-98
	Water Quantity:.....	3-104
	Ecological Integrity:.....	3-104
	Thriving Communities:.....	3-108
	Studies and Assessments:.....	3-112
3.4	Lake Minnetonka Subwatershed	3-113
	Watershed Description and Hydrology:.....	3-113
	Water Quality:.....	3-118
	Water Quantity:.....	3-126
	Ecological Integrity:.....	3-126
	Thriving Communities:.....	3-129
	Studies and Assessments:.....	3-133
3.5	Lake Virginia Subwatershed	3-135
	Watershed Description and Hydrology:.....	3-135
	Water Quality:.....	3-139
	Water Quantity:.....	3-145
	Ecological Integrity:.....	3-145
	Thriving Communities:.....	3-148
	Studies and Assessments:.....	3-152
3.6	Langdon Lake Subwatershed	3-153
	Watershed Description and Hydrology:.....	3-153
	Water Quality:.....	3-157
	Water Quantity:.....	3-163
	Ecological Integrity:.....	3-163



- Thrivng Communities:..... 3-167
- Studies and Assessments:..... 3-170
- 3.7 Long Lake Creek Subwatershed..... 3-170
 - Watershed Description and Hydrology:..... 3-171
 - Water Quality:..... 3-175
 - Water Quantity:..... 3-181
 - Ecological Integrity:..... 3-181
 - Thrivng Communities:..... 3-185
 - Studies and Assessments:..... 3-188
- 3.8 Minnehaha Creek Subwatershed 3-189
 - Watershed Description and Hydrology:..... 3-189
 - Water Quality:..... 3-193
 - Water Quantity:..... 3-200
 - Ecological Integrity:..... 3-200
 - Thrivng Communities:..... 3-205
 - Studies and Assessments:..... 3-208
- 3.9 Painter Creek Subwatershed 3-209
 - Watershed Description and Hydrology:..... 3-210
 - Water Quality:..... 3-214
 - Water Quantity:..... 3-220
 - Ecological Integrity:..... 3-220
 - Thrivng Communities:..... 3-224
 - Studies and Assessments:..... 3-227
- 3.10 Schutz Lake Subwatershed 3-228
 - Watershed Description and Hydrology:..... 3-228
 - Water Quality:..... 3-232
 - Water Quantity:..... 3-238
 - Ecological Integrity:..... 3-238
 - Thrivng Communities:..... 3-241
 - Studies and Assessments:..... 3-245
- 3.11 Six Mile Marsh Subwatershed..... 3-246
 - Watershed Description and Hydrology:..... 3-246
 - Water Quality..... 3-250
 - Water Quantity:..... 3-257
 - Ecological Integrity:..... 3-257
 - Thrivng Communities:..... 3-262
 - Studies and Assessments:..... 3-265
- 4.0 Inventory of Studies..... 4-266**

TABLES

Table 1.1 E-Grade Technical Threshold Descriptions 1-3

Table 2.1. Cities and townships in the Minnehaha Creek watershed.2-47

Table 2.2. Temperature averages in °F for the Minnehaha Creek watershed..... 2-6

Table 2.3. Precipitation averages in inches for the Minnehaha Creek watershed..... 2-6

Table 2.4. Soil characteristics and infiltration rates by Hydrologic Soils Group 2-6

Table 3.11. Cities in the Christmas Lake subwatershed.....3-14

Table 3.12. Physical characteristics of lakes in the Christmas Lake subwatershed.....3-61

Table 3.13. Selected water quality goals and current conditions of lakes in the Christmas Lake subwatershed.3-61

Table 3.14. Major streams in the Christmas Lake subwatershed.3-61

Table 3.15. Current conditions of streams in the Christmas Lake subwatershed.3-62

Table 3.16. National Wetland Inventory wetland types in the Christmas Lake subwatershed.....3-64

Table 3.17. 2010 land use in the Christmas Lake subwatershed.....3-71

Table 3.21. Cities in the Dutch Lake subwatershed3-33

Table 3.22. Physical characteristics of lakes in the Dutch Lake subwatershed.....3-61

Table 3.23. Selected water quality goals and current conditions of lakes in the Dutch Lake subwatershed.3-61

Table 3.24. Major streams in the Dutch Lake subwatershed.....3-61

Table 3.25. Current conditions of streams in the Dutch Lake subwatershed.3-62

Table 3.26. National Wetland Inventory wetland types in the Dutch Lake subwatershed.3-64

Table 3.27. 2010 land use in the Dutch Lake subwatershed.3-7147

Table 3.31. Cities in the Gleason Lake subwatershed3-51

Table 3.32. Physical characteristics of lakes in the Gleason Lake subwatershed.....3-61

Table 3.33. Selected water quality goals and current conditions of lakes in the Gleason Lake subwatershed.3-61

Table 3.34. Major streams in the Gleason Lake subwatershed.....3-61

Table 3.35. Current conditions of streams in the Gleason Lake subwatershed.3-62

Table 3.36. National Wetland Inventory wetland types in the Gleason Lake subwatershed.3-64

Table 3.37. 2010 land use in the Gleason Lake subwatershed.3-7165

Table 3.41. Cities in the Lake Minnetonka subwatershed3-69

Table 3.42. Physical characteristics of lakes in the Lake Minnetonka subwatershed.3-61

Table 3.43. Selected water quality goals and current conditions of lakes in the Lake Minnetonka subwatershed3-61

Table 3.44. Current conditions of streams in the Lake Minnetonka subwatershed.3-62

Table 3.45. National Wetland Inventory wetland types in the Lake Minnetonka subwatershed.3-64

Table 3.46. 2010 land use in the Lake Minnetonka subwatershed.3-7185

Table 3.51. Cities in the Lake Virginia subwatershed3-90

Table 3.52. Physical characteristics of lakes in the Lake Virginia subwatershed.3-61

Table 3.53. Selected water quality goals and current conditions of lakes in the Lake Virginia subwatershed3-61

Table 3.54. Major streams in the Lake Virginia subwatershed.....3-61

Table 3.55. Current conditions of streams in the Lake Virginia subwatershed.3-62

Table 3.56. National Wetland Inventory wetland types in the Lake Virginia subwatershed.3-6497

Table 3.57. 2010 land use in the Lake Virginia subwatershed.3-71104

Table 3.61. Cities in the Langdon Lake subwatershed..... 3-108

Table 3.62. Physical characteristics of lakes in the Langdon Lake subwatershed.....3-61

Table 3.63. Selected water quality goals and current conditions of lakes in the Langdon Lake subwatershed...3-61

Table 3.64. Major streams in the Langdon Lake subwatershed.....3-61

Table 3.65. Current conditions of streams in the Langdon Lake subwatershed.3-62

Table 3.66. National Wetland Inventory wetland types in the Langdon Lake subwatershed..... 3-64115

Table 3.67. 2010 land use in the Langdon Lake subwatershed..... 3-71122

Table 3.71. Cities in the Long Lake Creek subwatershed 3-126

Table 3.72. Physical characteristics of lakes in the Long Lake Creek subwatershed.....3-61

Table 3.73. Selected water quality goals and current conditions of lakes in Long Lake Creek subwatershed.....3-61

Table 3.74. Major streams in the Long Lake Creek subwatershed.3-61

Table 3.75. Current conditions of streams in the Long Lake Creek subwatershed.3-62



Table 3.76. National Wetland Inventory wetland types in the Long Lake Creek subwatershed..... 3-64133

Table 3.77. 2010 land use in the Long Lake Creek subwatershed..... 3-71140

Table 3.81. Cities in the Minnehaha Creek subwatershed..... 3-144

Table 3.82. Physical characteristics of lakes in the Minnehaha Creek subwatershed.....3-61

Table 3.83. Selected water quality goals and current conditions of lakes in the Minnehaha Creek subwatershed3-61

Table 3.84. Current conditions of streams in the Minnehaha Creek subwatershed.3-62

Table 3.85. National Wetland Inventory wetland types in the Minnehaha Creek subwatershed..... 3-64152

Table 3.86. Average discharge for stations in the Minnehaha Creek subwatershed.3-64157

Table 3.87. 2010 land use in the Minnehaha Creek subwatershed..... 3-71160

Table 3.91. Cities in the Painter Creek subwatershed 3-165

Table 3.92. Physical characteristics of lakes in the Painter Creek subwatershed.3-61

Table 3.93. Selected water quality goals and current conditions of lakes in the Painter Creek subwatershed3-61

Table 3.94. Current conditions of streams in the Painter Creek subwatershed.....3-62

Table 3.95. National Wetland Inventory wetland types in the Painter Creek subwatershed.3-64172

Table 3.96. 2010 land use in the Painter Creek subwatershed..... 3-71179

Table 3.101. Cities in the Schutz Lake subwatershed..... 3-183

Table 3.102. Physical characteristics of lakes in the Schutz Lake subwatershed.....3-61

Table 3.103. Selected water quality goals and current conditions of lakes in the Schutz Lake subwatershed.....3-61

Table 3.104. Major streams in the Schutz Lake subwatershed..... 3-188

Table 3.105. Current conditions of streams in the Schutz Lake subwatershed.3-62

Table 3.106. National Wetland Inventory wetland types in the Schutz Lake subwatershed..... 3-64190

Table 3.107. 2010 land use in the Schutz Lake subwatershed..... 3-71197

Table 3.111. Cities in the Six Mile Marsh subwatershed..... 3-201

Table 3.112. Physical characteristics of lakes in the Six Mile Marsh subwatershed.....3-61

Table 3.113. Selected water quality goals and current conditions of lakes in the Six Mile Marsh subwatershed3-61

Table 3.114. Current conditions of streams in the Six Mile Marsh subwatershed.3-62

Table 3.115. National Wetland Inventory wetland types in the Six Mile Marsh subwatershed..... 3-64209

Table 3.116. 2010 land use in the Six Mile Marsh subwatershed..... 3-71218

FIGURES

Figure 1.1. Scale of E-Grade Assessment Tool..... 1-2

Figure 2.1. The Minnehaha Creek Watershed District.....2-52

Figure 2.2. Hydrologic Soil Groups in the Minnehaha Creek watershed.....2-53

Figure 2.3. Topography and subwatersheds within the Minnehaha Creek watershed.....2-54

Figure 2.4. County ditches in the Minnehaha Creek watershed.....2-55

Figure 3.11.The Christmas Lake subwatershed.....3-58

Figure 3.12. Christmas Lake subwatershed MLCCS and imperviousness.3-59

Figure 3.13. Christmas Lake subwatershed catchments.....3-60

Figure 3.14.Christmas Lake subwatershed lakes and streams and impaired waters.....3-63

Figure 3.15. Christmas Lake subwatershed wetlands by type.....3-65

Figure 3.16. Christmas Lake subwatershed aquifer sensitivity and Wellhead Protection Areas.....3-66

Figure 3.17. Christmas Lake subwatershed natural resource areas.....3-70

Figure 3.18. Christmas Lake subwatershed 2010 Metropolitan Council land use.....3-73

Figure 3.19. Christmas Lake subwatershed recreational and other features.....3-74

Figure 3.21.The Dutch Lake subwatershed.....3-58

Figure 3.22. Dutch Lake subwatershed MLCCS and imperviousness.3-59

Figure 3.23. Dutch Lake subwatershed catchments.....3-60

Figure 3.24. Dutch Lake subwatershed lakes and streams and impaired waters.3-63

Figure 3.25. Dutch Lake subwatershed wetlands by type.....3-65

Figure 3.26. Dutch Lake subwatershed aquifer sensitivity and Wellhead Protection Areas.....3-66

Figure 3.27. Dutch Lake subwatershed natural resource areas.....3-70

Figure 3.28. Dutch Lake subwatershed 2010 Metropolitan Council land use.....3-73

Figure 3.29. Dutch Lake subwatershed recreational and other features.3-74

Figure 3.31.The Gleason Lake subwatershed.....3-58

Figure 3.32. Gleason Lake subwatershed MLCCS and imperviousness.3-59

Figure 3.33. Gleason Lake subwatershed catchments.....3-60

Figure 3.34. Gleason Lake subwatershed lakes and streams and impaired waters.3-63

Figure 3.35. Gleason Lake subwatershed wetlands by type.....3-65

Figure 3.36. Gleason Lake subwatershed aquifer sensitivity and Wellhead Protection Areas.....3-66

Figure 3.37. Gleason Lake subwatershed natural resource areas.....3-70

Figure 3.38. Gleason Lake subwatershed 2010 Metropolitan Council land use.....3-73

Figure 3.39. Gleason Lake subwatershed recreational and other features.3-74

Figure 3.41. The Lake Minnetonka subwatershed.....3-7171

Figure 3.42. Lake Minnetonka subwatershed MLCCS and imperviousness3-7172

Figure 3.43. Lake Minnetonka subwatershed catchments3-7173

Figure 3.44. Lake Minnetonka subwatershed lakes and streams and impaired waters3-7177

Figure 3.45. Lake Minnetonka subwatershed wetlands by type3-7179

Figure 3.46. Lake Minnetonka subwatershed aquifer sensitivity and Wellhead Protection Areas.....3-7180

Figure 3.47. Lake Minnetonka subwatershed natural resource areas3-7183

Figure 3.48. Lake Minnetonka subwatershed 2010 Metropolitan Council land use.....3-7186

Figure 3.49. Lake Minnetonka subwatershed recreational and other features3-7187

Figure 3.51. The Lake Virginia subwatershed.....3-7191

Figure 3.52. Lake Virginia subwatershed MLCCS and imperviousness3-7192

Figure 3.53. Lake Virginia subwatershed catchments3-7193

Figure 3.54. Lake Virginia subwatershed lakes and streams and impaired waters3-7196

Figure 3.55. Lake Virginia subwatershed wetlands by type3-7198

Figure 3.56. Lake Virginia subwatershed aquifer sensitivity and Wellhead Protection Areas.....3-7199

Figure 3.57. Lake Virginia subwatershed natural resource areas3-71102

Figure 3.58. Lake Virginia subwatershed 2010 Metropolitan Council land use.....3-71105

Figure 3.59. Lake Virginia subwatershed recreational and other features3-71106

Figure 3.61. The Langdon Lake subwatershed3-71109

Figure 3.62. Langdon Lake subwatershed MLCCS and imperviousness3-71110



Figure 3.63. Langdon Lake subwatershed catchments..... 3-71111

Figure 3.64. Langdon Lake subwatershed lakes and streams and impaired waters..... 3-71114

Figure 3.65. Langdon Lake subwatershed wetlands by type..... 3-71116

Figure 3.66. Langdon Lake subwatershed aquifer sensitivity and Wellhead Protection Areas..... 3-71117

Figure 3.67. Langdon Lake subwatershed natural resource areas..... 3-71120

Figure 3.68. Langdon Lake subwatershed 2010 Metropolitan Council land use 3-71123

Figure 3.69. Langdon Lake subwatershed recreational and other features..... 3-71124

Figure 3.71. The Long Lake Creek subwatershed 3-71127

Figure 3.72. Long Lake Creek subwatershed MLCCS and imperviousness..... 3-71128

Figure 3.73. Long Lake Creek subwatershed catchments..... 3-71129

Figure 3.74. Long Lake Creek subwatershed lakes and streams and impaired waters..... 3-71132

Figure 3.75. Long Lake Creek subwatershed wetlands by type..... 3-71134

Figure 3.76. Long Lake Creek subwatershed aquifer sensitivity and Wellhead Protection Areas 3-71135

Figure 3.77. Long Lake Creek subwatershed natural resource areas..... 3-71138

Figure 3.78. Long Lake Creek subwatershed 2010 Metropolitan Council land use 3-71141

Figure 3.79. Long Lake Creek subwatershed recreational and other features..... 3-71142

Figure 3.81. The Minnehaha Creek subwatershed 3-71145

Figure 3.82. Minnehaha Creek subwatershed MLCCS and imperviousness 3-71146

Figure 3.83. Minnehaha Creek subwatershed catchments..... 3-71147

Figure 3.84. Minnehaha Creek subwatershed lakes and streams and impaired waters..... 3-71151

Figure 3.85. Minnehaha Creek subwatershed wetlands by type..... 3-71153

Figure 3.86. Minnehaha Creek subwatershed aquifer sensitivity and Wellhead Protection Areas..... 3-71154

Figure 3.87. Minnehaha Creek subwatershed natural resource areas..... 3-71158

Figure 3.88. Minnehaha Creek subwatershed 2010 Metropolitan Council land use 3-71161

Figure 3.89. Minnehaha Creek subwatershed recreational and other features..... 3-71162

Figure 3.91. The Painter Creek subwatershed..... 3-71166

Figure 3.92. Painter Creek subwatershed MLCCS and imperviousness 3-71167

Figure 3.93. Painter Creek subwatershed catchments 3-71168

Figure 3.94. Painter Creek subwatershed lakes and streams and impaired waters 3-71171

Figure 3.95. Painter Creek subwatershed wetlands by type 3-71173

Figure 3.96. Painter Creek subwatershed aquifer sensitivity and Wellhead Protection Areas 3-71174

Figure 3.97. Painter Creek subwatershed natural resource areas 3-71177

Figure 3.98. Painter Creek subwatershed 2010 Metropolitan Council land use..... 3-71180

Figure 3.99. Painter Creek subwatershed recreational and other features 3-71181

Figure 3.101. The Schutz Lake subwatershed 3-71184

Figure 3.102. Schutz Lake subwatershed MLCCS and imperviousness..... 3-71185

Figure 3.103. Schutz Lake subwatershed catchments..... 3-71186

Figure 3.104. Schutz Lake subwatershed lakes and streams and impaired waters..... 3-71189

Figure 3.105. Schutz Lake subwatershed wetlands by type..... 3-71191

Figure 3.106. Schutz Lake subwatershed aquifer sensitivity and Wellhead Protection Areas..... 3-71192

Figure 3.107. Schutz Lake subwatershed natural resource areas..... 3-71195

Figure 3.108. Schutz Lake subwatershed 2010 Metropolitan Council land use 3-71198

Figure 3.109. Schutz Lake subwatershed recreational and other features..... 3-71199

Figure 3.111. The Six Mile Marsh subwatershed 3-71202

Figure 3.112. Six Mile Marsh subwatershed MLCCS and imperviousness..... 3-71203

Figure 3.113. Six Mile Marsh subwatershed catchments..... 3-71204

Figure 3.114. Six Mile Marsh subwatershed lakes and streams and impaired waters..... 3-71208

Figure 3.115. Six Mile Marsh subwatershed wetlands by type..... 3-71210

Figure 3.116. Six Mile Marsh subwatershed aquifer sensitivity and Wellhead Protection Areas..... 3-71211

Figure 3.117. Six Mile Marsh subwatershed natural resource areas..... 3-71217

Figure 3.118. Six Mile Marsh subwatershed 2010 Metropolitan Council land use 3-71219

Figure 3.119. Six Mile Marsh subwatershed recreational and other features..... 3-71220

Acronyms and Abbreviations

AIS	Aquatic Invasive Species
BMP	Best Management Practice
BWSR	Board of Water and Soil Resources
cfs	Cubic feet per second
cfu	Colony-forming unit
Chl- <i>a</i>	Chlorophyll- <i>a</i>
CIP	Capital Improvement Program
DNR or MNDNR	Minnesota Department of Natural Resources
DO	Dissolved oxygen
EPA or USEPA	US Environmental Protection Agency
F-IBI	Index of Biotic Integrity for fish
FAW	Functional Assessment of Wetlands
FWS	US Fish and Wildlife Service
FIS	Flood Insurance Study
FQI	Floristic Quality Index
HHPLS	Hydraulic, Hydrologic, and Pollutant Loading Study
HSG	Hydrologic Soils Group
LA	Load allocation
LGU	Local Government Unit
LWMP	Local Water Management Plan
MBS	Minnesota Biological Survey
MCWD	Minnehaha Creek Watershed District
mg/L	Milligrams per liter
Met Council	Metropolitan Council
M-IBI	Index of Biotic Integrity for macroinvertebrates
MLCCS	Minnesota Land Cover Classification System
MnRAM	Minnesota Routine Assessment Method
MOU	Memorandum of Understanding
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer System
MU	Management Unit
MUSA	2020 Metropolitan Urban Services Areas
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetland Inventory
RFQA	Rapid Floristic Quality Assessment
SD	Secchi depth or Secchi disc
SWPPP	Storm Water Pollution Prevention Program
TMDL	Total Maximum Daily Load
TP	Total phosphorus
TSS	Total suspended solids
µg/L	Microgram per liter
WD	Watershed District
WLA	Wasteload allocation
WMO	Watershed Management Organization

1.0 Introduction

This volume contains detailed information on the land and water resources within the Minnehaha Creek Watershed District (the District) and serves as the technical resource for additional data throughout the plan. Section 2.0 of this volume looks at the geography of the watershed and includes information on climate, topography and drainage, water resources, geology and soils. Section 3.0 looks at the characteristics of the 11 individual subwatersheds and provides the data from studies and assessments conducted within each of the subwatersheds. This section can be referenced for the technical information used to develop the subwatershed implementation plans detailed in Volume III. The data is presented following the four overarching strategic goals of the District:

- Water Quality
 - To preserve and improve the quality of surface and groundwater.
- Water Quantity
 - To manage the volume and flow of stormwater runoff to minimize the impacts of land use change on surface and groundwater.
- Ecological Integrity
 - To restore, maintain, and improve the health of ecological systems.
- Thriving Communities
 - To promote and enhance the value of water resources in creating successful, sustainable communities.

Monitoring Program Data:

The District maintains a Research and Monitoring Program to collect water quality, water quantity and ecological integrity data across the watershed. The program is a collaborative effort between the Three Rivers Park District (TRPD), the Minneapolis Park and Recreation Board (MPRB), the Minnesota Pollution Control Agency (MPCA), the Lake Minnetonka Conservation District (LMCD), and the Minnesota Department of Natural Resources (DNR).

The program, which was initiated in 1968 and was expanded in 1997, 2004, and 2011 to provide a comprehensive view of water quality, is currently being expanded again to broaden its focus into ecosystem services. This expansion, characterized as E-Grade (summarized below), provides data regarding the physical, chemical and biological components of the District, divided into ecosystem services by lakes, streams, wetlands and upland systems.

District's Monitoring Priorities:

The monitoring stations listed on maps in the Water Quality Section for each subwatershed in Volume II were monitored through 2016. In 2017, the District's Research and Monitoring Program is implementing a more focused and prioritized monitoring program to better achieve the goals of the organization. The new objectives (in order of priority) are to: diagnose drivers, identify trends in water quality, water quantity and ecological integrity, identify management strategies, and track the efficacy and progress of implementation efforts across the watershed. These efforts provide the foundation of analyses represented in Volume II as well as inform the structure of the Plan as a whole.

In order to meet these objectives, the data collected at many of the stations are switching from assessing long-term trends to characterizing ecological health on a rotational basis through E-Grade. Anchor stations that assess long-term trends have been selected to be reflective of the entire subwatershed. Often these stations have the longest data record and typically are major lakes or the furthest downstream station on the major streams. These stations will continue to be monitored every year to assess long-term changes throughout a subwatershed.

E-Grade Overview:

In 2014, the District began developing a new tool to evaluate and broadly characterize the health and function of the watershed. The Ecosystem Evaluation Program, or E-Grade, for short, will provide a holistic assessment of ecosystem health. The results from the E-Grade assessment will then allow the District to diagnose issues and stressors to guide management strategies.

Historically, water quality has been characterized by three measures: water clarity (i.e., Secchi depth measurements), chlorophyll-a, and total phosphorus concentrations. These measures are used to compute grades (ranging from A to F) on lakes. The public often uses the lake grades to assess which lakes to recreate upon, where to purchase lakefront property, and to request improvement of a waterbody from the District. However, the current grades are only a partial snapshot of a lake's health, because they exclude other indicators of a healthy ecosystem like flood control and habitat diversity. The current lake grading system also does not consider the interaction between lakes and other landscape types such as streams and uplands. The current system does not differentiate between deep and shallow lakes, which function very differently. Furthermore, there are more types of water bodies in the District than just lakes – such as wetlands and streams – yet the overall health and function of these waters has not been assessed to the same degree as lake systems, and the interaction amongst the many ecosystems has not been effectively studied and documented.

The E-Grade program will provide a better understanding of not only deep lakes, but also four other landscape types: (1) shallow lakes, (2) streams, (3) wetlands, (4) uplands. Each of the landscape types will be evaluated on six interdependent ecosystem services and the conditions that affect their performance. As it will more thoroughly assess waterbodies and uplands, E-Grade will lead to identification of more localized ecosystem issues and stressors, and better inform the management strategies of the District and its partners.

Program Design:

Ecosystem services are functions that natural systems perform to the benefit of the environment. Ecosystem services are key to sustainability, and how well they function affects the quality of ecosystems. Given this understanding, the United Nations (UN) Environment Programme began an integrated approach to ecosystem management that “focuses on sustaining ecosystems to meet both ecological and human needs” (*United Nations Environment* - web.unep.org/ecosystems/who-we-are/about-ecosystems). The UN's integrated ecosystem management approach identified about three dozen ecosystem services to manage.

The E-Grade Program is based on this integrated approach and is being developed as an integrated watershed management tool. For the District, six ecosystem services were selected to best characterize ecosystem quality. The E-Grade integrated watershed management tool will allow the District to preserve and improve water quality, water quantity, and ecological integrity while promoting and enhancing the value of water resources that will lead to thriving communities.

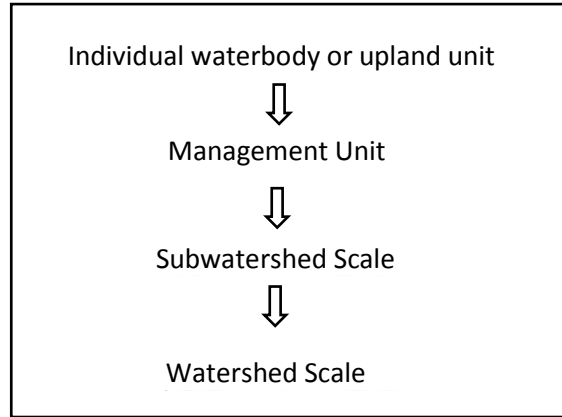
Development of E-Grade was performed by District staff and Wenck Associates, and included the participation of a Technical Advisory Committee (TAC). Members of the TAC included representatives of state, local, and regional agencies, as well as academics. The TAC provided guidance and feedback on which ecosystem services to select as well as the metrics to be used in assessing ecosystem performance. The TAC also helped identify the data collected by other agencies and schedules for collection of this data. Their effort fulfilled two goals – to maximize the use of existing data and to provide professional rigor to a scientific foundation for E-Grade.

Influence of Ecosystem Assessment:

MCWD will use the results of E-Grade in two avenues: (1) broadly characterize watershed health to better educate District staff as well as the public, and (2) diagnose issues and stressors at a project-specific scale to guide management strategies. As a result, project goals can be expanded beyond traditional metrics such as phosphorus reduction to include more complex metrics based on biological components. This science-based information will allow the District to better identify areas in highest need of improvement or protection, which in turn will inform priority-setting for District activities.

As previously noted, E-Grade will assess six ecosystem services for each of the five landscape types. The five landscape types are: deep lakes, shallow lakes, streams, wetlands and uplands, and the six ecosystem services assessment of the overall health and function will be scaled to individual waterbodies and summarized up to the watershed level.

Table 1.1. Scale of E-Grade Assessment Tool



A variety of relevant metrics have been identified for each of the ecosystem services. The classification breakpoints for all the metrics is based on literature, widely accepted state agencies' standards, and/or recommendations by the TAC. The performance of the ecosystem services for each of the five landscape types will be graded using the following terminology:

Table 1.2. E-Grade Technical Threshold Descriptions

Technical Threshold Descriptions	
Classification	Narrative description
Exceptional	Community structure and species composition or ecosystem processes are <u>near reference conditions</u> . The most relatively pristine communities.
Good	Community structure and species composition or ecosystem processes are <u>beginning to show signs of disturbance</u> , but support the ecosystem service.
Poor	Community structure and species composition or ecosystem processes <u>show obvious signs of disturbance</u> .
Degraded	Community structure and species composition or ecosystem processes are <u>showing high levels of disturbance</u> .

Implementation Schedule:

The E-Grade program is a ten-year cycle that broadly characterizes ecosystem health throughout the District. With this cycle, the five landscape types within each subwatershed will be intensively monitored over a three-year period followed by a seven-year lag until they are monitored again. The eleven subwatersheds have been divided into three groups for the more focused three-year monitoring and assessment required for E-Grade. These groups and their initial rotating schedules are:

- Group 1: Schutz Lake, Six Mile Marsh, Minnehaha Creek
 - Monitoring: 2014-2016
 - Program Completion: 2017

Report release: 2018

Group 2:Dutch Lake, Langdon Lake, Long Lake Creek, Painter Creek

Monitoring: 2018-2020

Report release: 2021

Group 3:Christmas Lake, Gleason Lake, Lake Minnetonka, Lake Virginia

Monitoring: 2021-2023

Report release: 2024

District-wide Report release: 2024

The E-Grade Program will characterize ecological health throughout the District on a subwatershed-scale rotation with the first subwatershed reports to be published in 2018. The data collected and analyzed will allow the District to better identify areas in highest need of improvement or protection. Volume II will be updated as E-Grade rotates through the subwatersheds collecting and analyzing new data sets.

MCWD Data Sets:

The District continues to maintain and develop a wealth of data to inform and guide implementation efforts within the watershed. This data is summarized and analyzed in Volume II of this Plan document, for ease of reference and to focus Volume III on implementation strategies. Also included in Volume II is a complete inventory of all available MCWD data, which is intended to be made available and searchable on the District’s website.

Data available to characterize issues and inform watershed management can generally be broken into the following categories:

- Monitoring Program Data
- Watershed Wide Studies
- Subwatershed Studies
- Waterbody Specific Studies or Total Maximum Daily Load Studies
- Project Feasibility or Small Area Plans

Most of these past planning efforts included extensive public participation. This Plan integrates these data sets and public participation into a long-range strategic plan to guide implementation across the eleven subwatershed planning units.

Watershed-Wide Studies:

The District has completed a number of watershed wide studies that inform the overall hydrology, water quality and ecological integrity of the District’s natural resources. These studies are outlined in Volume II, and will be made available and searchable on the District’s website. Some of the key watershed wide studies include:

- Hydrologic, Hydraulic and Pollutant Loading Study (HHPLS)
- Functional Assessment of Wetlands
- Stream Assessments

Hydrologic, Hydraulic and Pollutant Loading Study (HHPLS):

In 2003 the District completed a two year effort to compile existing and new information on the water resources in the District, to identify existing water management issues, define the impact of future land use change on the system, and identify management strategies for the District and its partners. At the time, this effort represented one of the most ambitious watershed studies undertaken by a watershed District in Minnesota. The HHPLS study was initiated to:

- Document the nature of the physical, chemical, and biological characteristics of the watershed
- Quantify the amount of water moving through the watershed
- Gather public input to assist in problem identification and solution mapping

- Tailor implementation efforts on a subwatershed basis

Functional Assessment of Wetlands:

In 2003 the District completed a *Functional Assessment of Wetlands* (FAW), covering all wetlands in the District larger than one-quarter acre in size. This assessment used a variant of the Minnesota Routine Assessment Method, and was developed in partnership with the Hennepin Conservation District to assess the overall function and value of individual wetland systems.

The analysis has been consistently used by the District and its partners to guide land use decisions and natural resource management decisions by providing consistent, comprehensive wetland data.

Stream Assessments:

In 2003 the MCWD assessed the physical and biological condition of Minnehaha Creek, Long Lake Creek, Gleason Creek, Classen Creek, Painter Creek and Six Mile Creek. The assessments characterized the general condition of the streams and provided baseline information that assists the District and its partners in developing management strategies to improve and protect streams as a vital part of the watershed system.

In 2012 the District updated and expanded its stream assessment to include first and second order tributaries to main stem streams. This assessment, coupled with HHPLS, the FAW and broad system monitoring, provides the MCWD with a thorough understanding of its lakes, streams and wetland systems.

Subwatershed Studies:

In systems data collected across the watershed, the District has also collected information at subwatershed scales which provide resource specific information regarding issues, the stressors driving those issues, and informs management strategies for the District and its partners.

Some of the notable studies conducted at a subwatershed scale include:

- Minnehaha Creek Visioning (2005)
- Minnehaha Creek Baseflow
- Six Mile Creek Diagnostic
- Painter Creek Feasibility Study
- Gleason Lake Management Plan

Waterbody Specific Studies or TMDLs:

The District has also collected information on specific waterbodies which provide resource specific information regarding issues, the stressors driving those issues, and informs management strategies for the District and its partners. The Total Maximum Daily Load Studies (TMDLs) have also been conducted on specific impaired waters.

Some of the studies conducted on specific waterbodies include:

- Preserving the Quality of Lake Minnetonka, 1971
- Blue Water Commission Report on Lake Nokomis and Lake Hiawatha, 1998
- MCWD Lakes TMDL – Lakes Nokomis, Parley, Virginia, and Wassermann, 2011
- Effects of Curlyleaf Pondweed Control on Gleason Lake, 2015

These studies are outlined in Volume II for each subwatershed and will be made available and searchable on the District's website.

2.0 Watershed Overview

The Minnehaha Creek Watershed District was established in 1967 and is responsible for managing and protecting the water resources of the Minnehaha Creek watershed drainage basin. The drainage basin extends for 181 square miles draining into the Minnehaha Creek and ultimately into the Mississippi River. The watershed district encompasses 11 subwatersheds which drains 12 creeks, 129 lakes, and thousands of wetlands throughout two counties, 27 cities, and two townships.

The watershed of Minnehaha Creek includes approximately 151 square miles in Hennepin County and 30 square miles in Carver County. The upper watershed includes Lake Minnetonka (est. 14,101 acres) and the land that drains into Lake Minnetonka. The lower watershed includes Minnehaha Creek (22 miles) and the land that drains into Minnehaha Creek east of Lake Minnetonka. The Lake Minnetonka outlet is located at Gray’s Bay Dam, the headwaters of Minnehaha Creek. Each watershed feature provides unique recreational opportunities and aesthetic resources.

CITIES:

The Minnehaha Creek Watershed District encompasses all or parts of 27 cities, two townships, a portion of the unorganized area of Ft. Snelling, and a very small area within an unorganized area of Shorewood (Figure 2.1). The legal boundary of the District is just over 177 square miles, with the hydrologic boundary just over 176 square miles. Table 2.1 shows the cities and their area within the District’s legal boundary.

Table 2.1. Cities and townships in the Minnehaha Creek watershed.

City or Township	Area (sq mi)	% of MCWD
Chanhassen	5.2	2.90%
Deephaven	1.7	1.00%
Edina	4.4	2.50%
Excelsior	0.7	0.40%
Golden Valley	0.1	0.10%
Greenwood	0.4	0.20%
Hopkins	2.2	1.20%
Independence	4.8	2.70%
Laketown Township	15.9	9.00%
Long Lake	0.9	0.50%
Maple Plain	0.3	0.20%
Medina	10.2	5.70%
Minneapolis	20.8	11.70%
Minnetonka	13.8	7.70%
Minnetonka Beach	0.5	0.30%
Minnetrissa	21.1	11.90%

City or Township	Area (sq mi)	% of MCWD
Mound	3.6	2.00%
Orono	25.1	14.20%
Plymouth	5.8	3.30%
Richfield	2.3	1.30%
Shorewood	12.1	6.80%
Spring Park	0.4	0.20%
St. Bonifacius	1.1	0.60%
St. Louis Park	9.6	5.40%
Tonka Bay	1	0.50%
Unorganized Territory of Fort Snelling Area	1.2	0.70%
Unorganized Territory of Shorewood	0	0.00%
Victoria	8.5	4.80%
Watertown Township	0.2	0.10%
Wayzata	3.1	1.80%
Woodland	0.6	0.30%
TOTAL	177.5	

CLIMATE:

Climate in the District is mid-continental. Both temperature and precipitation can vary widely and change abruptly. Table 2.2 shows the watershed’s temperature averages for the last 30 years, at the National Weather Service’s Chanhassen office.

Table 2.2. Temperature averages in °F for the Minnehaha Creek watershed.

Twin Cities (1981-2010)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Maximum	23.7	28.9	41.3	57.8	69.4	78.8	83.4	80.5	71.7	58.0	41.2	27.1	55.3
Minimum	7.5	12.8	24.3	37.2	48.9	58.8	64.1	61.8	52.4	39.7	26.2	12.3	37.3
Mean	15.6	20.8	32.8	47.5	59.1	68.8	73.8	71.2	62.0	48.9	33.7	19.7	46.3

Source: Minnesota State Climatology Office and National Climatic Data Center.

In a normal year, approximately 30 inches of precipitation falls on the watershed. Table 2.3 shows the watershed’s precipitation averages. Winter snowfall averages about 55 inches, and generally stays on the ground from mid-December to early March. Snow and rainfall data for the watershed is obtained at the National Weather Service’s Chanhassen office.

Table 2.3. Precipitation averages in inches for the Minnehaha Creek watershed.

Twin Cities (1981-2010)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Precipitation	0.90	0.76	1.89	2.65	3.36	4.25	4.04	4.29	3.07	2.43	1.76	1.15	30.57
Snow	11.7	8.5	10.8	2.8	0	0	0	0	0	0.6	8.9	12.2	55.5

Source: National Oceanic and Atmospheric Administration (NOAA) National Weather Service.

TOPOGRAPHY, SOILS, AND DRAINAGE:

Topography and Soils:

The topography of the watershed was formed by glacial action and is characterized by five distinct geomorphic units, each with its characteristic patterns of glacial drift. Following the glacial ice’s retreat, physical, chemical and biological processes turned the upper 2 to 4 feet of drift material into the soil layer that today covers the watershed. Because traits of the soil directly influence runoff, they affect total water volumes generated in the watershed. To estimate and help manage this runoff, the Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service) has indexed over 4,000 soil systems into four major hydrologic soil groups. This classification relies on two major processes: infiltration rate and transmission rate. Table 2.3 lists the four major hydrologic soil groups defined by the NRCS and Figure 2.2 illustrates their distribution across the watershed. These landforms and the geology underlying them are well described in the *2007 MCWD Comprehensive Water Resources Management Plan*.

Table 2.4. Soil characteristics and infiltration rates by Hydrologic Soils Group (HSG).

HSG	Infiltration Rate/Hour	Texture	Unified Soil Classification System
A	1.63"	Gravel, sandy gravel and silt gravels	GW – well graded gravels, sandy gravels GPO – Gap-graded or uniform gravels, sandy gravels GM – Silty gravels, silty sandy gravels SW – Well-graded, gravelly sands
	0.8	Sand, loamy sand or sandy loam	SP – Gap-graded or uniform sands, gravelly sands
B	0.45	Silt loam	SM – Silty sands, silty gravelly sands
	0.3	Loam	MH – Micaceous silts, diatomaceous silts, volcanic ash
C	0.2	Sandy clay loam	ML – Silts, very fine sand, silty or clayey fine sands
D	0.06	Clay loam, silty clay loam, sandy clay, silty clay or clay	GC – Clayey gravels, clayey sandy gravels SC – Clayey sands, clayey gravelly sands CL – Low plasticity clays, sandy or silty clays OL – Organic silts and clays of low plasticity CH – Highly plastic clays and sandy clays OH – Organic silts and clays of high plasticity

Source: Minnesota Stormwater Manual.

Drainage:

The watershed is divided into eleven principal subwatersheds (see Figure 2.3). The upper watershed (upstream of Gray’s Bay dam) is divided into ten principal subwatersheds. Nine of the upper most subwatersheds drain directly into Lake Minnetonka via streams, channels, and storm sewer. Lake Minnetonka and some small drainage areas comprise the tenth of the upper-most subwatersheds. This subwatershed discharges through a control structure, the Gray’s Bay dam, into Minnehaha Creek. The dam is managed to discharge water from Lake Minnetonka into Minnehaha Creek when the DNR-established runout elevation of the lake is exceeded.

The lower watershed (downstream of Gray’s Bay) drains to Minnehaha Creek and comprises one subwatershed. Some land area within the lower subwatershed does not drain directly or indirectly to Minnehaha Creek, but drains directly or indirectly to the Mississippi River. The central portion of the subwatershed drains to the Minneapolis Chain of Lakes, which in turn discharge to Minnehaha Creek.

WATER RESOURCES:

Lakes and Streams:

The lake inventory for the District includes 65 basins over 10 acres in size. Numerous streams drain the watershed. Minnehaha Creek, for which the watershed is named, is formed at the outlet of Gray’s Bay of Lake Minnetonka and flows 22 miles east to the Mississippi River. In the upper watershed, the primary streams include Long Lake Creek, Gleason Creek, Classen Creek, Painter Creek, and Six Mile Creek, although there are many other small streams and channels, named and unnamed. Data on these lakes and streams, including physical descriptions, current water quality and water quality trends, is shown in detail by subwatershed in Section 2 of this volume.

Ditches:

Historically, counties have been responsible for establishing and maintaining public drainage systems including ditches. Most ditches were established in the early 1900’s to promote agricultural activities on lands that were marginally productive because of wet conditions or to enable other uses. These areas were ditched and tiled

through establishment of a public drainage system under Minnesota Statute Chapter 103E so more land would be available for agricultural production or other use.

In areas that have since become urbanized, the need for agricultural productivity and drainage disappeared. Open ditches in urban areas of the District have been replaced with subsurface storm sewers. Often the storm sewers were constructed in different locations and alignment than that of the ditch they replaced and the old channels were filled in. However, in the more rural areas of the District the ditches remain, for the most part, open channels.

The District petitioned Hennepin County to transfer responsibility for the ditches to MCWD in 1971. The petition stated that MCWD intended to define the function of the ditches. The authority for Judicial Ditch 2 (Six-Mile Creek) was transferred to the District by court order on March 27, 1972 (a judicial ditch is located in more than one county). The authority for the seven Hennepin County Ditches was transferred by Hennepin County Board resolution on March 28, 1972.

The eight public ditches for which the District is responsible are:

1. Judicial Ditch 2 – Six Mile Creek (mainly open channel)
2. County Ditch 10 – Painter Creek (mainly open channel)
3. County Ditch 14 – from St. Louis Park into Lake Calhoun (storm sewer)
4. County Ditch 15 – into Gleason Lake (open channel/sewer)
5. County Ditch 17 – from Edina to Lake Calhoun (storm sewer)
6. County Ditch 27 – part of Long Lake Creek (mainly open channel)
7. County Ditch 29 – from St. Louis Park into Lake Calhoun (storm sewer)
8. County Ditch 32 – out of Gleason Lake in Wayzata (open channel/sewer)

Figure 2.4 shows the general locations of County/Judicial Ditches within the District. The term “ditch” as used here generally refers to a public drainage system established under Minnesota Statutes Chapter 103E.

Wetlands:

In the 1980s, the US Fish and Wildlife Service (FWS) compiled wetland maps from aerial photo interpretation as part of the National Wetland Inventory (NWI). Wetland scientists use two common classification schemes to identify wetland type – the FWS’s “Circular 39” system, and a replacement system developed by Cowardin et al., commonly referred to as the Cowardin system. The Circular 39 system was originally developed to classify wetlands for waterfowl habitat purposes. Eight of the Circular 39 freshwater wetland types are found in Minnesota. The Cowardin scheme is a hierarchical classification based on landscape position, substrate, flooding regime, and vegetation. While the Cowardin scheme has been officially adopted by the FWS and other agencies, the Circular 39 system is still commonly used because of its simplicity and ease of use. The DNR is updating the NWI across the state using remote sensing imagery; the East-Central region of Minnesota, including Hennepin and Carver Counties, was reevaluated using 2010 and 2011 imagery. Wetlands by Circular 39 type are shown in detail by subwatershed in Section 2 of this volume

In 2001-2003 the District undertook a *Functional Assessment of Wetlands* (FAW) on all wetlands greater than one-quarter acre in size. This assessment used a variant of the Minnesota Routine Assessment Method (MnRAM). Using the results of this analysis, individual wetlands were assigned to one of four management classes – Preserve, and Manage 1, 2, or 3. Wetlands that were evaluated as Exceptional or High on certain ecological or hydrologic values were assigned to the Preserve class. The balance of evaluated wetlands were assigned to a category based on this assessment of current functions and values, with Manage 1 wetlands exhibiting higher values and Manage 2 and 3 moderate or lower values. These management classifications are used in the regulation of wetland impacts within the District, with the level of protection and mitigation requirements dependent on the class of wetland. Refer to the *Functional Assessment of Wetlands* (2003) for details of methodology, classification, and management recommendations.

Public Waters:

The Department of Natural Resources' Public Waters Inventory identifies numerous basins within the Minnehaha Creek watershed under the jurisdiction of the DNR. For more information regarding the Public Waters Inventory in the watershed, please refer to *the 2007 MCWD Comprehensive Water Resources Management Plan*. Online interactive maps are available for Hennepin County at gis.hennepin.us/naturalresources/map/default.aspx and for Carver County at gis.co.carver.mn.us/publicparcel/.

Floodplain:

Land use regulations define the floodplain as the area that has a one percent chance of a flood occurring in a given year, also known as the 100-year flood. The floodplain is divided into two zoning districts: the floodway and flood fringe. The floodway includes the river channel and nearby land areas which must remain open to discharge the 100-year flood. The flood fringe, while in the flood plain, lies outside the floodway. Regulations usually allow development in the flood fringe but require flood-proofing or raising to the legal flood protection elevation.

In 1968, Congress created the National Flood Insurance Program (NFIP) to make flood insurance available to property owners at federally subsidized rates. The NFIP required communities to adopt local laws to protect lives and future development from flooding. The Federal Emergency Management Agency (FEMA) first must formally notify a community that it has special flood hazard areas (SFHA) before it can join the NFIP. FEMA notifies communities by issuing a Flood Hazard Boundary Map (FHBM). This map shows the approximate boundaries of the community's 100-year flood plain. Each participating community has a special conversion study or a Flood Insurance Study (FIS). The FIS includes a flood plain map depicting the community's flood hazard areas. Flood mapping was updated in 2016 for all communities in Hennepin County.

Floodplain maps are available at each City Hall or online at msc.fema.gov/portal.

In 2003 the District completed a *Hydrologic and Hydraulic and Pollutant Loading Study (HHPLS)* to develop an updated hydrologic and hydraulic model for the watershed and update flood elevations in Minnehaha Creek and five upper watershed streams. Watershed hydrology and hydraulics were modeled using the XP-SWMM model platform. This XP-SWMM model was submitted to FEMA to produce updated Flood Insurance Study (FIS) Flood Maps for Minnehaha Creek, and in 2013 FEMA modified the XP-SWMM model and subsequently used this modified version to produce flood maps. The District currently uses this modified XP-SWMM model to establish regulatory elevations for permitting development and redevelopment. Cities within the watershed are responsible for using the FIS maps to inform property owners about floodplain elevations for purposes of the National Flood Insurance Program and to regulate floodplain elevations within their zoning codes.

POTENTIAL ENVIRONMENTAL HAZARDS:

Groundwater connections, hazardous waste, leaking above- and below-ground storage tanks, and feedlots can be potential sources of surface and groundwater contamination. The MPCA maintains a current on-line mapping tool with information about air quality, hazardous waste, remediation, solid waste, tanks and leaks, and water quality. This tool is available at www.pca.state.mn.us/udgx680.

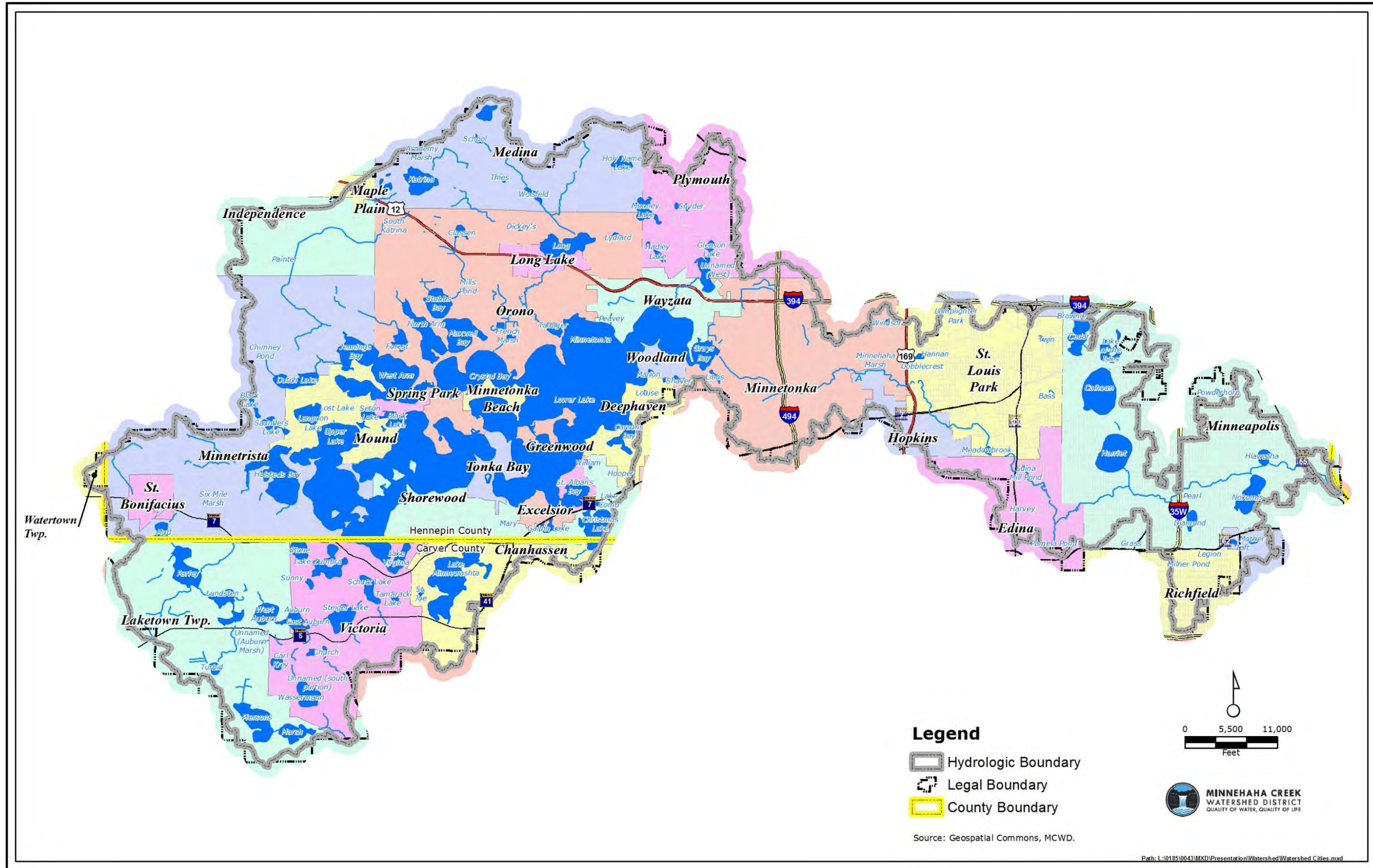


Figure 2.1. The Minnehaha Creek Watershed District.

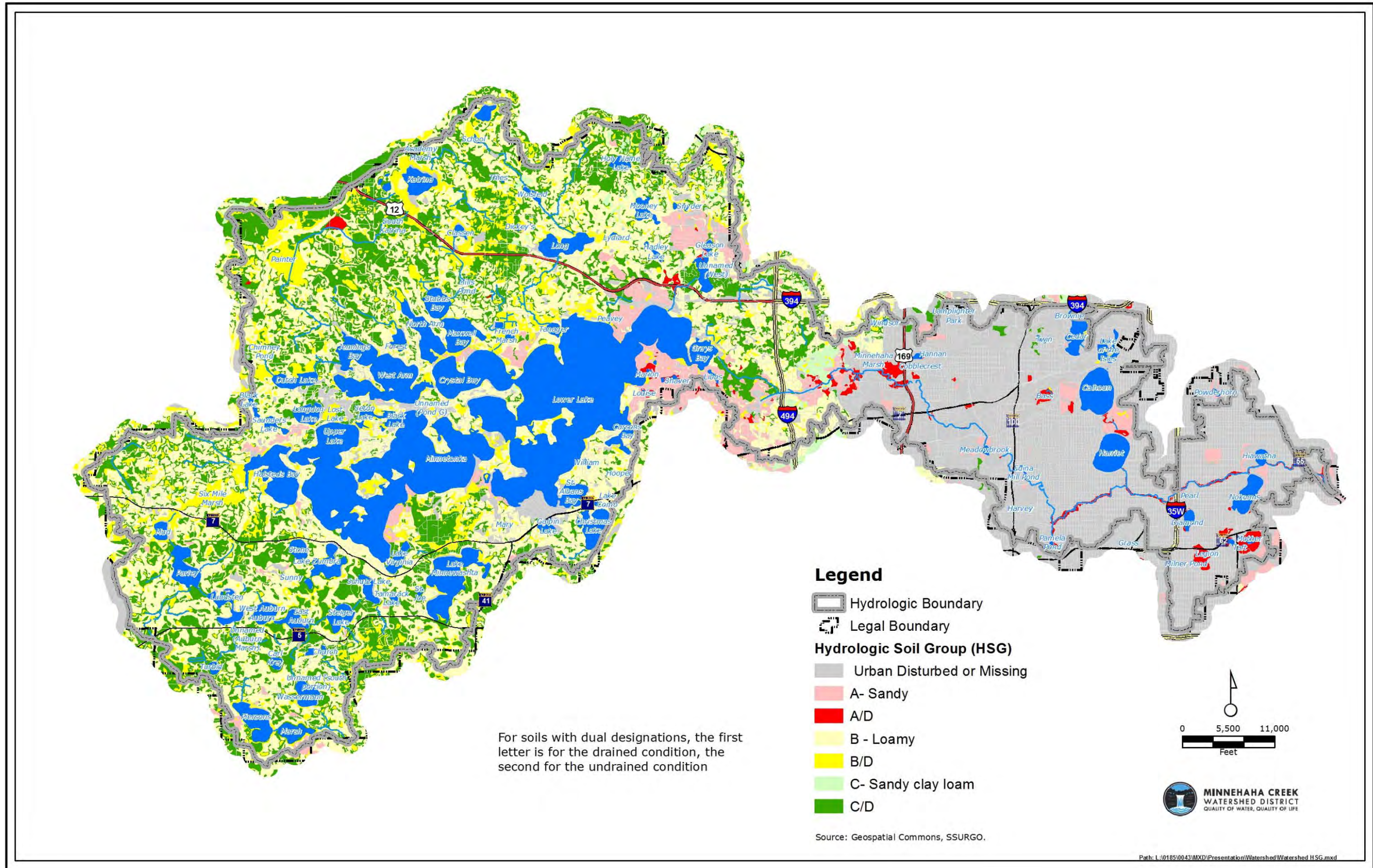


Figure 2.2. Hydrologic Soil Groups in the Minnehaha Creek watershed.

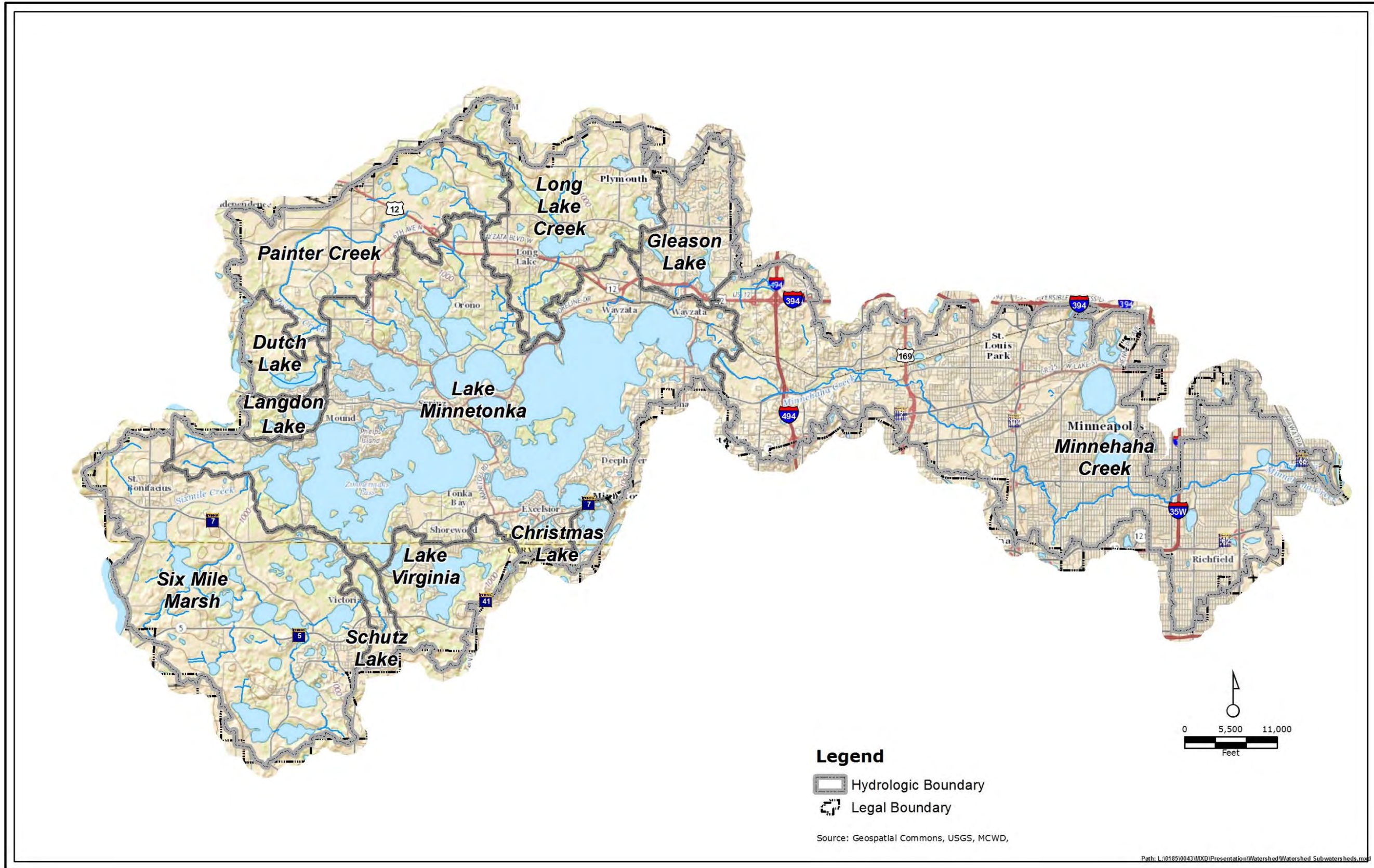


Figure 2.3. Topography and subwatersheds within the Minnehaha Creek watershed.

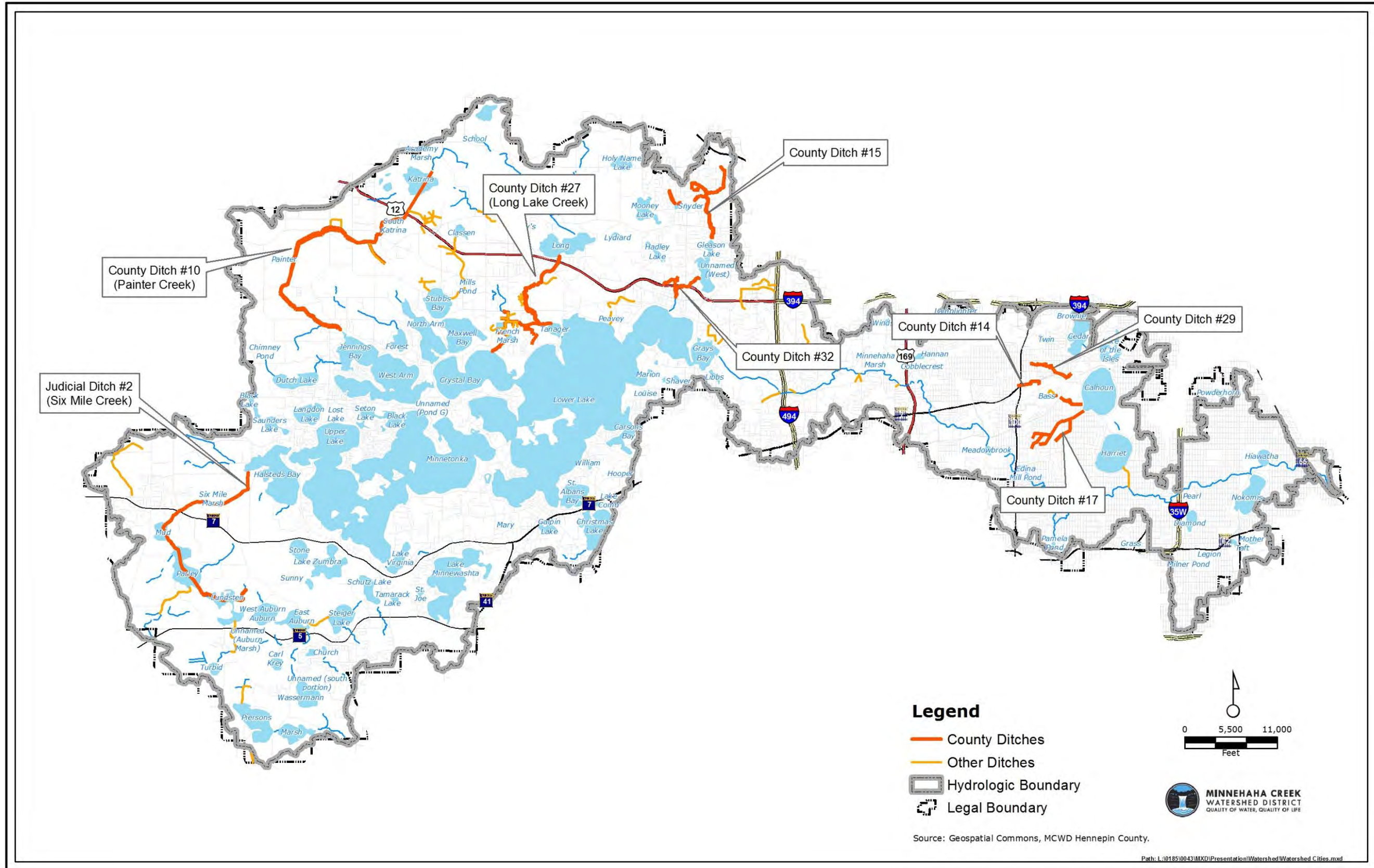


Figure 2.4. County ditches in the Minnehaha Creek watershed.



3.0 Subwatershed Inventory

3.1 CHRISTMAS LAKE SUBWATERSHED

The Christmas Lake Subwatershed is the smallest in the watershed district. The subwatershed is dominated by a mix of residential/business and woodland/wetland land cover. The nutrient contribution to Lake Minnetonka is minimal due to the fact that Christmas Lake does not often flow into St. Albans Bay. There are four cities that reside within the Christmas Lake Subwatershed boundary. The area of the Christmas Lake subwatershed in acres by individual city, in total and as a percentage of the total subwatershed is presented in Table 3.11 (Figure 3.11).

Table 3.11. Cities in the Christmas Lake subwatershed.

City	Area (Acres)	% of Subwatershed
Chanhassen	253.0	34%
Excelsior	2.6	0.4%
Greenwood	0.2	<0.1%
Shorewood	486.5	65.5%
Total	742.5	100%

Source: MCWD.

Watershed Description and Hydrology

The Christmas Lake subwatershed's topography is erratic surface relief and numerous depressed areas that form wetlands, small ponds and lakes. The eastern edge of the subwatershed is a highly sloped linear glacial formation that forms the bluffs on the east shore of Christmas Lake.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (Figure 3.12). Much of the subwatershed is developed to typical suburban densities with a low to medium degree of imperviousness. There are several small wetlands in the southern subwatershed, generally surrounded by small areas of woodland or grassland.

Soils within the watershed are predominantly classified as Natural Resources Conservation Service Hydrologic Soil Group B (loamy soils with moderate infiltration potential), with group D (clay soils with very low infiltration potential) soils found in low-lying areas and generally hydric, or showing indications of inundation.

Christmas Lake dominates the subwatershed. A small stream drains the upper part of the subwatershed and outlets into southwest Christmas Lake. The 2003 MCWD *Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Christmas Lake subwatershed into five subwatershed units, designated CL-1 through CL-5 (Figure 3.13).

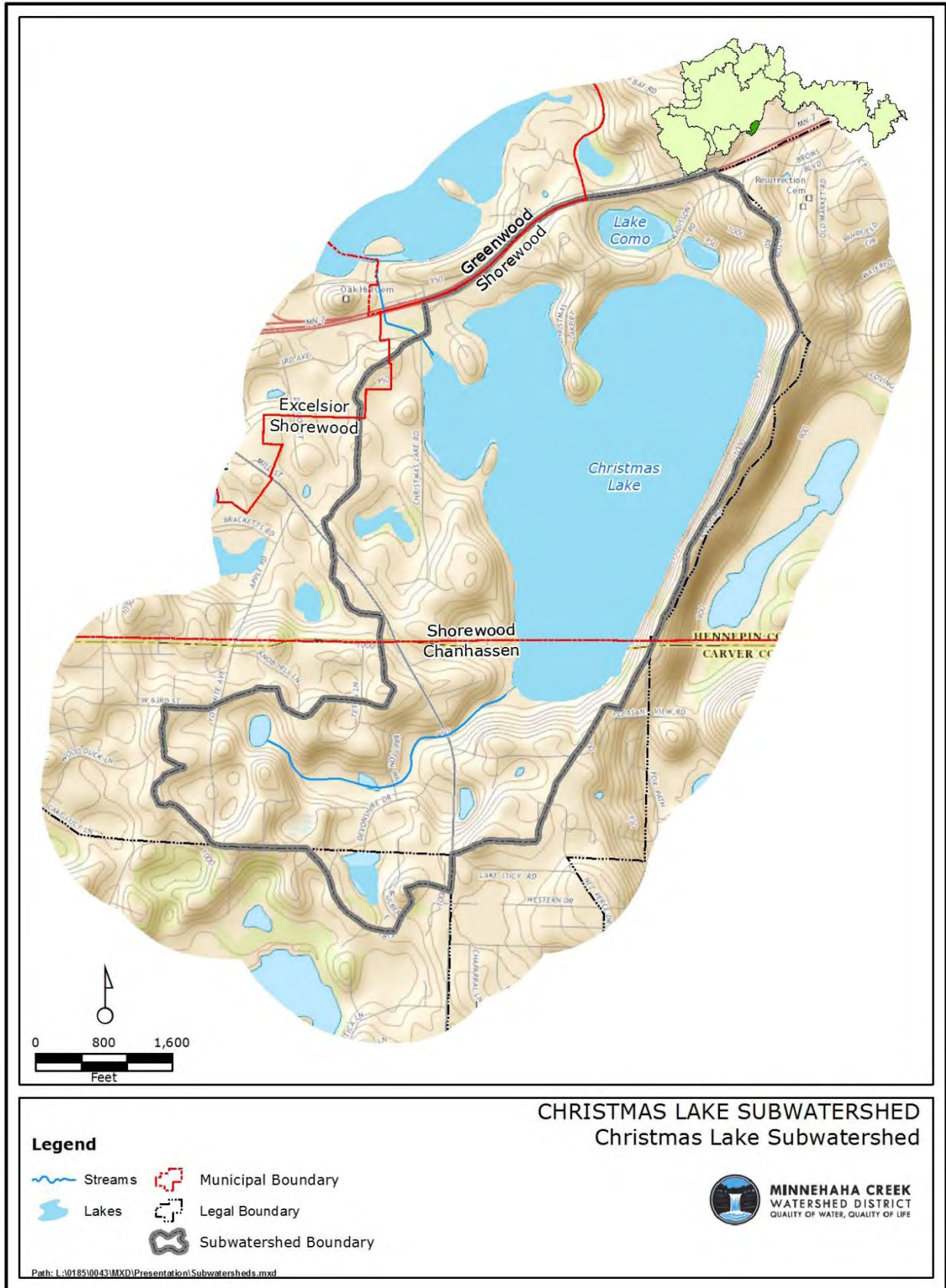


Figure 3.11. The Christmas Lake subwatershed.

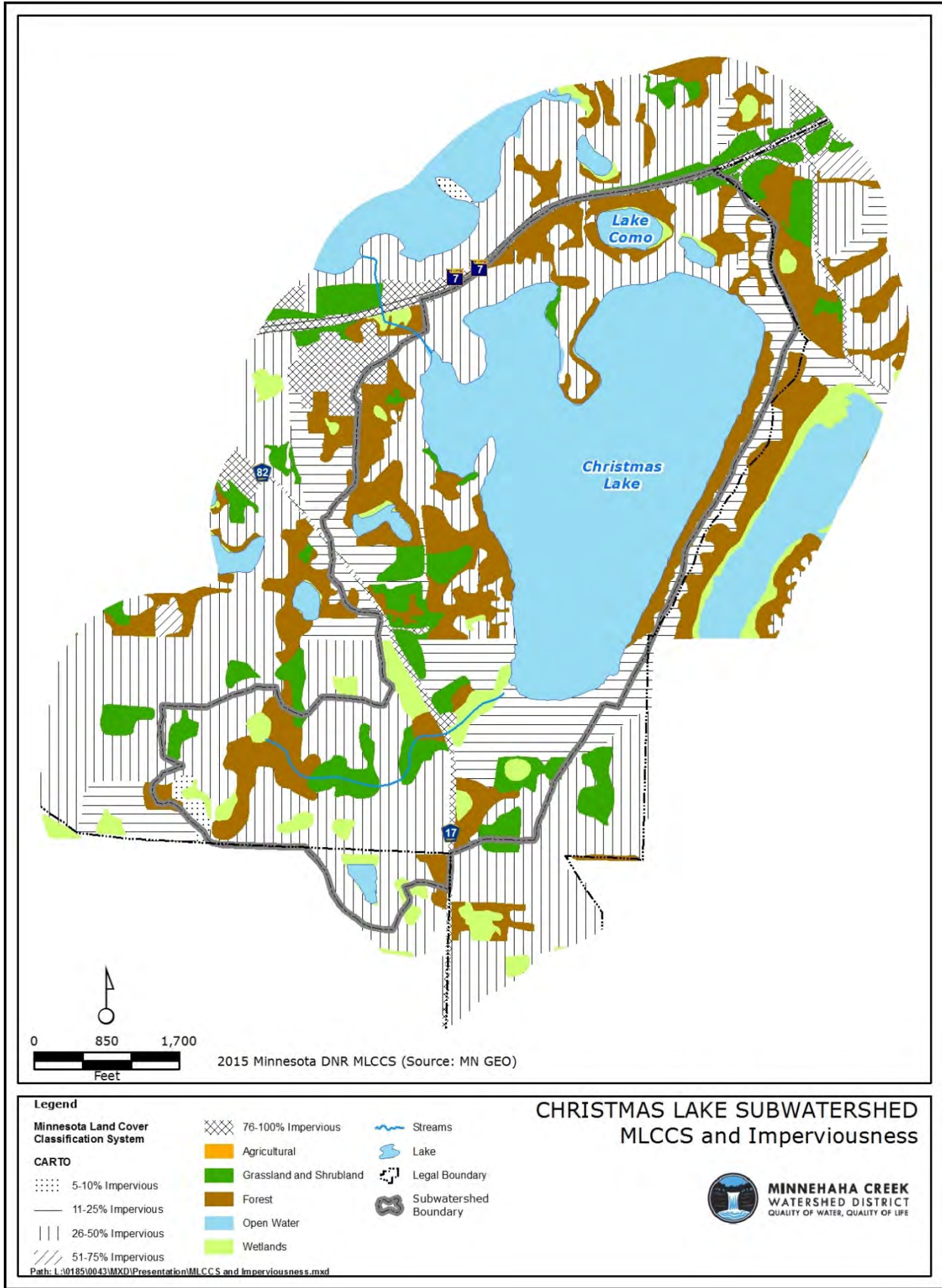


Figure 3.12. Christmas Lake subwatershed MLCCS and imperviousness.

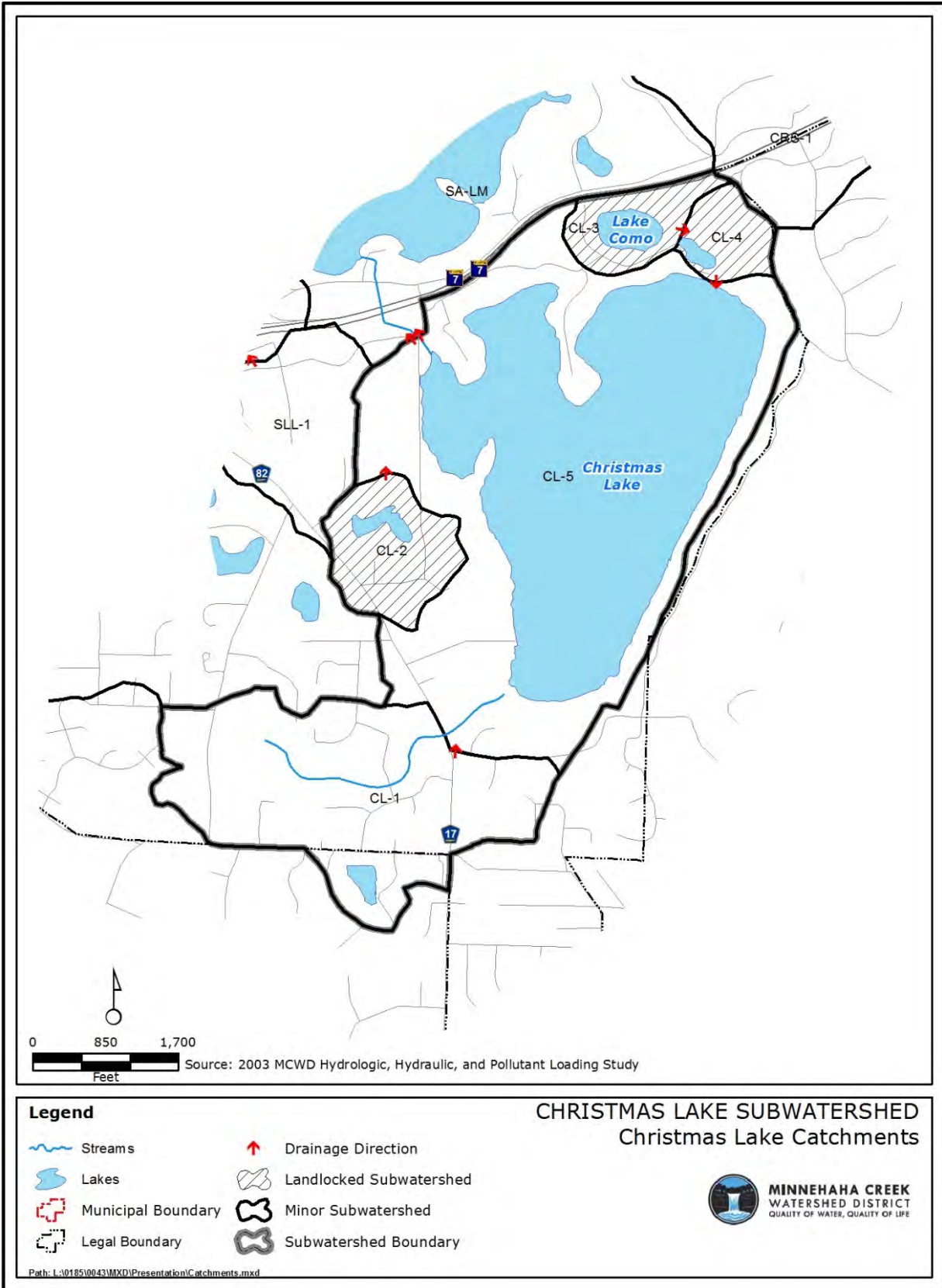


Figure 3.13. Christmas Lake subwatershed catchments.

Water Quality:

The following are summaries of the characteristics and classifications of lakes, streams, and wetlands within the subwatershed including water quality goals and trends.

Lakes:

Christmas Lake is the primary receiving water within the subwatershed, and is classified by the DNR for shoreland management purposes as a Recreational Development lake (Table 3.12). Christmas Lake has the best water quality in the District and is one of the highest-quality lakes in the Metro area. The lake is listed by the MPCA on the draft 2016 303(d) list of Impaired Waters for excess mercury in fish tissue and is included in the statewide mercury TMDL. Tables 3.12 and 3.13 below detail the physical and water quality characteristics of Christmas Lake. For more information regarding water quality in the subwatershed, please refer to the District’s Water Quality (Hydrodata) reports.

Table 3.12. Physical characteristics of lakes in the Christmas Lake subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Christmas	267	87	3:1	Recreational Development

Source: Minnesota DNR.

Table 3.13. Selected water quality goals and current conditions of lakes in the Christmas Lake subwatershed.

Lake	State TP Standard (µg/L)	2007 Plan Goal TP (µg/L)	Trend	2001-2015 Average		
				TP (µg/L)	Chl-a (µg/L)	Secchi (m)
Christmas	40	15	No trend	14	2	5.7

TP = total phosphorus, Chl-a =chlorophyll-a, Secchi = water clarity.

Source: MCWD.

Streams:

There is a channel that conveys drainage from the southern part of the subwatershed to the lake. This channel is experiencing some erosion, possibly conveying sediment to the lake. No information is available to assess the potential causes or extent of this erosion (see Figure 3.14).

Tables 3.14 and 3.15 below detail the physical and water quality characteristics of streams and tributaries within the subwatershed. At this time no streams are listed as Impaired Waters, although the Christmas Lake Inlet (CCH02) TP data is high relative to the State’s river eutrophication standards. The Christmas Lake Inlet has an average TSS of 14 mg/L, and the Christmas Lake outlet an average TSS of 4 mg/L; both below the 30 mg/L state standard for this ecoregion. However, those standards also look at other indicators such as chlorophyll-a, diel oxygen flux, and biological oxygen demand that haven’t been assessed in the stream. It is important to note that the number of samples collected for each parameter vary year to year depending on climate conditions. For more information regarding water quality in the subwatershed, please refer to the District’s Water Quality reports.

Table 3.14. Major streams in the Christmas Lake subwatershed.

Stream	Length (mi)
Christmas Lake – Christmas Lake Inlet	0.71
Christmas Lake – Christmas Lake Outlet	0.26

Table 3.15. Current conditions of streams in the Christmas Lake subwatershed.

See Figure 3.14 for monitoring locations.

Stream	Trend	2005-2015 Summer Average*			
		TP (µg/L)	TN (mg/L)	TSS(mg/L)	Cl (mg/L)
Christmas Lake Inlet (CCH02)	n/a	236	1.99	12	55
Christmas Lake Outlet (CCH01)	No trend	43	0.54	4	26

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride.

* Annual data not available for all years.

Source: MCWD.

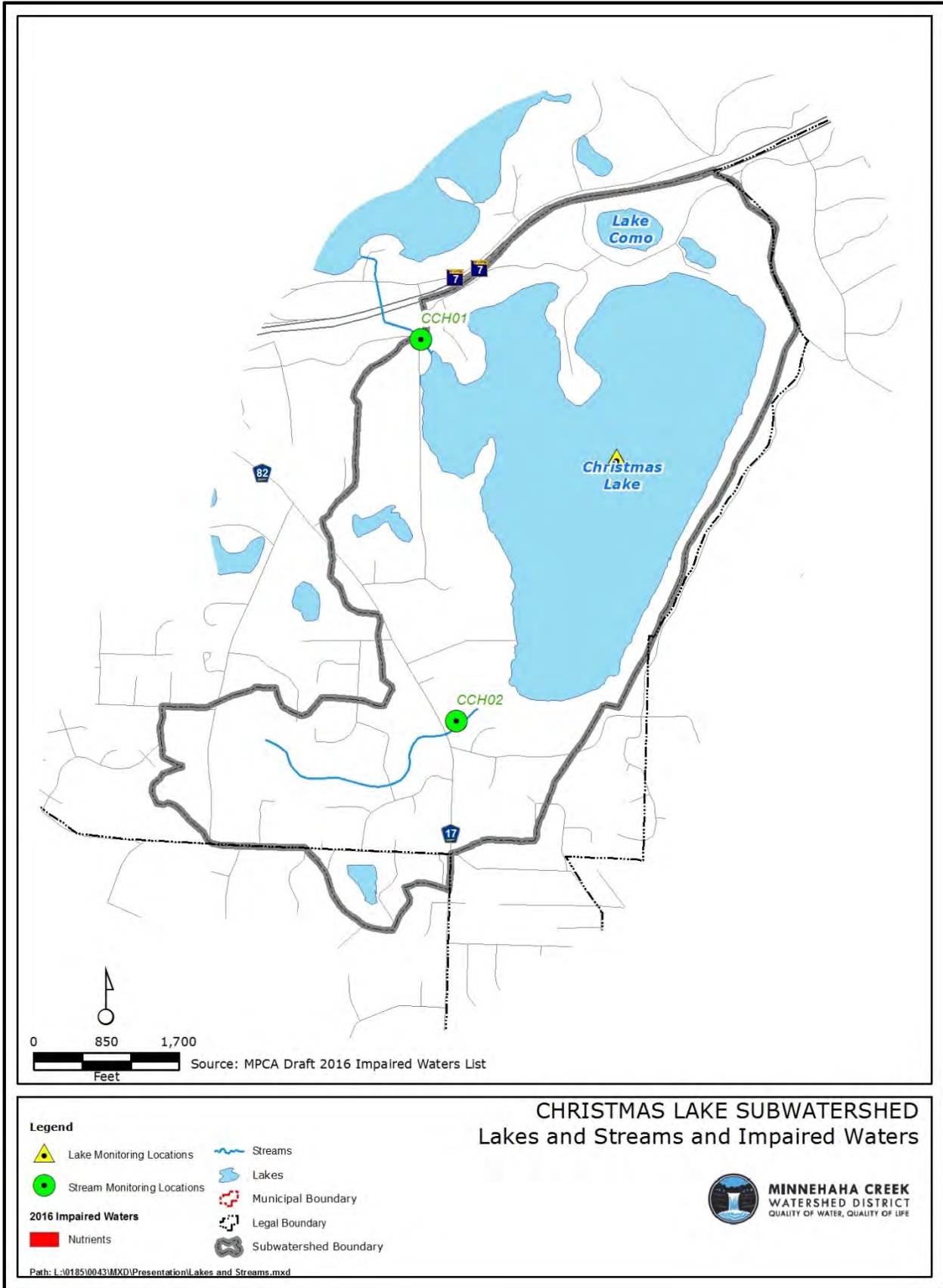


Figure 3.14. Christmas Lake subwatershed lakes and streams and impaired waters.

Wetlands:

According to the updated NWI, wetlands, including lakes, cover 41 percent of the subwatershed’s surface (Figure 3.15 and Table 3.16). A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands. Currently, no data is available.

Table 3.16. National Wetland Inventory wetland types in the Christmas Lake subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	8.4	1.1
2 - Wet Meadow	-	-
3 - Shallow Marsh	14.1	1.9
4 - Deep Marsh	11.2	1.5
5 - Open Water	271.2	36.5
6 - Scrub Shrub	-	-
7 - Forested	-	-
8 - Bog	-	-
Riverine	-	-
Wetland Total	304.9	41.0
Upland	437.1	59.0
TOTAL	742.0	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream baseflow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

The infiltration potential of the upland areas within the subwatershed is described as moderate. Because of the organic or clayey nature of the soils in the wetland areas, the general infiltration potential there is low. The *Carver County Water Resource Management Plan* classifies the groundwater resources of the southern subwatershed area as being of medium to low sensitivity to pollution. The *Hennepin County Geologic Atlas* classifies the northern subwatershed as generally low sensitivity, except for a narrow band at the north end of Christmas Lake classified as medium sensitivity.

The entire subwatershed is within the Wellhead Protection Areas for Eden Prairie, Chanhassen, and Shorewood municipal drinking water wells. The Minnesota Department of Health classifies these Areas as Low Vulnerability for contamination. Figure 3.16 shows areas in the subwatershed with groundwater sensitivity and that are designated Wellhead Protection Areas.

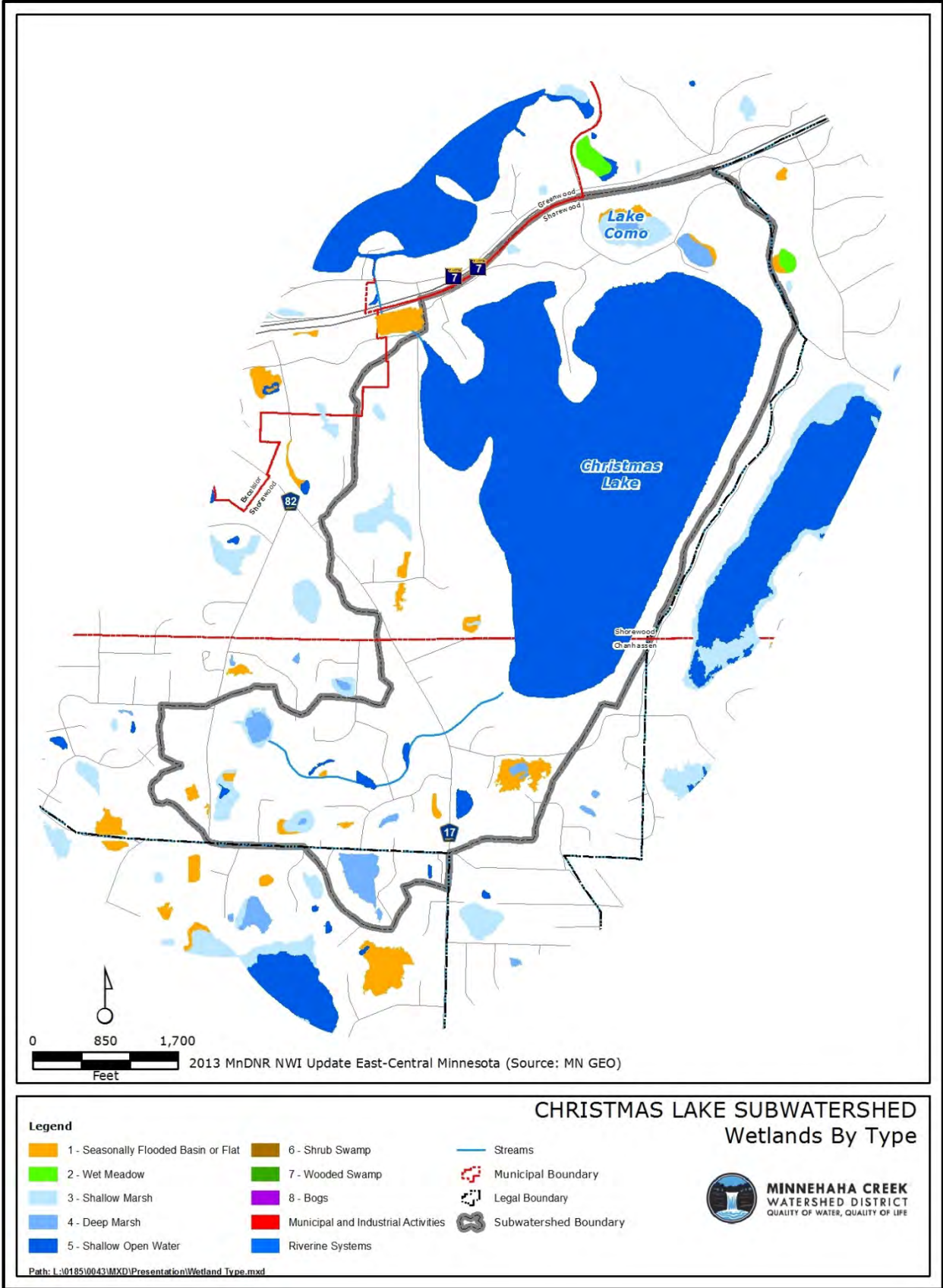


Figure 3.15. Christmas Lake subwatershed wetlands by type.

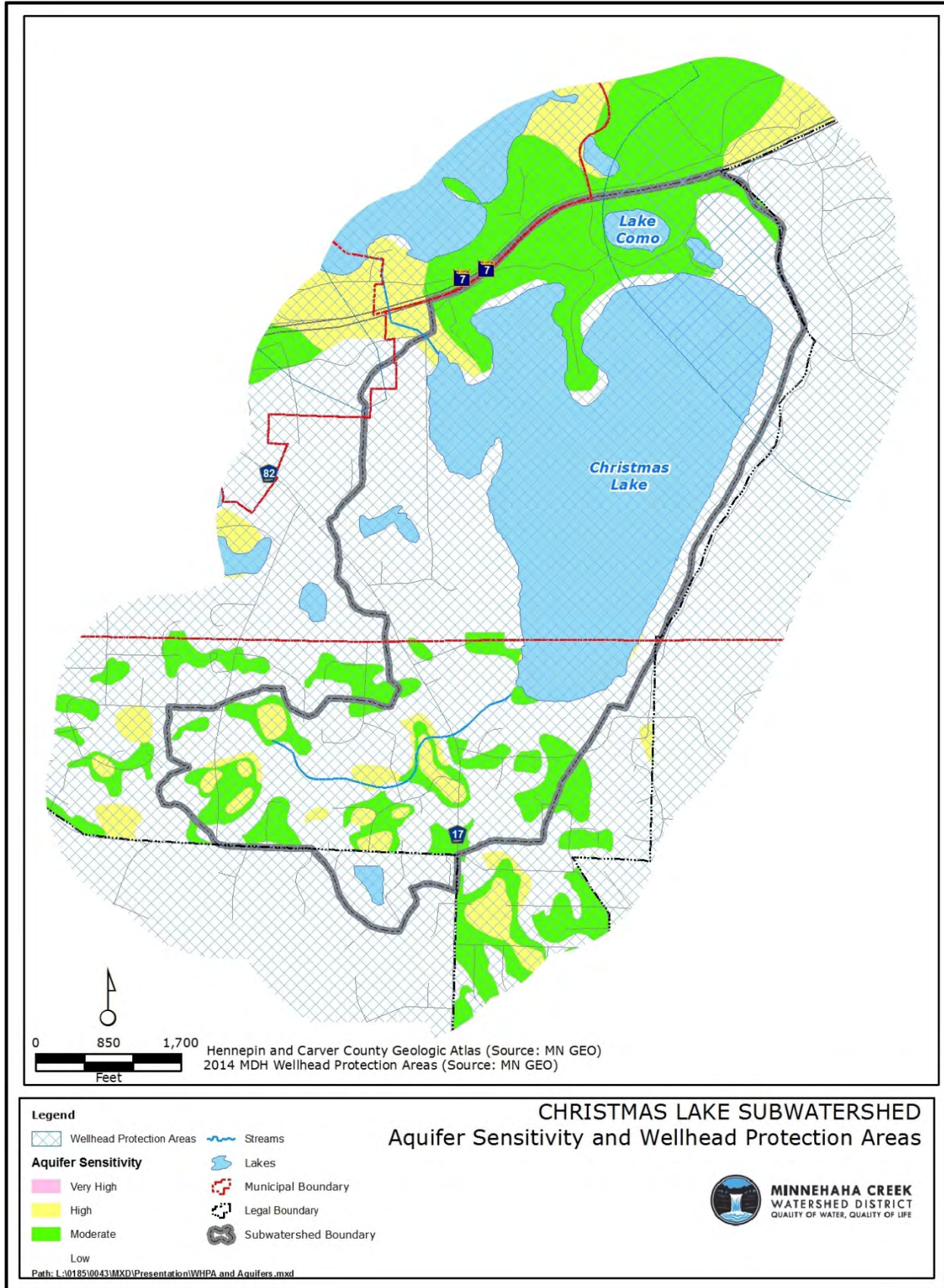


Figure 3.16. Christmas Lake subwatershed aquifer sensitivity and Wellhead Protection Areas.

Water Quantity:

As detailed in the HHPLS, the subwatershed discharges into an outlet under Highway 7 into St. Albans Bay of Lake Minnetonka. Surface flows in the Christmas Lake subwatershed are routed primarily through a system of culverts connecting small depressions. Flows are received by small pocket wetlands (some landlocked) and then to Christmas Lake before ultimately discharging into St. Albans Bay. Although Christmas Lake is not landlocked, these water elevations are frequently below the crest of the outlet control structure meaning the lake does not always discharge. Water elevations of Christmas Lake indicate that the lake is significantly influenced by evaporation and that there is likely a strong groundwater interaction.

There are several landlocked and semi-landlocked units and several small pocket wetland and depressions that do not typically contribute to Christmas Lake. Landlocked basins are particularly sensitive to stormwater volumes. Strong volume control standards are recommended in all areas draining to landlocked areas (Figure 3.13).

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity and habitat diversity and nutrient cycling. Nutrient cycling is described in Water Quality section. The Christmas Lake subwatershed has not yet been systematically evaluated by the E-Grade program. This section summarizes ecological integrity using existing data where available.

Lakes:

Biodiversity

Fish Community. No fish IBI data are available for the lakes in this subwatershed. Christmas Lake is stocked with rainbow trout and was last surveyed by the DNR in 2007. The DNR describes Christmas Lake as unique, because it is one of a few lakes in the Metro area that can support a two-story fishery. This means sufficient oxygen levels and cool water temperatures in deeper portions of the lake allow the over-summer survival of cold-water species, while warm-water species inhabit the warmer water above the thermocline. Christmas Lake is under a Fish Consumption Advisory for mercury, and was added to the state's Impaired Waters in 1998 for that reason.

Aquatic Vegetation Community. Biodiversity is determined by the number and variety of species, or richness. The most recent survey was conducted in 2015 and 26 species were observed. Floristic Quality Index (FQI) data from the 2015 survey was 28.8, which is considered "Good".

Aquatic Invasive Species. Zebra mussels were discovered in Christmas Lake in 2014. Initial treatments showed success at controlling zebra mussels within the treatment area by the access. However, more zebra mussels were found on the opposite end of the lake in 2015; the population is now established lakewide. Since 1992, Eurasian watermilfoil has been confirmed in Christmas Lake as was curly leaf pondweed but at lower densities.

Habitat diversity

Aquatic Vegetation Community. Habitat diversity is determined by the percent occurrence of species or the extent to which it may be dominated by a few species. This has not been calculated yet but will be available once E-Grade is completed in the subwatershed.

Shoreline Health. Shoreline health is assessed by looking at shoreline vegetative cover and the relative human disturbance. The DNR uses the *Score the Shore* protocol to relate shoreline conditions to fish community structure using the fish IBI metric. No Score The Shore data is available for the subwatershed; however, aerial photos shows that most of the lake is developed with turf grass, beach, and seawall/riprap, lacking in woodland or wetland fringes which are beneficial for controlling runoff and supporting emergent vegetation at the shoreline.

Streams:

Biodiversity

Fish Community. No fish data is available for the two unnamed streams within the subwatershed.

Macroinvertebrate Community. No macroinvertebrate data are available for the streams within the subwatershed.

Habitat diversity

Habitat Complexity. No Minnesota Stream Habitat Assessment data is available to assess habitat complexity for the two unnamed streams within the subwatershed.

Connectivity. Connectivity is defined by two metrics: 1) presence or absence of barriers, and 2) access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. There are no barriers to the two unnamed streams in this subwatershed.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS concentrations increase turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to the Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. The quick rising and falling of a stream in response to rain events can be stressful to organisms. In addition, streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is not available for the two unnamed streams in this subwatershed, although they are likely best characterized as minimal flow.

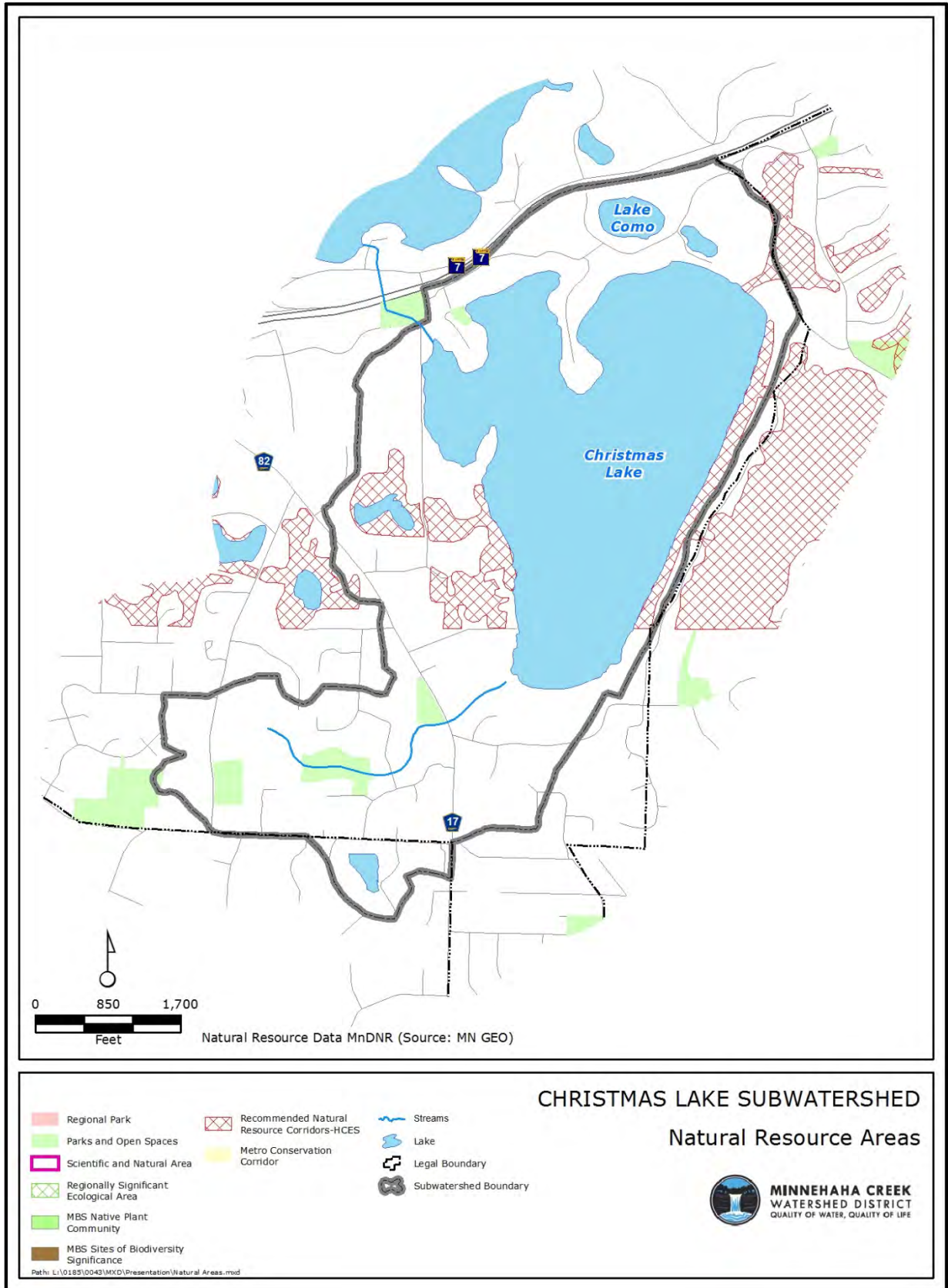


Figure 3.17. Christmas Lake subwatershed natural resource areas.

Wetlands:

Biodiversity

Vegetation Community. No Rapid Floristic Quality Assessment (RFQA) data are available for the wetlands in this subwatershed. However the *Functional Assessment of Wetlands* identified one small wetland with exceptional vegetative diversity and another with high diversity. Three wetlands were classified as having exceptional aesthetic and fish habitat values.

Habitat diversity

Connectivity. There are limited opportunities to connect wetlands within this subwatershed.

Size. Larger wetlands are more likely to support a notable on-site diversity and/or abundance of wildlife species. There are few large wetlands within this subwatershed.

Shoreline Protection. Riparian wetlands can provide significant shoreline protection and support emergent vegetation at the shoreline. The *Functional Assessment of Wetlands* evaluated riparian wetlands for their ability to protect lake or stream shoreline. Wetlands are present on less than two percent of the shoreline, concentrated in one small, shallow bay on the west side of the lake.

Uplands:

The subwatershed is almost fully developed, there are only a few remaining patches of undeveloped landscape. Most of these areas a wetlands or are wooded portions of large residential lots. No area within the subwatershed has been identified by the DNR or the Minnesota Biological Survey (MBS) as being high-value or ecological areas (Figure 3.17).

Thriving Communities:

Land use:

Table 3.17 shows the land uses within the area of the Christmas Lake subwatershed in acres and as a percentage of the total subwatershed. The predominant land use in the subwatershed is single family residential with a small percentage of park and open space (Figure 3.18). Much of the subwatershed is identified as water, while the vacant or undetermined land use is characterized as wetland.

Table 3.17. 2010 land use in the Christmas Lake subwatershed.

Land Use 2010	Acres	% of Subwatershed
Single - Family Residential	353.3	47.5
Water	273.0	36.7
Vacant or Undetermined	88.1	11.8
Parks and Open Space	14.7	1.9
Multi - Family Residential	5.7	0.7
Roads and Highways	5.0	0.6
Industrial	2.3	0.3
Institutional	0.4	<0.1
Commercial	N/A	N/A
Agricultural	N/A	N/A

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

Due to its clarity, Christmas Lake attracts snorkelers and SCUBA divers from across the Metro area. There are not any unique or scenic areas in this subwatershed. The Minnesota Historic features database lists three properties in the subwatershed: a former resort on Christmas Lake, and two farmhouses. There is a public boat launch on the north side of Christmas Lake (see Figure 3.19). The water clarity of the Christmas Lake allows for swimming and other recreation activities.

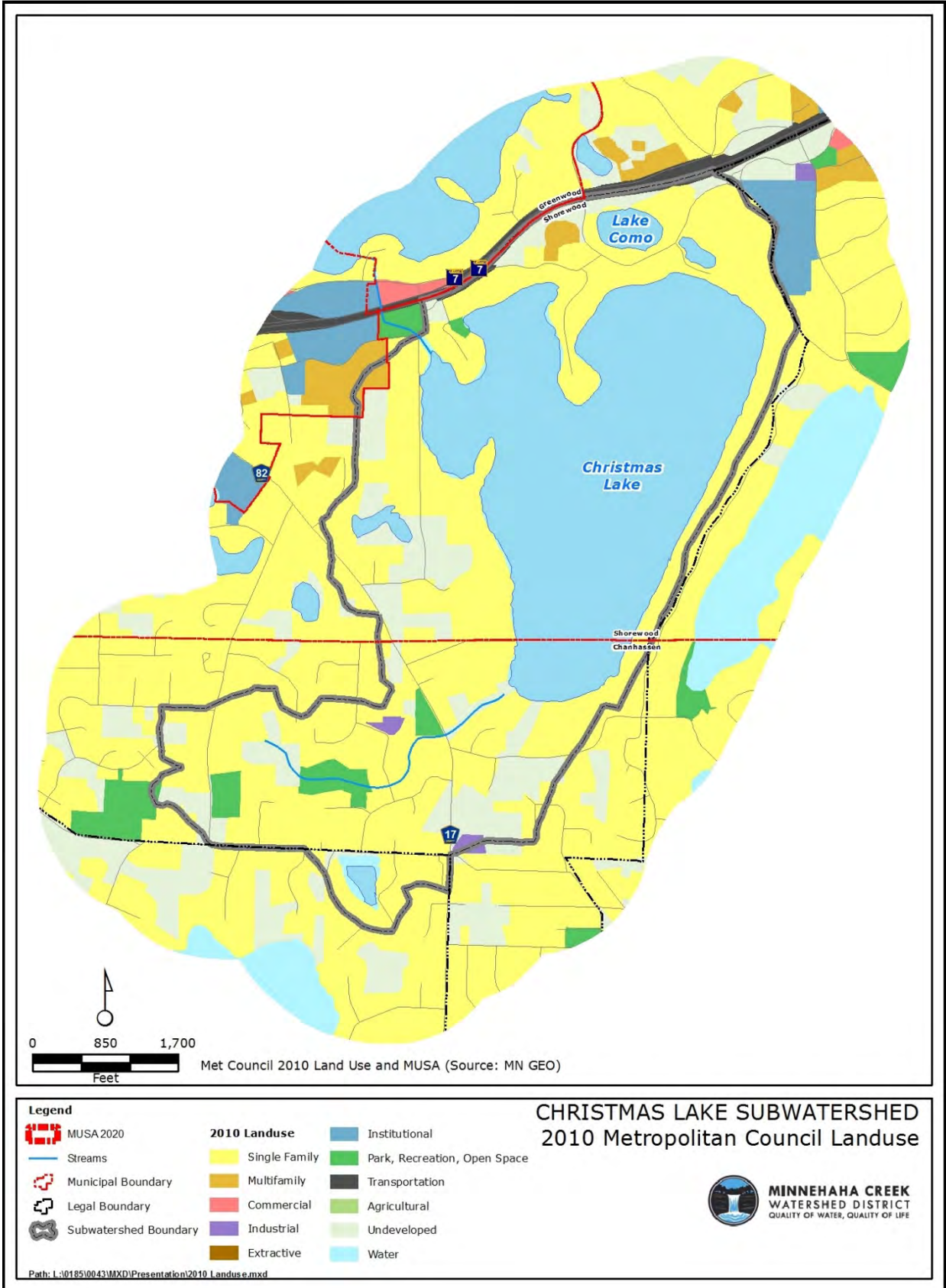


Figure 3.18. Christmas Lake subwatershed 2010 Metropolitan Council land use.

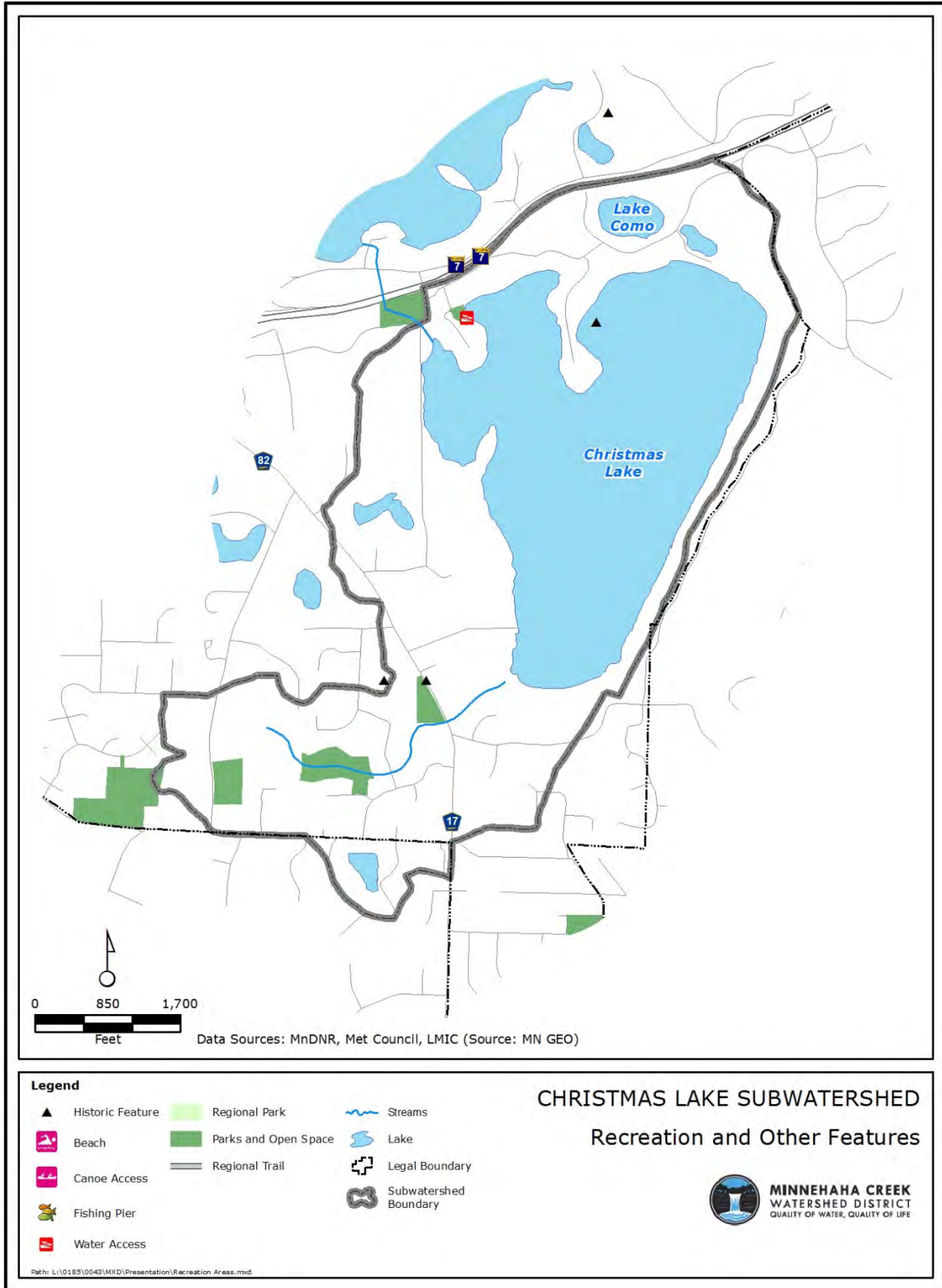


Figure 3.19. Christmas Lake subwatershed recreational and other features.

Studies and Assessments:

- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- Update East-Central Minnesota, MN DNR 2013
- Metropolitan Council from city Comprehensive Plans
- MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS), EOR 2003
- Minnesota Biological Survey
- Carver County Water Resource Management Plan
- Hennepin County Geologic Atlas
- Minnesota Land Cover Classification System (MLCCS)
- 2010 Metropolitan Council land use
- 2013 Milfoil Weevil Study
- 2014 Christmas Lake Rapid Response to Zebra Mussels

3.2 DUTCH LAKE SUBWATERSHED

The Dutch Lake Subwatershed has a land cover mix of wetlands, woodlands, agriculture, horse farms and residential that surround Dutch Lake. Dutch Lake inlet (CDU02) drains the wetland to the north into Dutch Lake, and the lake outlet (CDU01) flows into Jennings Bay, Lake Minnetonka. There are ecological impacts from the Dutch Lake outlet loading nutrients into Jennings Bay. Below is the area of the Dutch Lake subwatershed in acres by individual city, in total, and as a percentage of the total subwatershed (Table 3.21, Figure 3.21).

Table 3.21. Cities in the Dutch Lake subwatershed.

City	Area (Acres)	% of Subwatershed
------	--------------	-------------------

Minnetrasta	1,704.6	90%
Mound	183.8	10%
Total	1,888.4	100%

Source: MCWD

Watershed Description and Hydrology:

The Dutch Lake subwatershed is hummocky, rolling and hilly, with some steep slopes on the hillsides and along the southwestern shore of Dutch Lake and adjacent wetland.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (Figures 3.22). The subwatershed is primarily agriculture and open space in the north and grassland or turf with low to medium impervious surface typical of residential development in the south and east. The open space is dominated by wetland, forest and woodland.

Soils within the subwatershed are predominantly classified as Natural Resources Conservation Service Hydrologic Soil Group B (loamy soils with moderate infiltration potential) and D (clayey soils with very low infiltration potential). The Group D soils are found in low-lying areas and are generally hydric, or showing indications of inundation. For further information regarding geology and soils in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

The *2003 MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Dutch Lake subwatershed into seven subwatershed units, designated DL-1 through DL-7 (Figure 3.23). Dutch Lake is the primary receiving water within the subwatershed. There is one primary stream, Dutch Creek, which serves as the outlet of Dutch Lake and flows to Jennings Bay. The Dutch Lake subwatershed has two large wetland systems; a wetland complex dominates the western half of the subwatershed and another on the upper portion of the watershed that drains to a large wetland complex in the central watershed, which in turn drains south and then east to Dutch Lake.

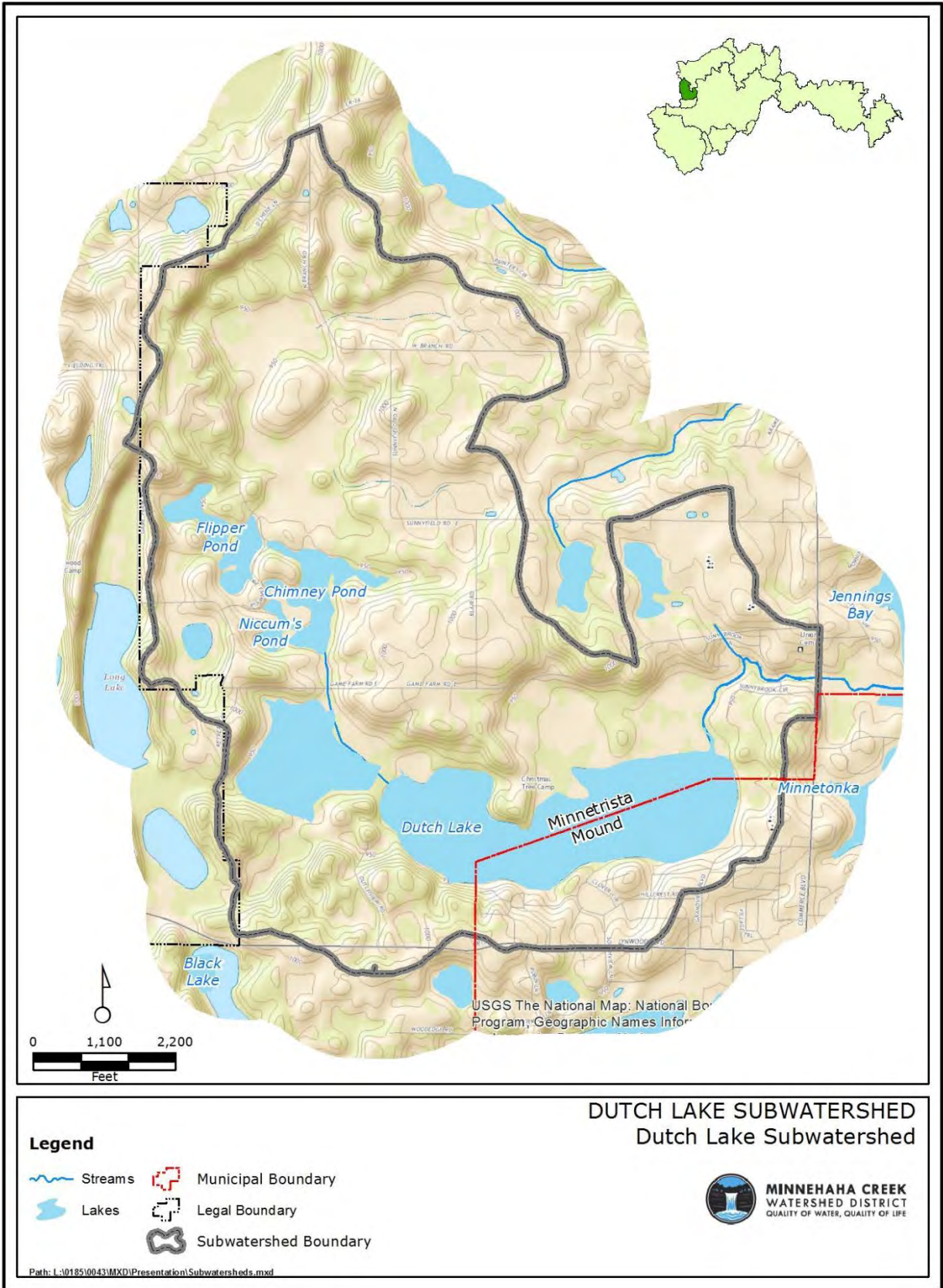


Figure 3.21. The Dutch Lake subwatershed.

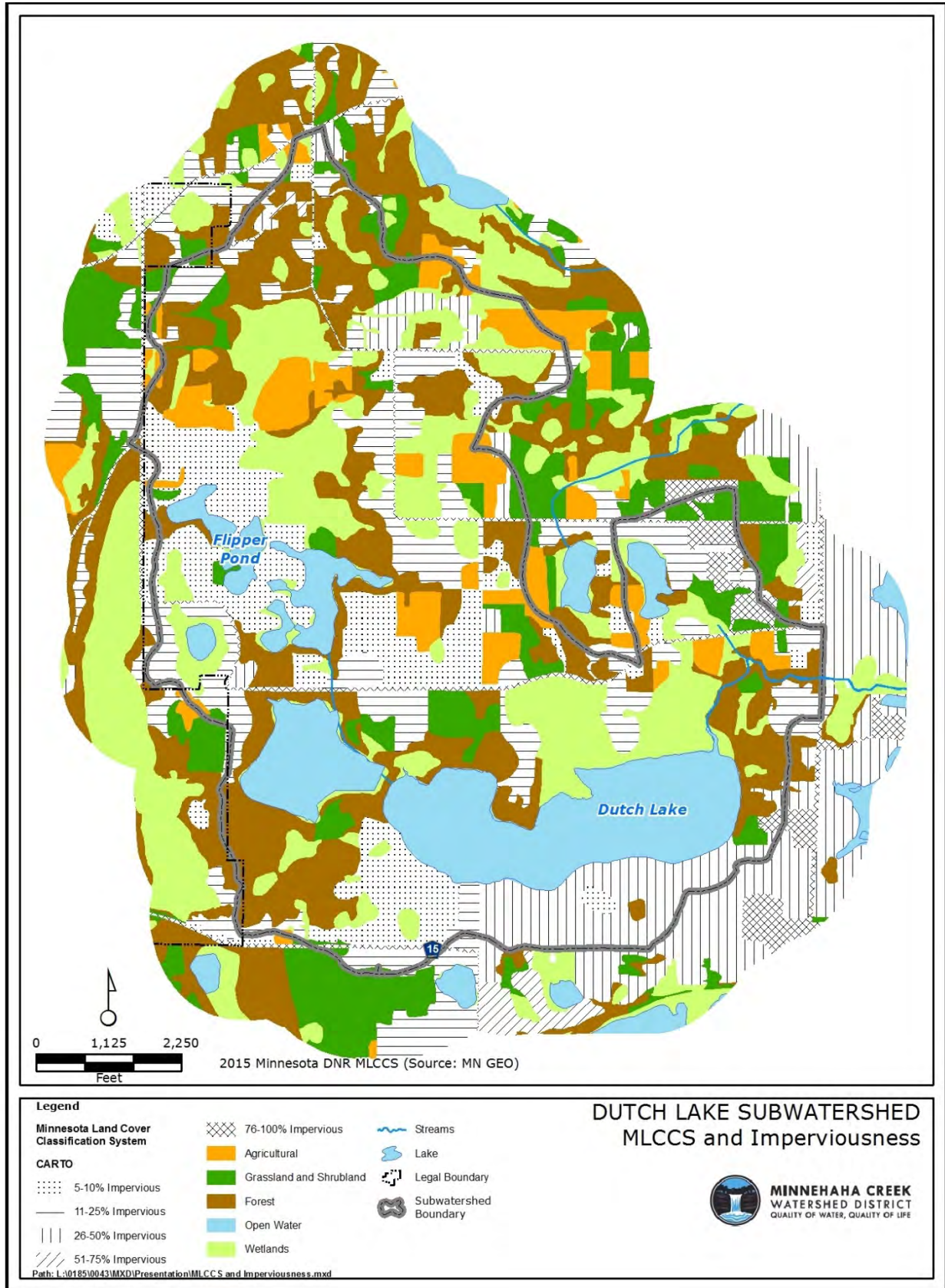


Figure 3.22. Dutch Lake subwatershed MLCCS and imperviousness.

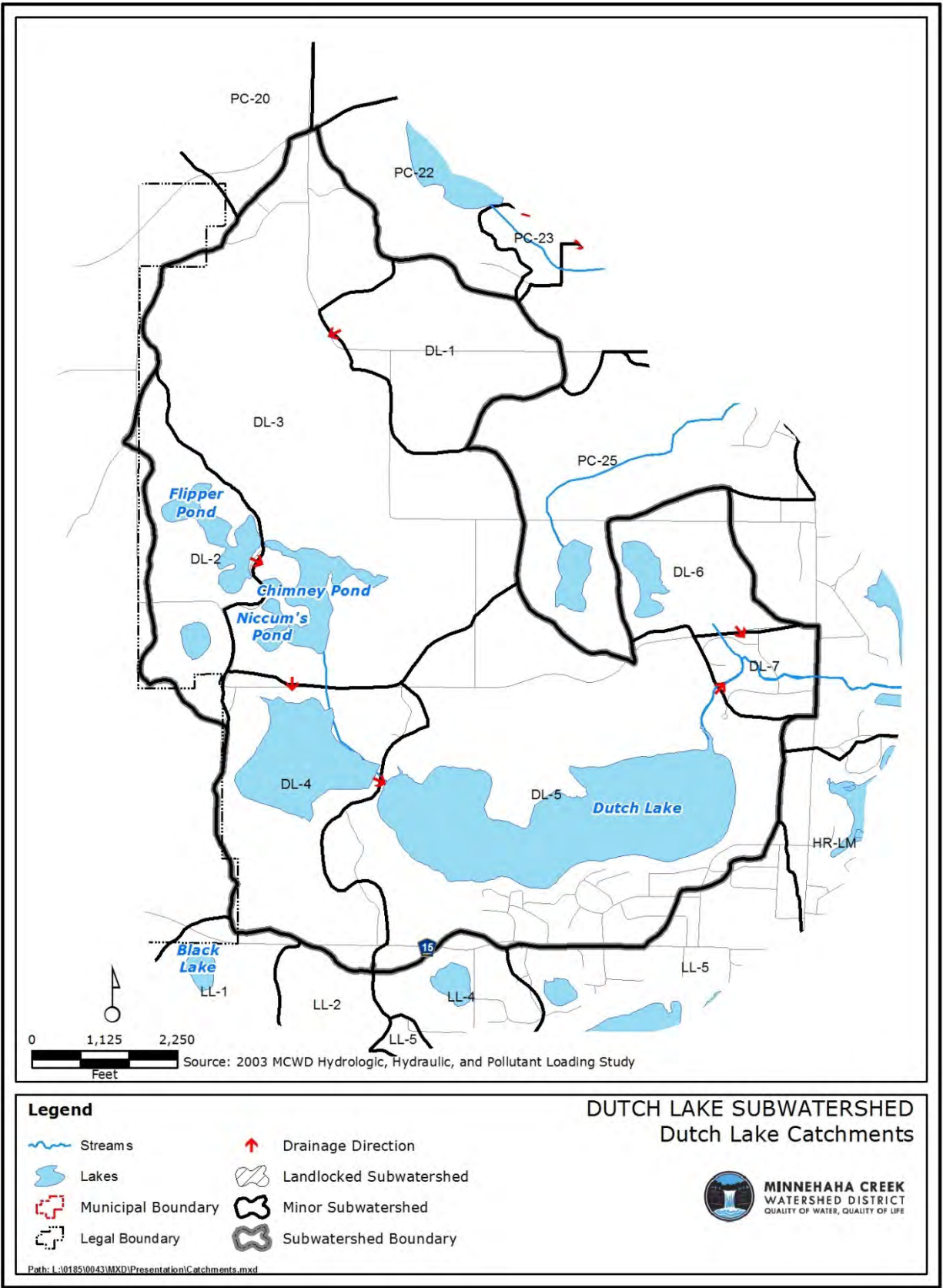


Figure 3.23. Dutch Lake subwatershed catchments.

Water Quality:

The following are summaries of the characteristics and classifications of lakes and streams within the subwatershed including water quality goals and trends.

Lakes:

Dutch Lake is the primary receiving water within the subwatershed, and is classified by the MnDNR for shoreland management purposes as a Recreational Development lake (Table 3.22).

Tables 3.22 and 3.23 below detail the physical and water quality characteristics of Dutch Lake.

Dutch Lake is listed on the State's Impaired Waters list for nutrient/eutrophication biologic indicators. Average summer nutrient concentrations are greater than the state standard. Algal blooms and poor water quality makes recreational activities undesirable at certain times of the year. For more information regarding water quality in the subwatershed, please refer to the District's 2015 annual Water Quality Report and the Upper Minnehaha Creek Watershed Lakes TMDL (Wenck 2014).

Table 3.22. Physical characteristics of lakes in the Dutch Lake subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Dutch	173	45	10:1	Recreational Development

Source: Minnesota DNR.

Table 3.23. Selected water quality goals and current conditions of lakes in the Dutch Lake subwatershed.

Lake	State TP Standard (µg/L)	2007 Plan Goal TP (µg/L)	Trend	2001-2015 Average		
				TP (µg/L)	Chl-a (µg/L)	Secchi (m)
Dutch	40	15	No trend	66	39	1.1

TP = Total phosphorus concentration

Source: MCWD and Minnesota DNR.

Streams:

There is one primary stream within the subwatershed; Dutch Creek, which serves as the outlet of Dutch Lake and flows to Jennings Bay. A small stream drains wetlands on the west side of Dutch Lake, which flows seasonally or intermittently. Flow in the stream is controlled by an outlet structure on Dutch Lake and is mainly runoff event-driven. Large events within the subwatershed can result in temporarily high flows into the Creek.

At this time no streams are listed as Impaired Waters, however both streams have TP concentrations that are high relative to the state river eutrophication standards. However, those standards also look at other indicators such as chlorophyll-a, diel oxygen flux, and biological oxygen demand that haven't been assessed in the Creek. Tables 3.24 and 3.25 below detail the physical and water quality characteristics of streams and tributaries within the subwatershed.

Table 3.25 shows the average concentrations at sites of the two unnamed streams in the subwatershed, Dutch Lake Creek Inlet and Dutch Lake Creek Outlet. The streams have an average TSS of 6 and 9 mg/l respectively, which is well below the 30 mg/L state standard. Maintaining sufficient DO is necessary to support aquatic life. The DO state standard requires the stream to never fall below 5 mg/L DO. Monitoring data show that both sites fall below the standard multiple times per year. For more information please refer to the District's Water Quality (Hydrodata) reports.

Table 3.24. Major streams in the Dutch Lake subwatershed.

Stream	Length (mi)
Dutch Lake Inlet (CDU02)	0.16
Dutch Lake Outlet (CDU01)	0.92

Table 3.25. Current conditions of streams in the Dutch Lake subwatershed.

See Figure 3.24 for monitoring locations.

Stream	Trend	2005-2015 Summer Average			
		TP (µg/L)	TN (mg/L)	TSS(mg/L)	Cl (mg/L)
Dutch Lake Inlet (CDU02)	n/a	240	1.01	6	26
Dutch Lake Outlet (CDU01)	No trend	115	1.25	9	31

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride.

Source: MCWD.

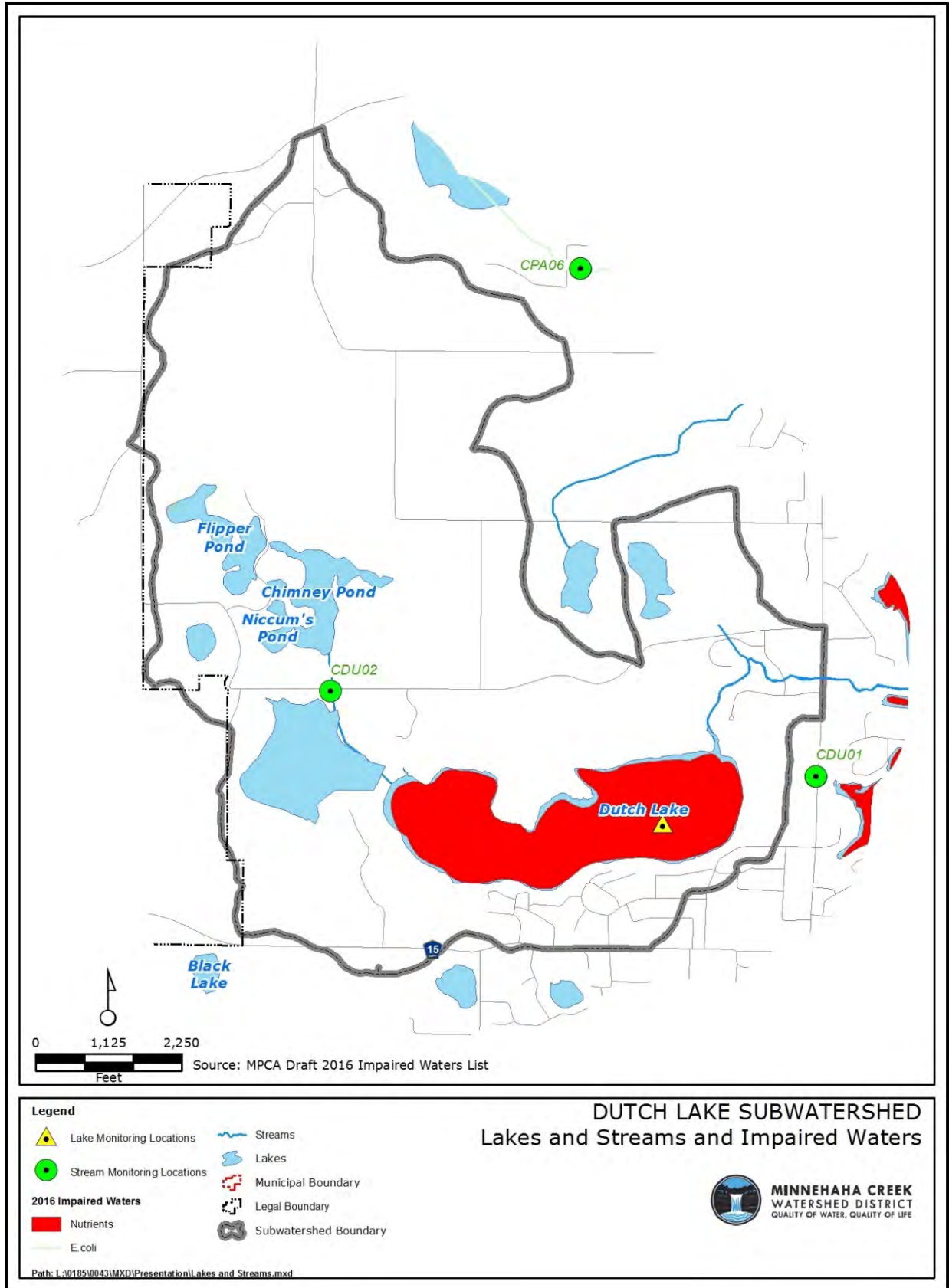


Figure 3.24. Dutch Lake subwatershed lakes and streams and Impaired Waters.

Wetlands:

According to the updated NWI, wetlands, including lakes, cover over 30 percent of the watershed’s surface (Figure 3.25 and Table 3.26). A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients to and from the subwatershed. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands.

Table 3.26. National Wetland Inventory wetland types in the Dutch Lake subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	93.3	4.9
2 - Wet Meadow	-	-
3 - Shallow Marsh	283.4	15.0
4 - Deep Marsh	7.5	0.4
5 - Open Water	180.7	9.5
6 - Scrub Shrub	8.3	0.4
7 - Forested	-	-
8 - Bog	2.1	<0.1
Riverine	-	-
Wetland Total	575.3	30.5
Upland	1,313.1	69.5
TOTAL	1,888.4	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream baseflow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

The infiltration potential of the upland areas in the subwatershed are described as low to medium. Because of the organic nature of the soils in the central wetland area, infiltration potential there is variable. The *Hennepin County Geologic Atlas* classifies most of the upland areas as being of low sensitivity to pollution, and the central wetland area as highly sensitive.

PART OF THE DUTCH LAKE SUBWATERSHED HAS BEEN DESIGNATED BY THE MINNESOTA DEPARTMENT OF HEALTH AS A DRINKING WATER SENSITIVITY MANAGEMENT AREA (DWSMA) AND A WELLHEAD PROTECTION AREA FOR A CITY OF MINNETRISTA PUBLIC WELL. WHILE THE AQUIFER SENSITIVITY IS HIGH, THE MDH HAS DESIGNATED THIS AREA TO BE OF LOW RISK AND LOW VULNERABILITY TO CONTAMINATION OF THE DRINKING WATER SUPPLY. FIGURE 3.26 SHOWS AREAS IN THE SUBWATERSHED WITH GROUNDWATER SENSITIVITY AND THAT ARE DESIGNATED WELLHEAD PROTECTION AREAS.

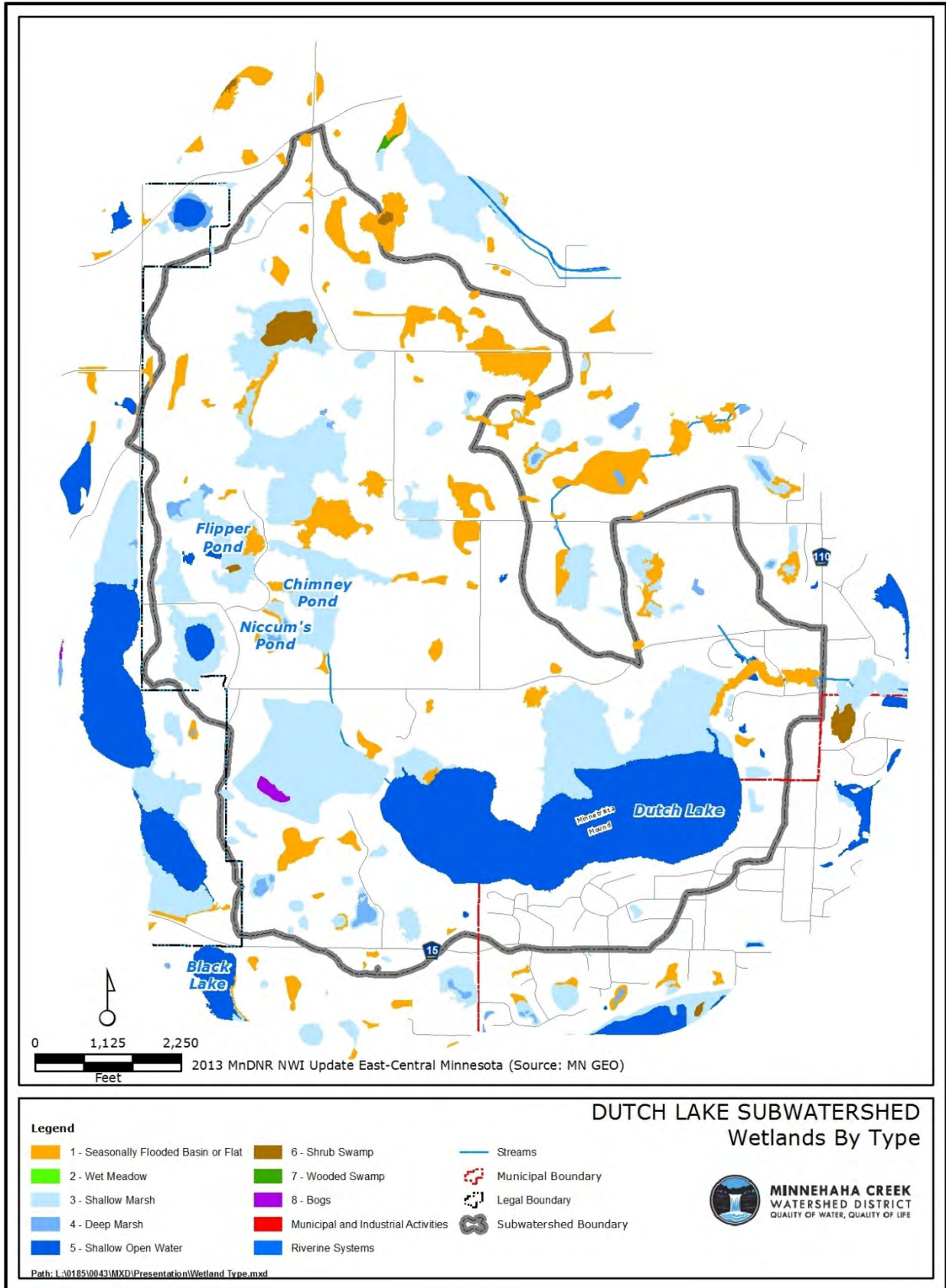


Figure 3.25. Dutch Lake subwatershed wetlands by type.

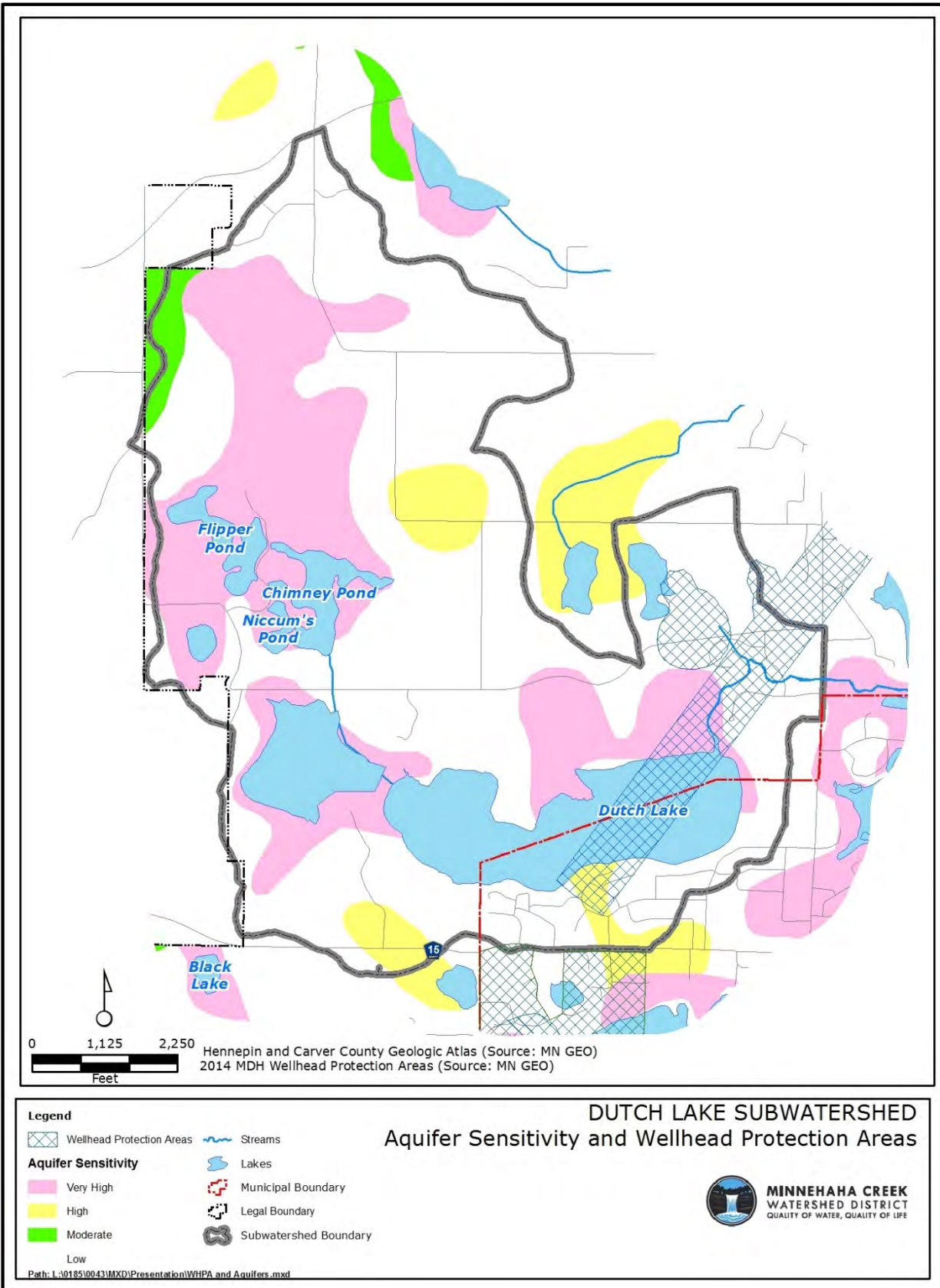


Figure 3.26. Dutch Lake subwatershed aquifer sensitivity and Wellhead Protection Areas.

Water Quantity:

A small stream drains wetlands on the west side of Dutch Lake, which flows seasonally or intermittently. The Dutch Lake subwatershed is characterized by a system of ditches and culverts conveying water into the main water bodies of the subwatershed.

To assess change in water yield, a Mann-Kendall statistical trend test was performed on data for the two monitoring stations to the west and east of Dutch Lake. Water yield did not exhibit any statistically significant trend upward or downward. The period of record for the station upstream of Dutch Lake was 2006-2015 and was 1997-2015 for the station downstream of Dutch Lake.

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity, habitat diversity, and nutrient cycling. The Dutch Lake subwatershed has not yet been systematically evaluated by the E-Grade program. This section summarizes ecological integrity using existing data where available (Figure 3.27).

Lakes:

Biodiversity

Fish Community. No fish IBI data are available for the lakes in this subwatershed. Dutch Lake was last stocked by the MnDNR in 2011 for bluegill and was last surveyed in 2014. At the time of that survey (late July) water clarity was 1.2 feet and the lake was strongly stratified with poor (<2 ppm) dissolved oxygen below 8 feet. That survey found that Northern Pike abundance was relatively low compared to other similar lakes in the state; however, typical of lakes with low density, mean size was larger than average. The pan fish community appears healthy. Yellow Perch have never been abundant in Dutch Lake and have always been sampled at a rate below average.

Aquatic Vegetation Community. Biodiversity is determined by the number and variety of species, or richness. Floristic Quality Index data was conducted in 1996. The FQI was 15.1, which is considered Poor. Dutch Lake is infested by Eurasian watermilfoil.

Habitat diversity

Aquatic Vegetation Community. Habitat diversity is determined by the number and variety of species. This has not been calculated yet, but will be once E-Grade is completed in the subwatershed.

Shoreline Health. Shoreline health is assessed looking at shoreline vegetative cover and the relative human disturbance. The MnDNR is using the Score The Shore protocol to relate shoreline conditions to fish community structure using the fish IBI metric. No Score The Shore data is available, however, aerial photos show that much of the west, north and east side of Dutch lake as well as many of the wetlands in the subwatershed have significant woodland or wetland fringes, which are beneficial for controlling runoff and supporting emergent vegetation at the shoreline.

Streams:

Biodiversity

Fish Community. No fish IBI data is available for the streams in this subwatershed.

Macroinvertebrate Community. No macroinvertebrate data is available for the streams in this subwatershed.

Habitat diversity

Habitat Complexity. No Minnesota Stream Habitat Assessment data is available to assess habitat complexity on either the inlet and outlet streams of Dutch Lake.

Connectivity. Connectivity is defined by two metrics: presence or absence of barriers, and access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. There are several barriers on the streams in this subwatershed, most of them culverts at road crossings. There is no stream cross section data available for either the inlet or outlet streams.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS concentrations increase turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. A stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, can be stressful to organisms. In addition, streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is not available, but based on observation, the average flow of both the inlet and outlet streams is low, which would be indicative of the low DO levels mentioned above.

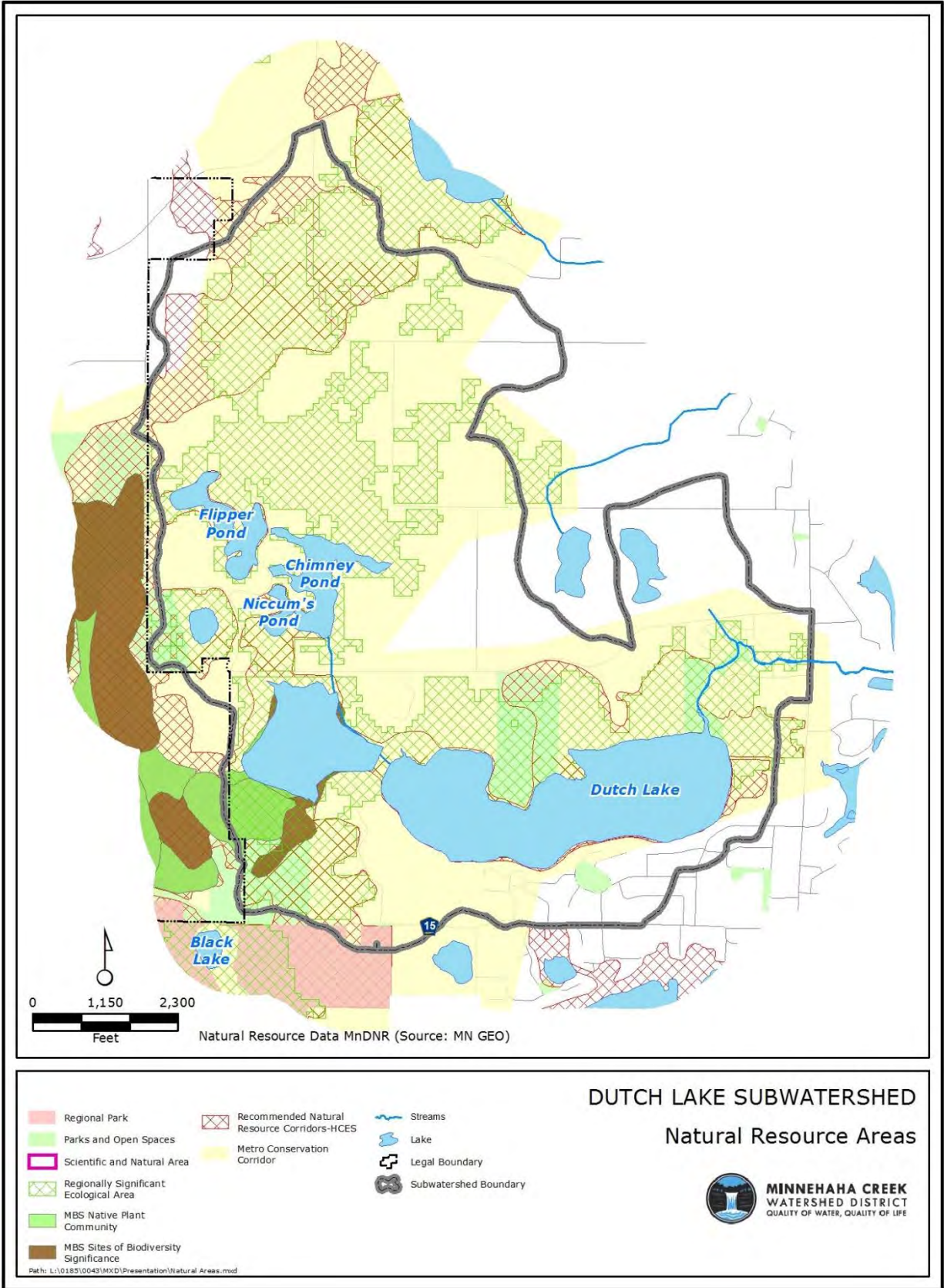


Figure 3.27. Dutch Lake subwatershed natural resource areas.

Wetlands:

Biodiversity

Vegetation Community. No Rapid Floristic Quality Assessment data are available for the wetlands in this subwatershed. However the *Functional Assessment of Wetlands* scored two large riparian wetlands highly – on the north side and west side of the lake - on vegetative diversity, fish and wildlife habitat, or aesthetics. There is one wetland in the subwatershed with high restoration potential. Numerous other small wetlands or moderate restoration potential are located throughout the subwatershed.

Uplands:

Biodiversity

Existing data sources do not highlight any unique or scenic areas in this subwatershed. However, much of the subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor and by the City of Minnetrista as a natural resources corridor due to the predominance and contiguity of wetlands (Figure 3.27).

Habitat diversity

Regionally significant ecological areas are places where larger tracts of minimally disrupted land provide habitat complexity. Much of the subwatershed has been identified by the MnDNR as a Metropolitan Conservation Corridor and by the City of Minnetrista as a natural resources corridor due to the predominance and contiguity of wetlands.

The Minnesota Biological Survey (MBS) has identified both terrestrial and aquatic locations in the watershed with intact native plant communities, and those with biodiversity significance (see Figure 3.16.) Native plant communities are a group of native plants that interact with each other and the surrounding environment in ways not greatly altered by humans or by introduced plant or animal species. On the west side of Dutch Lake are two native plant communities classified as Imperiled or Imperiled/Vulnerable. A 25-acre Tamarack Swamp and a 32 acre Sugar Maple-Basswood-Bitternut Hickory Forest are part of a native plant corridor between Dutch Lake and Long Lake/Little Long Lake, which are both outside the watershed.

Thriving Communities:

Land use:

Table 3.27 below shows the land uses within the area of the Dutch Lake subwatershed in acres and as a percentage of the total subwatershed. The predominant land use in the subwatershed is vacant land, mainly wetland and forest or woodland (Figure 3.28). There are scattered low density single family residential uses in the upper watershed, mainly isolated homes and farmsteads. The south and eastern portion of the subwatershed are dominated by single family residential. Mound Westonka High School is a large, institutional use in the eastern subwatershed.

Much of the watershed is outside of the MUSA 2020 boundary, and is not served by regional wastewater facilities.

Table 3.27. 2010 land use in the Dutch Lake subwatershed.

Land Use 2010	Acres	% of Subwatershed
Vacant or Undetermined	947.2	50.1
Single - Family Residential	371.7	19.6
Agricultural	188.8	9.9
Water	181.1	9.5
Parks and Open Space	112.4	5.9
Institutional	77.5	4.1
Multi - Family Residential	8.8	0.4
Commercial	0.6	0.03
Industrial	N/A	N/A
Roads and Highways	N/A	N/A

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

Existing data sources do not highlight any unique or scenic areas in this subwatershed. The Minnesota Historic Features database notes one historic site in this subwatershed, a farmhouse. There is one public boat access on Dutch Lake off of Grandview Boulevard, adjacent to Grandview Middle School (Figure 3.29). The YMCA operates Camp Christmas Tree on the north shore of the lake, with a wide variety of swimming, fishing and boating activities available to campers.

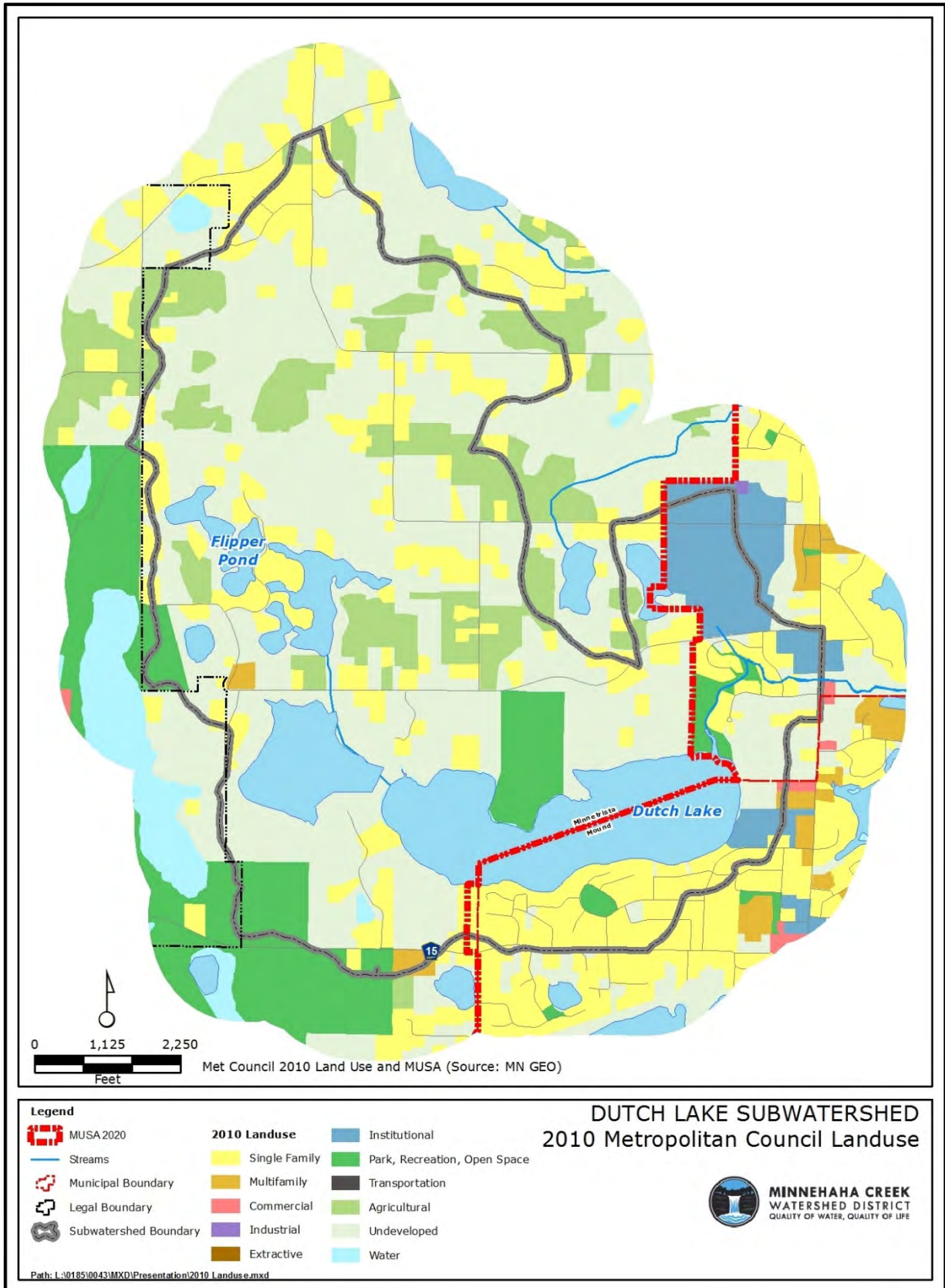


Figure 3.28. Dutch Lake subwatershed 2010 Metropolitan Council land use

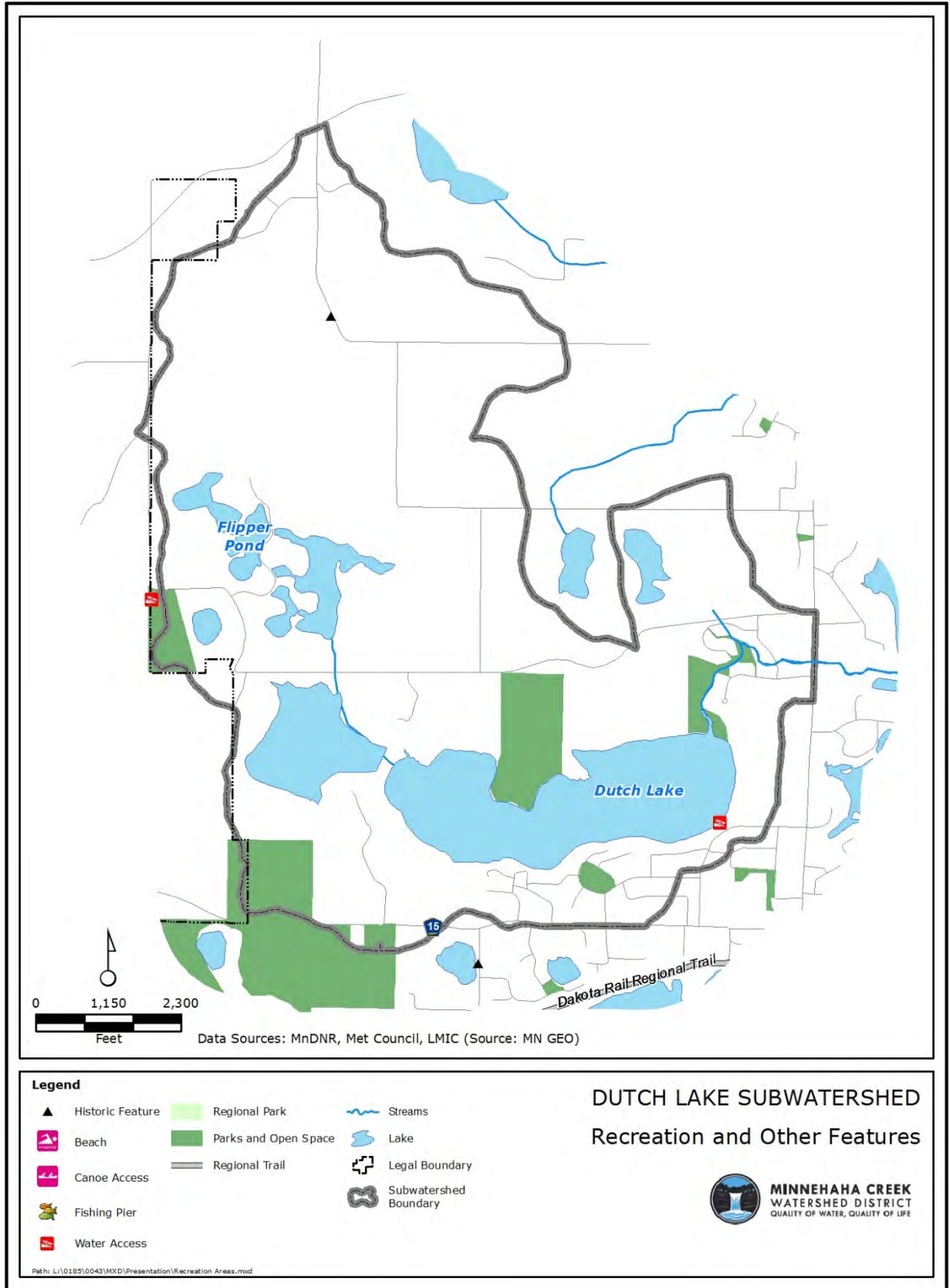


Figure 3.29. Dutch Lake subwatershed recreation and other features.

Studies and Assessments:

- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- Update East-Central Minnesota, MN DNR 2013
- MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS), EOR 2003
- Upper Minnehaha Creek Watershed Lakes TMDL (Wenck 2014)
- National Wetland inventory
- Hennepin County Geologic Atlas
- Functional Assessment of Wetlands
- Minnesota Biological Survey (MBS)
- 2020 Metropolitan Urban Service Area (MUSA)
- Minnesota Historic Features database
- Dutch Lake Wetland Restoration, 2009
- Dutch Lake Infiltration (DL-5), 2010
- Dutch Lake Infiltration (DL-7), 2012

3.3 GLEASON LAKE SUBWATERSHED

Gleason Lake Subwatershed is dominated by a mix of urban residential/business land cover with very little woodland and wetlands remaining. The subwatershed is drained in the west by Hadley Lake and in the east by Gleason Lake. All the water drains into Wayzata Bay, Lake Minnetonka. The nutrient loading into Wayzata Bay is not well understood. One of the outlets is piped and the other one drains into pond prior to discharging into Wayzata Bay. A 2013 Macroinvertebrate Assessment indicates poor water quality along the creek that discharges into Wayzata Bay. Table 3.31 shows the area of the Gleason Lake subwatershed in acres by individual city, in total and as a percentage of the total subwatershed (Figure 3.31).

Table 3.31. Cities in the Gleason Lake subwatershed.

City	Area (Acres)	% of Subwatershed
Minnetonka	51.4	1.4%
Orono	61.2	1.6%
Plymouth	3,116.5	82.8%
Wayzata	537.1	14.3%
Total	3,766.2	100%

Source: MCWD

Watershed Description and Hydrology:

The eastern portion of the subwatershed drains through several wetlands including Kreatz and Snyder Lakes and then to County Ditch #15, which discharges into Gleason Lake. The western watershed drains through Hadley Lake and then south to Gleason Lake Creek, which outlets the south end of Gleason Lake and flows by channel and culvert to Glenbrook Pond. The Pond outlets to a storm sewer that discharges downstream to Wayzata Bay.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (Figure 3.32). The subwatershed is mostly developed areas with low to medium imperious surface typical of residential development. Pockets of wetlands and wooded areas (mainly park lands) are present.

Soils within the subwatershed are predominantly classified as Natural Resources Conservation Service Hydrologic Soil Group B (loamy soils with moderate infiltration potential) and D (clayey soils with very low infiltration potential). For further information regarding geology and soils in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

The Gleason Lake subwatershed is comprised of gentle rolling hills with an abundance of lakes and ponds. The eastern portion of the subwatershed drains through several wetlands including Kreatz and Snyder Lakes and then to County Ditch #15, which discharges into Gleason Lake. The western watershed drains through Hadley Lake and then south to Gleason Lake Creek, which outlets the south end of Gleason Lake and flows by channel and culvert to Glenbrook Pond. The Pond outlets to a storm sewer that discharges downstream to Wayzata Bay.

The *2003 MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Gleason Lake subwatershed into 16 subwatershed units, designated GLC-1 through GLC-11, and HL-1 through HL-5 for that part of the subwatershed that is within the Hadley Lake drainage area (see Figure 3.33).

Mooney Lake has not natural outlets, however, it is pumped out under certain agreed upon conditions to prevent flooding.

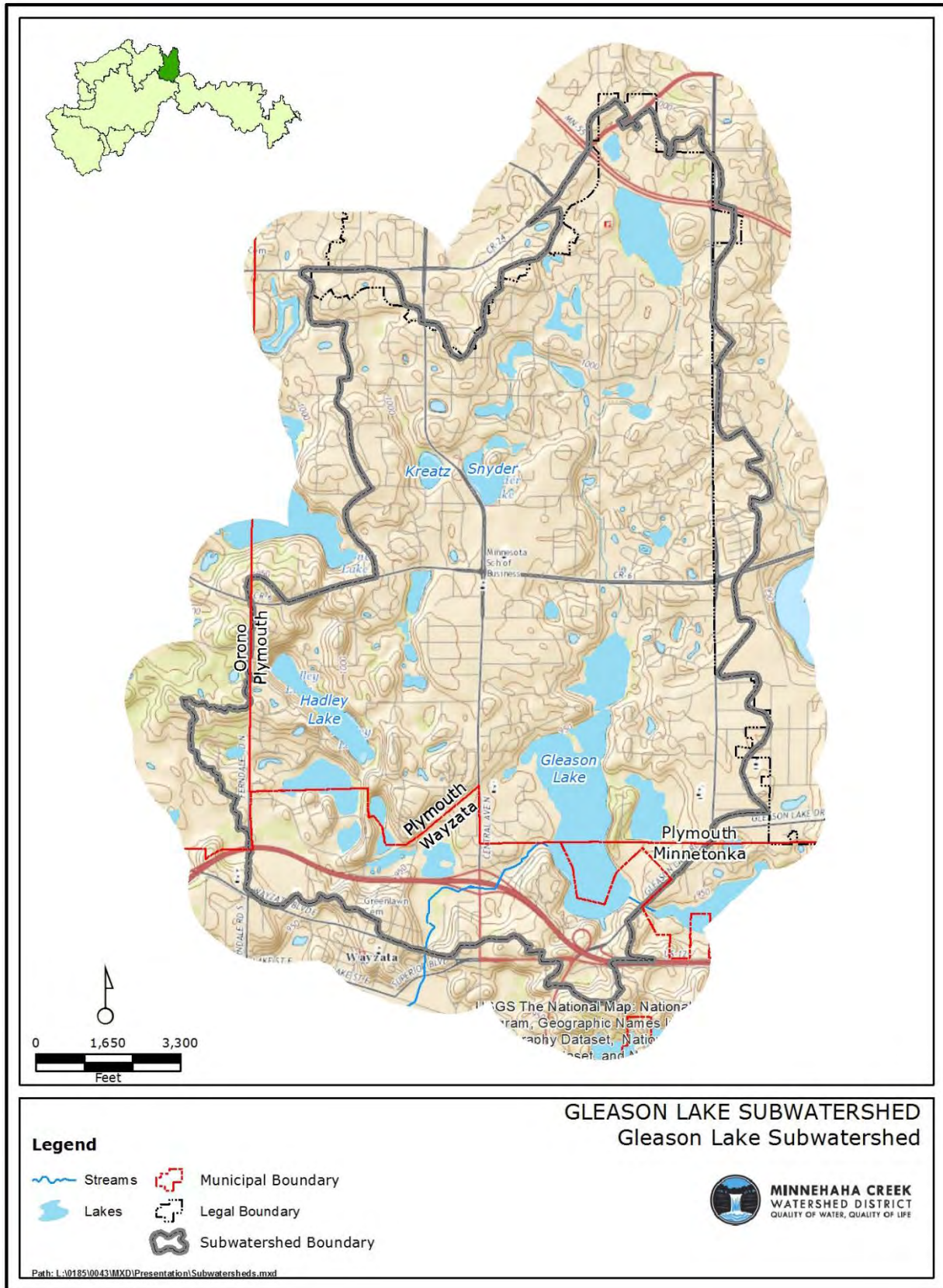


Figure 3.31. The Gleason Lake subwatershed.

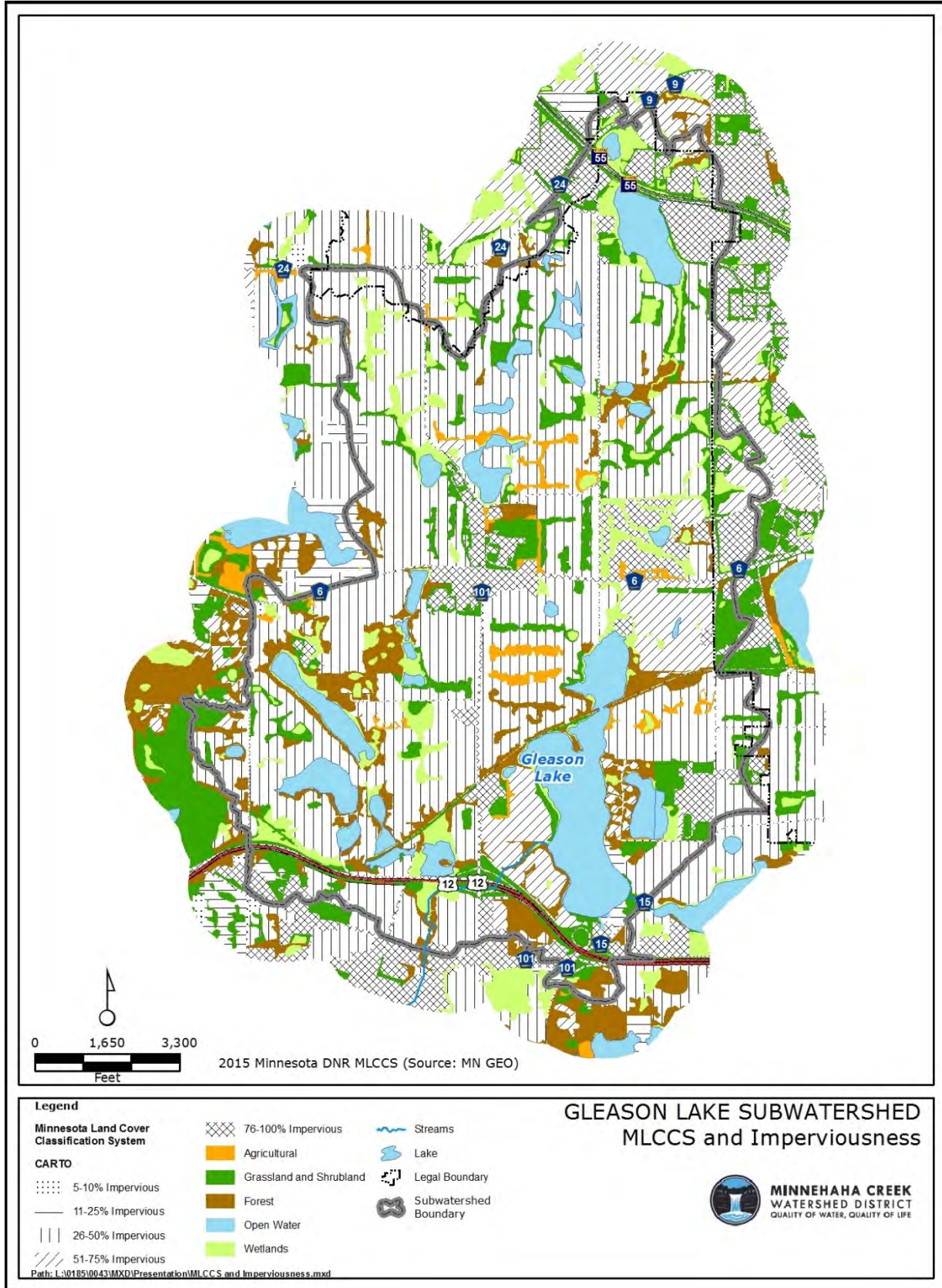


Figure 3.32. Gleason Lake subwatershed MLCCS and imperviousness.

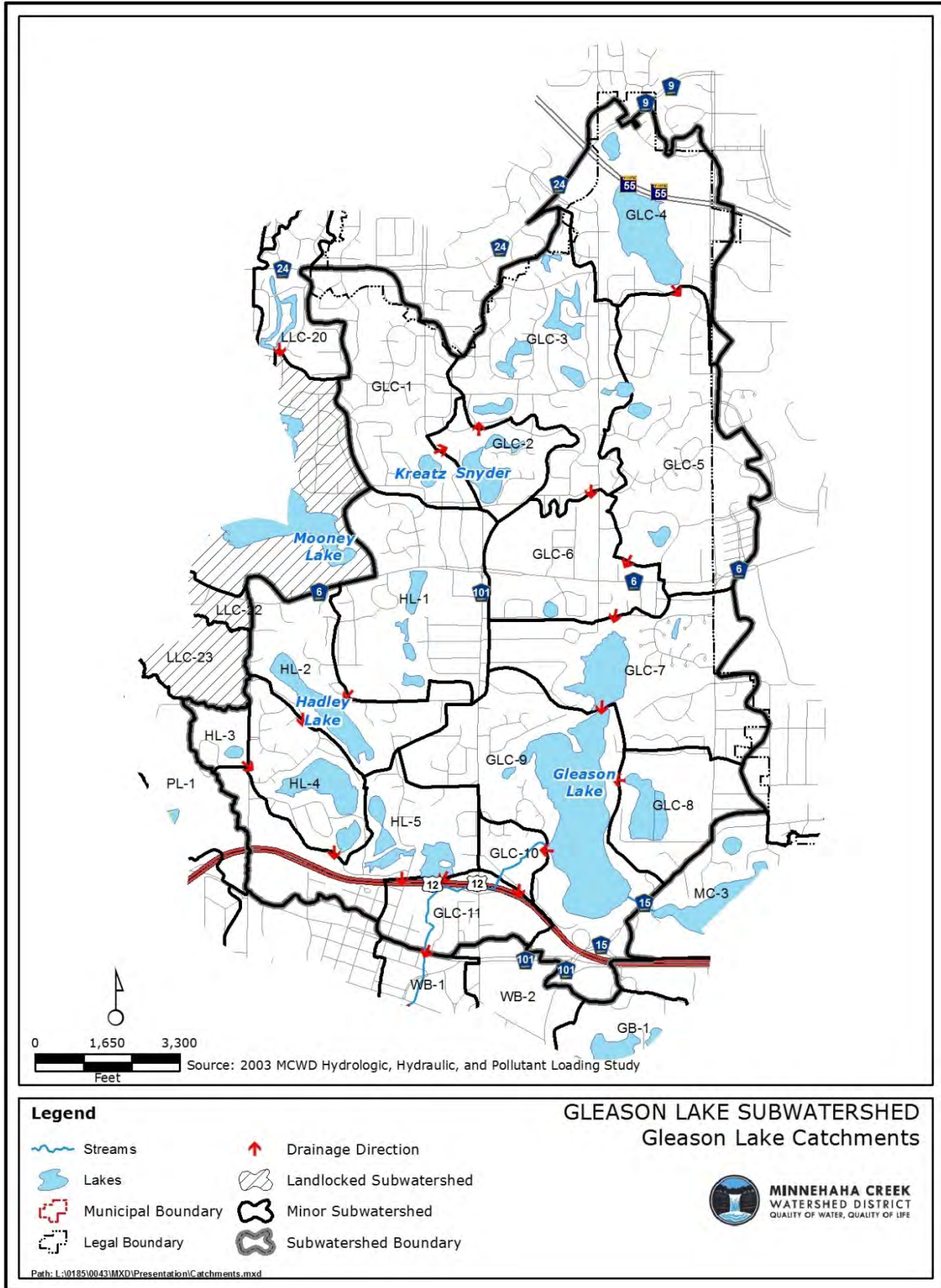


Figure 3.33. Gleason Lake subwatershed catchments.

Water Quality:

The following are summaries of the characteristics and classifications of lakes and streams within the subwatershed including water quality goals and trends.

Lakes:

Gleason Lake is the primary receiving water within the subwatershed, and is classified by the DNR for shoreland management purposes as a Recreational Development lake (Table 3.32). Other large water resources in the subwatershed are Hadley, Kreatz, Mooney and Snyder Lakes (Figure 3.34).

Four lakes in the subwatershed are listed on the State's Impaired Waters list, with average summer nutrient concentrations greater than the state standard: Gleason, Hadley, Mooney and Snyder Lakes. Tables 3.32 and 3.34 below detail the physical and water quality characteristics of Gleason Lake and other lakes within the subwatershed. For more information regarding water quality in the subwatershed, please refer to the District's annual Water Quality Reports and the Upper Minnehaha Creek Watershed Lakes TMDL (Wenck 2014).

Table 3.32. Physical characteristics of lakes in the Gleason Lake subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Gleason	164	16	16:1	Recreational Development
Hadley	22	N/A	24:1	Recreational Development
Kreatz	9	12	42:1	Recreational Development
Snyder	16	7	18:1	Recreational Development
Mooney	117	10	5:1	Recreational Development

Source: Minnesota DNR, MCWD

Table 3.33. Selected water quality goals and current conditions of lakes in the Gleason Lake subwatershed.

Lake	State TP Standard (µg/L)	2007 Plan Goal TP (µg/L)	Trend	2001-2015 Average		
				TP (µg/L)	Chl-a (µg/L)	Secchi (m)
Gleason ¹	60	n/a	n/a	97.895.7	50.749.1	1.11.2
Hadley ²	40	n/a	n/a	57.33	16.4	-
Kreatz ²				71.9	41.32	1.0
Snyder	60	n/a	n/a	197.56	46.6	0.79
Mooney	60	n/a	n/a	78	51	1.0

TP = total phosphorus, Chl-a =chlorophyll-a, Secchi = water clarity.

¹Data is 2005-2011 average, as shown in the Upper Watershed Lakes TMDL.

²Data is 2006-2008 average, as shown in the Upper Watershed Lakes TMDL.

Source: MCWD, Upper Minnehaha Creek Watershed Lakes TMDL, MPCA.

Streams:

County Ditch #15 drains the upper watershed to Gleason Lake. Gleason Creek is the outlet of Gleason Lake and flows to Glenbrook Pond in Wayzata, which is discharged by storm sewer into Wayzata Bay of Lake Minnetonka. Part of the creek was channelized as County Ditch #32 at some unknown past date. Flow in the creek is controlled by an outlet weir on Gleason Lake and is mainly runoff event-driven. The creek flows through five culverts at the US Highway 12/TH 101 interchange (Figure 3.34).

At this time no streams are listed as Impaired Waters. Total phosphorus concentrations on CD #15 at the Gleason Lake inlet are high relative to the state river eutrophication standards. However, those standards also look at

other indicators such as chlorophyll-a, diel oxygen flux, and biological oxygen demand that haven't been assessed in CD #15. Tables 3.34 and 3.35 below detail the physical and water quality characteristics of streams and tributaries within the subwatershed.

Table 3.35 shows the average concentrations in Gleason Creek and CD #15 to be well below the 30 mg/L state standard for this ecoregion. Maintaining sufficient DO is necessary to support aquatic life. The DO state standard requires the stream to never fall below 5 mg/L DO. Monitoring data show that Gleason Creek can fall below this standard in summer during periods of no or low flows. For more information please refer to the District's Water Quality (Hydrodata) reports.

Table 3.34. Major streams in the Gleason Lake subwatershed.

Stream	Length (mi)
Gleason Creek	0.87
County Ditch #15	2.47
County Ditch #32	1.01

Table 3.35. Current conditions of streams in the Gleason Lake subwatershed.

See Figure 3.34 for monitoring locations.

Stream	Trend	2005-2015 Summer Average			
		TP (µg/L)	TN (mg/L)	TSS(mg/L)	Cl (mg/L)
Gleason Creek (CGL01) – lake outlet	No trend	53	0.69	5	101*
CD #15 (CGL03) – lake inlet	n/a	150	0.891	12	130**

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride.

*Data is from 2009-2015; **Data is from 2008-2015.

Source: MCWD.

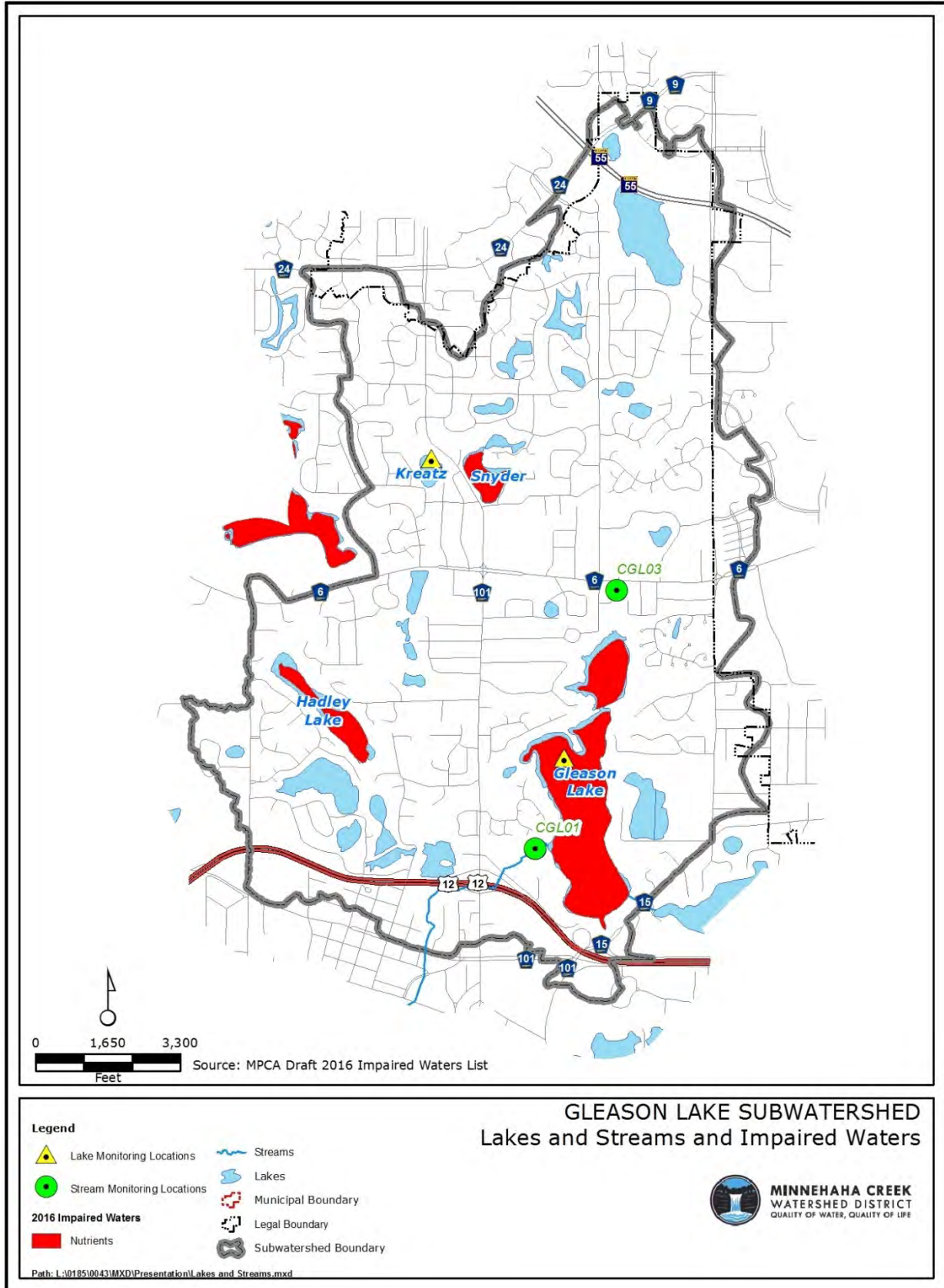


Figure 3.34. Gleason Lake subwatershed lakes and streams and Impaired Waters.

Wetlands:

According to the updated NWI, wetlands, including lakes, cover 15 percent of the watershed’s surface (Figure 3.35 and Table 3.36). A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients to and from the subwatershed. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands.

Table 3.36. National Wetland Inventory wetland types in the Gleason Lake subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	102.1	2.7
2 - Wet Meadow	-	-
3 - Shallow Marsh	122.1	3.2
4 - Deep Marsh	57.5	1.5
5 - Open Water	271.0	7.9
6 - Scrub Shrub	12.2	0.3
7 - Forested	0.7	<0.1
8 - Bog	-	-
Riverine	-	-
Wetland Total	567.2	15.0
Upland	3,198.8	85.0
TOTAL	3,766	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream baseflow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

The infiltration potential of the upland areas within the subwatershed is described as medium to low with some areas of variability where the soils are organic in nature. The *Hennepin County Geologic Atlas* classifies area to the north of Gleason Lake as high infiltration potential and also high aquifer sensitivity due to the outwash nature of the underlying soil deposits.

The entire Gleason Lake subwatershed has been designated by the Minnesota Department of Health as a Drinking Water Sensitivity Management Area (DWSMA) and Wellhead Protection Area (WHPA) for City of Plymouth public wells. The MDH has designated areas within the DWSMA as high to moderate risk and vulnerability to contamination of the drinking water supply. Figure 3.36 shows areas in the subwatershed with groundwater sensitivity and that are designated as higher Drinking Water Sensitivity.

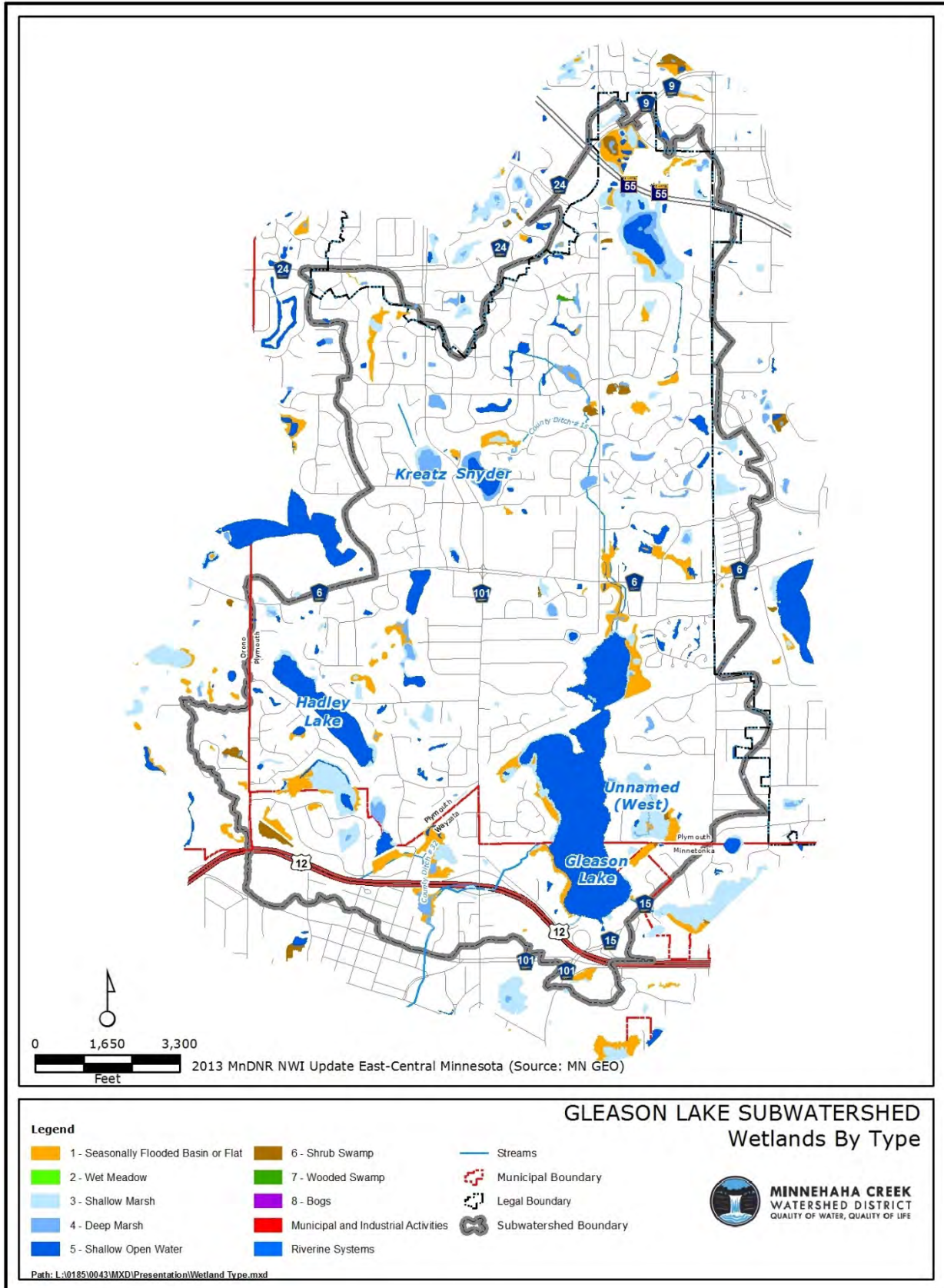


Figure 3.35. Gleason Lake subwatershed wetlands by type.

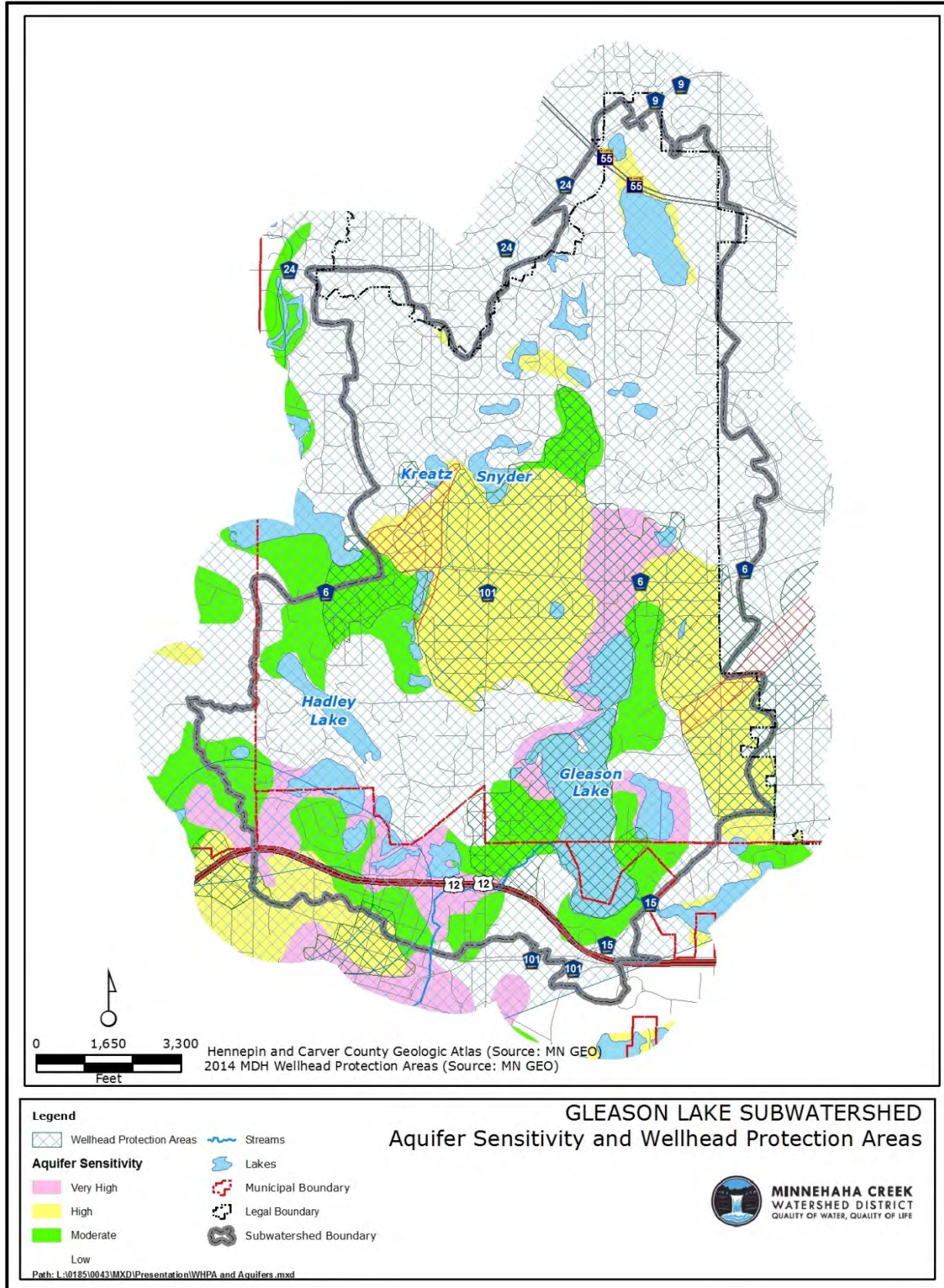


Figure 3.36. Gleason Lake subwatershed aquifer sensitivity and Wellhead Protection Areas.

Water Quantity:

Landlocked Basins. Mooney Lake basin is landlocked and pumps water out of the basin once the lake reaches a certain elevation towards HL-1 (Figure 3.33).

To assess changes in water-yield, a Mann-Kendall statistical trend test was performed on data for the monitoring stations both upstream and downstream of Gleason Lake. The test showed a small but statistically significant ($p < 0.05$) reduction in discharge from Gleason Lake between 1997-2015. The water yields for 2006-2015 upstream of the lake did not exhibit any statistically significant trend upward or downward.

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity, habitat diversity, and nutrient cycling. Nutrient cycling is described in the Water Quality section. The Gleason Lake subwatershed has not yet been systematically evaluated by the E-Grade program. This section summarizes ecological integrity using existing data where available (Figure 3.37).

Lakes:

Biodiversity

Fish Community. The most recent DNR fish survey for Gleason Lake was conducted in 1996. It identified a fishery dominated by bluegills and black crappies. Pumpkinseed sunfish were also found in above-average numbers. Northern pike were abundant. No fish survey data is available for the other lakes. In 2007, the District completed fish and macroinvertebrate sampling on Gleason to assess the impact of whole-lake Curlyleaf Pondweed treatments. Fish and invert IBI protocols were still in development at the time, so while IBI scores were computed they are similar to but not directly comparable to the current IBI protocols and metric scores used in the E-Grade program.

Fish sampling found bluegills to be the dominant species, with top predators underrepresented. Gleason Lake had a low IBI score based on the existing fish community. However the IBI score was within the expected range for lakes with similar trophic status and dominant watershed land use. The fish sampling was not repeated.

AQUATIC VEGETATION COMMUNITY. BIODIVERSITY IS DETERMINED BY THE NUMBER AND VARIETY OF SPECIES, OR RICHNESS. NO FLORISTIC QUALITY INDEX DATA IS AVAILABLE. AN AQUATIC VEGETATION SURVEY WAS COMPLETED IN 2002 BY BLUE WATER SCIENCE FOR THE GLEASON LAKE MANAGEMENT PLAN. GLEASON LAKE IS ALMOST ENTIRELY LITTORAL (LESS THAN ABOUT 15 FEET DEEP), WITH EXTENSIVE AQUATIC VEGETATION DOMINATED BY COONTAIL. CURLY LEAF PONDWEED WAS DETECTED AT ONE-THIRD OF THE STATIONS SAMPLED IN THE LAKE AT NUISANCE DENSITIES. A WHOLE-LAKE TREATMENT WAS APPLIED TO THE LAKE IN 2007, FOLLOWED BY SPOT TREATMENTS. JUST PRIOR TO TREATMENT CURLY LEAF PONDWEED WAS FOUND AT 8 OF THE 27 SAMPLE STATIONS IN THE SMALL NORTH BASIN AND AT 101 OF THE 127 SAMPLE STATIONS IN THE MAIN LAKE, AT AN AVERAGE OF 817 STEMS/M² BEFORE TREATMENT, WELL ABOVE THE NUISANCE THRESHOLD OF 100 STEMS/M². FOLLOWING TREATMENT, CURLY LEAF PONDWEED WAS FOUND AT ONLY 1 OF 27 SAMPLE STATIONS IN THE NORTH BASIN AND 1 OF 127 STATIONS IN THE MAIN LAKE. CURLY LEAF HAS NOT BEEN ERADICATED FROM THE LAKE, BUT IT HAS BEEN SUBSTANTIALLY REDUCED. A MORE RECENT SURVEY WAS PERFORMED IN 2014, AND A TOTAL OF 6 SPECIES WERE FOUND WITH COONTAIL DOMINATING THE COMMUNITY.

Habitat diversity

Aquatic Vegetation Community. Habitat diversity is determined by the percent occurrence of species, or the extent to which it may be dominated by a few species. Gleason Lake is almost entirely littoral (less than about 15 feet deep), with extensive aquatic vegetation dominated by coontail. Whole-lake and spot herbicide treatments appear to have controlled the previously nuisance-level of curly leaf pondweed.

Shoreline Health. Shoreline health is assessed looking at shoreline vegetative cover and the relative human disturbance. The MnDNR is using the Score The Shore protocol to relate shoreline conditions to fish community structure using the fish IBI metric. No Score The Shore data is available. Much of the shoreline around the lakes within this subwatershed is developed, with homes maintaining turf grass to the shoreline and scattered stands of emergent vegetation.

Macroinvertebrate Community. Macroinvertebrates were sampled in Gleason Lake in 2007 and 2012 using the MPCA's protocol for monitoring depression wetlands. At the time the MPCA's threshold of impairment was an IBI of 36 on a 100 point scale. The mean of four locations sampled on Gleason Lake was 47.5. In 2012, when sampling was repeated following whole-lake treatment of curly-leaf pondweed, the IBI threshold was 47. IBI scores at the four Gleason Lake locations ranged from a high of 50 to a low of 26, indicating impairment. It was hypothesized that following treatment the native plant community had not yet reestablished, and thus the lake lacked sufficient habitat to maintain a diverse invert population

Streams:

Biodiversity

Fish Community. No fish data is available for streams in the subwatershed.

Macroinvertebrate Community. Biological sampling on Gleason Creek was conducted as a part of the 2004 Upper Watershed Stream Assessment. Two sites were sampled; only one yielded more than the 100 organisms typically needed to assure sample reliability. The H-IBI fell into the Poor category. Seven taxa of organisms were found, dominated by pollution-tolerant species. In 2013 the invert sampling was replicated. The two sites scored 14 and 18 on a 100-point scale, falling well below the M-IBI impairment threshold of 43. The samples were dominated by pollution-tolerant species, and lacked representation from a broad range of functional feeding groups.

Habitat diversity

Habitat Complexity. No Minnesota Stream Habitat Assessment data is available to assess habitat complexity. However, notes taken for the 2004 Upper Watershed Stream Assessment were reviewed to better understand conditions in the in-stream zone and riparian zone, and to assess channel morphology. That survey divided the stream into 5 reaches. The survey found that the stream in some locations had moderately complex habitat and morphology, but in general the stream is less complex and more altered.

Connectivity. Connectivity is defined by two metrics: presence or absence of barriers, and access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. That survey divided the stream into 5 reaches, with the predominance of barriers located within reach 4. There are several barriers on the streams in this subwatershed, most of them are storm sewer outfalls, and culverts at road or trail crossings and where the stream crosses under Highway 12/101 interchange. There is no stream cross section data available, but notes taken for the 2004 Upper Watershed Stream Assessment indicate the stream generally has low banks and direct access to ponds and wetlands.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS concentrations increase turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. A stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, can be stressful to organisms. In addition,

SUBWATERSHED
INVENTORY

streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is not available, but based on observation, both Gleason Creek and CD #15 do run dry at times in the summer.

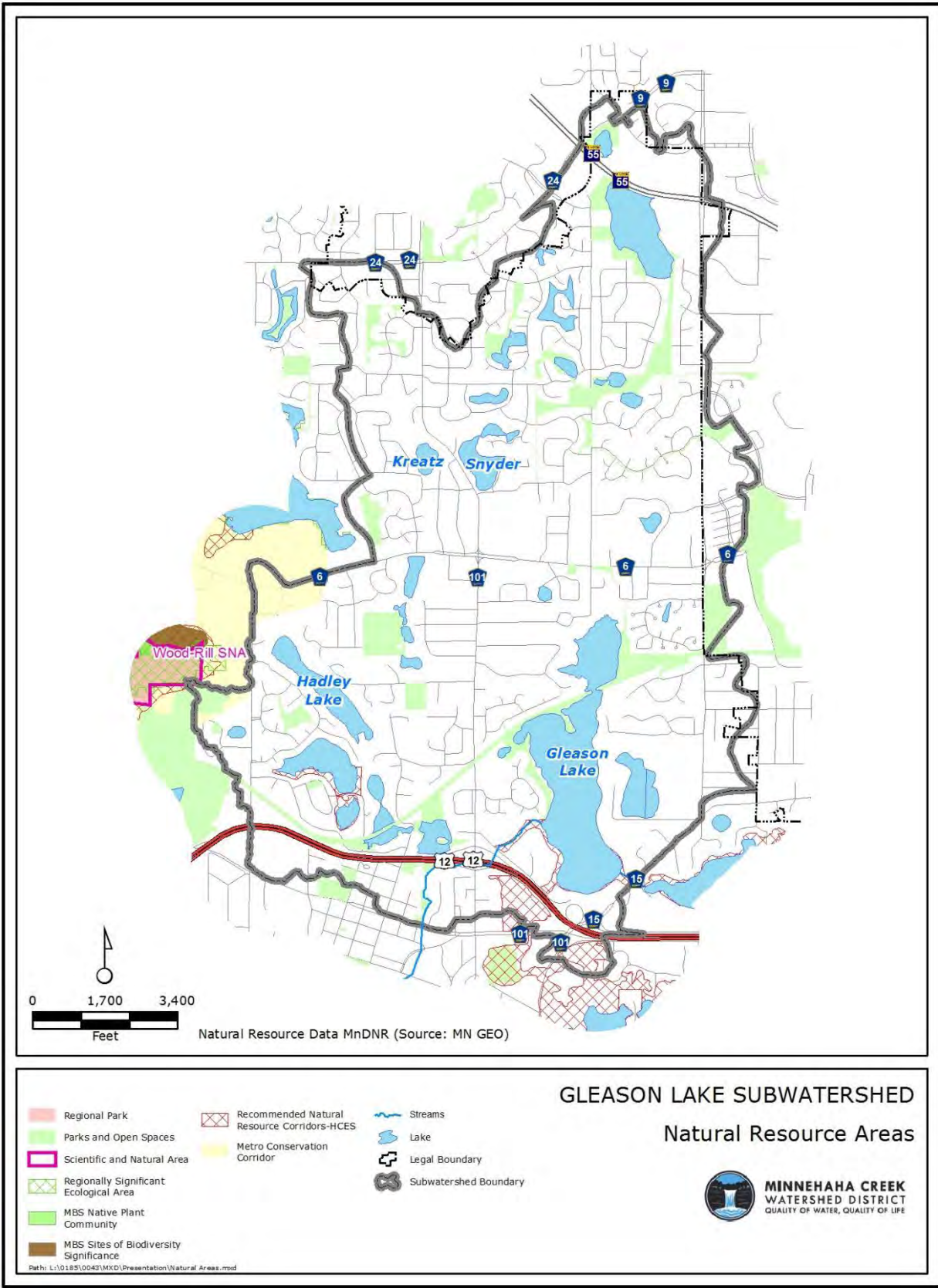


Figure 3.37. Gleason Lake subwatershed natural resource areas.

Wetlands:

Biodiversity

Vegetation Community. No Floristic Quality Index data are available for the wetlands in this subwatershed. However some scattered wetlands were identified in the *Functional Assessment of Wetlands* as having high vegetative diversity and wildlife habitat potential as well as having high aesthetic values. Wetlands riparian to Gleason Lake were noted as important fish habitat.

Habitat diversity

Connectivity. Some scattered wetlands were identified in the 2003 MCWD *Functional Assessment of Wetlands* (FAW) as having high vegetative diversity and wildlife habitat potential as well as having high aesthetic values. Wetlands in this subwatershed have little to no connectivity.

Size. Larger wetlands are more likely to support a notable on-site diversity and/or abundance of wildlife species. There are a few large wetlands in the subwatershed, to the east and west of Gleason Lake and another south of TH 55.

Shoreline Protection. Riparian wetlands can provide significant shoreline protection and support emergent vegetation at the shoreline. The *Functional Assessment of Wetlands* evaluated riparian wetlands for their ability to protect lake or stream shoreline. Approximately half of the Gleason Lake shoreline is identified as probable wetlands under the National Wetland Inventory (NWI) however most of that area is residential development with a very narrow band of emergent vegetation at the shoreline.

Uplands:

Biodiversity

Existing data sources do not highlight any other unique or scenic areas in this subwatershed. The Gleason Lake Creek subwatershed is mostly developed, with few intact areas of minimal disturbance. The Minnesota Biological Survey (MBS) did not identify any landscape areas of biological significance in this subwatershed, although the Wood-Rill Scientific and Natural Area is just outside of this subwatershed in Orono. Some wooded and wetland areas around Hadley Lake and a few pocket wetlands and wooded areas elsewhere in the subwatershed provide the most significant areas of habitat and biological integrity (Figure 3.37).

Habitat diversity

Regionally significant ecological areas are places where larger tracts of minimally disrupted land provide habitat complexity. Most of the Gleason Lake subwatershed is fully developed with limited upland areas in a natural state. Some wooded and wetland areas around Hadley Lake and a few pocket wetlands and wooded areas elsewhere in the subwatershed provide the most significant areas of habitat and biological integrity.

Thriving Communities:

Land use:

Table 3.37 below shows the land uses within the area of the Gleason Lake subwatershed in acres and as a percentage of the total subwatershed. The predominant land use in the subwatershed is single family residential (Figure 3.38). There is a commercial/industrial corridor along TH 55 and Vicksburg Lane in the upper subwatershed, and another commercial node at TH 101 and County Road 5. Some small pockets of undeveloped area remain, mainly large lots.

A small corner of the subwatershed in the City of Orono is outside the MUSA 2020 area.

Table 3.37. 2010 land use in the Gleason Lake subwatershed.

Land Use 2010	Acres	% of Subwatershed
Single - Family Residential	2,204.8	58.5
Multi - Family Residential	331.0	8.7
Parks and Open Space	308.5	8.1
Water	301.8	8.0
Institutional	187.5	4.9
Vacant or Undetermined	175.7	4.6
Commercial	126.5	3.3
Roads and Highways	101.4	2.6
Industrial	23.7	0.6
Agricultural	4.9	0.1

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

The Luce Line Regional Trail passes through this subwatershed, crossing the north end of Gleason Lake. Existing data sources do not highlight any other unique or scenic areas in this subwatershed. The Minnesota Historic Features database notes 15 historic features in this subwatershed, all farmhouses or residences (Figure 3.39). There is no public boat access, beach or parks on Gleason Lake other than the regional trail crossing and none on the other lakes in the subwatershed.

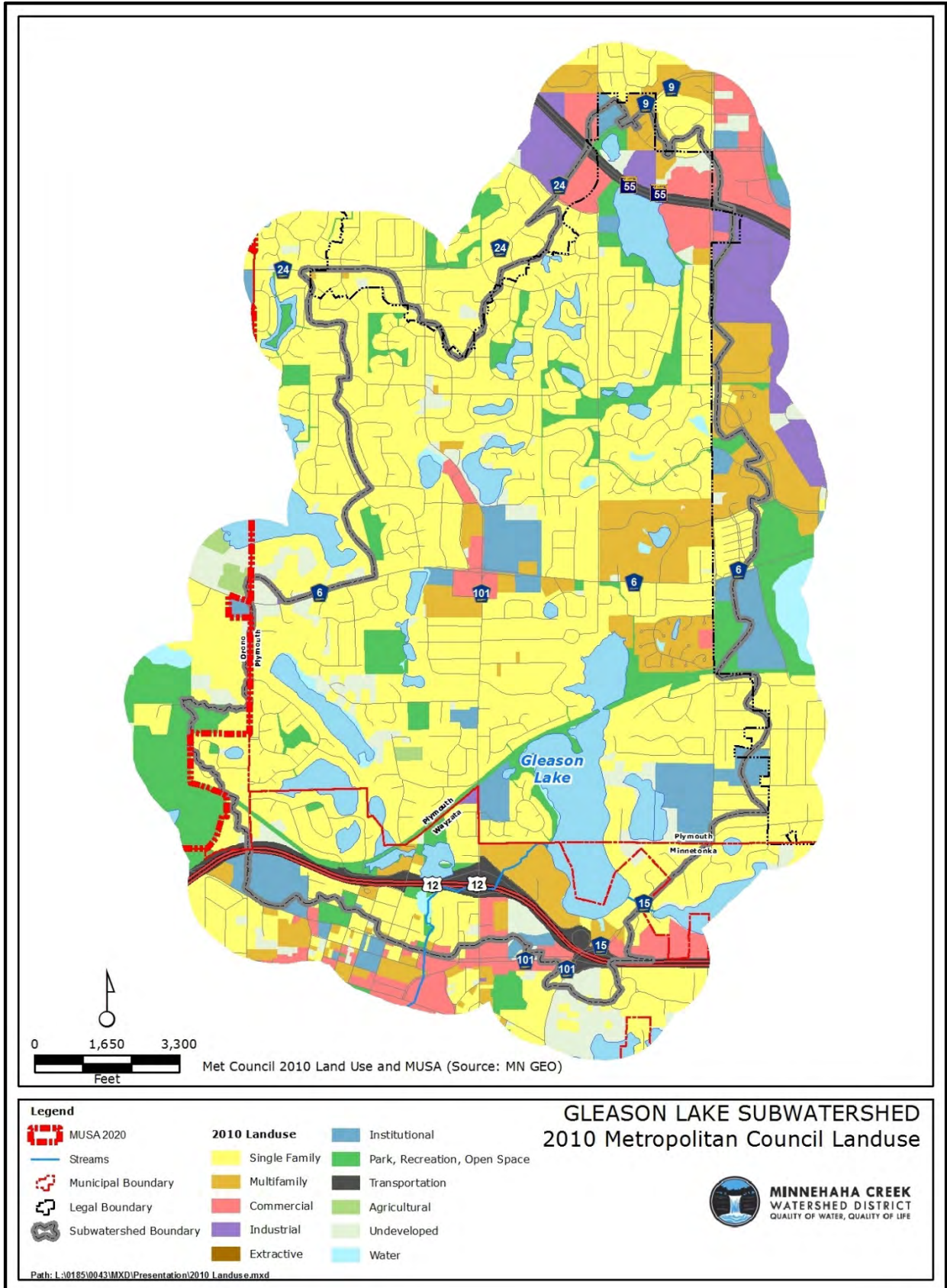


Figure 3.38. Gleason Lake subwatershed 2010 Metropolitan Council land use.

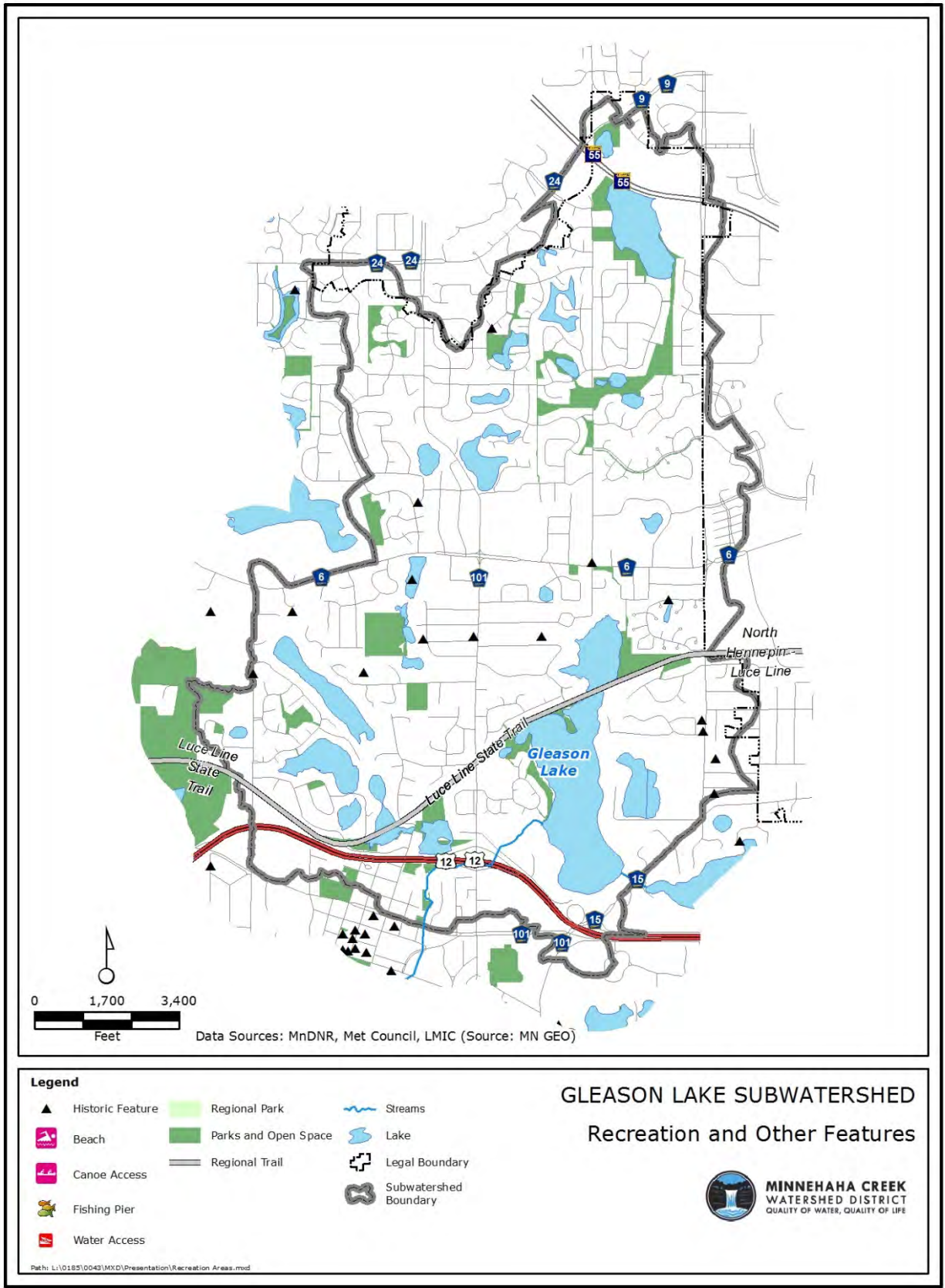


Figure 3.39. Gleason Lake subwatershed recreation and natural features.

Studies and Assessments:

- Minnesota Land Cover Classification System (MLCCS)
- MCWD Hydraulic, Hydrologic, and Pollutant Loading Study (HHPLS), EOR 2003
- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- Upper Minnehaha Creek Watershed Lakes TMDL, Wenck 2014
- National Wetland Inventory
- Hennepin County Geologic Atlas
- 2003 Upper Watershed Stream Assessment, Wenck 2004
- Functional Assessment of Wetlands
- Minnesota Biological Survey (MBS)
- 2020 Metropolitan Urban Service Area (MUSA)
- Minnesota Historic Features database
- Effects of Curlyleaf Pondweed Control on Gleason Lake, 2015
- Gleason Lake/ CR 6 Pond Project Feasibility Study, Houston Engineering 2009
- Gleason Lake Regional Infiltration (GL-4) Feasibility Study, 2008
- Mooney Lake Outlet Structure (Wetland Restoration#1), 2007
- Mooney Lake Plant Survey, 2011
- Mooney Lake Fish Survey, 2011

3.4 LAKE MINNETONKA SUBWATERSHED

The land cover in the Lake Minnetonka Subwatershed is comprised of lakes, wetlands and scattered pockets of forest, woodlands and grasslands. Single-family residences, marinas, sailing schools, and restaurants are concentrated along the shorelines. Agricultural uses exist on the western boundary of the subwatershed in the vicinity of Halsted Bay, Jennings Bay, North Arm and Stubbs Bay.

Unlike the other subwatersheds in the Minnehaha Creek Watershed District, the Lake Minnetonka Subwatershed receives direct drainage from nine major sources. The health and function of Lake Minnetonka is not only affected by these creek inlets, but also affected by aquatic invasive species. Lake Minnetonka was one of the first lakes in the Watershed District to be infested with Eurasian watermilfoil and zebra mussels.

Table 3.41 shows the area of the Lake Minnetonka subwatershed in acres by individual city, in total and as a percentage of the total subwatershed (Figure 3.41).

Table 3.41. Cities in the Lake Minnetonka subwatershed.

City	Area (Acres)	% of Subwatershed
Chanhassen	146.8	0.4%
Deephaven	1,993.6	6.1%
Excelsior	551.5	1.6%
Greenwood	660.7	2.0%
Long Lake	4.5	<0.1%
Minnetonka	722.0	2.2%
Minnetonka Beach	981.4	3.0%
Minnetrista	5,153.8	15.8%
Mound	2,543.2	7.8%
Orono	10,740.1	33.0%
Shorewood	3,912.2	12.0%
Spring Park	387.2	1.1%
Tonka Bay	1,346.2	4.1%
Victoria	293.2	0.9%
Wayzata	2,336.4	7.1%
Woodland	741.8	2.2%
Total	32,515.6	

Source: MCWD.

Watershed Description and Hydrology:

Rugged hills or knobs and deep irregular depressions called “kettles” dominate this subwatershed. The many bays, points and islands of Lake Minnetonka are formed from submerged knobs and kettles formed by melted glacial ice. The northwestern subwatershed is identified by thinly spread glacial drift and circular, level-topped hills with low slopes, small streams and numerous lakes and peat bogs. The dominate water feature in this subwatershed is Lake Minnetonka.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (Figure 3.42). Most of the subwatershed is fully developed, although the upper subwatershed includes some large agricultural and forested areas. Wetlands are scattered throughout the subwatershed. For more information regarding geology and soils in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

Drainage is conveyed from the watershed to the lake through several streams, including Gleason Creek, Long Lake Creek, Classen Creek, Painter Creek, and Six Mile Creek, as well as through smaller channels or storm sewers. The *2003 MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Lake Minnetonka

subwatershed district into 26 subwatershed units and the minor subwatersheds into 19 drainage areas that include from one to six subwatershed units (Figure 3.43).

The subwatershed outlets through a control structure on Grays Bay into Minnehaha Creek. The dam is operated by the District in accordance with the limitations set forth in the Headwaters Control Structure Management Policy and Operating Procedures and Minnesota DNR Permit #76-6240.

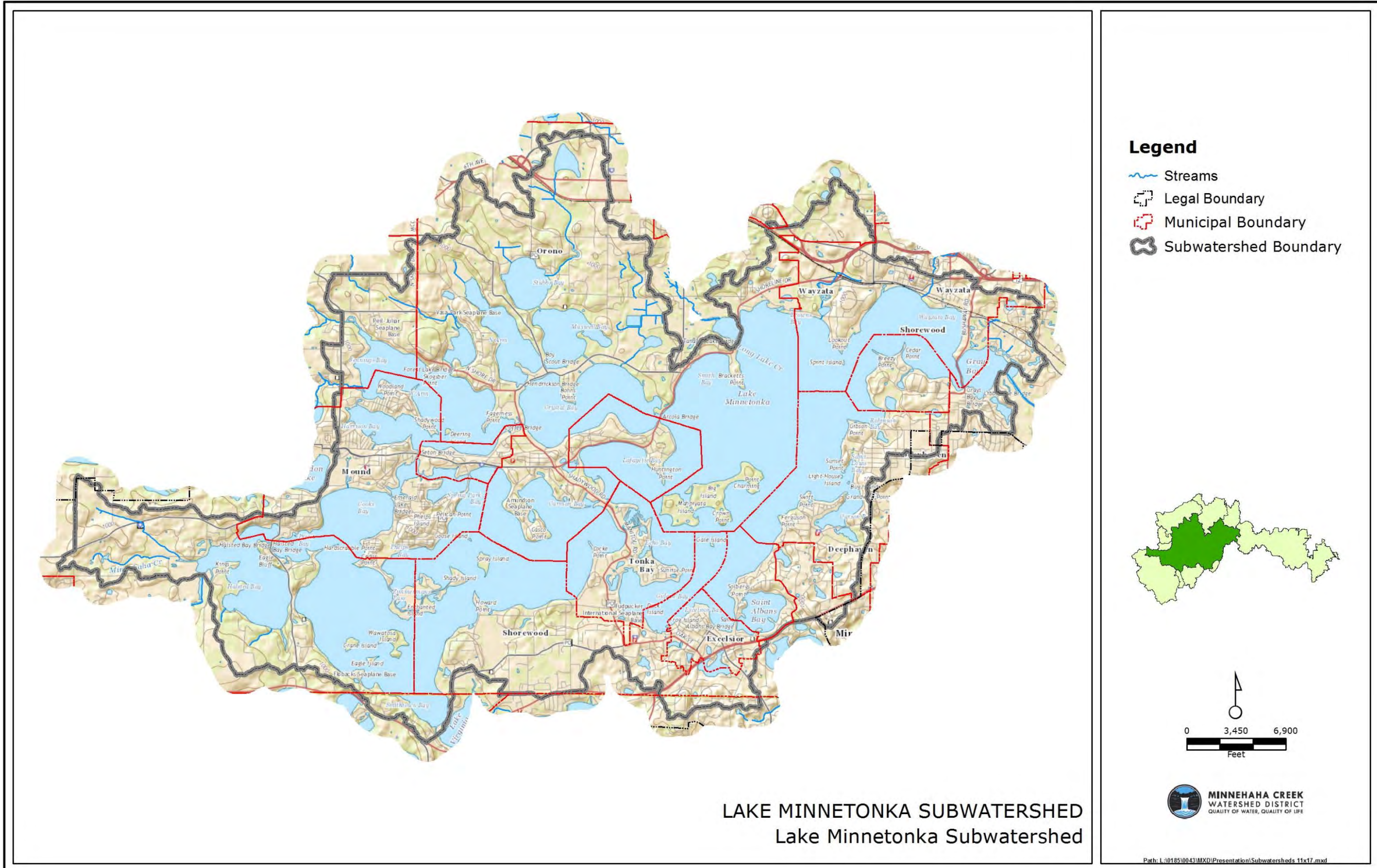


Figure 3.41. The Lake Minnetonka subwatershed.

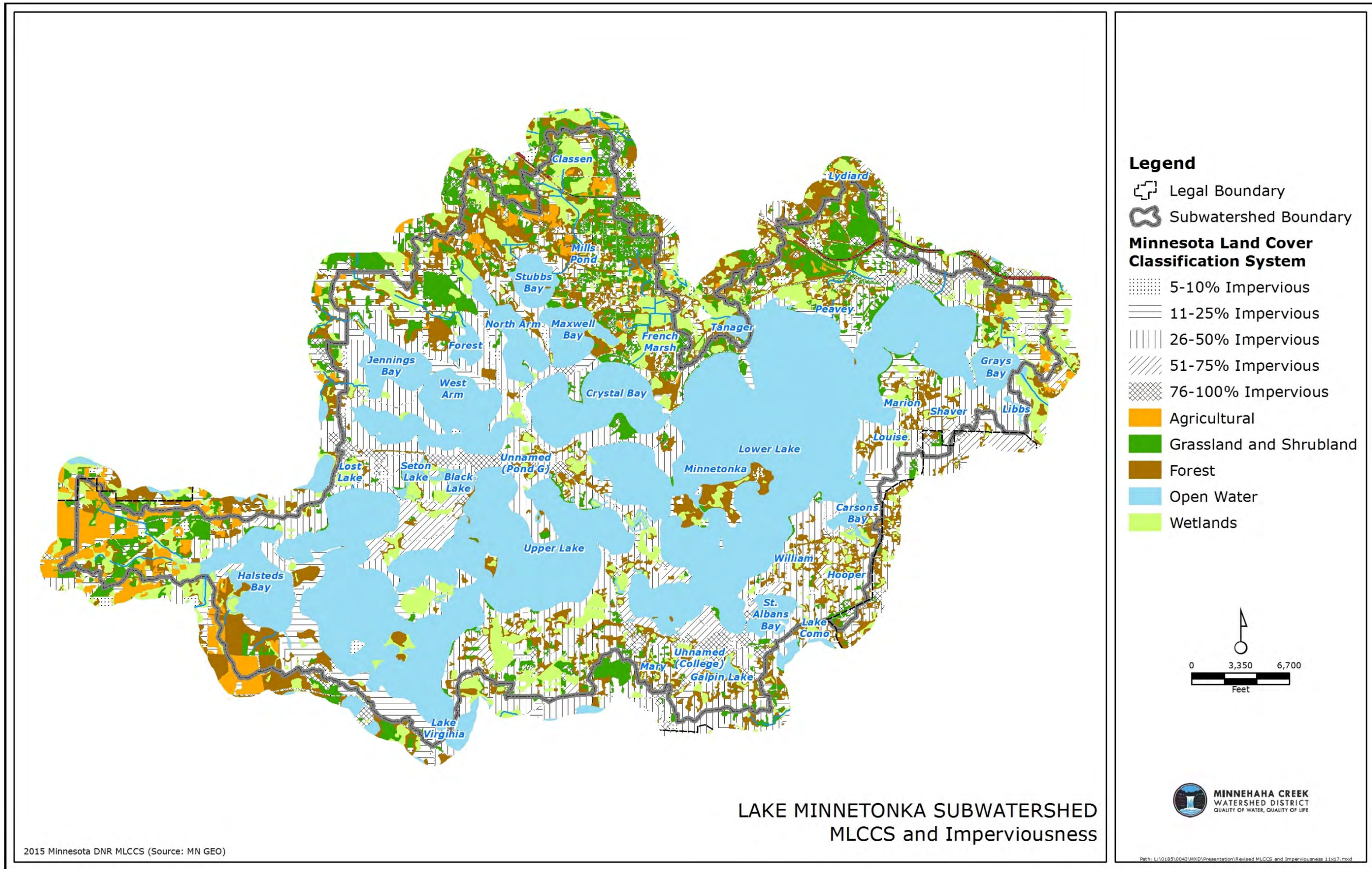


Figure 3.42. Lake Minnetonka subwatershed MLCCS and imperviousness.

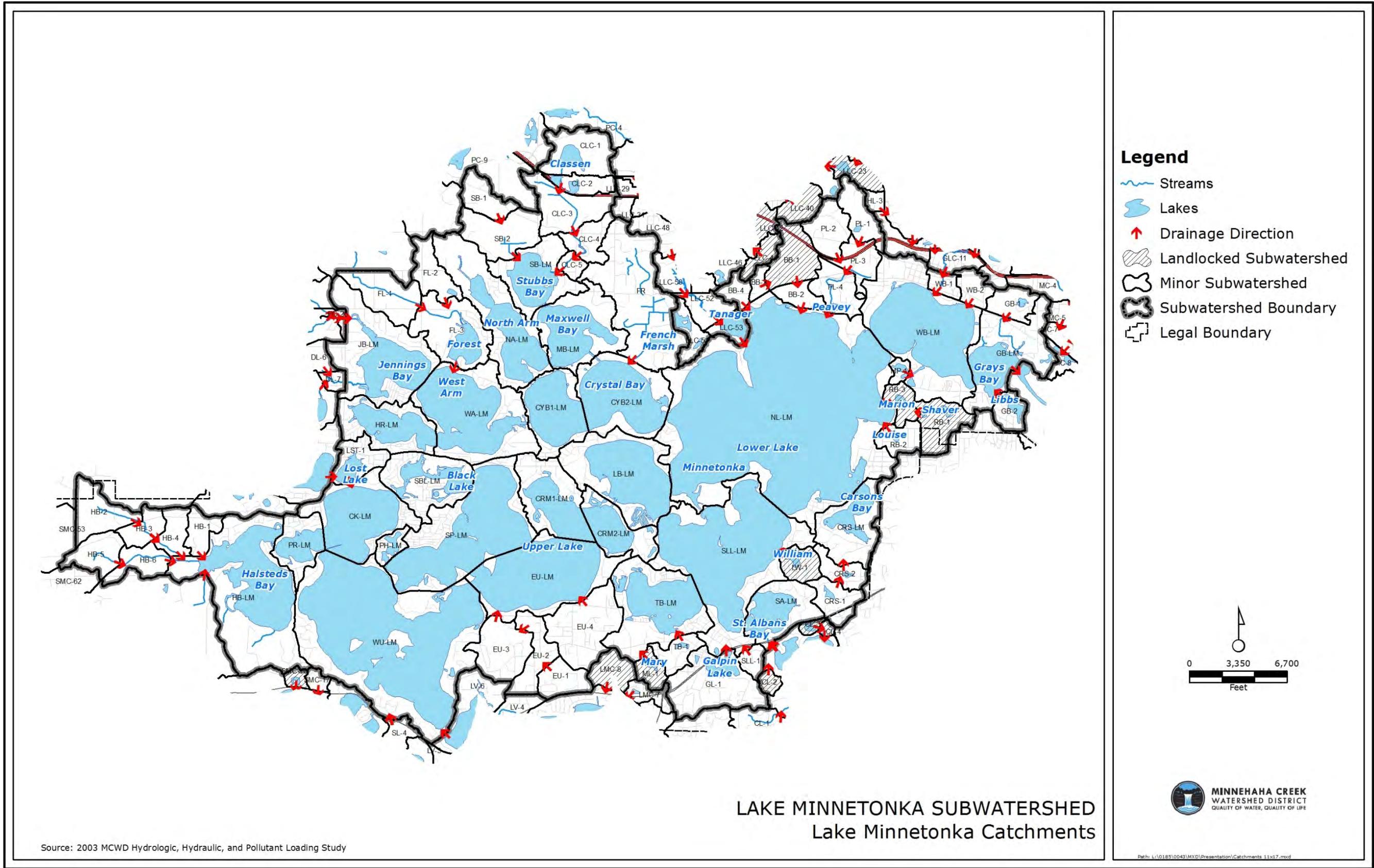


Figure 3.43. Lake Minnetonka subwatershed catchments.

Water Quality:

The following are summaries of the characteristics and classifications of lakes and streams within the subwatershed including water quality goals and trends. The *Upper Minnehaha Creek Watershed Lakes and Bacteria TDML Project* completed in 2012, includes four bays of Lake Minnetonka (Halsteds, Jennings, and Stubbs Bays and West Arm) and Forest Lake as impaired for excessive nutrients.

Lakes:

The subwatershed is dominated by Lake Minnetonka with its complex configuration of bays and channels. The lake is classified by the DNR for shoreland management purposes as a Recreational Development lake (Table 3.42). There are numerous other smaller lakes in the subwatershed. The District monitors Lake Minnetonka and some small lakes, while several of the small lakes are monitored by trained volunteers. Tables 3.42 and 3.43 below detail the physical and water quality characteristics of Lake Minnetonka and other lakes within the subwatershed.

Four Lake Minnetonka bays and Forest Lake exceed the state standard for total phosphorus, and are listed on the State's Impaired Waters list for nutrient/eutrophication biologic indicators. A TMDL completed for those impairments identified a significant amount of excess nutrients discharged into those water bodies from the watershed, as well as load contributed from internal sources such as lake sediments. . For more information regarding water quality in the subwatershed, please refer to the District's annual Water Quality Reports.

Table 3.42. Physical characteristics of lakes in the Lake Minnetonka subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Classen Lake	53	3.3	6:1	Natural Environment
Forest Lake	90	42	10:1	General Development
Lake Galpin	46	13	11:1	Recreational Development
Lake Marion	13	45	26:1	Recreational Development
Lake Minnetonka	14,004	113	5:1	Recreational Development
Libbs Lake	22	8	5:1	General Development
Lost Lake	N/A	N/A	2:1	N/A
Lake Louise	7	18	19:1	N/A
Peavey Pond	9	63	86:1	N/A
Shavers Lake	19	7	12:1	Recreational Development

Source: Minnesota DNR.

Table 3.43. Selected water quality goals and current conditions of lakes and bays in the Lake Minnetonka subwatershed.

Bay/Lake	State TP Standard (µg/L)	2007 Plan Goal TP (µg/L)	Trend	2001-2015 Average			Years Monitored
				TP (µg/L)	Chl- <i>a</i> (µg/L)	Secchi (m)	
Classen Lake	n/a	n/a	n/a	107	80	0.5	2009-2010
Forest Lake	40	n/a	No trend	63	49	.9	1996-2015
French Marsh	n/a	n/a	n/a	48	11	0.9	2011-2012
Lake Galpin	60	60	n/a	n/a	n/a	1.4	2011
Hooper Lake	n/a	n/a	n/a	29	10	1.8	2010-2011
Lake Marion	n/a	n/a	n/a	14	3	3.6	2009-2012
Libbs Lake	60	30	n/a	22	5	1.5	2011-2012
Lake Louise	n/a	n/a	n/a	47	16	1.8	2006-2008
Peavey Pond	n/a	n/a	Deg TP, SD	89	20	1.9	1999-2015
Shavers Lake	60	n/a	n/a	42	8	1.2	2001-2015
Lake William	n/a	n/a	n/a	38	8	1.1	2009-2015
<i>Lake Minnetonka Bays</i>							
Black Lake	40	45	Imp Chl- <i>a</i>	32	14	2.1	2006-2015
Carman	40	50	No trend	22	8	2.7	2004-2013
Carsons	40	50	Imp SD	22	4	3.5	2004-2015
Cooks	40	30	No trend	29	13	2.1	1997-2015
Crystal	40	25-30	Imp SD	26	10	2.6	1997-2015
Grays	40	20	Imp SD, TP	21	4	3.6	2004-2015
Halsted	40	50-60	No trend	104	62	0.9	1997-2015
Harrisons	40	50	No trend	58	48	0.9	2001-2013
Jennings	40	50-70	No trend	114	69	0.8	2005-2015
Lafayette	40	20	Imp SD, Chl- <i>a</i>	21	5.4	3.5	1997-2015
Lower Lake North	40	20	No trend	20	5	4	2005-2013
Lower Lake South	40	20	All imp	19	5	3.7	1997-2015
Maxwell	40	40	No trend	32	14	1.9	1997-2015
North Arm	40	30	No trend	31	13	1.9	2001-2013
Priests	40	30	Deg TP	27	38	1.4	2006-2016
St. Albans	40	20	All imp	20	4	4	1997-2015
Smithtown	40	n/a	No trend	22	8	2.5	2004-2013
Stubbs	40	50-55	No trend	47	52	0.9	2006-2015
Wayzata	40	20	Imp SD	21	4	3.7	1997-2015
West Arm	40	50	No trend	72	54	1	1997-2015
West Upper	40	25	No trend	26	8.7	2.6	1997-2015

TP = Total phosphorus concentration, chl-*a*= chlorophyll-*a*, SD= Secchi depth, Imp = improving, Deg = degrading.

Source: MCWD, MPCA, City of Minnetonka.

Streams:

There is one primary stream within the subwatershed: Classen Creek, which flows 1.9 miles from Classen Lake to Stubbs Bay. Two other small streams flow out of wetlands and into Stubbs Bay and Forest Lake. Several other small streams and channels provide drainage and local conveyance within the subwatershed.

At this time Classen Creek is not listed as an Impaired Water, but does exhibit TP concentrations that are high relative to the state river eutrophication standards. CST01 and CFO01 are both short wetland outlet channels discharging into Stubbs Bay and Forest Lake, respectively, and would not likely be assessed by the MPCA for

potential impairment. However, those standards also look at other indicators such as chlorophyll-a, diel oxygen flux, and biological oxygen demand that haven't been assessed. Each of these streams is likely contributing significant nutrients loads to their respective receiving waters. Table 3.44 below details the water quality characteristics of streams and tributaries within the subwatershed.

Table 3.44 shows the average concentrations at monitoring sites in the subwatershed, which are well below the 30 mg/L state standard. Maintaining sufficient DO is necessary to support aquatic life. The DO state standard requires the stream to never fall below 5 mg/L DO. Monitoring data show that DO at the Classen Wetland and Forest Lake inlet sites both fall below the standard multiple times per year, as does the Classes Creek upstream site.

Table 3.44. Current conditions of streams in the Lake Minnetonka subwatershed.

See Figure 3.44 for monitoring locations.

Stream	Trend	2005-2015 Summer Average			
		TP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)*
Classen Creek (CCL04)	n/a	163	1.46	8	59
Classen Creek at Stubbs Bay Inlet (CCL01)	No trend	193	1.34	20	60
Classen Wetland Cr at Stubbs Bay Inlet (CST01)	Deg TSS	277	1.47	7	48
Forest Lake Inlet (CFO01)	No trend	232	0.97	6	91

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride, Deg = degrading.

*Data from 2008-2015

Source: MCWD.

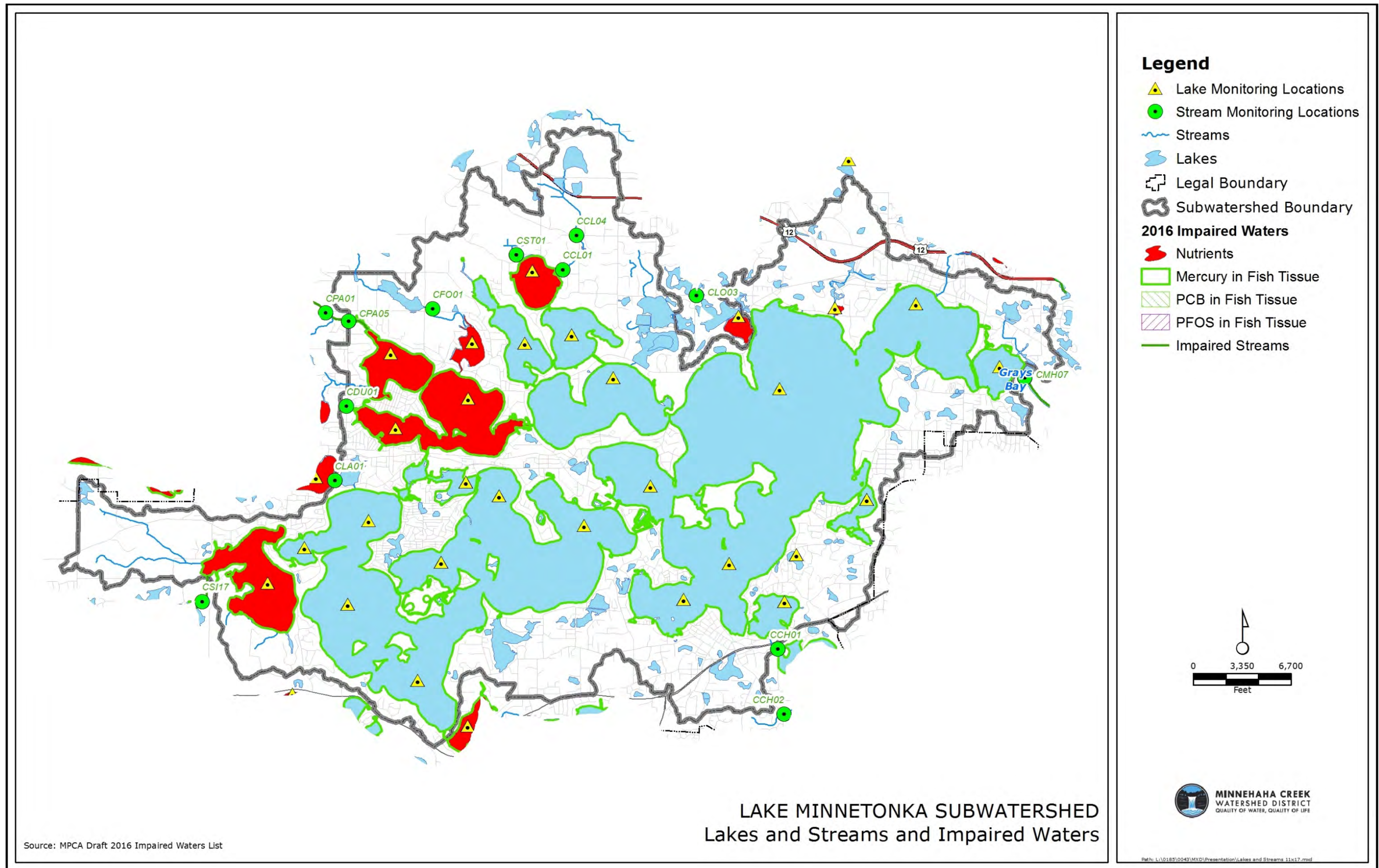


Figure 3.44. Lake Minnetonka subwatershed lakes and streams and Impaired Waters.



Wetlands:

According to the updated NWI, wetlands, including lakes, cover nearly 52 percent of the watershed’s surface (Figure 3.45 and Table 3.45). A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands.

Table 3.45. National Wetland Inventory wetland types in the Lake Minnetonka subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	467.9	2.8%
2 - Wet Meadow	14.9	0.1
3 - Shallow Marsh	1,536.9	9.1
4 - Deep Marsh	203.7	1.2
5 - Open Water	14,518.0	86.1
6 - Scrub Shrub	93.5	0.6
7 - Forested	6.0	<0.1
8 - Bog	5.9	<0.1
Riverine	6.9	<0.1
Wetland Total	16,853.8	51.8%
Upland	15,661.8	
TOTAL	32,515.6	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream baseflow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

The infiltration potential of the upland areas in the subwatershed are described as low to medium. A large area of high infiltration potential in the eastern subwatershed is associated with an area of sandy till and glacial outwash deposits. The *Hennepin County Geologic Atlas* classifies that till and outwash area, which is most of the area south of Wayzata Bay and much of the city of Wayzata, as well as the south side of the lower lake as being highly or very highly sensitive to pollution. Most of the upland areas are of low sensitivity to pollution.

Parts of the subwatershed have been designated by the Minnesota Department of Health as Drinking Water Sensitivity Management Areas (DWSMA) and Wellhead Protection Areas for various municipal wells. While there are areas of high aquifer sensitivity in these DWSMAs, the MDH has generally designated them to be of low risk and low vulnerability to contamination of the drinking water supply, with only a few areas designated as moderately vulnerable. Figure 3.46 shows areas in the subwatershed with groundwater sensitivity, designated Wellhead Protection Areas, and areas with moderate vulnerability.

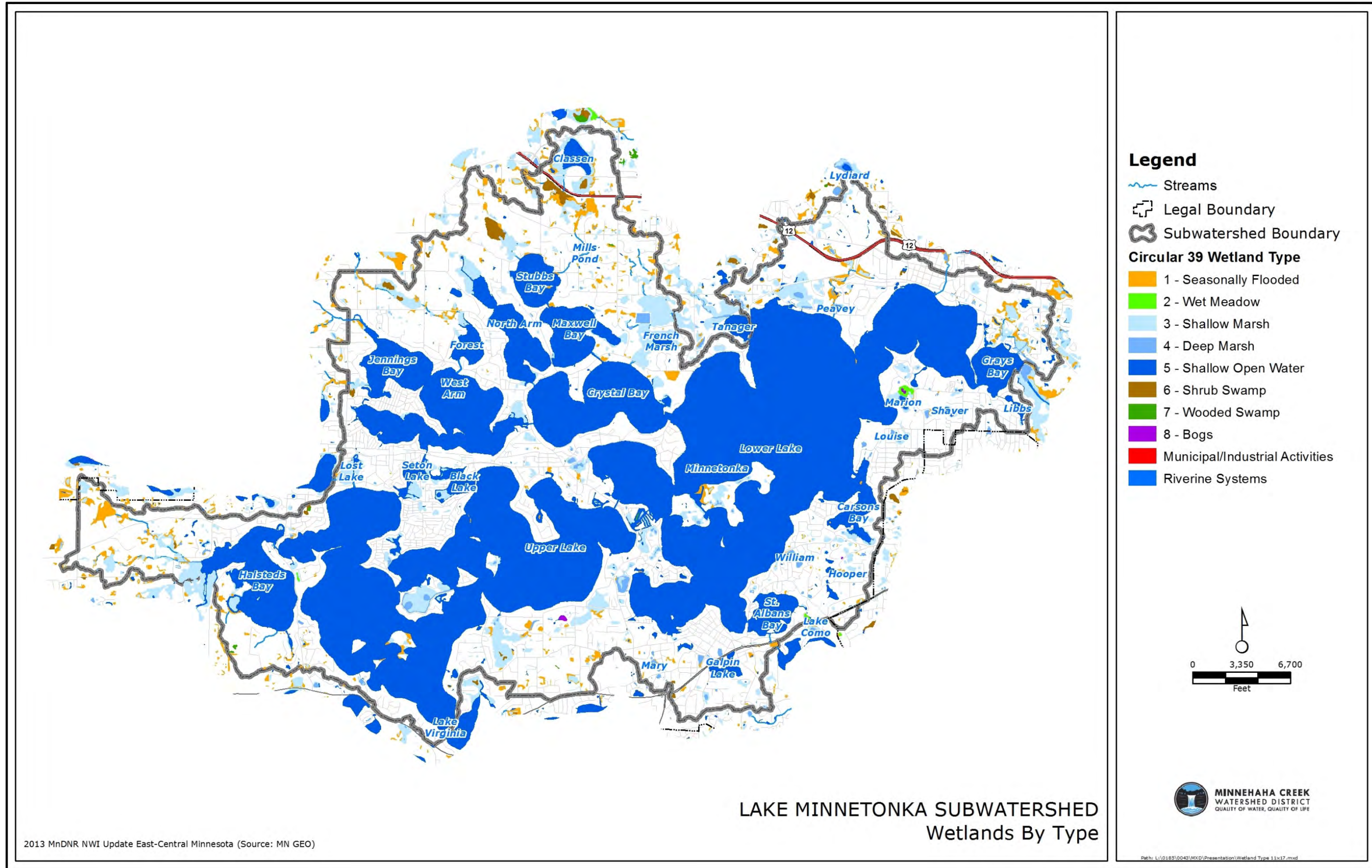


Figure 3.45. Lake Minnetonka subwatershed wetlands by type.

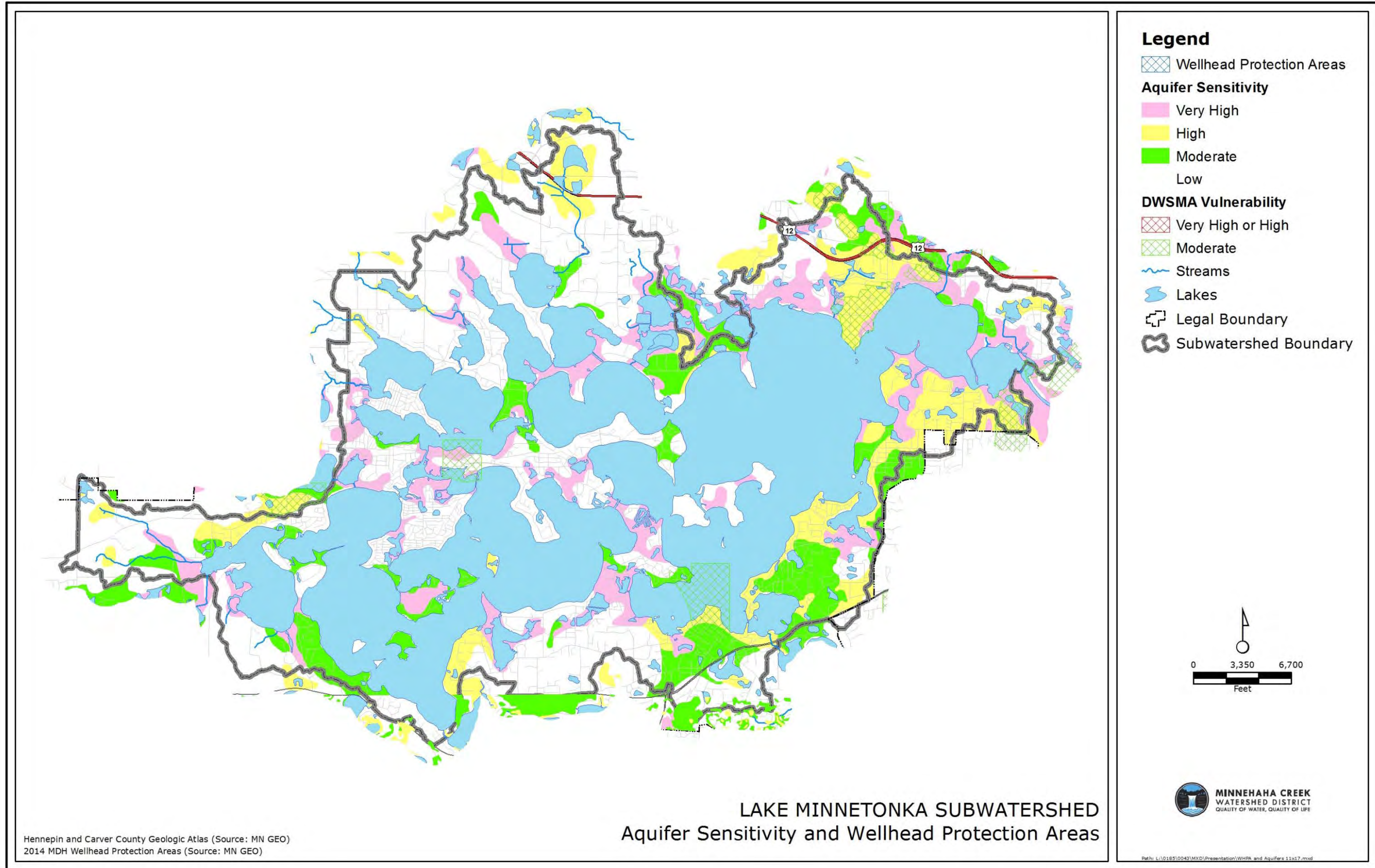


Figure 3.46. Lake Minnetonka subwatershed aquifer sensitivity and Wellhead Protection Areas.

Water Quantity:

The minor subwatersheds are drainage areas that are small relative to the 11 major subwatersheds, and do not contain lakes that were modeled for water quality purposes. Many of these minor subwatersheds include smaller lakes or ponds. There are several landlocked basins and subwatershed units, including Marion Lake, Mary Lake, Shavers Lake and William Lake.

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity, habitat diversity, and nutrient cycling. Nutrient cycling is described in the water quality section. The Lake Minnetonka subwatershed has not yet been systematically evaluated by the E-Grade program. This section summarizes ecological integrity using existing data where available (Figure 3.47).

Lakes:

Biodiversity

Fish Community. The DNR conducts extensive fish surveys in Lake Minnetonka every other year, and has found a diverse fish community (14 species) dominated by northern pike, bluegill, and walleye. Several bass tournaments are held on Minnetonka each year and the lake has a reputation for quality fishing for largemouth bass and muskellunge. Walleye and muskellunge are stocked nearly annually. Forest Lake, Peavey Pond, and Libbs Lake were last surveyed by the DNR in 1992, which found them to be dominated by panfish and rough fish.

Aquatic Vegetation Community. Biodiversity is determined by the number and variety of species, or richness. Generally, aquatic vegetation is more abundant and diverse in the eastern bays of Lake Minnetonka, which tend to have better water clarity. The far western bays tend to be more algae dominated, poorer clarity, and less aquatic vegetation.

Aquatic Invasive Species Zebra mussels are present in most of the bays of Lake Minnetonka, and influence water quality in several areas of the lake. Eurasian watermilfoil, common carp and flowering rush are also present. Milfoil and zebra mussels are also present in Forest Lake, Peavy Lake, Libbs and Galpin Lake.

Habitat diversity

Aquatic Vegetation Community. Habitat and diversity is determined by the percent occurrence of species, or the extent to which they may be dominated by a few species. This has not yet been calculated for Lake Minnetonka.

Shoreline Health. Shoreline health is assessed looking at shoreline vegetative cover and the relative human disturbance. The MnDNR is using the Score The Shore protocol to relate shoreline conditions to fish community structure using the fish IBI metric. No Score The Shore data is available, however, aerial photos show that many of the smaller lakes in the subwatershed have emergent wetland fringes, which are beneficial for controlling runoff and supporting emergent vegetation at the shoreline. Much of the shoreline of Lake Minnetonka is developed and maintained as turf grass and with a riprap shoreline.

Streams:

Biodiversity

Fish Community. No fish IBI data is available for the streams in this subwatershed.

Macroinvertebrate Community. Two sites on Classen Creek were sampled for macroinvertebrates in 2013. The M-IBI scores were 16 and 17, well below the impairment threshold for its stream type. The community was dominated by pollution-tolerant species and lacking in some functional groups.

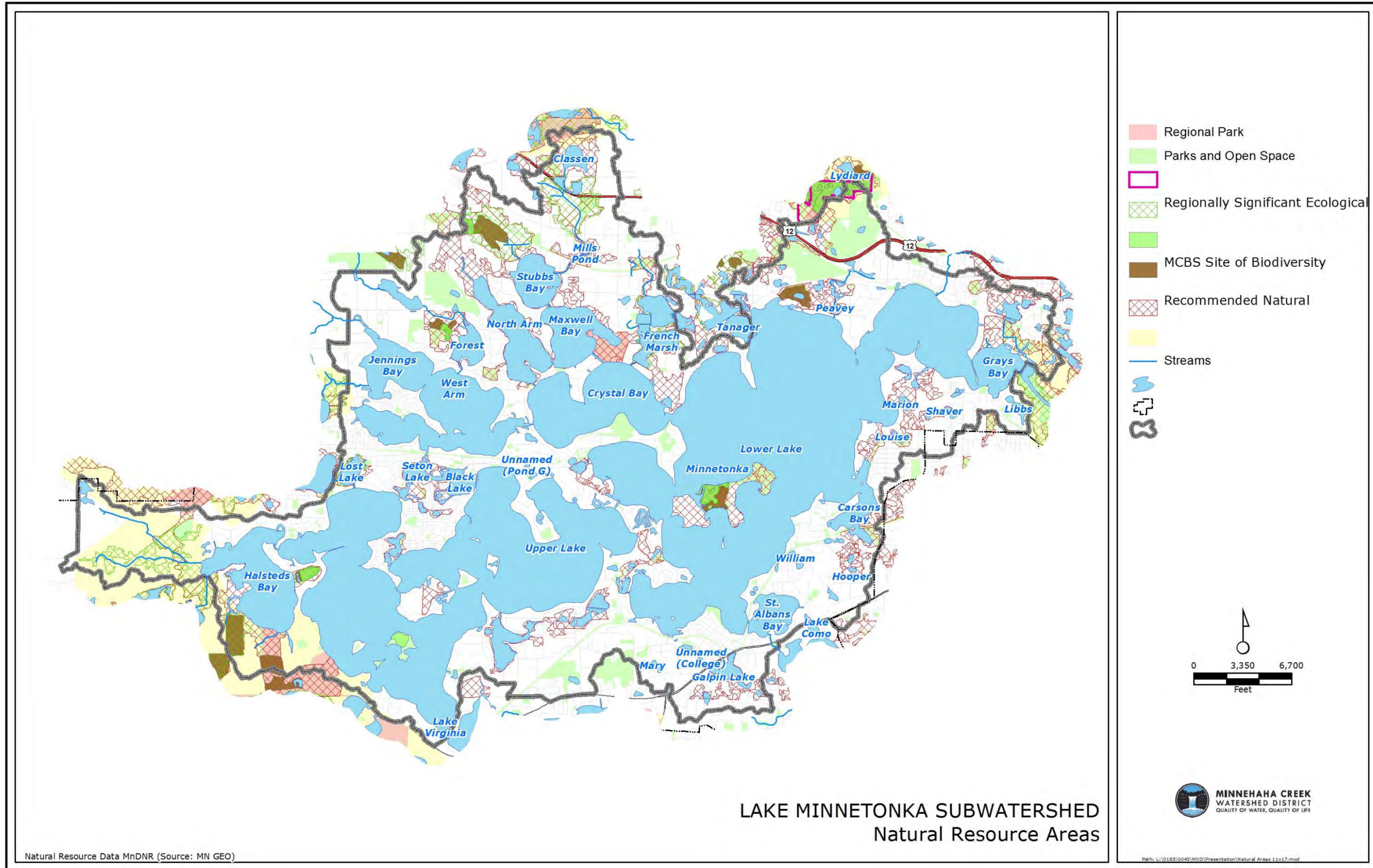
Habitat diversity

Habitat Complexity. No Minnesota Stream Habitat Assessment data is available to assess habitat complexity on Classen Creek. However, notes taken for the *2004 Upper Watershed Stream Assessment* were reviewed to better understand conditions in the in-stream zone and riparian zone, and to assess channel morphology. The survey found that the stream in some locations had moderately complex habitat and morphology, but in general the stream is less complex and more altered. There is a small impoundment created by a small earth dam and concrete weir. Several areas of significant streambank erosion were noted.

Connectivity. Connectivity is defined by two metrics; presence or absence of barriers, and access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. There are several barriers on the streams in this subwatershed, culverts at road crossings as well as a small dam and weir creating an impoundment. There is some access to floodplain, but also segments where the banks are steep.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS increases turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. A very flashy stream, that is, one that rises and falls very quickly, can be stressful to organisms. Streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is not available, but the average flow in all these streams is low, which would be indicative of low DO levels.



- Regional Park
- Parks and Open Space
- Regionally Significant Ecological
- MCBS Site of Biodiversity
- Recommended Natural
- Streams
- Streams
- Streams

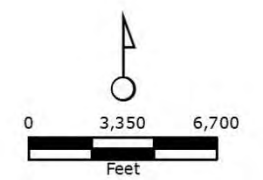


Figure 3.47. Lake Minnetonka subwatershed natural resource areas.

Wetlands:

Biodiversity

Vegetation Community. No Rapid Floristic Quality Assessment data are available for the wetlands in this subwatershed. The *Functional Assessment of Wetlands* score only a few scattered wetlands as having exceptional or high vegetative quality. The most notable is Classen Marsh on both sides of Highway 12, which was rated high on vegetative quality.

Habitat diversity

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands.

Uplands:

Biodiversity

A native plant community is a group of native plants that interact with each other and with their environment and are minimally altered by modern human activity or by introduced organisms. The Minnesota Biological Survey (MBS) have identified several native plant communities in the subwatershed (see Figure 3.61), including patches of sugar maple forest, southern mesic maple-basswood forest, a sedge meadow on Big Island, and sedge meadows in the small corner of Wood-Rill Scientific and Natural Area that is within the subwatershed. The MBS also assesses sites for biodiversity significance. That rank is based on the presence of rare species populations, the size and condition of native plant communities within the site, and the landscape context of the site. The subwatershed includes areas of moderate significance, including Ferndale Marsh, Big Island, Hardscrabble Woods, and one of high significance – Lowry Woods, which is a wooded/wetland complex upstream of Stubbs Bay.

Habitat diversity

Regionally significant ecological areas are places where larger tracts of minimally disrupted land provide habitat complexity. They are rated by examining important ecological attributes of the ecological patches including size, shape, cover type diversity, and adjacent land use. Several locations within the subwatershed have been designed by the DNR as being of ecological significance in the Metro area (Figure 3.47). Many of these areas contain intact native plant communities and are within DNR Metro Conservation Corridors. Hennepin County has also designated areas within the subwatershed as Recommended Natural Resources Conservation Corridors.

Thriving Communities:

Land use:

Table 3.47 below shows the land uses within the area of the Lake Minnetonka subwatershed in acres and as a percentage of the total subwatershed. The subwatershed is nearly one-half covered with water. Single family residential is the predominant non-water land use, with vacant or undetermined and parks and open space are also significant land uses (Figure 3.48). Much of the vacant land is large wetland or woodland tracts or grass and shrubland. Some large agricultural uses and forested tracts are present in the western subwatershed.

Parts of the western and northern subwatershed are outside of the MUSA 2020 boundary, and are not served by regional wastewater facilities.

Table 3.47. 2010 land use in the Lake Minnetonka subwatershed.

Land Use 2010	Acres	% of Subwatershed
Water	14,639.9	45.0
Single - Family Residential	9,416.1	28.9
Vacant or Undetermined	4,181.0	12.8
Parks and Open Space	2,088.2	6.4
Agricultural	641.7	1.9
Institutional	460.7	1.4
Multi - Family Residential	459.3	1.4
Commercial	395.0	1.2
Roads and Highways	171.3	0.5
Industrial	61.9	0.1

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

Two Three Rivers Park District regional parks are located within the subwatershed: Noerenberg Memorial Gardens in Orono and Lake Minnetonka Regional Park. The Park District also owns property on Big Island, Wawatasso Island, and Goose Island. Several regional trails, including the Luce Line, the Southwest Hennepin LRT trail, and the Dakota Rail trail, cross the subwatershed.

The Minnesota Historic features database notes about 460 historic features in this subwatershed, mostly residences, agricultural or commercial buildings, including over 300 buildings in historic Excelsior alone. The Crane Island Historic District in Minnetrista conserves 14 buildings that exemplify the type of seasonal residential lake cottages that served as retreats from city life in the early 20th century.

Lake Minnetonka offers a wide variety of opportunities for aquatic recreation (Figure 3.49), with numerous public and private boat accesses, beaches and fishing areas.

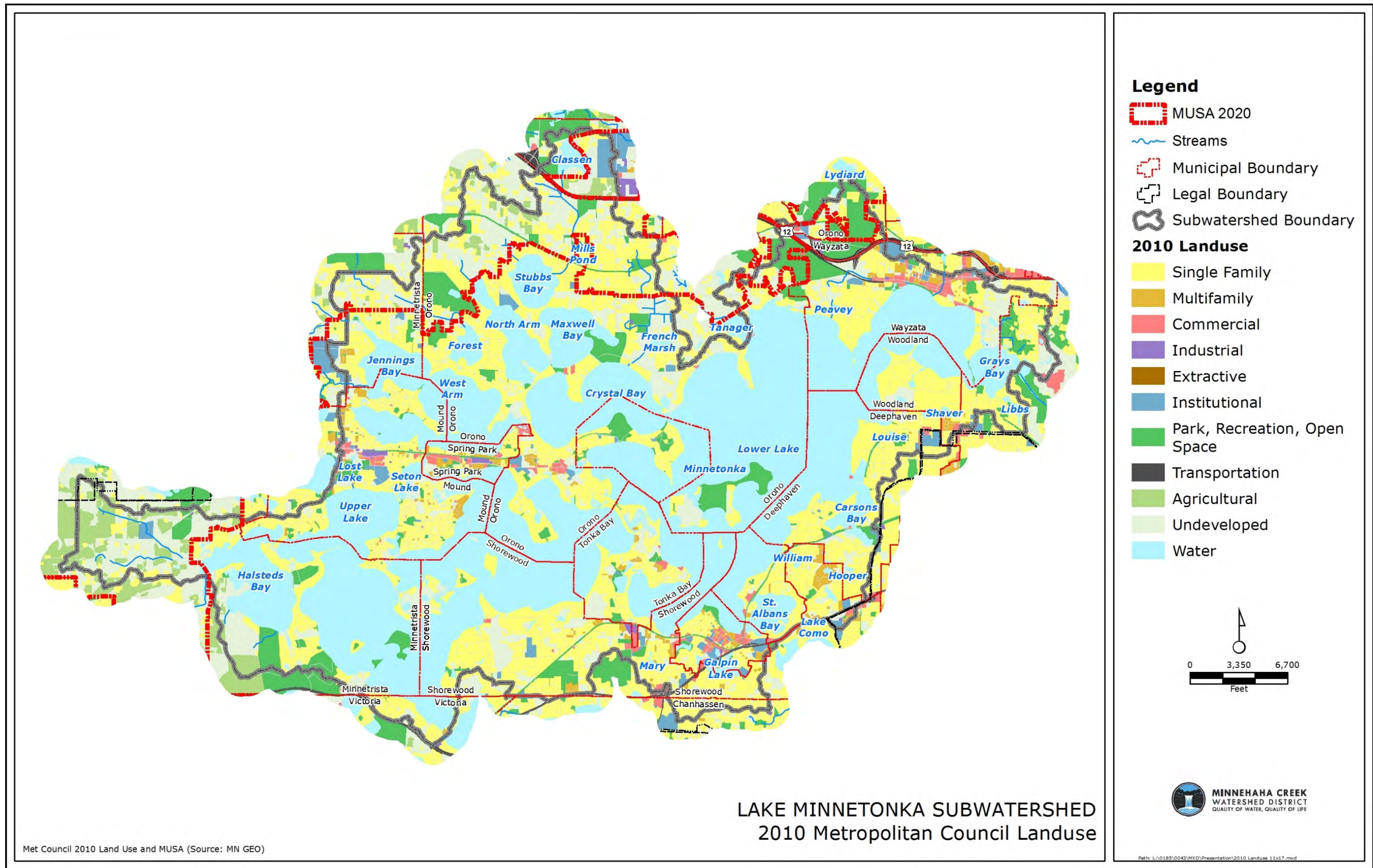


Figure 3.48. Lake Minnetonka subwatershed 2010 Metropolitan Council land use.

Studies and Assessments:

- Minnesota Land Cover Classification System (MLCCS)
- MCWD Hydraulic, Hydrologic, and Pollutant Loading Study (HHPLS), EOR 2003
- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- Upper Minnehaha Creek Watershed Lakes and Bacteria TDML
- Hennepin County Geologic Atlas
- 2004 Upper Watershed Stream Assessment
- 2020 Metropolitan Urban Service Area (MUSA)
- Minnesota Historic features database
- Lake Minnetonka Coordinated Herbicide Treatment Study on Carmans, Grays & Phelps, LMCD 2008 – 2011
- Spring Phenology of Native Plants, Freshwater Scientific Services 2015
- Zebra Mussel Control Trials with Zequanox, USGS & Marrone Bio Innovations 2014
- Flowering Rush Hand Removal Study on Lake Minnetonka, MCWD & Blue Water Science & Waterfront Restoration 2011-2015
- Flowering Rush Survey on Lake Minnetonka & Minnehaha Creek, Blue Water Science 2013
- Occurrence and Distribution of Eurasian, Northern and Hybrid Watermilfoil in Lake Minnetonka and Christmas Lake – Genetic Analysis, MCWD & University of Minnesota & Montana State University 2015-2016
- Six-Mile Creek Carp Assessment (Includes Halsteds Bay), University of Minnesota 2014-2017
- Field evaluation of toxicity of low-dose molluscicide treatments for zebra mussel veliger larvae – potential applications in lake management, Minnesota AIS Research Center 2016
- Minnetonka Zebra Mussel Study, MCWD 2011-present
- Solar Bees Study on Stubbs Bay, 2005
- Benthic Monitoring Study, 1969-1970
- Preserving the Quality of Lake Minnetonka, 1971
- Milfoil Harvesting in Lake Minnetonka, 1972
- Water Quality of Lake Minnetonka, TRPD 1994-1999, 2005
- Lake Minnetonka Boat Use Study, 2000
- Lake Minnetonka Boating Trends (1984-2000), 2001
- Milfoil Weevil Study in Lake Minnetonka, 2004
- Lake Minnetonka Boating Trends (1984-2004), 2005
- Bathymetric Mapping, 2008
- Lake Minnetonka 3D Model, 2010
- MCWD/City Minnetonka office Building Feasibility, 2011
- Lake Minnetonka Investigation, 1969-1970
- Lake Minnetonka Shoreline Inventory, 2010
- Lake Minnetonka Area Regional Interceptor, 2008
- Management Plan for Lake Minnetonka
- Gideon Glen, 2003
- Grays Bay Headwaters Projects, 2003
- Mound Downtown Redevelopment, 2004
- Stubbs Bay Improvements, 2004, 2006
 - Stubbs Bay Swan Lake Pond Excavation
 - Stubbs Bay Ravine Stabilization
- Halsted Bay Wetland Restoration, 2008
- Big Island Wetland Restoration – Phase I, 2008
- Lake Minnetonka Shoreline Restoration, 2008
- Lake Minnetonka Direct Infiltration (GB-LM), 2011

SUBWATERSHED
INVENTORY

- Lake Minnetonka Direct Infiltration (CLC-2), 2012
- Halsted Bay Internal Load Management, 2013
- Grays Bay Highway 101 Causeway Reconstruction (Bushaway Rd), 2013
- Excelsior Lagoon, 1998
- Lake Minnetonka Area Cities MLCCS Report, Bonestroo 2005
- 1969-1970 Lake Minnetonka Comprehensive Study, MPCA 1970

3.5 LAKE VIRGINIA SUBWATERSHED

The Lake Virginia Subwatershed is dominated by four lakes and a mix of wetlands, agricultural, and residential land cover. The Lake Minnewashta Regional Park resides within this subwatershed and provides recreational access to Lake Minnewashta from the east. The park is dominated by forest, woodland, grassland and wetlands. The water drains into Lake Virginia from Lake Minnewashta and Tamarack Lake. The outlet of Lake Virginia is ditched, connecting the lake directly to Smithtown Bay, Lake Minnetonka. The outlet into Smithtown Bay is inaccessible, and therefore is not monitored. Table 3.51 shows the area of the Lake Virginia subwatershed in acres by individual city, in total and as a percentage of the total subwatershed (Figure 3.51).

Table 3.51. Cities in the Lake Virginia subwatershed.

City	Area (Acres)	% of Subwatershed
Chanhassen	2,755.6	69%
Chaska	18.8	0.5%
Shorewood	344.1	8.6%
Victoria	872.4	21.8%
Total	3,991.2	

Source: MCWD.

Watershed Description and Hydrology:

The topography of the eastern subwatershed is rolling and hilly with areas of steep slopes along the eastern shore of Lake Minnewashta. The western subwatershed is distinguished by fewer steep slopes. There are two major lakes within the subwatershed – Lake Minnewashta and Lake Virginia – and two other primary lakes – Lake St. Joe and Tamarack Lake. Lake Minnewashta is located in the upper subwatershed and discharges by Minnewashta Creek to Lake Virginia.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (Figure 3.52). Lake Minnewashta Regional Park is a dominant feature in the watershed. North of Highway 5, much of the watershed is developed to typical suburban densities with a low to medium degree of imperviousness. The Arboretum and Regional Park lands include wetland, wooded, and grassland cover, as well as some agricultural uses. The area around and between Lake St. Joe and Tamarack Lake includes a number of wetlands and wooded tracts.

Soils within the watershed are predominantly Natural Resources Conservation Service Hydrologic Soil Group B (loamy with moderate infiltration potential). Group C (loamy clay with low infiltration potential) and D (clayey with very low infiltration potential) soils are found in low-lying areas and are generally hydric, or showing indications of inundation. For further information regarding geology and soils in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

Lakes Minnewashta and Virginia are the primary receiving waters within the subwatershed. Tamarack Lake and Lake St. Joe are additional lakes in the subwatershed. There is a small stream that conveys discharge from Lake Minnewashta to Lake Virginia known as Minnewashta Creek. The Lake Virginia subwatershed discharges by a small channel in Smithtown Bay, Lake Minnetonka. The *2003 MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Lake Virginia subwatershed into 16 subwatershed units, designated LMC-1 through LMC-10 in the Lake Minnewashta drainage area, and LV-1 to LV-6 in the downstream, Lake Virginia area (Figure 3.53).

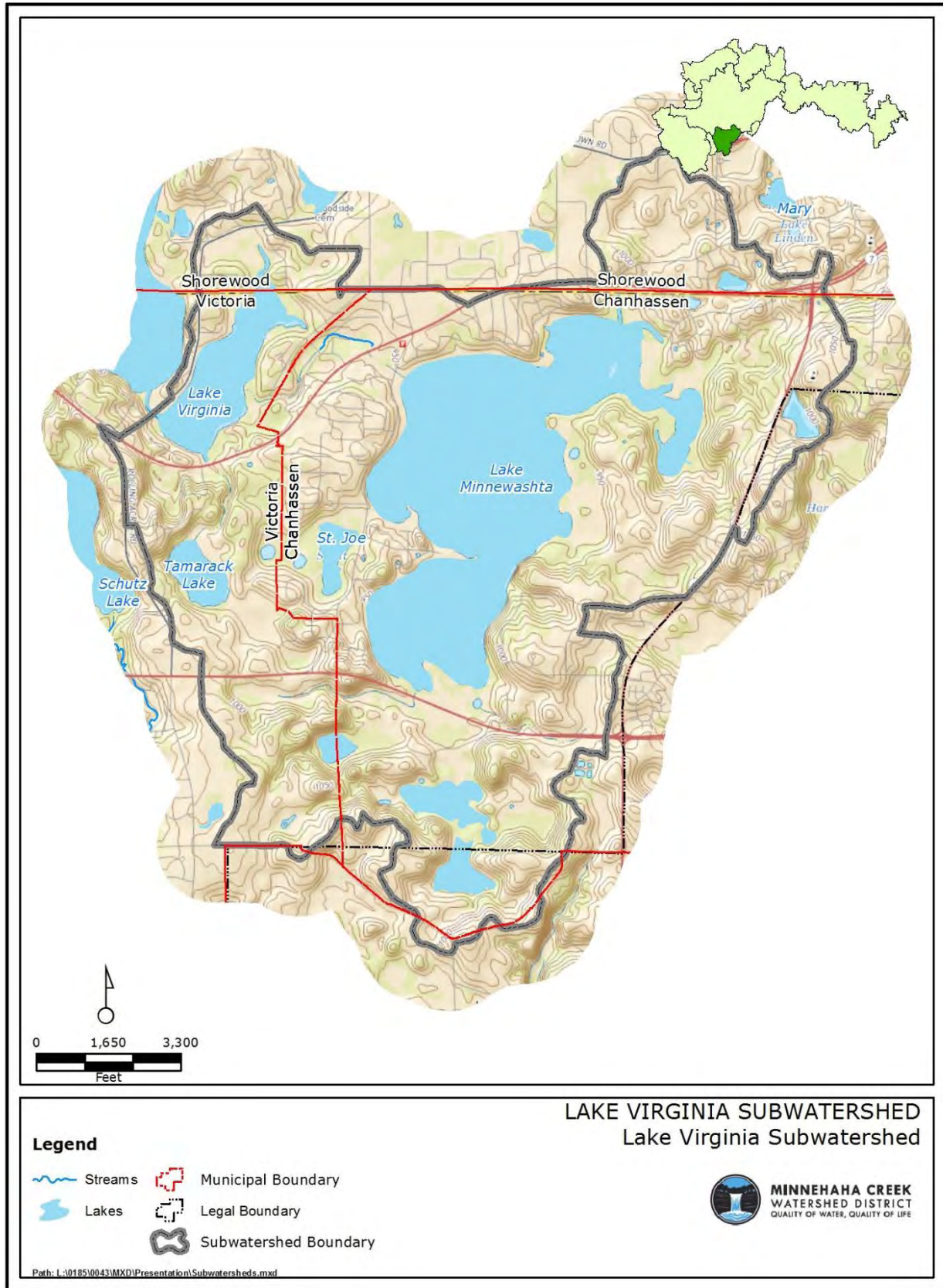


Figure 3.51. The Lake Virginia subwatershed.

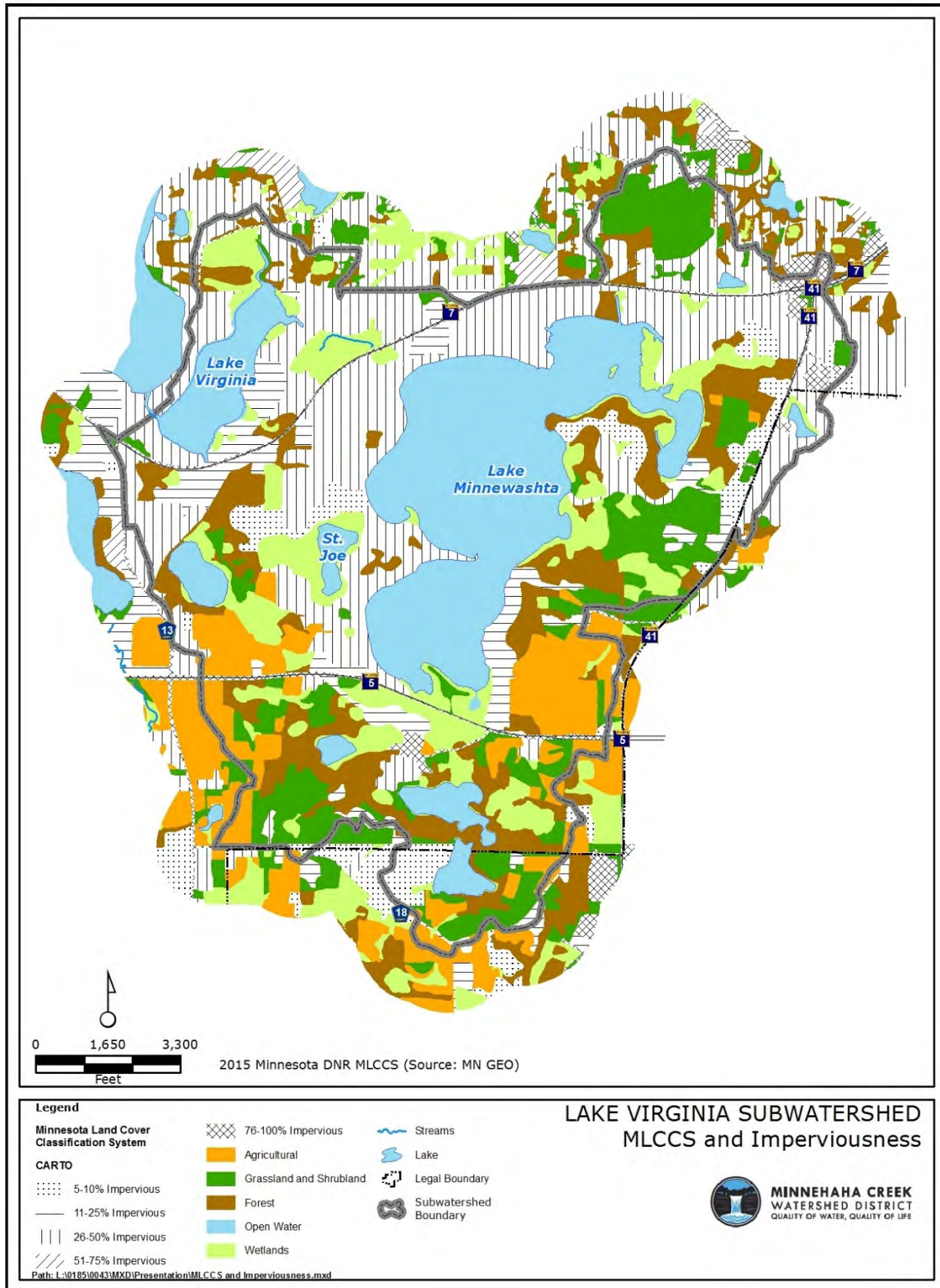


Figure 3.52. Lake Virginia subwatershed MLCCS and imperviousness.

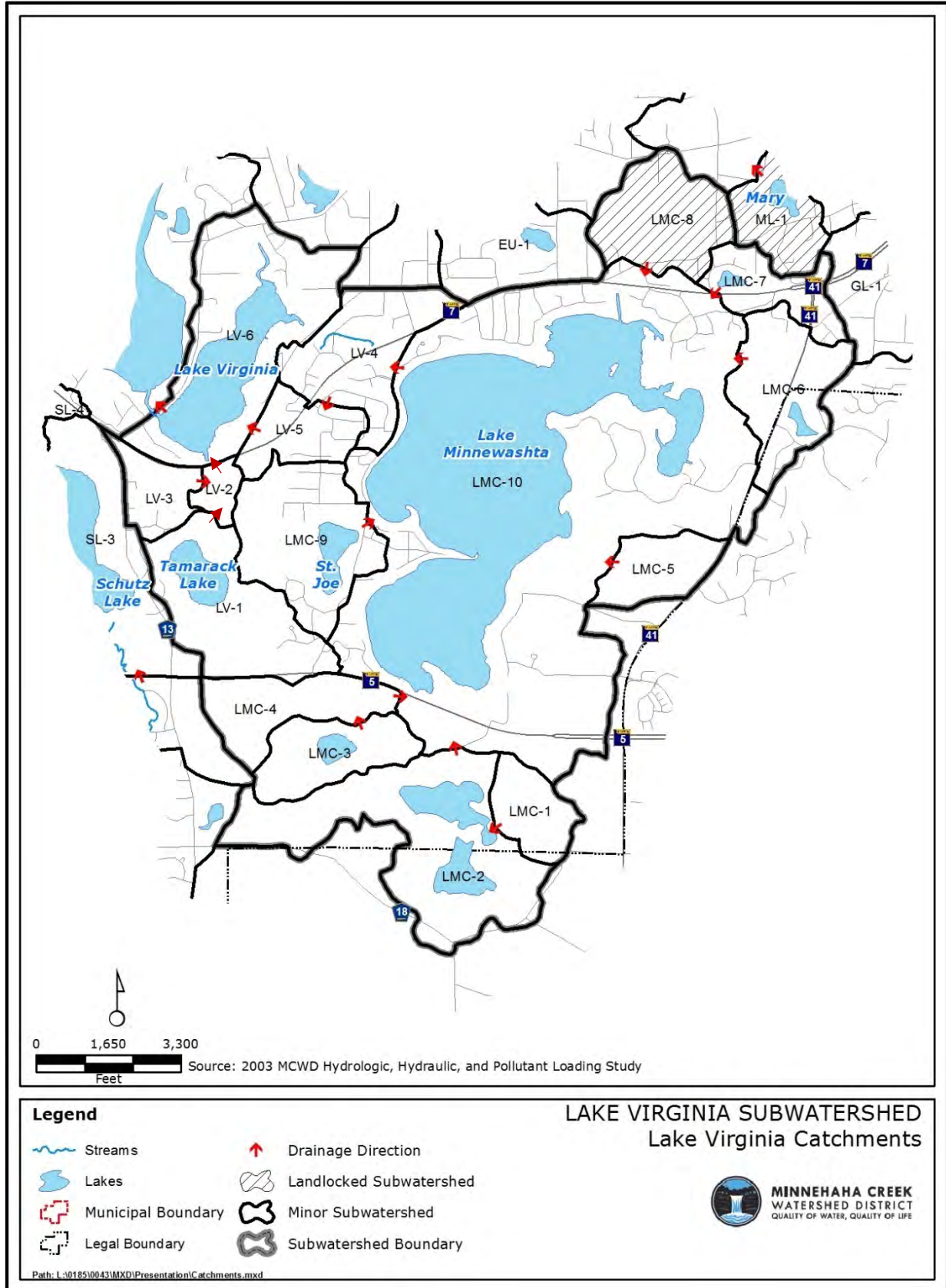


Figure 3.53. Lake Virginia subwatershed catchments.

Water Quality:

The following are summaries of the characteristics and classifications of lakes and streams within the subwatershed including water quality goals and trends.

Lakes:

Lakes Minnewashta and Virginia are the primary receiving waters within the subwatershed, and are classified by the DNR for shoreland management purposes as Recreational Development lakes. Tamarack Lake and Lake St. Joe are additional resources within the subwatershed, and are classified by the DNR as Natural Environment lakes (Table 3.52). Lake Virginia and Tamarack Lake are listed as Impaired Waters for excess nutrient concentrations; however, Tamarack Lake varies just above to just below the impairment threshold (Figure 3.54). Minnewashta and St. Joe Lakes enjoy excellent water quality, although St. Joe can experience algal blooms as evidenced by the somewhat elevated average chlorophyll-*a* concentrations.

The *Minnehaha Creek Watershed Lakes TMDL* (EOR 2011) prepared a TMDL for Lake Virginia while the *Upper Minnehaha Creek Watershed Lakes and Bacteria TDML Project* (Wenck 2014), prepared a TMDL for Tamarack Lake. Both Minnewashta and Virginia are listed as Impaired Waters for excess mercury in fish tissue, and the State of Minnesota has completed a statewide TMDL for those impairments. For more information, refer to the TMDL reports and the District’s Water Quality (Hydrodata) reports.

Tables 3.52 and 3.53 show the physical and water quality characteristics of the major lakes in the subwatershed. An analysis of water quality data on the four lakes did not reveal any statistically significant trends either improving or degrading (MCWD’s Research and Monitoring Report, 2015).

Table 3.52. Physical characteristics of lakes in the Lake Virginia subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Minnewashta	677	70	5:1	Recreational Development
St. Joe	19	52	11:1	Natural Environment
Tamarack	28	82	8:1	Natural Environment
Virginia	105	34	38:1	Recreational Development

Source: Minnesota DNR.

Table 3.53. Selected water quality goals and current conditions of lakes in the Lake Virginia subwatershed.

Lake	State TP Standard (µg/L)	2007 Plan Goal TP (µg/)	Trend	2001-2015 Summer Average		
				TP (µg/L)	Chl-a (µg/L)	Secchi (m)
Minnewashta ¹	40	20	No trend	22	9	2.4
St. Joe ²	40	None	No trend	26	5	2.7
Tamarack ²	40	None	No trend	37	15	2.3
Virginia ³	40	40	No trend	55	36	1.3

TP = total phosphorus, Chl-a =chlorophyll-a, Secchi = water clarity.

¹ (1997-2015) from MCWD.

² (2004-2015 irregularly monitored) from Citizen Assisted Monitoring Program (CAMP)

² (2004-2015) from Citizen Assisted Monitoring Program (CAMP) and MCWD Volunteer Program

³ (2005-2015) from MCWD.

Source: MCWD, Upper Minnehaha Creek Watershed Lakes TMDL, MPCA.

Streams:

There is a small stream that conveys discharge from Lake Minnewashta to Lake Virginia known as Minnewashta Creek (Figure 3.54). As an outflow channel, water quality in Minnewashta Creek is highly influenced by water quality in Lake Minnewashta. Average TP concentration in the Creek is well below the state river eutrophication standard. Depending on flow and concentration, the Minnewashta Creek outlet historically has relative lower TP concentrations and loading, though loading does show an increase during higher flow years. Tables 3.54 and 3.55 detail the physical and water quality characteristics of streams and tributaries within the subwatershed. For more information please refer to the District’s Water Quality (Hydrodata) Reports.

Table 3.55 shows the average concentrations at the monitoring site on Minnewashta Creek. Maintaining sufficient DO is necessary to support aquatic life. The DO state standard requires the stream to never fall below 5 mg/L DO. The most recent DO readings available by the District were above the standard.

Table 3.54. Major streams in the Lake Virginia subwatershed.

Stream	Length (mi)
Minnewashta Creek (CMW02)	1.03

Table 3.55. Current conditions of streams in the Lake Virginia subwatershed.

See Figure 3.54 for monitoring locations.

Stream	Trend	2006-2015 Annual Average			
		TP (µg/L)	TN (mg/L)	TSS(mg/L)	Cl (mg/L)
Minnewashta Creek (CMW02)	No trend	36	0.58	4	29*

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride.

*Cl data 2008-2014

Source: MCWD.

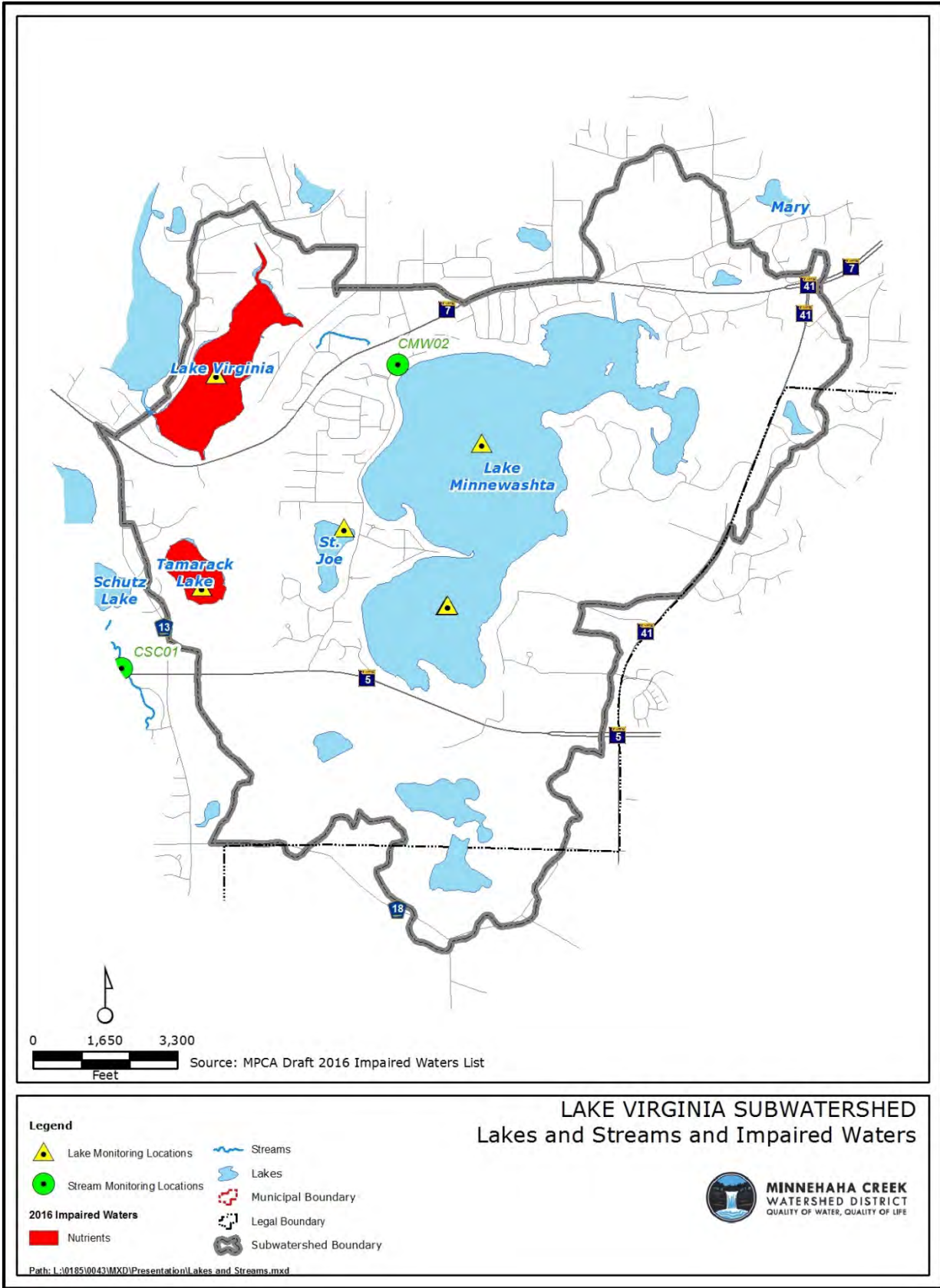


Figure 3.54. Lake Virginia subwatershed lakes and streams and Impaired Waters.

Wetlands:

According to the updated NWI, wetlands, including lakes, cover over 34 percent of the watershed’s surface (Figure 3.55 and Table 3.56). A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland.

In 2001-2003, the District undertook a *Functional Assessment of Wetland (FAW)* on all wetlands greater than one-quarter acre in size. The assessment was a variant of the Minnesota Routine Assessment Method developed in partnership with the Hennepin Conservation District to assess wetland functions and values. This analysis is a comprehensive inventory and assessment of existing wetland functions and values, both for District regulatory and management purposes and to assist the municipalities within the District by providing consistent, comprehensive wetland resources data. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients to and from the subwatershed. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands.

Table 3.56. National Wetland Inventory wetland types in the Lake Virginia subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	113.9	2.8
2 - Wet Meadow	-	-
3 - Shallow Marsh	305.0	7.6
4 - Deep Marsh	25.9	0.6
5 - Open Water	874.2	21.9
6 - Scrub Shrub	51.1	1.2
7 - Forested	-	-
8 - Bog	-	-
Riverine	-	-
Wetland Total	1370.2	34.3
Upland	2621	65.7
TOTAL	3991.2	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream base flow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

Infiltration potential of the upland areas within the subwatershed as generally medium, with a number of pockets of low potential clayey soils. Because of the organic nature of the soils in the wetland areas, in general infiltration potential there is variable. The *Carver County Water Resource Management Plan* and *Hennepin County Geologic Atlas* classifies those organic soil areas as highly sensitive to aquifer impacts, with the balance of the subwatershed as being of medium to low sensitivity to pollution, and the major wetland areas on the north and in the south as being highly sensitive.

Much of the northeastern part of the subwatershed as well as Lake Minnewashta, itself, has been designated a Drinking Water Sensitivity Management Area (DWSMA). Two Wellhead Protection Areas (WHPA) surrounding Chanhassen and Shorewood water supply wells are partly within this subwatershed. Figure 3.56 shows areas in the subwatershed with groundwater sensitivity and that are designated Wellhead Protection Areas.

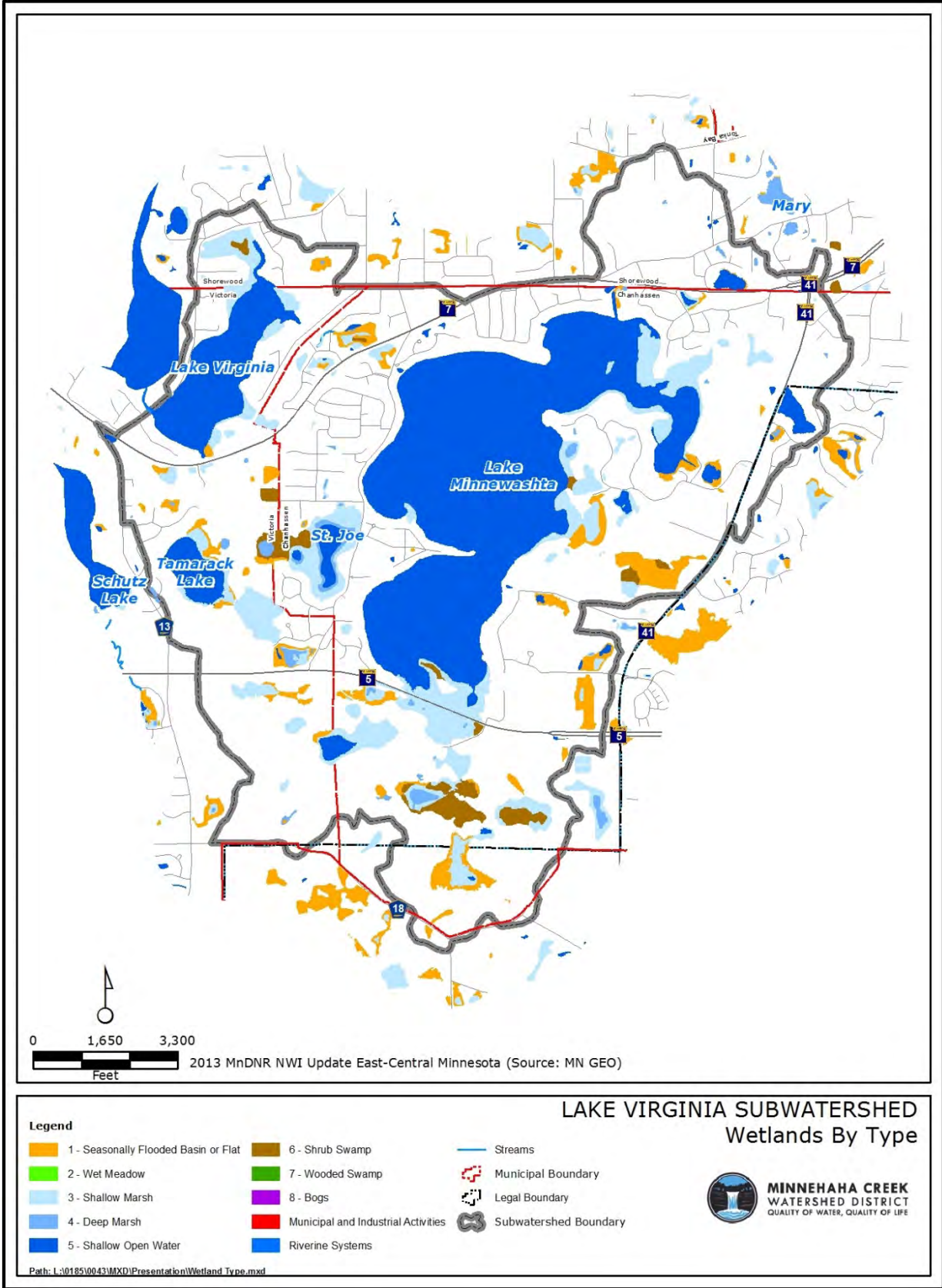


Figure 3.55. Lake Virginia subwatershed wetlands by type.

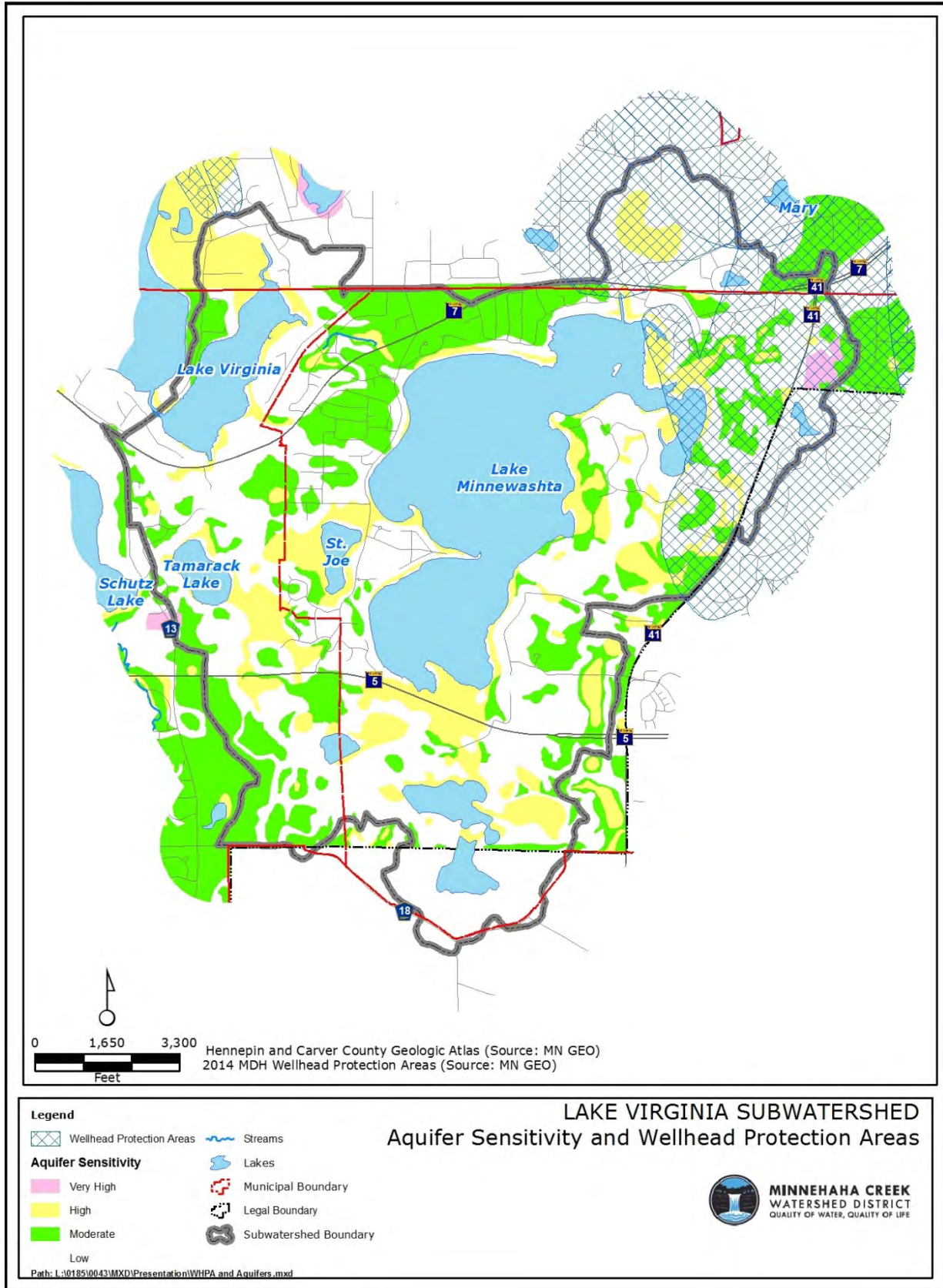


Figure 3.56. Lake Virginia subwatershed aquifer sensitivity and Wellhead Protection Areas.

Water Quantity:

As detailed in the *HHPLS*, two subwatershed units in the Lake Virginia subwatershed are landlocked (Figure 3.93).

To assess change in water yield, a Mann-Kendall statistical trend test was performed on annual water yield data for the monitoring station on Minnewashta Creek. Water yield for 2006–2015 did not exhibit any statistically significant trend upward or downward, indicating that there has not been a significant change in outflow over the past ten years.

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity, habitat diversity, and nutrient cycling. Nutrient cycling is described in the Water Quality section. The Lake Virginia subwatershed has not yet been systematically evaluated by the E-Grade program. This section summarizes ecological integrity using existing data where available (Figure 3.57).

Lakes:

Biodiversity

Fish Community. No Fish IBI data is available for the lakes in the subwatershed. Lake Minnewashta is a popular bass/northern/panfish lake that was last surveyed by the DNR in 2011. A catch-and-release only regulation for largemouth bass is in effect. Lake Virginia maintains a bass/northern/panfish fishery with abundant bluegills. Dissolved oxygen levels in the deeper parts of the lake in late summer fall below the levels needed to sustain aquatic life, which may impact certain sensitive species. Common carp and other rough fish are abundant. Lake St. Joe has a fish population dominated by small black bullheads, northern pike and several species of panfish. Tamarack Lake has not been surveyed since 1994. The fish population at that time was primarily panfish, although there were fair numbers of northern pike.

Aquatic Vegetation Community. Biodiversity is determined by the number and variety of species, or richness. A Floristic Quality Index (FQI) is available for Lake Minnewashta, Tamarack and St. Joe lakes. Lake Minnewashta FQI score of 28.8 – Good. This grade indicates the lake has moderate species diversity and a mixed assemblage of tolerant and intolerant species, beginning to show signs of anthropogenic disturbance. Tamarack Lake and St. Joe, with a score of 14.1 and 18.09 respectively – both classified as Poor meaning the community in both lakes is showing obvious signs of anthropogenic disturbance, low species diversity often comprised of non-native and/or intolerant species. Eurasian watermilfoil and Curlyleaf Pondweed are present in both Lakes Minnewashta and Lake Virginia.

Aquatic Invasive Species. In addition to Eurasian Watermilfoil, Curlyleaf Pondweed and Common Carp, Lake Minnewashta and Lake Virginia are both infested with zebra mussels. A rapid response occurred on Lake Minnewashta in 2016, and it will take several years to determine if zebra mussels were truly eradicated from the lake.

Habitat diversity

Aquatic Vegetation Community. Habitat diversity is determined by the percent occurrence of species, or the extent to which it may be dominated by a few species. The vegetation community has not been assessed yet for habitat diversity.

Shoreline Health. Shoreline health is assessed looking at shoreline vegetative cover and the relative human disturbance. The MnDNR is using the Score the Shore protocol to relate shoreline conditions to fish community structure using the fish IBI metric. No Score the Shore data is available for the lakes in this subwatershed. Aerial

photos show that much of eastern shore of Minnewashta Lake has significant shoreland vegetation along Lake Minnewashta Regional Park. About 40 percent of the perimeter of Lake Minnewashta and 35 percent of Lake Virginia are protected by riparian wetlands. Both Lake St. Joe and Tamarack Lake have fully intact shoreland vegetation.

Streams:

Biodiversity

Fish Community. No fish IBI data is available for the streams in this subwatershed.

Macroinvertebrate Community. No macroinvertebrate data is available for the stream in this subwatershed.

Habitat diversity

Habitat Complexity. No Minnesota Stream Habitat Assessment data is available to assess habitat complexity for Minnewashta Creek. By observation, this stream is more like a channel between the two lakes.

Connectivity. Connectivity is defined by two metrics: presence or absence of barriers, and access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. There are culverts that intersect Minnewashta Creek along its 1.03 mile course to Lake Virginia.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS concentrations increase turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. A stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, can be stressful to organisms. In addition, streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is not available, but instantaneous flow measured since 2006. Annual average flow for each year was computed first, and then all the years' averages were averaged together. Annual average flow at CMW02 was 3.54 cfs indicating generally low flow conditions at time of data collection.

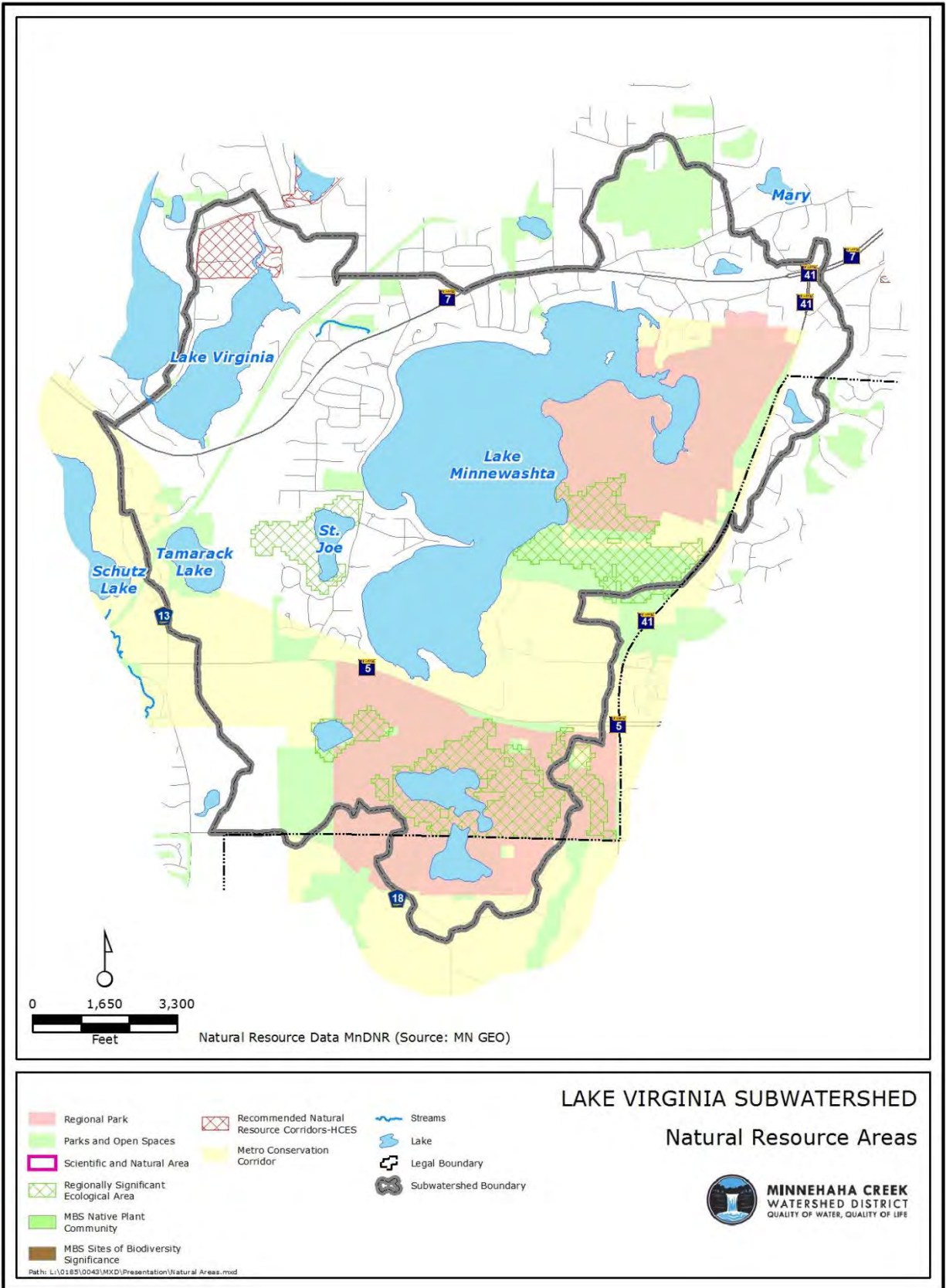


Figure 3.57. Lake Virginia subwatershed natural resource areas.

Wetlands:

Biodiversity

Vegetation Community. No FQI data are available for the wetlands in this subwatershed. Over 39 percent of the wetlands in the subwatershed were classified as “preserve” due to their exceptional or high vegetative diversity, or fish or wildlife habitat value. Those wetlands described as exceptional are present on the east side of Lake Minnewashta, the northwest shore of Lake Virginia and all of Lake St. Joe.

Macroinvertebrate Community. No macroinvertebrate data are available for the wetlands in this subwatershed. This data is not currently being collected in E-Grade.

Habitat diversity

Connectivity. Connected wetland corridors are desirable as they provide a variety of habitats as well as protected areas for passage. Most of the connectivity between wetlands is already protected within the Lake Minnewashta Regional Park and/or the University of Minnesota Landscape Arboretum.

Size. Larger wetlands are more likely to support a notable on-site diversity and/or abundance of wildlife species. Much of eastern shore of Minnewashta Lake has large wetlands present within Lake Minnewashta Regional Park. Both Lake St. Joe and Tamarack Lake also have large wetlands around their respective perimeters.

Shoreline Protection. Riparian wetlands can provide significant shoreline protection and support emergent vegetation at the shoreline. The *Functional Assessment of Wetlands* evaluated riparian wetlands for their ability to protect lake or stream shoreline. About 40 percent of the perimeter of Lake Minnewashta and 35 percent of Lake Virginia is protected by riparian wetlands. Both Lake St. Joe and Tamarack Lake have fully intact shoreland vegetation.

Uplands:

Biodiversity

Much of the subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor, including Lake Minnewashta Regional Park and the Minnesota Landscape Arboretum. Wetland and associated upland areas with high ecological value are present and should be conserved and connected to preserve their values, create larger areas of ecological value, and connect existing resources. The Minnesota Landscape Arboretum and Lake Minnewashta Regional Park lands include wetland, wooded and grassland cover as well as some agricultural uses.

Habitat diversity

Regionally significant ecological areas are places where larger tracts of minimally disrupted land provide habitat complexity. Figure 3.57 shows areas designated by the DNR as regionally significant within Lake Minnewashta Regional Park, the Landscape Arboretum, and riparian to Lake St. Joe. The Regional Park, University of Minnesota Horticultural Research Center, and Landscape Arboretum also preserve significant areas of lightly-disturbed woodlands and grasslands that provide significant habitat value to terrestrial and avian species in the subwatershed.

Thriving Communities:

Land use:

Table 3.57 shows the land uses within the area of the Lake Virginia subwatershed in acres and as a percentage of the total subwatershed. The principal land uses in the northern part of the subwatershed are parks and open space and single family residential (Figure 3.58). South of Highway 5 the subwatershed is mainly agriculture and

vacant or undetermined area with some single family and the campus of southwest Metro Catholic High School. Except for some very small areas in the south, the entire subwatershed is located within the 2020 Metropolitan Urban Services Areas (MUSA) boundary.

Table 3.57. 2010 land use in the Lake Virginia subwatershed.

Land Use 2010	Acres	% of Subwatershed
Parks and Open Space	1,132.9	28.3
Single - Family Residential	978.5	24.5
Water	876.0	21.9
Vacant or Undetermined	470.5	11.7
Agricultural	296.8	7.4
Institutional	139.3	3.4
Roads and Highways	60.2	1.5
Commercial	21.7	0.5
Multi - Family Residential	7.6	0.1
Industrial	7.2	0.1

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

Lake Minnewashta Regional Park encompasses most of the northeastern shore of Lake Minnewashta. Most of the subwatershed south of Highway 5 is part of the Minnesota Landscape Arboretum. The Southwest Hennepin LRT Regional Trail passes across the northwest corner of the subwatershed, to the east of Lake Virginia. The Minnesota Historic features database lists several properties in the subwatershed, including a home and farmhouse, and two clusters of buildings and sites associated with the Arboretum and its research activities.

There is one public boat launch in the Regional Park on Lake Minnewashta, and one on Lake Virginia (Figure 3.59). A canoe launch is available on Lake St. Joe. There is a beach and fishing pier on the east side of Lake Minnewashta in the Regional Park, and a beach on the west side of Lake Minnewashta in the City of Chanhassen’s Roundhouse Park.

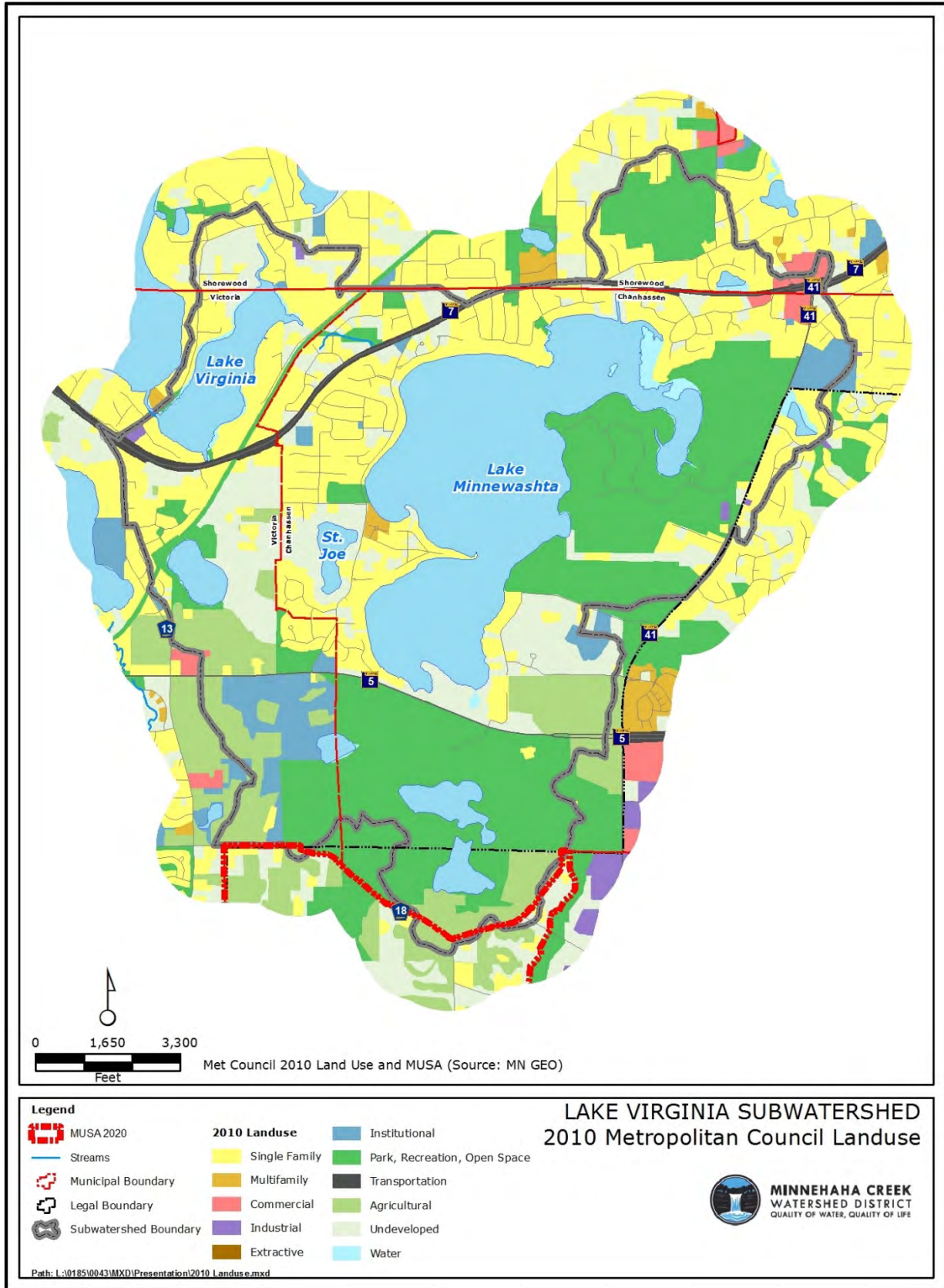


Figure 3.58. Lake Virginia subwatershed 2010 land use.

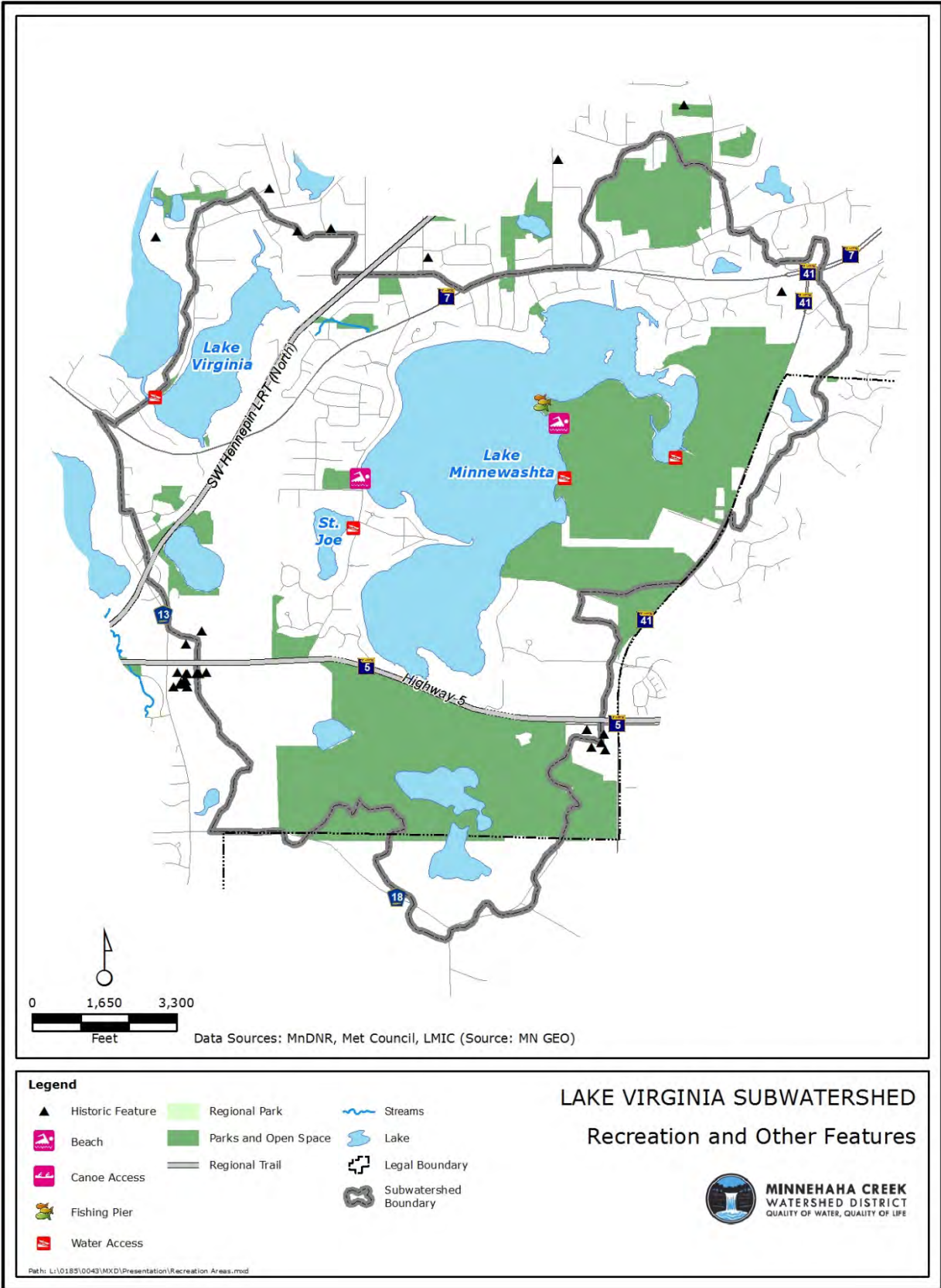


Figure 3.59. Lake Virginia subwatershed recreation and other features.

Studies and Assessments:

- Minnesota Land Cover Classification System (MLCCS)
- MCWD Hydraulic, Hydrologic, and Pollutant Loading Study (HHPLS), EOR 2003
- MCWD Lakes TMDL – Lakes Nokomis, Parley, Virginia, and Wassermann, EOR 2011
- Minnehaha Creek Watershed Lakes TMDL, EOR 2011
- Upper Minnehaha Creek Watershed Lakes and Bacteria TDML Project, Wenck 2014
- State of Minnesota Statewide Mercury TMDL
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- National Wetland Inventory
- Functional Assessment of Wetland (FAW), 2003
- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- Carver County Water Resource Management Plan
- Hennepin County Geologic Atlas
- Metropolitan Council from city Comprehensive Plans
- Minnesota Historic Features Database
- Lake Virginia Regional Infiltration (LV-5) Feasibility Study, 2012
- MN Landscape Arboretum Wetland Restoration Project, 1996
- Spring Peeper Meadow Project, 1996

3.6 LANGDON LAKE SUBWATERSHED

The land cover in the Langdon Lake Subwatershed is dramatically different between Minnetrista and Mound. In Minnetrista, the western portion of the subwatershed, there is a mix of woodlands, forests, grasslands, wetlands (Black-Flanagan and Saunders), and agricultural land use. In Mound, the eastern portion of the subwatershed, there are wetlands adjacent to Langdon Lake with the remaining land cover dominated by residential and commercial/institutional use. The Dakota Rail line runs north of Saunders and Langdon lakes. Langdon Lake inlet (CLA02) drains the subdivisions around Saunders Lake and flows through a wetland before reaching Langdon Lake. The lake outlet (CLA01) flows into Lost Lake wetland complex and eventually into Cooks Bay, Lake Minnetonka. Table 3.61 below shows the area of the Langdon Lake subwatershed in acres by individual city, in total and as a percentage of the total subwatershed (Figure 3.61).

Table 3.61. Cities in the Langdon Lake subwatershed.

City	Area (Acres)	% of Subwatershed
Minnetrista	539.3	51%
Mound	516.3	49%
Total	1,055.6	100%

Source: MCWD

Watershed Description and Hydrology:

The topography of the Langdon Lake subwatershed is rolling and hilly with steep slopes abutting Black Lake and its associated wetlands and abutting the shores of Saunders Lake. The subwatershed is bisected by a railroad corridor, which influences its hydrology. The Langdon Lake subwatershed is notable for its ecological resources and large wetlands. The northwestern part of the subwatershed, which includes several areas of high-value woods, grassland, and wetland, has been acquired by the Three Rivers Park District and incorporated into Gale Woods Regional Park.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (Figure 3.62). The eastern subwatershed is mostly developed at typical suburban densities, and has varying degrees of imperviousness. The western half of the subwatershed is dominated by a mosaic of forest and woodland, wetland and open water, with some agriculture in the southwest and some scattered, large-lot residential development.

Soils within the watershed are predominantly well-drained Natural Resources Conservation Service Hydrologic Soil Group B (loamy soils with moderate infiltration potential), with pockets of poorly-drained soils of varying infiltration potential. Group D soils (clayey soils with very low infiltration potential) are found in low-lying areas and are generally hydric, or showing indications of inundation. For further information regarding geology and soils in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

Langdon Lake is the primary receiving water within the subwatershed. Two other receiving waters within the subwatershed carry the informal designation of a lake: Saunders Lake and Black Lake, both of which are classified as wetlands. There is a small channel that conveys discharge from the outlet of Saunders Lake to Langdon Lake.

The *2003 MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Langdon Lake subwatershed into five subwatershed units, designated LL-1 through LL-5 (Figure 3.63).

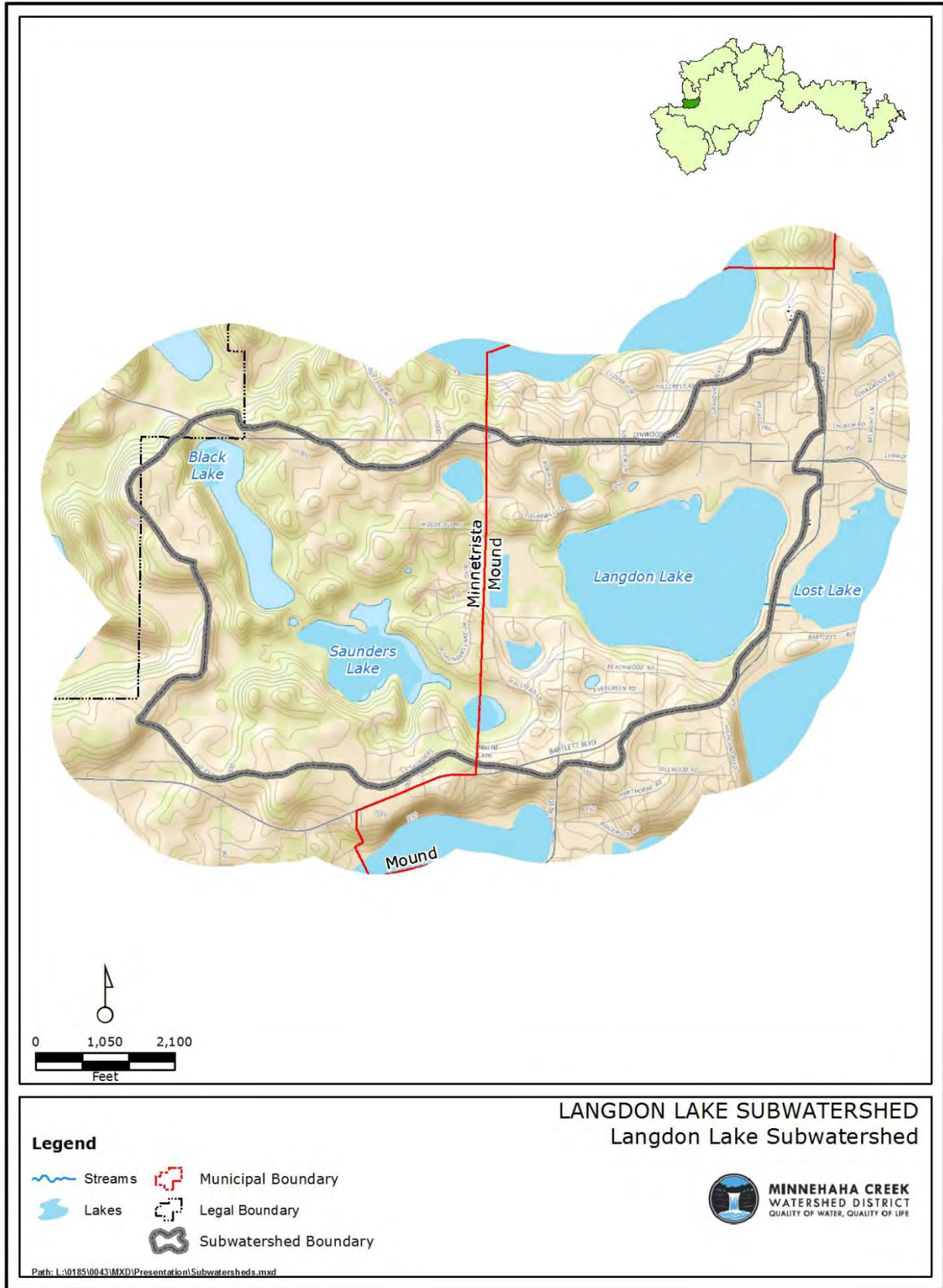


Figure 3.61. The Langdon Lake subwatershed

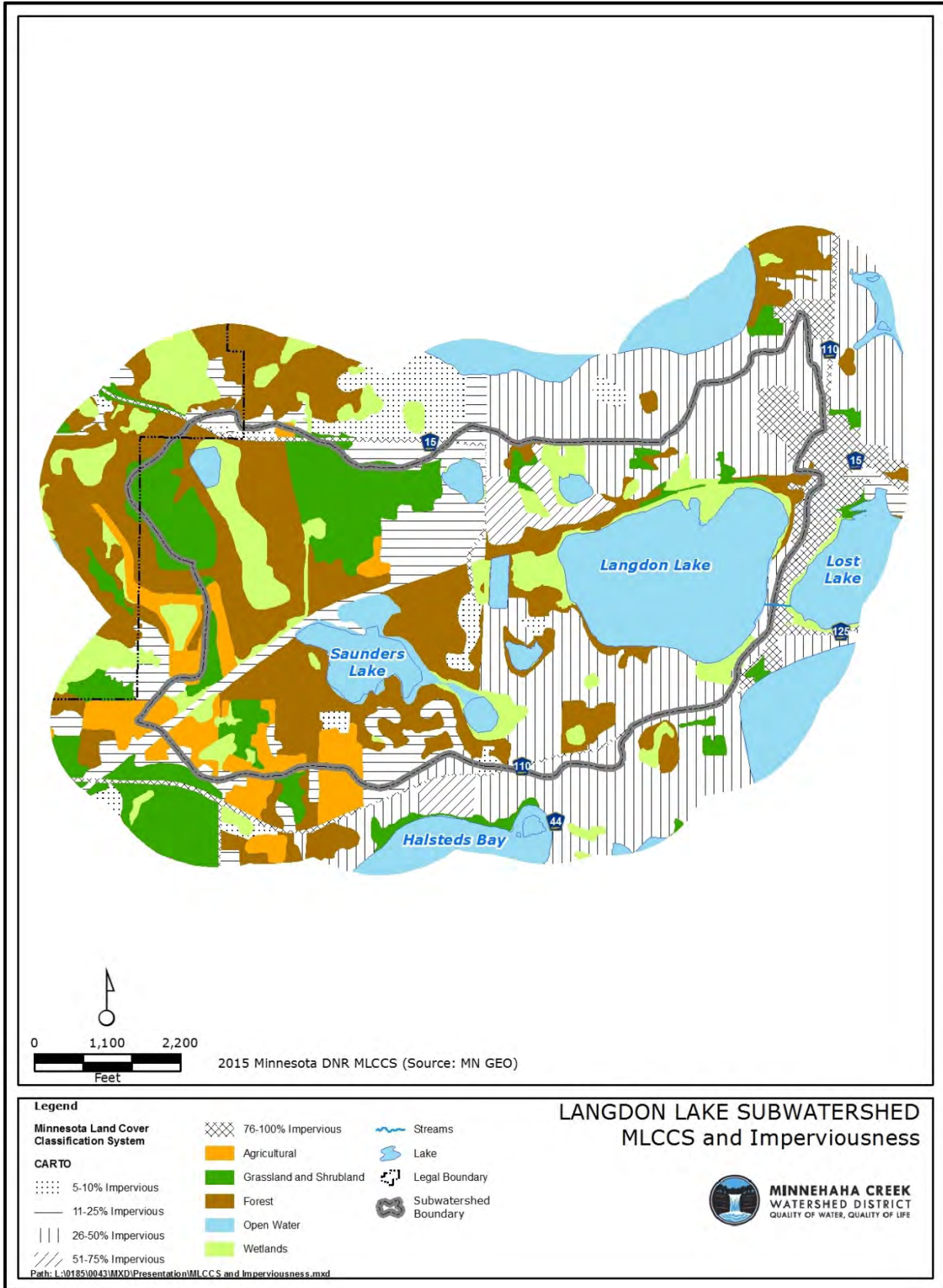


Figure 3.62. Langdon Lake subwatershed MLCCS and imperviousness.

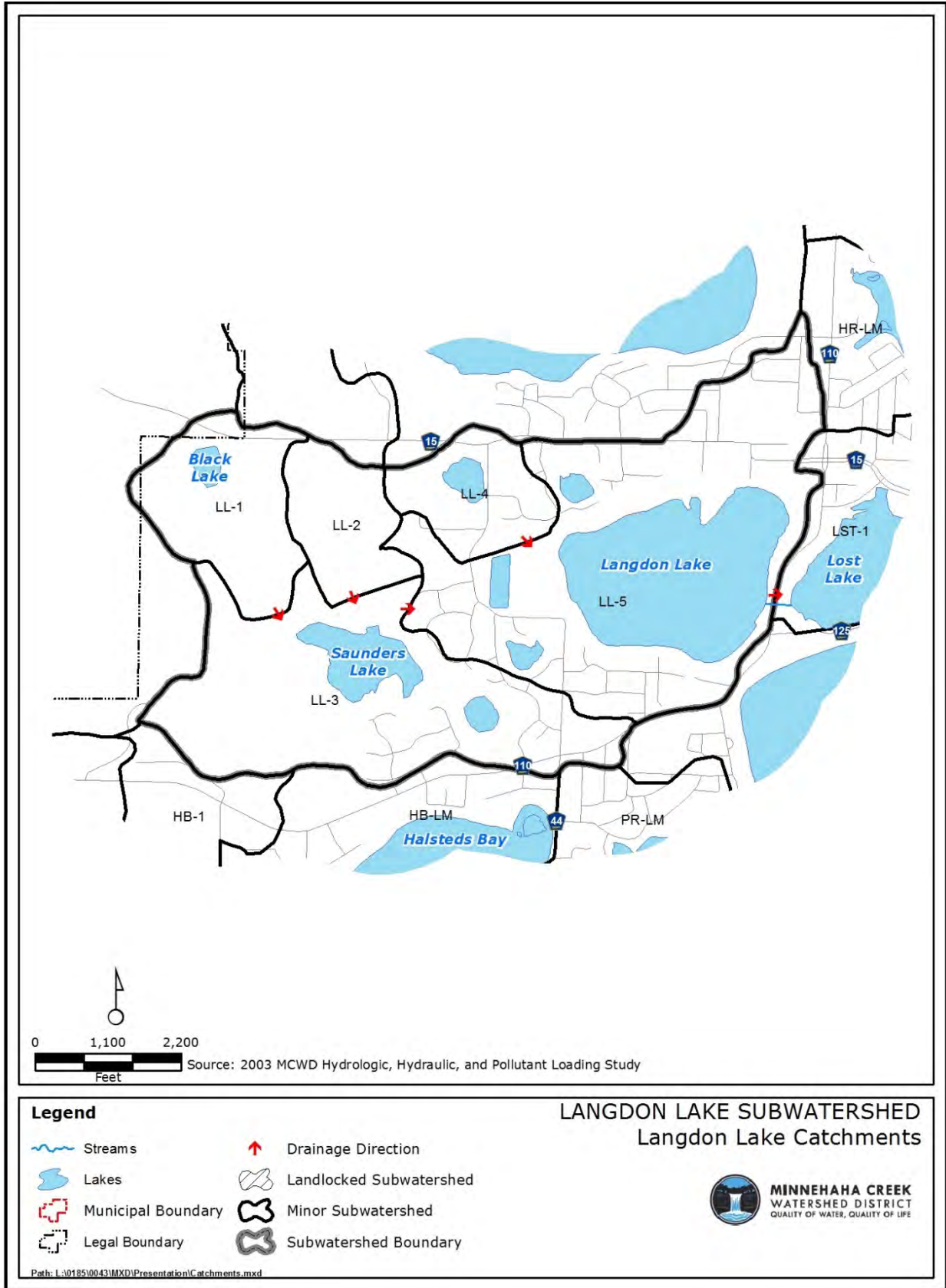


Figure 3.63. Langdon Lake subwatershed catchments.

Water Quality:

The following are summaries of the characteristics and classifications of lakes and streams within the subwatershed including water quality goals and trends.

Lakes:

Langdon Lake is the primary receiving water within the subwatershed, and is classified by the DNR for shoreland management purposes as a Recreational Development lake (Table 3.62). Two other receiving waters within the subwatershed carry the informal designation of lake: Saunders Lake and Black Lake. Black Lake is also known as Lake Flanagan. Saunders Lake is a large, Type 5 wetland, classified as a Natural Environment lake while Black Lake is a multi-type wetland with a small area of Type 5 open water.

Langdon Lake is listed on the State’s Impaired Waters list, with average summer nutrient concentrations greater than the state standard. Tables 3.62 and 3.63 below detail the physical and water quality characteristics of Langdon Lake and other lakes within the subwatershed. For more information regarding water quality in the subwatershed, please refer to the District’s Water Quality (Hydrodata) reports and the Upper Minnehaha Creek Watershed Lakes TMDL (Wenck 2014).

Table 3.62. Physical characteristics of lakes in the Langdon Lake subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Black	31	28	4:1	N/A
Langdon	144	39	8:1	Recreational Development
Saunders	26	12	20:1	Natural Environment

Source: Minnesota DNR.

Table 3.63. Selected water quality goals and current conditions of lakes in the Langdon Lake subwatershed.

Lake	State TP Standard (µg/L)	2007 Plan Goal TP (µg/L)	Trend	20012015 Summer Average		
				TP (µg/L)	Chl-a (µg/L)	Secchi (m)
Black ²	N/A	N/A	N/A	17	3	3.5
Langdon ¹	40	40	No trend	99	57	0.7
Saunders ³	N/A	N/A	N/A	27	5	1.2

TP = total phosphorus, Chl-a =chlorophyll-a, Secchi = water clarity.

¹Data is 2001-2015, from MCWD. ²Data is 2009-2010. ³Data is from 2009-2012.

Source: MCWD, Upper Minnehaha Creek Watershed Lakes TMDL, MPCA.

Streams:

There is a small channel that conveys discharge from the outlet of Saunders Lake to Langdon Lake. No water quality or flow data are available for this channel. There is a small stream (Langdon Lake outlet) that conveys flow to Lost Lake: Lake Minnetonka (Figure 3.64).

At this time no streams are listed as Impaired Waters. The Langdon Lake outlet stream is within the state river eutrophication standards. Tables 3.64 and 3.65 below detail the physical and water quality characteristics of streams and tributaries within the subwatershed. For more information please refer to District’s Water Quality (Hydrodata) reports.

Table 3.65 shows the average concentration of TSS at the one site on the Langdon Lake outlet stream to be 16 mg/L, below the 30 mg/L state standard for this ecoregion. Maintaining sufficient DO is necessary to support aquatic life. The DO state standard requires the stream to never fall below 5 mg/L DO. Monitoring data show that the site on the Langdon Lake outlet stream has stayed at or above the standard the last few years for the vast majority of samples; however, it has dipped below the standard intermittently. It is assumed based on the time of year that low DO values were due to low flow and high summer temperatures.

Table 3.64. Major streams in the Langdon Lake subwatershed.

Stream	Length (mi)
Langdon Lake Outlet (CLA01)	0.4

Table 3.65. Current conditions of streams in the Langdon Lake subwatershed.

See Figure 3.64 for monitoring locations.

Stream	Trend	2006-2015 Annual Average			
		TP (µg/L)	TN (mg/L)	TSS(mg/L)	Cl (mg/L)
Langdon Lake Outlet (CLA01)	Imp TP, TSS	108	1.49	16	45*
Langdon Lake Inlet (CLA02)	n/a	108	0.943	7	23*

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride Imp = Improving

*Cl data from 2008-2015.

Source: MCWD.

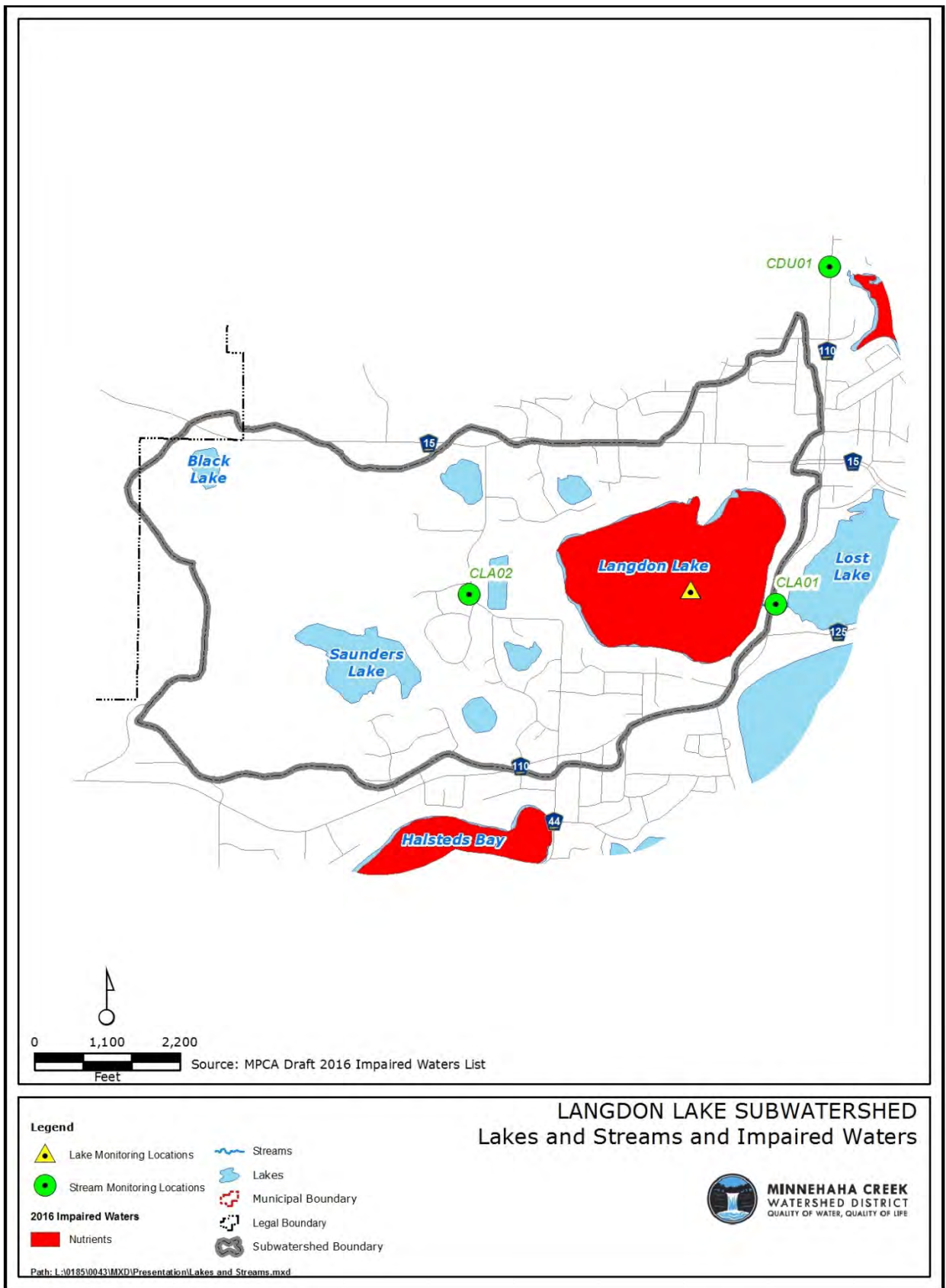


Figure 3.64. Langdon Lake subwatershed lakes and streams and Impaired Waters.

Wetlands:

According to the updated NWI, wetlands, including lakes, cover 30 percent of the subwatershed’s surface (Figure 3.65 and Table 3.66). A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands.

Table 3.66. National Wetland Inventory wetland types in the Langdon Lake Creek subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	22.7	2.1
2 - Wet Meadow	0.1	<0.1
3 - Shallow Marsh	68.7	6.5
4 - Deep Marsh	3.3	0.3
5 - Open Water	216.1	20.4
6 - Scrub Shrub	3.5	0.3
7 - Forested	0.3	<0.1
8 - Bog	-	-
Riverine	-	-
Wetland Total	319.7	30.3
Upland	735.3	69.7
TOTAL	1,055	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream baseflow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

Upland areas within the subwatershed have low to medium infiltration potential, with an area of high infiltration potential to the south and west of Langdon Lake in an area of ice-stratified sand and gravel till. The *Hennepin County Geologic Atlas* classifies most of the western subwatershed area as being of low sensitivity to pollution, while the area around Langdon Lake is variously medium to high to very highly sensitive, especially in the areas of gravel till deposits.

Part of the Langdon Lake subwatershed has been designated by the Minnesota Department of Health (MDH) as Drinking Water Sensitivity Management Areas (DWSMA) and Wellhead Protection Areas (WHPA) City of Mound and Minnetrista municipal wells. The MDH has designated this area to be of low to moderate risk of contamination of the drinking water supply. Figure 3.66 shows areas in the subwatershed with groundwater sensitivity and that are designated Wellhead Protection Areas.

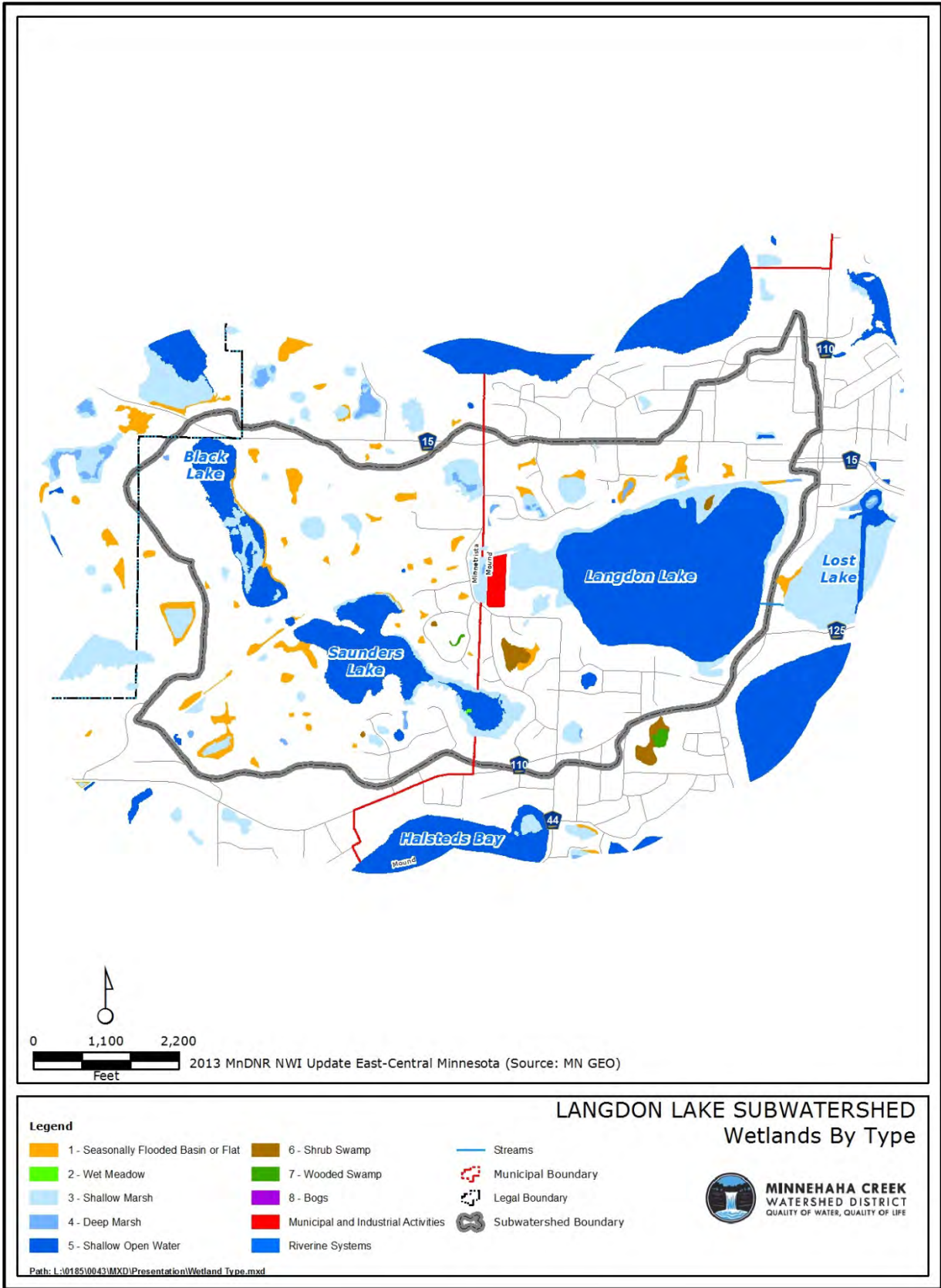


Figure 3.65. Langdon Lake subwatershed wetlands by type.

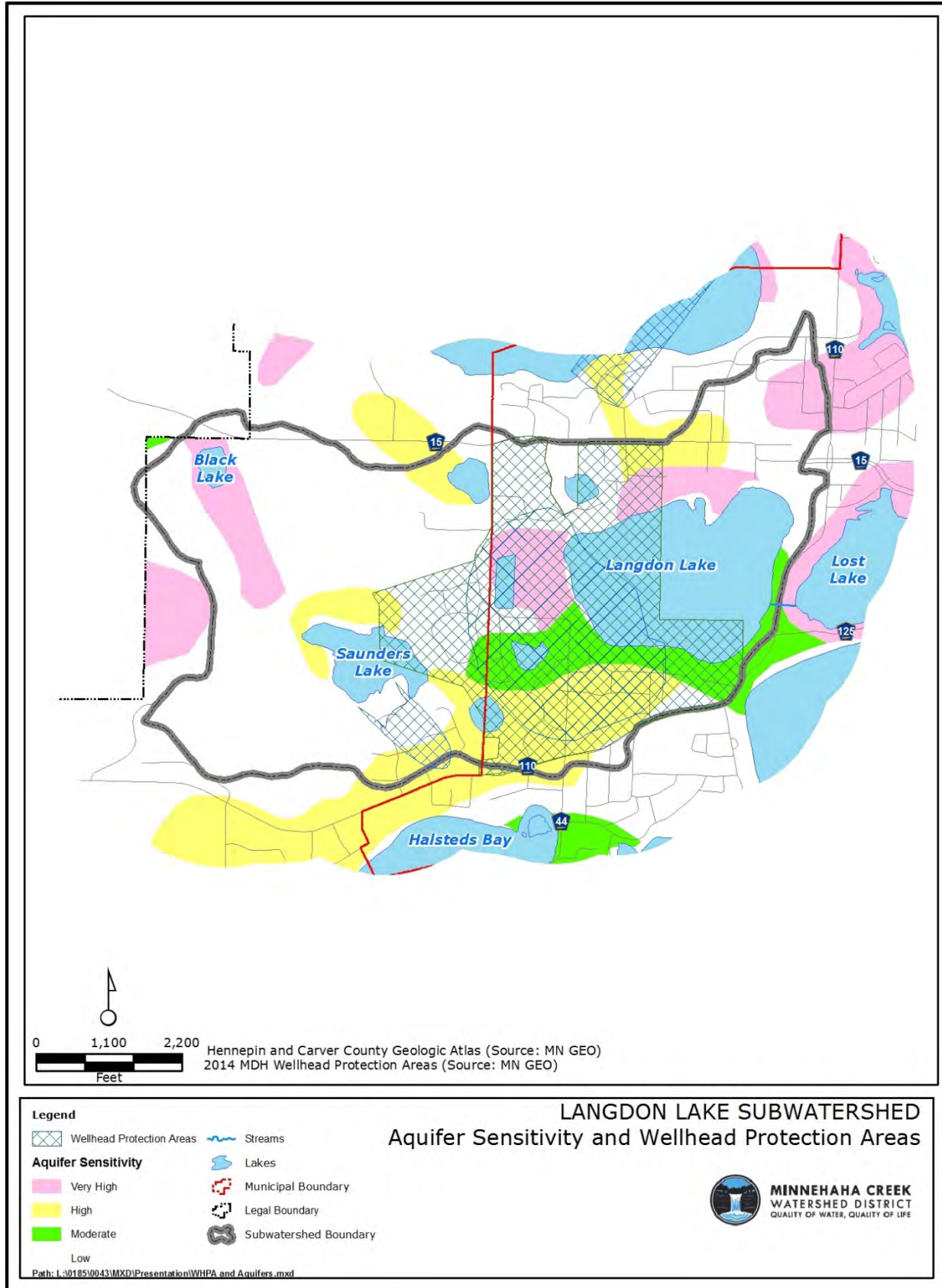


Figure 3.66. Langdon Lake subwatershed aquifer sensitivity and Wellhead Protection Areas.

Water Quantity:

LL-1 and LL-2 drain to Saunders Lake, a large wetland complex that is discharged through a small channel to Langdon Lake. Langdon Lake discharges through a culvert under Highway 110 into Lost Lake, which outlets into Cooks Bay: Lake Minnetonka. The subwatershed is bisected by a railroad corridor, which influences its hydrology (Figure 3.63).

To assess change in water yield, a Mann-Kendall statistical trend test was performed on annual water yield data for the monitoring station upstream of Langdon Lake. Water yield for 2006-2015 did not exhibit any statistically significant trend indicating that there has not been a significant change in outflow over the past ten years.

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity, habitat diversity, and nutrient cycling. Nutrient cycling is described in the Water Quality section. The Langdon Lake subwatershed has not yet been systematically evaluated by the E-Grade program. This section summarizes ecological integrity using existing data where available (Figure 3.67).

Lakes:

Biodiversity

Fish Community. No fish IBI data are available for the lakes in this subwatershed. The most recent DNR fish survey of Langdon Lake was conducted in 1993. At that time the fish population was dominated by black bullhead, a fish that is typical of turbid waters, and various species of sunfish.

Aquatic Vegetation Community. Biodiversity is determined by the number and variety of species, or richness. The most recent survey was conducted in 2015 with 6 species observed. Floristic Quality Index (FQI) data from the 2015 survey was 12.7 – Degraded. The E-Grade indicates the aquatic vegetation community has very low species diversity with non-native and/or intolerant species, most disturbed communities present. By observation, the turbidity of the water limits the growth of aquatic macrophytes that in turn limits the fishery.

Habitat diversity

Aquatic Vegetation Community. Habitat diversity is determined by the percent occurrence of species, or the extent to which it may be dominated by a few species. The vegetation community has not been assessed yet for habitat diversity.

Shoreline Health. Shoreline health is assessed looking at shoreline vegetative cover and the relative human disturbance. The MnDNR is using the Score the Shore protocol to relate shoreline conditions to fish community structure using the fish IBI metric. No Score the Shore data is available; however, aerial photos show that around Saunders Lake the majority of the shoreline has wooded or wetland fringes as does the northern half of Langdon Lake. Black Lake (a wetland) has a fully intact wooded or vegetated fringe. Fridge is beneficial for controlling runoff and supporting emergent vegetation at the shoreline.

Streams:

Biodiversity

Fish Community. There is no fish data for any of the streams in this subwatershed.

Macroinvertebrate Community. There is no macroinvertebrate data are available for the streams in this subwatershed.

Habitat diversity

Habitat Complexity. No Minnesota Stream Habitat Assessment data is available to assess habitat complexity for the unnamed stream within the subwatershed. By observations, the creek is a straight ditch and is not deep or wide.

Connectivity. Connectivity is defined by two metrics: presence or absence of barriers, and access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. There are no identified barriers along the unnamed stream within the subwatershed.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS concentrations increase turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. A stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, can be stressful to organisms. In addition, streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is not available, but instantaneous flow measured since 2006. Annual average flow for each year was computed first, and then all the years' averages were averaged together. Annual average flow at CLA01 was 1.18 cfs indicating generally low flow conditions at time of data collection.

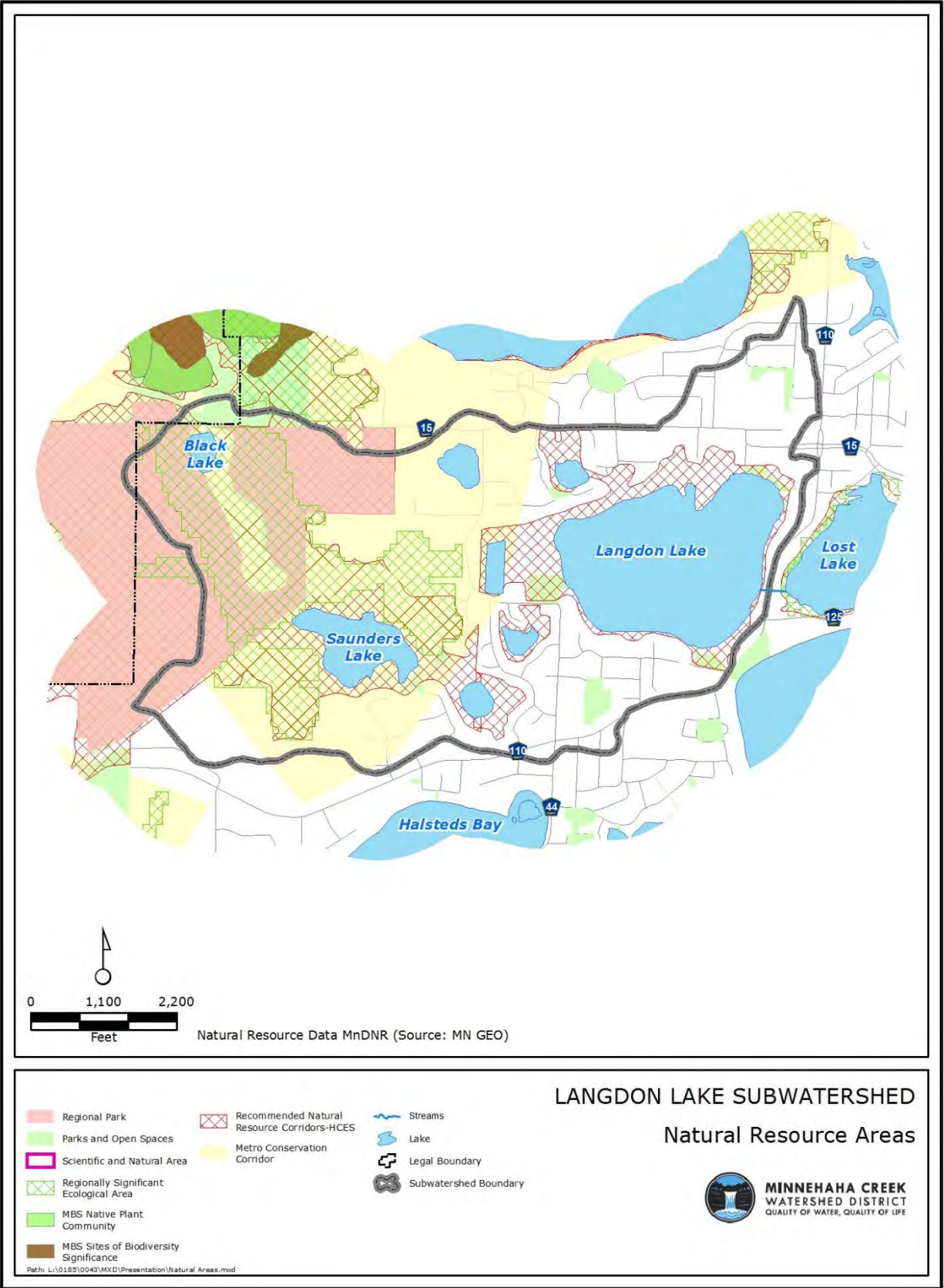


Figure 3.67. Langdon Lake subwatershed natural resource areas.

Wetlands:

Biodiversity

Vegetation Community. No FQI data are available for the wetlands in this subwatershed. The *Functional Assessment of Wetlands* has classified several wetlands as having high vegetative diversity and wildlife habitat potential as well as having exceptional aesthetic and fish habitat values. The highest vegetative diversity was found in the wetland complex associated with Black Lake within the Gale Woods Regional Park and the wetlands riparian to Saunders Lake. The wetlands riparian to Saunders and Langdon Lakes were evaluated as having high fish habitat values. There are four wetlands in the subwatershed that were identified as being of high restoration potential; three are located in Gale Woods Regional Park.

Macroinvertebrate Community. No macroinvertebrate data are available for the wetlands in this subwatershed. This data is not currently being collected in E-Grade.

Habitat diversity

Connectivity. While there are high quality wetlands within this subwatershed, the elevated Dakota Rail Regional Trail limits connectivity between the major wetlands.

Size. Larger wetlands are more likely to support a notable on-site diversity and/or abundance of wildlife species. There are several large wetland complexes in the subwatershed, including Black Lake, a multi-type wetland with a small area of Type 5 open water, and Saunders Lake, a large Type 5 wetland.

Shoreline Protection. Riparian wetlands can provide significant shoreline protection and support emergent vegetation at the shoreline. The *Functional Assessment of Wetlands* evaluated riparian wetlands for their ability to protect lake or stream shoreline. Approximately 75 percent of the Langdon Lake shoreline is protected by wetlands, especially present in the west and north. About 60 percent of the shoreline around Saunders Lake, especially the southern eastern-most lobe is protected by wetlands, some of which front residential development. Lastly, Black Lake itself is classified as a wetland.

Uplands:

Biodiversity

A portion of the western subwatershed is within Gale Woods Regional Park. The western half of the subwatershed is dominated by a mosaic of forest and woodland, wetland, and open water, with some agriculture in the southwest and some scattered, large-lot residential. Existing data sources do not highlight any other unique or scenic areas in this subwatershed.

The Minnesota Biological Survey (MBS) did not identify any terrestrial or aquatic locations in the watershed with intact native plant communities, or those with biodiversity significance (see Figure 3.67.) However, the largely intact open space surrounding Black Lake and the north and west sides of Saunders Lake are classified as a Regionally Significant Ecological Area.

Habitat diversity

Regionally significant ecological areas are places where larger tracts of minimally disrupted land provide habitat complexity. Nearly the entire western portion of the subwatershed has been identified as important conservation corridors worthy of protection by Hennepin County and the Metropolitan Council. The wide wetland areas along the western and northern areas of Langdon Lake have also been identified. The Dakota Rail Regional Trail may act as a barrier to wildlife migration between the north and south halves of the subwatershed.

Thriving Communities:

Land use:

Table 3.67 shows the land uses within the subwatershed in acres and as a percentage of the total subwatershed. The principal land use in the eastern part of the subwatershed is single family residential, with some vacant or undetermined land that is predominately wetland (Figure 3.68). The western watershed is dominated by Gale Woods Regional Park, Black Lake and Saunders Lake and their associated wetlands, other wetlands, and some remaining agriculture and undeveloped land. The western subwatershed is outside the 2020 Metropolitan Urban Service Areas (MUSA).

Table 3.67. 2010 land use in the Landon Lake subwatershed.

Land Use 2010	Acres	% of Subwatershed
Single - Family Residential	338.0	32.0
Water	234.8	22.2
Vacant or Undetermined	217.6	20.6
Parks and Open Space	196.2	18.5
Agricultural	24.6	2.3
Multi - Family Residential	13.5	1.2
Industrial	12.1	1.1
Institutional	11.3	1.0
Commercial	7.1	0.6

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

The Langdon Lake subwatershed is notable for its ecological resources and large wetlands. The northwestern part of the subwatershed includes several areas of high-value woods, grassland, and wetland, and has been acquired by the Three Rivers Park District and incorporated into Gale Woods Regional Park. The Dakota Rail Regional Trail bisects the subwatershed, offering views of Langdon and Saunders Lakes.

There is no public boat access to Langdon Lake (see Figure 3.69). There is City of Mound-owed open space on the west side of the lake, adjacent to a Metropolitan Council Environmental Services wastewater handling site, but there are no trails or other improvements. There are no public beaches on the lake; however, there is one small park. The City of Minnetrista operates Cusoke Park adjacent to Saunders Lake, a pedestrian trail and boardwalk which cross the “narrows” at the south end of the lake. Activities are limited to hiking/biking and viewing.

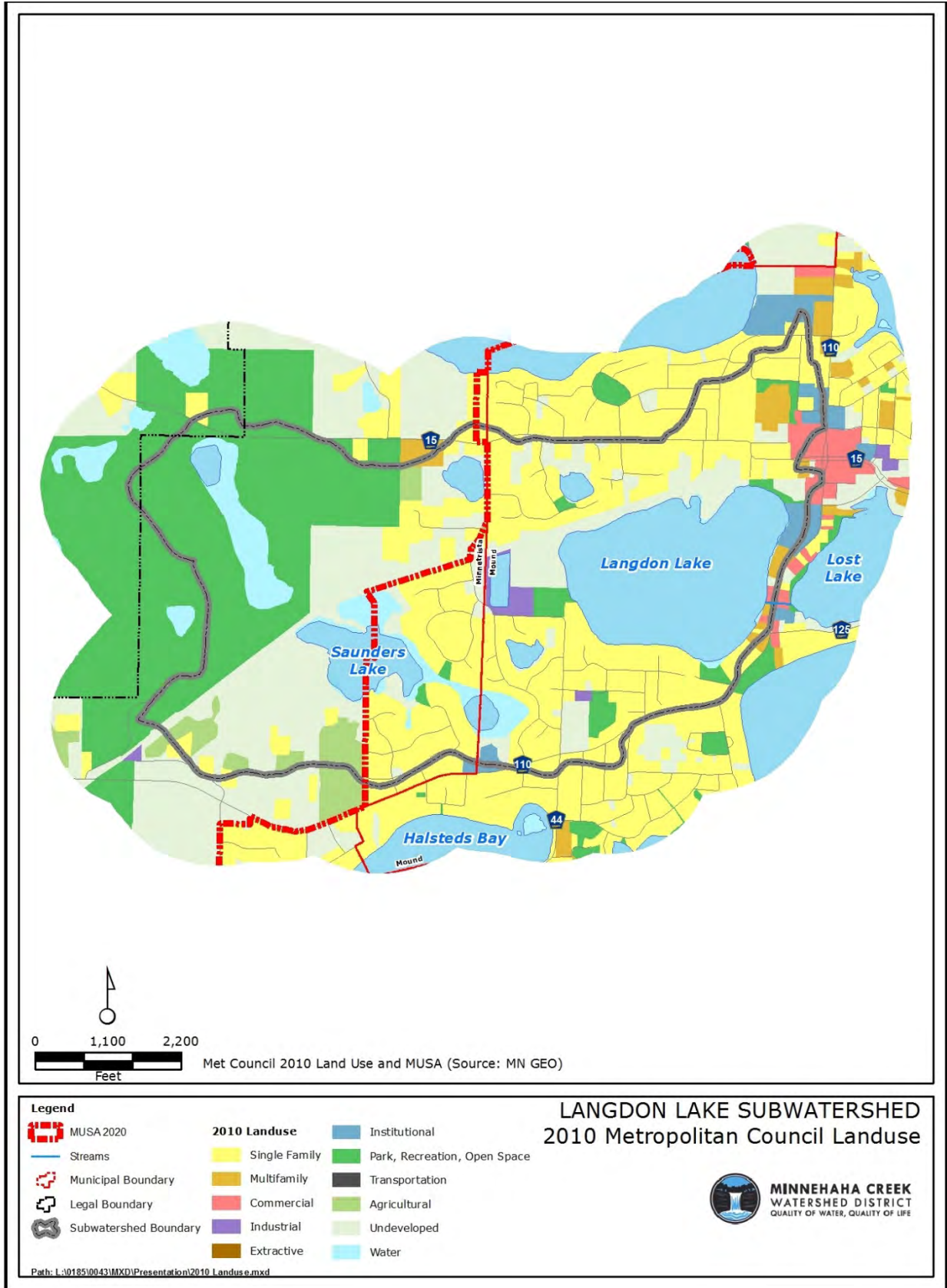


Figure 3.68. Langdon Lake subwatershed 2010 Metropolitan Council land use.

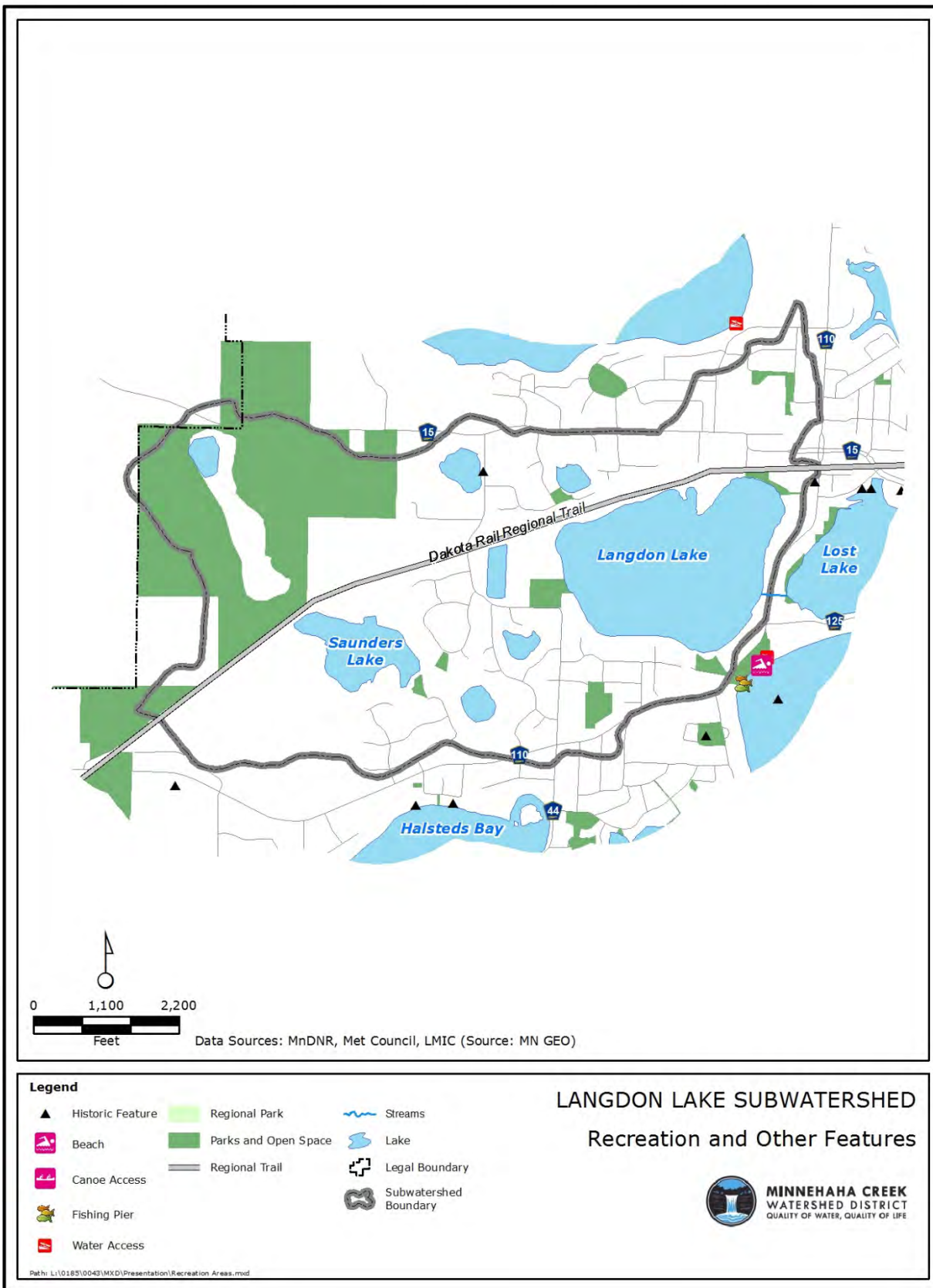


Figure 3.69. Langdon Lake subwatershed recreation and other features.

Studies and Assessments:

- Minnesota Land Cover Classification System (MLCCS)
- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS), EOR 2003
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- Upper Minnehaha Creek Watershed Lakes TDML Project, Wenck 2014
- National Wetland Inventory
- Hennepin County Geologic Atlas
- Functional Assessment of Wetland (FAW), 2003
- Minnesota Biological Survey (MBS)
- 2020 Metropolitan Urban Service Area (MUSA)
- Metropolitan Council from city Comprehensive Plans
- Langdon Lake Infiltration (LL-2) Feasibility Study, 2008
- Langdon Lake Infiltration (LL-3) Feasibility Study, 2010
- Langdon Lake Water Quality Improvement Project Feasibility Study, 2010
- Environmental Testing Report - Lagoon Test, MCES 2008

3.7 LONG LAKE CREEK SUBWATERSHED

The Long Lake Creek Subwatershed has a mix of land use with agricultural and open space and residential/business development in the south. The land cover is a mix of wetlands, forests, woodlands, grasslands and impervious cover. About 1600 acres drain into the primary inlet of Long Lake (CLO05). Long Lake drains south into wetland that discharges into Lake Minnetonka: Tanager Lake (CLO03). The creeks in the Long Lake Subwatershed are intermittent with loading influenced by precipitation and flow. Tanager Lake's inlet is also influenced by the water level of Lake Minnetonka, which produces backflow conditions. Table 3.71 below shows the area of the Long Lake Creek subwatershed in acres by individual city, in total and as a percentage of the total subwatershed (Figure 3.71).

Table 3.71. Cities in the Long Lake Creek subwatershed.

City	Area (Acres)	% of Subwatershed
Long Lake	607.2	7.5%
Medina	3,962.8	48%
Orono	3,218.9	39%
Plymouth	430.3	5.5%
Total	8,218.3	100%

Source: MCWD

Watershed Description and Hydrology:

The eastern half of the subwatershed is gentle rolling hills with an abundance of lakes and ponds, reflected in the area’s many wetlands. The western half is generally comprised of circular, level-topped hills.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (see Figure 3.72). The subwatershed is mostly developed in the south with low to medium density impervious surface typical of residential development. The City of Long Lake is located along the southern shore of its namesake lake. The area north of Long Lake is much less densely developed, punctuated with agriculture – mostly pastures and orchards with some row crops - as well as large open areas of forest and wetlands.

Soils within the watershed are predominantly classified as Natural Resources Conservation Service Hydrologic Soil Group B (loamy soils with moderate infiltration potential) and D (clayey soils with very low infiltration potential). For further information regarding geology and soils in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

Upstream of Long Lake, a series of channels and wetlands drain the western part of the subwatershed from School Lake through Wolsfeld Lake to Long Lake. Similarly, the eastern part of the upper subwatershed drains via a channel from Holy Name Lake through wetlands, where it discharges into the western channel just north of County Road 6. Long Lake Creek flows out of Long Lake south to Tanager Lake, which is connected by a short channel to Lake Minnetonka.

The *2003 MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Long Lake Creek subwatershed into 53 subwatershed units, designated LLC-1 through LLC-53 (see Figure 3.73).

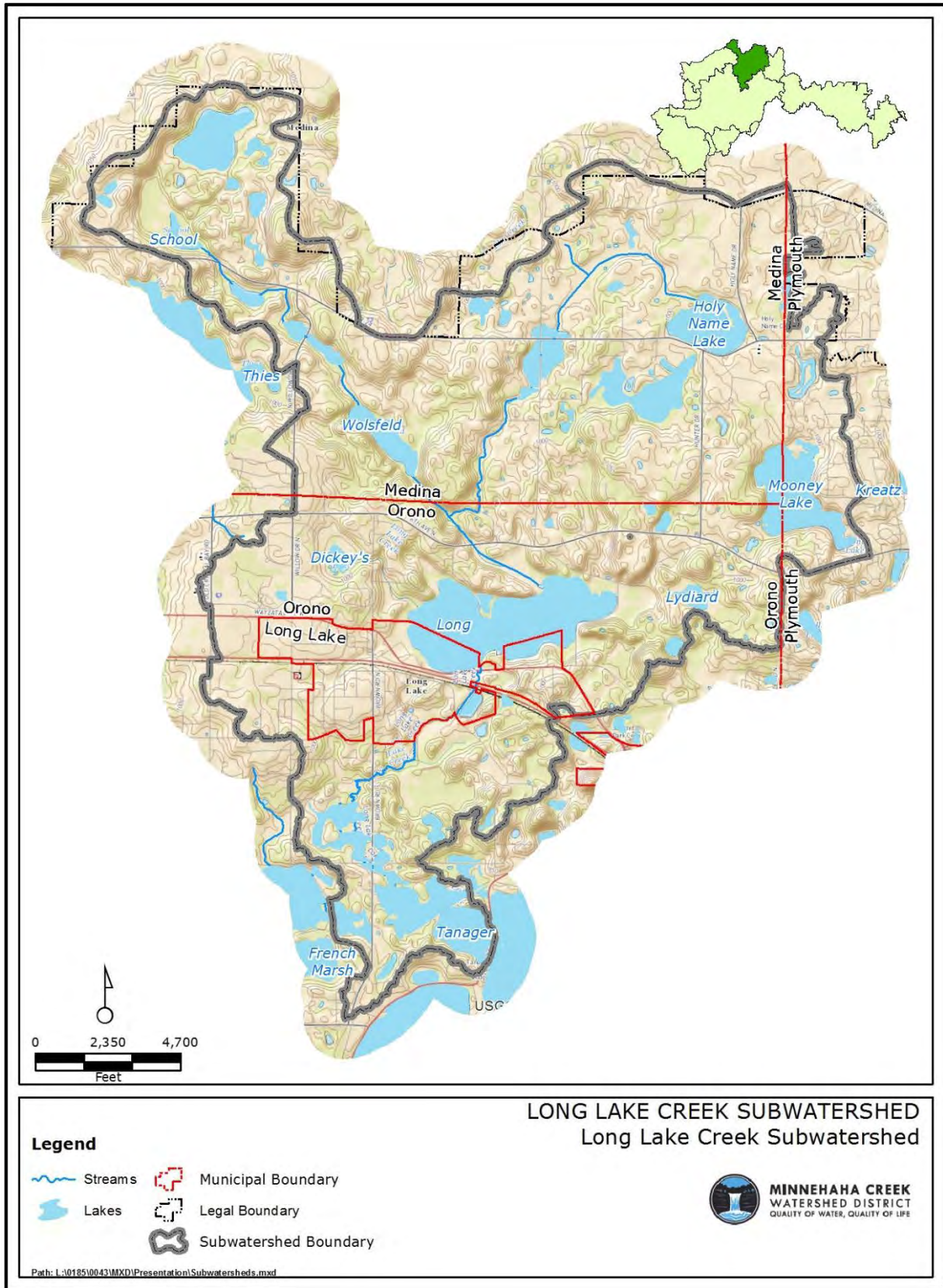


Figure 3.71. The Long Lake Creek subwatershed.

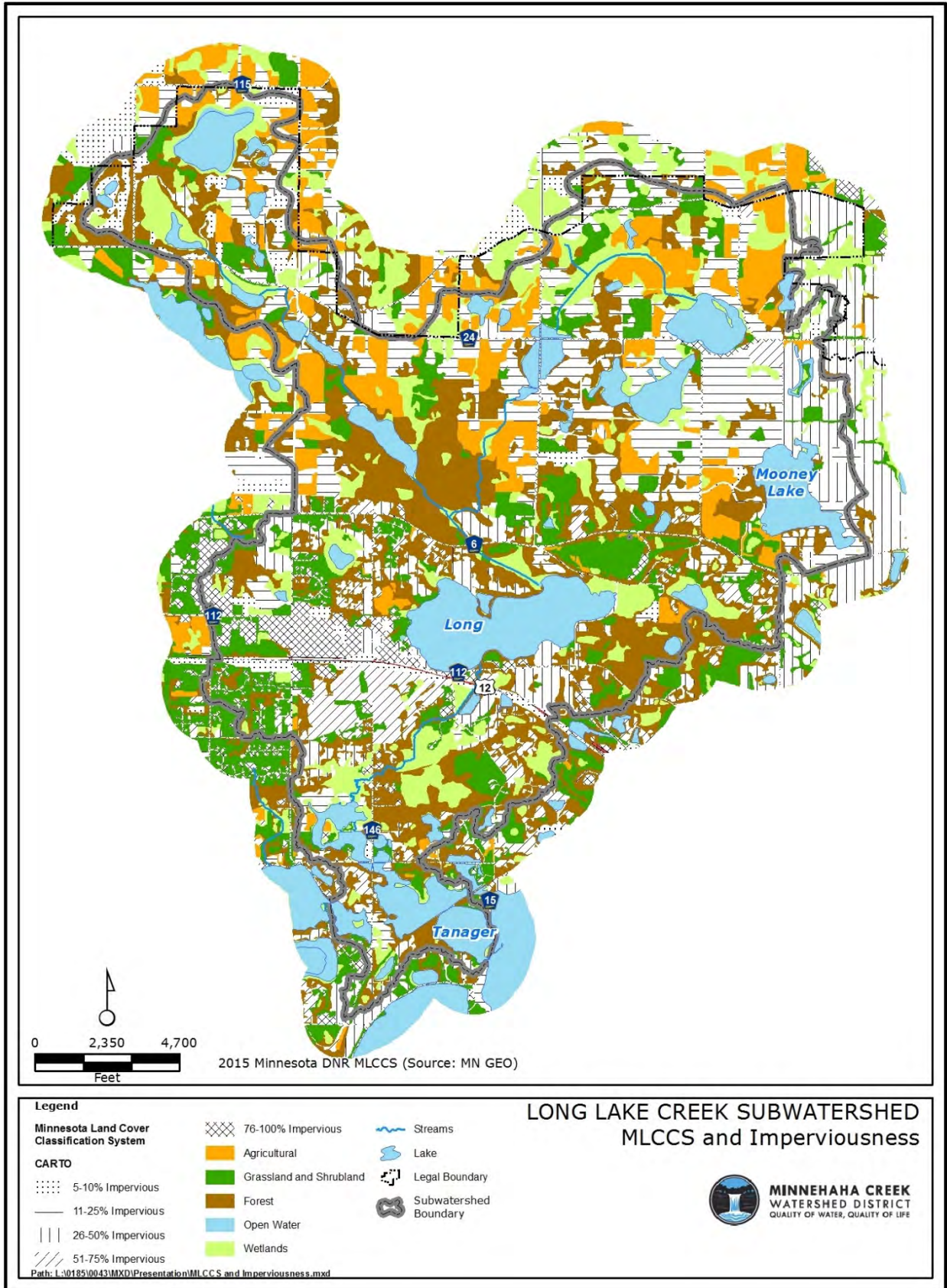


Figure 3.72. Long Lake Creek subwatershed MLCCS and imperviousness.

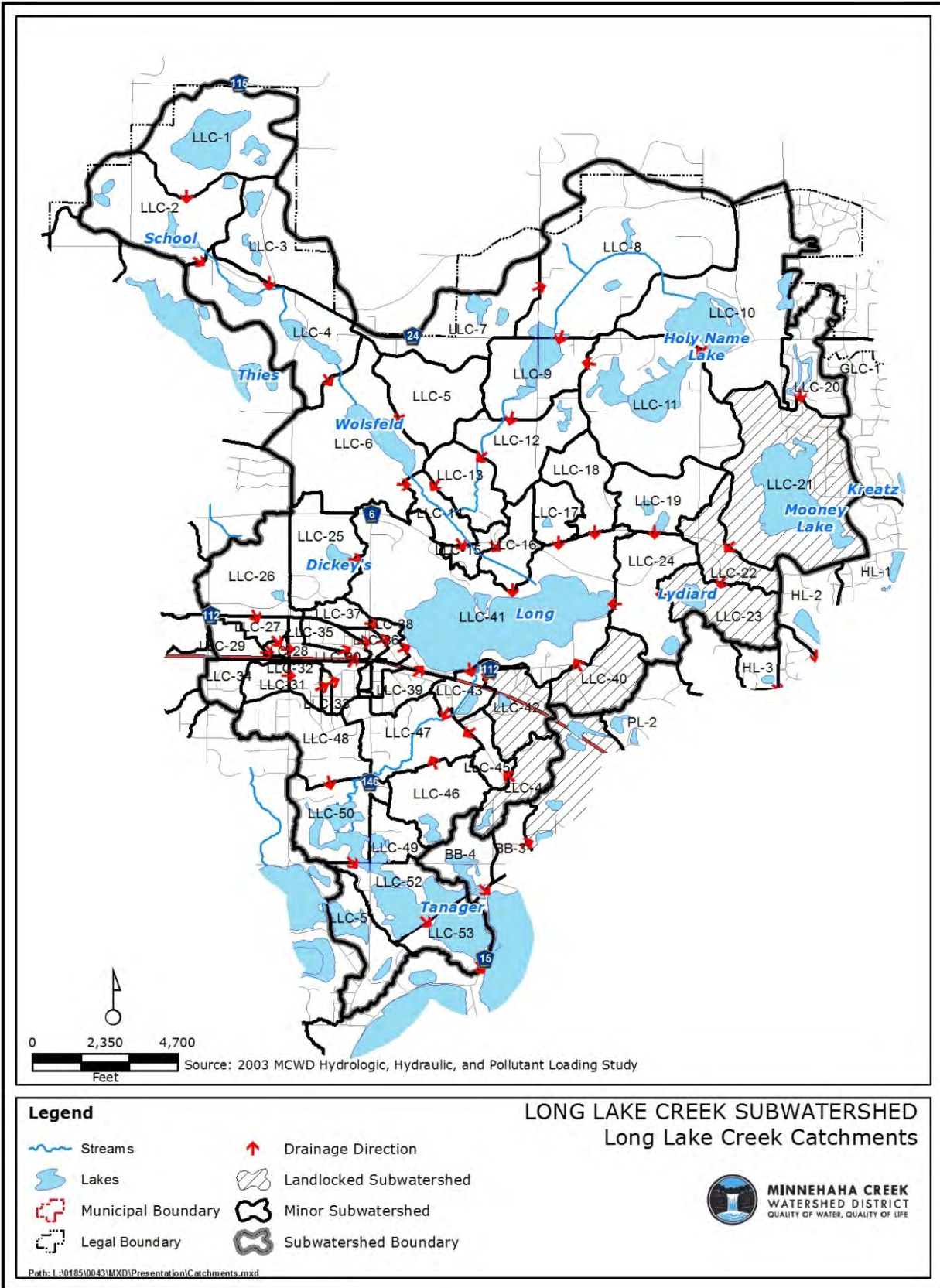


Figure 3.73. Long Lake Creek subwatershed catchments.

Water Quality:

The following are summaries of the characteristics and classifications of lakes and streams within the subwatershed including water quality goals and trends.

Lakes:

Long Lake is the primary receiving water within the subwatershed, and is classified by the DNR for shoreland management purposes as a Recreational Development lake (see Figure 3.74). Six lakes in the subwatershed are listed on the State’s Impaired Waters list: School, Wolsfeld, Holy Name, Long, and Tanager Lakes. Average summer nutrient concentrations are greater than the state standard with excessive nutrients being conveyed to them from the watershed for these six lakes. Tables 3.72 and 3.73 below detail the physical and water quality characteristics of Long Lake and other lakes within the subwatershed. For more information regarding water quality in the subwatershed, please refer to the District’s Water Quality (Hydrodata) Reports and the Upper Minnehaha Creek Watershed Lakes TMDL (Wenck 2014).

Table 3.72. Physical characteristics of lakes in the Long Lake Creek subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Dickey’s	12	26	13:1	Natural Environment
Holy Name	68	7	7:1	Recreational Development
Long	285	33	23:1	Recreational Development
Lydiard	33	52	26:1	Natural Environment
School	11	21	51:1	Natural Environment
Tanager	54	23	151:1	Recreational Development
Wolsfeld	34	26	47:1	Natural Environment

Source: Minnesota DNR, MCWD

Table 3.73. Selected water quality goals and current conditions of lakes in the Long Lake Creek subwatershed.

Lake	State TP Standard (µg/L)	2007 Plan Goal TP (µg/L)	Trend	2001-2015 Summer Average		
				TP (µg/L)	Chl-a (µg/L)	Secchi (m)
Dickey’s ¹	40	n/a	n/a	49	8.8	2.6
Holy Name ²	60	n/a	n/a	94.82	54.2	0.9
Long	40	40-50	No trend	68	42	1.0
Lydiard ¹	40	n/a	n/a	19	4	3.0
School ³	60	n/a	n/a	154	89	0.3
Tanager ⁴	60	70	No trend	97	73	0.9
Wolsfeld ²	40	n/a	n/a	90	59	0.7

TP = total phosphorus, Chl-a =chlorophyll-a, Secchi = water clarity.

¹Data is 2009-2015. ²Data is 2006-2008, 2014-2015 average. ³Data is 2009-2010 average. ⁴Data is 2006-2015. ⁵Data is 2006-2008, 2011-2015.

Source: MCWD, Upper Minnehaha Creek Watershed Lakes TMDL, MPCA.

Streams:

There is one primary stream within the subwatershed: Long Lake Creek, which serves as the outlet of Long Lake and flows to Tanager Lake, when then discharges to Browns Bay of Lake Minnetonka. Part of the creek was channelized as County Ditch #27 in 1915. Flow to the creek is controlled by an outlet weir on Long Lake. Six

storm sewer outfalls discharge into the creek. The creek flows through two large wetlands prior to discharging into Tanager Lake and then into Browns Bay (see Figure 3.74).

Tables 3.74 and 3.75 below detail the physical and water quality characteristics of streams and tributaries within the subwatershed. No streams are listed as Impaired Waters, although Long Lake Creek TP data is high relative to the state river eutrophication standards; however, those standards also look at other indicators such as chlorophyll-a, diel oxygen flux, and biological oxygen demand that haven't been assessed in the Long Lake Creek.

Table 3.75 shows the average concentrations at three sites on Long Lake Creek to be less than 10 mg/L, below the 30 mg/L state standard for this ecoregion. Maintaining sufficient DO is necessary to support aquatic life. The DO state standard requires the stream to never fall below 5 mg/L DO. Monitoring data show that the site above Long Lake and the site above Tanager Lake both fall below this standard at least several times per year.

Table 3.74. Major streams in the Long Lake Creek subwatershed.

Stream	Length (mi)
Holy Name Tributary	2.24
School Lake Tributary	3.55
Long Lake Creek	1.25

Table 3.75. Current conditions of streams in the Long Lake Creek subwatershed.

See Figure 3.74 for monitoring locations.

Stream	Trend	2005-2015 Annual Average			
		TP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)
Long Lake Cr –lake inlet (CLO05)	n/a	183	1.37	8	37
Long Lake Cr – lake outlet (CLO01)	n/a	85	1.40	8	49
Long Lake Cr – Tanager inlet (CLO03)	No trend	124	1.14	9	43

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride.

Source: MCWD.

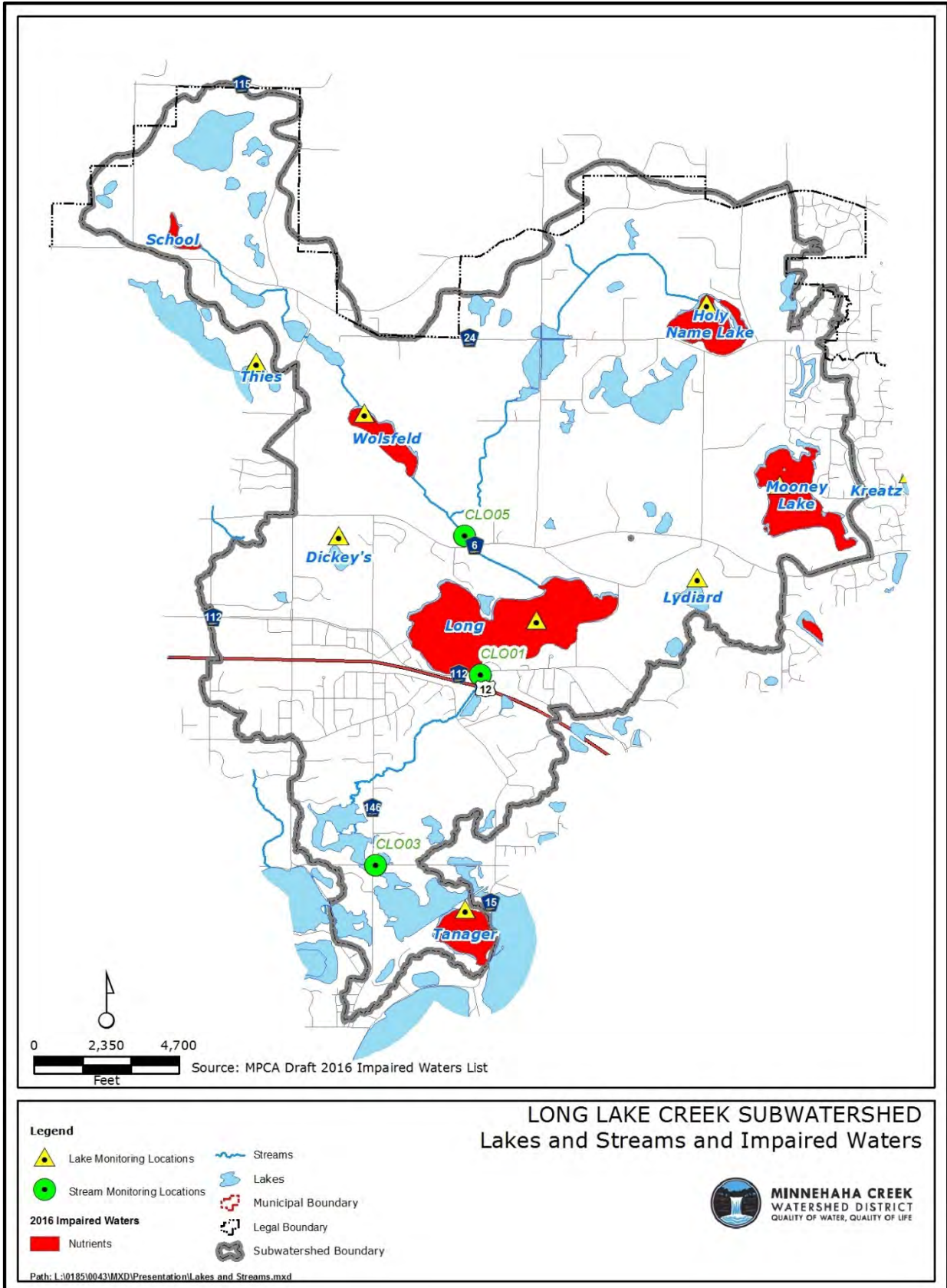


Figure 3.74. Long Lake Creek subwatershed lakes and streams and Impaired Waters.

Wetlands:

According to the updated NWI, wetlands, including lakes, cover over 23 percent of the watershed’s surface (Figure 3.75 and Table 3.76). A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients to and from the subwatershed. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands.

Table 3.76. National Wetland Inventory wetland types in the Long Lake Creek subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	277.6	3.4
2 - Wet Meadow	6.1	0.1
3 - Shallow Marsh	679.9	8.3
4 - Deep Marsh	85.5	1.0
5 - Open Water	750.9	9.1
6 - Scrub Shrub	82.7	1.0
7 - Forested	37.5	0.5
8 - Bog	0.9	<0.1
Riverine	2.6	<0.1
Wetland Total	1,923.7	23.4
Upland	6,294.7	76.6
TOTAL	8,218.3	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream baseflow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

Areas of moderate to high or very high aquifer sensitivity roughly follow the two tributary/wetland corridors in the upper subwatershed and the Long Lake Creek corridor to Browns Bay. Elsewhere the *Hennepin County Geologic Atlas* classifies most of the upland areas as being of low to moderate sensitivity to pollution.

Portions of the Long Lake subwatershed have been designated by the Minnesota Department of Health as a Drinking Water Sensitivity Management Area (DWSMA) and Wellhead Protection Area for City of Plymouth and City of Long Lake public wells. The MDH has designated much of this area to be of low risk and vulnerability to contamination of the drinking water supply, with a small area located in a till deposit being of moderate risk and vulnerability. Figure 3.76 shows areas in the subwatershed with groundwater sensitivity and that are designated Wellhead Protection Areas.

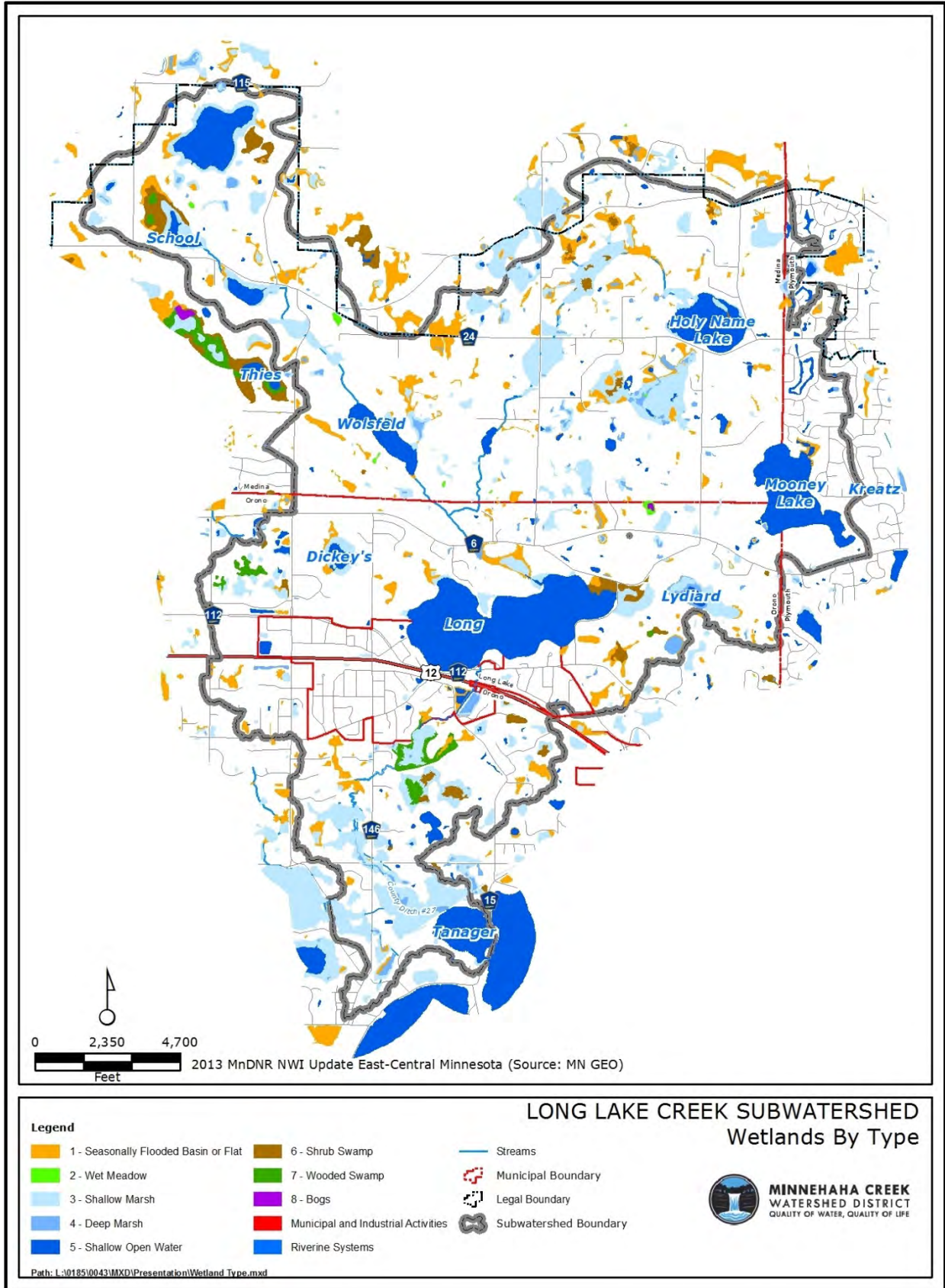


Figure 3.75. Long Lake Creek subwatershed wetlands by type.

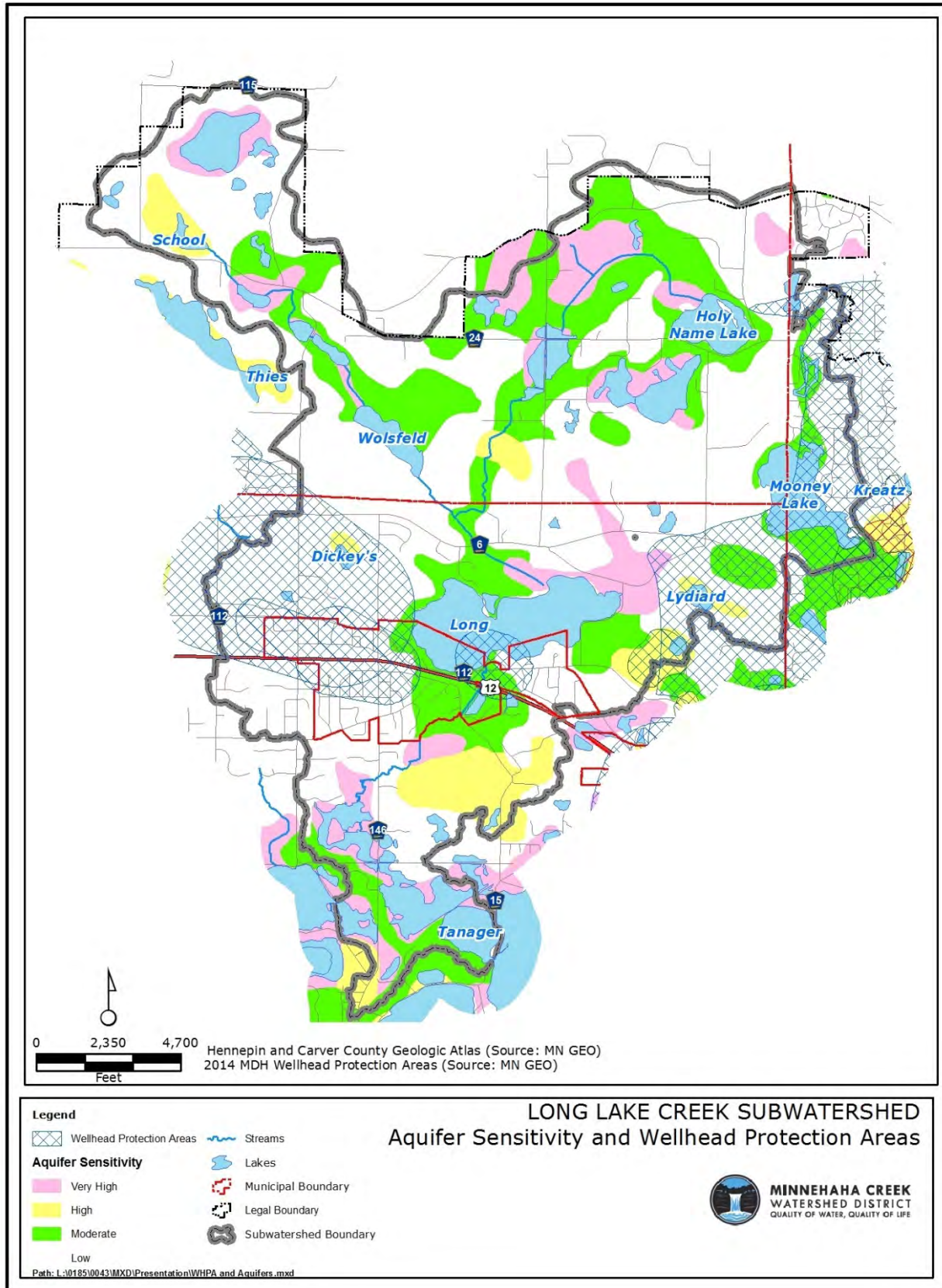


Figure 3.76. Long Lake Creek subwatershed aquifer sensitivity and Wellhead Protection Areas.

Water Quantity:

Two significant areas within the subwatershed are landlocked. The first is units LLC-22, and 23, which include Lydiard Lake, and have no natural outlet. Units LLC-40, 42, and 43 contain wetlands that have no or limited outlet (Figure 3.73).

To assess change in water yield, a Mann-Kendall statistical trend test was performed on annual water yield data for the monitoring station upstream of Long Lake. Water yield for 2006-2015 did not exhibit any statistically significant trend upward or downward.

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity, habitat diversity, and nutrient cycling. Nutrient cycling is described in the Water Quality section. The Long Lake subwatershed has not yet been systematically evaluated by the E-Grade program. This section summarizes ecological integrity using existing data where available (Figure 3.77).

Lakes:

Biodiversity

Fish Community. No fish IBI data are available for the lakes in this subwatershed. Long Lake is stocked and maintained as a walleye fishery and was last surveyed by the DNR in 2013. That survey found that the walleye community was balanced, but the low dissolved oxygen and high summer temperatures were potentially limiting optimal growth and survival. The survey also found an abundant pike and panfish population. Limited fish survey data is available for the other lakes in the subwatershed.

Aquatic Vegetation Community. Biodiversity is determined by the number and variety of species, or richness. A survey was conducted on Long Lake in 2014, with 5 species observed. The Floristic Quality Index (FQI) data from the survey was 8.05 – Degraded indicating very low species diversity with non-native and/or intolerant species. The most disturbed communities present. Surveys have also been conducted on Dickey's, Lydiard and Wolsfeld. Dickey's and Wolsfeld have low biodiversity, less than 4 species observed, and an FQI score of less than 10, E-Grade = Degraded. Lydiard had 11 species observed, and a FQI score of 18.39, E-Grade = Poor, indicating obvious signs of anthropogenic disturbance. Lydiard has low species diversity often comprised of non-native and/or intolerant species.

Aquatic Invasive Species. Common carp are found throughout the subwatershed. Eurasian watermilfoil is present in Long Lake and Tanager Lake, and zebra mussels are found in very low numbers in Tanager Lake.

Habitat diversity

Aquatic Vegetation Community. Habitat diversity is determined by the percent occurrence of species, or the extent to which it may be dominated by a few species. This has not been assessed yet.

Shoreline Health. Shoreline health is assessed looking at shoreline vegetative cover and the relative human disturbance. The MnDNR is using the Score the Shore protocol to relate shoreline conditions to fish community structure using the fish IBI metric. No Score the Shore data is available, however, aerial photos show that many of the lakes in the subwatershed have significant woodland or wetland fringes, which are beneficial for controlling runoff and supporting emergent vegetation at the shoreline.

Streams:

Biodiversity

Fish Community. Limited fish data are available for Long Lake Creek. The DNR conducted a fish survey at one site in 2010. The fish IBI score for that survey was 40, which is on the border of Good and Poor. Fathead minnows were the most prevalent fish, a species that is tolerant of turbid, low oxygen conditions. A few lake species were also present.

Macroinvertebrate Community. Limited macroinvertebrate data are available for Long Lake Creek. The DNR conducted a survey in 2010; the IBI score for that survey was 41, which is just below the impairment threshold. The District conducted a survey at five locations on Long Lake Creek in 2013, and the IBI scores ranged from 9 to 12, well below the impairment threshold. Organisms found at these sites were very pollution-tolerant, and certain functional groups were not represented.

Habitat diversity

Habitat Complexity. No Minnesota Stream Habitat Assessment data is available to assess habitat complexity, but notes taken for the 2003 *Upper Watershed Stream Assessment* were reviewed to better understand conditions in the in-stream zone and riparian zone, and to assess channel morphology. That survey found that the stream in some locations had moderately complex habitat and morphology, but there are reaches that are less complex and more altered.

Connectivity. Connectivity is defined by two metrics: presence or absence of barriers, and access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. There are several barriers on the streams in this subwatershed, most of them culverts at road or trail crossings. There is no stream cross section data available, but notes taken for the 2003 *Upper Watershed Stream Assessment* indicate the stream generally has low banks and ready access to the floodplain.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS concentrations increase turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. A stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, can be stressful to organisms. In addition, streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is available at CLO01 station, and not available at CLO03 station. CLO01 station is the lake outlet, controlled by a weir, is often fast, but not flashy discharge. Instantaneous flow at CLO03 is not flashy and often has backflow, and since 2006, the CLO03 station has an average of discharge of 8.76 cfs. Note: Annual average flow for each year was computed first, and then all the years' averages were averaged together.

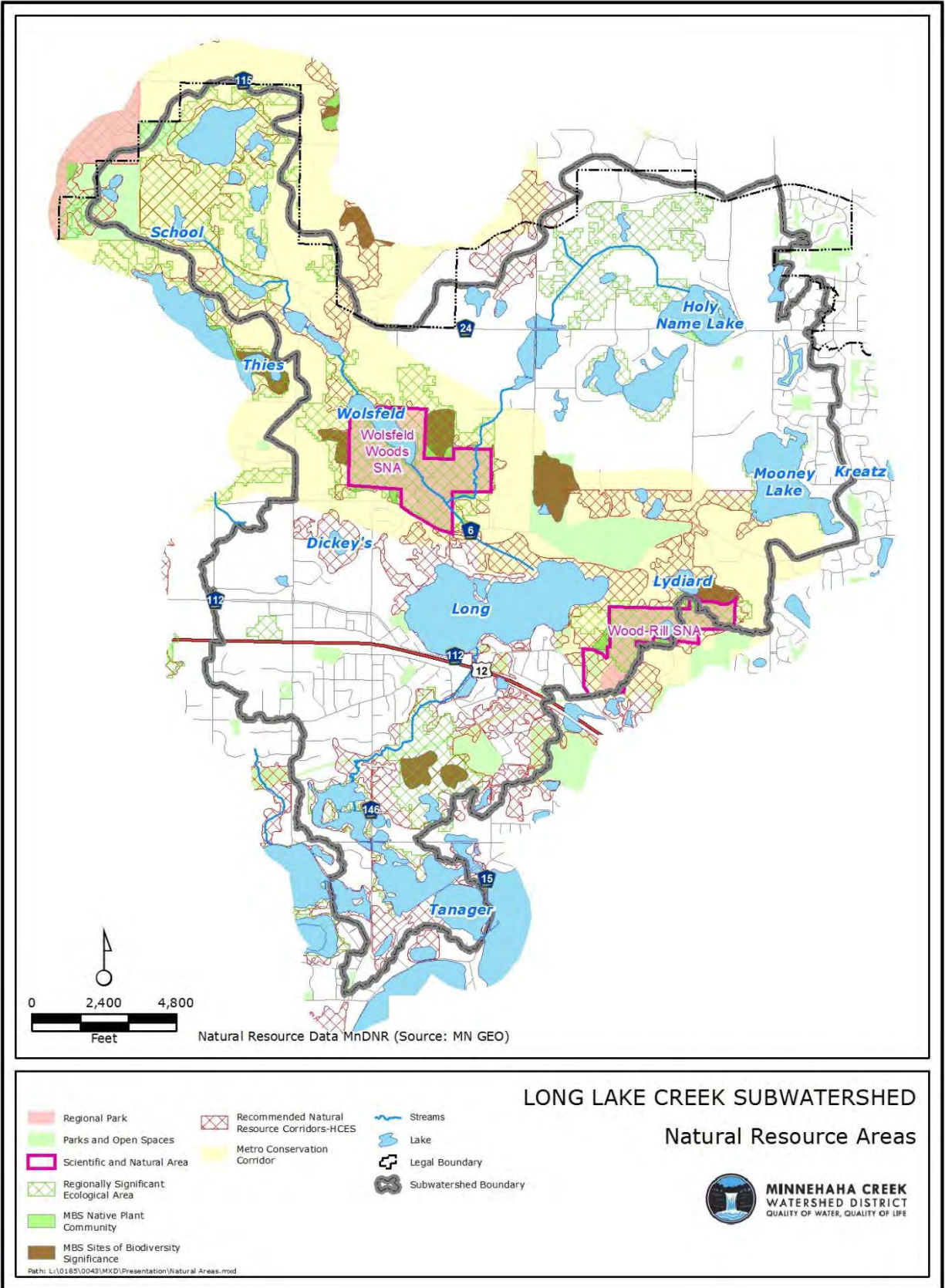


Figure 3.77. Long Lake Creek subwatershed natural resource areas.

Wetlands:

Biodiversity

Vegetation Community. No Rapid Floristic Quality Assessment (RFQA) data are available for the wetlands in this subwatershed. However the *Functional Assessment of Wetlands* classified several large wetlands in the subwatershed as having exceptional vegetative diversity, including School Lake, wooded swamps in Wolsfeld Woods Scientific and Natural Area, and scrub shrub and wooded swamp wetlands in the Wood-Rill Scientific and Natural Area.

Macroinvertebrate Community. No macroinvertebrate data are available for the wetlands in this subwatershed. This data is not currently being collected in E-Grade.

Habitat diversity

Connectivity. There are several interconnected wetland corridors providing exceptional connectivity between wetlands of different type.

Size. Larger wetlands are more likely to support a notable on-site diversity and/or abundance of wildlife species. There are numerous large wetland complexes in the subwatershed, including wetlands along the two tributary corridors in the upper subwatershed and along Long Lake Creek.

Shoreline Protection. Riparian wetlands can provide significant shoreline protection and support emergent vegetation at the shoreline. The *Functional Assessment of Wetlands* evaluated riparian wetlands for their ability to protect lake or stream shoreline. About 22 percent of the Long Lake shoreline is protected by wetlands. About half the shoreline of Holy Name Lake and a third of Wolsfeld Lake is protected moderately well by fringing wetlands. School, Dickey's and Lydiard Lakes are ringed completely with wetlands and emergent vegetation.

Uplands:

Biodiversity

Two DNR Scientific and Natural Areas are present in the subwatershed: Wolsfeld Woods and Wood-Rill. Wolsfeld Woods is an example of the original "Big Woods" forest that once covered the south central part of the state. The large, mature stand of hardwoods covers gently rolling hills with a wide variety of tree species, including red oak, ironwood, butternut, maple, elm and basswood. Wolsfeld Lake is within this Scientific and Natural Area. Wood-Rill also preserves a remnant of the Big Woods, with land cover including maple-basswood forest, wetlands, ponds, and wet meadows. A moist lowland forest of red maple, black ash, hackberry, basswood, and green ash, grades into a small tamarack swamp at one end.

The Minnesota Biological Survey (MBS) has identified both terrestrial and aquatic locations in the watershed with intact native plant communities, and those with biodiversity significance (see Figure 2.43.) Native plant communities are a group of native plants that interact with each other and the surrounding environment in ways not greatly altered by humans or by introduced plant or animal species.

Habitat diversity

Regionally significant ecological areas are places where larger tracts of minimally disrupted land provide habitat complexity. These sites are numerous enough in the Long Lake Creek subwatershed that Hennepin County and the Metropolitan Council have identified several corridors within the subwatershed as important conservation corridors.

Thriving Communities:

Land use:

Table 3.77 shows the land uses within the area of the Long Lake Creek subwatershed in acres and as a percentage of the total subwatershed. The predominant land use in the subwatershed is vacant or undetermined use, mainly large wetland or woodland tracts (see Figure 3.78). Single family residential dominates the central and eastern subwatershed. There is a commercial and industrial corridor along US Highway 12, in the City of Long Lake. Some large agricultural parcels remain in the upper subwatershed, mainly row crops and hobby farms.

Table 3.77. 2010 land use in the Long Lake Creek subwatershed.

Land Use 2010	Acres	% of Subwatershed
Vacant or Undetermined	3,062.1	37.2
Single - Family Residential	2,385.0	29.0
Water	786.4	9.5
Agricultural	768.8	9.3
Parks and Open Space	768.6	9.3
Institutional	139.2	1.6
Industrial	99.2	1.2
Roads and Highways	84.1	1.0
Commercial	80.2	0.9
Multi - Family Residential	44.2	0.5

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

The Luce Line Regional Trail passes through this subwatershed, as will the proposed Southwest Hennepin Regional Trail. The Minnesota Historic features database notes 22 historic features in this subwatershed, most are residences or farmhouses or agricultural buildings (see Figure 3.79). The listing includes a school and a cemetery as well as three bridges, including a Luce Line bridge.

There is one public boat access, fishing pier and two public beaches on Long Lake. There is public boat (i.e., canoe) access to Holy Name Lake at Holy Name Park in Medina.

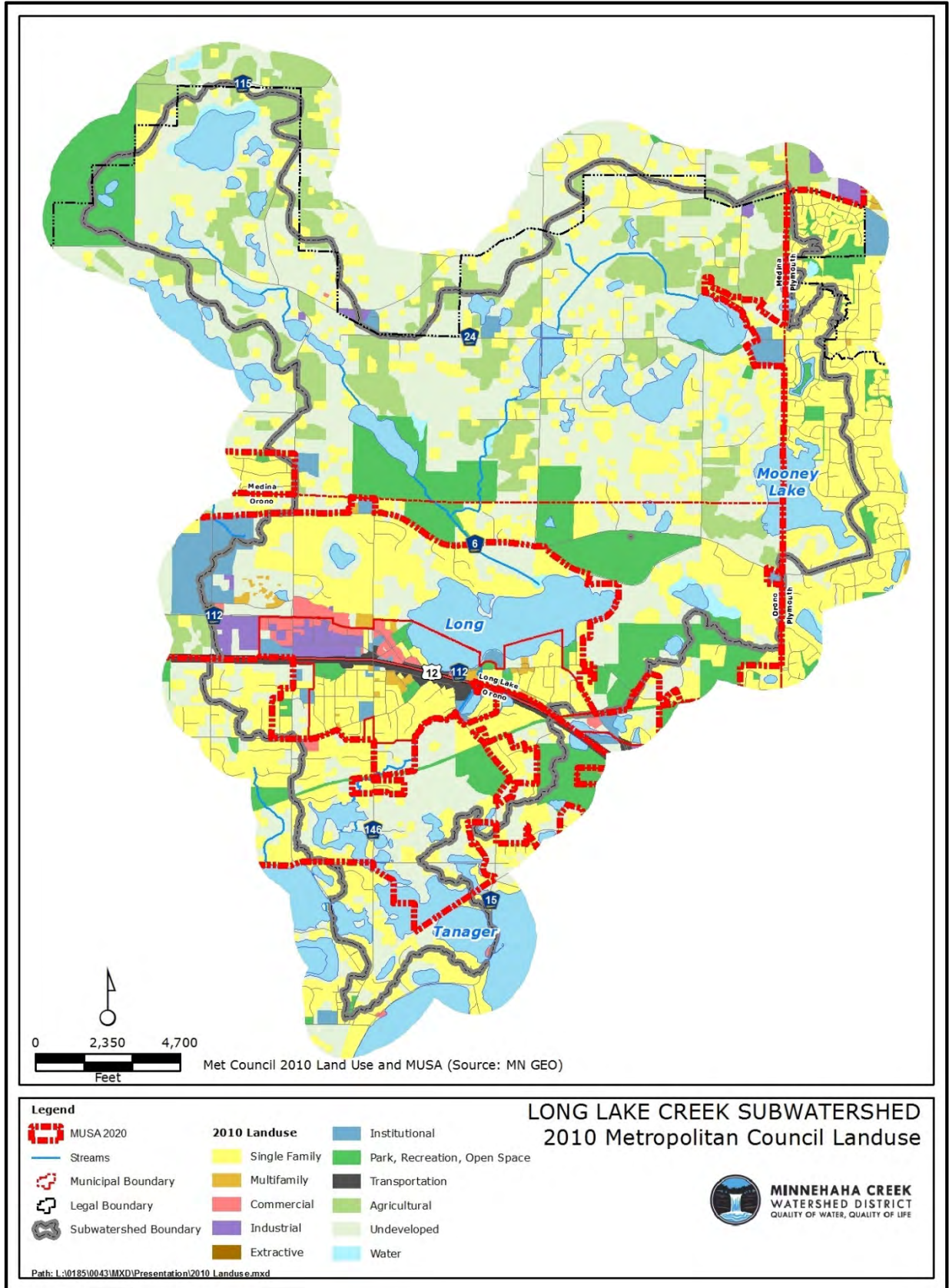


Figure 3.78. Long Lake Creek subwatershed 2010 Metropolitan Council land use.

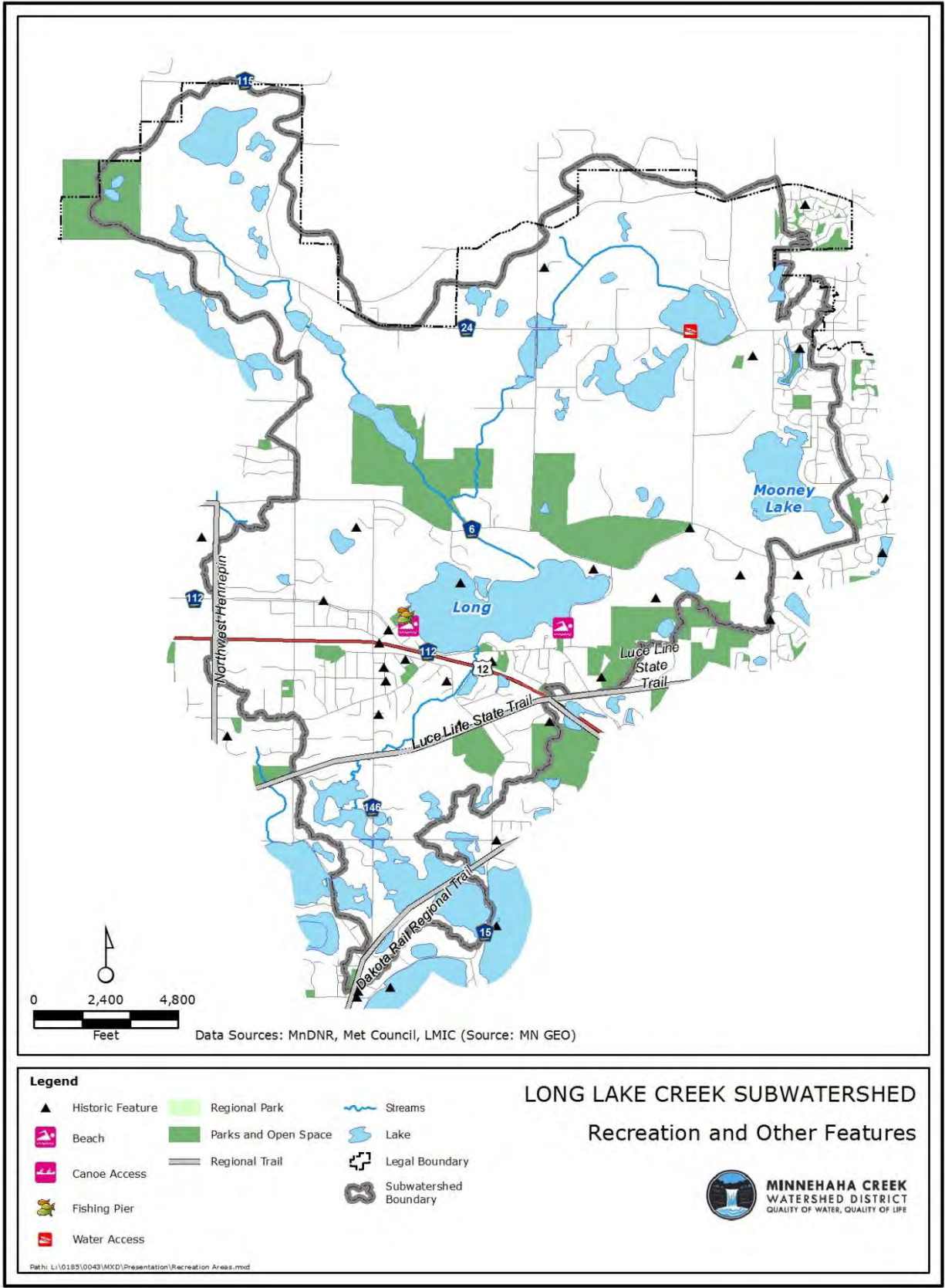


Figure 3.79. Long Lake Creek subwatershed recreation and other features.

Studies and Assessments:

- Minnesota Land Cover Classification System (MLCCS)
- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS), EOR 2003
- National Wetland Inventory
- Hennepin County Geologic Atlas
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- 2013 Macroinvertebrate Assessment, RMB 2014
- MCWD Stream Assessment, Wenck 2004
- Functional Assessment of Wetlands, 2003
- Minnesota Biological Survey (MBS)
- Minnesota Historic Features database
- Long Lake Water Quality Improvement Project: Conceptual Downtown Redevelopment Stormwater Design, HR Green 2006
- Long Lake Creek Channel Restoration and Reconstruction Feasibility Study, EOR 2011
- Long Lake Wetland Restoration Project#2, BARR 2009
- Long Lake Regional Infiltration: LLC-8 Feasibility Study, HR Green 2012
- Long Lake Improvement Projects: Deer Hill Road Pond and CR 6 Pond 1998 Performance Monitoring Report, Wenck 1999
- Long Lake Improvement Projects: Deer Hill Road Pond 1997 Monitoring Report, Wenck 1998
- Operations and Maintenance Plan for Long Lake Improvement Project, Wenck 1997
- Technical Memo: Effectiveness of Alum on Long Lake Water Quality, Wenck 2004

3.8 MINNEHAHA CREEK SUBWATERSHED

Minnehaha Creek Subwatershed is the only subwatershed east of the Lake Minnetonka. The land use is dominated by residential, business and industrial developments. The impervious cover on the land is higher in this subwatershed compared to the other ten subwatersheds. Land designated for parks and recreational areas are scattered throughout the subwatershed; many are adjacent to the lakes and the creek, as are the majority of the remaining wetlands and woodlands. Table 3.81 below shows the area of the Minnehaha Creek subwatershed in acres by individual city, in total and as a percentage of the total subwatershed. An additional 437.8 acres is included from Fort Snelling (Figure 3.81).

Table 3.81. Cities in the Minnehaha Creek subwatershed.

City	Area (Acres)	% of Subwatershed
Edina	2,634.3	8.7%
Fort Snelling	437.8	1.4%
Golden Valley	79.4	0.2%
Hopkins	1,193.7	3.9%
Minneapolis	11,096.3	36.6%
Minnetonka	7,068.0	23.3%
Plymouth	207.5	0.6%
Richfield	1321.1	4.3%
St. Louis Park	6,143.3	20.2%
Wayzata	119.3	0.3%
Total	30,301.1	

Source: MCWD.

Watershed Description and Hydrology:

The lower portion of this subwatershed generally east of the city of Hopkins is typified by gently rolling terraces and bottom lands punctuated by small lakes formed from melted blocks of glacial ice. The upper portion of this subwatershed is characterized by gently rolling to steep hilly landscapes with numerous lakes formed in deep irregular depressions called kettles. Soils within the watershed are predominantly urban disturbed soils that have not been classified. Where the soils have been classified, they are mainly Group B (loamy soils with moderate infiltration potential) and D (clayey soils with very low infiltration potential). For more information regarding geology and soils in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (Figure 3.82). Urban areas with moderate to high densities of impervious surface characterize the subwatershed which is entirely developed. There are some sizable areas of wetland and forest/woodland in the City of Minnetonka and in some locations along the creek corridor. An extensive, but narrow park system surrounds the Minneapolis lakes and Minnehaha Creek and along the Mississippi River.

The *2003 MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Minnehaha Creek subwatershed into 184 subwatershed units, designated MC-1 through MC-184 (Figure 3.83). Minnehaha Creek is formed at the outlet of Grays Bay and flows 22 miles to the Mississippi River. A significant area of the central portion of the subwatershed drains to the Chain of Lakes (Brownie, Cedar, Isles, Calhoun, and Harriet) in the City of Minneapolis, which outlets by a channel to Minnehaha Creek. Lake Nokomis is separated from Minnehaha Creek by a weir to reduce the influence of the creek on the lake's water quality. Lake Hiawatha, however, is located in-line to Minnehaha Creek and is heavily influenced by it.

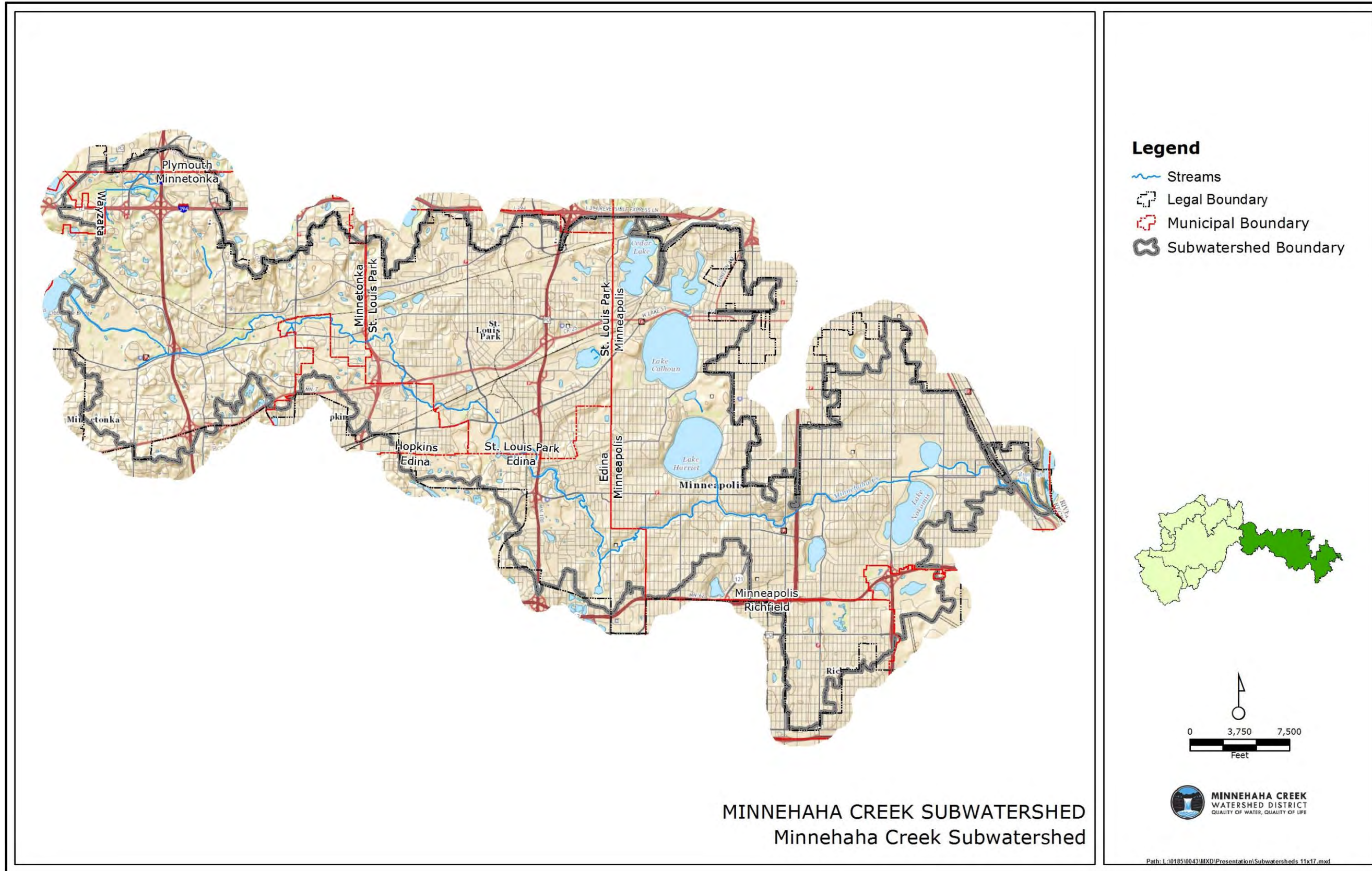


Figure 3.81. The Minnehaha Creek subwatershed.

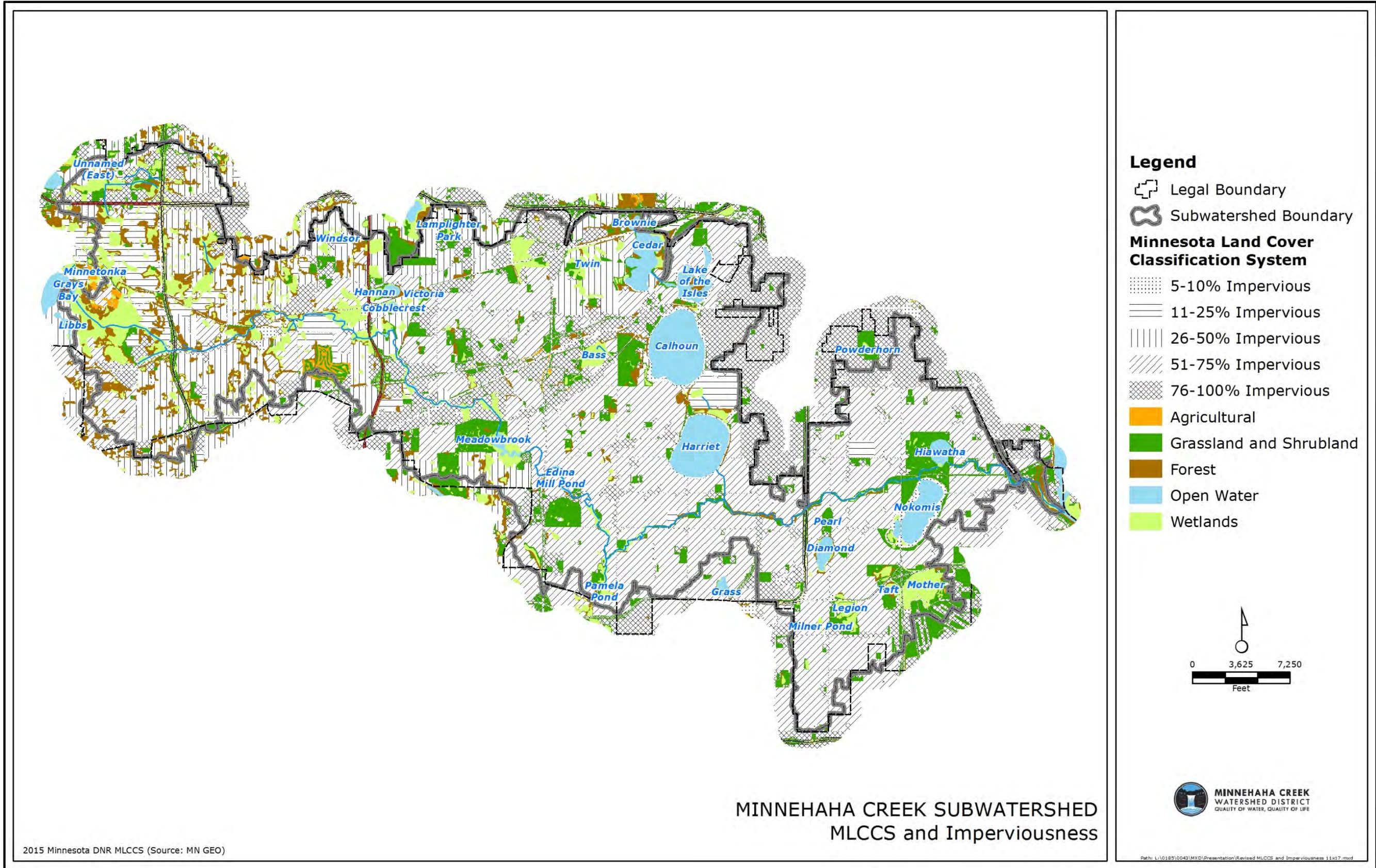


Figure 3.82. Minnehaha Creek subwatershed MLCCS and imperviousness.

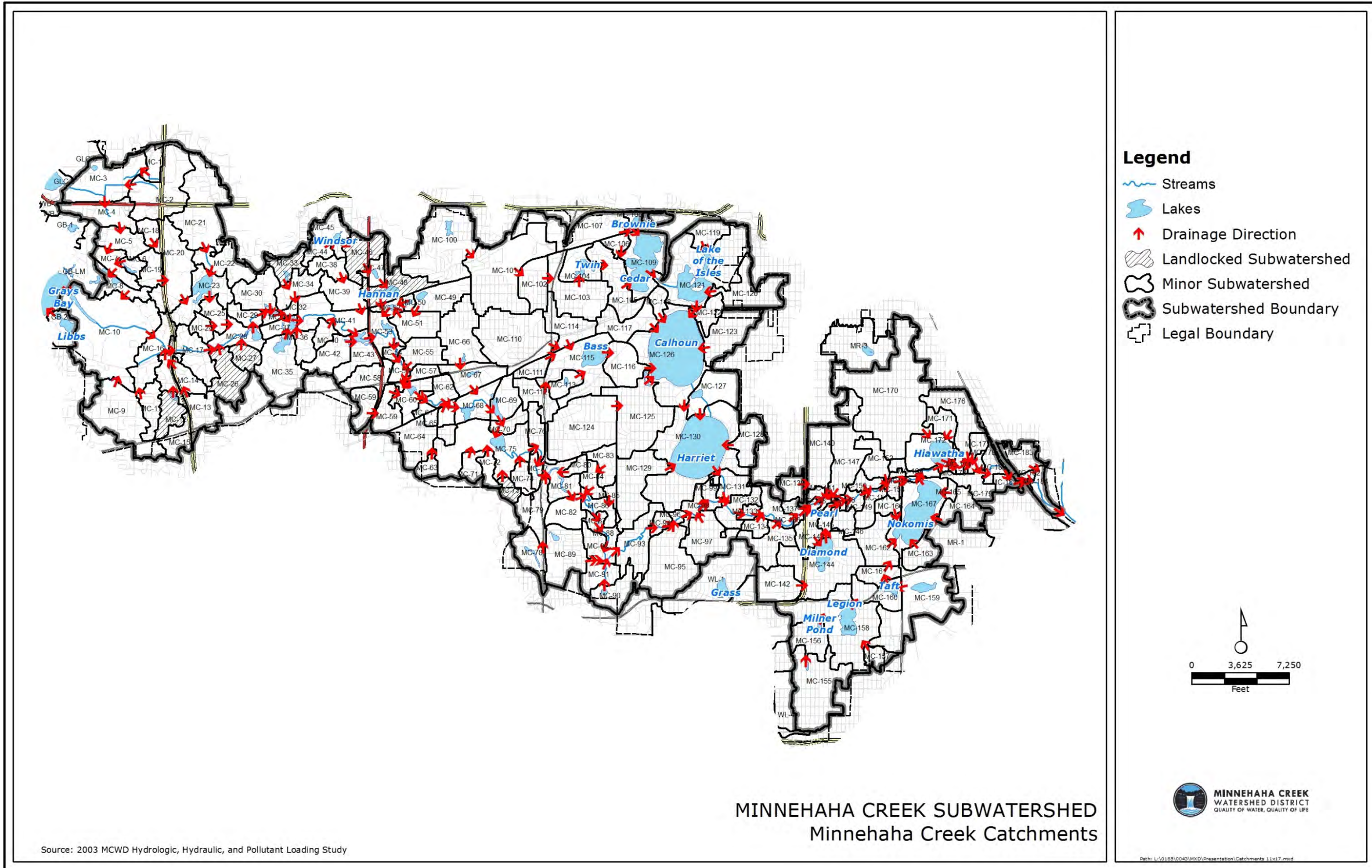


Figure 3.83. Minnehaha Creek subwatershed catchments.

Water Quality:

The following are summaries of the characteristics and classifications of lakes and streams within the subwatershed including water quality goals and trends.

Lakes:

The Minnehaha Creek subwatershed includes the Chain of Lakes in Minneapolis and several other smaller lakes (Figure 3.84). Powderhorn Lake in Minneapolis does not drain to the creek, but rather is pumped to the Mississippi River. Tables 3.82 and 3.83 below detail the physical and water quality characteristics of the major lakes within the subwatershed and Table 3.82 includes the DNR shoreland management classification.

The District, the Minneapolis Park and Recreation Board (MPRB), and trained volunteers monitor many of the lakes in the subwatershed. Five lakes in the subwatershed are listed on the State’s Impaired Waters list for exceeding the state standard for total phosphorus, with excessive nutrients being conveyed to them from the watershed. TMDLs have been completed for two of those lakes: Hiawatha and Nokomis. Powderhorn and Brownie had been listed previously, but meet standards and were delisted in 2012 and 2010, respectively. However, the water quality in Powderhorn Lake, from 2011-2016, is indicating that lake could once again be evaluated for re-listing (District’s Water Quality (Hydrodata) reports).

Several lakes are also impaired for excess mercury and PFOS or PCBs in fish tissue (*Statewide Mercury TDML*). Two lakes – Powderhorn and Brownie - are impaired by excess chloride, likely from road salt. Diamond Lake is classified as a wetland, but is listed as impaired for chloride in the TCMA Chloride TMDL (MPCA 2016). For more information regarding water quality in the subwatershed, please refer to the District’s Water Quality (Hydrodata) Reports.

Table 3.82. Physical characteristics of lakes in the Minnehaha Creek subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Brownie	10	50	22:1	Natural Environment
Calhoun	419	82	13:1	Recreational Development
Cedar	164	51	16:1	Recreational Development
Diamond	52	6	15:1	General Development
Harriet	341	87	26:1	Recreational Development
Hiawatha	53	33	546:1	Natural Environment
Isles	112	31	32:1	Recreational Development
Nokomis	201	33	12:1	Natural Environment
Powderhorn	11	24	28:1	Natural Environment

Source: Minnesota DNR.

Table 3.83. Selected water quality goals and current conditions of lakes in the Minnehaha Creek subwatershed.

Lake	State TP Standard (µg/L)	2007 Plan Goal TP (µg/L)	Trend	2001-2015 Summer Averages		
				TP (µg/L)	Chl- <i>a</i> (µg/L)	Secchi (m)
Brownie	60	35	n/a	44	12	1.3
Calhoun	40	25	No trend	17	4	3.7
Cedar	40	25	Deg SD	25	9	2.0
Diamond	60	90	n/a	149	46	0.5
Harriet	40	20	Deg TP	21	5	3.0
Hiawatha	50*	50	No trend	70	18	1.4
Isles	40	40	No trend	44	28	1.3
Nokomis	50*	50	Imp TP, Chl- <i>a</i>	52	22	1.2
Powderhorn	60	90	No trend	114	28	1.0

TP = Total phosphorus concentration, chl-*a*= chlorophyll-*a*, SD= Secchi depth, Imp = improving, Deg = degrading.

*Both Nokomis and Hiawatha were granted a site-specific standard by the MPCA due to unique conditions.

Source: MCWD, MPCA.

Streams:

Minnehaha Creek is the primary stream within the subwatershed. It is formed at the outlet of Grays Bay in Lake Minnetonka and flows 22 miles to the Mississippi River. Lake Hiawatha is in-line to the creek and heavily influenced by it. As an outlet for Lake Minnetonka and the upper watershed, Minnehaha Creek must discharge large volumes of water during spring snowmelt runoff, summer and fall. During a typical year, 4-6 inches of runoff from the 122 square mile upper watershed are discharged to Minnehaha Creek. The typical average flow in the creek due to this runoff is 60 to 90 cfs.

An operating plan was established for Grays Bay dam headwaters control structure when it was put into service in 1980. The plan was intended to emulate the historical discharge hydrograph produced by previous controls and the natural outlet of Lake Minnetonka. In drier periods, Lake Minnetonka typically does not discharge water, and portions of the Creek may experience low or even no flow.

Total phosphorus concentrations on Minnehaha Creek are less than the state river eutrophication standards. The state river eutrophication standards also look at other indicators such as chlorophyll-*a*, diel oxygen flux, and biological oxygen demand, which have not been assessed on the Creek. The primary nutrient cycling concern for Minnehaha Creek is that it conveys phosphorus load to Lake Hiawatha.

Minnehaha Creek, however, is included in the State’s Impaired Waters List due to excess chloride, fecal coliform concentrations and low dissolved oxygen as well as impaired fish and macroinvertebrate communities. Table 3.84 shows the average concentrations in Minnehaha Creek to be well below the 30 mg/L state standard for this ecoregion. Maintaining sufficient DO is necessary to support aquatic life. The DO state standard requires the stream to never fall below 5 mg/L DO. Monitoring data show that Minnehaha Creek upstream of the Browndale Dam can fall below this standard in summer, but the reaches below the dam have not been observed to do so. The upstream reaches are influenced by through-flow and riparian wetlands, which may increase sediment oxygen demand.

Minnehaha Creek was studied in-depth in 2003 and 2012 as part of the District’s *Minnehaha Creek Stream Assessment*, which included a physical inventory, erosion survey, and a fluvial geomorphic assessment to determine channel stability. For more information regarding these parameters, please refer to the *Minnehaha Creek Stream Assessments*. For more information regarding water quality in the subwatershed, please refer to the District’s Water Quality (Hydrodata) Reports.

A small, unnamed channel (CGL04) that outlets the wetland on the southeast corner of Gleason Lake is also listed as impaired for chloride (Table 3.84).

Table 3.84. Current conditions of streams in the Minnehaha Creek subwatershed.

See Figure 3.84 for monitoring locations.

Stream	Trend	2005-2015 Annual Average			
		TP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)
Unnamed Gleason Channel (CGL04)	n/a	156	0.97	6	312
Gray's Bay Dam (CMH07)	n/a	21	0.76	2	45
I-494 (CMH01)*	Imp TSS	43	0.76	4	61
W. 34 th Street (CMH02)	Imp TSS	52	0.82	6	69
Excelsior Blvd (CMS11)	Imp TSS	70	0.86	11	73
Browndale Dam (CMH03)	Imp TP, TSS	62	0.87	5	80
W. 56 th Street (CMH04)	n/a	61	0.78	8	78
Xerxes Avenue (CMH15)	Imp TP, TSS	68	0.80	9	85
21 st Avenue (CMH24)	n/a	74	0.85	17	83
28 th Avenue (CMH18)	n/a	71	0.93	6	90
Hiawatha Avenue (CMH06)	Imp TSS	75	0.97	8	86

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride, Imp = Improving

*Station used to be named CMH19, but due to historic data findings, the station was renamed CMH01.

Source: MCWD.

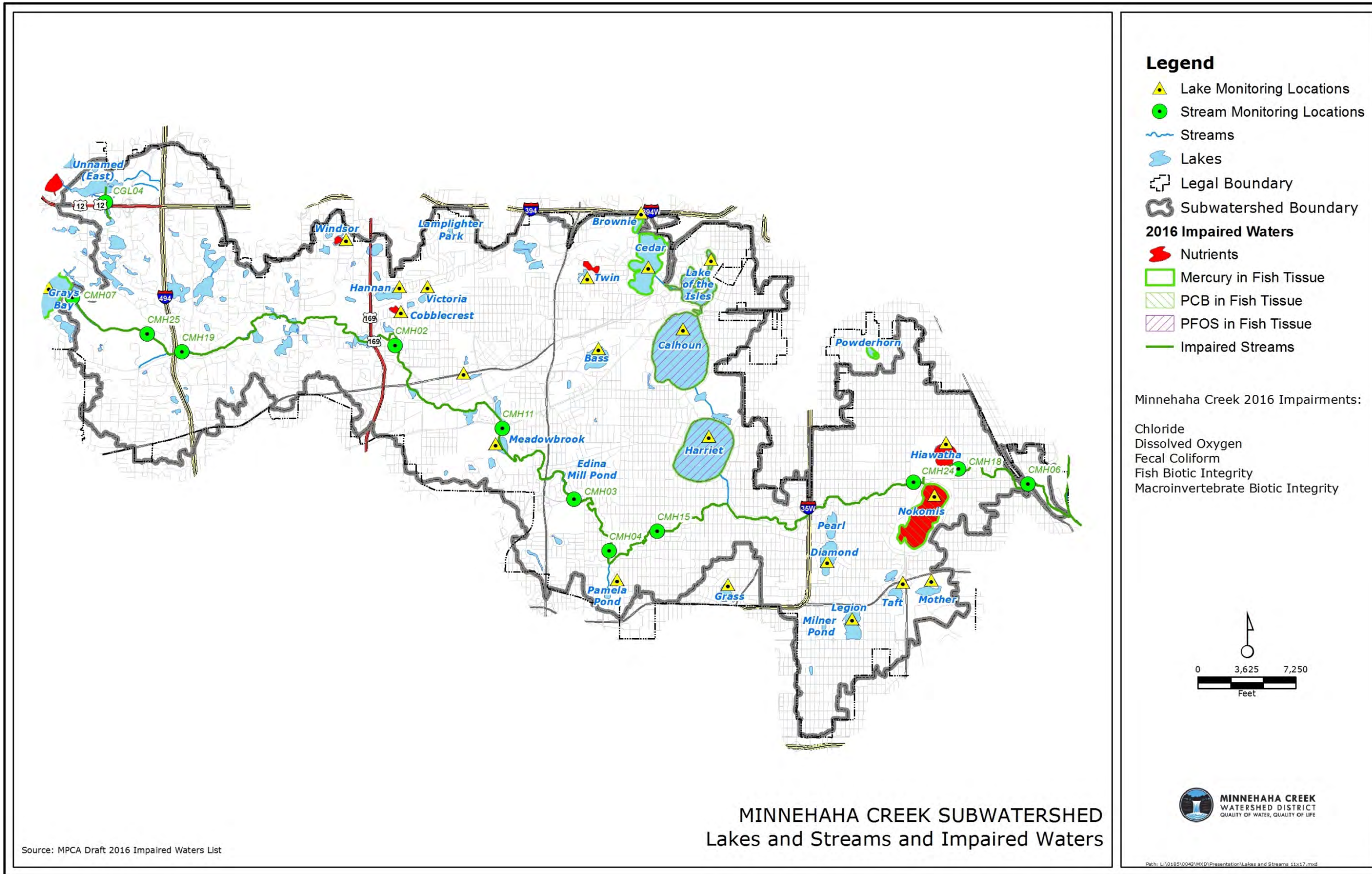


Figure 3.84. Minnehaha Creek subwatershed lakes and streams and Impaired Waters. *Note: CMH19 has been renamed as CMH01.

Wetlands:

According to the updated NWI, wetlands, including lakes, cover just over 12 percent of the subwatershed’s surface (Figure 3.85 and Table 3.85). A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients to and from the subwatershed. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands.

Table 3.85. National Wetland Inventory wetland types in the Minnehaha Creek subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	630.2	17.0
2 - Wet Meadow	2.1	0.1
3 - Shallow Marsh	1,084.0	29.2
4 - Deep Marsh	96.6	2.6
5 - Open Water	1,683.1	45.3
6 - Scrub Shrub	68.1	1.8
7 - Forested	5.1	0.1
8 - Bog	0.0	0.0
Riverine	146.8	4.0
Wetland Total	3,716.0	12.3
Upland	26,585.1	87.7
TOTAL	30,301.1	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

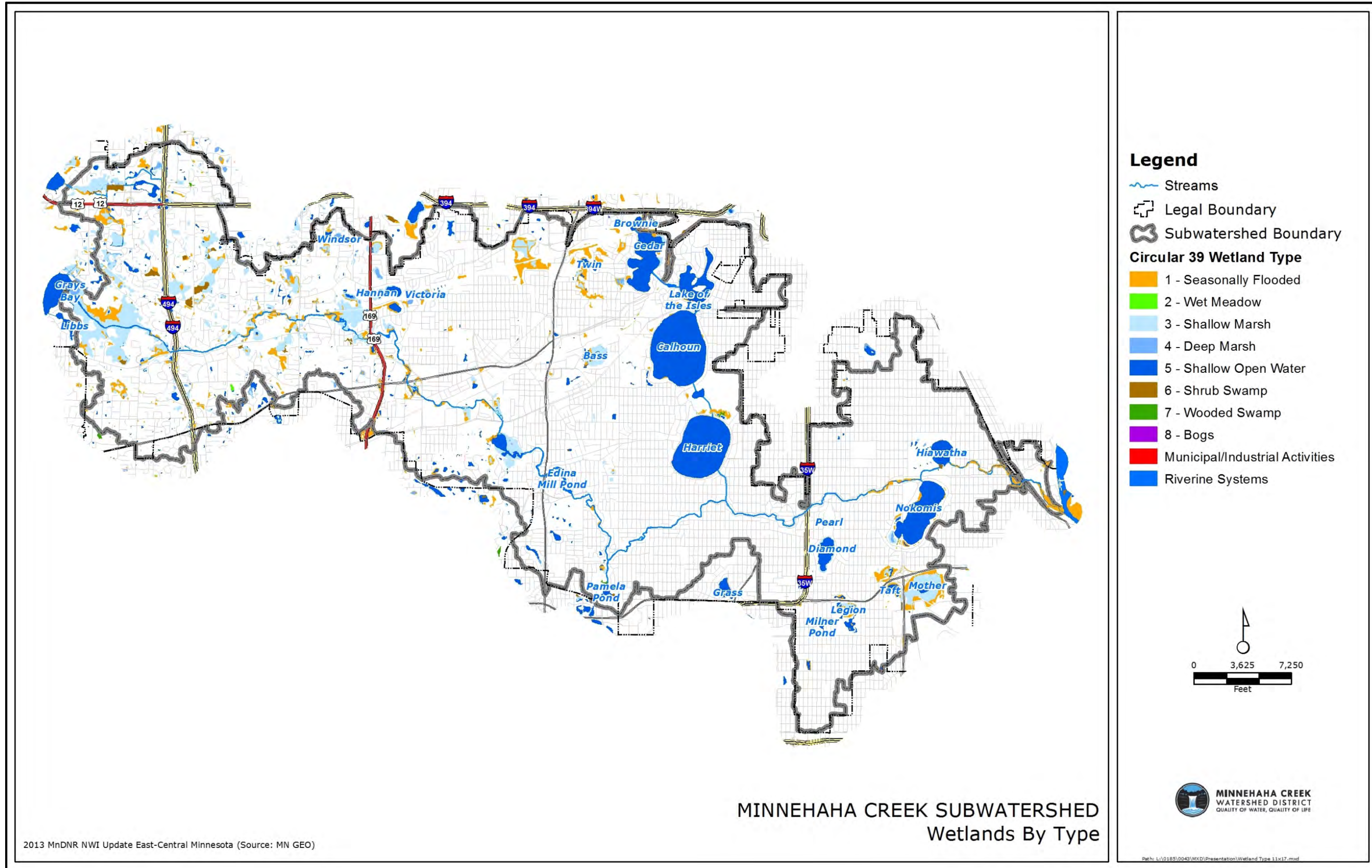
Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream baseflow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

The *HHPLS* identified the infiltration potential of the upland areas within the subwatershed as high to medium with some areas of variability where the soils are organic in nature. Most of the lower subwatershed is classified by the Hennepin County Geologic Atlas as being of high to very high aquifer sensitivity, reflecting the glacial outwash deposits that underlay the soils and the shallow depth to bedrock. The upper subwatershed, an area of loamy till, is classified as being generally of low to moderate sensitivity to pollution except along the Creek and in the large Grays Bay wetland complex.

There are a number of springs and seeps in the Mississippi River gorge area, including Camp Coldwater Spring, the largest limestone bedrock spring in the Metro area.

Much of the subwatershed has been designated by the Minnesota Department of Health as Drinking Water Sensitivity Management Area (DWSMA) and Wellhead Protection Area (WHPA) for various municipal public wells. The MDH has designated areas within the DWSMAs as very high to moderate risk and vulnerability to contamination of the drinking water supply. Figure 3.86 shows areas in the subwatershed with groundwater sensitivity and that are designated as higher Drinking Water Sensitivity.



MINNEHAHA CREEK SUBWATERSHED
Wetlands By Type

Figure 3.85. Minnehaha Creek subwatershed wetlands by type.

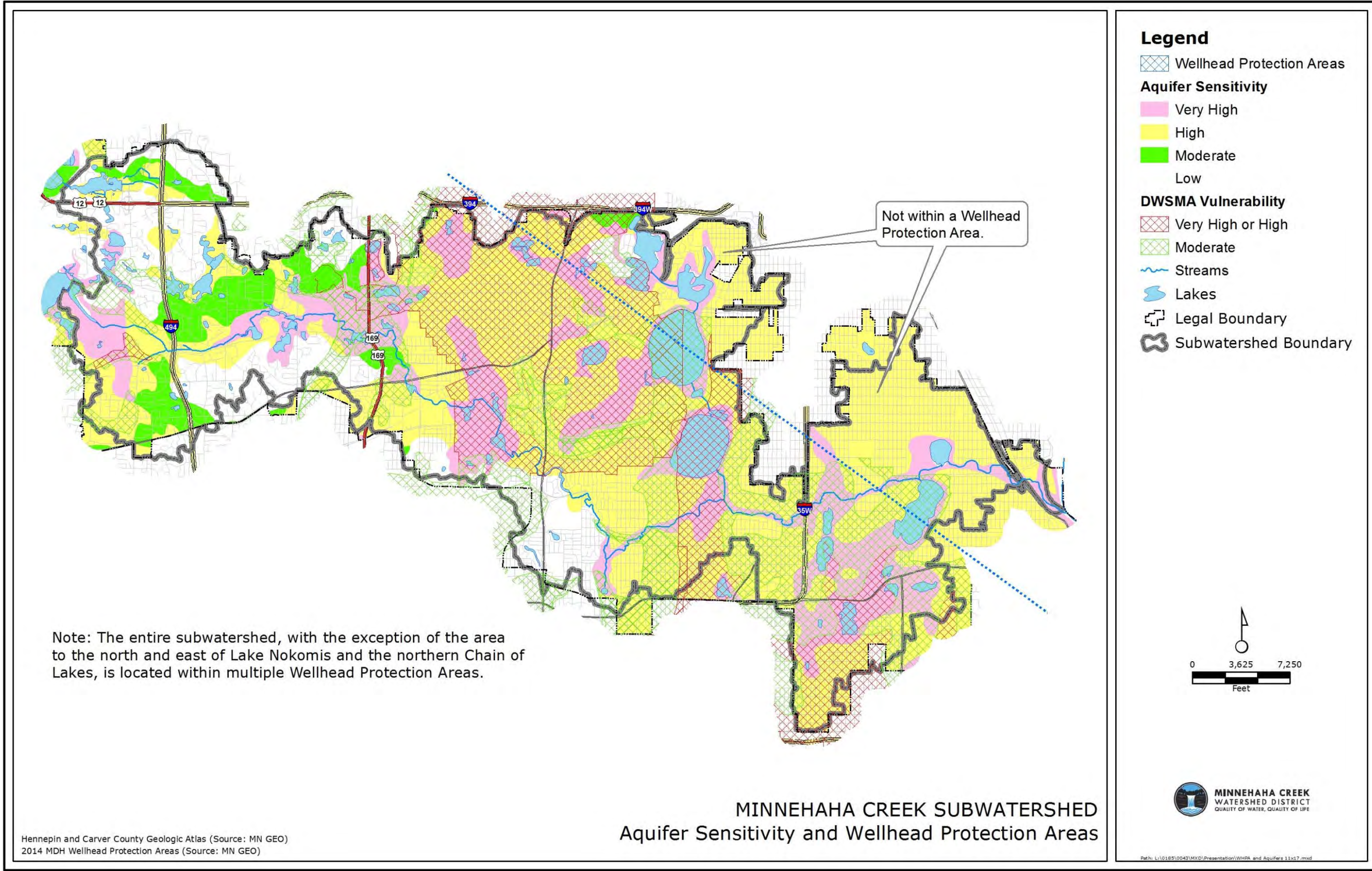


Figure 3.86. Minnehaha Creek subwatershed aquifer sensitivity and Wellhead Protection Areas.

Water Quantity:

Several landlocked basins and many smaller landlocked pocket wetlands exist in the upper reaches of the Minnehaha Creek drainage area including large areas within the City of Minnetonka and portions of Hopkins, Edina and St. Louis Park (Figure 3.83). The District partnered with the University of Minnesota and the Mississippi Watershed Management Organization (MWMO) to complete a baseflow and stormwater infiltration study of Minnehaha Creek (2014). Refer to section Studies and Assessments for additional studies assessing volume control and storm water management throughout the Minnehaha Creek Subwatershed.

To assess change in water yield, a Mann-Kendall statistical trend test was performed on annual water yield data for the monitoring stations downstream of the Gray's Bay dam. The water yields for 2006-2015 did not exhibit any statistically significant trend.

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity, habitat diversity, and nutrient cycling. Nutrient cycling is described in the Water Quality section. The Minnehaha Creek subwatershed has been systematically evaluated by the E-Grade program in 2015-2017. At this time, only some of the E-Grade metrics have been assessed. The final E-Grade report for this subwatershed will not be available until 2018. This section summarizes ecological integrity using E-Grade and other existing data where available (Figure 3.87).

Lakes:

Biodiversity

Fish Community. Biodiversity is measured using the Index of Biotic Integrity (IBI) for fish developed by the DNR. Fish IBI data are available for five of the lakes in the subwatershed. Cedar Lake and Lake of the Isles are classified as Good and meet state ecological integrity requirements. Lakes Calhoun, Harriet, and Nokomis are classified as Poor, meaning the biodiversity has been disturbed and the IBI is below the state threshold.

AQUATIC VEGETATION COMMUNITY. BIODIVERSITY IS DETERMINED BY THE NUMBER AND VARIETY OF SPECIES, OR RICHNESS. AQUATIC VEGETATION SURVEYS ARE AVAILABLE ON MANY OF THE LAKES IN THE SUBWATERSHED AND LED TO FQI SCORES FOR E-GRADE. BROWNIE, CALHOUN, AND CEDAR WERE CLASSIFIED AS GOOD, MEANING THEY HAD A GOOD VARIETY OF SPECIES, INCLUDING SENSITIVE SPECIES. LAKE NOKOMIS AND THE SHALLOW LAKES IN THE SUBWATERSHED THAT WERE CLASSIFIED AS POOR. LAKES HARRIET, HIAWATHA, NOKOMIS, AND ISLES WERE CLASSIFIED AS DEGRADED, DUE TO LOW SPECIES DIVERSITY.

Aquatic Invasive Species. Biodiversity can be negatively impacted by the presence of aquatic invasive species (AIS). The most common AIS on the lakes in this subwatershed include curlyleaf pondweed, Eurasian water milfoil, and common carp. Zebra mussels have been found in Lake Hiawatha. Lake Nokomis is listed for zebra mussels due to its connectivity to Minnehaha Creek via a weir, but zebra mussels have yet to be found in the lake.

Habitat diversity

Aquatic Vegetation Community. Habitat diversity is determined by the percent occurrence of species, or the extent to which it may be dominated by a few species. The vegetation community has not been assessed for habitat diversity yet.

Shoreline Health. Shoreline health is assessed looking at shoreline vegetative cover and the relative human disturbance. The MnDNR is using the Score the Shore protocol to relate shoreline conditions to fish community structure using the fish IBI metric. The protocol subdivides the riparian area into three zones: aquatic, shoreline and shoreland and evaluates various metrics such as vegetative cover, land use, human disturbance, and emergent vegetation. Brownie Lake's shoreline health was classified as Exceptional. Cedar Lake and some of the smaller shallow lakes were classified as Good, while most the lakes in the lower subwatershed were classified as Poor. In lakes classified as Poor, suitable shoreland and shoreline vegetation is lacking and has disturbances such as seawalls or riprap shorelines.

Streams:

Biodiversity

Fish Community. The DNR periodically assesses the fish community in Minnehaha Creek. Fish IBI data are available at six locations along the Creek. Five of the sites were last surveyed in 2010, while the sixth has not been updated since 2000. The monitoring site just upstream of 34th Avenue in southeast Minneapolis was classified as Degraded, scoring well below the state's fish IBI standard. The site in Big Willow Park in Minnetonka was also classified as Degraded, although that data is from 2000. The other four sites on the Creek were classified as Poor, showing signs of disturbance and falling below the IBI threshold.

Macroinvertebrate Community. The District collected macroinvertebrate samples at 23 sites on Minnehaha Creek in 2013 and 2015. The DNR also collected macroinvertebrate samples at five sites as part of its fish sampling. Macroinvertebrates are more sensitive to the stream conditions in their immediate vicinity, so the IBI scores can vary from site to site, even those in close proximity. A majority of the sites were classified as Degraded, meaning they were highly disturbed, with low species diversity and dominated by pollution-tolerant species. However, other sites were classified as Poor, with slightly better diversity and supporting some pollution-intolerant species. For more information, refer to the Minnehaha Creek E-Grade Report, 2018.

Habitat diversity

Habitat Complexity. Minnesota Stream Habitat Assessment data is available to assess habitat complexity, which is evaluated in three zones: instream, riparian, and channel shape. Complexity is highly variable along the length of the stream due to decades of human disturbance. However, the lower reaches of the stream are located within and protected by a parkway, which helps limit the impacts of urbanization. Generally, the reaches in the stream above the Browndale Dam have greater habitat complexity than the lower reaches and are classified as Good. The lower reaches, where the channel form or morphology is more likely to have been disturbed, are classified as either Good or Poor, with a few locations classified as Degraded in one or more of the three zones. For more information, refer to the Minnehaha Creek E-Grade Report, 2018.

Connectivity. Connectivity is defined by two metrics: presence or absence of barriers, and access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. There are several barriers on Minnehaha Creek, the most significant being Minnehaha Falls, which disconnects the Creek from the Mississippi River. There are also three dams (Highway 55, 54th Street, and Browndale) and at least one significant culvert at McGinty Road. Access to floodplain is variable, and greatest in the upper subwatershed where there are riparian wetlands and low streambanks.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS concentrations increase turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. A stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, can be stressful to organisms. In addition, streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is available, and will be assessed and included in the Minnehaha Creek E-Grade report (2018). However, by

observation, Minnehaha Creek is an urban stream with numerous storm sewer outfalls, and it can rise quickly during rain events. Instantaneous flow is also available along the Creek. Annual average flow for each year was computed first, and then all the years' averages were averaged together. The average discharge for the major stations in Minnehaha Creek are listed in Table 3.86.

Table 3.86. Average discharge for stations in the Minnehaha Creek subwatershed.

See Figure 3.84 for monitoring locations.

Stream	2006-2015 Annual Average
	Discharge (cfs)
Gray's Bay Dam (CMH07)	85.06
I-494 (CMH01)	60.65
W. 34 th Street (CMH02)	62.29
Excelsior Blvd (CMS11)	54.80
Browndale Dam (CMH03)	68.66
W. 56 th Street (CMH04)	68.72
Xerxes Avenue (CMH15)	66.46
21 st Avenue (CMH24)	67.79
28 th Avenue (CMH18)	67.93
Hiawatha Avenue (CMH06)	80.67

Source: MCWD.

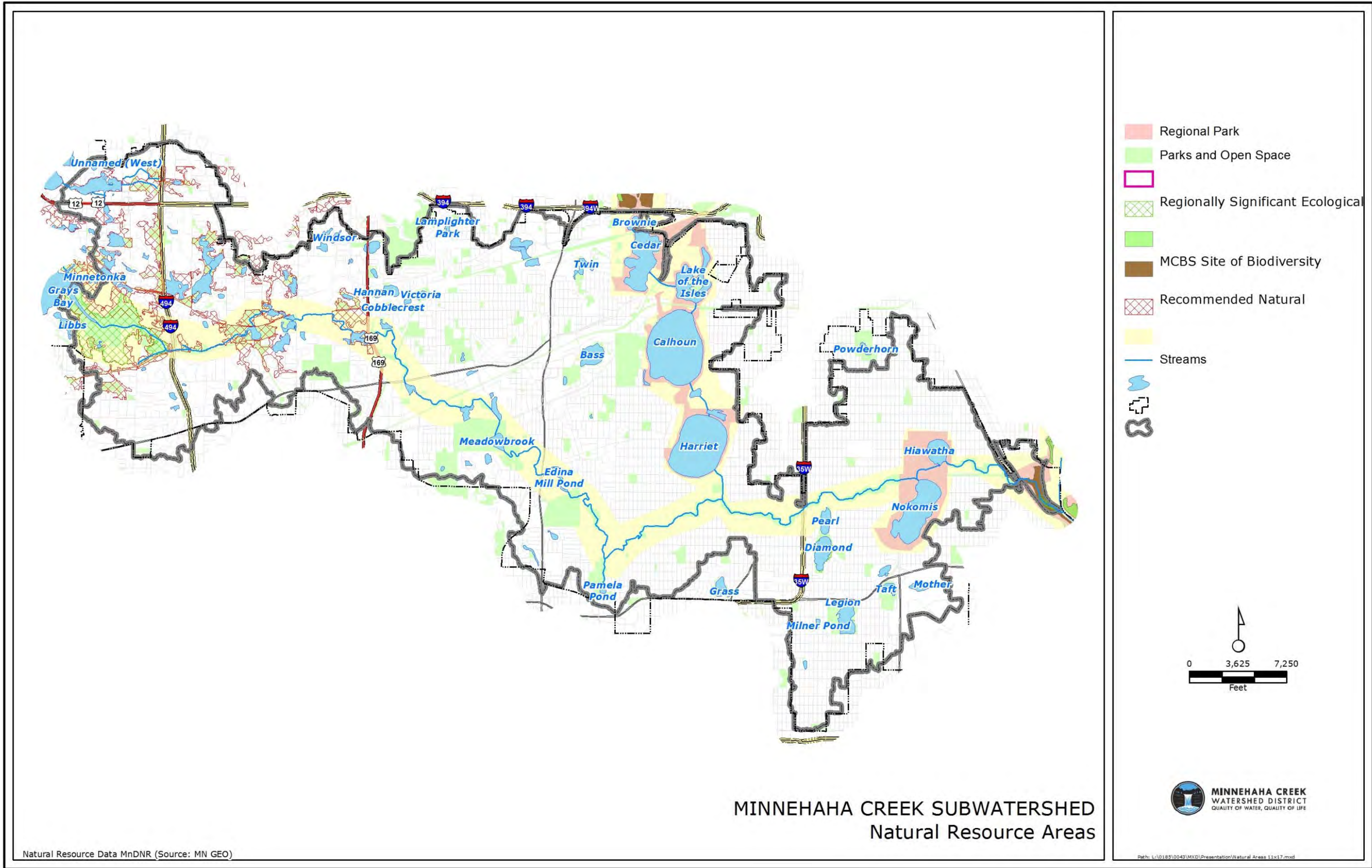


Figure 3.87. Minnehaha Creek subwatershed natural resource areas.

Wetlands:

Biodiversity

Vegetation Community. The FQI developed by the DNR can be used to evaluate the biodiversity of vegetation in wetlands. A cross section of 26 wetlands in the subwatershed were assessed for their vegetation condition, twelve in the upper subwatershed and fourteen in the lower subwatershed. Three of the twelve assessed in the upper subwatershed were classified as Degraded while nine were classified as Poor. Six of fourteen assessed in the lower subwatershed were classified as Degraded, and eight were classified as Poor. Wetlands ranked degraded tend to have fewer communities, primarily fresh meadow and/or floodplain forest. Buckthorn and reed canary grass tend to dominate in these communities. Some of the seasonally flooded basins are maintained as mowed turf.

Macroinvertebrate Community. No macroinvertebrate data are available for the wetlands in this subwatershed. This data is not currently being collected in E-Grade.

Habitat diversity

Connectivity. Hennepin County has identified the large wetland complex at the headwaters of Minnehaha Creek, and some wetlands and uplands connected to it, as Recommended Natural Resource Corridors. Minnehaha Creek itself and associated riverine and riparian wetlands is an important connected corridor, linking Lake Minnetonka, the Chain of Lakes, and the Mississippi River. Other smaller wetlands in the subwatershed are primarily isolated with limited opportunities for connectivity.

Size. Larger wetlands are more likely to support a notable on-site diversity and/or abundance of wildlife species. Most of the larger wetlands are in the upper subwatershed, to the west of TH 169. In the lower subwatershed, wetlands are smaller and isolated, and less likely to support a diversity of wildlife.

Shoreline Protection. Riparian wetlands can provide significant shoreline protection and support emergent vegetation at the shoreline. The *Functional Assessment of Wetlands* evaluated riparian wetlands for their ability to protect lake or stream shoreline. there are numerous riverine or riparian wetlands on Minnehaha Creek helping to stabilize the streambanks. However, there are few riparian wetlands protecting lakeshore. Cedar and Diamond Lakes have some moderate coverage, but most of the lakes do not.

Uplands:

Biodiversity

The Minnesota Biological Survey (MBS) did not identify any areas of biodiversity significance in the uplands of this subwatershed. (Figure 3.87).

Habitat diversity

The lower subwatershed – generally the area east of TH 169 – is developed with minimal areas of ecological significance. Regionally significant ecological areas are places where larger tracts of minimally disrupted land provide habitat complexity. The only such area in this subwatershed is the large wetland complex at the outflow from Gray's Bay, which is the headwaters of Minnehaha Creek, and some wetlands and uplands connecting that complex to other larger wetlands in the upper subwatershed.

Thriving Communities:

Land use:

Table 3.87 shows the land uses within the area of the Minnehaha Creek subwatershed in acres and as a percentage of the total subwatershed. The predominant land use in the subwatershed is single family residential, followed by parks and open space (Figure 3.88). The subwatershed is fully developed at typical urban and suburban densities and land uses. Redevelopment and infill development have increased since the last plan update, notably with an increase in multi-family residential. Most of the remaining vacant or undetermined land is large wetland or woodland tracts. The entire subwatershed is within the MUSA 2020 area.

Table 3.87. 2010 land use in the Minnehaha Creek subwatershed.

Land Use 2010	Acres	% of Subwatershed
Single - Family Residential	15,583.3	51.4
Parks and Open Space	4,313.1	14.2
Multi - Family Residential	2,299.5	7.5
Water	1,675.1	5.5
Commercial	1,480.1	4.8
Institutional	1,449.9	4.7
Roads and Highways	1,407.9	4.6
Vacant or Undetermined	1,306.3	4.3
Industrial	785.6	2.5
Agricultural	0	0
TOTAL	30,300.8	

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

The subwatershed contains numerous regional recreational facilities (Figure 3.89). The National Parks Service oversees the Mississippi River and Recreational Area, which includes the Mississippi River gorge area within the subwatershed, including Minnehaha Falls. The Falls area includes a number of structures constructed by the Works Progress Administration (WPA), including retaining walls along the creek. The Minneapolis Park and Recreation Board (MPRB) operates a popular park and trail system around the Chain of Lakes and along Minnehaha Creek east of Lake Harriet. The North and South branches of the Three Rivers Park District's Southwest LRT Regional Trail connects the Chain of Lakes with the western subwatershed.

Camp Coldwater Spring, a site with significance to Native American communities and the location of the first white settlement in Minnesota, is located in the extreme southeast part of the subwatershed. The Minnesota Historic Features database notes over 1300 historic features in this subwatershed, mostly residences or commercial buildings. Three Historic Districts are listed on the National Register of Historic Places: the Minnehaha District in the vicinity of Minnehaha Falls; the Nokomis Knolls District, a residential district at the southwest corner of Lake Nokomis; and the Country Club District in Edina, an area of over 500 historic residences, commercial buildings, and other properties, including the Minnehaha Grange. More detail regarding the Camp Coldwater Springs and other locations significant to the watershed's early history can be found in the *2007 MCWD Comprehensive Water Resources Management Plan*.

There are numerous boat accesses and beaches on the lakes in the subwatershed. There are seventeen canoe launches on Minnehaha Creek, and this popular urban canoe trail winds through numerous parks and open spaces. Most of these launches have parking available, and several have picnic areas and restrooms.

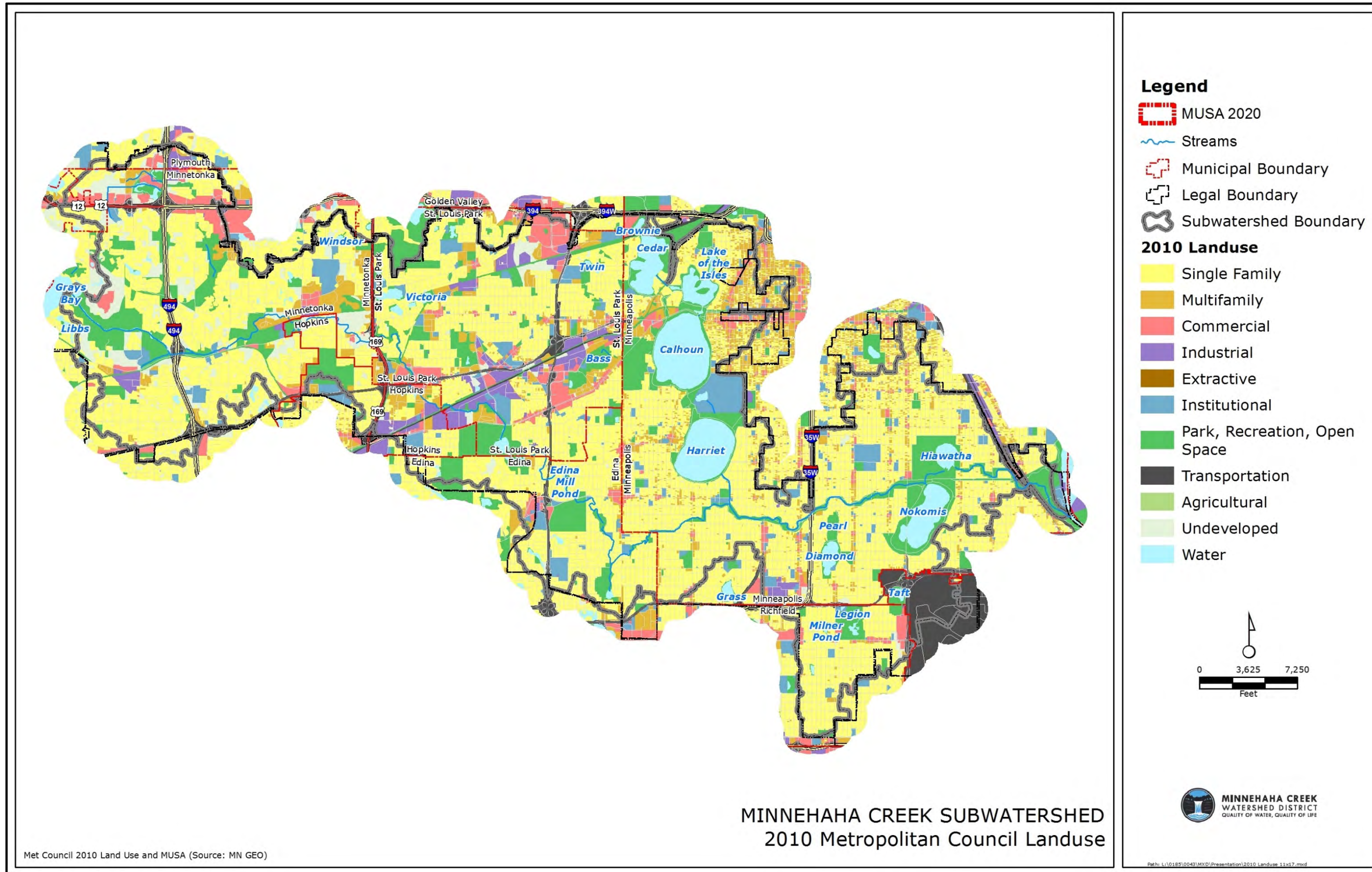


Figure 3.88. Minnehaha Creek subwatershed 2010 Metropolitan Council land use.

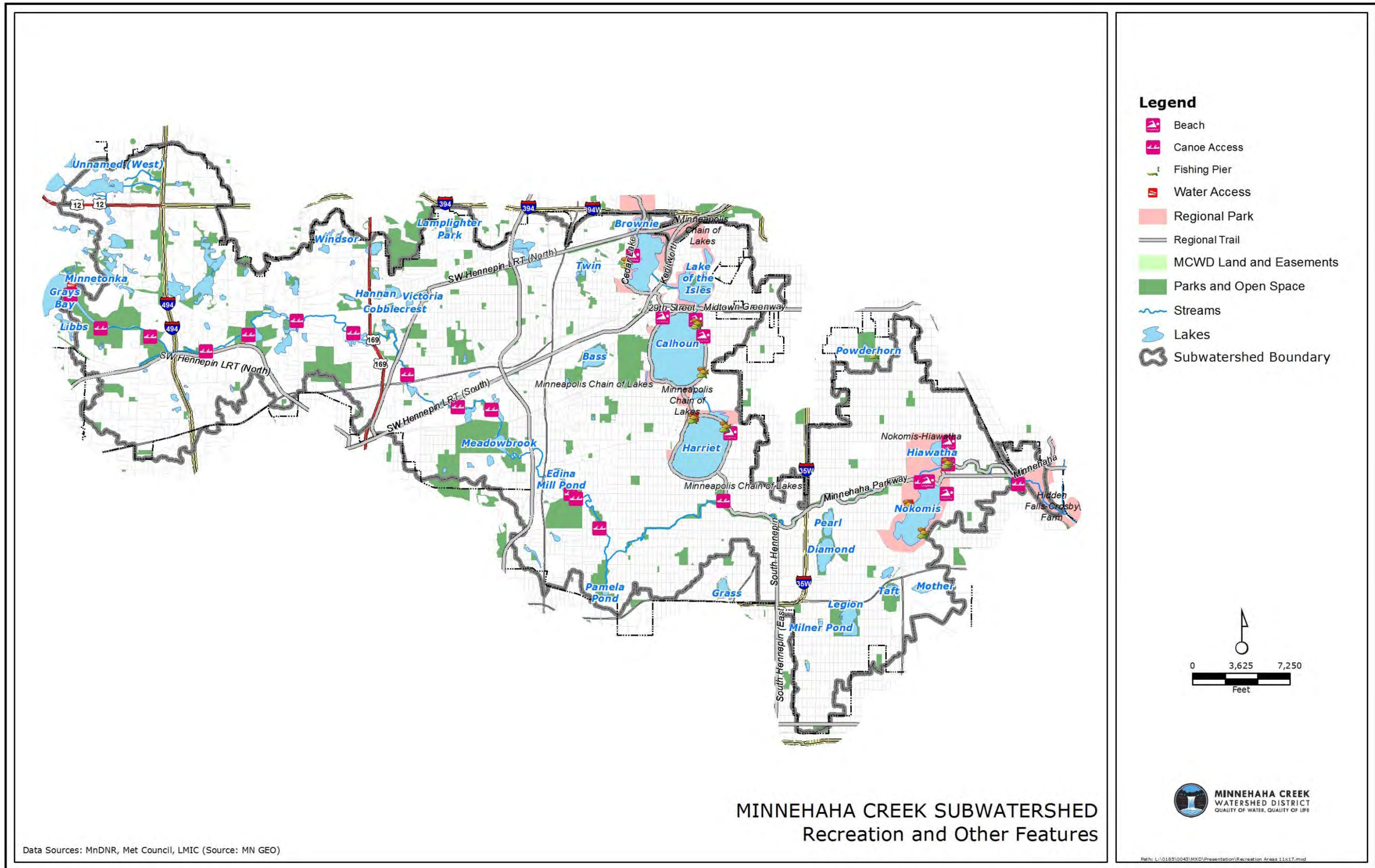


Figure 3.89. Minnehaha Creek subwatershed recreation and other features.

Studies and Assessments:

- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- Minnesota Land Cover Classification System (MLCCS)
- MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS), EOR 2003
- MCWD Lakes TMDL – Lakes Nokomis, Parley, Virginia, and Wassermann, EOR 2011
- Minnehaha Creek *E. coli* Bacteria/ Lake Hiawatha Nutrients, Tetra Tech Inc. 2013
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- Twin Cities Metropolitan Area (TCMA) Chloride TMDL, MPCA 2016
- State of Minnesota Statewide Mercury TMDL
- MCWD Stream Assessment, Wenck 2004
- 1st Order Drainage Assessment and Fluvial Geomorphic Assessment Update, Inter-Fluve Inc. 2013
- Baseflow Restoration in Minnehaha Creek Watershed with Stormwater Infiltration, University of Minnesota 2014
- National Wetland Inventory
- Hennepin County Geologic Atlas
- Minnehaha Creek E-Grade Report, Wenck 2018
- Functional Assessment of Wetland (FAW), 2003
- Minnesota Biological Survey (MBS)
- 2020 Metropolitan Urban Service Area (MUSA)
- Minnesota Historic Features database
- Memo: Lake Calhoun Alum Treatment, 2002
- Lake Nokomis Alum Study, 2004
- Cities of Minneapolis Storm Water NPDES Part II (Monitoring and Modeling Results), HDR Engineering 1992
- Minneapolis Chain of Lakes Clean Water Partnership Project: Stormwater Monitoring Study, BARR 1992
- Grass Lake Hydrologic Study, Wenck 1996
- Memo: 1997-1998 Data Comparison of Minnehaha Creek, Wenck 1998
- Blue Water Commission Report, 1998
- Memo: Comments on MAC application for Groundwater Appropriation Permit, BARR 2000
- Surface Water Pathogen Study, Wenck 2003
- Effects of Barley Straw on Water Clarity in Powderhorn Lake, Blue Water Science 2008
- Memo: 1997 Minnehaha Creek Phosphorus Loads, 1999
- Minnehaha Creek Cooperative Agreement Preliminary Report, Hickok and Associates, Pre-1990's
- Minnehaha Creek Restoration Project: Methodist Hospital Campus Site Design Report, Inter-Fluve Inc. and HR Green 2008
- Minnehaha Falls and Glen Restoration, 2011
- Memo: Reach 8-Channel Restoration and Reconstruction Concept Design Report, 2007
- Reach 7-Channel Restoration and Reconstruction Feasibility Study, Inter-Fluve Inc. 2010
- Reach 14-Channel Restoration and Reconstruction Feasibility Study, Inter-Fluve Inc. 2011
- Reach 19-21-Channel Restoration and Reconstruction (Reach 20), Inter-Fluve Inc. and HR Green 2011
- Minnehaha Creek Restoration – 325 Blake Road (Cold Storage): Stormwater Management Feasibility Study, Wenck 2013
- Minnehaha Creek Infiltration (Volume Control): MCs-129, 134, 146, 147, 170, 58, 70-75, 95, 97 Feasibility Study, 2011
- Taft-Legion Lakes Watershed Water Quality Improvement Project Feasibility Study, WSB & Associates 2010
- Cottageville Park Feasibility Study, Cuningham Group Architecture Inc. and WSB & Associates 2013
- Phase I Environmental Site Assessment for Knollwood Mall Redevelopment, Braun Intertec 2013
- Stormwater Management Feasibility Study for Powell Road Relocation (St. Louis Park, MN), Wenck 2013

- MCWD 15320 Minnetonka Blvd Office Wetland and Riparian Forest Restoration Plan, MCWD and Wetland Habitat Restoration LLC 2013
- Lake Hiawatha Stormwater Management Feasibility Study – Task 7, Houston Engineering 2015
- Lake Hiawatha Golf Course, 2015
- Concept Plan Presentation and Public Hearing: Meadowbrook Golf Course, MPRB 2015
- Feasibility Report: City Lakes Improvement Project, Wenck 1994
- Twin Lakes Improvement Study: City of St. Louis Park, Hickok and Associates 1984
- Lake Nokomis Water Quality Improvements: Lake Nokomis Wetland Settling Ponds Project, 1998
- Lake Nokomis Water Quality Improvements: Lake Nokomis Outlet Weir Project, 1998 and 2013
- Lake Nokomis Water Quality Improvements: Lake Nokomis Biomanipulation Study, Blue Water Science 2017
- 60th Street and 1st Avenue Pond Project, 1999
- Pamela Park Wetland Restoration, 1999
- St. Mary's Greek Orthodox Church (Low Impact Development), 2010
- El Colegio Charter School (Low Impact Development), 2011
- West End Redevelopment (Low Impact Development), 2012

3.9 PAINTER CREEK SUBWATERSHED

Painter Creek Subwatershed drains the land and wetlands into Painter Creek, and eventually drains into Lake Minnetonka: Jennings Bay. The largest lake, Lake Katrina, was recently recommended by MPCA to be classified as a wetland. Wetlands make up over 25% of the land cover in the subwatershed, while the remaining 75% is a mix of agriculture, forests and woodlands, grasslands, and impervious cover. Painter Creek flows in and out of Katrina and flows through woodlands and through Painter Marsh before curving towards Lake Minnetonka. Most of Painter Creek is classified as ditched due to efforts to drain the landscape. Table 3.91 below shows the area of the Painter Creek subwatershed in acres by individual city, in total and as a percentage of the total subwatershed (Figure 3.91).

Table 3.91. Cities in the Painter Creek subwatershed.

City	Area (Acres)	% of Subwatershed
Independence	3,069.1	35.4%
Maple Plain	202.8	2.3%
Medina	2,498.9	28.8%
Minnetrista	1,562.7	18.0%
Orono	1,336.0	15.4%
Total	8,669.7	

Source: MCWD.

Watershed Description and Hydrology:

Topography in the subwatershed is gently rolling, with circular, level-topped hills and numerous large wetlands. Soils within the watershed are predominantly classified as Natural Resources Conservation Service Hydrologic Soil Group B (loamy soils with moderate infiltration potential) and D (clay soils with very low infiltration potential). For more information regarding geology and soils in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (Figure 3.92). There is a wide variety of land cover types in the subwatershed. Wetland and forest/woodland cover dominate the central subwatershed along the Painter Creek corridor, while low-density development is dispersed throughout the subwatershed. There is a small area of higher density development in the City of Maple Plain. Large areas in agricultural use are present in the lower watershed.

The upper subwatershed drains through streams and channels to Lake Katrina in the Baker Park Reserve. Painter Creek is the outlet of Lake Katrina, flowing 6.2 miles south and east from the lake to Jennings Bay: Lake Minnetonka. Painter Creek was channelized as County Ditch #10 in 1905, connecting and outletting wetlands to support agriculture in the subwatershed.

The *2003 MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Painter Creek subwatershed into 26 subwatershed units, designated PC-1 through PC-26 (Figure 3.93).

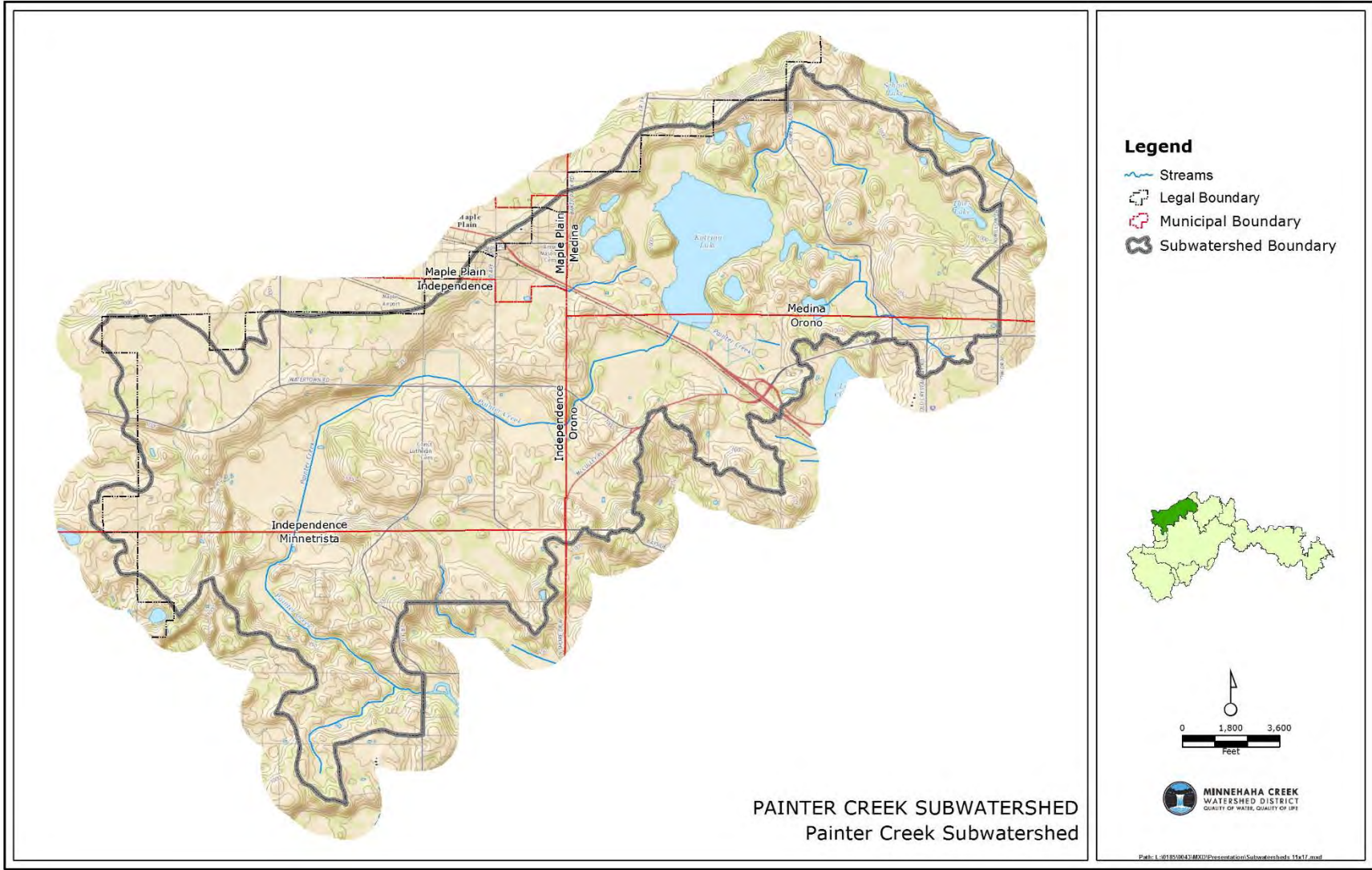


Figure 3.91. The Painter Creek Subwatershed.

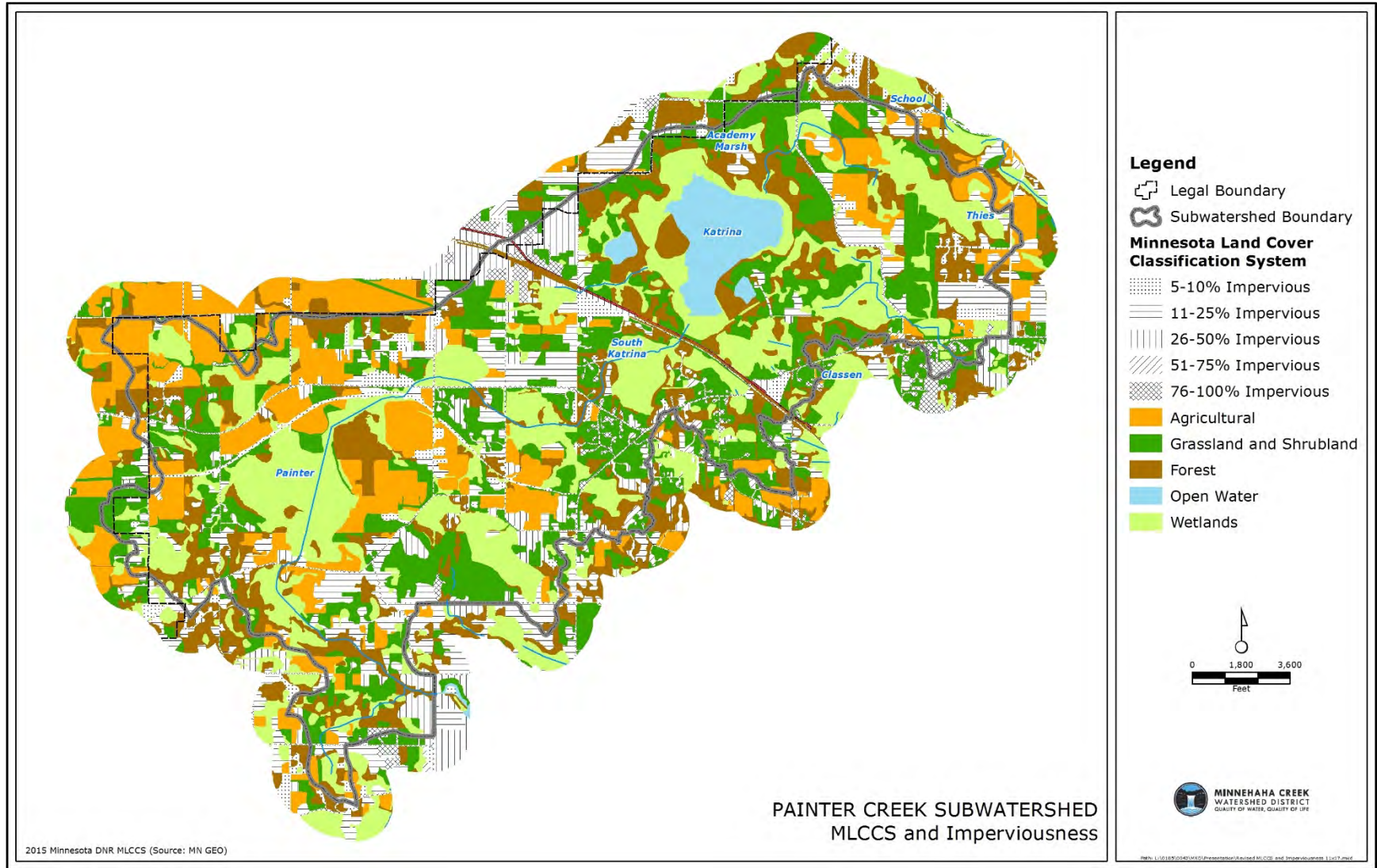


Figure 3.92. Painter Creek subwatershed MLCCS and imperviousness.

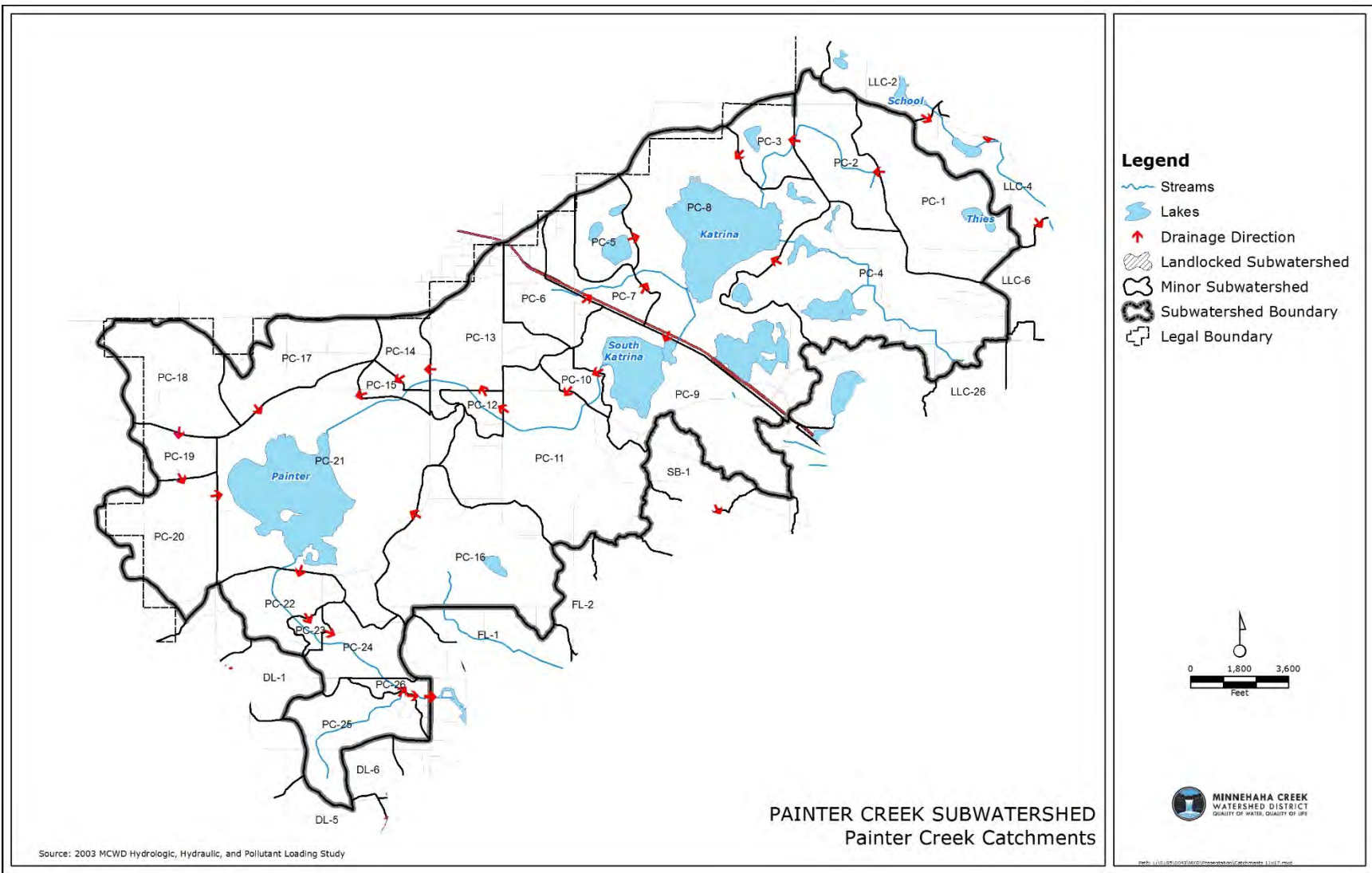


Figure 3.93. Painter Creek subwatershed catchments.

Water Quality:

The following are summaries of the characteristics and classifications of lakes, streams and wetlands within the subwatershed including water quality goals and trends.

Lakes:

Lake Katrina carries the informal designation of lake as the primary waterbody within the subwatershed, and is the headwaters for Painter Creek. Thies Lake is a small lake located in the top of the subwatershed (Figure 3.94). Lake Katrina is periodically monitored by the Three Rivers Park District and was monitored for three years by MCWD, while Thies Lake is monitored by trained volunteers. Tables 3.92 and 3.93 below detail the physical and water quality characteristics of Katrina and Thies Lakes and includes the DNR shoreland management classification.

While Lake Katrina is considered to be a wetland rather than a shallow lake, it does exceed the state standards for shallow lakes. Thies Lake exceeds the state standard for deep lakes (Table 3.92). For more information, refer to District's Water Quality (Hydrodata) Reports.

Table 3.92. Physical characteristics of lakes in the Painter Creek subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Katrina	202	N/A	16:1	Natural Environment
Thies	11	29	42:1	Natural Environment

Source: Minnesota DNR.

Table 3.93. Selected water quality goals and current conditions of lakes in the Painter Creek subwatershed.

Lake	State TP Standard (µg/L)	2007 Plan Goal TP (µ/L)	Trend	2006-2015 Summer Average*		
				TP (µg/L)	Chl- <i>a</i> (µg/L)	Secchi (m)
Katrina	N/A	N/A	n/a	158	72	0.7
Thies	40	50	n/a	54	24	1.3

TP = Total phosphorus concentration. *Katrina data is 2006-2014; Thies data is 2009-2015.

Note: Katrina has been classified by the MPCA as a wetland rather than a lake, so the lake standard does not apply

Source: MCWD, MPCA.

Streams:

Painter Creek outlets Lake Katrina, flowing 6.2 miles to Jennings Bay. It is comprised mainly of ditches through large wetlands connected by relatively short reaches of channel. Flow is controlled by weirs at the outlets of Katrina Lake, South Katrina Marsh, Painter Marsh and Pond 937. The creek was channelized as County Ditch #10 in 1905. Several small streams and channels provide local conveyance (Figure 3.94). It was also studied in-depth in 2003 as part of the District's *Upper Watershed Stream Assessment* and the *Painter Creek Feasibility Study*.

Table 3.94 below details Painter Creek's water quality characteristics. Monitoring sites along the Painter Creek find TP concentrations high relative to the state river eutrophication standards. However, those standards also look at other indicators such as chlorophyll-*a*, diel oxygen flux, and biological oxygen demand that have not been assessed in the Creek.

Painter Creek has low TSS concentrations, as shown on Table 3.94. Maintaining sufficient DO is necessary to support aquatic life. The DO state standard requires the stream to never fall below 5 mg/L DO. District monitoring data show that all the monitoring sites on the creek fall below the standard multiple times per year.

Painter Creek downstream of Painter Marsh is designated an Impaired Water due to elevated levels of *E. coli* bacteria. The state standard requires that the geometric mean of the aggregated monthly *E. coli* concentrations for one or more months must not exceed 126 organisms per 100 mL. A water body is also considered impaired if more than 10% of the individual samples within a month exceed 1,260 organisms per 100 mL. Data from 2001 to 2011 shows that flow in Painter Creek exceeds the monthly standard July to October, and the acute, individual standard 25% of the time in September and October. For more information, refer to District’s Water Quality (Hydrodata) Reports.

Table 3.94. Current Painter Creek conditions.

See Figure 3.94 for monitoring locations.

Stream	Trend	2005-2015 Annual Average			
		TP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)
Jennings Bay Inlet (CPA05)	n/a	281	1.45	15	40
W Branch Road (CPA01)	Deg TP	293	1.61	11	43
Painter Creek Drive (CPA06)	n/a	277	1.38	5	46
Painter Marsh Outlet (CPA04)	n/a	272	1.21	3	43
Katrina Wetland Outlet (CPA03)	n/a	201	1.31	4	52

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride, Deg = degrading.

Source: MCWD.

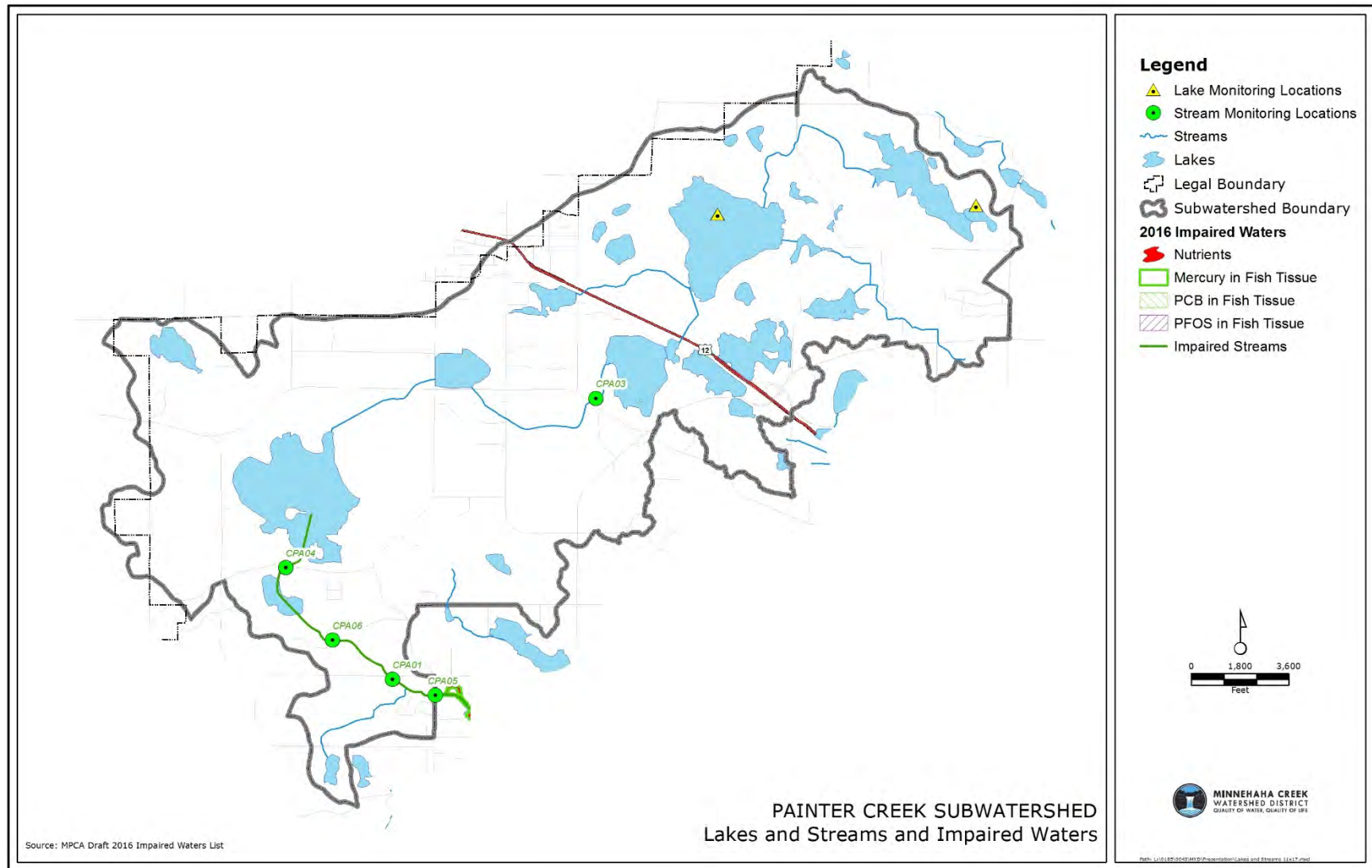


Figure 3.94. Painter Creek subwatershed lakes and streams and Impaired Waters.

Wetlands:

According to the updated NWI, wetlands, including lakes, cover almost 29 percent of the watershed’s surface (Figure 3.95 and Table 3.95).

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients to and from the subwatershed. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands.

A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

Table 3.95. National Wetland Inventory wetland types in the Painter Creek subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	838.1	33.6%
2 - Wet Meadow	46.4	1.9
3 - Shallow Marsh	1,056.0	42.3
4 - Deep Marsh	83.2	3.3
5 - Open Water	318.0	12.7
6 - Scrub Shrub	97.6	3.9
7 - Forested	41.8	1.7
8 - Bog	3.8	0.2
Riverine	12.1	0.5
Wetland Total	2,497.0	28.8%
Upland	6,172.7	71.2
TOTAL	8,669.7	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream baseflow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

The HHPLS identified the infiltration potential of the upland areas within the subwatershed as medium to low with some areas of variability where the soils are organic in nature. Areas of moderate to high or very high aquifer sensitivity roughly follow the Painter Creek corridor to Jennings Bay. Elsewhere the Hennepin County Geologic Atlas classifies most of the upland areas as being of low to moderate sensitivity to pollution.

Two small areas of the Painter Creek subwatershed have been designated by the Minnesota Department of Health as Drinking Water Sensitivity Management Areas (DWSMA) for a City of Orono well and a City of Medina well. The MDH has designated these areas to be of low risk and vulnerability to contamination of the drinking water supply. Figure 3.96 shows areas in the subwatershed with groundwater sensitivity and that are designated Wellhead Protection Areas.

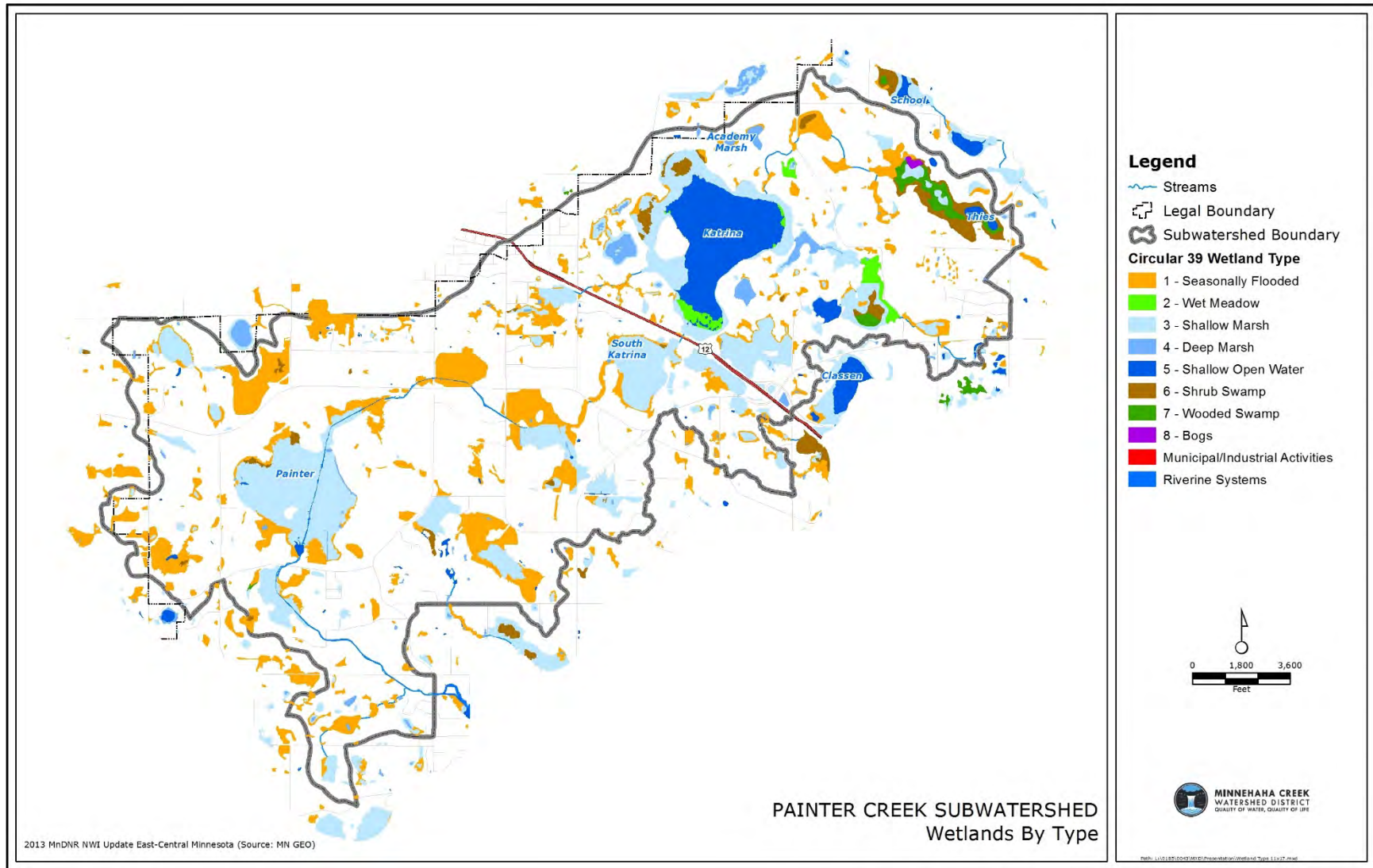


Figure 3.95. Painter Creek subwatershed wetlands by type.

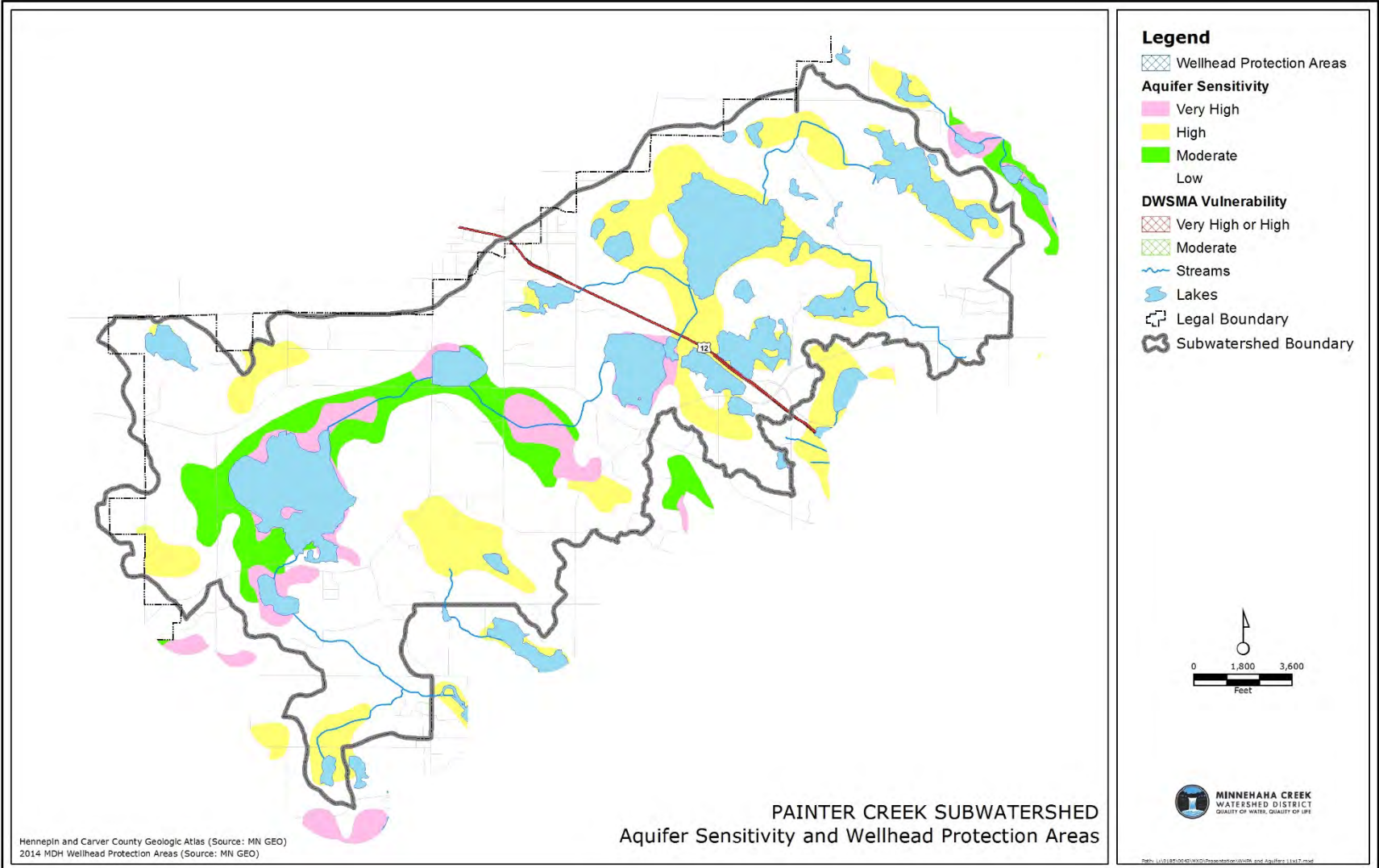


Figure 3.96. Painter Creek subwatershed aquifer sensitivity and Wellhead Protection Areas.

Water Quantity:

There are no landlocked basins in this subwatershed (Figure 3.93).

To assess change in water yield, a Mann-Kendall statistical trend test was performed on annual water yield data for the two monitoring stations upstream of Jennings Bay. The period of record for the station upstream just upstream of Jennings Bay was 2005-2015 and was 1997-2015 for the next station upstream. Water yield did not exhibit any statistically significant trend.

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity, habitat diversity, and nutrient cycling. Nutrient cycling is described in the Water Quality section. The Painter Creek subwatershed has not yet been systematically evaluated by the E-Grade program. This section summarizes ecological integrity using existing data where available (Figure 3.97).

Lakes:

Biodiversity

Fish Community. No fish IBI or survey data are available for the lakes in this subwatershed.

Aquatic Vegetation Community. Biodiversity is determined by the number and variety of species, or richness. No aquatic vegetation survey or Floristic Quality Index (FQI) data are available for the lakes in this subwatershed.

Habitat diversity

Aquatic Vegetation Community. No Floristic Quality Index (FQI) data is available for the lakes in the subwatershed.

Shoreline Health. Shoreline health is assessed looking at shoreline vegetative cover and the relative human disturbance. The MnDNR is using the Score the Shore protocol to relate shoreline conditions to fish community structure using the fish IBI metric. No Score the Shore data is available; however, aerial photos show that the lakes and larger wetlands with open water are bordered with riparian wetland or woodland.

Streams:

Biodiversity

Fish Community. The DNR conducted a fish survey on Painter Creek in 2010. The fish IBI score was 67, above the state's threshold. The survey found a variety of species and a good abundance of fish, including blackchin shiners and Iowa darters, both of which are intolerant species. The fish community in Painter Creek downstream of Painter Marsh, where this survey was completed, is likely colonized from Jennings Bay: Lake Minnetonka. Largemouth bass, bluegill, several sunfish species, and common carp were also present.

Macroinvertebrate Community. The DNR conducted a macroinvertebrate survey twice in 2010, and the District surveyed several sites along the creek in 2013. The DNR's M-IBI scores were 5 and 8 out of 100, well below the state's threshold. Scores from the District's surveys ranged from 3 to 20. Species were very pollution-tolerant, and there was low species diversity.

Habitat diversity

Habitat Complexity. No Minnesota Stream Habitat Assessment data is available to assess habitat complexity, but notes taken for the 2004 *Upper Watershed Stream Assessment* were reviewed to better understand conditions in

the in-stream zone and riparian zone, and to assess channel morphology. That survey found that the stream has been channelized and straightened, with altered and limited habitat and morphology.

Connectivity. Connectivity is defined by two metrics: presence or absence of barriers, and access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. There are several barriers on the streams in this subwatershed, most of them culverts at road crossings, or outlet structures on the larger of the flow-through wetlands.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS concentrations increase turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. A stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, can be stressful to organisms. In addition, streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is available for CPA01 and CPA03. Instantaneous flow at CPA01 can be flashy following storm events, and since 2006, the CPA01 station has an average of discharge of 8.35 cfs. Note: Annual average flow for each year was computed first, and then all the years' averages were averaged together.

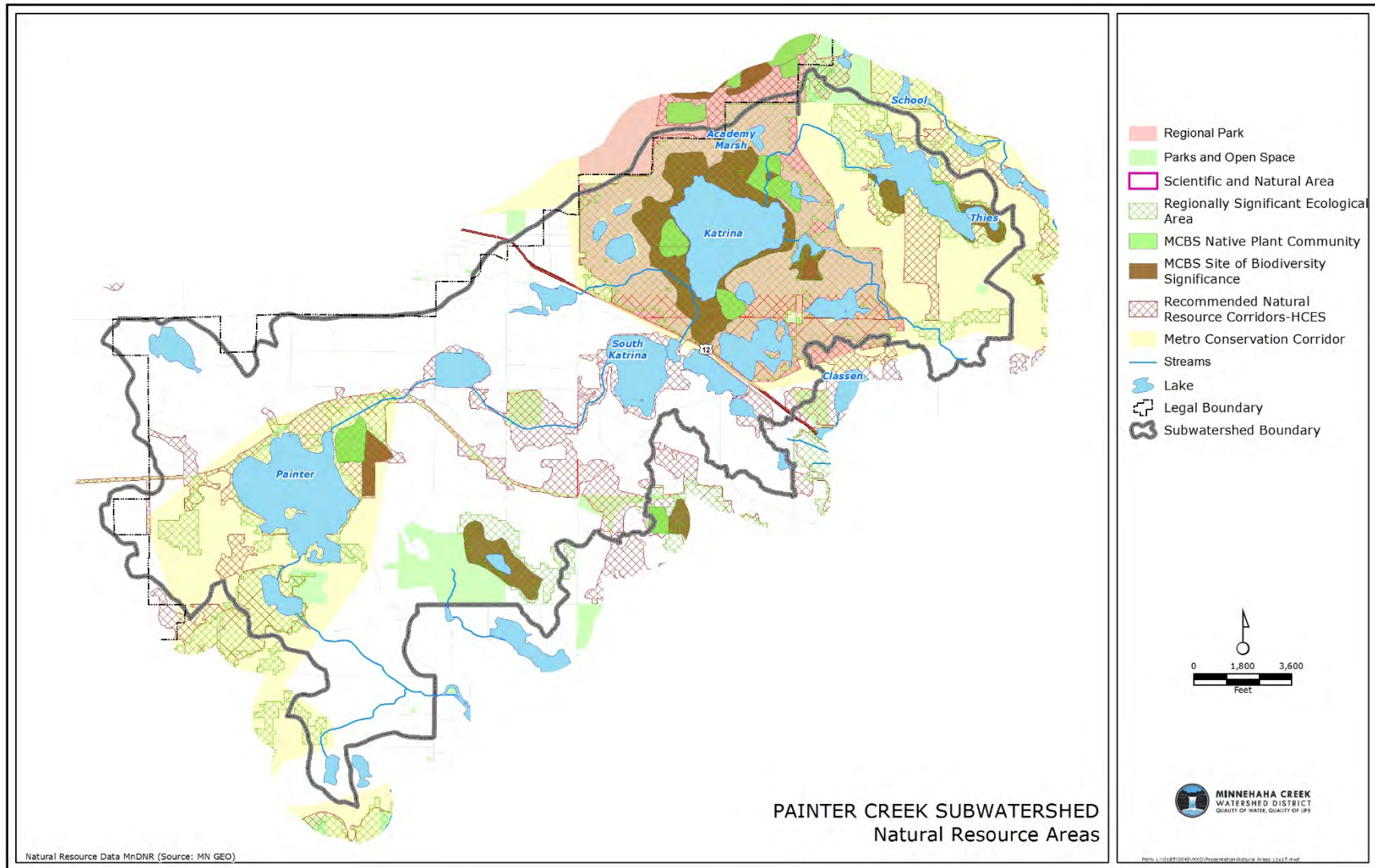


Figure 3.97. Painter Creek subwatershed natural resource areas

Wetlands:

Biodiversity

Vegetation Community. No Rapid Floristic Quality Assessment (RFQA) data are available for the wetlands in this subwatershed. However, the *Functional Assessment of Wetlands* assessed two large riparian wetlands – around Lake Katrina and Thies Lake, which scored highly on vegetative diversity, fish and wildlife habitat, or aesthetics. Most of these high functions and values wetlands are located within Baker Park Reserve.

Macroinvertebrate Community. No macroinvertebrate data are available for the wetlands in this subwatershed. This data is not currently being collected in E-Grade.

Uplands:

Biodiversity

Regionally Significant Ecological Areas are places where larger tracts of minimally disrupted land provide habitat complexity. Large areas of undisturbed or minimally disturbed forest and wetland in the subwatershed, including the Baker Park Reserve and Painter Marsh, have been designated Regionally Significant Ecological Areas by the DNR. The Minnesota Biological Survey (MBS) determined that several areas in the subwatershed were of moderate or high biodiversity significance, including a tamarack swamp complex; the wetland and upland areas surrounding Lake Katrina; and patches of maple-basswood and oak forest that are ranked as imperiled and vulnerable to extirpation (Figure 3.97).

Habitat diversity

The Baker Park Reserve and a large area in the lower subwatershed surrounding and including Painter Marsh are part of a DNR-designated Metro Conservation Corridor. The lower subwatershed conservation corridor area is part of a much larger corridor that extends south into the Dutch Lake and Langdon Lake subwatersheds, eventually connecting with the Gale Woods Regional Park in Minnetrista.

Thriving Communities:

Land use:

Table 3.96 shows the land uses within the area of the Painter Creek subwatershed in acres and as a percentage of the total subwatershed. The predominant land use in the subwatershed is vacant or undetermined use, followed by parks and open space and agriculture (Figure 3.98). The percentage of single family residential has increased since the last plan update. Some large tracts of agricultural uses remain in the lower subwatershed, while the upper watershed is dominated by Baker Park Reserve. Much of the watershed is outside of the MUSA 2020 boundary, and is not served by regional wastewater facilities.

Table 3.96. 2010 land use in the Painter Creek subwatershed.

Land Use 2010	Acres	% of Subwatershed
Vacant or Undetermined	3,277.5	37.8
Parks and Open Space	1,630.8	18.8
Agricultural	1,614.5	18.6
Single - Family Residential	1,525.8	17.5
Water	395.6	4.5
Institutional	69.1	0.7
Roads and Highways	67.3	0.7
Industrial	40.5	0.4
Commercial	29.0	0.3
Multi - Family Residential	19.1	0.2

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

The Three Rivers Park District's Baker Park Reserve covers much of the upper subwatershed. The park includes numerous wetlands and Lake Katrina, and bicycle/hiking trails provide access to many natural features. The Luce Line Regional Trail passes across this subwatershed. There are no boat accesses or beaches on the lakes in the subwatershed, nor on Painter Creek.

The Minnesota Historic Features database notes 14 historic features in the subwatershed, most being residences, farmhouses or agricultural buildings. The listing includes a church, a post office as well as two commercial buildings in Maple Plain (Figure 3.99).

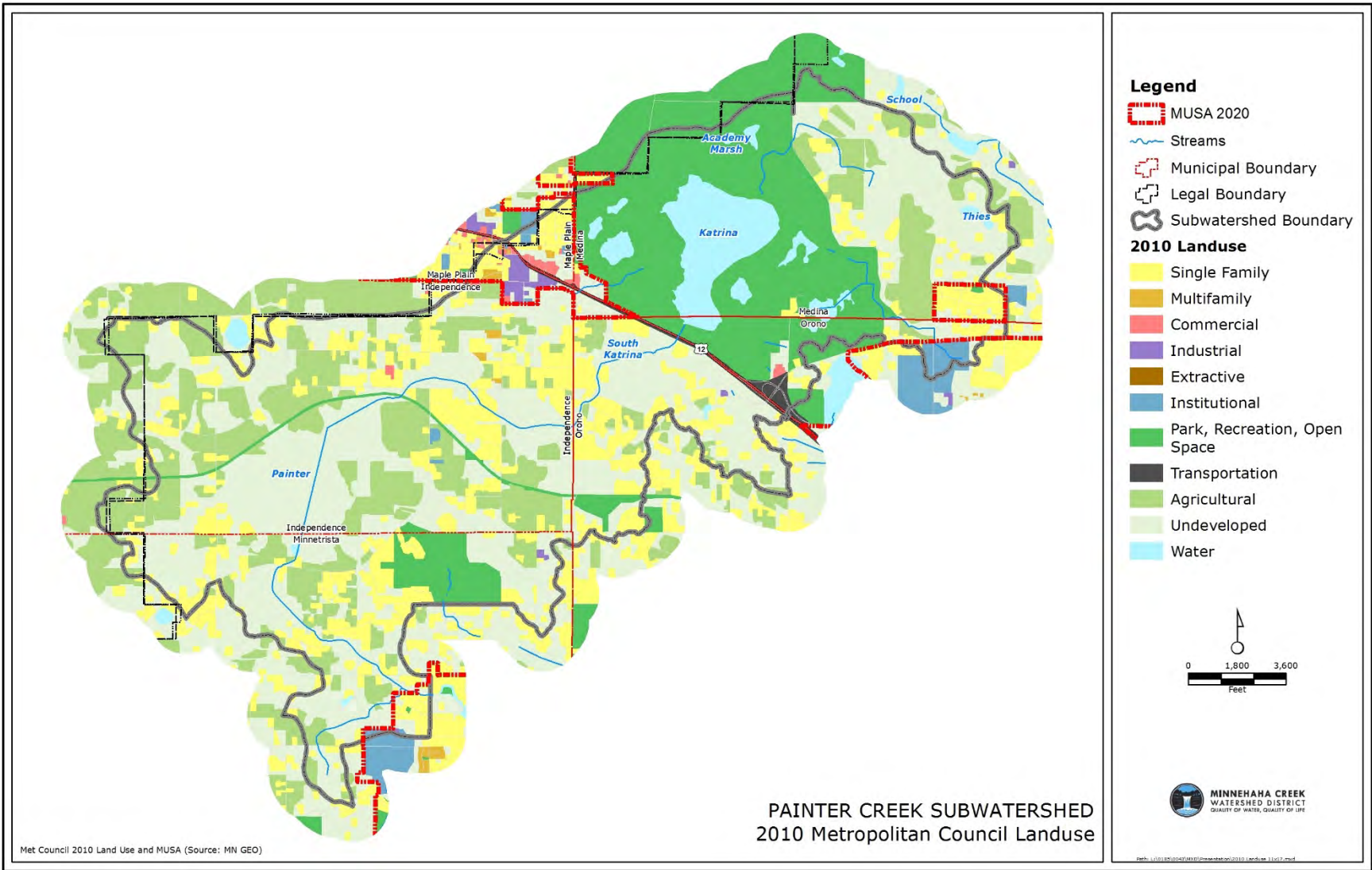


Figure 3.98. Painter Creek subwatershed 2010 Metropolitan Council land use.

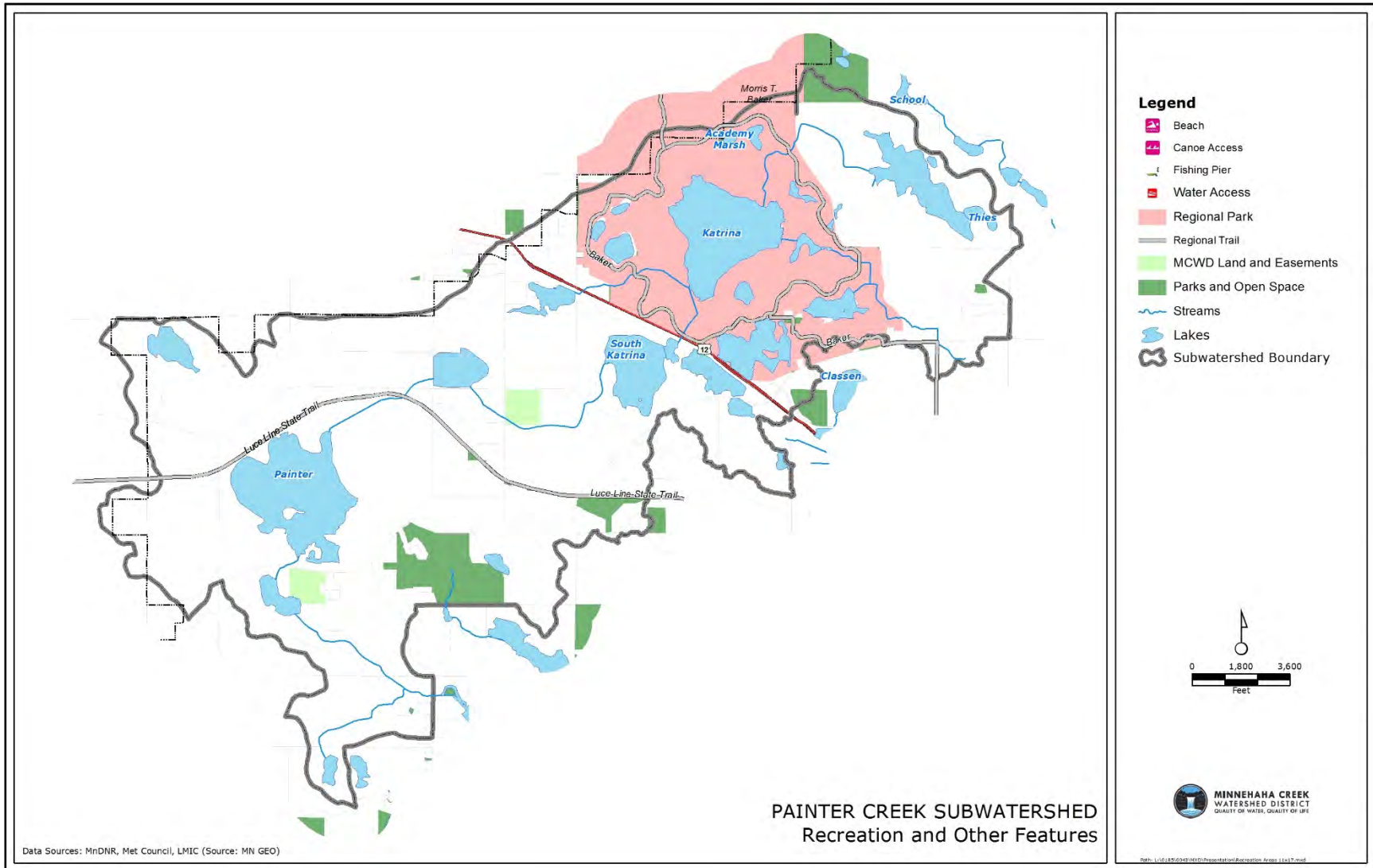


Figure 3.99. Painter Creek subwatershed recreation and other features.

Studies and Assessments:

- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- Minnesota Land Cover Classification System (MLCCS)
- MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS), EOR 2003
- 2003 Upper Watershed Stream Assessment, Wenck 2004
- 2013 Macroinvertebrate Assessment, RMB 2014
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- National Wetland Inventory
- Hennepin County Geologic Atlas
- Functional Assessment of Wetlands, 2003
- Minnesota Biological Survey (MBS)
- 2020 Metropolitan Urban Service Area (MUSA)
- Minnesota Historic Features database
- Feasibility Study: Painter Creek (PC-2, 6 and 7) Volume and Load Reduction, Wenck 2012
- Painter Creek Feasibility Study, EOR 2004
- Environmental Assessment Worksheet (EAW) Highway 26 Wetland Restoration, EOR 2005
- Phase I Environmental Site Assessment (Palm Parcel (Potato Farm), West Independence, MN), Wenck 2007

3.10 SCHUTZ LAKE SUBWATERSHED

Schutz Lake Subwatershed is one of the smaller subwatersheds throughout MCWD. It has a mixed land use - open space in Carver Park Reserve in the north, residential use in the east and agricultural use in the south. Wetlands, forests and woodlands are patchy throughout the subwatershed, but mostly concentrated around Schutz Lake. The subwatershed drains into Schutz Lake and then the lake drains into Lake Minnetonka: Smithtown Bay. The nutrient contribution to Lake Minnetonka from the Schutz Lake Subwatershed is not well understood. Table 3.101 below shows the area of the Schutz Lake subwatershed in acres by individual city, in total and as a percentage of the total subwatershed (Figure 3.101).

Table 3.101. Cities in the Schutz Lake subwatershed.

City	Area (Acres)	% of Subwatershed
Victoria	969.2	100%
Total	969.2	100%

Source: MCWD

Watershed Description and Hydrology:

The Schutz Lake subwatershed is rolling and hilly with steep slopes abutting Schutz Lake and the wetlands to the north. A portion of the northwestern subwatershed is located within the Carver Regional Park Reserve, while the southern subwatershed contains lands that are part of the University of Minnesota Horticultural Research Center and Landscape Arboretum. The southern subwatershed contains agriculture and scattered residential development and drains through Schutz Creek north under Highway 5 to Schutz Lake. The lake dominates the northern subwatershed, with some residential development on its east side. Schutz Lake outlets into a large wetland that discharges to an outlet under Highway 7 into Smithtown Bay: Lake Minnetonka. For information regarding geology and soils in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (Figure 3.102). The subwatershed is bisected by Highway 5. The lake dominates the north, with the forest, woodland and grasslands of the Carver Park Reserve to the west and residential areas with low to medium impervious surface to the east. The southern half of the subwatershed is maintained or natural grassland and agriculture with scattered residential development.

The *2003 MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Schutz Lake subwatershed into four units, designated SL-1 through SL-4 (Figure 3.103).

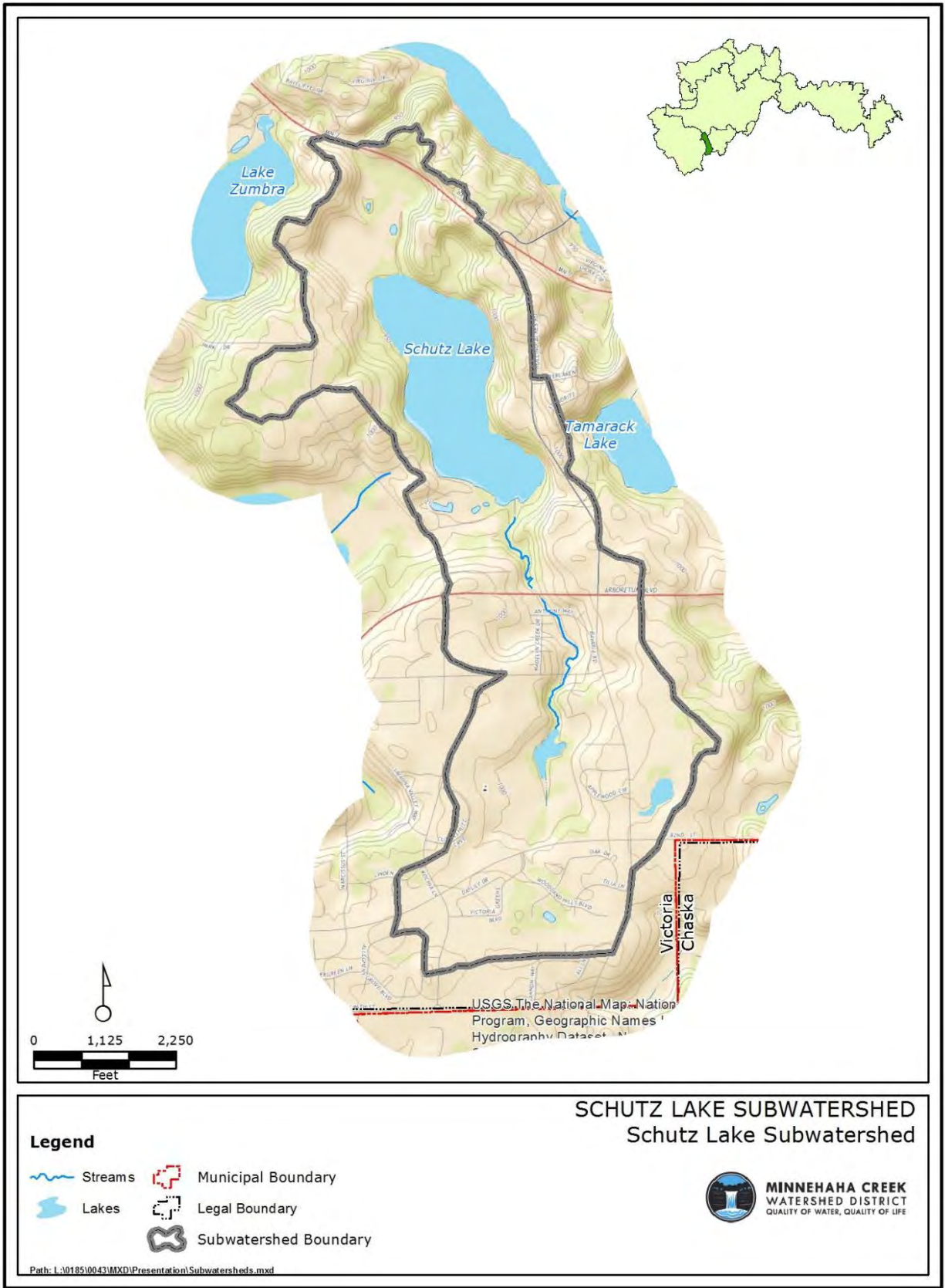


Figure 3.101. The Schutz Lake subwatershed.

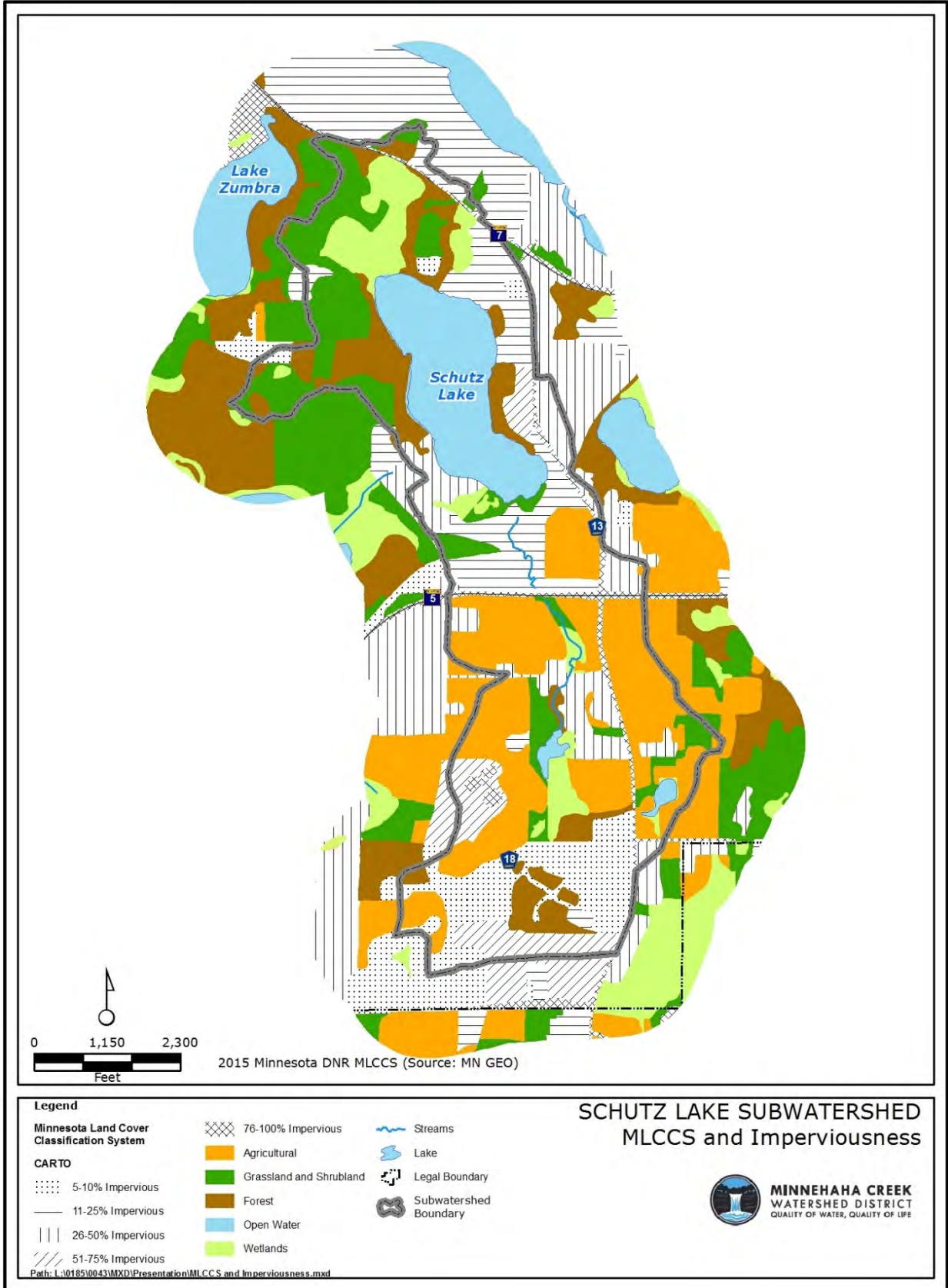


Figure 3.102. Schutz Lake subwatershed MLCCS and imperviousness.

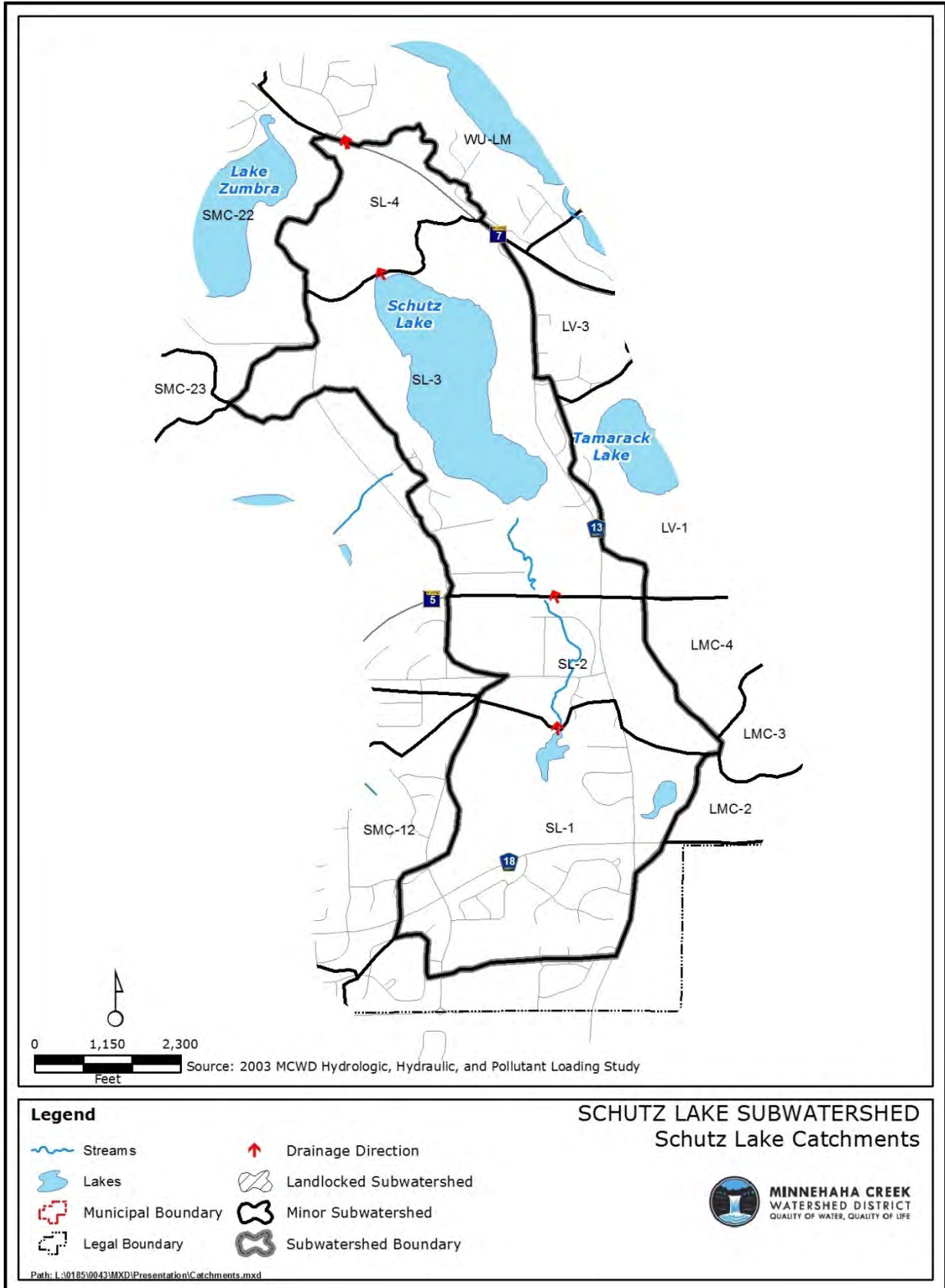


Figure 3.103. Schutz Lake catchments.

Water Quality:

The following are summaries of the characteristics and classifications of lakes and streams within the subwatershed including water quality goals and trends.

Lakes:

Schutz Lake is the primary receiving water within the subwatershed, and is classified by the DNR for shoreland management purposes as a Recreational Development lake (Figure 3.104). Schutz Lake is not on the State's Impaired Waters list. However, the lake is eutrophic, with observations of greenish-brown water (an indication of algae). Tables 3.102 and 3.103 below detail the physical and water quality characteristics of Schutz Lake includes the DNR shoreland management classification.

A Mann-Kendall trend analysis was performed on lake water quality data for the period 2002-2015. This analysis showed no trend in total phosphorus concentration or lake clarity, but showed a statistically significant ($p < 0.05$) degrading trend in chlorophyll-a, which is a measure of algal growth. For more information please refer to the District's Water Quality (Hydrodata) reports.

Table 3.102. Physical characteristics of lakes in the Schutz Lake subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Schutz	106	49	8:1	Recreational Development

Source: Minnesota DNR.

Table 3.103. Selected water quality goals and current conditions of lakes in the Schutz Lake subwatershed.

Lake	State TP Standard ($\mu\text{g/L}$)	2007 Plan Goal TP ($\mu\text{g/L}$)	Trend	2002-2015 Summer Average		
				TP ($\mu\text{g/L}$)	Chl-a ($\mu\text{g/L}$)	Secchi (m)
Schutz	40	40	Degrading	39	22	1.6

TP = total phosphorus, Chl-a =chlorophyll-a, Secchi = water clarity.

Source: MCWD.

Streams:

Schutz Creek conveys discharge through the upper subwatershed north under Highway 5 and empties into Schutz Lake (Figure 3.104). It is not listed as an Impaired Water; however, summer average total phosphorus concentration is greater than the nutrient component of the state's river eutrophication standard. Elevated levels of total phosphorus suggest that: 1) excess nutrients may be conveyed from the watershed to Schutz Lake through Schutz Creek, and/or 2) riparian wetlands in the watershed may be discharging phosphorus to the stream, indicating wetland disturbance. Tables 3.104 and 3.105 below detail the physical and water quality characteristics of streams and tributaries within the subwatershed.

Table 3.105 shows the average concentrations at the monitoring site of the Schutz Lake Creek outlet. Maintaining sufficient DO is necessary to support aquatic life. The DO state standard requires the stream to never fall below 5 mg/L DO. The most recent DO readings available by the District were above the standard. For more information, refer to District's Water Quality (Hydrodata) reports.

Table 3.104. Major streams in the Schutz Lake subwatershed.

Stream	Length (mi)
Schutz Lake Creek Inlet (CSC01)	1.14

Table 3.105. Current conditions of streams in the Schutz Lake subwatershed.

See Figure 3.104 for monitoring locations.

Stream	Trend	2006-2015 Annual Average			
		TP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)
Schutz Lake Creek Inlet (CSC01)	No trend	182	1.23	12	54*

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride.

*Cl data 2008-2015

Source: MCWD.

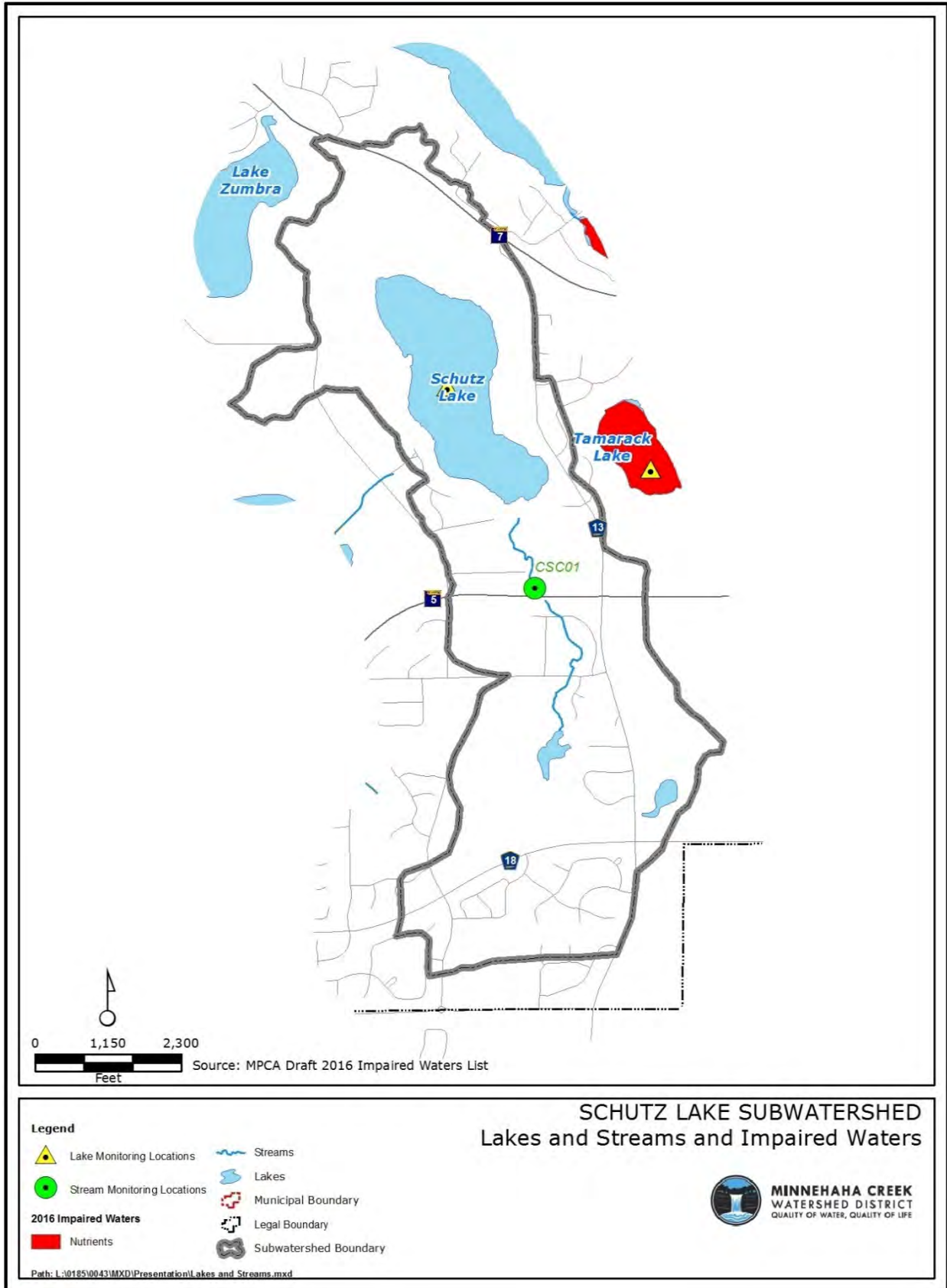


Figure 3.104. Schutz Lake subwatershed lakes and streams and Impaired Waters.

Wetlands:

According to the updated NWI, wetlands, including lakes, cover over 20 percent of the watershed’s surface (Figure 3.105 and Table 3.106). A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients to and from the subwatershed. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands.

Table 3.106. National Wetland Inventory wetland types in the Schutz Lake Creek subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	39.2	4.0
2 - Wet Meadow	-	-
3 - Shallow Marsh	38.2	3.9
4 - Deep Marsh	5.8	0.5
5 - Open Water	114.8	11.8
6 - Scrub Shrub	0.9	<0.1
7 - Forested	-	-
8 - Bog	-	-
Riverine	-	-
Wetland Total	198.8	20.5
Upland	770.2	79.5
TOTAL	969.0	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream base flow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

Infiltration potential of the upland areas within the subwatershed is generally medium, with the areas of loamy clay soils classified as low potential. Because of the organic nature of the soils in the wetland areas, generally, the infiltration potential there is variable. The *Carver County Water Resource Management Plan* classifies the groundwater resources of most of the western subwatershed area as being of medium to low sensitivity to pollution, and the major wetland areas on the north and in the south as being highly sensitive.

The western edge of the subwatershed has been designated by the Minnesota Department of Health as a Drinking Water Sensitivity Management Area (DWSMA) and Wellhead Protection Area for the City of Victoria. Figure 3.106 shows areas in the subwatershed with groundwater sensitivity and that are designated Wellhead Protection Areas.

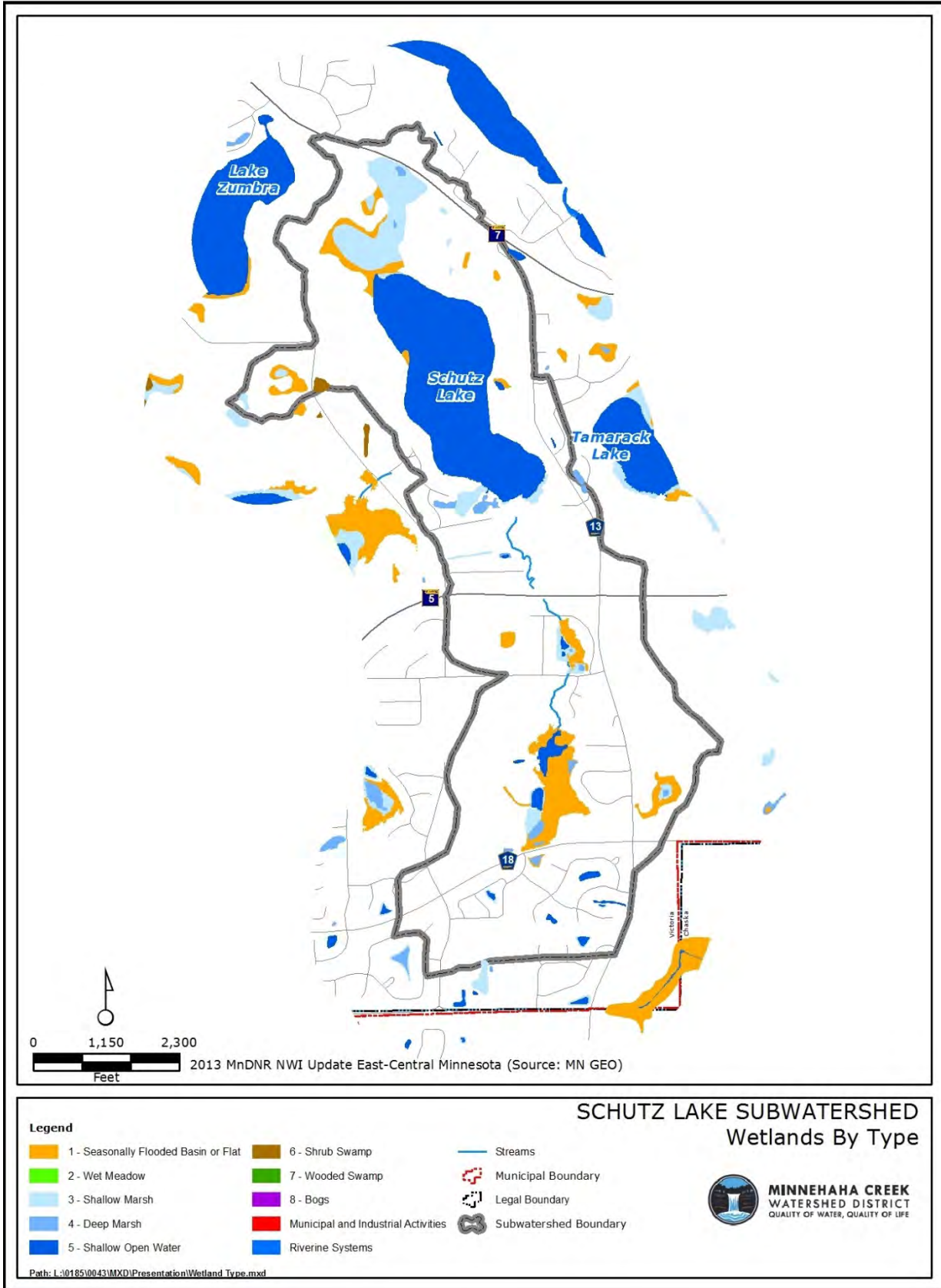


Figure 3.105. Schutz Lake subwatershed wetlands by type.

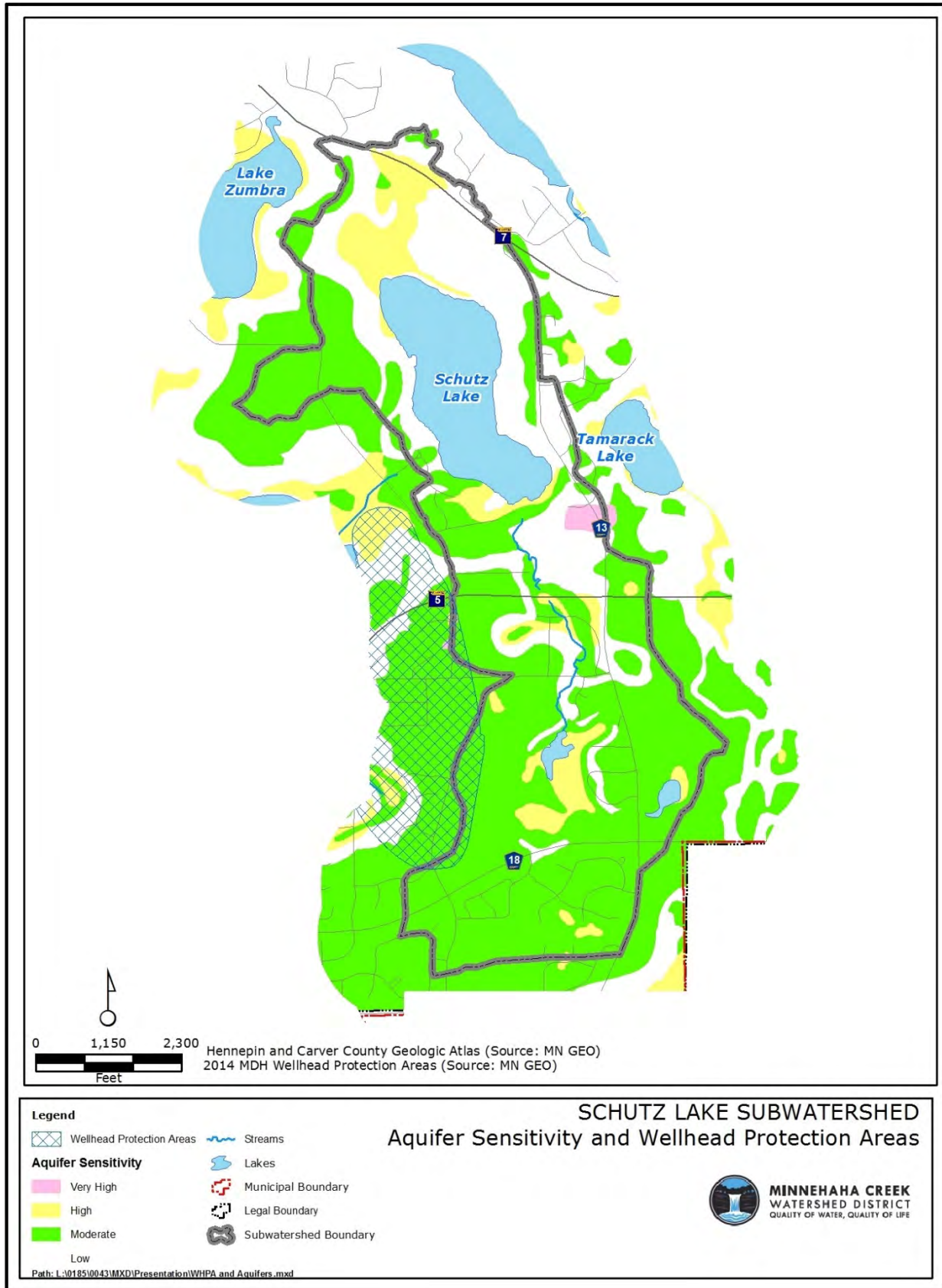


Figure 3.106. Schutz Lake subwatershed aquifer sensitivity and Wellhead Protection Areas.

Water Quantity:

There are no landlocked basins in this subwatershed.

To assess change in water yield, a Mann-Kendall statistical trend test was performed on annual water yield data for the monitoring station downstream of Highway 5. Water yield between 2006 and 2015 showed a statistically significant ($p=0.03$) increasing trend. There has been some development in the upper subwatershed during that period.

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity, habitat diversity, and nutrient cycling. Nutrient cycling is described in the Water Quality section. The Schutz Lake subwatershed is being systematically evaluated by the E-Grade program in 2015-2017. At this time, only some of the E-Grade metrics have been assessed. The final E-Grade report for this subwatershed will not be available until 2018. This section summarizes ecological integrity using E-Grade and other data where available (Figure 3.107).

Lakes:

Biodiversity

Fish Community. Biodiversity is measured using the Index of Biotic Integrity (IBI) for fish developed by the DNR. MCWD surveyed Schutz Lake in 2015 for E-Grade. Schutz Lake's Fish IBI score is 22.8, which is classified as Poor, with the community showing obvious signs of anthropogenic disturbance compared to other similar lakes. Schutz Lake was last surveyed by the DNR in 1991. At that time the fish population was dominated by bluegill, black crappie, and largemouth bass in above average numbers.

Aquatic Vegetation Community. Biodiversity is determined by the number and variety of species, or richness. A Floristic Quality Index (FQI) assessment was completed for the Schutz Lake aquatic vegetation community. The FQI score was 9.4, which is classified as Degraded, with very low species richness and with a community comprised of non-native and/or intolerant species. Schutz Lake is infested by Eurasian watermilfoil.

Habitat diversity

Aquatic Vegetation Community. Habitat diversity is determined by the percent occurrence of species, or the extent to which it may be dominated by a few species. The habitat diversity of the vegetation community has not been assessed yet.

Shoreline Health. Shoreline health is assessed looking at shoreline vegetative cover and the relative human disturbance. The MnDNR is using the Score the Shore protocol to relate shoreline conditions to fish community structure using the fish IBI metric. Score the Shore data is available, but has not been assessed yet through E-Grade. Aerial photos, however, show that much of Schutz Lake has significant woodland or wetland fringes, which are beneficial for controlling runoff and supporting emergent vegetation at the shoreline. For more information, refer to the Schutz Lake Subwatershed E-Grade Report, 2018.

Streams:

Biodiversity

Fish Community. No fish IBI data is available for the streams in this subwatershed.

Macroinvertebrate Community. Macroinvertebrate samples were collected in 2013 and 2015 in Schutz Creek. The M-IBI scores were 19 and 28, below the M-IBI threshold of 37 for a Southern Streams riffle/run stream. The community lacked species richness and was missing certain classes of organisms, which is indicative of poor water quality or habitat alteration.

Habitat diversity

Habitat Complexity. E-Grade uses the Minnesota Stream Habitat Assessment tool to assess habitat complexity in Schutz Creek. Habitat Complexity is determined by evaluating three zones: in-stream, riparian or near-stream, and channel morphology, or channel form. Schutz Creek scored 27 of 46 points for conditions in-stream, which is classified as Good. The stream bed was a good mix of cobble, gravel and sand, there were riffles and pools present, and multiple types of cover, although in low quantities. The riparian zone was scored 10 of 14, also Good. The riparian zone is moderately wide, the banks exhibit little erosion, and riparian tree cover provides adequate shading. Channel morphology was scored 28 out of 35, classified Exceptional. The channel was very sinuous, was well developed with variable depths, pools, and riffles, and minimal modifications.

Connectivity. Connectivity is defined by two metrics: presence or absence of barriers, and access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. Schutz Creek is classified as Poor by the presence of culverts at Highway 5 and at the trail crossing.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS concentrations increase turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. A stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, can be stressful to organisms. In addition, streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is not available, but instantaneous flow has been measured since 2006. Annual average flow for each year was computed first, and then all the years' averages were averaged together. Annual average flow at CSC01 was 1.44 cfs indicating generally low flow conditions at time of data collection.

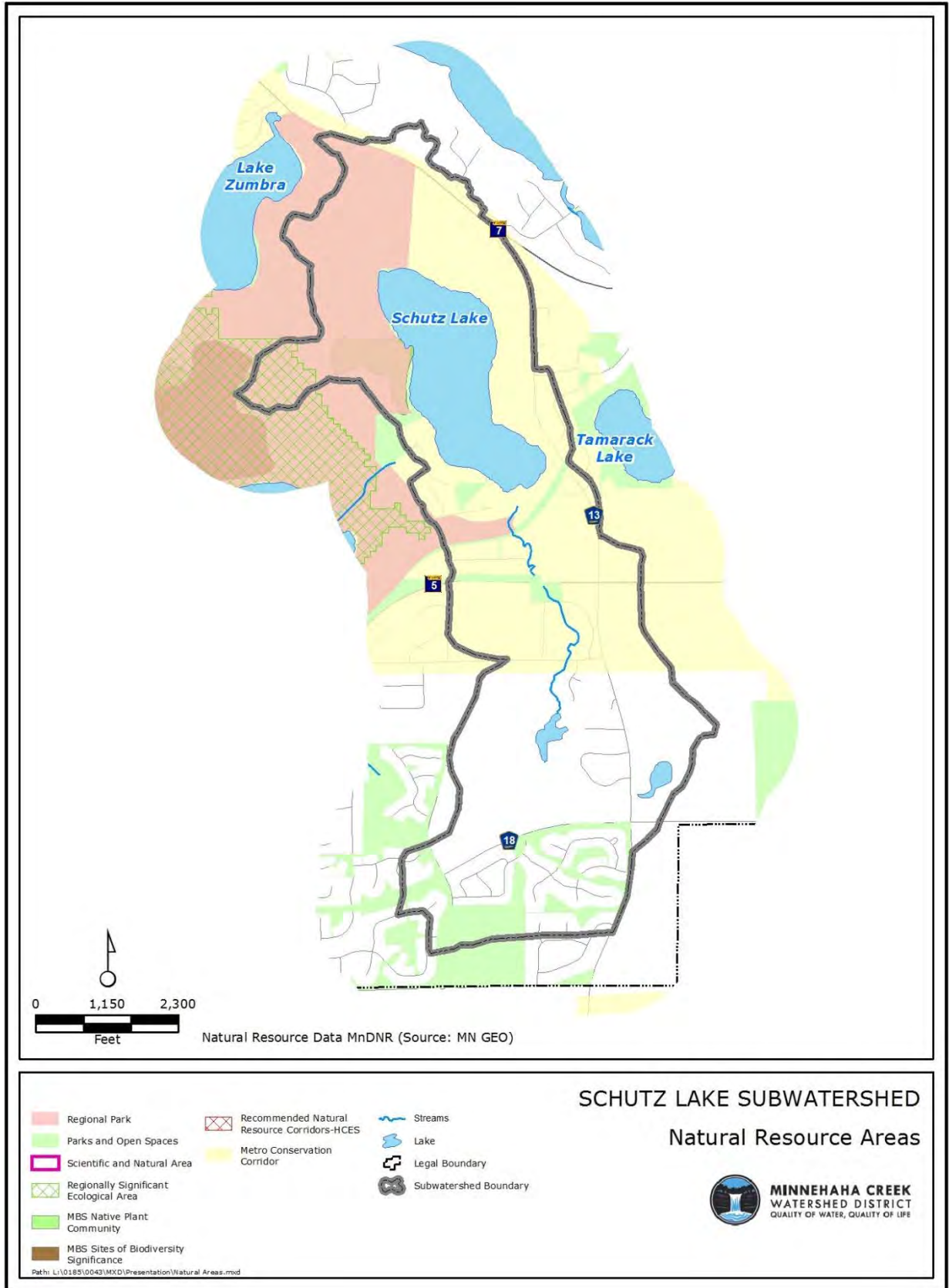


Figure 3.107. Schutz Lake subwatershed natural resource areas.

Wetlands:

Biodiversity

Vegetation Community. Floristic Quality Index (FQI) data are available for seven wetlands in this subwatershed. One small wetland to the west of Mt. Olivet Church on Rolling Acres Road was classified as Good floristic quality. Four wetlands, including the large wetland at the headwaters of Schutz Creek to the northeast of Holy Family Catholic High School, were classified as Poor. Two small wetlands in the residential area to the north of Schutz Lake were classified as Degraded. Both were heavily infested with buckthorn, reed canary grass, and Canadian wood-nettle.

Habitat diversity

Connectivity. Few wetlands are present in the subwatershed, therefore there is limited opportunity to provide connectivity.

Size. Larger wetlands are more likely to support a notable on-site diversity and/or abundance of wildlife species. There are several large wetlands present in the west of the watershed, along the headwaters of Schutz Creek to Schutz Lake as well as on the north side of Schutz Lake.

Shoreline Protection. Riparian wetlands can provide significant shoreline protection and support emergent vegetation at the shoreline. The *Functional Assessment of Wetlands* evaluated riparian wetlands for their ability to protect lake or stream shoreline. About 30 percent of the Schutz Lake shoreline is protected by wetland.

Uplands:

Biodiversity

Within the Carver Park Reserve on the west side of the lake is a large patch of maple-basswood forest that has been designated on the Minnesota Biological Survey (MBS) as being a high-value native plant community. The larger area within Carver Park Reserve has been designated by the DNR as a regionally significant ecological area within the Metro area. (Figure 3.107).

Habitat diversity

Regionally significant ecological areas are places where larger tracts of minimally disrupted land provide habitat complexity. A portion of the northwestern subwatershed is located within the Carver Regional Park Reserve, while the southern subwatershed contains lands that are part of the University of Minnesota Horticultural Research Center and Landscape Arboretum.

Thriving Communities:

Land use:

Table 3.107 below shows the land uses within the area of the Schutz Lake subwatershed in acres and as a percentage of the total subwatershed. The principal land uses in the northern part of the subwatershed are single-family residential and parks and open space (Figure 3.108).

Table 3.107. 2010 land use in the Schutz Lake subwatershed.

Land Use 2010	Acres	% of Subwatershed
Parks and Open Space	232.5	23.9
Single - Family Residential	219.2	22.6
Agricultural	155.9	16.0
Institutional	117.7	12.1
Water	109.8	11.3
Vacant or Undetermined	82.3	8.4
Multi - Family Residential	26.7	2.7
Commercial	13.3	1.3
Roads and Highways	11.5	1.1
Industrial	N/A	N/A

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

There are no public beaches or accesses to the lake; however, there is a private access that the property owner has granted permission for a fee to anglers and monitoring agencies. The Carver Park Reserve abuts the northwesterly portion of the lake. A park trail loops through the area but does not access the lake. The Southwest Hennepin LRT Regional Trail crosses the subwatershed and portions of the southern subwatershed are part of the University of Minnesota Horticultural Research Center and Landscape Arboretum (Figure 3.109).

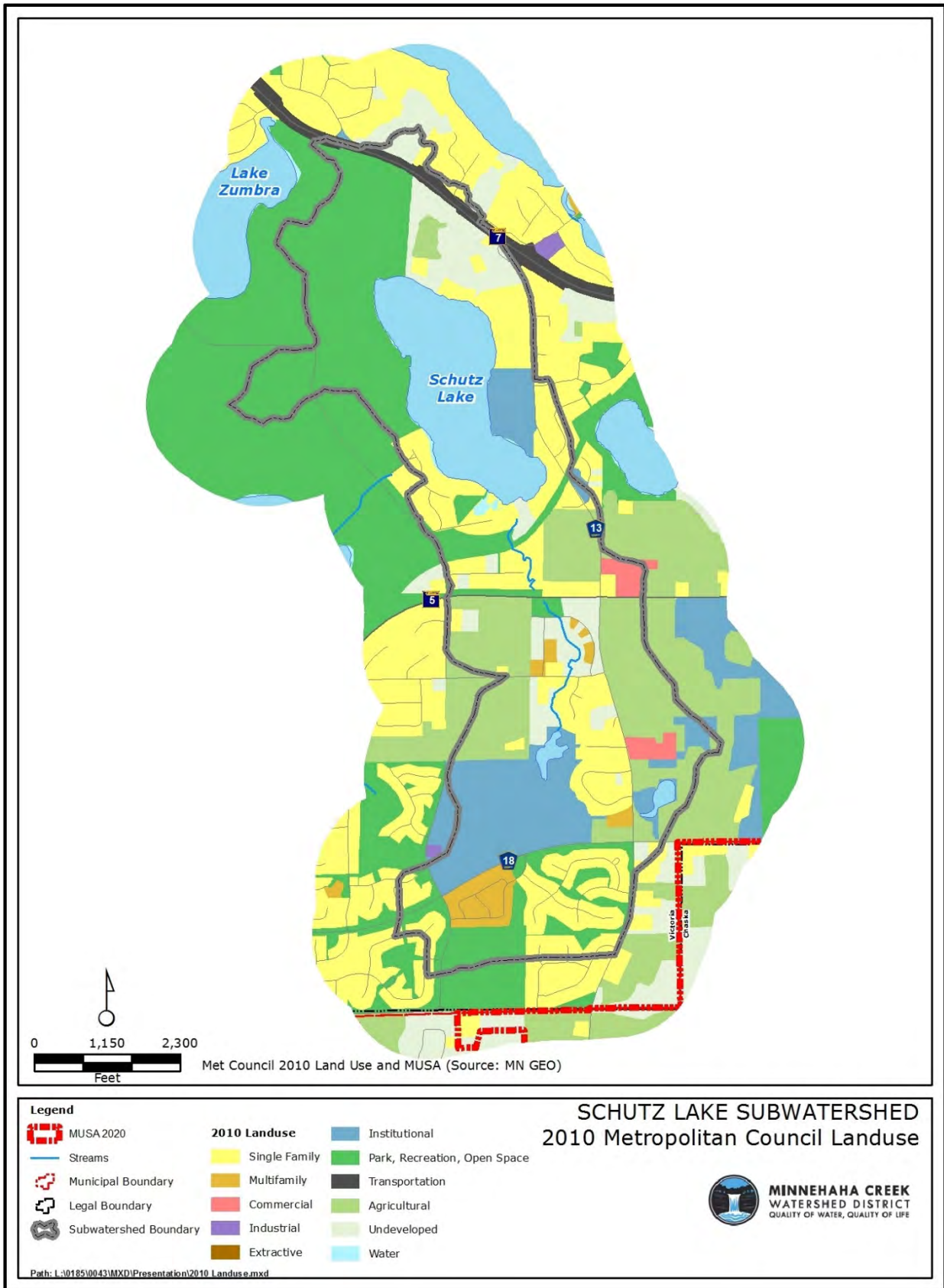


Figure 3.108. Schutz Lake subwatershed 2010 Metropolitan Council land use.

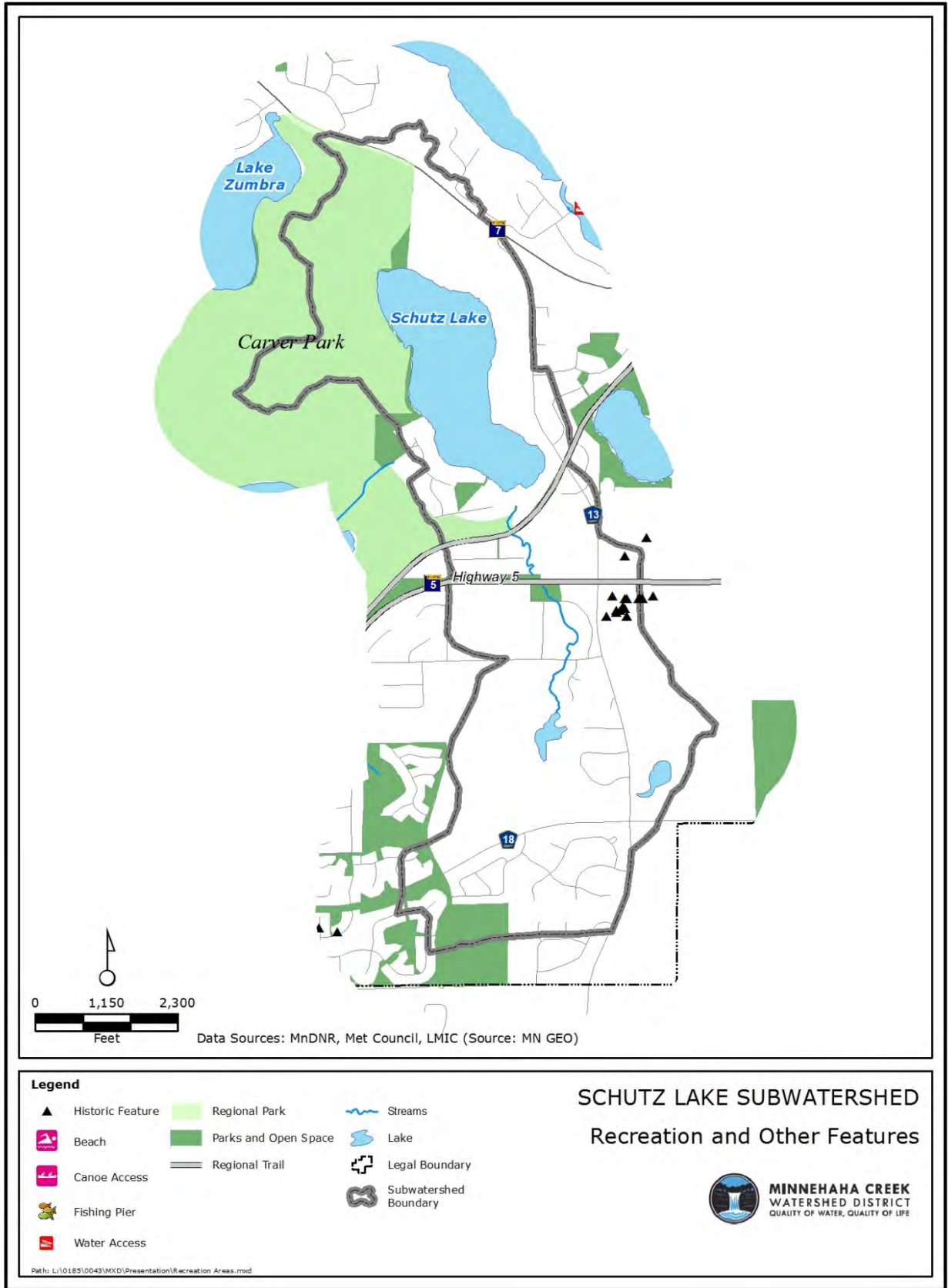


Figure 3.109. Schutz Lake subwatershed recreation and other features.

Studies and Assessments:

- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- Minnesota Land Cover Classification System (MLCCS)
- MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS), EOR 2003
- 2013 Macroinvertebrate Assessment, RMB 2014
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- National Wetland Inventory
- Carver County Water Resource Management Plan
- Functional Assessment of Wetlands, 2003
- Minnesota Biological Survey (MBS)
- Schutz Lake Subwatershed E-Grade Report, Wenck 2018

3.11 SIX MILE MARSH SUBWATERSHED

Six Mile Marsh Subwatershed is the third largest subwatershed within Minnehaha Creek Watershed. The land use is primarily agricultural, but residential and commercial development is on the rise as cities and townships within the subwatershed grow. Natural, open areas reside within the Carver Park Reserve, which is managed by Three Rivers Park District. The land cover within Carver Park Reserve is grassland, woodlands, forest and wetlands that surrounds the following lakes: Steiger, Lundsten, Auburn and portions of Zumbra. These lakes are part of a larger series of lakes within the subwatershed nicknamed the ‘western chain of lakes.’ Six Mile Creek, which is actually 11 miles long, flows through the “western chain of lakes,” beginning with Piersons Lake and passes through Mud Lake wetland before discharging into Lake Minnetonka: Halsted Bay. Table 3.111 below shows the area of the Six Mile Marsh subwatershed in acres by individual city, in total and as a percentage of the total subwatershed (Figure 3.111).

Table 3.111. Cities and Townships in the Six Mile Marsh subwatershed.

City	Area (Acres)	% of Subwatershed
Minnetrissa	3,572.2	20.9%
St. Bonifacius	662.2	3.8
Victoria	4,476.2	26.2
Laketown Township	8,154.0	47.8
Watertown Township	167.9	0.9
Total	17,032.8	100%

Source: MCWD

Watershed Description and Hydrology:

The Six Mile Marsh subwatershed has a rolling landscape with low slopes, small streams, numerous lakes and peat bogs. The subwatershed is drained by Six Mile Creek, which flows 11 miles from Piersons Lake to Halsted Bay: Lake Minnetonka. Many of the subwatershed’s lakes are located in the Carver Regional Park Reserve.

Land cover is classified by the Minnesota Land Cover Classification System (MLCCS) (Figure 3.112). The subwatershed is dominated by agriculture in the southwest and northwest, while forest and woodland along with grass and shrubland is predominant through the central section. Smaller areas of lower density development are present in the southeast corner of the subwatershed. Wetlands are scattered throughout the subwatershed.

For more information regarding geology and soils in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

The *2003 MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS)* subdivided the Six Mile Marsh subwatershed into 66 subwatershed units, designated SMC-1 through SMC-66 (Figure 3.113). More detailed information about the hydrology of the subwatershed can be found in the *Six Mile Creek Diagnostic Study* (Wenck 2013). That study divided the subwatershed into five Watershed Management Units (MUs): including Piersons-Marsh-Wassermann, Carver Park Reserve, Turbid-South Lundsten, Auburn-North Lundsten, and Parley-Mud.

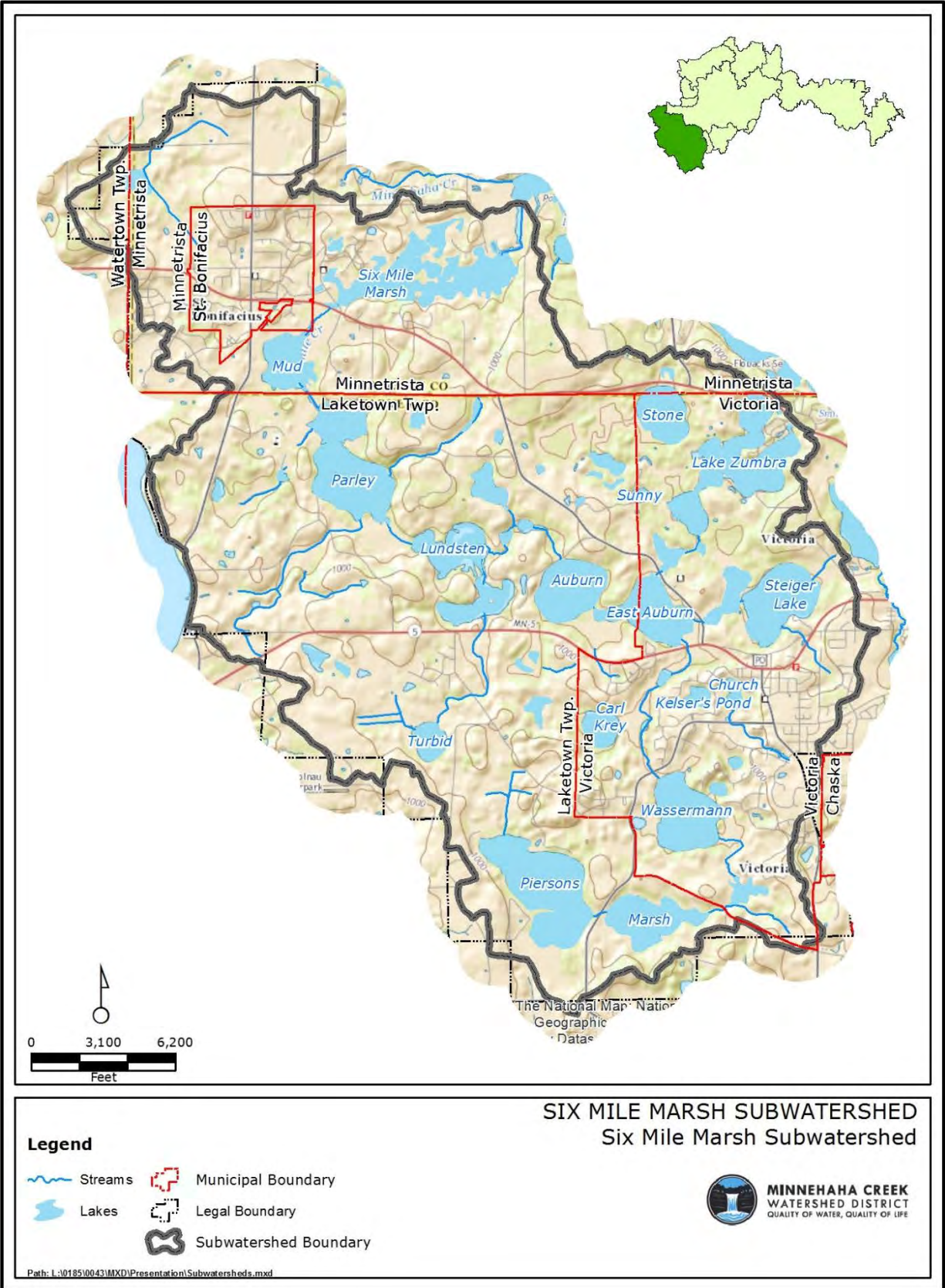


Figure 3.111. The Six Mile Marsh subwatershed.

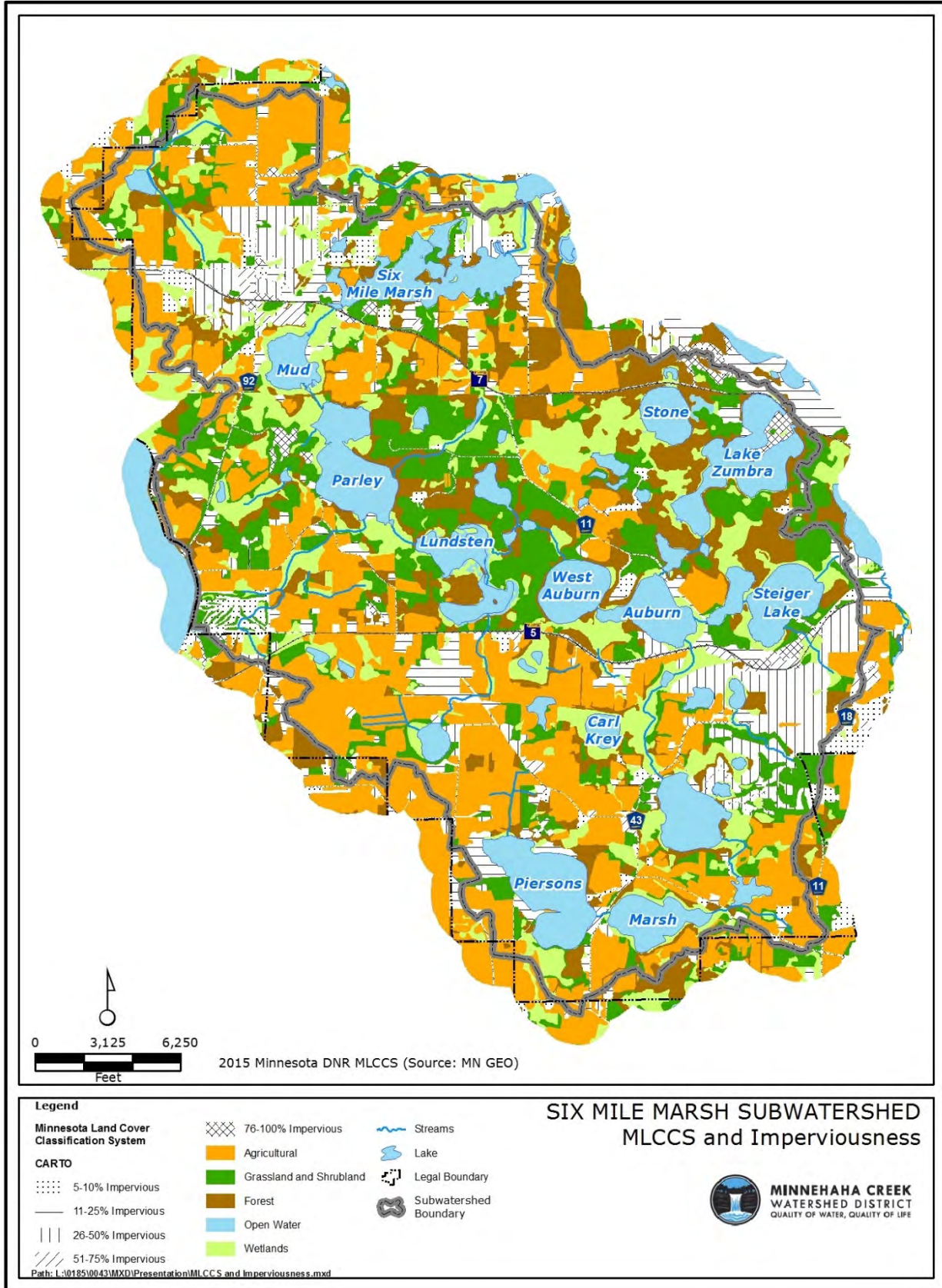


Figure 3.112. Six Mile Marsh subwatershed MLCCS and imperviousness.

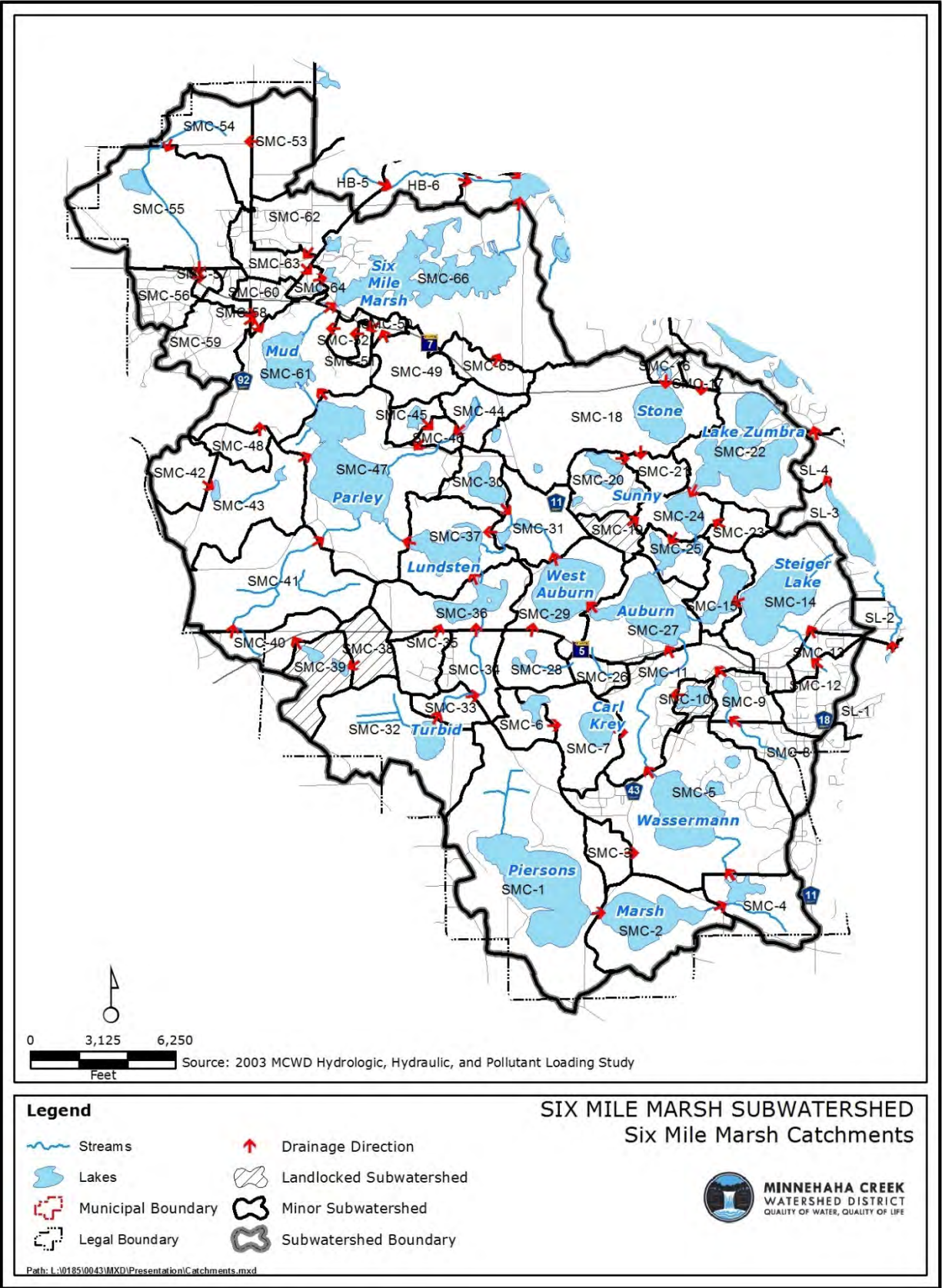


Figure 3.113. Six Mile Marsh subwatershed catchments.

Water Quality

The following are summaries of the characteristics and classifications of lakes and streams within the subwatershed including water quality goals and trends.

Lakes:

The subwatershed includes several lakes through which Six Mile Creek flows, as well as other lakes not associated with that stream. Many of the lakes are located within the Carver Park Reserve (Figure 3.114). Most of the lakes are monitored either as part of the District’s monitoring program or by Three Rivers Park District. Little or no water quality data is available for smaller lakes scattered throughout the subwatershed. Tables 3.112 and 3.113 below detail the physical and water quality characteristics of the lakes and DNR shoreland classification within the subwatershed.

The following lakes in the Six Mile Marsh subwatershed are on the State’s Impaired Waters List for excessive phosphorus: West Auburn, Parley, Stone and Wassermann. *Six Mile Creek Diagnosis Study* and the *Upper Minnehaha Creek Watershed Lakes TMDL* highlight whether external, internal or both are the sources contributing excessive nutrients to these lakes. Lakes Zumbra-Sunny, Steiger, and Wassermann are on the State’s Impaired Waters List for Mercury in Fish Tissue, and is included in the statewide mercury TMDL. For more information regarding water quality in the subwatershed, please refer to the District’s Water Quality (Hydrodata) Reports and the *Six Mile Creek Diagnostic Study*.

Table 3.112. Physical characteristics of lakes in the Six Mile Marsh subwatershed.

Lake	Surface Area (acres)	Maximum Depth (ft)	Watershed to Lake Area Ratio	DNR Classification
Auburn East	148	40	52:1	Recreational Development
Auburn West	145	80	54:1	Recreational Development
Carl Krey	44	15	8:1	Natural Environment
Church	12	54	28:1	Recreational Development
Lundsten	181	10	60:1	Natural Environment
Mud	144	6	105:1	Natural Environment
Parley	257	19	48:1	Recreational Development
Piersons	267	119	5:1	Recreational Development
Stone	96	30	9:1	Natural Environment
Steiger	166	37	5:1	Recreational Development
Turbid	39	37	14:1	Natural Environment
Wassermann	170	41	17:1	Recreational Development
Zumbra	271	58	2:1	Recreational Development

Source: Minnesota DNR.

Table 3.113. Selected water quality goals and current conditions of lakes in the Six Mile Marsh subwatershed.

Lake	State TP Standard (µg/L)	2007 Plan Goal TP (µ/L)	Trend	2001-2015 Summer Average			Years Monitored
				TP (µg/L)	Chl-a (µg/L)	Secchi (m)	
Parley	<60	96	No trend	95	69	0.7	1999-2015
Piersons	<40	27	No trend	26	9	2.4	1997-2015
Stone	<40	10	Imp chl-a	40	13	2.4	2007-2015
Steiger	<40	14	Imp chl-a, SD	35	14	2.2	2002-2015
Wassermann	<40	77	No trend	78	51	0.9	1997-2015
Zumbra	<40	9	Imp all	25	8	3	1994-2015

TP = total phosphorus, Chl-a =chlorophyll-a, SD=Secchi depth, Imp = improving, Deg = degrading.

Source: MCWD, MPCA.

Streams:

There is one primary stream within the subwatershed: Six Mile Creek, which flows to Halsted Bay. Several other small streams and channels provide drainage and local conveyance within the subwatershed. The creek was channelized as Judicial Ditch #2 in 1903 and is comprised of a series of small channels connecting flow-through lakes and wetlands. There are no known storm sewer outfalls to the creek, mainly due to minimal near-stream development. There are 5 bridge crossings, and some culvert crossings, which are mainly park trail, and path crossings. Table 2.64 below details the water quality characteristics of Six Mile Creek. Due to its nature as short channels connecting lakes, water quality in the stream is highly influenced by outflow from those lakes.

A majority of the Six Mile Creek stations are less than the State’s river eutrophication standards for total phosphorus, except for Highland Rd (Mud Lake outlet (CSI02)). The state river eutrophication standards also look at other indicators such as chlorophyll-a, diel oxygen flux, and biological oxygen demand, for which chlorophyll-a has been assessed at the Highland Rd (CSI02) station. Chlorophyll-a concentrations are above the State’s river eutrophication standards for the response (stressor) variable. The primary nutrient cycling concern for Six Mile Creek is that it conveys phosphorus load to Halsted’s Bay: Lake Minnetonka.

Table 3.114 shows the average concentrations in Six Mile Creek to be below the 30 mg/L state standard for this ecoregion. Maintaining sufficient DO is necessary to support aquatic life. The DO state standard requires the stream to never fall below 5 mg/L DO. Six Mile Creek flows between lakes and wetlands. Monitoring data shows that stations along Six Mile Creek often fall below this standard in summer. Stations (i.e., CSI14, and CSI10) that have DO above 5 mg/L earlier in the season, can run dry by mid-late summer. Stretches of the creek that are influenced by riparian wetlands may have increase sediment oxygen demand.

For more information on Six Mile Creek and tributaries, please refer the District’s Water Quality (Hydrodata) Reports, District’s 2003 *Upper Watershed Stream Assessment*, and *Six Mile Creek Diagnostic Study*.

Table 3.114. Current conditions of streams in the Six Mile Marsh subwatershed.

See Figure 3.114 for monitoring locations.

Stream	Trend	2005-2015 Annual Average				
		TP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)*	Chl-a (µg/L)**
Highland Rd (CSI02)	Imp TP	155	1.90	21	30	50
Lundsten Lake Outlet (CSI01)	n/a	70	0.98	8	22	n/a
Auburn Lake Outlet (CSI09)	n/a	38	0.99	3	30	n/a
Auburn Lake Inlet (CSI05)	n/a	106	0.97	4	23	n/a
Wasserman Outlet (CSI12)	n/a	87	1.36	9	22	n/a
Marsh Lake Outlet (CSI11)	n/a	63	0.79	11	22	n/a
Piersons Lake Outlet (CSI14)***	n/a	27	0.81	9	24	n/a

TP = total phosphorus, TN =total nitrogen, TSS = total suspended solids, Cl = chloride, Imp = Improving
*Cl data 2008-2015; **Chl-a data June-Sept 2013-2015; ***All data 2010-2015

Source: MCWD.

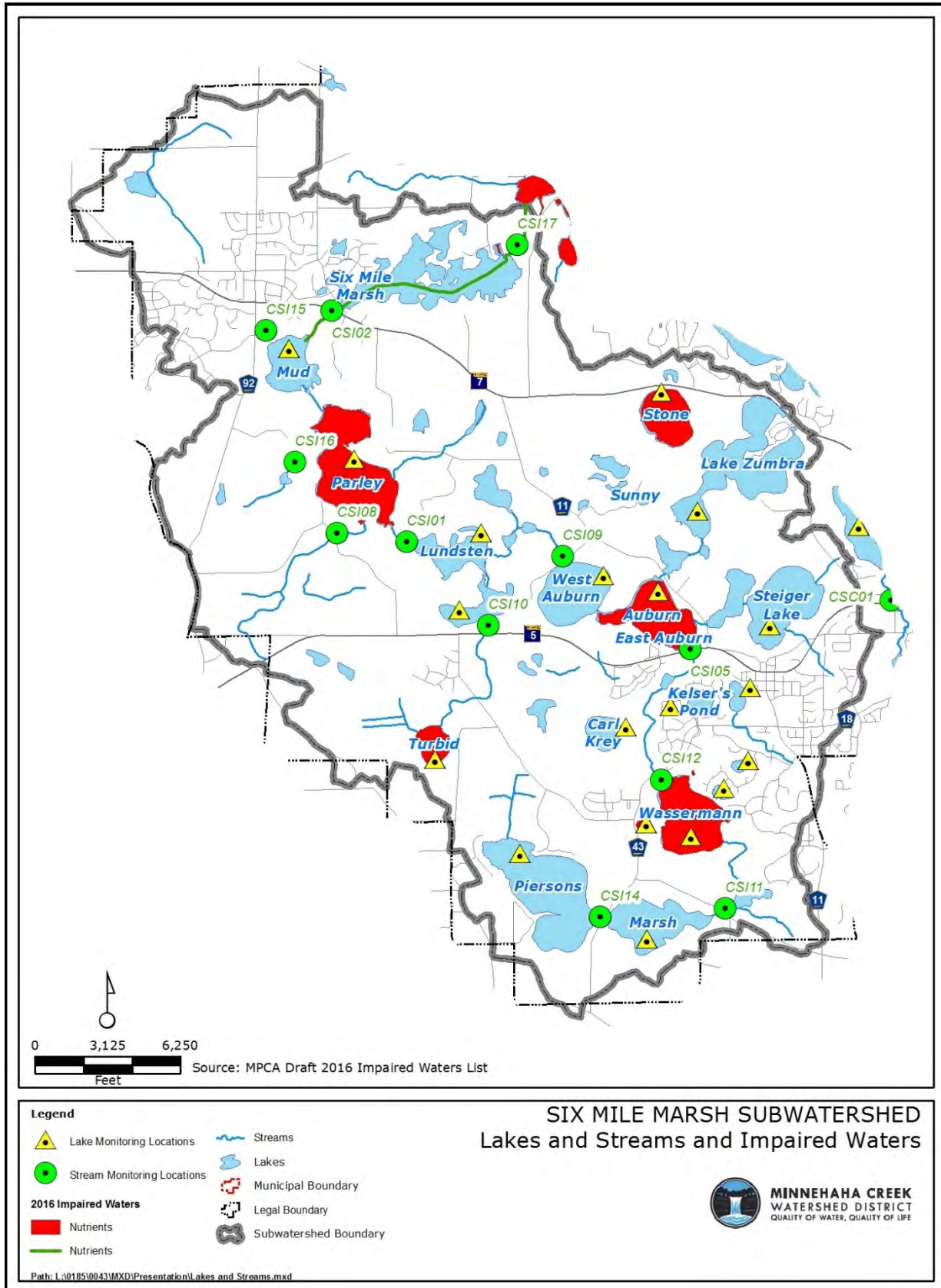


Figure 3.114. Six Mile Marsh subwatershed lakes and streams and Impaired Waters.

Wetlands:

According to the updated NWI, wetlands, including lakes, cover over 30 percent of the subwatershed’s surface (Figure 3.115 and Table 3.115). A delineation of wetland boundaries is required to be completed any time development or other impacts may occur near or in a wetland. For more information regarding wetlands in the subwatershed, please refer to the *2007 MCWD Comprehensive Water Resources Management Plan*.

Table 3.115. National Wetland Inventory wetland types in the Six Mile Marsh Creek subwatershed.

Circular 39 Wetland Type	Area (acres)	Percent
1 - Seasonal	881.8	17.2%
2 - Wet Meadow	37.2	0.7
3 - Shallow Marsh	1694.8	33.1
4 - Deep Marsh	147.8	2.9
5 - Open Water	2201.3	42.9
6 - Scrub Shrub	130.8	2.6
7 - Forested	12.0	0.2
8 - Bog	2.3	<0.1
Riverine	19.4	0.4
Wetland Total	5127.4	30.1%
Upland	11,905.4	69.9%
TOTAL	17,032.8	

Source: Minnesota DNR, 2013 Update East-Central Minnesota.

Groundwater:

The District’s roles in managing groundwater are to 1) promote surficial groundwater recharge to protect wetland hydrology and stream base flow, and 2) assist in protecting deeper aquifers used for drinking water by limiting infiltration in sensitive recharge areas.

Infiltration potential of the upland areas within the subwatershed is generally medium. Because of the organic nature of the soils in the wetland areas, in general infiltration potential there is variable. Groundwater sensitivity is low to medium in the uplands and high to very high in the wetlands.

Parts of the subwatershed have been designated by the Minnesota Department of Health as Drinking Water Sensitivity Management Areas (DWSMAs) and Wellhead Protection Areas for the Cities of Victoria, Minnetrista, and St. Bonifacius. Figure 3.116 shows areas in the subwatershed with groundwater sensitivity and that are designated Wellhead Protection Areas.

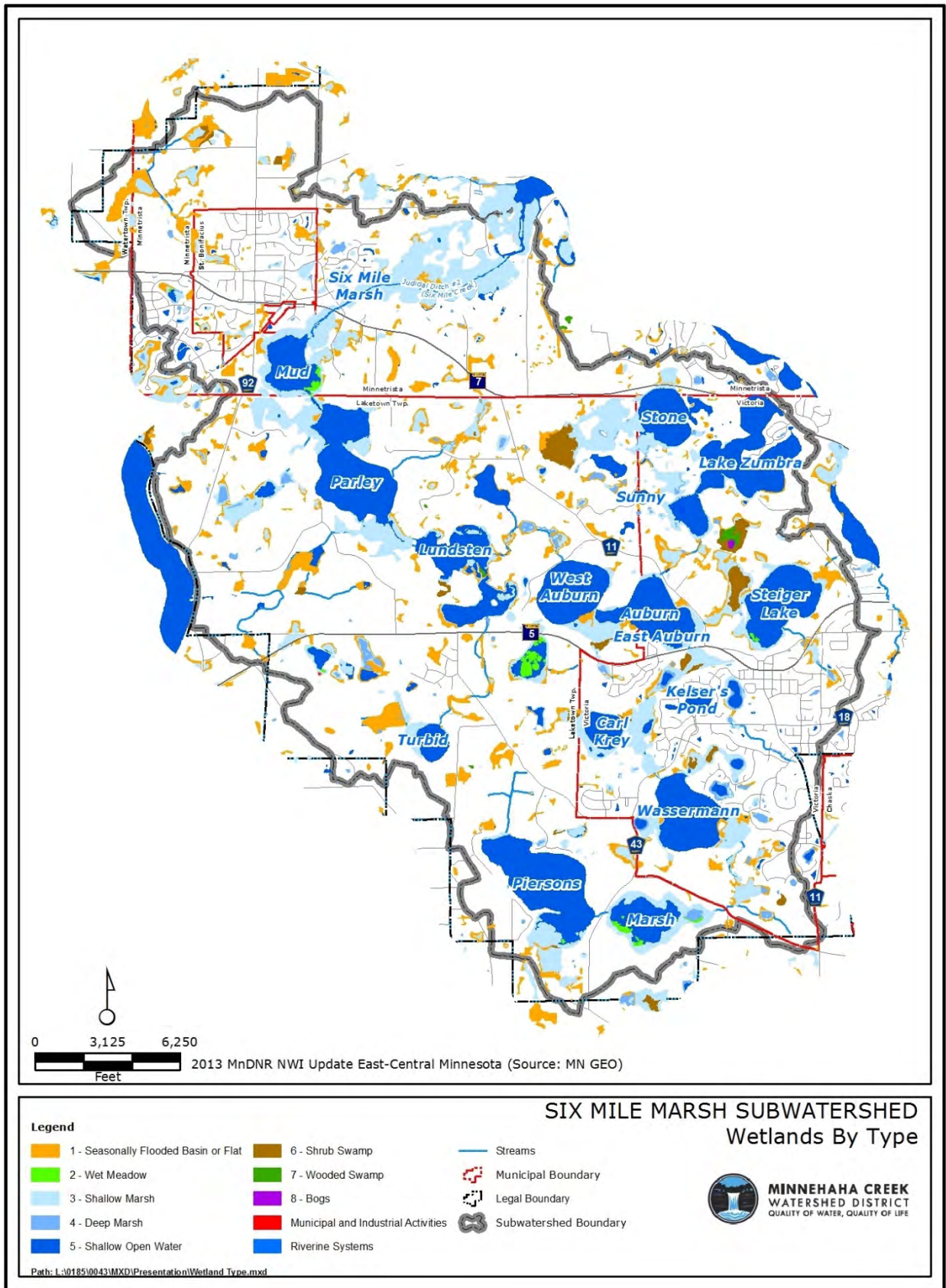


Figure 3.115. Six Mile Marsh subwatershed wetlands by type.

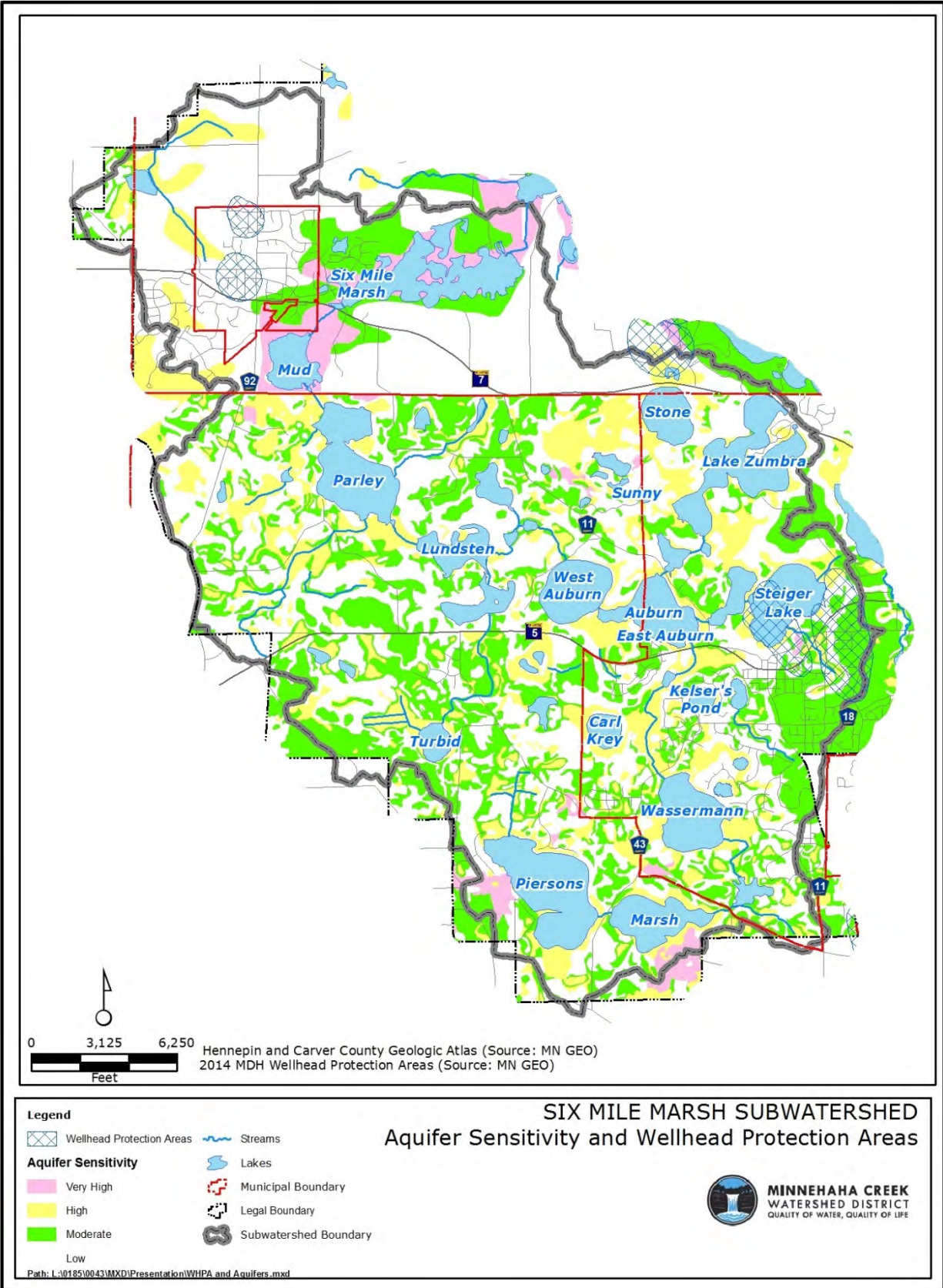


Figure 3.116. Six Mile Marsh aquifer sensitivity and wellhead Protection Areas.

Water Quantity:

Landlocked basins: There are four landlocked basins in the Six Mile Marsh subwatershed (Figure 3.113).

To assess change in water yield, a Mann-Kendall statistical trend test was performed on annual water yield data for the monitoring station at Highland Road near the outlet of the subwatershed. Water yield did not exhibit any statistically significant trend upward or downward.

Ecological Integrity:

The E-Grade program defines watershed ecological integrity as the degree to which the watershed provides three key ecosystem services: biodiversity, habitat diversity, and nutrient cycling. Nutrient cycling is described in the Water Quality section. The Six Mile Marsh subwatershed is being systematically evaluated by the E-Grade program in 2015-2017. At this time, only some of the E-Grade metrics have been assessed. The final E-Grade report for this subwatershed will not be available until 2018. This section summarizes ecological integrity using E-Grade and other data where available (Figure 3.117).

Lakes:

Biodiversity

Fish Community.

Piersons-Marsh-Wassermann MU: E-Grade data that is available indicates F-IBI scores for Piersons, Wassermann lakes and Kelser's Pond are classified as Poor. This score means the biodiversity has been disturbed and the IBI is below the state threshold. For more information, refer to *Six Mile Creek Diagnostic Study, Six Mile Carp Assessment, and Six Mile Marsh Subwatershed E-Grade Report*.

Carver Park Reserve MU: E-Grade data that is available indicates F-IBI scores for Stieger and Zumbra lakes are classified as Poor. This score means the biodiversity has been disturbed and the IBI is below the state threshold. For more information, refer to *Six Mile Creek Diagnostic Study, Six Mile Carp Assessment, and Six Mile Marsh Subwatershed E-Grade Report*.

Auburn-North Lundsten MU: E-Grade data that is available indicates F-IBI scores for East and West Auburn lakes are classified as Degraded. This score means there is very low species diversity, there has been great disturbance to the fish community. The F-IBI is very below the state threshold. For more information, refer to *Six Mile Creek Diagnostic Study, Six Mile Carp Assessment, and Six Mile Marsh Subwatershed E-Grade Report*.

Turbid-South Lundsten MU: There is no F-IBI scoring available for Turbid and South Lundsten due to the small acreage of the lakes. The most recent fish survey for Turbid Lake is from 1992, more than 20 years ago. At that time, the fish population was dominated by rough fish, mostly black bullheads. No carp were captured during this sampling event. Overall, the lake had a very poor fish community. For more information, refer to *Six Mile Creek Diagnostic Study, Six Mile Carp Assessment, and Six Mile Marsh Subwatershed E-Grade Report*.

Parley-Mud MU: E-Grade data that is available indicates F-IBI scores for Parley Lake. The lake is preliminarily classified as Good, meaning they had a good variety of species, including sensitive species. For more information, refer to *Six Mile Creek Diagnostic Study, Six Mile Carp Assessment, and Six Mile Marsh Subwatershed E-Grade Report*.

Aquatic Vegetation Community.

Piersons-Marsh-Wassermann MU: Floristic quality index (FQI) score was available for the following lakes in the Management Unit including Piersons, Marsh, Wassermann, Church, Kelser's Pond, and Carl Krey Lake. Piersons

Lake is classified as Good, meaning moderate species diversity with mixed assemblage of tolerant and intolerant species. Kelser's Pond and Carl Krey are classified as Poor. Obvious signs of anthropogenic disturbance are present and low species diversity as non-native and/or intolerant species are present in these lakes. Wassermann and Church lakes are classified as Degraded. This score means there is very low species diversity, and there has been great disturbance to the vegetation community. For more information, refer to *Six Mile Creek Diagnostic Study* and *Six Mile Marsh Subwatershed E-Grade Report*.

Carver Park Reserve MU: Steiger, Zumbra and Stone have FQI data for deep lakes, and Sunny has FQI data available for shallow lakes. Zumbra Lake is classified as Good, meaning the vegetation community is beginning to show signs of anthropogenic disturbance and there is moderate species diversity. Sunny, the adjacent bay to Zumbra, and Steiger are classified as Poor. Obvious signs of anthropogenic disturbance are present and low species diversity as non-native and/or intolerant species are present in these lakes. Stone is classified as Degraded. This score means there is very low species diversity, and there has been great disturbance to the vegetation community. For more information, refer to *Six Mile Creek Diagnostic Study* and *Six Mile Marsh Subwatershed E-Grade Report*.

Auburn-North Lundsten MU: East and West Auburn lakes and North Lundsten lake have FQI scores that classifies the vegetation community as Poor. Obvious signs of anthropogenic disturbance are present and low species diversity as non-native and/or intolerant species are present in these lakes. For more information, refer to *Six Mile Creek Diagnostic Study* and *Six Mile Marsh Subwatershed E-Grade Report*.

Turbid-South Lundsten MU: South Lundsten has a FQI score that classifies the vegetation community as Poor. Obvious signs of anthropogenic disturbance are present and low species diversity as non-native and/or intolerant species are present. The FQI score for Turbid Lake classifies the vegetation community as Degraded, meaning there is very low species diversity, and there has been great disturbance to the vegetation community. For more information, refer to *Six Mile Creek Diagnostic Study* and *Six Mile Marsh Subwatershed E-Grade Report*.

Parley-Mud MU: Both Parley and Mud lakes have FQI scores that classifies the vegetation communities as Degraded. This score means that there is very low species diversity with non-native and/or intolerant species. There has been great disturbance to the vegetation community in both of these lakes. For more information, refer to *Six Mile Creek Diagnostic Study* and *Six Mile Marsh Subwatershed E-Grade Report*.

Aquatic Invasive Species:

Piersons-Marsh-Wassermann MU: Pierson, Marsh, and Wassermann lakes have Eurasian watermilfoil and curly-leaf pondweed present with Pierson Lake demonstrating the densest populations.

Carver Park Reserve MU: Zumbra and Steiger lakes have Eurasian watermilfoil and curly-leaf pondweed with Steiger being heavily infested with Eurasian watermilfoil.

Auburn-North Lundsten MU: East and West Auburn lakes are dominated by Eurasian watermilfoil, while North Lundsten and both Auburn lakes have curly-leaf pondweed.

Turbid-South Lundsten MU: South Lundsten and Turbid lakes have curly-leaf pondweed.

Parley-Mud MU: Parley Lake has curly-leaf pondweed and Eurasian watermilfoil. Mud Lake only has curly-leaf pondweed.

Habitat diversity

Aquatic Vegetation community. Habitat diversity is determined by the percent occurrence of species, or the extent to which it may be dominated by a few species. The vegetation community has not been assessed yet habitat diversity.

Shoreline Health. Shoreline health is assessed looking at shoreline vegetative cover and the relative human disturbance. The MnDNR is using the Score the Shore protocol to relate shoreline conditions to fish community

structure using the fish IBI metric. Score the Shore data is available, but has not been assessed yet through E-Grade. For more information, refer to the Six Mile Marsh Subwatershed E-Grade Report, 2018.

Streams:

Biodiversity

Fish Community. No fish IBI data is available for the streams in this subwatershed.

Macroinvertebrate Community. Macroinvertebrate samples were collected in 2003, 2013 and 2015 in Six Mile Creek. For the 2013 assessment, Six Mile Creek showed the best biological community of the Upper Watershed streams, but it is still impacted by urbanization. The M-IBI scores were 22-47. The station with M-IBI score of 47 was above the threshold for glide/pool streams. The rest of the stations were below the M-IBI threshold. Two stations that were classified as riffle/run habitat were at the M-IBI threshold for modified use. Species richness ranged from 17 to 34 taxa. Five of the six stations sampled showed good overall diversity and good POET diversity.

The 2003 assessment had M-IBI scores for most of the sites below the M-IBI threshold. However, the M-IBI does not allow discrimination between low scores due to poor water quality or low scores due to lack of habitat. Six Mile Creek showed the most diversity of the upper watershed streams, with thirteen aquatic invertebrate taxa representing thirteen families. Most of the taxa found were those that are tolerant of poor water quality, although some taxa that are less tolerant were identified in some reaches. Six Mile Creek is mainly a wetland stream, and lacks the habitat complexity necessary to sustain a varied macroinvertebrate community.

Refer to the Six Mile Marsh Subwatershed E-Grade Report (2018) for 2015 macroinvertebrate findings.

Habitat diversity

Habitat Complexity. E-Grade uses the Minnesota Stream Habitat Assessment tool to assess habitat complexity in Six Mile Creek. Habitat complexity is determined by evaluating three zones: in-stream, riparian or near-stream, and channel morphology, or channel form. For information, please refer to the Six Mile Marsh Subwatershed E-Grade report, 2018.

Connectivity. Connectivity is defined by two metrics: presence or absence of barriers, and access to floodplain. Barriers such as dams, weirs, and culverts limit or prevent organisms from moving freely in the stream. Six Mile Creek has many culverts and water control structure at Lundsten Lake outlet. For information, please refer to the Six Mile Marsh Subwatershed E-Grade report, 2018.

Water Quality. Water quality factors impacting stream habitat diversity include concentrations of TSS and DO. Higher TSS concentrations increase turbidity, which can interfere with aquatic predators seeking their prey and which can limit growth of aquatic vegetation. Refer to Water Quality section for data.

Hydrology Indicators. Stream hydrology is an important factor in habitat diversity. A stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, can be stressful to organisms. In addition, streams that periodically are dry or have minimal flow are hostile to aquatic life. Continuous streamflow data is available at Highland Rd (CSI02), Parley Lake inlet (CSI08), Lundsten Lake North outlet (CSI01), and instantaneous flow has been measured at all other stations since 2006. Instantaneous flow at CSI01 can be flashy following a clean out of the water control structure that is often obstructed by beavers, but the stream is buffered by wetlands downstream. Instantaneous flow at CSI02 is often slow with backflow conditions in the summer. Following storm events, CSI02 does receive higher flows, but the rise is gradual, not flashy. Annual average flow for each year was computed first, and then all the years' averages were averaged together. The annual average discharge at CSI02 is 16.52 cfs.

Wetlands:

Biodiversity

Vegetation Community. A high density of wetlands is present in the subwatershed. A number of them were identified in the 2003 MCWD *Functional Assessment of Wetlands* (FAW) as having exceptional to high vegetative diversity and wildlife habitat potential as well as having high aesthetic values. Tamarack swamp is present in the Carver Park Reserve and contains mostly invasive or non-native vegetation. The riparian wetlands adjacent to much of Six Mile Creek include cattails and some reed canary grasses.

Habitat diversity

Connectivity. There are numerous wetlands in this subwatershed; therefore, opportunities for connectivity is possible. For more information, refer to the Six Mile Marsh Subwatershed E-Grade Report, 2018.

Size. Larger wetlands are more likely to support a notable on-site diversity and/or abundance of wildlife species. For more information, refer to the Six Mile Marsh Subwatershed E-Grade Report, 2018.

Shoreland Protection. Riparian wetlands can provide significant shoreline protection and support emergent vegetation at the shoreline. The *Functional Assessment of Wetlands* evaluated riparian wetlands for their ability to protect lake or stream shoreline. Much of the riparian area along Six Mile Creek is wetland. For more information, refer to the Six Mile Marsh Subwatershed E-Grade Report, 2018.

Uplands:

Biodiversity

The Minnesota County Biological Survey (MCBS) identified several areas of moderate or high biodiversity significance both within and outside of the regional park, including a large area of maple-basswood forest and tamarack swamp surrounding and west of Stone, Steiger and Zumbra Lakes. Areas of (Figure 3.117). For more information, refer to the Six Mile Marsh Subwatershed E-Grade Report, 2018.

The Minnesota Natural Heritage Information System lists several rare natural features in this subwatershed. These include bald eagle, a federally-listed threatened species; trumpeter swans, a state-listed threatened species; and cerulean warbler, a bird of state species special concern; and the least darter, a fish of state species of special concern.

Habitat diversity

There are small patches of forest and woodland as well as larger, more extensive grasslands in the upland areas of the Carver Park Reserve. The forest and wetland in the subwatershed have been designated Regionally Significant Ecological Areas by the DNR, including nearly all of the Carver Park Reserve. (*MCWD Comprehensive Water Resources Management Plan*, Wenck 2007). For more information, refer to the Six Mile Marsh Subwatershed E-Grade Report, 2018.

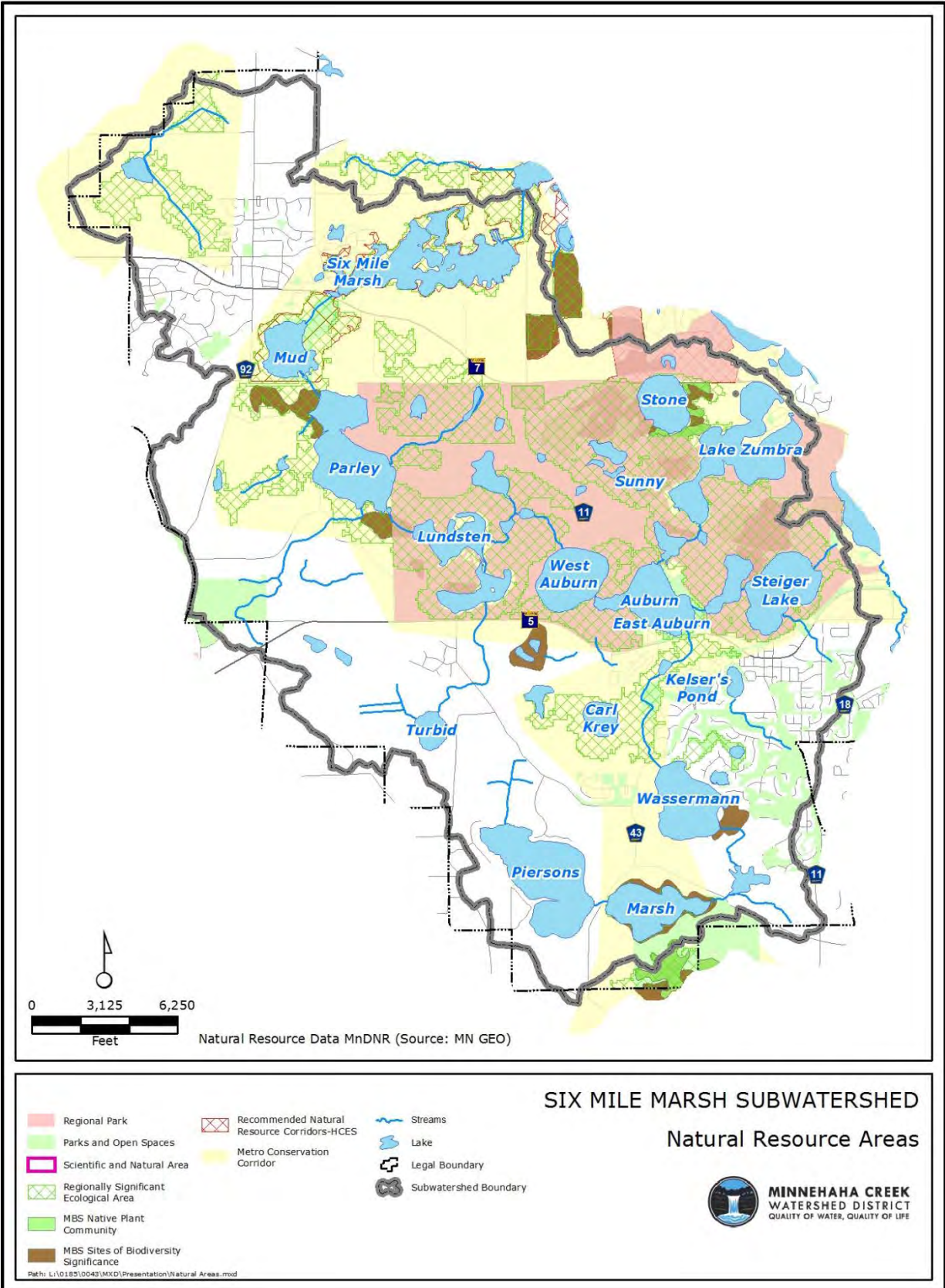


Figure 3.117. Six Mile Marsh subwatershed natural resource areas.

Thriving Communities:

Land use:

Table 3.117 below shows the land uses within the area of the Six Mile Marsh subwatershed in acres and as a percentage of the total subwatershed. The predominant land use in the subwatershed is agricultural, followed by parks and open space and vacant or undetermined (Figure 3.118). Much of the vacant land is either large wetland or woodland tracts or grass and shrubland. Some large agricultural uses are present in Laketown Township, Victoria and St. Bonifacius. There are also other areas scattered throughout the west central and north central and northwest parts of the subwatershed.

Table 3.117. 2010 land use in the Six Mile Marsh subwatershed.

Land Use 2010	Acres	% of Subwatershed
Agricultural	4,240.7	24.8
Parks and Open Space	4,125.5	24.2
Vacant or Undetermined	3,834.1	22.5
Water	2,411.8	14.1
Single - Family Residential	1,872.7	10.9
Institutional	196.3	1.5
Roads and Highways	109.5	0.6
Multi - Family Residential	93.9	0.5
Commercial	84.5	0.4
Industrial	63.3	0.3

Source: Metropolitan Council from city Comprehensive Plans.

Recreation:

The Three Rivers Park District's Carver Park Reserve covers much of the central subwatershed. The park includes numerous wetland and several lakes, and bicycling/hiking trails provide access to many natural features. The Minnesota Historic Features database notes about 50 historic features in this subwatershed, mostly residences or farmhouses or agricultural buildings. The listing also includes 5 churches and several commercial buildings in Victoria and St. Bonifacius. Part of the Three Rivers Park District's Lake Minnetonka Regional Park is located in the subwatershed.

The Carver County Park Reserve offers numerous opportunities for aquatic recreation in the Six Mile Marsh subwatershed (Figure 3.119). Three fishing piers are available, with one located on the east southeast side of Steiger Lake and two on West Lake Auburn. Public water access can be found at Parley Lake, Piersons Lake, Wassermann Lake, Steiger Lake, Lake Auburn and Lake Zumbra. There are no access points directly to Six Mile Creek.

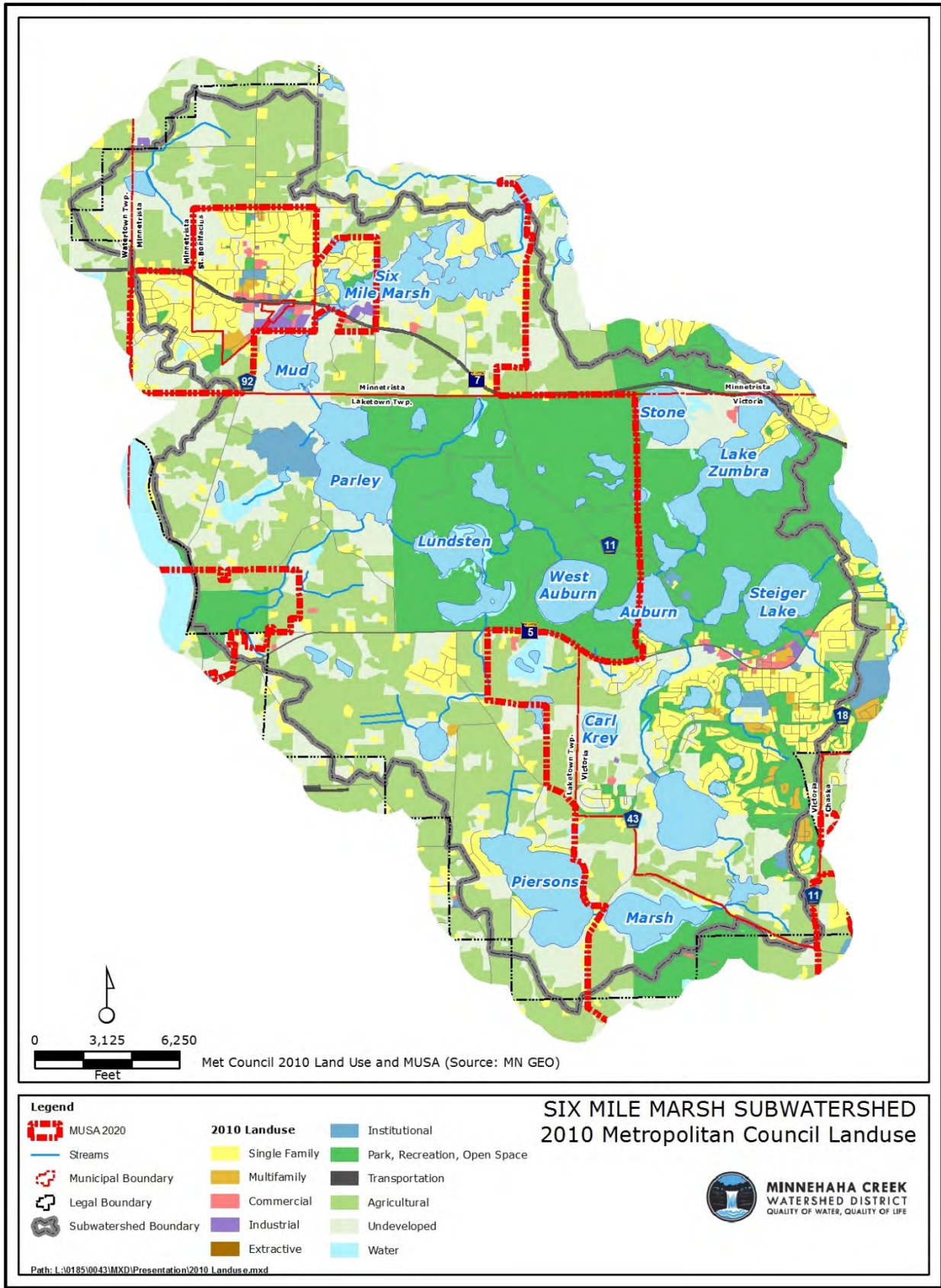


Figure 3.118. Six Mile Marsh subwatershed 2010 land use.

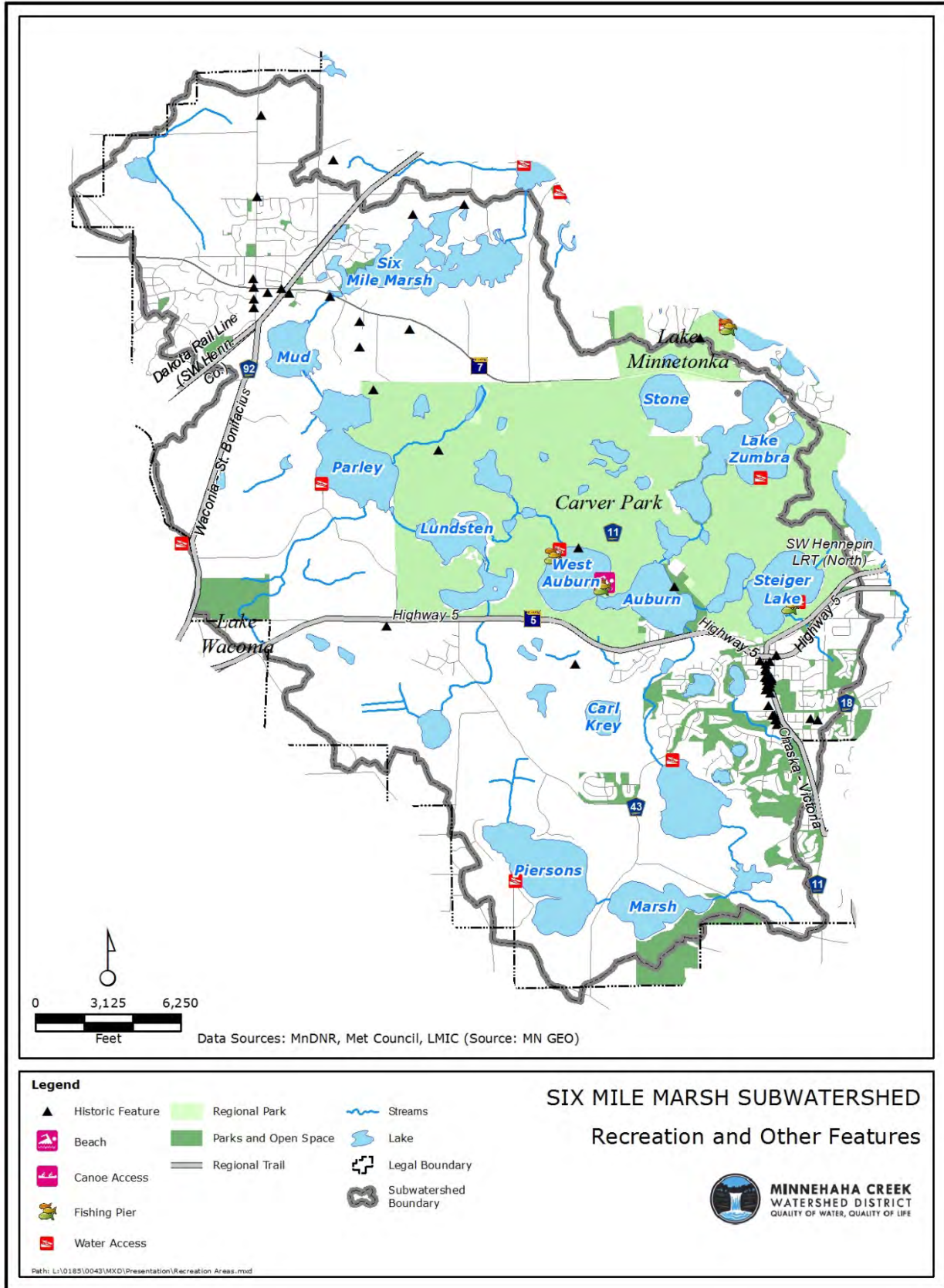


Figure 3.119. Six Mile Marsh subwatershed recreation and other features.

Studies and Assessments:

- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- Minnesota Land Cover Classification System (MLCCS)
- MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS), EOR 2003
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- MCWD Lakes TMDL – Lakes Nokomis, Parley, Virginia, and Wassermann, EOR 2011
- Six Mile Creek Diagnostic Study, Wenck 2013
- 2003 Upper Watershed Stream Assessment, Wenck 2004
- National Wetland Inventory
- Six Mile Marsh Subwatershed Carp Assessment, University of Minnesota 2017
- Six Mile Marsh Subwatershed E-Grade Report, Wenck 2018
- Wassermann Lake Wetland Restoration Project Phase II, Barr 2010
- Six Mile Marsh Corridor Natural Resource Assessment, Cross River Consulting 2010
- Wasserman Lake Wetland Restoration Project, HR Green and Inter-Fluve 2007
- Turbid/Lundsten Corridor Restoration Phase II, MCWD 2011
- Turbid-Lundsten Wetland Restoration, Wenck 2010
- Memo: Lake Zumbra High Water Level Investigation, Wenck 2015
- Marsh-Wassermann Corridor Plan, Cross River Consulting 2009
- Halverson Dimler: Conservation Alternatives Evaluation Report, Cross River Consulting 2010

4.0 Inventory of Studies

District-Wide

- MCWD Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS), EOR 2003
- Wellhead Protection, Minnesota Department of Health (MDH) 2014, health.state.mn.us/divs/eh/water/swp/whp/index.htm
- Lakefinder, Minnesota Department of Natural Resources (MDNR) 2015, dnr.state.mn.us/lakefind/index.html
- Minnesota Geospatial Commons, 2015, gisdata.mn.gov/
- Twin Cities Metropolitan Area Chloride Total Maximum Daily Load Study, Minnesota Pollution Control Agency (MPCA) and LimnoTech 2016, pca.state.mn.us/water/road-salt-and-water-quality
- Minnehaha Creek E. Coli Bacteria / Lake Hiawatha Nutrients Total Maximum Daily Load, Tetra Tech. 2013, pca.state.mn.us/water/tmdl/minnehaha-creek-bacteria-and-lake-hiawatha-excess-nutrients-metro-tmdl-project
- 2003 Upper Watershed Stream Assessment- Volume 2: Upper Watershed Streams, Wenck 2004
- Upper Minnehaha Creek Watershed Lakes and Bacteria TDML Project, Wenck 2014
- National Oceanic and Atmospheric Administration (NOAA) National Weather Service.
- Minnesota State Climatology Office and National Climatic Data Center.
- Minnesota Stormwater Manual
- MCWD Comprehensive Water Resources Management Plan, Wenck 2007
- MCWD Water Quality (Hydrodata) Reports, 1968-1988, 1992-2015
- 2013 Macroinvertebrate Assessment, RMB 2014
- Carver County Water Resource Management Plan
- Hennepin County Geologic Atlas
- Minnesota Biological Survey
- Minnesota Land Cover Classification System
- 2010 Metropolitan Council land use
- Functional Assessment of Wetlands
- 2010 Metropolitan Council land use
- 2020 Metropolitan Urban Service Area (MUSA)
- Minnesota Historic Features database
- Ditch Records and Policy Considerations Report, Wenck 2003
- Diatom Inferred TP in MCWD Lakes Report, Science Museum of MN & St. Croix Watershed Research Station 2006
- Diatom Inferred TP in MCWD Lakes Report Phase II, Science Museum of MN & St. Croix Watershed Research Station 2009
- MCWD 1st Order Drainage Assessment, Fluvial Geomorphic Assessment Update Report, Inter-Fluve Inc. 2013
- MCWD Lakes – Statistical Analysis I Report, HDR 2013
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- MCWD Streams – Statistical Analysis Report, HDR 2015
- MCWD: 30 Years of Water Resources Management 1967-1997, MCWD 1998
- Benefits of Wetland Buffers: A Study of Functions, Values and Size, EOR 2001
- 2003 Study of the Water Quality of Metropolitan Area Lakes, Metropolitan Council 1994
- 2009 Study of the Water Quality of 194 Metropolitan Area Lakes, Metropolitan Council 2010
- Summary of MCWD Plans, Studies and Reports, US Army Corps of Engineers 2004
- MCWD Period of Record Hydrographs, EOR 2005

- Update East-Central Minnesota, MN DNR 2013
- State of Minnesota Statewide Mercury TMDL
- Evaluating and Monitoring BMPs with Networked Wireless Sensors, University of Minnesota 2012

Christmas Lake Subwatershed

- Metropolitan Council from city Comprehensive Plans
- Carver County Water Resource Management Plan
- 2010 Metropolitan Council land use
- 2013 Milfoil Weevil Study
- 2014 Christmas Lake Rapid Response to Zebra Mussels

Dutch Lake Subwatershed

- Dutch Lake Wetland Restoration, 2009
- Dutch Lake Infiltration (DL-5), 2010
- Dutch Lake Infiltration (DL-7), 2012

Gleason Lake Subwatershed

- Upper Minnehaha Creek Watershed Lakes TMDL, Wenck 2014
- Effects of Curlyleaf Pondweed Control on Gleason Lake, 2015
- Gleason Lake/ CR 6 Pond Project Feasibility Study, Houston Engineering 2009
- Gleason Lake Regional Infiltration (GL-4) Feasibility Study, 2008
- Mooney Lake Plant Survey, 2011
- Mooney Lake Fish Survey, 2011
- Mooney Lake Outlet Structure (Wetland Restoration#1), 2007

Lake Minnetonka Subwatershed

- Lake Minnetonka Coordinated Herbicide Treatment Study on Carmans, Grays & Phelps, LMCD 2008 – 2011
- Spring Phenology of Native Plants, Freshwater Scientific Services 2015
- Zebra Mussel Control Trials with Zequanox, USGS & Marrone Bio Innovations 2014
- Flowering Rush Hand Removal Study on Lake Minnetonka, MCWD & Blue Water Science & Waterfront Restoration 2011-2015
- Flowering Rush Survey on Lake Minnetonka & Minnehaha Creek, Blue Water Science 2013
- Occurrence and Distribution of Eurasian, Northern and Hybrid Watermilfoil in Lake Minnetonka and Christmas Lake – Genetic Analysis, MCWD & University of Minnesota & Montana State University 2015-2016
- Six-Mile Creek Carp Assessment (Includes Halsteds Bay), University of Minnesota 2014-2017
- Field evaluation of toxicity of low-dose molluscicide treatments for zebra mussel veliger larvae – potential applications in lake management, Minnesota AIS Research Center 2016
- Minnetonka Zebra Mussel Study, MCWD 2011-present
- Solar Bees Study on Stubbs Bay, 2005
- Benthic Monitoring Study, 1969-1970
- Preserving the Quality of Lake Minnetonka, 1971
- Milfoil Harvesting in Lake Minnetonka, 1972
- Water Quality of Lake Minnetonka, TRPD 1994-1999, 2005
- Lake Minnetonka Boat Use Study, 2000
- Lake Minnetonka Boating Trends (1984-2000), 2001
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- Bathymetric Mapping, 2008
- Lake Minnetonka 3D Model, 2010
- MCWD/City Minnetonka office Building Feasibility, 2011
- Lake Minnetonka Investigation, 1969-1970
- Lake Minnetonka Shoreline Inventory, 2010
- Lake Minnetonka Area Regional Interceptor, 2008
- Management Plan for Lake Minnetonka
- Gideon Glen, 2003
- Grays Bay Headwaters Projects, 2003
- Mound Downtown Redevelopment, 2004
- Stubbs Bay Improvements, 2004, 2006
 - Stubbs Bay Swan Lake Pond Excavation
 - Stubbs Bay Ravine Stabilization
- Halsted Bay Wetland Restoration, 2008
- Big Island Wetland Restoration – Phase I, 2008
- Lake Minnetonka Shoreline Restoration, 2008
- Lake Minnetonka Direct Infiltration (GB-LM), 2011
- Lake Minnetonka Direct Infiltration (CLC-2), 2012
- Halsted Bay Internal Load Management, 2013
- Grays Bay Highway 101 Causeway Reconstruction (Bushaway Rd), 2013
- Excelsior Lagoon, 1998
- Lake Minnetonka Area Cities MLCCS Report, Bonestroo 2005
- 1969-1970 Lake Minnetonka Comprehensive Study, MPCA 1970

Lake Virginia Subwatershed

- Carver County Water Resource Management Plan
- Metropolitan Council from city Comprehensive Plans
- Lake Virginia Regional Infiltration (LV-5) Feasibility Study, 2012
- MN Landscape Arboretum Wetland Restoration Project, 1996
- Spring Peeper Meadow Project, 1996

Langdon Lake Subwatershed

- Metropolitan Council from city Comprehensive Plans
- Langdon Lake Infiltration (LL-2) Feasibility Study, 2008
- Langdon Lake Infiltration (LL-3) Feasibility Study, 2010
- Langdon Lake Water Quality Improvement Project Feasibility Study, 2010
- Environmental Testing Report - Lagoon Test, MCES 2008

Long Lake Creek Subwatershed

- Long Lake Water Quality Improvement Project: Conceptual Downtown Redevelopment Stormwater Design, HR Green 2006
- Long Lake Creek Channel Restoration and Reconstruction Feasibility Study, EOR 2011
- Long Lake Wetland Restoration Project#2, BARR 2009
- Long Lake Regional Infiltration: LLC-8 Feasibility Study, HR Green 2012
- Long Lake Improvement Projects: Deer Hill Road Pond and CR 6 Pond 1998 Performance Monitoring Report, Wenck 1999

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- Operations and Maintenance Plan for Long Lake Improvement Project, Wenck 1997
- Technical Memo: Effectiveness of Alum on Long Lake Water Quality, Wenck 2004

MINNEHAHA CREEK SUBWATERSHED

- MCWD Lakes TMDL – Lakes Nokomis, Parley, Virginia, and Wassermann, EOR 2011
- Minnehaha Creek *E. coli* Bacteria/ Lake Hiawatha Nutrients, Tetra Tech Inc. 2013
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DRAFT

A background photograph showing a park setting. In the foreground, a person wearing a wide-brimmed straw hat and blue gloves is kneeling and working on a garden bed filled with small black pots containing plants. In the middle ground, another person in a blue jacket is standing and looking down. The background features a paved path, a blue trash can, and lush green trees under bright sunlight.

VOLUME 3 IMPLEMENTATION PLAN

3.1 INTRODUCTION:	270
3.2 DISTRICT PHILOSOPHY:	270
3.3 DISTRICT GOALS	274
3.4 IMPLEMENTATION MODEL:	274
3.5 MCWD PROGRAMS	283
3.6 REVIEW OF LOCAL WATER PLANS AND MUNICIPAL COORDINATION	304
3.7 EVALUATION AND REPORTING	325
3.8 PLAN AMENDMENTS	325
3.9 SUBWATERSHED PLANS	327
3.10 IMPLEMENTATION TABLES	327

3.1 INTRODUCTION:

This volume of the Plan constitutes the Minnehaha Creek Watershed District’s (MCWD or District) Implementation Plan. It serves as an actionable roadmap, outlining natural resource issues within the Minnehaha Creek Watershed, the system drivers that cause those issues, and the management strategies that the District and its partners can employ to achieve measurable change in identified goals.

Also included is a description of the MCWD’s *Balanced Urban Ecology* philosophy of water resource planning and implementation, which emphasizes the social and economic value created when built and natural systems work in harmony. Following is an outline of MCWD’s methodology of prioritizing water resource issues, the planning and implementation of management strategies, a summary of how MCWD’s programs are aligned to accomplish its mission, and the administrative procedures which govern them.

Nested within this volume, the District’s overarching Implementation Plan has been further subdivided geographically into eleven (11) subwatershed implementation plans. Each of these plans lays out a framework for actions that can be taken by the District and its partners to address the combination of issues and drivers, unique to each area of the watershed.

These subwatershed plans are not intended to serve as a prescriptive formula for action. Watershed issues and the stressors driving the system may be relatively static, but the successful implementation of solutions requires partners to be able to respond fluidly to opportunities emerging across the landscape. Accordingly, each subwatershed plan is designed to provide a foundation to guide future collaborative implementation efforts.

3.2 DISTRICT PHILOSOPHY:

The MCWD sees natural resources as an integral component of vibrant communities, serving to create a sense of place, providing vital connections, and enhancing social and economic value. It aspires to a vision of *a landscape of vibrant communities where the natural and built environments in balance create value and enjoyment.*

This vision stems from the District’s 2014 adoption of the *Balanced Urban Ecology* (BUE) policy, which now serves as the MCWD’s underlying organizational strategy, prioritizing partnership with the land use community to integrate policy, planning and implementation; leveraging the value created when built and natural systems are in harmony.

This policy guided the creation of the Minnehaha Greenway, and was



Figure 1.22 A boardwalk at Grays Bay, credit: Melary Renee



Figure 1.23 Minnehaha Falls, Peter Stratmoen



Figure 1.24 Saunders raingarden



Figure 1.25 District philosophy

developed in direct response to a series of policy analyses that identified the governance gap between land use and water planning, and a call for increased integration to improve the watershed management model in Minnesota.

For example, the 2007 Evaluation Report on Watershed Management, drafted by the Office of the Legislative Auditor, concluded that efforts to manage water quality are most effective when coordinated with land use decisions.

Reinforcing these findings, in 2009 the Minnesota Environmental Initiative found that water and land planning in Minnesota is compartmentalized at all levels, under separate bodies of regulation and various agency jurisdictions. This evaluation noted that, “a coordinated planning cycle will result in more informed land use decisions and a better balance between planning and implementation activities for land and water resources.”

Similarly, a 2011 Hennepin County Water Governance Project noted a complicated relationship between politically managed built systems and watershed based management that requires significant effort to coordinate. This study recognized “the potential for implementing good water management practices through better integration of water management plans and comprehensive land use plans of all kinds. Effective collaboration in the planning stage before spending funds on intensive capital improvement projects can save valuable resources.”

The 2013 Water Regulation and Governance Evaluation, drafted by the Minnesota Pollution Control Agency (MPCA), found that opportunities to address land use and water connections have waned in recent decades, that state land use statutes lack an explicit connection to water plans, and that the major water management goals of the state can be achieved only by strong integration with land use management.

One reason for the persistent disconnect between watershed management and land use planning has been the difficulty in synchronizing planning between watershed districts and land use authorities. Land use decisions are made relatively quickly compared with the historically static ten-year comprehensive and capital improvement plans developed by watershed districts. Land may be bought and sold, platted, and moved into construction within months. For watershed planners working under fixed ten-year plans and state rules, this can make it difficult to integrate watershed capital improvements or design enhancements into the development plans of a private or institutional developer.

A secondary issue has been the prevailing perception of watershed organizations acting principally as regulatory agencies. Historically, watershed districts have used regulation as a foundational tool to connect with local land

Successful, sustainable, livable communities are built on a foundation of integrated planning – planning that recognizes communities as living organisms and takes into consideration all components of the urban ecology.



Figure 1.26 Lake Bde Maka Ska / Calhoun



use planning and infrastructure investment. Such programs guarantee a certain level of integration of water resource planning into the built environment. However, this view often results in watershed districts receiving development or infrastructure plans through the permit review channel, rather than in the due diligence or feasibility period of development or infrastructure planning.

Recognizing these challenges within the realm of water management, and the opportunity for MCWD to meaningfully integrate its work into the planning of vibrant communities, the District has strategically realigned its planning and implementation model emphasizing water's complementary, rather than competing, role in the urban landscape.

A source of inspiration for the Districts vision policy, *A Balanced Urban Ecology*, was the 1994 Hennepin Community Works model. This now celebrated urban planning model acknowledged the power of natural systems to be developed as the underlying structure of place, underpinning local community identity. Community Works found that well designed and carefully integrated natural systems and infrastructure projects are able to maintain and enhance the long-term tax base of neighborhoods while improving the quality of life.

Since its adoption in 2014 the District now views its mission of water resource protection and improvement through the lens of *A Balanced Urban Ecology*:

Rather than viewing the natural and built environments as a clash of opposing forces, we recognize the interrelated and interdependent character of modern life; communities cannot thrive without healthy natural areas, and healthy natural areas become irrelevant without the interplay of human activity. This is the integrated setting in which we live. Indeed, our quality of life and our economic wellbeing are inextricably linked. Any notion that land development and environmental protection are locked in a winner-take-all battle is sadly outdated.

Successful, sustainable, livable communities are built on a foundation of integrated planning – planning that recognizes communities as living organisms and takes into consideration all components of the urban ecology.

Our work will be strengthened through these collaborative efforts. Not only will they offer greater community impact, they will produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits. Going it alone is no longer the best path forward.

The *Balanced Urban Ecology* policy represents the MCWD's fundamental philosophy and way of doing business and is guided by the following three principles:

- » Intensifying and maintaining focus on high-priority projects
- » Partnering with others to pursue watershed management goals
- » Being flexible and creative in adapting to the needs of partners

3.3 DISTRICT GOALS

The District has established four strategic goals. All specific issues within the watershed nest under these goals.

- » **Water Quality** - To preserve and improve the quality of surface and groundwater.
- » **Water Quantity** - To manage the volume and flow of stormwater runoff to minimize the impacts of land use change on surface and groundwater.
- » **Ecological Integrity** - To restore, maintain, and improve the health of ecological systems.
- » **Thriving Communities** - To promote and enhance the value of water resources in creating successful, sustainable communities.

While the Plan is organized around these four simple strategic goals, the MCWD recognizes that watershed management requires a holistic approach of ecosystem management, and it accordingly approaches planning and implementation in a manner that integrates hydrologic, chemical, physical, biological and built components of the subwatershed system. More about this approach is contained within the E-Grade description contained within Volume 2.

3.4 IMPLEMENTATION MODEL:

The District’s approach under this Plan is guided by the BUE policy and its principles of focus, partnership, and flexibility. The implementation model to support this approach is ongoing and iterative, but can be simplified into four basic steps:

1. Understanding resource needs
2. Understanding land use plans and opportunities
3. Integrating and prioritizing
4. Program implementation

The following sections provide further detail on each of these elements. Each of the District’s eleven (11) subwatershed plans in Section 3.9 are also structured to follow this sequence.

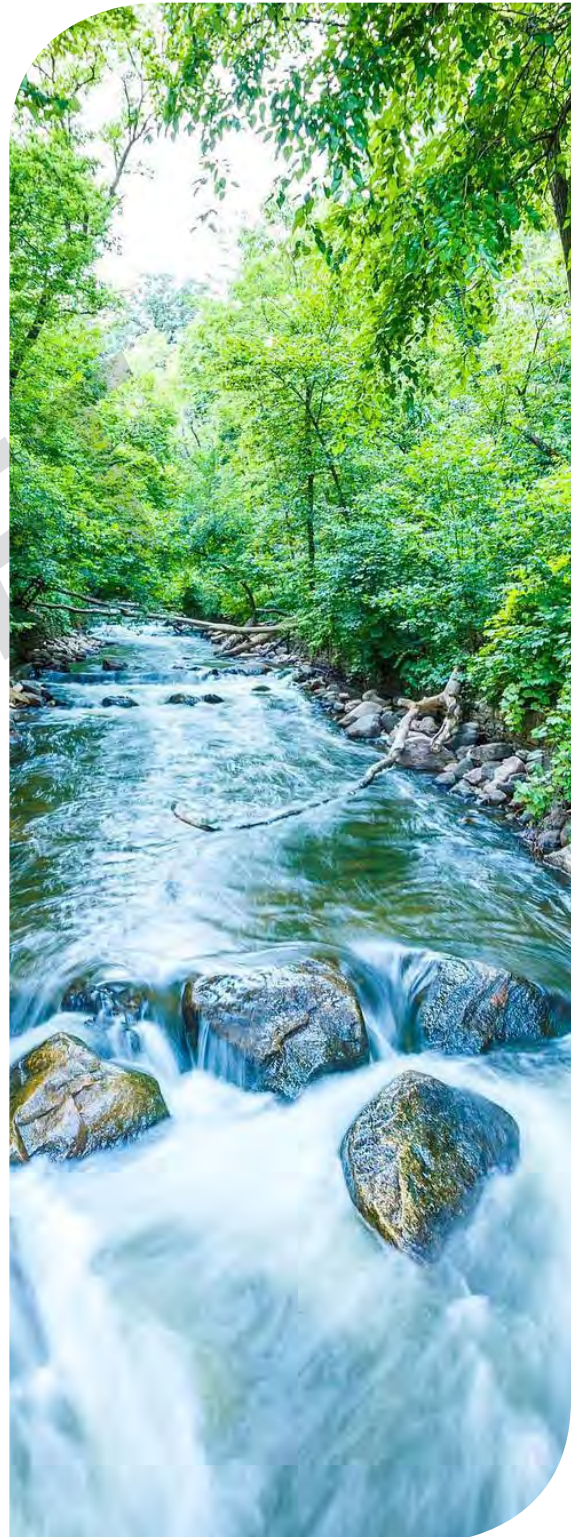


Figure 1.27 Minnehaha Creek, credit: Nathan Lodermeier



Figure 1.28 Planning layers diagram

3.4.1 UNDERSTANDING RESOURCE NEEDS

The first element of the District’s implementation model is to understand water resource needs on a subwatershed basis. The MCWD maintains multiple technical data sets, summarized in Volume 2, that provide the District and its partners with the information needed to guide implementation planning. Analysis of these data enables the District to identify areas of highest need, based on sound science. This represents the first step in the iterative process of establishing implementation priorities.

Each subwatershed plan within Section 3.9 follows an issues, drivers, and strategies sequence as described below.

Issues:

For purposes of Plan organization, all natural resource issues within the District are nested within the three strategic goal areas of Water Quality, Water Quantity, and Ecological Integrity. Each of these three goal areas are described in more detail below.

No issues are outlined within the goal area of Thriving Communities. Thriving Communities serves as an overarching organizing element to guide the District in implementing its natural resource mission. The District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. As such, this goal area is informed by the goals of individual communities and no specific issues are identified within this plan under Thriving Communities.

Water Quality Issues:

The Environmental Protection Agency (EPA) and the Minnesota Pollution Control Agency (MPCA) define acceptable water quality as that which supports the designated use of the waterbody (e.g. fishable, swimmable, drinkable).

Pollution discharged to waterbodies impacts water quality. Pollutant discharge within the Minnehaha Creek watershed is primarily from non-point sources, carried to lakes, streams and wetlands by snowmelt or rainfall that runs across the landscape. Land use within the landscape influences both the quality and quantity of the runoff. Runoff contains sediment, nutrients and other contaminants that exceed what lakes, streams and wetlands would receive in an undeveloped watershed.

Within freshwater systems, an excess of nutrients like phosphorus (eutrophication) is the most common problem impacting the use of lakes and streams. Phosphorus impacts algal and plant productivity, water clarity, fish habitat and aesthetics. While other pollutants do stress freshwater systems, phosphorus is used as standard indicator of the health of a system.

This Plan considers good water quality to be achieved when the physical, chemical, biological and aesthetic characteristics of a waterbody support designated use. Because the principal standard by which water quality is judged is total phosphorus concentration, the water quality emphasis of this Plan is on reducing phosphorus loads to lakes to achieve standards set by the state.

Water Quantity Issues:

As watersheds are altered and developed by humans, the flow of water across the landscape changes. In undeveloped watersheds rainfall largely infiltrates into the ground. However, historically, as watersheds were built out, drainage systems were installed both to remove surface water and lower groundwater for agricultural production, and to channelize and accelerate removal of surface runoff for urban development and infrastructure.

As watersheds begin to include built components, channels were straightened, wetlands were filled, drainage ways were placed into pipes, natural vegetation was removed, and hard surfaces (parking lots, roofs, roads, etc.) were built.

Combined, these modifications reduce the infiltration and storage of water. The result is larger volumes of water draining through the system faster. The volume of water and the rate at which it moves through the watershed are defined as water quantity issues.

Water quantity is most often recognized as flooding. Flooding occurs when a watershed is overwhelmed with rainfall that cannot infiltrate into the ground, or be appropriately stored on the landscape. Flooding can occur at a system level, across the watershed on major lakes and streams, or more locally in ponds and in street systems that cannot adequately store or convey the water being received during and after storm events.

However, water quantity is also an issue when there is not enough water. Water is essential for aquatic life and the health of aquatic systems. Streams with highly modified watersheds, like Minnehaha Creek, have high levels of hard surfaces that pipe water directly to the stream. In an undeveloped condition water would be stored in wetlands or infiltrated into the ground. This water would then be slowly released into the stream channel, promoting long periods of stable water flow. In modified watersheds stream flow can be “flashy”, with water moving through the system quickly after rainfall events. In streams like Minnehaha Creek, this can result in intermittent flow and periods where the channel is dry. This water quantity issue directly impacts the ecological health of the stream, stressing fish, macroinvertebrates, plants, and other aquatic life.



Figure 1.29 Stream monitoring equipment

Within this Plan, the District is focused on water quantity issues that stress the regional system. The District will work with its partners to plan and implement solutions that create a more resilient system that is capable of handling both ends of the water quantity spectrum.

Ecological Integrity Issues:

Ecological integrity encompasses issues of water quality and water quantity, but is broken out for simplicity in Plan organization. The three primary elements of an ecosystem are its structure, composition and function. Structure refers to all of the living and non-living physical components that make up an ecosystems. Composition refers to the variety of living things within an ecosystems. Function refers to all of the natural processes that occur within an ecosystem.

Ecological integrity exists when the composition and function of the ecosystem are unimpaired by stresses from human activity. When natural ecological processes are intact and self-sustaining, with the system evolving naturally, with a capacity for self-renewal.

Within this plan, ecological integrity focuses on achieving balance between the built and natural environments, with ecosystems providing the highest possible measures of structure, composition and function. Emphasis is placed within the implementation plan not only improving structure, composition and function at an individual resource level, but connectivity between aquatic and terrestrial ecosystems, and connectivity at a regional landscape scale.

Drivers:

Within this plan, issue drivers are identified. A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. For example, in regards to water quality issues, stormwater runoff and altered wetlands can drive excess nutrient loading, increase the quantity of water flowing downstream, and degrade habitat and ecological integrity.

Management Strategies:

To guide planning and implementation efforts, the District has established a simple framework of general strategies that will address the identified issues. Management Strategies correlate directly to the drivers of the subwatershed system. If, for example, stormwater runoff is driving an increase in water quantity and degrading water quality, the appropriate management strategy will be managing stormwater runoff through the use of best management practices tailored to the individual circumstance. If, degraded water quality within a lake is driven by the presence of common carp and internal loading, management strategies may include rough fish management, and alum



Figure 1.30 Lake Hiawatha during the 2014 flood



Figure 1.31 Mallard ducks at Lake Calhoun, credit: Svetlana Schulte

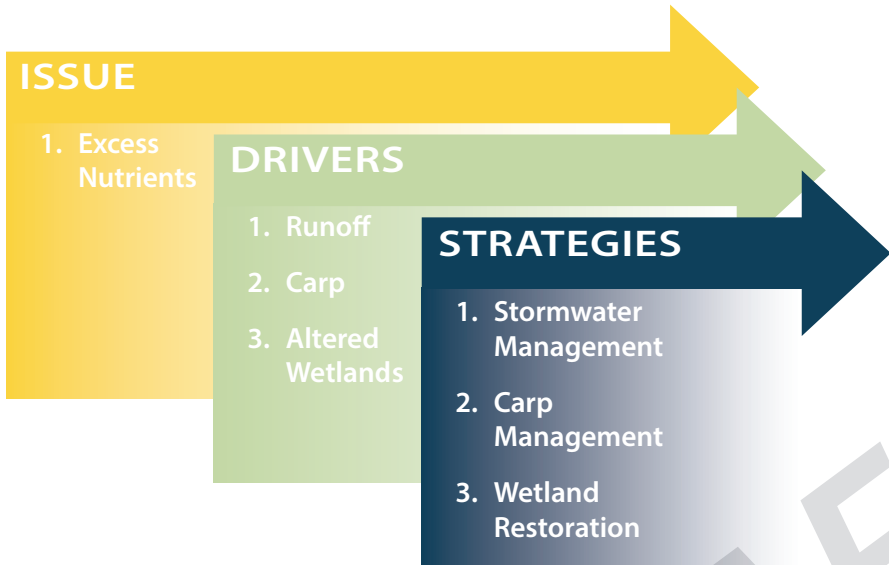


Figure 1.32 Issues, drivers, strategies diagram

dosing. These strategies cover both the short and long-term, and serve to guide the identification and prioritization of individual implementation efforts.

3.4.2 UNDERSTANDING LAND USE PLANS

The second element of the District’s implementation model is to understand the land use setting. Guiding all of District’s implementation efforts to protect and improve the landscape is the principle of integrated planning, through collaboration with public and private partners. To better integrate our efforts with those acting on the landscape and operate effectively within the dynamic environment in which water resource management efforts are implemented, the District has adopted a partnership framework to create alignment between our goals and the goals of others.

The District uses several mechanisms to understand the land use environment within its boundaries and align its water resource planning with land use planning. These include, but are not limited to:

- » Review and coordination of local water management plans
- » Annual meetings with cities
- » Exchange of land use, infrastructure, park, and capital improvement plans with cities, counties, and agencies

To better integrate our efforts with those acting on the landscape and address the dynamic environment in which water resource management efforts are implemented, the District has adopted a partnership framework to create alignment between our goals and the goals of others.



Figure 1.33 Figure title

- » Early regulatory coordination on pending development activity
- » Coordination agreements with public and private partners

This effort to improve communication and collaboration between the District and its communities is further described in Section 3.6.

3.4.3 INTEGRATION AND PRIORITIZATION

The subwatershed plans in Section 3.9 describe the resource needs and corresponding management strategies across the District's eleven (11) subwatersheds. The District recognizes that it is not feasible to address all of the resource issues throughout the watershed within a 10-year plan cycle. For this reason, the District prioritizes using both its knowledge of water resource needs and understanding of land use plans and opportunities.

When setting implementation priorities, the MCWD considers factors such as these:

- » Water resource issues/impairments
- » Public value of resources
- » Probability of achieving measurable resource improvement
- » Local partnerships and support
- » Known project opportunities
- » Funding opportunities

The MCWD first uses its water resource data to identify issues and set implementation priorities across the District. For example, based on long term monitoring data, the District can prioritize water quality issues based on the degree of water quality impairment. This information enables the District to identify regionally significant waterbodies that are the most degraded, as well as waterbodies that currently meet standards but are at a "tipping point" – poised to become impaired.

In addition to prioritizing based on water resource data, the District also considers what is happening on the landscape. For instance, if an area is projected to undergo significant redevelopment, or there is a major infrastructure project planned by another entity, these changes present opportunities to address water resource issues in ways that are well-integrated with land use plans and more cost-effective.

The District prioritizes at multiple scales. At a subwatershed scale, the District identifies priorities for implementation based on the resource needs of that system. Then as opportunities for implementation arise, the District can weigh them against the resource needs and priorities it has identified.

Prioritization is also done at a watershed-wide scale. The District has found that it can most effectively achieve its mission to manage and improve water resources, not when it seeks to apply its resources evenly across the watershed at all times, but rather when it coordinates its programs and capital investments so as to focus on specific areas of high need and opportunity. For this reason, the District identifies priority subwatersheds on which to focus on system-level planning and implementation.

Through sustained focus in a subwatershed, the District is able to develop a thorough understanding of a system's issues and drivers, build relationships, identify opportunities, and coordinate plans and investments with its partners for maximum natural resource and community benefit. This focused approach is best suited in areas where there are significant resource needs and a level of complexity that require sustained effort and coordination across multiple public and private partners. This process is described further in the next section.

Establishing implementation priorities is an iterative process. The priorities identified in this Plan are based on information available at the time the Plan was drafted; however, the District recognizes the need to continually scan for threats and opportunities and adjust its priorities accordingly. In cases where new priorities are identified that are beyond the scope of this Plan, the District will pursue a plan amendment as described in Section 3.8.

3.4.4 PROGRAM IMPLEMENTATION

The last element is implementation. The District has a wide range of programs and services that work together to make progress toward the District's goals and provide value to its communities. These services include:

- » Monitoring – collecting and analyzing data to identify issues and inform implementation
- » Technical Assistance – providing guidance to landowners, cities, and others on best management practices
- » Permitting Assistance – assisting applicants by coordinating with other regulatory agencies and identifying alternatives that meet the applicants' goals and meet or exceed requirements
- » Education and Outreach – providing education and capacity building for communities and residents
- » Capital Improvement Projects – constructing physical improvements on the landscape
- » Land Conservation – preserving and restoring high-value green infrastructure



Figure 1.34 Boardwalks trace a restored stream at the Minnehaha Creek Preserve.



- » Ecosystem Management – managing invasive species, such as carp, for water quality and ecological integrity benefit
- » Grants – identifying funding sources through the District’s own competitive grants or other federal, state, and regional sources

Focal Subwatershed Planning

The previous section describes the rationale behind the District’s selection of priority subwatersheds. The District has identified three priority subwatersheds in which to focus its implementation efforts for the 2017-26 plan cycle – Minnehaha Creek, Six Mile-Halsted Bay, and Painter Creek. These three subwatersheds have been prioritized based on a combination of resource needs and opportunities, as described in the subwatershed plans in Section 3.9.

Within these focal subwatersheds, the District acts as a convener to bring together cities, counties, park districts, and others involved in land use change to develop a coordinated implementation and investment plan. Through this planning process, the parties align goals and plans to create a roadmap for implementation including both short-term actions and long-term efforts that can be executed as land use change takes place. This scale of coordinated implementation planning also positions the District and its partners well to pursue federal, state, and regional funding sources.

Opportunity-Driven Implementation

In addition to these focused planning and implementation efforts, the District’s approach watershed-wide is to remain responsive to opportunities created by land use change or partner initiatives. Development of local water plans will produce a coordination framework through which the District will maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined in the subwatershed plans in Section 3.9 and determine the appropriate response. As noted above, the District has a range of services it can mobilize to address resource needs and support partner efforts. As the District evaluates opportunities for implementation, it custom-tailors its response based on the community and resource need. The level of response will also depend on the urgency of the opportunity and the District’s capacity. For instance, in some cases, the District may play more of a supporting role by providing data and technical assistance or helping to pursue grant funds. In other cases, the District may take more of a lead role by developing a management plan or implementing a capital project.

As the regional water resource authority, the District is responsible to understand hydrologic systems on a watershed basis and what is needed for their health and sustainability. Through its review of local water plans, the District seeks to engage its LGUs as partners in incorporating this basis of knowledge and understanding into the exercise of land use planning, regulatory, capital, infrastructure maintenance and related local authorities.



Figure 1.35 Figure title



Figure 1.36 A young fisherman casts his line on Lake Minnewashta



Figure 1.37 The Minneapolis skyline overlooks Lake of the Isles.

3.5 MCWD PROGRAMS

The MCWD exists to protect and improve land and water for current and future generations. It does this work through public and private partnerships guided by a Balanced Urban Ecology, which emphasizes the social and economic value created when built and natural systems are planned to work in harmony.

The two overarching organizational strategies with which the District will achieve its mission are:

- » Developing high impact capital improvement projects that are integrated with non-water initiatives through multi-jurisdictional partnerships; and
- » Improving the integration of land-use and water resource planning and policies to produce value added partnerships with private development and public infrastructure investments.

All District programs work in support of these efforts. Descriptions of the major District program areas are included below. These programs include:

- » Planning
- » Research and Monitoring
- » Permitting
- » Education and Communications
- » Capital Improvement Projects
- » Land Conservation
- » Project Maintenance and Land Management
- » Grants

3.5.1 PLANNING

District planning is focused in three main areas:

- » Developing high impact capital improvements
- » Developing policies to improve the integration of land-use and water planning and implementation
- » Aligning and deploying District programs and resources to address identified opportunities

Capital Project Planning

Over recent years, the District has invested significant organizational effort into developing new policy models for planning and partnerships, with the goal of improving the success of capital project implementation in partnership with the local land-use community. The District’s capital improvement planning

model is described in more detail below.

Policy Development

Following the Balanced Urban Ecology policy, the Planning program seeks to develop shifts in policy which increase the synergy of land-use and water planning. Specifically, the District wishes to improve collaboration with public and private partners in the following areas:

- » Private Development
- » Public Infrastructure
- » Land use and water planning and policy

Section 3.6 outlines how the District wishes to collaborate with local municipalities through the development and coordination of Local Surface Water Management Plans, to continue strengthening partnership connections in these areas.

The District will also rely heavily on its Permitting Program and Education and Communications Program, to improve integration in these areas through efforts including:

- » Engaging the private development community to increase awareness of partnership opportunities
- » Working with land use planning staff and officials to increase awareness of partnership opportunities

Aligning and Deploying Program Resources

The District's Planning Program also works proactively with the MCWD Board of Managers to scan the environment for opportunities to achieve the District's mission, and recommends the alignment and deployment of policy, project, and program resources. This work includes periodically conducting strategic assessments of existing and proposed District programming, recommending and maintaining organizational alignment, and evaluating and reporting on District effectiveness.

3.5.2 RESEARCH AND MONITORING

The Research and Monitoring (R&M) program serves as the scientific base for the implementation of the District's mission, by collecting and analyzing data across the watershed's natural resources. This information is used primarily to inform District planning and implementation, and secondarily to inform and educate members of the public. The program has the four following areas of focus.



Figure 1.38 Subwatershed planning meeting



Figure 1.39 Staff gathering a sample



Figure 1.40 Staff inspecting a retaining wall

- » Diagnosing drivers of water resource issues
- » Collaborating to identify management strategies
- » Broadly characterizing ecological health
- » Communicating analyses of data and recommendations

It accomplishes these goals through the following programmatic activities:

- » Diagnostic monitoring – smaller scale, higher resolution monitoring that identifies the cause of water resource impairment, to inform planning and implementation.
- » Anchor and performance monitoring – maintaining long term data sets across the watershed, at select representative sites, to monitor watershed-scale trends over time and to monitor priority projects to demonstrate efficacy.
- » E-Grade – broadly characterizing ecosystem health at a subwatershed or system scale to support planning and public communications.

The R&M Program also includes aquatic biology expertise focused on assessing and managing the impact aquatic invasive species (AIS) have within the watershed. District AIS monitoring and management efforts help to inform a more holistic interpretation of the watershed's ecological health. R&M programming focused on AIS includes the following activities:

- » Managing species with high ecological impact (i.e. common carp) in coordination with capital project planning, to improve water quality and ecological integrity.
- » Early detection monitoring and rapid response – conducting monitoring to identify recent introductions and responding with management and control, where appropriate, to address ecological impact and prevent new infestations.
- » Promoting research – encouraging the development of strategic partnerships that advance the use of the watershed as a living laboratory to advance AIS science while informing District planning and implementation.
- » Supporting the prevention efforts led by District partners – develop financial and technical partnerships to influence, engage and support partners in AIS prevention activities.

3.5.3 PERMITTING

The primary aim of the Permitting program is to protect the MCWD's natural resources from degradation that can occur as a result of land use change by administering permits for construction activity and ensuring compliance with the District's regulations.

The program also prioritizes the identification and development of partnerships with permit applicants, including local land use authorities and the development community, to achieve project outcomes that exceed regulatory requirements and create mutual benefit.

Given that the staff of the Permitting program interact with the public on a daily basis, the program also serves as the public face of the District, which enables the Permitting program to operate in an educational capacity.

The Permitting program performs the following four functions:

- » Permit Administration – plan review and permit issuance
- » Compliance – field inspections and compliance generation
- » Partnerships – creating public-private partnerships to achieve outcomes that exceed requirements
- » Communication and Education – increasing public awareness of water resource management and MCWD’s vision and mission

Permit Administration and Compliance

Future development in the watershed is expected to impact water and other natural resources. The District administers a permitting program to ensure that construction projects that change land use comply with standards that minimize the impact to natural resources. These standards are outlined in the District’s rules, which include regulations for:

- » Erosion and Sediment Control
- » Floodplain Alteration
- » Wetland Protection
- » Dredging
- » Shoreline and Streambanks
- » Waterbody Crossings
- » Stormwater Management

The District works with permit applicants, and coordinates with other permitting agencies, to ensure that plans, designs and specifications for proposed construction projects meet requirements that minimize the impact a project will have on the watershed’s natural resources. Once a project has been approved and moves into construction, the District monitors the projects implementation for compliance with the approved design. When violations are found, the enforcement process generally includes correspondence with



Figure 1.41 Cottageville Park ribbon cutting



Figure 1.42 Master Water Stewards project



Figure 1.43 Minnehaha Creek clean-up

permittees, coordination with the city and other permitting agencies, and, when necessary, compliance orders by the MCWD Board of Managers.

Partnership

The District also views its Permitting Program as an opportunity to provide a value added service for permit applicants, by identifying creative opportunities to the challenges of designing and constructing projects – that achieve natural resource protections that exceed rule requirements while providing benefit to the project (e.g reduced costs, addressing unique site constraints, etc.)

3.5.4 EDUCATION AND COMMUNICATIONS

The District's Education and Communications program supports the District's mission by:

- » Promoting and supporting the policy objectives of Balanced Urban Ecology, to integrate land-use and water planning with policy makers, business leaders, and the land-use planning community
- » Supporting District programs by building awareness and support for the District and cultivating partnerships
- » Affecting change on the landscape by providing target audiences with the knowledge and skills needed to take action

The Education and Communications program provides this support through a variety of program initiatives, including but not limited to:

- » Developing a Balanced Urban Ecology education program by promoting and developing knowledge about the added value created when development, public infrastructure, planning, and policy are coordinated early with the District.
- » Engaging communities in the planning, design, and placed-based programming of District capital projects.
- » Maintaining a network of public agencies and non-profit partners that align with and support the District's mission and implementation priorities.
- » Creating broad and targeted awareness through newsletters, fact sheets, media, website, events, and other means.
- » Managing a Citizen Advisory Committee to engage a broad and representative cross-section of watershed residents in the District's planning, policy development, and implementation.
- » Providing target audiences with the skills they need to adopt clean water practices through trainings and workshops, including: Non-point Education for Municipal Officials (NEMO), Clean Water Summit, winter

maintenance, turf maintenance, raingardens, and shoreline restoration.

- » Providing engaged citizens with skills to implement clean water practices and to influence others on clean water issues through programs such as Master Water Stewards and the Watershed Association Initiative.

3.5.5 CAPITAL IMPROVEMENT PROJECTS

Program Description

The District’s implementation plan includes a capital improvement program (CIP). In accordance with Minnesota Rules 8410.0105, subpart 2, the CIP describes structural solutions to attain the following strategic goals of the District:

- » Water Quality - Preserve and improve the quality of surface water and groundwater.
- » Water Quantity - Manage stormwater runoff volume and flow to minimize the impacts of land use change on surface waters and groundwater.
- » Ecological Integrity - Restore, maintain and improve the health of ecological systems.
- » Thriving Communities - Promote and enhance the value of water resources to successful, sustainable communities.

The CIP table in Section 3.10 groups capital projects by subwatershed. The organizing principle of the Plan is to make these four strategic goals concrete on a subwatershed basis. This is done by analyzing the water resource issues, causes of those issues, stakeholder capacities and opportunities within each subwatershed. Like the other elements of the District’s implementation plan, its CIP is derived through this analysis.

As described in Section 3.2 of the Plan, the District implements its programs and projects through its Balanced Urban Ecology approach. This approach rests on an ongoing awareness of the interests and plans of subwatershed partners, public and private. Its goal is to capture opportunities as they arise, for cost-effective investments that serve both District water resource goals and other partner goals.

The CIP reflects this approach. Subwatershed assessment has identified certain capital projects that are specific as to project location and as to the land alteration, technique or technology to be implemented. However, other projects have less specificity. The CIP defines them by a set of water quality, water quantity and ecological integrity needs within an identified part of the subwatershed that are prioritized; a set of approaches suited to address that set of needs; and a programmed spending cap for such work over the planning period. The District will maintain a posture of ongoing monitoring of



Figure 1.44 Bushaway Road shoreline project



Figure 1.45 Cottageville Park



Figure 1.46 Long Lake wetland restoration

land use developments and landowner interests, communication with public and private interest holders and feasibility review. In that posture, the District will be prepared to recognize opportunities and initiate specific projects that address the defined subwatershed water resource issues cost-effectively and also support other public and private goals.

The CIP is a planning and budgeting tool. It also is a means to inform partners, District residents and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs and other policy considerations before a formal decision to proceed to construction is made. The "Procedures" section below describes the development and evaluation steps that will occur before the District will commit resources to a project.

That section also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with the procedures described below.

A capital improvement is "a physical improvement that has an extended useful life." (Minn. Rules 8410.0020, subpart 3.) The District undertakes a variety of such improvements to achieve its water resource goals. The District's capital work includes both the construction or installation of structural improvements (e.g., lake outlet or water elevation management structures, water quality treatment devices, structural shoreline stabilization) and improvements in the form of permanent land alterations (e.g., stormwater basins, wetland restorations). The capital work that the District has identified for potential implementation over the planning period is listed in the CIP. Implementation of this work will follow the "Procedures" section below.

Certain District improvements with capital improvement aspects are not considered capital improvements, and for that reason are not in the CIP or subject to capital improvement procedures. For example:

- » Some actions are larger scale improvements to the natural environment but are not considered a “physical improvement with an extended life.” These may include, for example, vegetation restoration and management in wetlands or on upland, lake treatments for water quality, and rough fish management.
- » Some District activities may include work of a capital nature, but as a subordinate element of a non-capital program. Examples here include smaller-scale water quality or shoreline stabilization work funded principally for education or demonstration purposes; boardwalks and educational signage for recreational sites; and temporary barrier installations for fish management.
- » The District is programming, and intends to budget for, grant programs that fund work by partners to advance the District’s water quality, water quantity and ecological integrity goals. Funded work may be capital in nature, but BWSR rules stipulate that these incentive programs may be administered separately from the CIP. A description of these programs is found at Section 3.5.5 of this Plan.
- » Maintenance and capital replacement for existing District projects will be administered under the District’s Project Maintenance and Land Management Program. A description of this program is found at Section 3.5.7 of this Plan.

Procedures

Before implementing a capital project or committing levied funds to its design or construction, the District will perform feasibility work to identify an effective design concept; develop confidence that the property agreements, permits and approvals to build and maintain it can be obtained; and establish a project cost estimate. Pursuant to Minnesota Statutes §103B.251, the District then will provide notice of a public hearing before the Board of Managers. The Board will consider the presentation of District staff and engineer, as well as input offered by partners and interested parties. On the basis of that information, the Board will decide whether the project should be established. In addition to statutory notice, the District will provide written notice to all properties within 600 feet of the project location.

In the course of feasibility work for a project, the District expects to maintain close coordination with the host LGU. LGU support for a project will be an important consideration in the District decision to advance a project and the District expects that, in all but the unusual case, this support will be an element of the feasibility work. Nevertheless, in addition to the above statutory process, before the Board establishes a capital improvement project for which District-levied funds are estimated to exceed \$300,000, the District will seek a resolution of support or equivalent project concurrence from the LGU(s) where the project is located.



Figure 1.47 Cottageville Park

In addition, before the Board approves final design of such a project, the District will hold at least one public information meeting at a location near the project site, with notice to properties within 600 feet of the project location as well as published notice in an appropriate local newspaper.

The District also will review its CIP each year, as a part of its budgeting process. The District will review the status of all capital projects and their priority for budget and levy purposes, and will allocate funds for the following year accordingly. On a two-year basis, the District will review its capital improvement program and its capital project priorities more comprehensively, on a District-wide and a subwatershed basis, to meet the requirements of Minnesota Rules 8410.0150, subpart 3.E.

As a part of annual budgeting, by late June each year, the District will transmit revised copies of its 10-year CIP to Hennepin and Carver Counties and all of the cities within the District for a 30-day review and comment opportunity. No later than late August each year, the District will mail Hennepin and Carver Counties copies of any comments from cities, and District responses. At the pleasure of either County, but by the first Friday in November, the District will meet with the County Board to discuss the District's CIP and annual budget and levy. Any comments received from the County Board will be considered by the District Board of Managers, and any resulting levy decrease or, if permitted, increase will be certified to the County Auditor before the date it certifies the County levy to the State.

Minnesota Rules 8410.0140 and Section 3.8 of this Plan describe the procedures to amend the Plan. An amendment will be required when the District elects to proceed beyond feasibility or conceptual design to advance a capital improvement that is not in the CIP. An amendment for this purpose may concern a single project, or may be programmatic. When the District undertakes a collaborative planning process for a subwatershed or other defined hydrologic area, as generally defined in Section 3.4 of this Plan, the outcome of that process normally will be an implementation plan for the planning area that includes capital projects. Here, the entire slate of potential capital projects would be incorporated into the CIP by a plan amendment.

Project Funding

When the District cooperates with public or private partners in the construction of a capital project, it will do so pursuant to an explicit allocation of project costs. Costs will be allocated equitably and the District will fund only those project elements related to achieving the water resource purposes of the project. As has been its practice, the District intends to fund its share of project costs through its use of the watershed-wide ad valorem property tax levy, though in an unusual circumstance, it may consider other means

of allocating its costs. Any decision to depart from use of the ad valorem levy would be publicly made and, if required, by amendment of the Plan. In addition to other sources of funding, the District will actively pursue grants and financing from state, federal and other sources.

Project Maintenance

When District staff presents a capital improvement to the Board for the purpose of a decision to establish the improvement under Minnesota Statutes §103B.251, the record before the Board will include a general description of maintenance requirements and a general estimate of maintenance costs. Maintenance of existing District capital improvements will be programmed and carried out under the District's Project Maintenance and Land Management Program and funding determined through annual budgeting. Pursuant to a project agreement, maintenance responsibility for a District capital improvement may be allocated to a partner such as a property owner or an LGU. As a general policy, the District will prefer to maintain its own projects, including both structural elements and vegetation. However, in any event it will seek a fair allocation of maintenance costs and in appropriate cases may agree to allocate the maintenance responsibility, or a part of it, to a partner.

3.5.6 LAND CONSERVATION

The District operates a Land Conservation Program to conserve natural resource areas for the purpose of protecting and enhancing water resources and ecological integrity. Under the Land Conservation Program, the District may acquire land in fee title or may acquire an easement or lesser interest.

The District acquires land interests for several purposes. The land may be a desired site for a District capital project or other improvement identified in its implementation plan. In this circumstance, the acquisition would be considered an element of the project in question and would not be funded or carried out under the Land Conservation Program.

Differently, a tract of land may be a site suited for improvements not yet programmed but available under favorable conditions. Preserving the land in its unimproved state, or actively restoring and managing its ecological condition, may serve water resource goals identified in the subwatershed plan. A primary purpose of the Land Conservation Program is to conserve, restore and enhance green infrastructure for regional stormwater management, regional management of sediment and phosphorus flows resulting from land alteration, corridor protection, habitat, and other water resources benefits.

Background

In the District's 2007 watershed management plan, targets for land rights acquisition were mapped by identifying strategic locations at a landscape



Figure 1.48 Six Mile Creek



Figure 1.49 Cottageville Park



Figure 1.50 Long Lake wetland restoration

scale. Qualifying lands were those with resources protecting surface water and groundwater quality and quantity; those demonstrating high-value habitat characteristics; those protecting aquatic habitat; or those offering habitat supporting aquatic-based species abundance. More specifically, the District sought to:

- » Create corridors along streams and channels to provide buffers for water quality and stream stability and create wildlife corridors.
- » Include wetlands previously identified with exceptional or high vegetative diversity or wildlife habitat, or moderate-to-high restoration potential.
- » Include high-value upland areas, such as forested areas with connected habitat and high potential infiltration or evapotranspiration.
- » Incorporate land cover types identified in the Minnesota Land Cover Classification System (MLCCS) survey conducted by Hennepin County as minimally disturbed with potential high-value habitat.
- » Contain areas with multiple natural resource values, such as Minnesota County Biological Survey (MCBS) sites of biodiversity significance; Metro regionally significant ecological areas; or areas where the DNR had documented rare or threatened species.
- » Incorporate green and natural resource corridors as designated by the DNR, Metropolitan Council, Hennepin County and local communities.

Figure XX shows lands where the District owns fee title or a conservation easement as a result of implementing the Land Conservation Program over the prior planning period. As the result of applying the above criteria, the District has acquired rights in ecologically connected tracts that together afford the District a land platform for regionally significant work in locations such as the Painter Creek and Six Mile Creek subwatersheds. However, acquisition strategy was not explicitly driven by aggregating holdings for such purposes or by the intent to serve specifically prioritized subwatershed goals.

Program Description

The Plan is oriented on achieving District strategic water quality, water quantity and ecological integrity goals. Each subwatershed plan will particularize these goals at a subwatershed level and identify implementation actions to achieve them. Land Conservation Program activity will be driven more specifically to achieve these subwatershed goals and to facilitate these implementation actions. The District will seek to implement the Program through the partnership framework of the Plan, so that District land and easement acquisitions and other Program activity defining land use and protection will align with land use priorities of local units of government, park agencies and other local partners.

In addition to its own acquisition of lands and land rights, under the Land Conservation Program the District may direct funds and staff resources toward the following, when they serve District strategic goals:

- » Assisting landowners and local units of government to explore conservation options.
- » Encouraging natural-resource oriented land management and ecological restoration.
- » Facilitating conservation development by participating in local land use planning and ordinance development, assisting technical evaluation and serving as a conservation easement holder.
- » Supporting cost-share, partnership, and tax incentive opportunities for landowners and other partners.

This Plan specifically supports District land rights acquisition through both the watershed-wide implementation program and specific subwatershed plans.

- » Each subwatershed plan addresses the role of the Land Conservation Program in achieving subwatershed goals. The implementation program in each subwatershed will identify land rights acquisition needs as well as land management and technical assistance and similar support activities that the District has determined to be appropriate to achieve such goals.
- » The watershed-wide implementation program specifies a 10-year budget for the Land Conservation Program, further broken down into Program activities ranging from land rights acquisitions and management of District landholdings to technical assistance. Acquisitions under the implementation program budget will link to the land rights acquisition descriptions in subwatershed plan implementation programs. The budget amount will indicate total expenditures net of funds received into the program by grants, property reconveyance and any other external source.

The implementation program descriptions do not identify specific acquisitions. Instead, they identify land-based implementation actions that will achieve subwatershed goals and the general location within the subwatershed within which these actions are to be carried out. Land rights availability is highly opportunity-based and, further, identifying specific properties in a plan format would put public funds at a disadvantage in negotiating with landowners. In addition, the timing of land rights purchases typically is driven by external (landowner) requirements that would not easily accommodate additional procedures to formally incorporate specific acquisitions into the Plan. The above implementation program descriptions, with their linkage to identified subwatershed goals, and in conjunction with the procedures stated here, are

intended to meet Plan requirements for capital expenditures.

In addition, individual land acquisition opportunities not specifically rooted in subwatershed implementation programs may arise. The District may have an opportunity to acquire a fee or easement interest for a favorable price. It may be property owned by the state for nonpayment of taxes and available to local units of government, or private land placed on the market on favorable terms, or offered to the District at a below-market price for tax benefits or other reasons. It may be undevelopable land that has a low market value but value for water resource purposes.

The Land Conservation Program allows the District to acquire such lands or easements. Before committing funds to acquire a fee or easement interest under this circumstance, the Board of Managers will consider and make findings as to the following:

- » The potential suitability of the property for a capital project or other project identified in the Plan.
- » The potential for the land rights to facilitate the District's pursuit of its strategic water quality, water quantity and ecological integrity goals with respect to the specific subwatershed.
- » The market value of the rights to be acquired, by means of appraisal or other valuation as the Board of Managers determines appropriate for the transaction.
- » The extent to which the water resource purposes of the acquisition may be achieved without the District's spending public funds, due to physical, regulatory or similar constraints on use of the property.
- » Ongoing property management costs.
- » The District's ability to dispose of its property interests if the potential use on which the decision to acquire is based fails to materialize.

Acquisition Procedures

For any land rights acquisition under the Land Conservation Program, the District will follow these procedures:

1. The District will solicit review by a technical advisory team that includes staff from several natural resource agencies. The advisory team's recommendations will be a part of the record forwarded to the Board of Managers as it decides on a potential acquisition.
2. The District will consult with the local unit of government in which the land is located regarding alignment of the District's proposed acquisition with local land use, park and related plans. The precise means of

consultation will vary depending on circumstances such as the extent of ongoing coordination, timing urgency, the sensitivity of negotiations, the scale of the acquisition and what District staff determines to be warranted in order to establish the LGU's position with confidence. The result of the consultation also will be forwarded to the Board of Managers.

3. The acquisition will be valued by appraisal or other means pursuant to a written appraisal policy adopted by the Board of Managers.
4. The District's legal counsel will be retained to advise as to the structure and terms of, and prepare the necessary documents for, the transaction.
5. In accordance with Minnesota Statutes §103B.251 governing capital expenditures, the Board of Managers will notice and hold a public hearing to receive public comment on the proposed acquisition.
6. The Board of Managers will approve any acquisition in open meeting.

These steps may be updated from time to time by the Board of Managers without a formal amendment to this plan, provided that they continue to advance a detailed and thorough case-by-case review of each potential transaction, have an appropriate level of legal review, and continue to require final approval of all transactions by the Board of Managers.

Land Management and Restoration

When an acquisition occurs, the District will prepare a management plan for the property that will present a recommended management status and, as relevant, evaluate restoration opportunities and costs in more detail. Site management and restoration activities on District land or pursuant to a District easement may be funded under the Land Conservation Program or under another identified land restoration program. The types of activities that the District may include in parcel restoration work include activities such as the following:

1. Regrading for natural system restoration.
2. Excavating to enlarge or improve wetland functions and values.
3. Remeandering of a small section of creek, ditch or other watercourse.
4. Removing drainage tiles, placing ditch plugs and other steps to restore natural hydrology.
5. Installing erosion control and stabilizing banks with engineered and bioengineered features.



Figure 1.51 Staff seeding wild rice



Organization/Agency	Role
MCWD	Acquisition of conservation easements and fee title; restoration of conserved lands; cost-share on private land restoration
Cities	Varies by city. Some have active land and easement acquisition programs (ex. Minnetonka). Others use park dedication through the development process to help secure greenway areas (ex. Minnetrista). Also see LGU requirements below.
Minneapolis Park and Recreation Board	Park and trail acquisition and management
Hennepin County Dept. of Environmental Services	Acquisition of donated conservation easements; cost-share and technical assistance for restoration and best management practices
Carver County Parks	Park and trail acquisition and management
Three Rivers Park District	Park and trail acquisition and management
Metropolitan Council	Partial funding for regional parks and trails
State of Minnesota	DNR Owns and manages Wolsfeld Woods and Woodrill Scientific and Natural Areas. DNR provides grants to cities for acquisition. Funding for state and regional parks and trails.
US Department of Agriculture/Natural Resources Conservation Service and Farm Services Agency	Cost-share and technical assistance for restoration and best management practices
US Fish and Wildlife Service	Cost-share and technical assistance for restoration
The Trust for Public Land	Assists government agencies and non-profit organizations with acquisitions, financing for acquisitions, and prioritizing lands to conserve in urban and developing areas.
MN Land Trust	Acquires and monitors conservation easements, primarily through donation or as part of conservation development projects. Works with individual landowners and developers.
The Nature Conservancy	Owns and manages two nature reserves in the District – Hardscrabble Woods (Minnetrista), Ferndale Marsh (Wayzata)
Embrace Open Space	Education, technical assistance, and communications on open space issues for local communities.
Wildlife Organizations (e.g. Minnesota Waterfowl Association)	Cost-share and technical assistance for restoration

6. Installing local stormwater conveyance/control structures such as culverts and weirs.
7. Installing stormwater treatment best management practices.
8. Planting native vegetation.
9. Managing existing vegetation and invasive species via cutting, herbicides, prescribed burning and other techniques.

When the proposed work constitutes a capital improvement, it will be considered and authorized pursuant to the formal process specified at Minnesota Statutes §103B.251. If the proposed work is a capital improvement beyond the scope of restoring the natural features and function of the acquired property, it will not fall within the Land Conservation Program and must be established independently through applicable plan amendment and ordering procedures.

Partners and Funding

The District expects to fund activities under this program area through its annual ad valorem levy on the basis of annual budgeting of funds for potential acquisitions. Collaboration with other units of government may supply funds and the Board of Managers may finance acquisitions through loans, bonding and other legally available means. These are some of the agencies active in the District and roles in the Land Conservation Program these agencies may assume:

MCWD Land Conservation Program potential partners.

3.5.7 PROJECT MAINTENANCE AND LAND MANAGEMENT (PMLM)

Actions detailed in the subwatershed plans will require ongoing maintenance and management activities. The PMLM program's role is to maintain the District's capital investments, manage District lands, operate functional District infrastructure, and coordinate the District's response for flood events. The PMLM program has compiled an Operations and Maintenance (O&M) Manual which outlines the inspection, operation, and maintenance requirements and responsibilities for each of the District's past capital improvement projects. The O&M Manual will be updated regularly to include new capital improvement projects as they are implemented.

The PMLM program has also assembled an Infrastructure Maintenance Plan, which identifies annual repairs and their associated costs needed to repair and replace District infrastructure as it ages. Implementation of the District's Infrastructure Maintenance Plan will proactively address issues with aging

infrastructure and limit liability associated with infrastructure failure. The Capital Improvement Program includes a cost estimate for the ongoing project maintenance and land management activities.

The District is the drainage authority for County Ditch 10, 14, 15, 17, 27, 29, and 32 and Judicial Ditch 2. The PMLM program inspects and maintains public ditch systems within the District as required under Statutory jurisdiction. The District regularly inspects the public ditches within MCWD and maintains as needed to adjust for changes within the regulatory scope and authority under Minnesota Statute Chapter 103E. In urban areas of the District, a majority of the public ditches have been replaced with subsurface storm sewers, including County Ditch 14, 17, and 29. In these instances, the District may pursue turning jurisdiction of over to local communities. County Ditch 10, 15, 27, and 32 and Judicial Ditch 2 follow a natural watercourse and may be considered waters of the state. In these instances, the District will consider abandoning , where appropriate, and redefining these ditches within the watershed as streams where natural conditions dominate in the context of State Law.

3.5.8 GRANTS

Program Description:

Minnesota Rules 8410.0105, subpart 7, identifies a cost-share or grant program as an appropriate implementation element for watershed district plans. The program description must define “the general purpose, scope, time period, amount of funds, funding source [and] general eligibility criteria for disbursing funds, and a clear link to the goals the program addresses.” A cost-share program is one means to afford the District the framework and flexibility to effect the three above tactical approaches for externally driven opportunities.

To facilitate actions to improve stormwater management, enhance water resources and implement green infrastructure, the District will administer a number of cost-share programs to provide financial assistance to landowners, the development community and public agencies.

Opportunity Grants for Green Infrastructure:

To achieve the District’s strategic goals for water quality, water quantity and ecological integrity, the Opportunity Grant for Green Infrastructure will provide financial incentives for value added collaboration with public agencies, private developers and land owners.

The District will provide financial incentive for actions that advance its strategic goals, address drivers of watershed impacts in a subwatershed plan, and align with the management strategies identified and prioritized within the plan. Based on the tactical approaches outlined above, the District anticipates cost-share implementation opportunities arising via three routes:



Figure 1.52 Raingarden in Mound



Figure 1.53 Shoreline restoration in Edina



Figure 1.54 Shoreline restoration in Orono

- » Public Agency Coordination
- » MCWD Permitting Program
- » Landowner and Developer Requests

Early Public Agency Coordination:

Through the partnership framework of this Plan, municipal local water management plans, and a Balanced Urban Ecology Education Program, and as local government units and other public agencies elect, the District will be included in early coordination on private, institutional and public infrastructure planning and investment. The District would partner on small area planning and infrastructure feasibility studies and capital improvement programs for roads, sewer, water and stormwater. Through enhanced municipal partnerships the District increasingly would be involved in development review early in the process, for example at the sketch plan stage, rather than solely through its own regulatory review once layout and design largely have been completed and, in some cases, local approvals issued.

Based on the coordination framework that the District will establish with engaged local government units through this Plan and the local water plans, the District intends to formulate a periodically updated Project Priority List (PPL). Cost-share opportunities will be evaluated for proof of concept, cost, and benefit, and measured against subwatershed priority issues, drivers and management strategies.

The District will use this project priority list to formulate a planned approach to potential financial incentive opportunities, allowing the District's Opportunity Grant for Green Infrastructure to become increasingly synchronized with two- to three-year public agency infrastructure investment plans and planned development.

MCWD Permitting Program and Landowner/ Developer Requests:

In addition to its effort to become integrated earlier in public infrastructure and development planning, the District also will remain responsive to opportunities for green infrastructure improvements identified through the District's Regulatory Program or brought forward by individual landowners. District funding and applicant cost-share would apply not to defray applicant compliance costs, but to secure benefits beyond or independent of compliance. In this setting, the District would evaluate an opportunity only with landowner or developer interest and with a clear understanding as to any effect on the timing of the permit review process. A landowner or developer who seeks a required District permit and does not wish to explore District funding for added value will be entitled to standard permit review procedures and timing.

These opportunities similarly will be evaluated for proof of concept, cost, and benefit, and measured against subwatershed priority issues, drivers and management strategies and, on that basis, added to the existing Project Priority List.

Community Engagement Grants:

To achieve the District's goal of protecting and improving water quality; managing water quantity; restoring, maintaining and improving ecological integrity and creating sustainable communities, the Community Engagement Grant will incentivize the installation of best management practices by public agencies, private organizations, non-profit groups, and neighborhoods who will promote those practices to others through robust education and outreach plans.

The District will provide financial incentives for projects that have meaningful, measurable natural resource benefits, and that serve as effective, valuable education tools in their communities. The District believes that by seeing tangible, impactful improvements on the landscape and learning about their importance from their neighbors and other community leaders, people are more likely to make similar improvements on their property. This not only enhances the impact of the District's education activities, but also, the water quality benefit of the District's work.

The District anticipates identifying opportunities for cost-share funding of community engagement grants through the following routes:

- » WAI and Master Water Stewards Program
- » Proactive recruitment in focal geographies and near MCWD project sites
- » Solicit proposals for projects that align with District mission and priorities
- » MCWD's Planning and Permitting Programs

Program Administration:

Annual funding for the District cost-share program will be set through the budget process. The District will administer the program by means of program guidance documents adopted by the Board of Managers. Guidance will be used to better define staff's generation and maintenance of Project Priority Lists and will specify procedures by which the District will solicit, accept and review cost-share proposals. The guidance also will refine terms of cost-share programs including who may apply, project funding limits, cost-share obligations and how the above funding criteria will be refined and applied to evaluate proposals.

Minnesota Rules 8410.0105 establishes cost-share and grant programs as a separate category of implementation action. Although District-supported projects necessarily will not proceed through the District's own capital improvement program, they may include elements of capital construction. At the same time, a project may be principally for experimental, demonstration or education purposes.

These purposes may include supporting research to advance water resource protection knowledge, demonstrating innovative methods, developing local capacity for water resource protection, or fostering community service and public education. As appropriate, demonstration and education benefits will be secured through program requirements for educational signage and reasonable access for public viewing.

Because an action supported by District cost-sharing may involve a substantial District funding contribution and a significant alteration of the environment of a capital or non-capital nature, it is important that the District afford some measure of public process. Largely this will be achieved through the very nature of the District's collaborative approach from which the Project Priority List will develop, but as described above, opportunities may arise independently of that process.

One purpose of District cost-sharing is to encourage a property owner, developer or public works department of a local unit of government to perform planned work in a more innovative and protective manner, or to incorporate demonstration and education elements into it. In other cases, action may be required to address public infrastructure, land or ecological values at risk due to an unstable bank or channel or similar condition. The timing of District cost-share involvement thus typically is externally driven, in the one case by opportunity, and in the other by need. Program administration must meet these externally driven timelines based on need or opportunity.

The formal structure by which the District will manage its cost-share expenditures is as follows:

First, the overall program funding level will be set annually through the District's budgeting process. This is an open process that occurs in August and early September each year, and includes a public hearing required by statute at which all parties can review and address the Board of Managers on the District's proposed program budget.

Second, the District will review its implementation priorities biennially in accordance with Minnesota Rules 8410.0105, subpart 1. As a part of this review, the District will conduct one or more public hearings with prior

published notice and written notice to all counties and cities within the watershed. The Board will hear and consider all public comments and make plan implementation and funding adjustments in open public meeting.

Third, cost-share funding proposals will be processed and evaluated according to adopted written guidance as described above, to: (a) provide for consistency in District review and selection of proposals for funding; and (b) direct District funds to projects and locations that will further Plan goals and priorities effectively. The District will enter into formal grant agreements with awardees to guarantee project completion and maintenance.

Fourth, the citizens' advisory committee will have a formalized role in reviewing both program guidance and submitted proposals. The Board and, where delegated grant approval authority, the Administrator carefully will consider the committee's recommendations.

Finally, where an action proposed for cost-share funding includes a significant capital construction element, the District will follow a process of public notice and hearing equivalent to that specified under Minnesota Statutes §103B.251, so that public agencies and interested members of the public can understand, consider and address the Board of Managers on the specific proposed work.

Program Duration and Funding Source:

The District intends the cost-share program to operate for the duration of the planning period, though the Board of Managers may adjust program focus or priorities to match evolving District priorities and the nature of arising opportunities. The District expects to fund its cost-share programs from the ad valorem property tax levied annually on property within the watershed. However, other funding sources such as regional, state or federal grants; subwatershed levies; or stormwater utility fees may be explored in the future.

The financial impact of the cost-share program on local units of government will be positive, as it will reduce stormwater infrastructure and management costs into the future. Awardees, including local units of government, will assume a funding responsibility and incur costs to perform maintenance and other obligations, but this assumption of costs follows a voluntary choice to seek District cost-share funding.

3.6 REVIEW OF LOCAL WATER PLANS AND MUNICIPAL COORDINATION

3.6.1 STATUTORY REQUIREMENTS FOR LOCAL WATER PLANS





Minnesota Statutes §103B.235 prescribes that after the District watershed management plan (WMP) is approved or amended, each local government unit (LGU) having land use planning and regulatory responsibility for territory within the District must prepare a local water management plan, capital improvement program, and official controls as necessary so that local water management conforms with the WMP within the time period prescribed in the WMP implementation program. The local water plan, in turn, is a required element of the LGU comprehensive land use management plan that it must prepare and maintain in accordance with Minnesota Statutes §§473.858-473.864.

This planning framework shows the link that the legislature has recognized between land use and water resource planning. More precisely, it reflects the legislature's intent that regional development patterns and infrastructure, as well as site-level development, both the province of the LGU as the local land use authority, be well integrated with the hydrologic systems within which they are set. As the regional water resource authority, the District is responsible to understand hydrologic systems on a watershed basis and what is needed for their health and sustainability. Through its review of local water plans, the District seeks to engage its LGUs as partners in incorporating this basis of knowledge and understanding into the exercise of land use planning, regulatory, capital, infrastructure maintenance and related local authorities.

Local water management plans must conform to Minnesota Statutes §103B.235, Minnesota Rules 8410.0160 and this Plan. Requirements from the statute and rules are noted within the discussion below. With respect to this Plan, the District approach to local plan requirements reflects a change from the approach under the District's 2007 WMP.

3.6.2 A SHIFT IN THE DISTRICT'S APPROACH TO LOCAL WATER PLANNING

The District's 2007 WMP was organized around the District's eleven subwatersheds and phosphorus load reduction goals for the principal receiving waters within each subwatershed. Necessary load reductions then were allocated among local government units. Local plans were required to commit to reductions identified in the 2007 WMP by identifying and programming capital projects and other implementation actions that would produce the required reductions. This approach was similar in form to the federal Total Maximum Daily Load (TMDL) process. In part, it defined needed phosphorus load reductions for non-impaired waters within the District and other waters for which federal TMDLs have not been adopted.

This framework has produced some very useful collaborative efforts, but more so had the tendency to send District projects off on a separate trail from

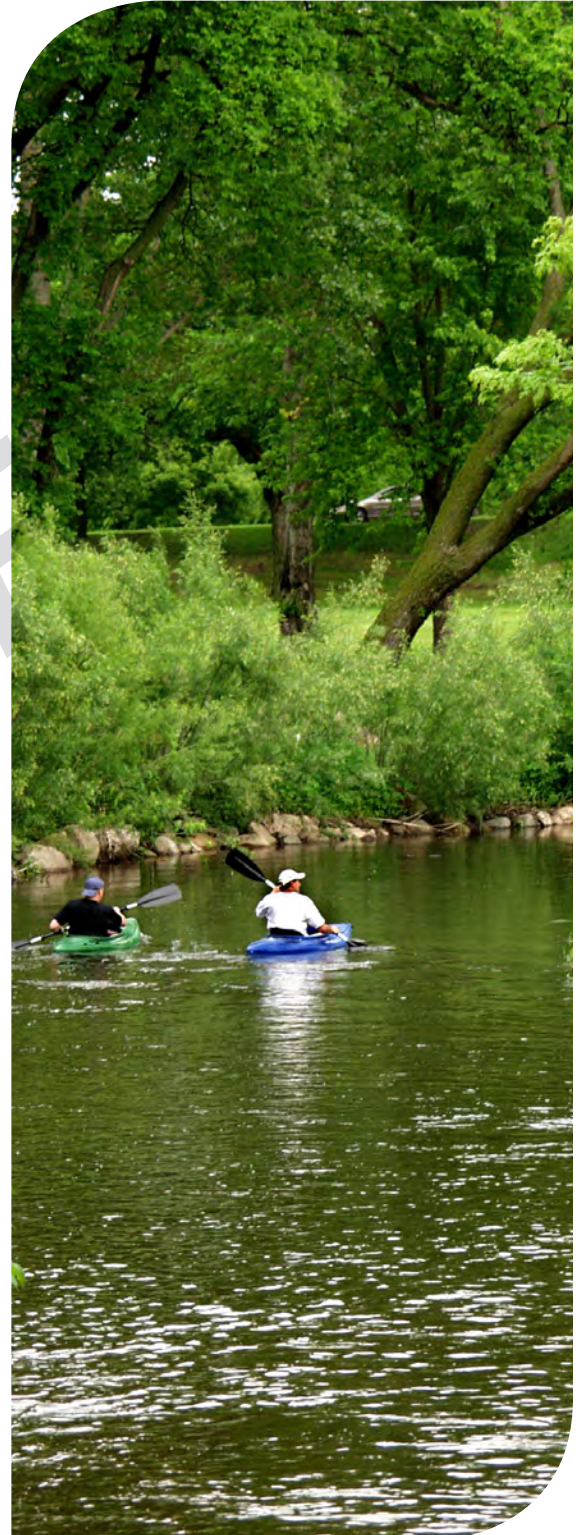


Figure 1.55 Kayakers on Minnehaha Creek

The District invites a partnership framework that fosters increased and early flow of information, to provide for a stronger coordination of land use and water resource management, and to achieve water quality and flood management goals.

local projects and to consider land use regulation as a role carried out in a reactive fashion and separate from District- or LGU-initiated project work. The District's identification of the LGU share of pollutant load reduction appeared more as a mandate and less as something that the District could facilitate through coordination.

This Plan departs from the prior centering on phosphorus load reductions, and the prior mandate imposed on LGUs to specify and implement actions to achieve those reductions. There are two chief reasons for this:

- » The past 10-year planning period has witnessed a continuing evolution in LGU capacity, the relationship of the District and LGUs, and the District's approach to partnership. LGUs within the watershed have water resource capacity and knowledge needed to recognize water resource needs and incorporate them into development controls, capital programs and planning. LGUs have been operating under federal municipal stormwater (MS4) permits and, in some cases, federal antidegradation (formerly "non-degradation") requirements, for nearly 15 years and have institutionalized baseline stormwater management programs to meet MS4 permit requirements. Under the District's partnership approach, the District is not seeking to mandate LGU actions toward goals identified in the Plan, but instead to invite those LGUs that see alignment between their goals and District goals to use their local water plan to, in effect, present their vision for collaboration.
- » This Plan reflects the District's movement from a water quality criterion based predominantly on phosphorus concentration to a broader approach to ecosystem evaluation. This broader approach is reflected in the District's Ecosystem Evaluation Program ("E-Grade"), a method that evaluates subwatershed health from the standpoint of flood control, biodiversity, habitat diversity, recreation, drinking water supply and nutrient cycling.

The E-grade recognizes a broader concept of hydrologic function and beneficial public use. This increases both the need to work, and the benefit from working, in concert with LGUs and other local partners so that outcomes of potential resource investments can be assessed from all relevant standpoints and investments are leveraged to achieve multiple public and private goals.

3.6.3 THE ROLE OF THE LOCAL WATER PLAN IN ACHIEVING REGIONAL LAND AND WATER GOALS

An important component of the local water plan is defining a set of protocols that supports ongoing communication and promotes value-added collaboration between the District and LGU. Through these communications, the District and LGU will coordinate programs and be best situated to

anticipate and identify opportunities for collaboration.

The District invites a partnership framework that fosters increased and early flow of information, to provide for a stronger coordination of land use and water resource management, and to achieve water quality and flood management goals. Targeted areas of collaboration include:

- » Land use policy development and its implementation through planning activities including long-range land use and infrastructure plans and area-wide plans.
- » Capital improvement feasibility planning for public infrastructure including roads, sewer, drinking water and localized power generation.
- » Land use and development regulation, from initial development feasibility through ongoing inspection and facility maintenance functions.
- » LGU operations and facility maintenance.

The District asks that the LGU plan complete the assessment of water resource needs by identifying local water resource issues and provide finer-grained data concerning those issues. Then, it will look to the LGU to describe how it intends to align planning, regulatory and investment decisions to address both District- and LGU-identified water resource goals. The framework for communication and collaboration will be the key to creating opportunities for partnership at the intersection of municipal, private and District interests.



Figure 1.56 Bikers enjoy one of the many trail systems woven throughout the watershed



Figure 1.57 Figure name

As it implements the WMP over the ten-year planning period, the District will be engaged in a continuing process of reviewing priorities and programming the commitment of technical resources and funds. The District is inviting each LGU to use its local plan to communicate its interest in the collaborative relationship described in this section and to help erect the framework that the District and LGU will use over the planning period to promote opportunities to achieve mutual goals. The LGU is invited to use its local water plan to articulate its water resource goals; how it will pursue these in conjunction with its development, transportation, parks and recreation and other public goals; and how it proposes to integrate its vision, investments, expenditures and regulatory programs with those of the District. The District is prepared to program staff capacity to track planning, development, public infrastructure and program activity within interested LGUs, so as to position the District to work with public and private interests within those LGUs in pursuit of the shared and compatible goals of each.



Figure 1.58 Photo credit Garrett Graves

In addition to capital projects and other work undertaken collaboratively, the District will continue to implement projects and programs independently as well. As the District programs resources for this work, local water plans, and LGU implementation of those plans, will be relevant in that District efforts will tend to leverage greatest benefit within a local setting where the LGU is working toward complementary goals and the stakeholder environment otherwise is supportive. The following are examples where decisions as to District spending and use of resources are likely to depend in part on local water plan focus and LGU commitment as shown in the local plan and the LGU's implementation of it:

- » Joint grant applications: Coordination to seek funding for work that serves aligned interests of the District and LGU.
- » District cost-share programs: Cost-share funds awarded at the discretion of the Board of Managers to an LGU, or to institutional or individual property owners within an LGU.
- » Technical assistance: Services of the District staff or engineer to assist LGUs and their residents in resolving water resource issues or pursuing opportunities in areas such as flood management, wetland banking and others.
- » Education initiatives and coordination of education activities for MS4 compliance and other purposes.
- » Conservation third party: Helping LGU and its property owners achieve mutual conservation goals by serving as easement holder for conservation development, assuming wetland bank maintenance obligations, and similar roles.
- » Watershed management district: Using watershed district authority



Figure 1.59 Image credit Brianna Prah



Figure 1.60 Minnehaha Falls, Tom Dixon



to establish localized taxing district to allow lake associations or other groups with common, geographically defined interests to raise funds in order to pursue community goals.

3.6.4 LOCAL WATER PLAN CONTENT REQUIREMENTS

1. Data and Information

The District maintains certain regional data systems that it makes available to its LGUs and others for their own benefit and for consistency across the watershed. An LGU should identify these data systems in its local plan and describe their application to LGU activity in order for the District to ensure that the LGU is aware of these systems and that they are being used for common intended purposes. These systems, with a brief description of their applications, are as follows:

- » Hydrology and hydraulics (H&H) model
- » Waterbody flood elevations derived from Atlas 14 precipitation data
- » Functional assessment of wetlands
- » E-grade lake and watercourse reach data

In addition to information the District is requiring Minnesota Rules 8410.0160 specifies certain local data and information that the local plan must include. These combined requirements are as follows:

- » A summary of water resource management-related agreements, including joint powers agreements, into which the LGU has entered with watershed management organizations, adjoining LGUs, private parties or others.
- » Maps of current land use and land use at the LGU planning horizon.
- » Maps of drainage areas under current and future planned land use with paths, rates and volumes of stormwater runoff.
- » A stormwater conveyance map meeting standards of the current MS4 general permit and indicating an outfall or a connection at the LGU boundary.
- » An inventory of public and private stormwater management facilities including the location, facility type and party responsible for maintenance (e.g., landowner, homeowner's association, LGU, other third party).
- » A listing and summary of existing or potential water resource-related problems wholly or partly within LGU corporate limits. A problem assessment consistent with Minnesota Rules 8410.0045, subpart 7, is to be completed for each. This includes but is not limited to:

- Areas of present or potential future local flooding.
- Landlocked areas.
- Regional storage needs.

Finally, Minnesota Rules 8410.0160 requires that the local plan include: (a) an executive summary stating highlights of the local water plan; and (b) a statement of the process to amend the local plan. The latter must be consistent with Minnesota Statutes §103B.235.

2. LGU Housekeeping

The purpose of this section is for the LGU to describe its land, facilities and operations; assess the contribution to pollutant load, water quality impacts or demand on water resources; and identify potential actions to address these. Potential actions may be unilateral or may involve cooperation with property owners, the District or other partners.

(a) Land

The local plan is to inventory real property owned by the LGU. A map may be used, coordinates can be provided or each parcel or tract may be located by other means. The inventory should classify properties in useful terms such as developed parcels, land suited to development or redevelopment, right of way, dedicated outlots, park and recreational land, and nondevelopable or conservation land. The inventory should indicate locations of facilities and operations identified in the LGU SWPPP, as noted below.

The purpose of this inventory is to assist the District, and the District and LGU together, in scanning opportunities for stormwater management retrofit, engagement in conservation development, regional stormwater management, water reuse, water-related recreation, conservation corridors, leveraged public investment in adjacent lands, and similar land-based initiatives. With this inventory, the LGU should discuss what it sees, from its perspective, as: (i) water resource issues and opportunities associated with its properties; and (ii) potential opportunities to coordinate with the District or other partners.

(b) Facilities and Operations

In the NPDES MS4 stormwater pollution prevention program (SWPPP) that the Minnesota Pollution Control Agency requires each LGU to prepare, the LGU is required to inventory facilities that it owns or operates and municipal operations that may contribute pollutants to groundwater or surface waters. It then is required to describe best management practices that it commits to implement to address potential water resource impacts.

The SWPPP requirement is comprehensive. It includes the following types of



Figure 1.61 Six Mile marsh



Figure 1.62 Minnehaha Creek Preserve



Figure 1.63 Sunset at the Burwell House on Minnehaha Creek, credit, Aldo Abelleira

facilities:

- » Composting and recycling sites, landfills and solid waste handling and transfer
- » Hazardous waste handling, transfer and disposal
- » Pesticide storage
- » Salt, sand and materials storage yards or facilities
- » Equipment and vehicle fueling, storage, washing and maintenance facilities
- » Public works yards
- » Public parking lots
- » Parks, public golf courses and public swimming pools

And the following operations:

- » Waste disposal and storage, including dumpsters
- » Vehicle fueling, washing and maintenance
- » Cleaning of maintenance equipment, building exteriors and dumpsters, and the disposal of associated waste and wastewater
- » Street and parking lot sweeping
- » Landscaping, park, golf course and lawn maintenance
- » Road maintenance, including pothole repair, road shoulder maintenance, pavement marking, sealing and repaving
- » Right-of-way maintenance, including mowing
- » Application of herbicides, pesticides, and fertilizers
- » Cold-weather operations, including snow removal, sand use, and application of deicing compounds
- » Management of temporary and permanent stockpiles of materials such as street sweepings, snow, salt and other deicing materials, sand and sediment removal piles
- » Emergency response, including spill prevention plans

This information is of substantial interest to the District. For example, it will assist the District to understand potential pollution sources within specific catchments and subwatersheds; assist the District to identify project, cost-share and educational opportunities; and provide data for planning associated with subwatershed-based implementation plans. Taken together, the information from all local plans within the District will give the District a watershed-wide inventory of LGU practices that is likely to be very useful in assessing and prioritizing potential District actions or programs pertaining to

municipal operations, and in identifying LGUs that may be useful contacts for such matters.

The District does not intend to create any added burden related to transmittal of this information. Therefore, in the text or as an attachment, the local plan may simply incorporate the inventory and description of practices from its SWPPP. However, to the extent the SWPPP inventory is not current, the LGU should supplement it as necessary.

The LGU also is invited to discuss issues or opportunities related to particular facilities or operations where the District's technical assistance, LGU/District cooperation, shared facilities/services with other LGUs or other forms of collaboration with other interested parties may result in water resource benefits.

(c) Stormwater Management Facilities

Under its NPDES MS4 permit administered by the Minnesota Pollution Control Agency, the LGU is required to prepare a map that locates, among other things, all structural stormwater best management practices within the LGU's stormwater conveyance system. In addition, it is required to prepare an inventory of all stormwater management basins within its political boundaries, whether owned by the LGU or otherwise.

The local plan is to include this map and inventory, with any adjustments so that it is current. As the public agency with the responsibility to understand and manage hydrologic systems and water quality issues at a regional level, the District requires this information for its regional system-level understanding and, more specifically, to assist in maintaining its watershed hydrologic and hydraulic models accurate and current. In addition, the District has offered and will continue to offer assistance to LGUs in matters of stormwater facility maintenance, including deferred maintenance of private facilities and potential collaborative means to fund and perform future maintenance of public and private facilities efficiently.

For each basin and other stormwater management practice contained in the map and inventory, the local plan is to identify the party responsible to maintain the practice; state whether the practice is in maintained condition (or that the LGU does not know); and, for those practices that the LGU is responsible to maintain, the date of next maintenance, if maintenance is programmed.

In addition, the LGU is asked to describe its approach to maintenance of stormwater management practices constructed in conjunction with private development. This includes: (a) whether the LGU assumes maintenance



Figure 1.64 Red Osier Dogwood

The most substantial policy shift from the previous WMP to this one is the District's effort to more closely integrate land use planning and water resource management.

responsibility and, if so, under what circumstances; (b) the LGU's program to inspect practices and secure maintenance by private parties; (c) the means by which the LGU funds its maintenance and inspection activities; and (d) other means of funding that are within its legal authority but that it does not presently use.

Finally, noted above is the issue of deferred maintenance of public and private stormwater management practices. Each LGU is invited to discuss the scope of its knowledge on this issue with regard to practices within its boundaries. The District intends to explore the problem of deferred maintenance and potential approaches to reduce the scope of deferred maintenance. The District's interest presumes cooperation with interested LGUs and consideration of alternative procedures and funding mechanisms. The LGU is invited to include in its local plan any consideration it has given to this issue and any information that may be useful in exploring a cooperative approach with the District.

3. Land Use Planning and Development Regulation

Under the Metropolitan Land Planning Act (MLPA), by December 31, 2018, each land use authority (LUA) must revise its local comprehensive land use plan (CLUP). The law requires that once the CLUP is approved by the Metropolitan Council and adopted by the LUA, the LUA must amend its development code to be consistent with the CLUP. Further, the MLPA requires that in order for the Metropolitan Council to approve a CLUP, it must contain the local water plan

approved by the District.

The most substantial policy shift from the previous WMP to this one is the District's effort to more closely integrate land use planning and water resource management. Land use, and how it is planned and executed, is what most directly determines water quality and quantity conditions within the hydrologic system. The thrust of the District's Balanced Urban Ecology approach is to integrate water resource goals into LGU land use planning, private development and redevelopment intentions, and LUA development regulation in order to be alert to, and exploit, opportunities to achieve multiple public and private goals with well-timed and efficient investments.

The District's interest in LGU land use planning and development regulation, then, is threefold:

- » First, to establish a framework to be informed as to current LGU land use and infrastructure planning and enable early coordination of land use and water resource management. The purpose here is to incorporate regional water resource considerations before broader patterns of land development are fixed or regional infrastructure investments are programmed. Planning coordination also allows for District and LGU exploration of methods to manage development impacts at a regional level.
- » Second, to foster LGU development regulation that integrates water resource protection. Integration allows for public goals often seen as competing (economic development, landowner rights, protection of natural systems) to be favorably reconciled and sets clear expectations so that development and redevelopment may proceed with a more limited risk of disruption due to water resource compliance requirements arising after site plans have been fixed and invested in. It also facilitates managing development footprints and targeting park dedications to:
 - (i) support supra-parcel priority resources and conservation corridors;
 - and (ii) advance water-related recreation and use goals.
- » Third, to identify and capitalize on project opportunities that can result in beneficial water resource outcomes while also serving goals of the LGU and other public and private partners such as infrastructure and operations cost savings, economic and jobs development, park and public space improvements, amenity and property value enhancements, and public recreational and educational benefits.

(a) Land Use Planning

To serve the above purposes, the District asks that the local water plan include the content that follows. This content will constitute a baseline for the District to understand the LGU's planning status and procedures. Combined with the

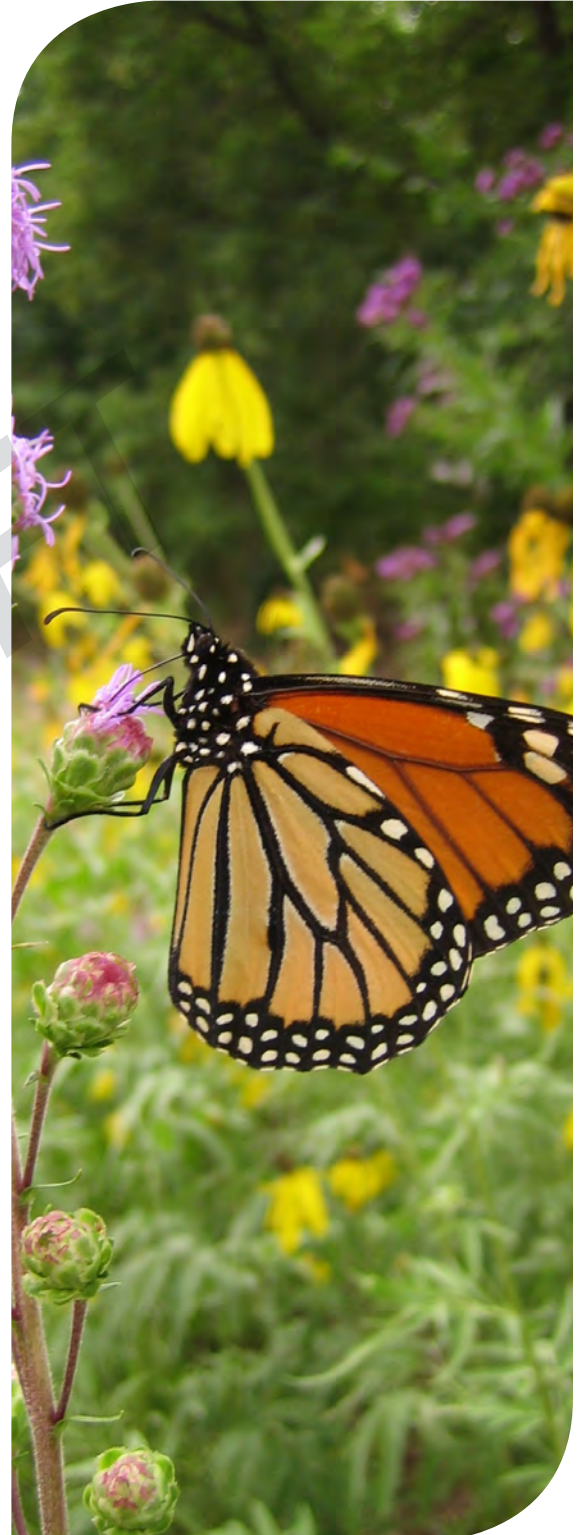


Figure 1.65 A Monarch butterfly on a Blazing Star.

LGU/District coordination plan described at subsection XX.X, below, this will allow the District to understand and participate usefully in the LGU's land use planning efforts to achieve the described goals.

Local plan content is as follows:

1. Identify those areas within or adjacent to the LGU that the LGU has designated in its CLUP for potential development or redevelopment within the CLUP planning horizon. This includes planned rezoning, land assembly, and infrastructure extension or expansion.
2. List and describe completed or programmed small area plans and similar planning activities to assess the LGU's role with respect to defined-area redevelopment.
3. Describe the procedures by which the LGU plans, programs and implements each of the following:
 - Transportation infrastructure
 - Sewer and water infrastructure
 - Park and recreation land acquisition and management
 - Conservation land acquisition and management
 - The description should include the date of the most recent approved capital implementation or land acquisition and management program, the frequency of program updating, the internal procedures to develop and approve the implementation program and to implement specific actions, and how programming and implementation is coordinated with other LGU activities.
4. Provide links to small area/redevelopment plans, capital implementation programs, and land acquisition and management plans listed pursuant to items 2 and 3.

(b) Development Regulation

The LGU's application of its zoning and subdivision codes can integrate water resource and conservation protection in a number of ways. In this section, the LGU is asked to evaluate its official controls with respect to the integration of such concerns and specifically consider means of improving this integration.

The following are some elements of a local development code that can maximize overall public water resource benefit without inhibiting private development of property:

- » Regulatory tools that create incentives to consolidate development

footprint to protect resources (e.g., conservation development, clustering, density credits, transfer of development rights).

- » Dedication or development fees applied to support acquisition or consolidation of public park, recreation or conservation land, particularly as directed toward acquiring or protecting priority water resource areas.
- » Setbacks and/or vegetated buffer requirements with respect to wetland or other surface waters, reconciled with other terms of its development code that restrict development footprint to prioritize waterbody protection where feasible.
- » Controls on mature tree removal.

The LGU is invited, in its local plan, to review these or similar measures that it has adopted or is considering and to indicate any role the District might play in evaluating or implementing such measures.

Also, several aspects of the interplay between LGU and District development regulation arise systematically. The District seeks to resolve these in the best way and, for that purpose, will benefit from certain specific information relating to LGU regulatory programs. The local plan therefore is requested to inform the District on the following:

- » Does the LGU development review process incorporate voluntary or obligatory low-impact site design review? If so, what is the process and would it accommodate District participation?
- » Does the LGU require that stormwater management practices, wetlands or wetland buffers be platted on outlots? If not, what are the obstacles to doing so?
- » Does the LGU assume maintenance responsibility for stormwater management practices within residential, industrial or other subdivisions? Explain the LGU's policy and practice, and how the LGU funds the obligations it assumes.
- » In its role as the Safe Drinking Water Act public water supplier, does the LGU have an approved and operative wellhead protection plan? How does it implement the plan? Does it have an established policy as to where and when infiltration will not be required or permitted as a stormwater management practice?
- » Describe provisions of official controls or LGU practices that make applicants aware of District permitting requirements.

Finally, in the local water plan, the LGU is to identify other regulatory mandates concerning water resources under which it operates. For each, the LGU should briefly describe its legal role and responsibility, if any; its legal compliance



Figure 1.66 Dutch Lake



status; and other implementing roles that are not legally mandated, but that it elects to perform. This may be presented in tabular form if the LGU chooses. Finally, the LGU is invited to identify any District assistance or coordination that would benefit its implementation of any particular program. The following should be specifically addressed:

- » NPDES MS4 stormwater program
- » Total Maximum Daily Load program
- » Federal and state anti-degradation requirements
- » Safe Drinking Water Act/state wellhead protection program
- » National Flood Insurance Program
- » State floodplain management law
- » State shoreland management law
- » Minnesota Wetland Conservation Act

4. Implementation Program

Minnesota Rules 8410.0160 requires that the local plan contain a local implementation program. According to the state rule, the program must:

- » Describe nonstructural, programmatic, and structural solutions to water resource problems identified in **XXX**, above.
- » Present these implementation elements in a table that briefly describes each element, details the schedule, estimated cost and funding sources for the element, and includes annual budget totals.
- » Break out within this table a capital improvement program that sets forth, by year, details of each contemplated capital improvement including schedule, estimated cost and funding source.
- » Prioritize implementation elements consistent with the principles of Minnesota Rules 8410.0045, subpart 1.A, and District priorities as described in the WMP and communicated to the LGU.

Each LGU should include an implementation program as in its judgment will meet these legal requirements. The District will not place great emphasis on this table. The District's emphasis is to establish a framework of communication and collaboration to develop and exploit opportunities as they arise. The implementation program framework as formed by the state rule contemplates a more static process of identifying projects in advance and then constructing them over the planning period. While the District will find it useful to know of any such LGU plans, it will be more interested to look to the partnering framework that the LGU creates in its local plan to complement this WMP. Under the state rule, the District must find that the local implementation program will not jeopardize the achievement of WMP goals. Provided a



Figure 1.67 Fisherman on Lake Harriet, credit: Stan Waldhauser



Figure 1.68 Langdon Lake

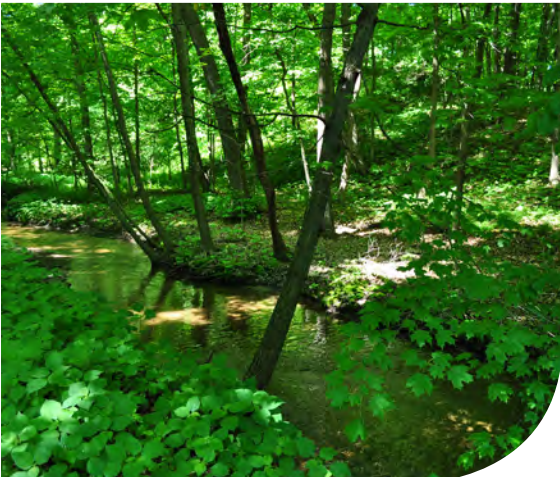


Figure 1.69 A stream in the Schutz Lake subwatershed

programmed action is not in direct conflict with a District goal, the District is not likely to find that an LGU program fails to meet this criterion.

5. LGU/District Coordination Plan

The crux of the District’s approach to water resource management is communication and coordination with its LGUs. The goal is to maintain awareness of needs and opportunities and to implement programs and projects that: (i) develop out of coordinated, subwatershed-based planning; (ii) reflect the cooperation of other public and private partners; (iii) align investments; and (iv) secure a combined set of District, LGU and partner goals.

The LGU, in its local plan, is asked to describe the elements of a coordination plan that the LGU and District can implement at a staff level to achieve this goal. The District looks to the LGU in the first instance to propose a plan that is reasonable in the demands it places on LGU staff but that connects the LGU and the District in ways that efficiently provide for timely coordination.

The following are elements that the coordination plan should address:

- » An annual meeting to review water resource plan implementation
- » Mutual transmittal of the annual NPDES MS4 report
- » How the District can receive notice of and consult with the LGU on its land use, infrastructure, park and recreation, and capital improvement planning efforts
- » LGU notice to the District:
 - Updates to LGU road and infrastructure implementation programs
 - Updates to park and recreation plans
 - Institution and completion of small area plans and other focused development or redevelopment actions
 - Significant alterations within the LGU MS4 system (to maintain currency of the District watershed-wide hydrology and hydraulics model)
- » District notice to the LGU:
 - WMP amendments
 - Annual capital improvement program updates
- » District notice of significant events related to prospective development/redevelopment and receipt of proposed preliminary plats
- » Regulatory coordination
 - Ensuring applicants aware of permitting authority of both bodies

- Mutual notice of development/redevelopment applications filed
- Pre-application meetings
- Sharing of complaint information
- Coordinating compliance inspections
- Coordinating on enforcement
- Providing for District consultation with Technical Evaluation Panel when LGU is the Wetland Conservation Act LGU
 - » Partnership or coordination as to public communications and education
 - » Which LGU staff positions are to be made aware of the coordination plan

The LGU's proposed coordination plan should identify specific departments or staff positions that will constitute appropriate points of contact, and should provide some clarity as to the timing of coordination actions in relation to LGU decisionmaking procedures. The District will work with LGU staff during local plan review to reach consensus on a simple but adequate coordination plan. A separate coordination plan document will be created and adopted as a part of LGU local water plan approval by the District Board of Managers.

3.6.5 DISTRICT REVIEW AND APPROVAL OF LOCAL WATER PLANS

1. Review and Implementation Procedure

Minnesota Statutes §103B.235 states that each LGU must adopt a local water plan not more than two years before its local comprehensive land use plan is due. Before an LGU adopts its local water plan, it must submit its plan to the District for review and approval. Approval rests on the District's finding that the local plan is consistent with the WMP.

The District must complete its review within 60 days of receipt. If it finds that the local water plan is not yet complete or not consistent with the WMP, it will advise the LGU and will provide guidance as will be helpful to the LGU in preparing a final plan for District approval. Within this review period, the District may receive comments from the Metropolitan Council addressing the question of consistency with the Council's comprehensive development guide for the metropolitan area. The District must take these comments into account in its review.

After District approval, the LGU must adopt and implement its plan within 120 days, must notify the District and Metropolitan Council within 30 days thereafter, and must complete any required amendments to its official controls within 180 days.

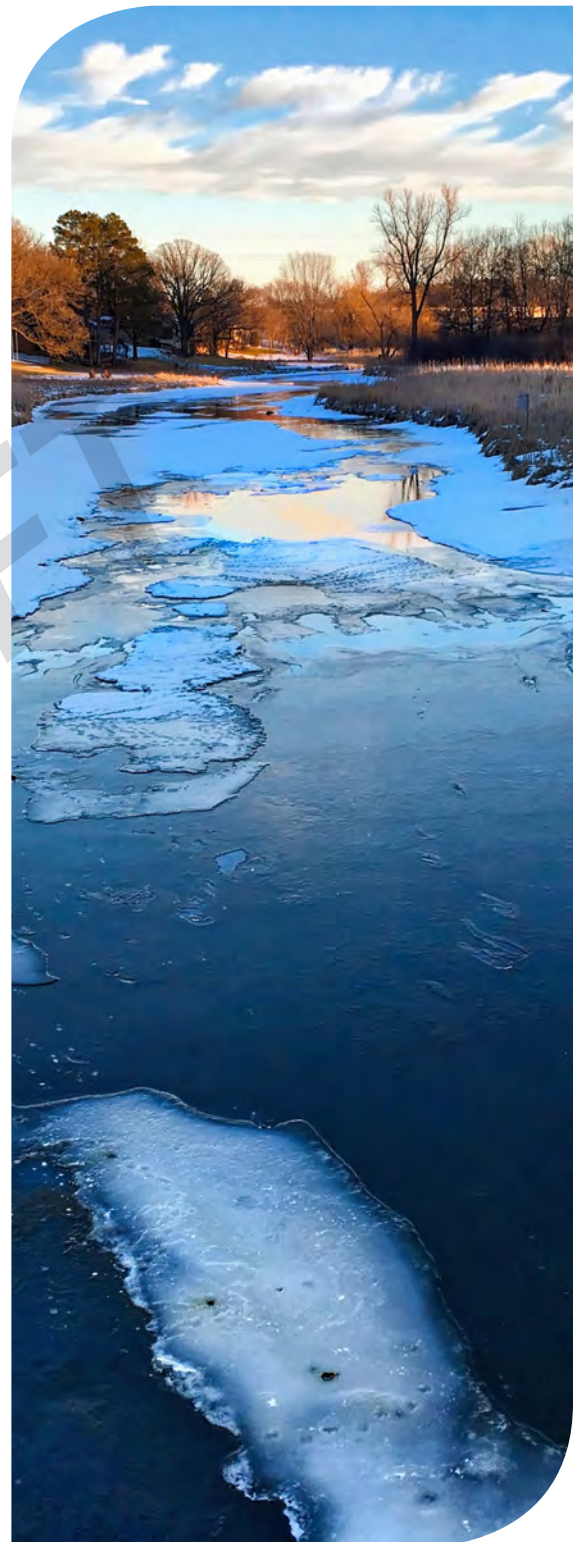


Figure 1.70 Frozen Minnehaha Creek, Aldo Abelleira

2. Water Resource Official Controls

The LGU, under its police powers, and the District, under Minnesota Statutes §103D.341, each have the authority to adopt and apply rules and permitting requirements for activities that may create impacts on water resources. These are parallel authorities and, ordinarily, a landowner or other responsible party must obtain permits from both the LGU and the District, and therefore meet both sets of regulatory requirements.

An LGU may elect to simplify this duplication by requesting that the District cease to apply its rules within the LGU's boundaries on District approval of the LGU local water plan. Specifically, Minnesota Statutes §103B.211, subdivision 1(a)(3), authorizes the District to regulate the use and development of land within its boundaries when one or more of the following conditions exist:

- » The LGU does not have a District-approved local water plan, or has not adopted the implementation program described in the plan;
- » An application to the LGU for a permit for the use and development of land requires an amendment to or variance from the adopted local water plan or its implementation program; or
- » The LGU has authorized the organization to require permits for the use and development of land.

Pursuant to the third condition, an LGU may specify in its local plan that it does not wish the District to cease exercising regulatory authority within its boundaries. However, if it does wish the District to cease exercising such authority, it must meet the standards set forth in this section. These standards are intended to assure the District that LGU official controls are at least as protective of water resources as the District rules, that the LGU has made a conscious decision to allocate sufficient resources to the regulatory program, that it has procedures in place to provide for proper monitoring and compliance oversight after permit issuance, and that the District can remain informed as to the operation of the LGU regulatory program.

An LGU may elect to exercise sole regulatory authority in the following specific areas of District regulation: erosion control, floodplain alteration, wetland protection, waterbody crossings and structures, and stormwater management rules. The District in all cases will continue to apply its dredging and shoreline and streambank stabilization rules within the LGU, as they concern interjurisdictional resources that LGUs have limited authority to regulate. Also, it will continue to apply its appropriations and illicit discharge rules, as it is under an independent statutory mandate to implement these rules. The LGU may choose to assume sole authority for all five listed rules, or fewer. The local plan must identify those District rules for which it wishes to assume sole regulatory authority.

The following are the standards the District will apply when an LGU has requested that the District cease exercising authority with respect to one or more of its rules:

- » For the relevant District rule, the local plan must include existing or proposed ordinances for a District determination that they are at least as protective of water resources as the associated District rules. District staff may provide checklists of substantive requirements and other guidance to LGUs for their use in understanding the standards that must be met. A proposed ordinance need not be submitted in final form, provided there is adequate detail for a District determination. If the ordinance has not yet been adopted, the District plan approval resolution may be contingent on confirming that the adopted ordinance conforms to the proposed ordinance as approved.
- » Procedural details of local ordinances (relating to, for example, permit processing, hearings or public notice) may differ from District rules provided they do not compromise water resource protection.
- » The LGU must describe the technical expertise it has or will acquire to implement its ordinances, and provide an estimate of its annual cost to implement its program.
- » The local plan must establish written protocols for: (i) LGU procedures to administer and enforce its water resource ordinances, including maintenance of those stormwater practices constructed or installed for compliance with LGU ordinances and that the LGU owns or has assumed the obligation to maintain; and (ii) procedures for District review of LGU regulatory program implementation. Administration and enforcement procedures must address work without a permit; active work under permit; maintenance of vegetated buffers; and maintenance of stormwater management practices.
- » The following will apply to LGU administration of its rules:
 - With respect to proposed activities of state agencies or any other entity over whom the LGU does not have regulatory jurisdiction, the LGU authorizes the District to exercise jurisdiction.
 - The LGU need not formally issue itself a permit for its own activities, but for each activity that would be subject to permitting if performed by another party, the LGU will prepare a memorandum documenting its review and determination that its ordinance standards are met. These memoranda will be available to the District in any review of LGU permitting activity.
 - If a permit application requires an amendment to or variance from an LGU ordinance approved by the District under this section, the District will have permitting jurisdiction.



Figure 1.71 Six Mile marsh



Figure 1.72 Figure title

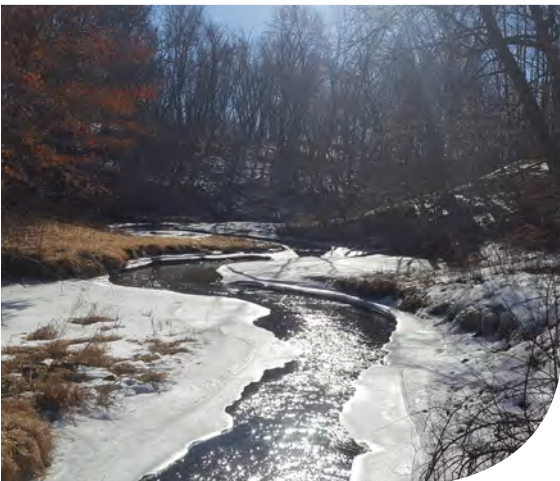


Figure 1.73 Figure title

- The District will retain permitting jurisdiction as required by a legal obligation under its NPDES MS4 permit or any other independent law.
 - As a general matter or on a case-by-case basis, the LGU may request that the District exercise its regulatory jurisdiction, and the District may accede to that request.
- » If the District revises a rule in a manner that it considers significant, and thereafter advises the LGU in writing, the LGU will revise its own ordinance to maintain equivalent water resource protection. If the District has not approved the LGU's revision within six months or such other time as mutually agreed, the District may reassert regulatory jurisdiction with respect to the affected rule. If an LGU chooses not to make the revision, it may authorize the District to reassert its regulatory authority for that rule within LGU boundaries.
 - » The District may reassert regulatory jurisdiction if the District Board of Managers finds that the LGU is not implementing its local water plan or the regulatory program. Before the Board reasserts jurisdiction, the District will engage the LGU to review concerns and work with the LGU to mutually address those concerns.
 - » The District's withdrawal of regulatory authority will expire two years after it adopts the ten-year WMP that succeeds this one, or at another time by agreement of the District and LGU.

3. Minnesota Wetland Conservation Act

The local plan must state whether the LGU intends to assume the role of "local government unit" responsible to implement the Minnesota Wetlands Conservation Act (WCA) within that part of the LGU that lies within the watershed or, conversely, whether it chooses for the District to assume that role. If the former, it must describe the technical expertise it has or will acquire to implement WCA, describe how it will monitor and enforce WCA compliance, and present an estimate of its annual cost to implement and enforce WCA. If the LGU elects to assume the role of WCA LGU, the District asks that it include in its local plan a commitment to reasonable coordination and consultation between the LGU member of the Technical Evaluation Panel and District regulatory staff. §

3.7 EVALUATION AND REPORTING

The District uses a variety of strategies to evaluate its performance and measure progress toward its strategic goals of Water Quality, Water Quantity, Ecological Integrity, and Thriving Communities. These evaluation and reporting processes are designed to meet the requirements of MN Rules 8410 and the District's Municipal Separate Stormsewer System (MS4) Permit.

TYPES OF EVALUATION AND REPORTING

Observed Outcomes

The District has a robust monitoring program that measures progress toward the District's water quality, water quantity, and ecological integrity goals using a variety of metrics. This includes regular baseline monitoring to identify impairments and track trends over time; expanded monitoring through the District's E-grade program to broadly characterize ecosystem health on a 10-year rotating basis; and effectiveness monitoring to more directly measure the effects of select District capital projects. The District's monitoring program is described in more detail in Section 2.1, and the specific metrics measured by the District are listed in Table 3.7.2 below.

Projected Outcomes

Given the length of time it can take to observe changes in water quality, water quantity, and ecological integrity on the landscape, and the difficulty of attributing those changes directly to the District's work, the District also relies on projections or estimates to measure progress toward its goals. These include the use of models to estimate metrics like phosphorus load reduction or volume reduction resulting from District capital projects, permit compliance, and grants. The District also tracks a number of discrete metrics that have assumed water quality, water quantity, and ecological integrity benefit, such as acres of wetland restored and lineal feet of shoreline restored.

The District also tracks a number of metrics related to citizen engagement and awareness based on the assumption that increased awareness leads to action. Through various methods of data collection, the District is able to assess how many people are being reached, what they are learning, and the actions they are taking to protect and improve water quality. Approximately every five years the District conducts a public opinion survey of its residents to assess their level of awareness of the District and water quality issues, their perception of the condition of local lakes and streams, the personal actions they take to protect clean water and other metrics. The District also tracks and evaluates participation in its events, workshops, and programs such as Master Water Stewards and Watershed Association Initiative. Analytics from the District's online presence provide information on how many people are following the District's social media accounts (Facebook, Twitter, Instagram and YouTube), subscribe to the District's on-line newsletter, and visit the District's website.

While the District does not define specific issues or objectives related to its strategic goal of Thriving Communities, the District is interested in quantifying and tracking outcomes related to broader community value. Examples include increased green space, recreation opportunities, and access to water resources.

District Effectiveness

As part of the development of this Plan, the District undertook an internal strategic planning process to establish a clear and focused mission, vision, goals, and guiding principles; and evaluate District programs to ensure alignment with the newly defined mission and improve focus and effectiveness. The process resulted in a Strategic Alignment Plan that established clear and focused priorities for each program and the District as a whole. The District intends to use this Strategic Alignment Plan as a foundation to evaluate new initiatives and revisit existing work to ensure that the District maintains its focus and alignment moving forward.

GOALS AND METRICS

In addition to the District’s four strategic goals, the District has established specific measurable goals as summarized in the following table.

Strategic Goal	Measurable Goal
Water Quality	Phosphorus levels below MPCA impairment threshold, where applicable, or below MCWD 2007 Plan Goals (see Section 2.3 for specific waterbody goals)
Water Quantity	No net increase in volume of stormwater runoff for 1, 10, or 100 year event
Ecological Integrity	Index of biotic integrity above MPCA impairment threshold for fish and macroinvertebrates
All of the above	No net loss of wetlands

Figure 1.74 Table 3.7.1

As described above, the District uses a combination of observed and projected outcomes to track progress toward its goals. The following table provides a summary of key metrics that are tracked by the District, the programs responsible for tracking and reporting, and the frequency with which they are reported.

3.8 PLAN AMENDMENTS

The Plan will extend through the year 2027. The Plan will remain in effect as revised and amended, until superseded by a subsequent plan approved by the Board of Water and Soil Resources (BWSR) and adopted by the District.

Only the District Board of Managers can initiate a formal plan amendment. Other individuals or entities may petition the Board to initiate an amendment, but the decision to do so will remain a matter for the Board’s discretion. All plan amendments must follow the process provided in Minnesota Statutes, §103B.231, subdivision 11, except in the following two instances:

Strategic Goal	Metric	Programs	Reporting Frequency
Water Quality	Phosphorus loading – modeled (lbs)	Projects, Grants, Permitting	Biannually
	Lake and stream concentrations for: <ul style="list-style-type: none"> • Total and dissolved phosphorus • Total suspended solids • Chlorophyll-a • Secchi disc depth • Dissolved oxygen • Chlorides • E. coli bacteria (streams only) 	Research and Monitoring	Annually
	Lake and stream trends for: <ul style="list-style-type: none"> • Total phosphorus • Total suspended solids • Chlorophyll-a • Secchi disc depth 	Research and Monitoring	Annually
Water Quantity	Volume of runoff – modeled (acre-feet)	Projects, Grants, Permitting	Biannually
	Stream discharge and trends	Research and Monitoring	Biannually
Ecological Integrity	Index of Biotic Integrity for fish and macroinvertebrates	Research and Monitoring	10 year E-Grade Report
	Stream Habitat Assessment Protocol	Research and Monitoring	10 year E-Grade Report
	Shoreline/streambank restored (lineal feet)	Projects	Biannually
All of the above	Wetland restoration/loss (acres)	Projects, Permitting	Biannually
	Community engagement: <ul style="list-style-type: none"> • Public opinion survey responses • Participants in events, workshops, and programs • Analytics on District website, social media, and newsletter 	Education and Communications	Biannually

Figure 1.75 Table 3.7.2

- » **Plan changes that do not constitute plan amendments.** When such changes are made, they will be distributed to those on the distribution list indicated below in a form that communicates deleted and new text. These changes include the following:
- Plan reformatting or reorganization;
 - Revision of a procedure meant to streamline plan administration;
 - Clarification of existing plan goals or policies;
 - Inclusion of additional data that don't require interpretation;
 - Expansion of public process;
 - Adjustments in implementing program activities within the District's discretion.
- » With respect to changes to the District's implementation action table that fall within this subsection, this subsection will be implemented through a revised table distributed annually. Such changes may include a change in the timing of one or more actions, or a change in the estimated cost of a program or project where the revised estimate does not exceed 120 percent of the existing estimate.
- **Minor plan amendments.** The District will send the proposed amendment to each of the plan review authorities, as defined in Minnesota Rules 8410, for a review and comment period of at least 30 days. The notice will state that the minor amendment procedure is being followed, and will direct that comments be sent to the District and to BWSR. The amendment will be considered a minor amendment if:
 - BWSR has agreed that the amendment is minor or has failed to act within five working days of the end of the comment period, or such other period to which BWSR and the District have agreed;
 - Neither the Hennepin nor the Carver County Board of Commissioners has filed an objection to the amendment with the District and BWSR within the comment period, or such other period to which the County and the District have agreed; and
 - The amendment is not needed to make the Plan consistent with an approved and adopted county groundwater plan.
- » Before adopting a proposed minor amendment, the District will hold a public meeting to explain and receive comment on the amendment. This will occur after legal notice of the meeting has been published twice, at least seven and at least 14 days before the meeting date.

The District will transmit draft and final amendments to the distribution list electronically, and in paper format to any entity that has requested to receive amendments in that form. Draft amendments will show deleted text as stricken and new text as underlined. A final amendment adopted by the District will be in the form of replacement pages for the Plan, with each page renumbered as appropriate and stating the effective date of the amendment.

The District will maintain a distribution list of agencies and individuals who have received a copy of the Plan, which includes “plan review authorities” as defined in Minnesota Rules 8410. The District will distribute copies of an adopted amendment to all on the distribution list and post the amendment on its website within 30 days of adoption.

It is the intent of this section to conform to procedures stated in Minnesota Rules 8410. If BWSR should amend those rules in any manner that makes them inconsistent with this section, the District will adjust its amendment practice to maintain conformity with Minnesota Rules 8410 pending any formal amendment of this section.

3.9 SUBWATERSHED PLANS

[Sub plans]

3.10 IMPLEMENTATION TABLES

The following table summarizes the District’s programs, their general activities, approximate annual budgets, funding sources, and schedule. More detail descriptions for each of these programs can be found in Section 3.5.

*See Section 3.4.4 for more information on funding sources

The following table summarizes the District’s Capital Improvement Program (CIP), including the subwatershed where the project is located, project name, estimated cost, potential funding sources, and schedule. More detailed descriptions for each project can be found in the Subwatershed Plans in section 3.9.

*See Section 3.4.4 for more information on funding sources

Program Activities	Approximate Annual Budget	Funding Sources*	Schedule
Education and Communications	\$1,000,000	MCWD Levy	Ongoing
Build support for District policy, programs, and projects Engage and educate communities on water resource issues			
Incentive Programs	\$500,000	MCWD Levy	Ongoing
Opportunity Grants Stewardship Grants			
Land Conservation	\$2,500,000	MCWD Levy	Ongoing
Continue proactive efforts to conserve high-value natural resources Service debt for past land purchases and capital expenses			
Permitting	\$650,000	MCWD Levy	Ongoing
Permit administration Field inspection and compliance enforcement Opportunity identification and partnership-building			
Planning	\$1,000,000	MCWD Levy	Ongoing
Capital project planning and implementation Policy development and coordination with District partners Internal program coordination and alignment			
Project Maintenance and Land Management (PMLM)	\$750,000	MCWD Levy	Ongoing
Maintain District capital projects, lands, and infrastructure Provide technical assistance to partners and landowners Coordinate District flood response			
Research and Monitoring	» \$1,000,000	MCWD Levy	Ongoing
Data collection and analysis to inform management efforts Carp management AIS early detection, rapid response, and support of partner efforts			
Capital Improvement Program	» \$3,500,000	See Table 3.10.2	
See Table 3.10.2			

Subwatershed	v
Christmas Lake	Stormwater Volume and Pollutant Load Reduction
Dutch Lake	Stormwater Volume and Pollutant Load Reduction
Gleason Lake	Stormwater Volume and Pollutant Load Reduction
Lake Minnetonka	Halsted Bay Internal Phosphorus Load Reduction
Lake Minnetonka	Stormwater Volume and Pollutant Load Reduction
Lake Virginia	Stormwater Volume and Pollutant Load Reduction
Langdon Lake	Stormwater Volume and Pollutant Load Reduction
Long Lake Creek	Stormwater Volume and Pollutant Load Reduction
Long Lake Creek	Long Lake Subwatershed Wetland Restoration
Long Lake Creek	Long Lake Internal Phosphorus Load Reduction
Minnehaha Creek	Minnehaha Creek FEMA Flood Damage Repairs
Minnehaha Creek	325 Blake Road Regional Stormwater and Greenway
Minnehaha Creek	Meadowbrook Golf Course Ecological Restoration
Minnehaha Creek	Arden Park Stream Restoration
Minnehaha Creek	Greenway to Cedar Trail Connection and Streambank Restoration
Minnehaha Creek	Boone-Aquilla Floodplain
Minnehaha Creek	Cottageville Park Phase II Riparian Restoration
Minnehaha Creek	West Blake Greenway Enhancement
Minnehaha Creek	Meadowbrook Greenway Expansion
Minnehaha Creek	Hiawatha Golf Course Restoration
Minnehaha Creek	Minnehaha Parkway Stormwater Management
Minnehaha Creek	Stormwater Volume and Pollutant Load Reduction
Minnehaha Creek	Channel/Streambank Restoration
Painter Creek	Potato Marsh Restoration
Painter Creek	SOBI Marsh Restoration
Painter Creek	Upper and Lower Painter Marsh Restoration
Painter Creek	South Katrina Marsh Restoration
Painter Creek	Stormwater Volume and Pollutant Load Reduction
Painter Creek	Stream Restoration
Painter Creek	Wetland Restoration
Schutz Lake	Stormwater Volume and Pollutant Load Reduction
Six Mile-Halsted Bay	East Auburn Stormwater Enhancement Project
Six Mile-Halsted Bay	Wassermann West External Load Reduction and Landscape Restoration
Six Mile-Halsted Bay	Pierson Lake Headwaters Restoration
Six Mile-Halsted Bay	Turbid-Lundsten Wetland Restoration
Six Mile-Halsted Bay	Mud Lake Watershed Load Reductions
Six Mile-Halsted Bay	Wassermann Internal Load Management
Six Mile-Halsted Bay	East Auburn Wetland Restoration
Six Mile-Halsted Bay	Halsted Bay Watershed Load Management
Six Mile-Halsted Bay	Wetland Restoration
Six Mile-Halsted Bay	Stormwater Volume and Pollutant Load Reduction
Six Mile-Halsted Bay	Stream Restoration

Capital Cost	Potential Funding Sources*	Proposed Implementation Year
\$200,000	MCWD levy, partner contributions, grants	2018-2027
\$780,000	MCWD levy, partner contributions, grants	2018-2027
\$600,000	MCWD levy, partner contributions, grants	2018-2027
\$1,400,000	MCWD levy, partner contributions, grants	2018-2027
\$1,000,000	MCWD levy, partner contributions, grants	2018-2027
\$650,000	MCWD levy, partner contributions, grants	2018-2027
\$225,000	MCWD levy, partner contributions, grants	2018-2027
\$1,320,000	MCWD levy, partner contributions, grants	2018-2027
\$ 1,900,000	MCWD levy, partner contributions, grants	2018-2027
\$ 1,025,000	MCWD levy, partner contributions, grants	2018-2027
\$500,000	MCWD levy, partner contributions, grants	2017-2018
\$2,747,100	MCWD levy, partner contributions, grants	2018-2019
\$2,200,000	MCWD levy, partner contributions, grants	2018-2019
\$4,100,000	MCWD levy, partner contributions, grants	2018-2019
\$511,000	MCWD levy, partner contributions, grants	2019-2020
\$500,000	MCWD levy, partner contributions, grants	2019-2020
\$276,000	MCWD levy, partner contributions, grants	2019-2020
\$417,120	MCWD levy, partner contributions, grants	2020-2021
\$950,000	MCWD levy, partner contributions, grants	2020-2021
\$1,935,000	MCWD levy, partner contributions, grants	2020-2021
\$1,400,000	MCWD levy, partner contributions, grants	2021-2022
\$2,450,000	MCWD levy, partner contributions, grants	2018-2027
\$3,120,000	MCWD levy, partner contributions, grants	2018-2027
\$ 870,000	MCWD levy, USACE Section 206, partner contributions, grants	2019
\$242,000	MCWD levy, USACE Section 206, partner contributions, grants	2020
\$2,804,000	MCWD levy, USACE Section 206, partner contributions, grants	2021
\$1,265,000	MCWD levy, USACE Section 206, partner contributions, grants	2022
\$980,000	MCWD levy, partner contributions, grants	2018-2027
\$2,985,000	MCWD levy, partner contributions, grants	2018-2027
\$330,000	MCWD levy, partner contributions, grants	2018-2027
\$250,000	MCWD levy, partner contributions, grants	2018-2027
\$170,000	MCWD levy, partner contributions, grants	2017-2018
\$2,250,000	MCWD levy, partner contributions, grants	2018-2019
\$315,000	MCWD levy, partner contributions, grants	2019-2021
\$900,000	MCWD levy, partner contributions, grants	2019-2021
\$6,115,000	MCWD levy, partner contributions, grants	2019-2025
\$290,000	MCWD levy, partner contributions, grants	2020-2022
	MCWD levy, partner contributions, grants	2020-2021
\$7,728,000	MCWD levy, partner contributions, grants	2022-2025
	MCWD levy, partner contributions, grants	
	MCWD levy, partner contributions, grants	
	MCWD levy, partner contributions, grants	

3.7.1 CHRISTMAS LAKE SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Christmas Lake Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Christmas Lake is a 1.2 square mile (742 acre) subwatershed located along the southwestern boundary of the MCWD and includes portions of the cities of Chanhassen and Shorewood, with a small area in Excelsior.

The subwatershed is dominated by single family residential uses (48%) and the 276 acre Christmas Lake (37%), with the remaining balance being wetland or woodland (12%). There are a few isolated wetlands in the watershed and some that are riparian to the lake.

A small stream drains the upper part of the subwatershed and outlets into the southwest side of Christmas Lake. Some of the small basins in the subwatershed are landlocked and have no natural outlet. The subwatershed discharges into St. Albans Bay of Lake Minnetonka.

Water quality in Christmas Lake is better than state standards and is typically among the best in the District. Zebra mussels infested Christmas Lake in 2014 and are now established lakewide. The channel that conveys drainage from the southern subwatershed unit to the lake is experiencing some erosion, possibly conveying sediment to the lake, and phosphorus concentrations in the stream are elevated compared to state standards.

Management strategies within the Christmas Lake subwatershed will focus on protecting water quality in the lake by limiting nutrients and sediment in stormwater runoff. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Christmas Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality: **Lakes and Streams:**

The Christmas Lake subwatershed is dominated by Christmas Lake itself. Water quality in Christmas Lake is better than state standards and is typically among the best in the District.

There is a small stream that conveys drainage from the upper subwatershed to Christmas Lake. While it is not listed as an Impaired Water for nutrients, the stream exhibits significantly high total phosphorus concentrations, and exceeds state river eutrophication standards.

Zebra mussels are established in the lake, and when abundant, can drive water quality changes through their filtering ability and can have the potential to mask other nutrient loading issues.

Wetlands:

There are few wetlands in the Christmas Lake subwatershed, about 33.7 acres of wetlands. Most are small and isolated, but there are some riparian to the lake that provide fish and wildlife habitat.

Groundwater:

While most of the subwatershed has only low to moderate sensitivity to pollution, some scattered areas are classified



Figure 1.76 Christmas Lake Base map



as highly sensitive. The entire subwatershed is designated as a Wellhead Protection Area. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity:

Surface flows in the Christmas Lake subwatershed are routed primarily through a system of culverts connecting small depressions. A small channel drains the upper subwatershed into the southeast corner of Christmas Lake.

Most of the wetlands in the subwatershed are combination discharge-recharge, but some of the wetlands with the highest functions and values in the watershed are discharge wetlands. Changes in the surficial groundwater table or flow can negatively impact discharge wetlands' vegetation and biota, making it important to protect and increase groundwater recharge.

Ecological Integrity:

Lakes and Streams:

Christmas Lake is one of a few lakes in the Metro Region that can support a two-story fishery, supporting both cold-water species in the cooler, deeper portions of the lake and warm-water species in the warmer water above the thermocline.

Zebra mussels infested Christmas Lake in 2014 and while initial treatments controlled the population within the treatment area, they were found established lakewide by fall of 2015. The zebra mussel population in Christmas Lake are expected to be limited due to low algal concentrations in the lake; however, even a small population could impact the healthy native mussel population in the lake.

There is an abundant and diverse aquatic plant community in the lake that benefits biodiversity and habitat diversity. The invasive Eurasian watermilfoil and curly leaf pondweed are both present in the lake, but thus far have not had a great impact on the overall aquatic plant community.

Wetlands:

Wetland assessments have classified one small wetland as having exceptional vegetative diversity and another has high diversity. Three wetlands were classified as having exceptional

aesthetic and fish habitat values. Their conservation is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

Uplands and Natural Corridors:

The subwatershed is almost fully developed, and there are only a few remaining patches of undeveloped landscape. Most of these areas are wetlands or wooded portions of large residential lots. No areas within the subwatershed have been identified by the DNR or the Minnesota County Biological Survey (MCBS) as being high-value or ecological areas.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Christmas Lake subwatershed.

The principal issues within the Christmas Lake subwatershed are:

Water Quality

- » Excessive nutrients from stream input

Water Quantity

- » Localized flooding

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Stormwater runoff
- » Altered channels

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved fraction) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use

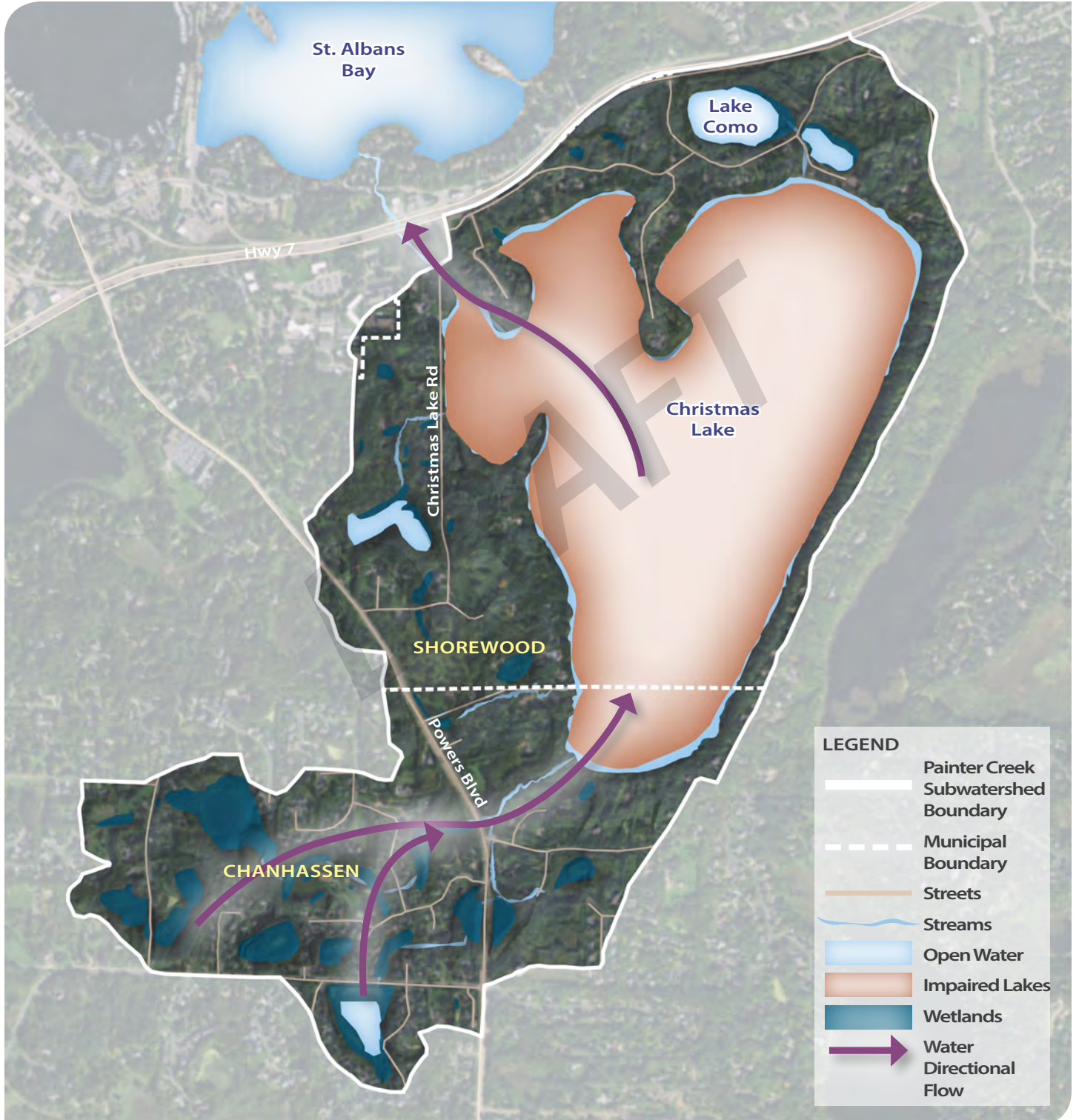


Figure 1.77 Christmas Lake Water Resources map



intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients causing nutrient impairments in downstream surface waters.

There are few remaining wetlands in the Christmas Lake subwatershed aside from those riparian to the lake. There is a series of flow-through, riparian small ponds and altered wetlands along the small channel that drains the upper subwatershed into the southwest corner of Christmas Lake. That channel has elevated concentrations of total phosphorus, one of the sources of which could be wetland export.

Stormwater Runoff:

Watershed runoff from rainfall events or stormwater can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding and change stream flow that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up pollutants such as excess nutrients, bacteria (e.g., *E. coli*), chloride from road salt, and toxic pollutants. In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters, because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

The Christmas Lake subwatershed is almost fully developed with single family residential uses. Storm water runoff is conveyed to either the drainage channel in the upper subwatershed or directly to the lake. There is some water quality treatment of this runoff. The channel has elevated concentrations of total phosphorus, the source of which could be untreated stormwater runoff, wetland export, sedimentation from an eroding channel, or a combination of these sources.

Altered Channels:

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

The channel that drains the upper subwatershed is likely to be a historically ephemeral stream that was an outlet for wetlands and which conveyed large events and snowmelt, but has been altered and straightened to convey urbanized stormwater runoff. Portions of the channel are confined to storm sewer. Below Powers Boulevard, the stream is experiencing some erosion, which may be conveying excess sediment and nutrients to the lake and stressing the local biotic community.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Christmas Lake subwatershed. These strategies are both short- and long-term, and establish a framework for the Christmas Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

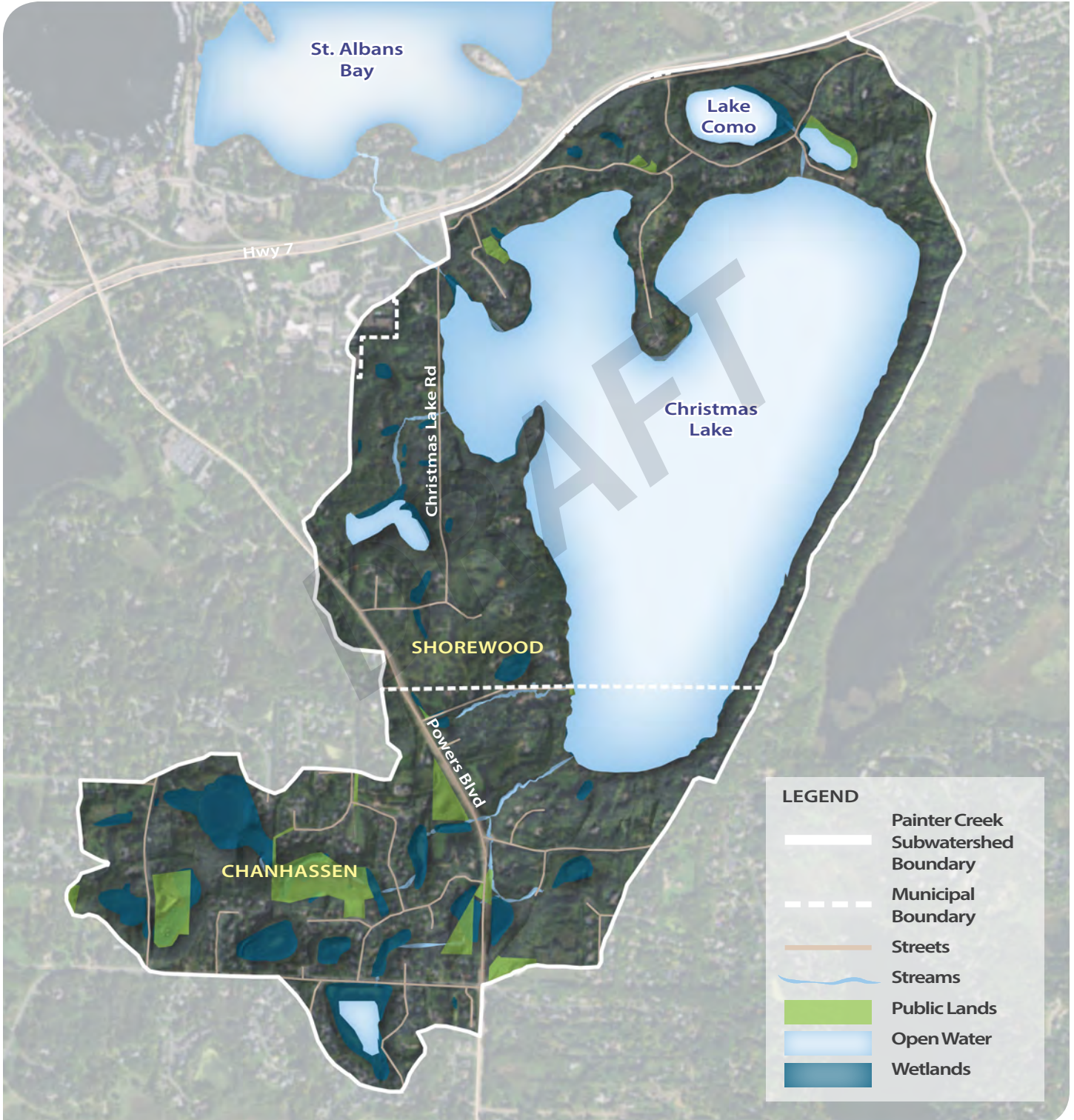


Figure 1.78 Christmas Lake Parks, Trails, and Open Space map



To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

The series of wetlands west of, and in, Curry Farms Park in Chanhassen, through which the upper subwatershed channel flows, was classified with moderate restoration potential. Each of these wetlands were assessed as being currently of moderate vegetative quality. Wetland restoration may improve habitat and aesthetics as well as reduce the export of nutrients into the channel downstream to Christmas Lake.

Stormwater Management:

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

The overall strategy for protecting water quality in Christmas Lake is to reduce pollutant loading and stormwater runoff volume from the subwatershed by retrofitting developed areas with Best Management Practices (BMPs) as infrastructure and development/redevelopment opportunities arise, and to encourage property owners to incorporate BMPs on their own properties.

Stream Channel Restoration:

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates.

Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and reaeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Below Powers Boulevard, the stream is experiencing some erosion, which may be conveying excess sediment and nutrients to the lake and stressing the local biotic community. Stream restoration would stabilize the streambanks, filter overland runoff, enhance habitat, and reduce nutrient and sediment load downstream.

Watershed Protection

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of the development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

LAND USE

EXISTING CONDITIONS

The subwatershed includes portions of the cities of Shorewood and Chanhassen, with a small area in Excelsior. The subwatershed is fully developed with single family residential (48%) dominating the land use, followed by open water (37%) and undeveloped (11%), which is primarily undevelopable wetland.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Sections 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

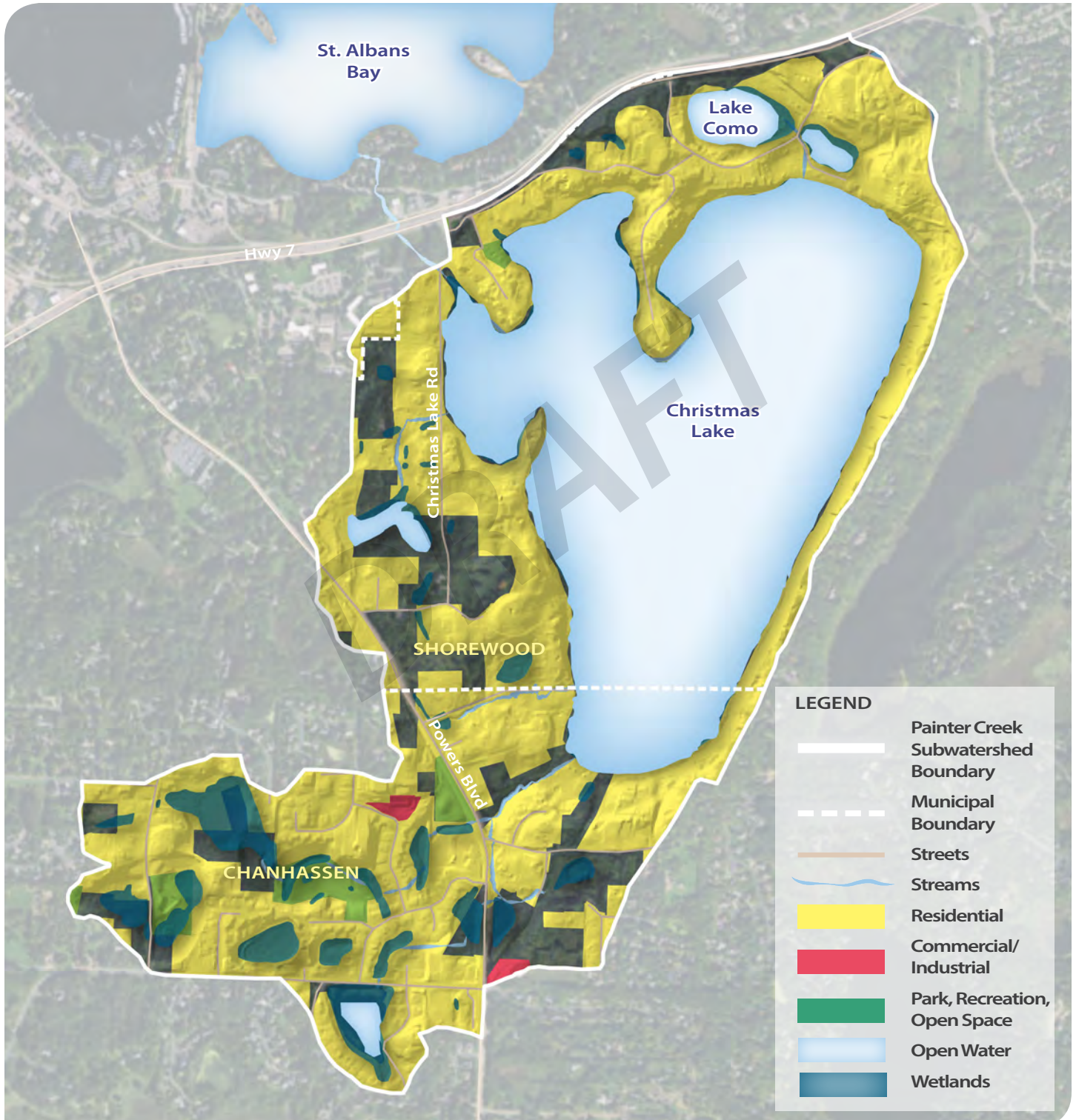


Figure 1.79 Christmas Lake Land Use map



As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for the 2017-26 (see Appendix for details on the public input process). This information was used to broadly characterize opportunities that existed at the time to inform the District's implementation plans. Below is a brief summary of the information received. It is meant to serve only as a guide, not to restrict collaborative efforts. As discussed in Section 3.6, the District intends to coordinate with its communities on an ongoing basis to stay apprised of new opportunities.

The subwatershed is largely residential with potential redevelopment identified on the lake and along Christmas Lake Road. There are some localized flooding issues which the cities will look to address as part of future road improvements.

There is an active lake association for Christmas Lake. Priority issues identified by the group include aquatic invasive species (AIS) prevention and management, regulation of single family home redevelopment, and shoreline erosion from boat wakes.

The municipalities and Christmas Lake Association are actively engaged in protecting Christmas Lake. By Shorewood ordinance, watercraft must be inspected for AIS before entering Christmas Lake. Such inspections are provided at the boat launch for no charge.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, water quality in Christmas Lake is better than state standards and is typically among the best in the District. The channel that conveys drainage from the southern subwatershed unit to the lake is experiencing

some erosion, possibly conveying sediment to the lake, and phosphorus concentrations in the stream are elevated compared to state standards.

Based on these conditions, management strategies within the subwatershed will focus on protecting water quality in the lake by limiting nutrients and sediment in stormwater runoff. This will be achieved primarily through the District's rules which require no net increase in runoff and pollutant loading for new developments. For redevelopment, the rules require a reduction in runoff and pollutant loading depending on the development size and current conditions.

The Christmas Lake subwatershed is relatively small and mostly built out, so opportunities from land use change are expected to be limited. The Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects. The CIP for the subwatershed, detailed in the next section, includes a project for stormwater management should an opportunity arise through land use change or a partner initiative.

As noted in the previous section, there is an active lake association for Christmas Lake. The District will continue to work with its lake associations to build their capacity and target their implementation efforts.

Zebra mussels infested Christmas Lake in 2014 and are now established lakewide. The zebra mussel population in Christmas Lake are expected to be limited due to low algal concentrations in the lake. The District will continue to monitor any impacts or trends.

The subwatershed is scheduled to be assessed through the



E-grade Program in 2021-2023 with a report released in 2024. The E-Grade Program will characterize ecological health in the subwatershed. The data collected and analyzed through the program will further inform the identification of issues and priorities for the subwatershed.

CAPITAL IMPROVEMENT PLAN

Given the limited resource needs and anticipated opportunities within the Christmas Lake subwatershed relative to other parts of the watershed, the District does not expect to initiate any capital improvement efforts in the subwatershed during this plan cycle. The District has included a project in its CIP for stormwater management in the event that an opportunity arises through land use change or a partner initiative.

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Christmas Lake, including but not limited to construction of infiltration basins and devices, wetland restoration, reforestation, revegetation, and stormwater detention or redirection.
Need	Christmas Lake displays excellent water quality but is sensitive to potential future loading increases. The channel that conveys drainage from the southern subwatershed unit to the lake exhibits phosphorus concentrations that are elevated compared to state standards.
Outcome	Minimized pollutant loads conveyed by stormwater runoff to Christmas Lake.
Estimated Cost	Capital costs: \$200,000, excluding land, in 2017 dollars. O&M costs for infiltration projects: \$25,000 per year in 2017 dollars based on 20-year project life.
Potential Funding Sources	MCWD levy, partner contributions, grants
Schedule	2018-2027

SUBWATERSHED PLAN SUMMARY

The following table summarizes the proposed implementation action items and their relationship to overall District and subwatershed goals, issues and strategies identified in this subwatershed plan.

[Insert table]

3.9.2 DUTCH LAKE SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Dutch Lake Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Dutch Lake is a 3.0 square mile (1,888 acre) subwatershed located along the northwestern boundary of the MCWD and includes portions of the cities of Mound and Minnetrista. The subwatershed is generally characterized by undeveloped land (50%), including numerous large wetland systems and wooded areas, low-density development (24%), agricultural uses (10%), parks and open spaces (6%), and water (10%). Mound Westonka High School is a large, institutional use in the eastern subwatershed.

The subwatershed includes large areas of undisturbed or minimally disturbed wetland and woodland. Much of the subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor and by the City of Minnetrista as a natural resources corridor due to the predominance and contiguity of wetlands.

The Dutch Lake subwatershed has two large wetland systems, which through a series of ditches and culverts both drain to Dutch Lake, the primary receiving water within the subwatershed. The small stream that drains wetlands on the west side of Dutch Lake flows intermittently. There is one primary stream, Dutch Creek, which serves as the outlet of Dutch Lake and flows to Lake Minnetonka: Jennings Bay.

The Dutch Lake subwatershed has several issues relating to water quality, water quantity, and ecological integrity. Dutch Lake is impaired by excess nutrients and the inlet and outlet of Dutch Lake have elevated levels of total phosphorus. The outlet of Dutch Lake is also at high risk of chloride impairment. The fish and vegetation communities in Dutch Lake and its inlet and outlet may be negatively impacted by nutrient enrichment, low dissolved oxygen, and reduced water clarity. The subwatershed

also contains areas of high quality, extensively connected wetland and upland, including several regionally significant ecological areas. Overall, the system has moderate to high ecological integrity.

Management strategies within the Dutch Lake subwatershed will focus on promoting infiltration, reducing pollutant loading, managing carp, improving biodiversity and protecting existing resources. The District will collaborate on these management strategies with local and state government, developers, lake associations, citizens' groups and other parties to implement. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Dutch Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality: **Lakes and Streams:**

Dutch Lake is listed on the State's Impaired Waters list for nutrient/eutrophication biologic indicators, and a TMDL identifying nutrient load reduction goals and suggested actions has been completed.

No streams are listed as Impaired Waters; however, both Dutch Creek and a small stream draining wetlands on the west side of Dutch Lake have elevated total phosphorus concentrations. In addition, Dutch Creek has elevated chloride concentrations and is at high risk of chloride impairment.

Wetlands:

DUTCH LAKE
SUBWATERSHED

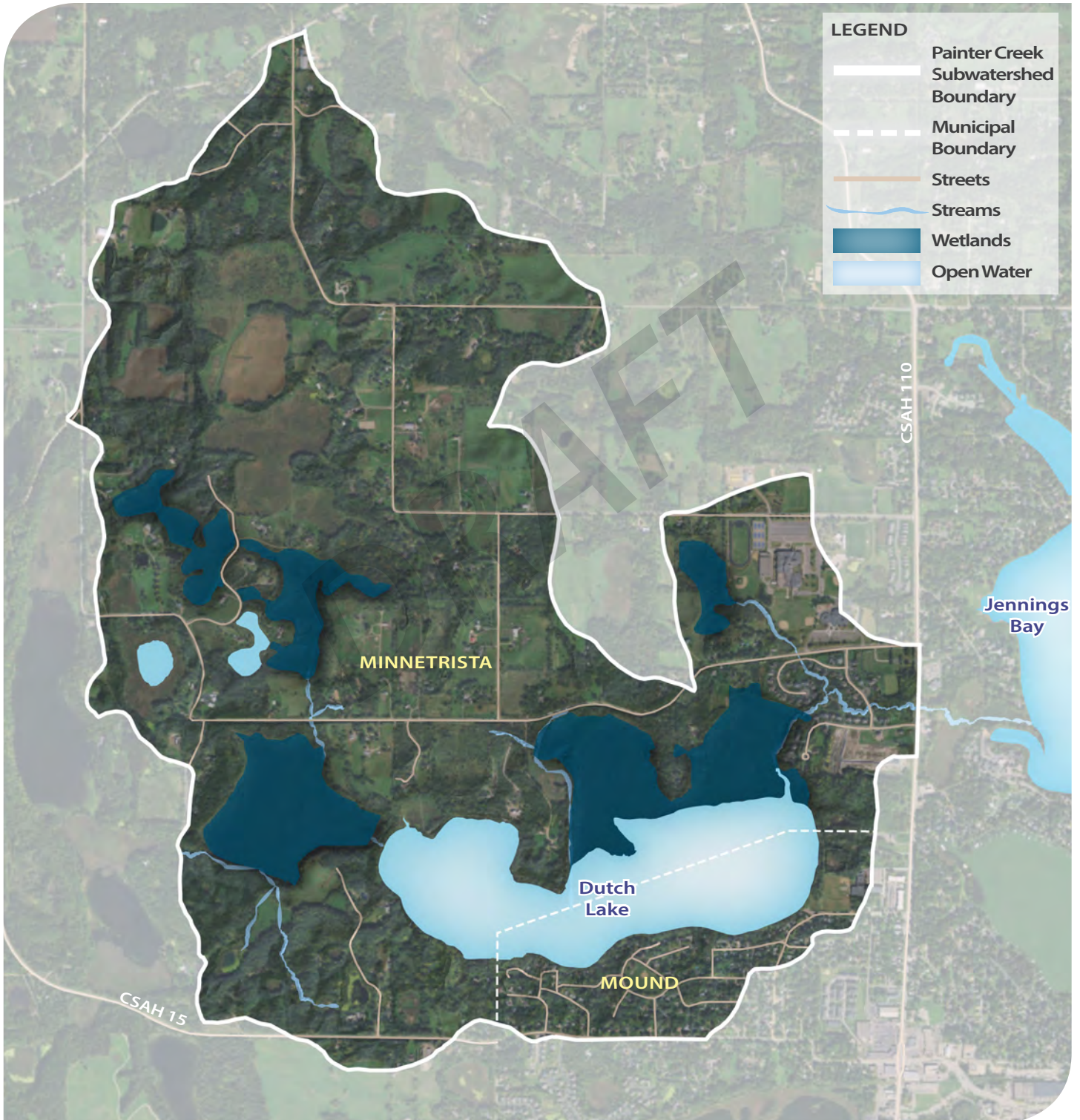


Figure 1.81 Gleason Lake Base map



The Dutch Lake subwatershed has two large riparian wetlands – one on the north side and one on the west side of Dutch Lake - that have scored highly on vegetative diversity, fish and wildlife habitat, or aesthetics. The subwatershed also has numerous small wetlands. These wetlands are sensitive to the quality of stormwater inputs and should be protected.

Groundwater:

There are wide areas of aquifer sensitivity in the Dutch Lake Subwatershed, particularly those within wellhead protection areas. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity:

There are no known flooding issues, but modeling suggests that the Dutch Lake culvert may provide less freeboard than required. This culvert is also unstable and needs maintenance.

There are wetlands and streams in the subwatershed that rely on steady inflow from surficial groundwater.

A small area of the subwatershed is within a Wellhead Protection Area and there may be restrictions on the use of infiltration as a water quality practice within that area.

Ecological Integrity:

Lakes and Streams:

Dutch Lake maintains a moderately healthy fishery, according to limited fish data. Although excess nutrients, reduced water clarity, and low dissolved

oxygen may negatively impact the lake's fish community. Dutch Lake is infested with Eurasian watermilfoil, and overall the aquatic vegetation community is degraded due to excess nutrients and low water clarity. Dutch Lake has significant woodland or wetland fringes, which are ecologically beneficial.

Streams in the subwatershed include a small stream that drains wetlands on the west side of Dutch Lake and Dutch Creek, which serves as an outlet to Dutch Lake and flows into Lake Minnetonka: Jennings Bay. In the small unnamed stream on the west side of Dutch Lake, total phosphorus concentrations are elevated relative to the state river eutrophication standards. Dutch Creek shows elevated concentrations of total phosphorus and dissolved oxygen levels that fall below the state standard several times per year. Chloride concentrations are also elevated and the stream is at high risk of surpassing the state chloride standard. Stream connectivity is also low, as there are several culverts and road crossings that may impede passage for fish and other aquatic organisms.

Wetlands:

There are extensive high quality wetlands in the subwatershed. Due to the predominance and contiguity of wetlands, much of the subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor and by the City of Minnetrista as a natural resources corridor. Wetland assessments have classified two wetlands in the subwatershed (one north and one west of Dutch Lake) as having excellent vegetative diversity, fish and wildlife habitat, or aesthetics. Further,

these wetlands are large and have high connectivity, which makes them more likely to support notable diversity and/or abundance of wildlife. Wetlands in the subwatershed should be protected and considered for preservation to maximize habitat and biodiversity.

Uplands and Natural Corridors:

Within the subwatershed, there are extensive corridors of upland habitat that should be protected. On the west side of Dutch Lake there are two native plant communities classified as Imperiled or Imperiled/Vulnerable: a 25-acre Tamarack Swamp and a 32-acre Sugar Maple-Basswood-Bitternut Hickory Forest, which are part of a native plant corridor between Dutch Lake and Long Lake/Little Long Lake.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Dutch Lake subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Dutch Lake subwatershed are:

Water Quality

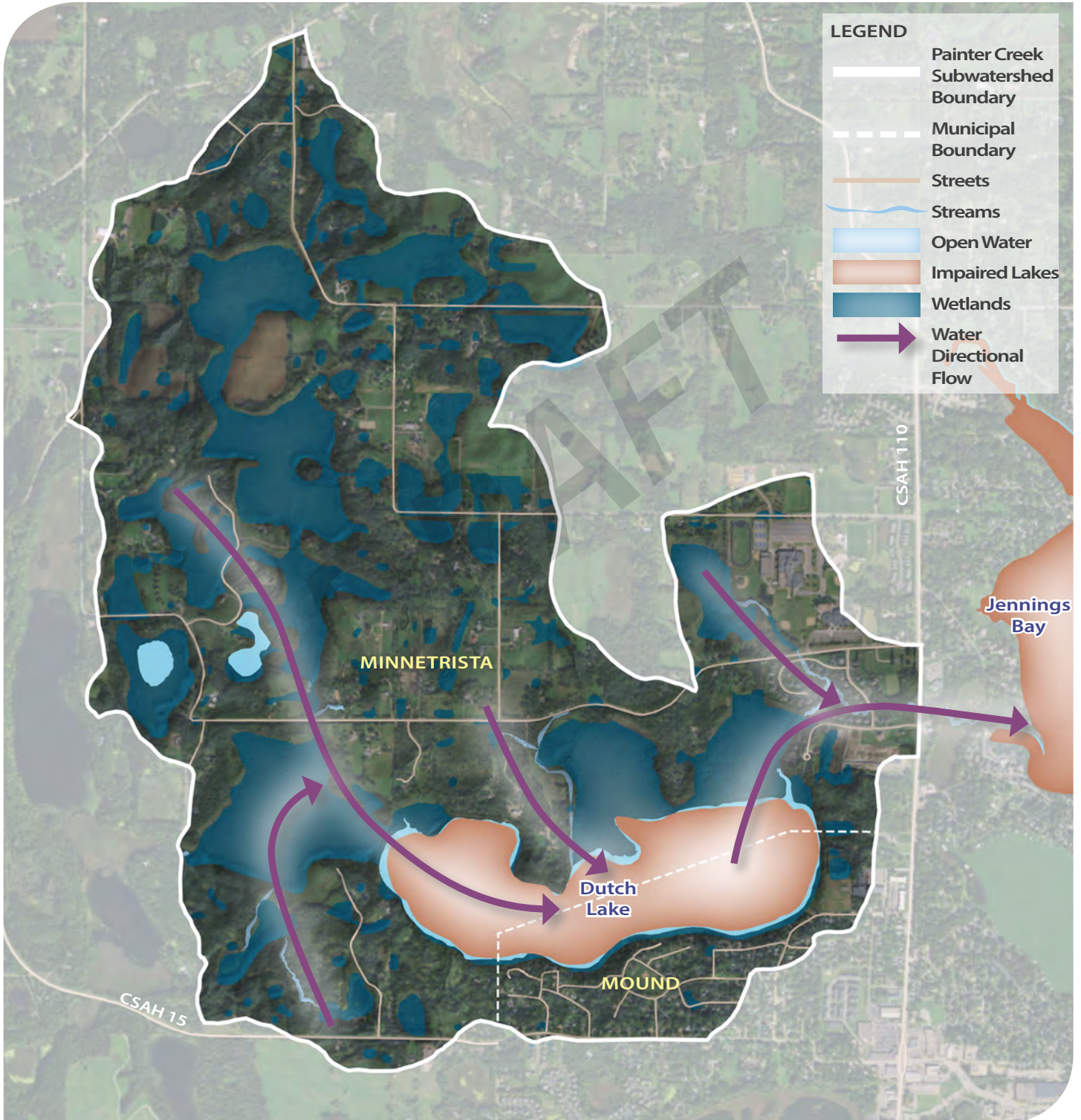


Figure 1.82 Gleason Lake Water Resources map



- » Excess nutrients
- » Low dissolved oxygen (DO)
- » Elevated chloride concentrations

Water Quantity

- » Culverts may need repair or replacement

Ecological Integrity

- » Fish community in Dutch Lake may be negatively impacted by reduced clarity and low DO
- » Degraded aquatic plant community
- » Nutrient enrichment and low DO in Dutch Creek Inlet and Outlet could negatively impact biota

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Carp
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Many wetlands in the subwatershed are of high or exceptional quality, but some have been ditched or altered in the area's agricultural past. As a result of alteration, the natural hydrology of wetlands is disrupted. Water quality monitoring shows excess nutrients in Dutch Lake and Dutch Creek. Wetland alteration may have caused export of nutrients from upstream wetlands to these water bodies, contributing to water quality issues.

Carp:

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus from re-suspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

Common carp were noted in the TMDL for Dutch Lake as being present and a potential source of water quality and ecological issues, but at an unknown level. Dutch Lake outlets to Jennings Bay of Lake Minnetonka, which has been confirmed to have a high abundance of common carp. A carp assessment would need to be completed in the Dutch Lake subwatershed to determine the impact carp are having in the system, and to develop management strategies.

Stormwater Runoff:

Watershed runoff from rainfall events or stormwater can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer



including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Dutch Lake is impaired for excess nutrients, and Dutch Creek has elevated total phosphorus concentrations relative to state river eutrophication standards. Runoff from lawns, streets, and agriculture in the subwatershed could be a source of nutrients and sediment to these water bodies. The Dutch Lake TMDL requires a sixty percent reduction in nutrients from stormwater runoff to meet state lake water quality standards.

Altered Channels:

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

There are only a few channels in the subwatershed upstream of Dutch Lake, and they have not been evaluated. Dutch Creek is relatively unaltered, but there are areas with little bank vegetation to buffer runoff and stabilize banks.

Internal Sediment Phosphorus Loading:

Long-term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

The Dutch Lake TMDL found that internal sediment load

contributes an estimated 30 percent of the annual phosphorus load to the lake, and requires a ten percent reduction in that internal sediment load to meet state lake water quality standards.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Dutch Lake subwatershed. These strategies are both short- and long-term, and establish a framework for the Dutch Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

Although there are large, high quality wetlands in the subwatershed, there are several wetlands that have high or moderate restoration potential. Numerous other small wetlands of moderate restoration potential are located throughout the subwatershed. If restored, these wetlands could improve vegetative diversity and provide connected habitat within the watershed in addition to improving the water quality of Dutch Lake and Dutch Creek.

Carp Management:

Historically, carp management focused on removal of carp populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal, but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

Surveys should be conducted to determine the abundance of common carp in Dutch Lake and could warrant a subwatershed-wide assessment to inform management strategies. Carp management may need to occur prior to implementing other strategies to reduce internal loading.

Stormwater Management:

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

In the Dutch Lake subwatershed, the focus will be on installing infiltration and load reduction BMPs, requiring stormwater pretreatment before discharge into any wetland, and enhancing buffers along Dutch Creek. The Dutch Lake TMDL also recommended enhancing shoreline buffers to filter runoff from lakeshore turf grass lawns. The District is also considering other strategies to reduce nutrient loads from the subwatershed. These include promoting repair or replacement of failing septic systems, assessing phosphorus loading from Camp Christmas Tree, and implementing BMPs on Camp Christmas Tree's property if necessary.

Stream Channel Restoration:

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and reaeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Dutch Creek and other channels in the watershed should be investigated for restoration potential. While there is no biologic monitoring data available to document whether current conditions are stressful to aquatic life, Dutch Creek could benefit from streambank stabilization, buffer enhancement, improvements to stream aeration, and habitat enhancement.

Internal Sediment Phosphorus Control:

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Once nutrient loads from the subwatershed have been reduced and common carp managed to low densities, an internal load reduction strategy, such as alum treatment or a flocculation system, should be considered for Dutch Lake. Additional data will need to be collected to determine appropriate treatment options.

Watershed Protection

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of development. This

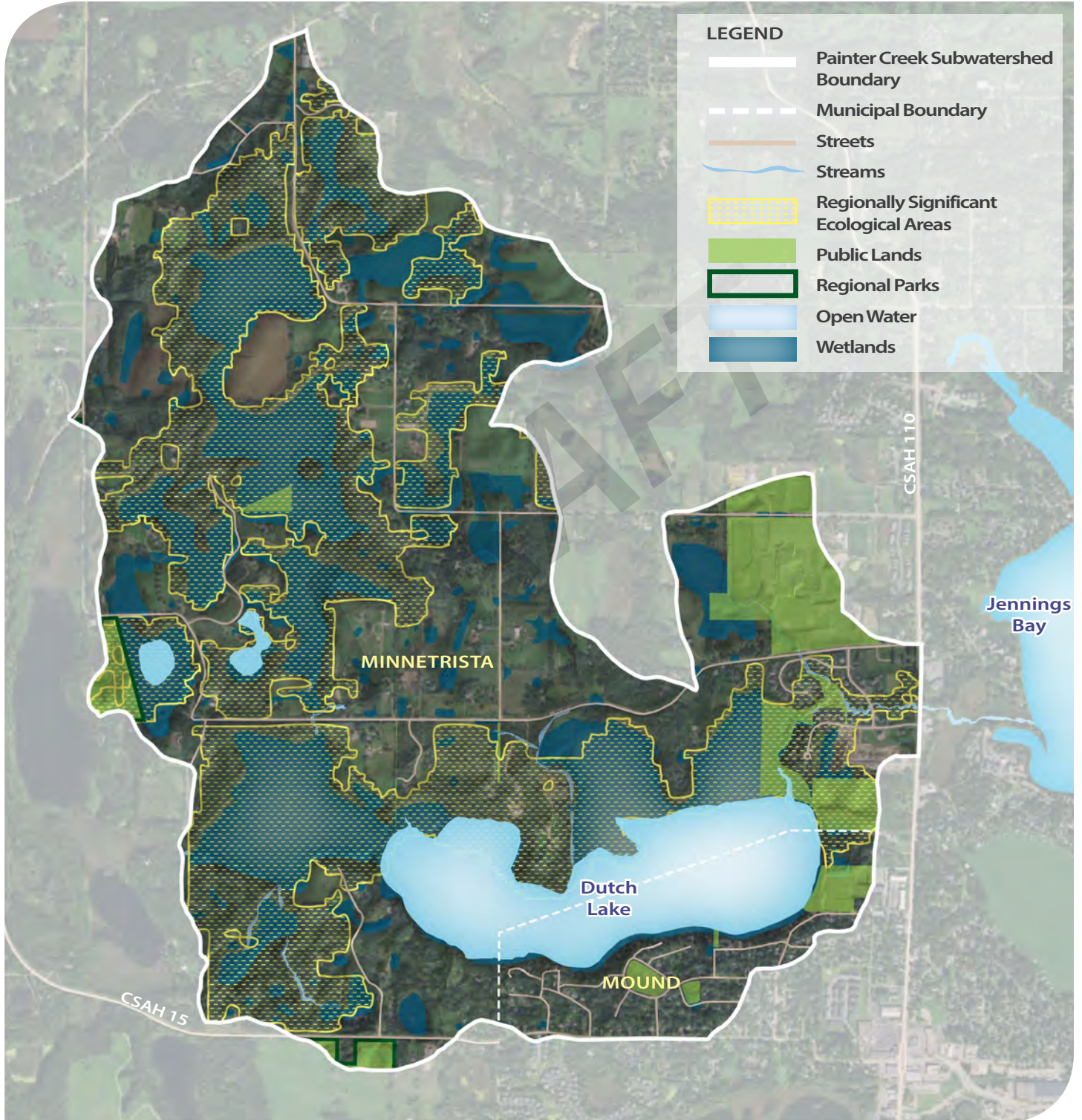


Figure 1.83 Gleason Lake Parks, Trails, and Open Space map



is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

There are extensive high quality wetlands and uplands in the subwatershed. Much of the subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor and by the City of Minnetrista as a natural resources corridor. These natural areas are large and have high connectivity, creating corridors of habitat between Dutch Lake and Long Lake/Little Long Lake. The focus in this subwatershed will be to preserve these high-value resources through Land Conservation, where appropriate, and by working with cities and developers to minimize disturbance during development and construction.

LAND USE

EXISTING CONDITIONS

The subwatershed includes portions of the cities of Mound and Minnetrista. Land use in the subwatershed is generally characterized by undeveloped land (50%), including numerous large wetland systems and wooded areas, low-density development (24%), agricultural uses (10%), parks and open spaces (6%), and water (10%). The subwatershed includes large areas of undisturbed or minimally disturbed wetland and wooded areas. Much of the subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor and by the City of Minnetrista as a natural resources corridor due to the predominance and contiguity of wetlands.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for the 2017-26 plan cycle (see Appendix for details on the public input process). This information was used to broadly characterize opportunities that existed at

the time to inform the District's implementation plans. Below is a brief summary of the information received. It is meant to serve only as a guide, not to restrict collaborative efforts. As discussed in Section 3.6, the District intends to coordinate with its communities on an ongoing basis to stay apprised of new opportunities.

One of the priorities identified by cities in the Dutch Lake Subwatershed was maintaining the area's rural character and access to natural resources. There was little anticipated for development or infrastructure investment within this subwatershed in the near-term, though some single family home rebuilds on Dutch Lake are expected.

There is an active lake association for Dutch Lake that is working to expand its membership. The Association plans to conduct outreach efforts to promote native shoreline plantings and residential stormwater management through raingardens or other BMPs.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, Dutch Lake is impaired by excess nutrients, and the inlet and outlet of Dutch Lake have elevated levels of total phosphorus. The outlet of Dutch Lake is also at high risk of chloride impairment. The fish and vegetation communities in Dutch Lake and its inlet and outlet may be negatively impacted by nutrient enrichment, low dissolved oxygen, and reduced water clarity. The subwatershed also contains areas of high quality, extensively connected wetland and upland, including several regionally significant ecological areas. Based on these conditions, management strategies within the subwatershed will focus on promoting infiltration, reducing

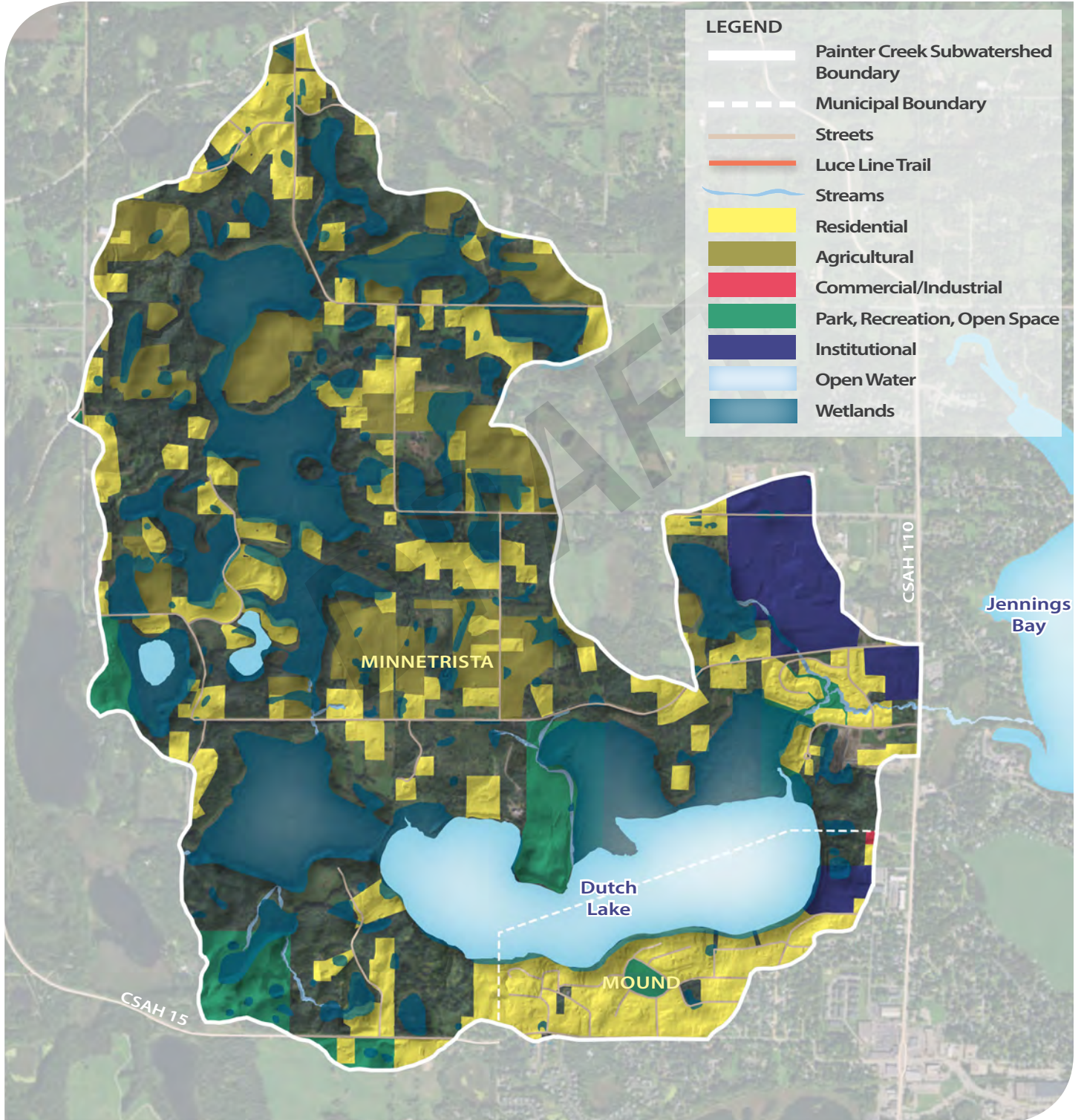


Figure 1.84 Dutch Lake Land Use map



pollutant loading, managing carp, improving biodiversity and protecting existing resources.

The Dutch Lake subwatershed is relatively small and there is little anticipated for development or infrastructure investment within this subwatershed in the near-term, so opportunities from land use change are expected to be limited. The Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects. The CIP for the subwatershed, detailed in the next section, includes a project for stormwater management should an opportunity arise through land use change or a partner initiative.

In 2012, the District installed a sand-iron filter on the creek that flows into the northwest side of Dutch Lake in order to remove dissolved phosphorus. The project showed a significant reduction in phosphorus levels initially, but its performance has declined. The District is investigating why performance has declined and will seek to restore and maintain function to the project.

There are extensive high quality wetlands and uplands in the subwatershed. The focus in this subwatershed will be to preserve these high-value resources through Land Conservation, where appropriate, and by working with cities and developers to minimize disturbance during development and construction.

The District may pursue a carp assessment for the Dutch Lake subwatershed as part of a larger assessment for the northwestern bays of Lake Minnetonka and their tributary subwatersheds. The goal of the assessment would be to understand the movement and recruitment patterns of carp in the system to inform management efforts. This work will be

dependent on the District's ability to secure partner support and funding. A description of this work is included in the CIP for the Lake Minnetonka subwatershed in Section 3.9.4.

Dutch Creek was identified as being at high risk for chloride impairment. The District will continue to provide education and training for public and private applicators and residents on best practices for chloride use.

As noted in the previous section, there is an active lake association for Dutch Lake. The District will continue to work with its lake associations to provide education and technical assistance to build their capacity and target implementation efforts.

CAPITAL IMPROVEMENT PLAN

Capital projects in the Dutch Lake subwatershed include stormwater management projects to reduce runoff volumes and rates while addressing pollutant loading that occurs from runoff producing rainfall events. These projects will progress the District and its partners toward achieving their various goals for the subwatershed. This program is not a comprehensive list of all capital needs or potential projects within the subwatershed, and is limited by available financial resources and staff capacity to manage projects.

Given the limited resource needs and opportunities identified within the Dutch Lake subwatershed relative to other parts of the watershed, the District does not anticipate initiating any capital improvement efforts in the subwatershed during this plan cycle. However, the District has included this project in its CIP in the event that an opportunity arises through land use change or a partner initiative.



Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Dutch Lake and downstream Jennings Bay, including but not limited to construction of infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Dutch Lake exceeds state excess nutrient standards. A TMDL identified a need to reduce external phosphorus loading by 60% (193 pounds of total phosphorus reduction) to Dutch Lake.
Outcome	Reduction of sediment and nutrients exported to Dutch Lake and downstream Jennings Bay.
Estimated Cost	Capital costs: \$780,000, excluding land, in 2017 dollars. O&M costs: \$25,000 per year in 2017 dollars based on 20-year project life.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

SUBWATERSHED PLAN SUMMARY

The following table summarizes the proposed implementation action items and their relationship to overall District and subwatershed goals, issues and strategies identified in this subwatershed plan.

References

Minnesota Pollution Control Agency (MPCA). 2016. Minnesota’s Impaired Waters List. pca.state.mn.us/water/minnesotas-impaired-waters-list

Wenck. 2014. Upper Minnehaha Creek Watershed Nutrient and Bacteria TMDL Study. pca.state.mn.us/water/tmdl/upper-minnehaha-creek-watershed-lakes-and-bacteria-metro-tmdl-project

3.9.3 GLEASON LAKE SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Gleason Lake Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan. The Implementation Plan for the subwatershed summarizes issues of water quality, water quantity, and ecological integrity. The Plan identifies what is driving these issues, and outlines a roadmap of management strategies to guide the implementation efforts of the District, and its public and private partners.

EXECUTIVE SUMMARY

Gleason Lake is a 6.8 square mile (4,365 acre) subwatershed located along the northern boundary of the MCWD and includes portions of the cities of Minnetonka, Orono, Plymouth and Wayzata.

The subwatershed is generally characterized by low density development, including many single-family homes (64%), water (10%), parks and open spaces (8%), and undeveloped land (7%). The subwatershed contains several lakes, including Gleason, Hadley, Mooney, Kreatz and Snyder. Some scattered wetlands are identified as having high vegetative diversity and wildlife habitat.

The eastern portion of the subwatershed drains through several wetlands including Kreatz and Snyder Lakes and then to County Ditch #15, which discharges into Gleason Lake. The western watershed drains through Hadley Lake and then south to Gleason Lake Creek, which outlets the south end of Gleason Lake and flows by channel and culvert to Glenbrook Pond. The Pond outlets to a storm sewer that discharges downstream to Wayzata Bay. Mooney Lake is naturally land-locked, but under high water is pumped out towards Hadley Lake.

Gleason Lake subwatershed has several issues relating to water quality, water quantity and ecological integrity. Four lakes in the subwatershed, Mooney, Kreatz, Gleason and Hadley are listed on the State's Impaired Waters list for excessive nutrients. One county ditch also has elevated levels of total phosphorus

and chloride. Modeling predicts that the subwatershed will experience localized flooding during large rain or snowmelt events due to overtopping of infrastructure. Overall, the system has moderate ecological integrity. There are areas of high quality wetland, which must be protected, but the lower watershed lacks high-quality wetland and habitat connectivity. There are also impaired macroinvertebrate and fish communities within the subwatershed, as well as invasive vegetation and low dissolved oxygen.

Management strategies within Gleason Lake subwatershed will focus on promoting infiltration, reducing pollutant loading, improving biodiversity and protecting existing resources. The District will collaborate on these management strategies with local and state government, developers, lake associations, citizens' groups and other parties to implement. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES:

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Gleason Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality: **Lakes and Streams:**

Four lakes in the subwatershed are listed on the State's Impaired Waters list, with average summer nutrient concentrations greater than the state standard: Gleason, Hadley, Mooney and Kreatz Lakes. In addition, Snyder Lake exceeds the state water quality standards, but does not meet the state's size threshold for impairment. A TMDL identifying nutrient load reduction goals and suggested actions has been completed for those

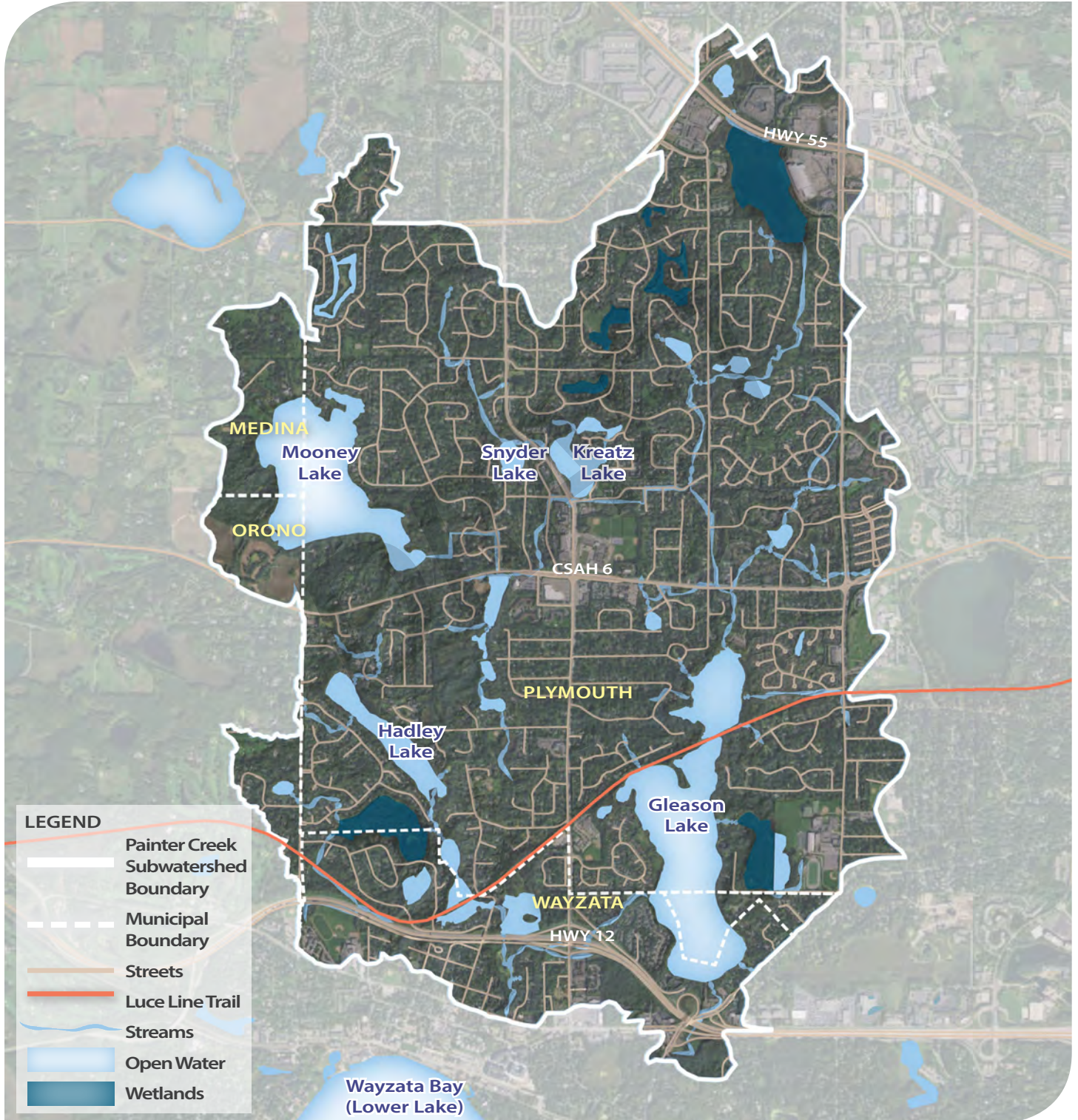


Figure 1.85 Gleason Lake Base map



lakes. There is limited water quality data for the other lakes in the subwatershed.

The inlet to Gleason Lake has elevated levels of total phosphorus and chloride. Gleason Creek, the outlet to Gleason Lake, also has elevated levels of chloride.

Wetlands:

Most of the wetlands in the subwatershed have been impacted by development and stormwater inflow, and serve mainly to protect downstream water quality.

Groundwater:

There are areas of aquifer sensitivity in the subwatershed. The entire Gleason Lake subwatershed has been designated by the Minnesota Department of Health as a Drinking Water Sensitivity Management Area and as a Wellhead Protection Area for City of Plymouth public wells. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity:

Locations throughout the system have been identified through observation and the District’s modeling as vulnerable to localized flooding.

Many of the wetlands in this subwatershed are groundwater-fed discharge or recharge-discharge wetlands. Groundwater recharge is important within the subwatershed to maintain wetland hydrology and stream baseflow, as well as to recharge aquifers that supply public and private drinking water wells.

Nearly the entire subwatershed is within a Wellhead Protection Area and there may be restrictions on the use of infiltration as a water quality practice.

Mooney Lake has no natural outlet. In 2007, the City of Plymouth and the District undertook a cooperative project to install infrastructure to support future emergency pumping, including an outlet pipe, lift station, and connection to the Plymouth storm sewer system. Plymouth is responsible for operating the system, and the District is responsible for monitoring downstream areas and potential adverse impacts.

Ecological Integrity:

Lakes and Streams:

Data suggests that Gleason Lake maintains a moderately healthy fishery and vegetation community, although the vegetation community lacks biodiversity. Curly leaf pondweed is present and has been managed in the lake.

Gleason Creek also has a highly degraded macroinvertebrate community dominated by pollution-tolerant species. The Creek experiences periods of low dissolved oxygen. No fish data is available for any streams within the subwatershed.

Wetlands:

Scattered wetlands have been identified as having high vegetative diversity and wildlife habitat, as well as high aesthetic values. Two large wetlands scored highly on vegetative diversity, fish and wildlife habitat or aesthetics. Wetlands with these qualities are in need of protection. Their conservation is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

One small wetland within in the watershed has high restoration potential and a few small wetlands have moderate restoration potential.

Uplands and Natural Corridors:

Uplands in the subwatershed are mostly developed, with few intact areas of minimal disturbance. The Minnesota Biological Survey (MBS) did not identify any landscape areas of biological significance in this subwatershed. Some wooded and wetland areas around Hadley Lake and a few pocket wetlands and wooded areas elsewhere in the subwatershed provide the most significant areas of habitat and biological integrity.

DRIVERS:

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water

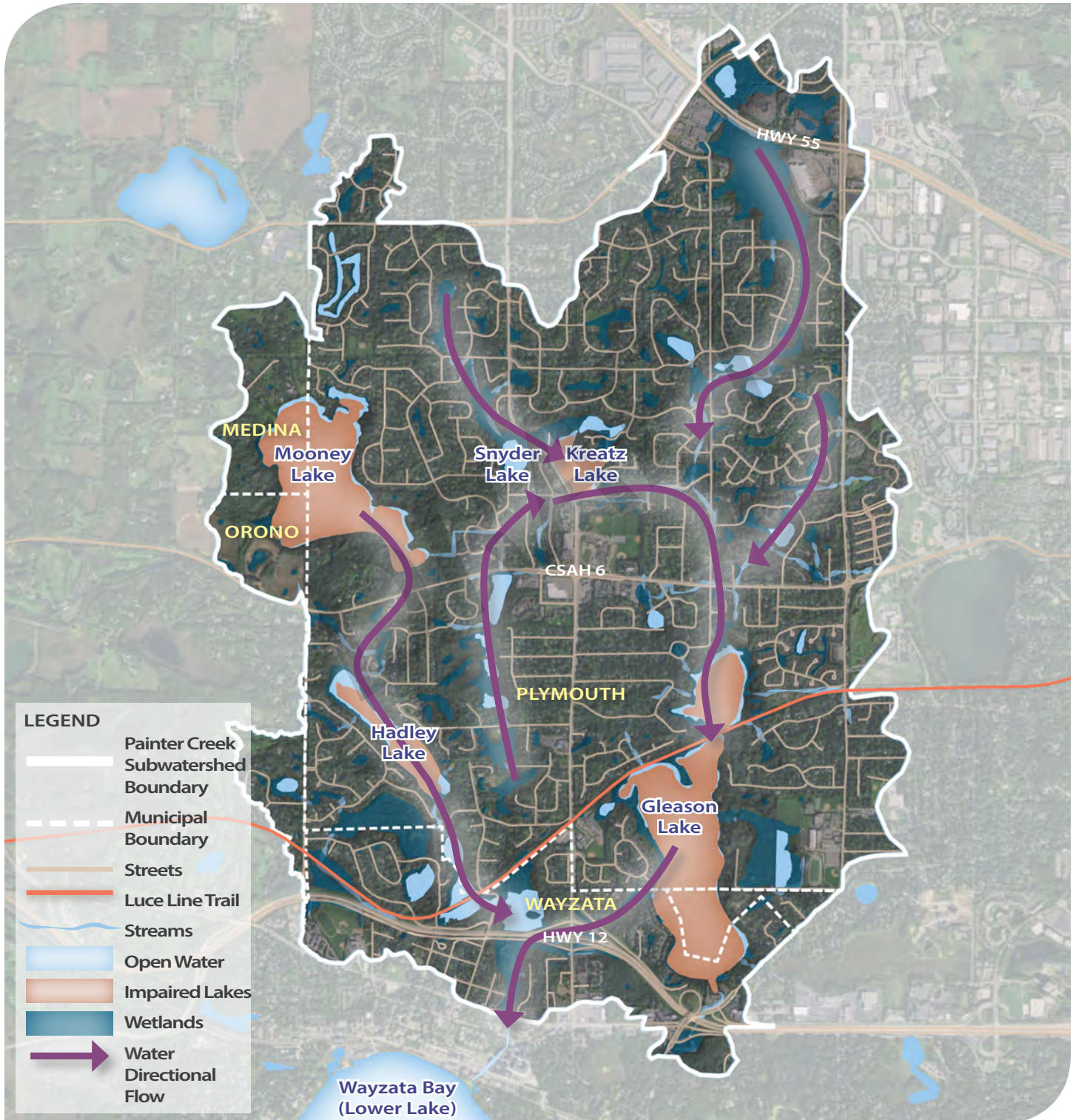


Figure 1.86 Gleason Lake Water Resources map



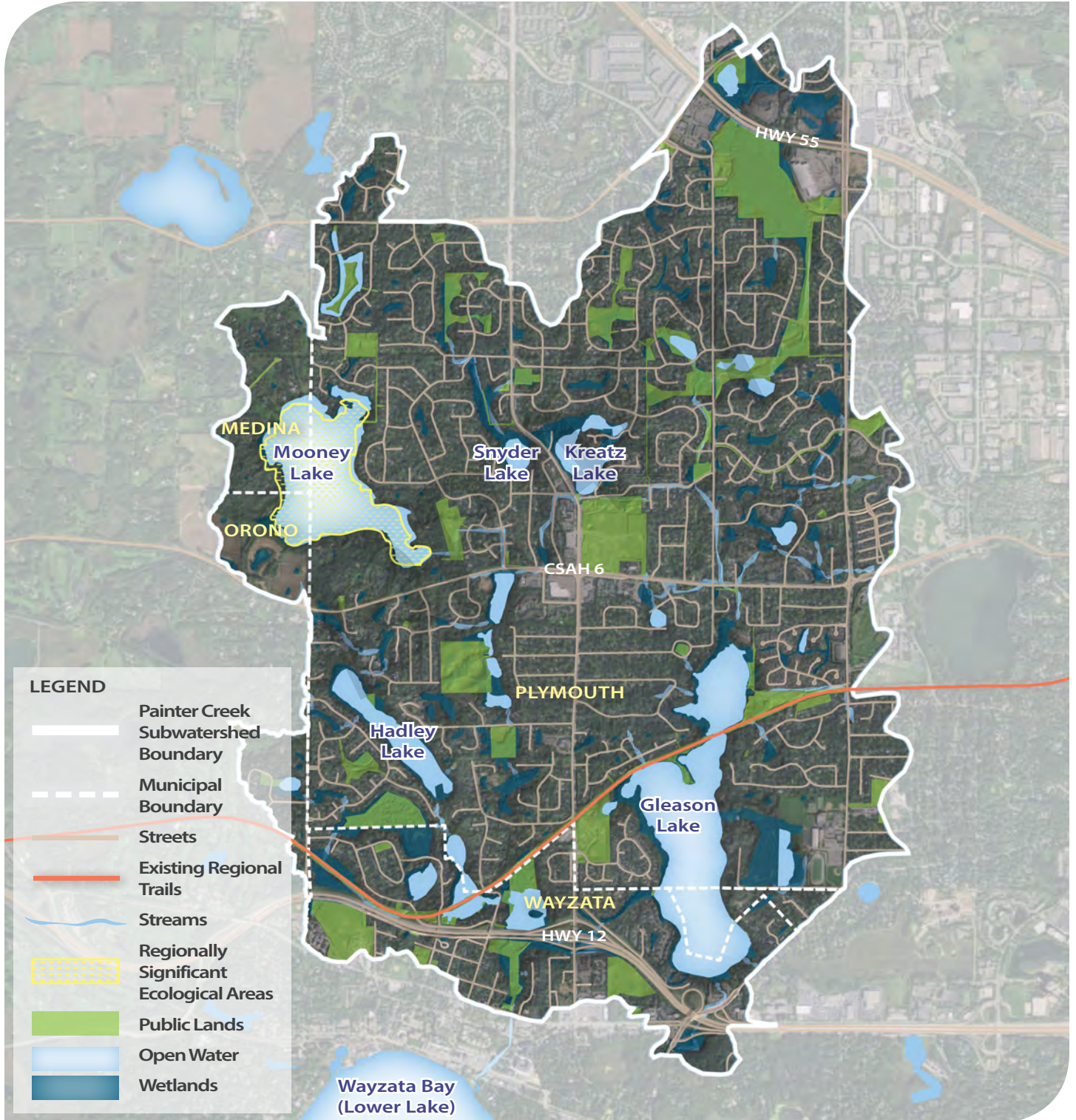
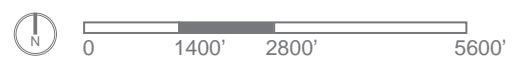


Figure 1.87 Gleason Lake Parks, Trails, and Open Space map





quantity, and ecological integrity issues within the Gleason Lake subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Gleason Lake subwatershed are:

Water Quality

- » Excess nutrients in lakes and streams
- » Low dissolved oxygen
- » Elevated chloride concentrations in streams

Water Quantity

- » Localized flooding
- » Emergency pumping from Mooney Lake

Ecological Integrity

- » Degraded macroinvertebrate community
- » Degraded and disconnected wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Common carp
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading
- » Water quality from upstream waterbodies

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved fraction) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

There are scattered wetlands in the Gleason Lake subwatershed.

County Ditch #15, which flows south through open channel and storm sewer along Dunkirk Lane flows through some ponds and small remnant wetlands. South of County Road 6 it flows through a pond/wetland system before discharging into Gleason Lake. Nutrient concentrations in the channel at the lake's inlet are elevated, which is likely a combination of nutrient load from the urbanized subwatershed and load from sediment release in the altered wetlands.

Stormwater Runoff:

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up pollutants such as excess nutrients, bacteria (e.g., *E. coli*), chloride from road salt, and toxic pollutants. In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters, because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally, as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Gleason, Hadley, Mooney and Kretz Lakes exceed the state standard for total phosphorus, and Gleason Creek has elevated levels of phosphorus and chloride. Runoff from lawns and streets in the subwatershed could be a source of phosphorus and chloride to these water bodies. The Upper Watershed Lakes TMDL requires reductions in nutrients from stormwater runoff

to meet state lake water quality standards in each lake by 64, 41, 89, and 33 percent respectively.

Altered Channels:

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

At least two altered channels exist within the Gleason Lake subwatershed. County Ditch #15 drains the upper watershed to Gleason Lake. County Ditch #32 is the channelized portion of Gleason Creek, the outlet of Gleason Lake. Gleason Creek has a highly degraded macroinvertebrate community, which is likely due in part to habitat degradation that occurred when the stream was channelized. No data exists for macroinvertebrate communities in County Ditch #15.

Internal Sediment Phosphorus Loading:

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Internal loading does not appear to be a significant issue for Mooney and Kreatz Lakes, but the Upper Watershed Lakes TMDL requires reductions in nutrients from internal sources to meet state lake water quality standards of 50 percent in Gleason Lake and 54 percent in Hadley.

Upstream Waterbodies:

Headwater streams, lakes and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water

quality ultimately contribute nutrients to downstream waters that can lead to eutrophication. Consequently, restoration of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Mooney Lake is upstream of Hadley Lake, which is tributary to Gleason Lake. Kreatz and Snyder Lakes are also upstream of Gleason Lake, which exceeds the state standard for total phosphorus. High-phosphorus discharge from these upstream lakes likely contributes to elevated phosphorus concentrations to tributary lakes and eventually to Gleason Lake.

MANAGEMENT STRATEGIES:

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Gleason Lake subwatershed. These strategies are both short- and long-term, and establish a framework for the Gleason Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

The District has identified one small wetland within in the watershed with high restoration potential and a few small wetlands with moderate restoration potential.



Stormwater Management:

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

In the Gleason Lake subwatershed, the focus will be on installing infiltration and load reduction BMPs, requiring stormwater pretreatment before discharge into any wetland, enhancing buffers along streambanks, regulating freeboard required on new developments and redevelopments, and requiring local plans to discuss flood prevention and mitigation. In addition, actions to limit new or reduce existing stormwater volumes to Mooney Lake will help to minimize adverse effects from high water levels.

Stream Channel Restoration:

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and reaeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

In the Gleason Lake subwatershed, there are limited options to restore streams to more natural conditions. However, County Ditches #15 and #32, Gleason Creek, and other channels should be comprehensively inspected to determine the extent of any current or potential erosion and restoration needs. In 2012, the District partnered with the City of Plymouth to complete a stream stabilization project.

Internal Sediment Phosphorus Control:

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes.

There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

The 2014 TMDL determined that internal load plays a significant role in the water quality of Gleason and Hadley Lakes. Additional information such as bathymetry and sediment core release data is necessary to determine the most effective approach to internal load management in Hadley Lake. A potential alum treatment on Gleason Lake could be beneficial in controlling release of internal nutrient loads.

Restoration of Upstream Waterbodies:

Upstream water bodies that are currently impaired can discharge large nutrient loads to downstream water bodies thereby contributing to downstream water quality impairments. Therefore, prior to, or concurrent with, significant efforts to restore downstream water quality, the water quality in upstream water bodies must be improved. Nutrient impaired upstream lakes may require external and internal nutrient reductions using the strategies listed in this section.

The 2014 Upper Watershed Lakes TMDL determined that phosphorus export from stream water bodies such as Mooney, Hadley, Kreatz and Snyder Lakes and several wetlands, was contributing to the impairment the water quality of Gleason Lake. Improvement to those upstream water bodies is essential to the improvement of Gleason Lake.

LAND USE

EXISTING CONDITIONS

Most of the subwatershed is within the city of Plymouth, with a portion of the city of Wayzata, and very small areas within Medina, Minnetonka, and Orono. The subwatershed is generally characterized by low density development, including many single-family homes (64%), water (10%), parks and open spaces (8%), and undeveloped land (7%). The subwatershed contains

several lakes, including Gleason, Hadley, Mooney, Kreatz and Snyder. Some scattered wetlands are identified as having high vegetative diversity and wildlife habitat.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Sections 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for the 2017-26 plan cycle (see Appendix for details on the public input process). This information was used to broadly characterize opportunities that existed at the time to inform the District's implementation plans. Below is a brief summary of the information received. It is meant to serve only as a guide, not to restrict collaborative efforts. As discussed in Section 3.6, the District intends to coordinate with its communities on an ongoing basis to stay apprised of new opportunities. The cities will also be updating their Comprehensive and Local Water Management Plans in 2017-2018, which will further inform the District of local plans and priorities.

The cities do not expect any major development to occur within the subwatershed in the near future, though there may be some pockets of residential infill. The cities will seek to incorporate stormwater Best Management Practices (BMPs) in municipal infrastructure projects, where possible. The City of Plymouth has a number of drainage improvement, stormwater management, and stream restoration projects identified in its 5-year CIP that may present opportunities for District partnership.

The City of Plymouth conducts some of its own water quality, quantity, and effectiveness monitoring and also develops some education materials related to water resources. The District and City will seek to coordinate on these programmatic activities to minimize duplication of effort.

There are active lake associations for both Mooney and Gleason Lakes. The Gleason Lake Association conducts some monitoring of water quality and invasive species and has also undertaken some invasive vegetation management. The associations look to the District for technical assistance and guidance to support their management efforts.

IMPLEMENTATION PLAN

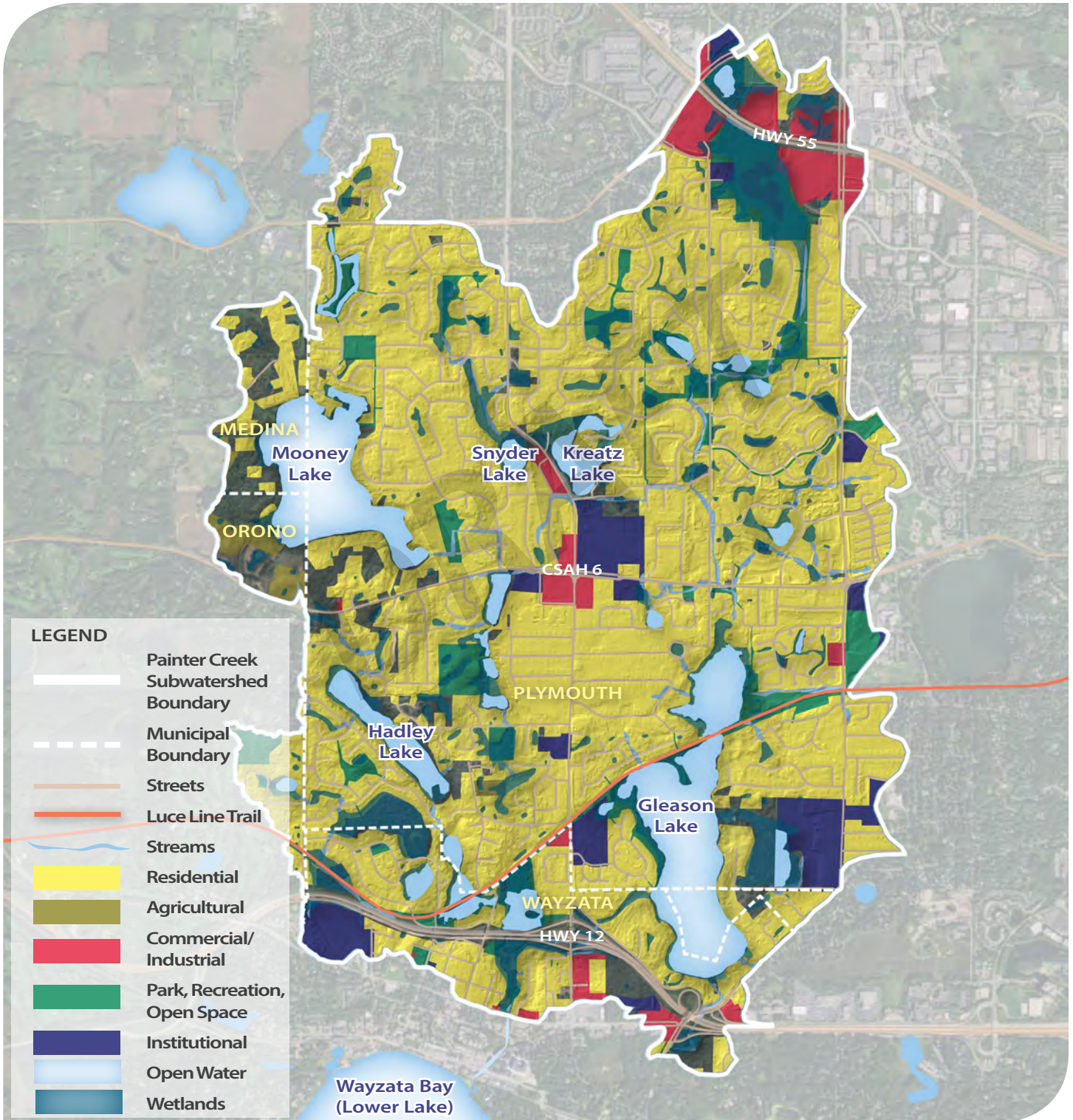
The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, the Gleason Lake subwatershed has several issues relating to water quality, water quantity and ecological integrity. Four lakes in the subwatershed, Mooney, Kreatz, Gleason and Hadley are listed on the State's Impaired Waters list for excessive nutrients. One county ditch also has elevated levels of total phosphorus and chloride. Modeling predicts that the subwatershed will experience localized flooding during large rain or snowmelt events due to overtopping of infrastructure. There are areas of high quality wetland, which must be protected, but the lower watershed lacks high-quality wetland and habitat connectivity. There are also impaired macroinvertebrate and fish communities within the subwatershed, as well as invasive vegetation and low dissolved oxygen. Based on these conditions, management strategies within Gleason Lake subwatershed will focus on promoting infiltration, reducing pollutant loading, improving biodiversity, and protecting existing resources.

The Gleason Lake subwatershed is mostly developed and there is little anticipated for development within this subwatershed in the near-term, so opportunities from land use change are expected to be limited. The City of Plymouth has a number of drainage improvement, stormwater management, and stream restoration projects identified in its 5-year CIP that may present opportunities for District partnership. The Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource



LEGEND


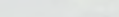
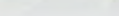
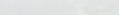


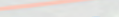
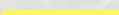




-  Painter Creek Subwatershed Boundary
-  Municipal Boundary
-  Streets
-  Luce Line Trail
-  Streams
-  Residential
-  Agricultural
-  Commercial/Industrial
-  Park, Recreation, Open Space
-  Institutional
-  Open Water
-  Wetlands

Figure 1.88 Gleason Lake Land Use map



needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

The inlet to Gleason Lake has elevated levels of total phosphorus and chloride. Gleason Creek, the outlet to Gleason Lake, also has elevated levels of chloride. The District will continue to monitor chloride levels and provide education and training for public and private applicators and residents on best practices for chloride use.

As noted in the previous section, there are active lake associations for Mooney and Gleason Lakes. The District will continue to work with its lake associations to provide education and technical assistance to build their capacity and target implementation efforts.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. In the future, should a larger, more concentrated scale of capital and program implementation be determined to be needed by the District or its partners, a discrete subwatershed planning process may be initiated that:

- » Provides high resolution diagnostic of watershed issues and drivers
- » Maps current projected land use and infrastructure changes
- » Defines a detailed and integrated capital and program implementation plan
- » Outlines a funding strategy including program costs and sources

The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Comprehensive Plan.

CAPITAL IMPROVEMENT PLAN

Capital projects in the Gleason Lake subwatershed include stormwater management projects to reduce runoff volumes

and rates while addressing pollutant loading that occurs from runoff producing rainfall events. These projects will progress the District and its partners toward achieving their various goals for the subwatershed. This program is not a comprehensive list of all capital needs or potential projects within the subwatershed, and is limited by available financial resources and staff capacity to manage projects.

Given the limited resource needs and opportunities identified within the Gleason Lake subwatershed relative to other parts of the watershed, the District does not anticipate initiating any capital improvement efforts in the subwatershed during this plan cycle. However, the District has included this project in its CIP in the event that an opportunity arises through land use change or a partner initiative.



Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Gleason, Mooney, Hadley, and Snyder lakes, including but not limited to construction of infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Four lakes in the subwatershed exceed state excess nutrient standards - Gleason, Hadley, Mooney, and Snyder. A TMDL identified a need to reduce external phosphorus loading by 64% (207 pounds) to Gleason Lake, 90% (58 lbs) to Mooney Lake, 41% (25 lbs) to Hadley Lake, and 33% (4 lbs) to Snyder Lake.
Outcome	Reduction of sediment and nutrients exported to Gleason, Hadley, Mooney, and Snyder lakes.
Estimated Cost	Capital costs: \$600,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

References

Minnesota Pollution Control Agency (MPCA). 2016. Minnesota's Impaired Waters List. pca.state.mn.us/water/minnesota-impaired-waters-list

Wenck. 2014. Upper Minnehaha Creek Watershed Nutrient and Bacteria TMDL Study. pca.state.mn.us/water/tmdl/upper-minnehaha-creek-watershed-lakes-and-bacteria-metro-tmdl-project

3.9.4 LAKE MINNETONKA SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Lake Minnetonka Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan. The Implementation Plan for the subwatershed summarizes issues of water quality, water quantity, and ecological integrity. The Plan identifies what is driving these issues, and outlines a roadmap of management strategies to guide the implementation efforts of the District, and its public and private partners.

EXECUTIVE SUMMARY

Lake Minnetonka is a 50.8 square mile (32,515 acre) subwatershed located in the western portion of the MCWD and includes portions of the cities of Chanhassen, Deephaven, Excelsior, Greenwood, Long Lake, Minnetonka, Minnetonka Beach, Minnetrista, Mound, Orono, Shorewood, Spring Park, Tonka Bay, Victoria, Wayzata and Woodland.

The subwatershed is generally characterized by water (45%), most of which is Lake Minnetonka, and low density development (34%). The subwatershed also contains undeveloped land (13%), parks and open spaces (6%), agricultural land (2%). Most land in the subwatershed is developed, although the upper subwatershed includes some large agricultural and forested areas, with wetlands scattered throughout.

Lake Minnetonka is the primary receiving water within the subwatershed. Drainage is conveyed from the watershed to Lake Minnetonka through several streams, including Gleason Creek, Long Lake Creek, Classen Creek, Painter Creek, and Six Mile Creek, as well as through smaller channels or storm sewers. The subwatershed outlets through a control structure on Grays Bay into Minnehaha Creek.

The Lake Minnetonka subwatershed has several issues relating to water quality, water quantity and ecological integrity. Four bays (Halsted, Jennings, West Arm, Stubbs) and Forest Lake are listed on the State's Impaired Waters List due to excess nutrients, and pursuant to an approved Total Maximum Daily

Load (TMDL) require both external and internal load reductions. Impairments are generally a product of large tributary drainage areas (e.g. Six Mile – Halsted, Painter – Jennings) and the level of internal loading (phosphorus into the water column from organic sediments) which can be exacerbated by the presence of common carp and some aquatic plants.

Regarding water quantity, there are locations in the subwatershed within Lake Minnetonka's floodplain that are subject to localized flooding due to the volume of water received from tributary subwatersheds, which can cause lake levels to rise. Lake levels are managed through the operation of the Gray's Bay Dam, informed by existing lake level, downstream capacity in Minnehaha Creek, seasonal variation, and precipitation predicted through partnership with the National Weather Service.

Lake Minnetonka does contain aquatic invasive species, but overall, the subwatershed enjoys high ecological integrity with an excellent fish community in Lake Minnetonka and exceptional vegetative diversity in wetlands.

Management strategies within the subwatershed will focus on addressing impaired bays within Lake Minnetonka by reducing external loading to the lake from upstream tributary subwatersheds, and by addressing internal loading within the lake; protecting existing high value natural resources; and improving ecological integrity by promoting shoreline best management through partnership with local communities, shoreline contractors and landowners. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed

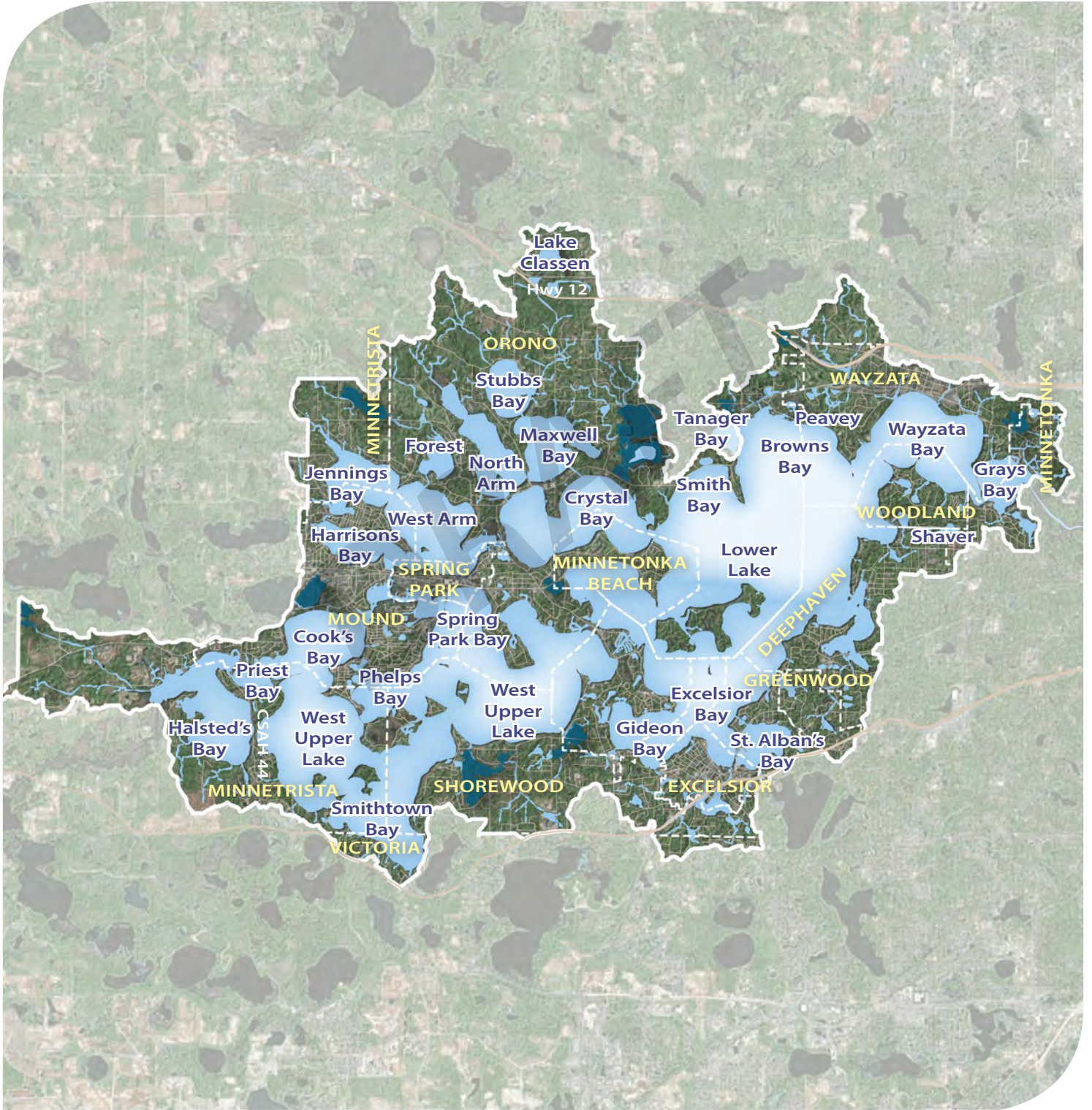


Figure 1.89 Lake Minnetonka Base map



several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Lake Minnetonka subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality:

Lakes and Streams:

Four bays in Lake Minnetonka (Halsted Bay, Jennings Bay, Stubbs Bay and West Arm) and Forest Lake are listed on the State's Impaired Waters list, with average summer phosphorus concentrations greater than the state standards. External loading from the watershed and internal loading from lake sediments are contributing to these concentrations.

At this time, no streams are listed as impaired. Classen Creek, which serves as the outlet of Lake Classen and flows to Stubbs Bay, and two other small streams are not listed as Impaired Waters for nutrients, but have high total phosphorus concentrations which exceed state river eutrophication standards for phosphorus.

Wetlands:

There are wetlands in the subwatershed with high vegetative diversity that are sensitive to the quality of stormwater inputs.

Groundwater:

There are areas of moderate to high aquifer sensitivity in the subwatershed. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity:

The District's hydrologic model predicts several locations where trails or provide drives may overtop during large rain events.

Lake levels on Lake Minnetonka are managed by the Gray's Bay Dam. The lake outlets through an adjustable structure on Gray's Bay which controls Lake Minnetonka discharge into Minnehaha Creek. In an effort to reduce flooding on Lake Minnetonka and Minnehaha Creek the District operates this structure in accordance with the Headwaters Control Structure Management Policy and Operating Procedures which was approved by the Minnesota DNR. The operating plan

prescribes discharge zones based the time of year, the existing lake level, creek capacity in Minnehaha Creek, and forecasted precipitation identified through partnership with the National Weather Service.

There are wetlands in the subwatershed that rely on steady inflow from surficial groundwater. Groundwater recharge is important within the subwatershed to maintain wetland hydrology and stream baseflow, as well as to recharge aquifers that supply public and private drinking water wells.

Ecological Integrity:

Lakes and Streams:

The Lake Minnetonka subwatershed enjoys moderate to high ecological integrity. Lake Minnetonka is the primary receiving water in the subwatershed. The fish community in Lake Minnetonka is excellent and is actively managed by the DNR. Invasive species are present within the lake, including zebra mussels, Eurasian watermilfoil and flowering rush.

Classen Creek, the primary stream in the subwatershed, has locations of moderately complex habitat and morphology, but in general the stream is less complex and more altered. The creek contains a degraded macroinvertebrate community, which consists primarily of pollution-tolerant species, and is lacking certain classes of organisms. Monitoring reveals nutrient enrichment and low DO, which likely impact the macroinvertebrates in Classen Creek. The creek also contains a weir and generally has low flow, two factors that limit connectivity.

Wetlands:

Scattered wetlands in the subwatershed have been classified as wetlands with high vegetative diversity and wildlife habitat, the largest of which are Classen Lake Marsh and French Lake Marsh. Only one wetland, which surrounds Lake Marion, is considered to have high restoration potential, but all are in need of protection. Conservation of wetlands is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

Uplands and Natural Corridors:

Several locations within the subwatershed have been identified by Hennepin County and the DNR as important natural

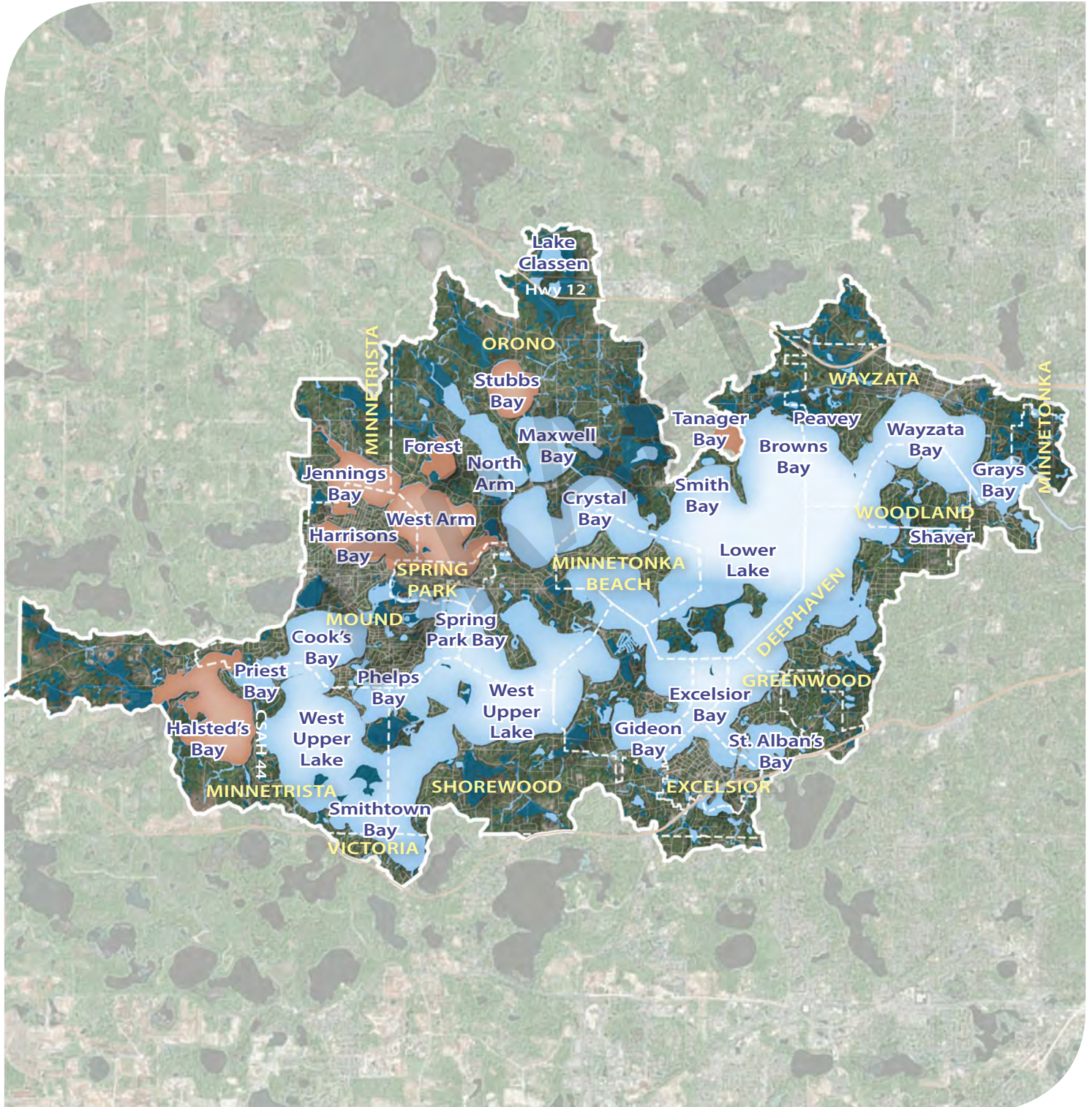


Figure 1.90 Lake Minnetonka Water Resources map



corridors containing high quality aquatic and upland habitat. For example, there are patches of intact sugar maple forest that must be protected. Many of the higher quality aquatic upland habitats are patchy and disconnected, and new connected habitat should be created when possible.

Shoreland within this subwatershed is heavily altered. A 2010 shoreland inventory found that of the 122 miles of Lake Minnetonka shoreline, over 65% was modified as riprap.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Lake Minnetonka subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Lake Minnetonka subwatershed are:

Water Quality

- Excess nutrients

Water Quantity

- Localized flooding

Ecological Integrity

- Degraded macroinvertebrate populations
- Altered shoreline

These issues are primarily the result of the following drivers:

- Altered wetlands
- Stormwater runoff
- Altered channels
- Internal sediment phosphorus loading
- Water quality from upstream waterbodies

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Some wetlands in the subwatershed are of high quality, and do not appear to be significantly altered by ditching and draining. These wetlands are sensitive to the quality of stormwater inputs and rely on groundwater to maintain their hydrology. Altered wetlands upstream of Lake Minnetonka may be in part responsible for elevated phosphorus levels in some of Lake Minnetonka's bays. For example, the Six Mile Marsh wetland complex upstream of Halsted Bay contributes to Halsted Bay's impaired phosphorus concentrations.

Stormwater Runoff:

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas,



stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally, as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

The Lake Minnetonka subwatershed is almost fully developed with mostly single family residential uses, but also some agriculture in the western portion of the subwatershed. These land uses increase the volume of stormwater runoff and the phosphorus loads carried by this runoff. Four bays in Lake Minnetonka and Forest Lake exceed the state standard for total phosphorus, and runoff from lawns, streets and agriculture in the subwatershed is a significant source of excess nutrients and sediment.

Altered Channels:

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Classen Creek, the primary stream in the Lake Minnetonka subwatershed, has been historically altered, which has degraded habitat complexity and channel morphology. The creek has a small earth dam and concrete weir, as well as several areas of significant streambank erosion. These factors probably contribute to the stream's degraded macroinvertebrate community. Other channels in the subwatershed have not been assessed, but have also been altered historically.

Internal Sediment Phosphorus Loading:

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms.

Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Four bays in Lake Minnetonka (Halsted Bay, Jennings Bay, Stubbs Bay and West Arm) and Forest Lake exceed the state standard for total phosphorus and are listed as Impaired Waters. Internal phosphorus loading is likely contributing to these high phosphorus concentrations, especially in Halsted and Jennings Bays, which were secondary receiving waters for municipal wastewater treatment plants until the 1970s. Excess phosphorus loads from wastewater treatment plant discharge may still be present in the bottom sediments. The Upper Minnehaha Creek Watershed Nutrient and Bacteria TMDL requires a 70 and 79 percent reduction in internal load in Halsted and Jennings Bays, respectively.

Upstream Waterbodies:

Headwater streams, lakes and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters that can lead to eutrophication. Consequently, restoration of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Phosphorus export from upstream wetland and stream systems within the subwatershed may be a contributing source of phosphorus to Lake Minnetonka and other downstream water bodies. There are several tributary streams to Lake Minnetonka, including Long Lake Creek, Gleason Creek, Classen Creek, Painter Creek, and Six Mile Creek and associated wetland complexes are exporting and conveying excess nutrient and sediment loads to the bays of Lake Minnetonka.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Lake Minnetonka subwatershed. These strategies are both short- and long-term, and establish a framework for the Lake Minnetonka

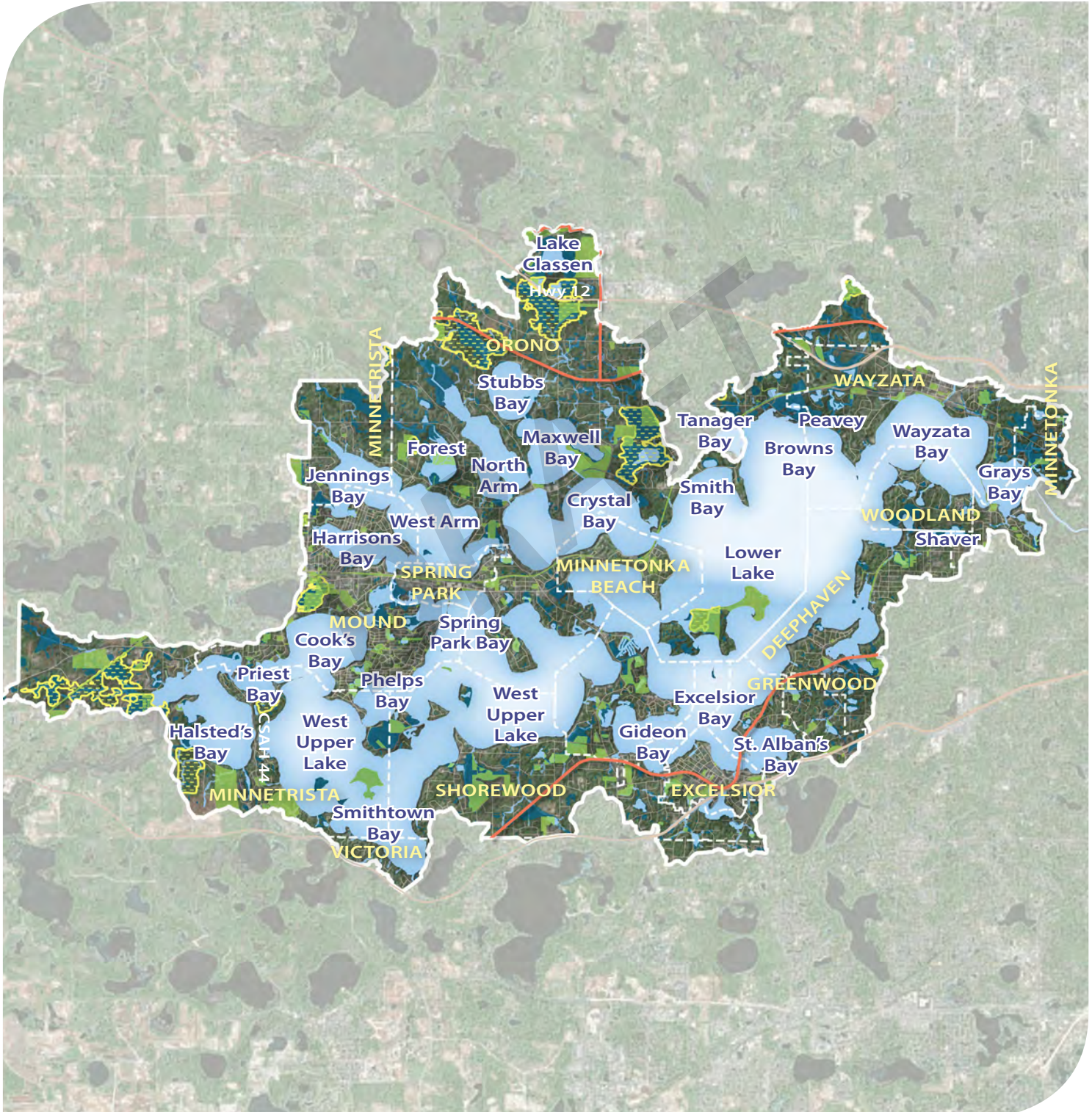


Figure 1.91 Lake Minnetonka Parks, Trails and Open Space map





subwatershed Implementation Plan programs and projects.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

Only one wetland within the Lake Minnetonka subwatershed, the wetland that surrounds Lake Marion, is considered to have high restoration potential. Other wetlands are not currently high priorities for restoration, but only a few have scored highly on vegetative diversity, wildlife habitat, or aesthetics. Outlet monitoring at certain wetlands could be performed to document phosphorus export, which could be followed by new assessments for restoration potential.

Stormwater Management:

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

The focus in the Lake Minnetonka subwatershed will be on reducing nutrient and sediment loading into upstream waterbodies, installing infiltration and load reduction BMPs,

requiring stormwater pretreatment before discharge into any wetland, and continuing to address the legacy effects of wastewater treatment discharge into Halsted and Jennings Bays.

Stream Channel Restoration:

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and reaeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Classen Creek and other channels in the watershed should be investigated for restoration potential. Given the elevated phosphorus levels and degraded macroinvertebrate community in Classen Creek, the creek could likely benefit from streambank stabilization, buffer enhancement, improvements to stream aeration, and habitat enhancement.

Internal Sediment Phosphorus Control:

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Additional water quality monitoring data, sediment chemistry, and fish and aquatic vegetation surveys are necessary to evaluate the most appropriate techniques to improve water quality in Halsted and Jennings Bays, and other water bodies with internal phosphorus loading. Future alum treatment will be considered.

Restoration of Upstream Waterbodies:

Upstream water bodies that are currently impaired can discharge large nutrient loads to downstream water bodies thereby contributing to downstream water quality impairments. Therefore, prior to, or concurrent with, significant

efforts to restore downstream water quality, the water quality in upstream water bodies must be improved. Nutrient impaired upstream lakes may require external and internal nutrient reductions using the strategies listed in this section.

The Lake Minnetonka subwatershed is downstream from nine other subwatersheds, each of which outlet through streams, channels, and storm sewers into Lake Minnetonka. The focus in Management Unit Three will be on restoration of those upstream water bodies to improve the impaired bays and lakes, and in Units Two and One will be on strategic restoration to protect the current good water quality of the lower lake.

LAND USE: EXISTING CONDITIONS

The subwatershed includes portions of the cities of Chanassen, Deephaven, Excelsior, Greenwood, Long Lake, Minnetonka, Minnetonka Beach, Minnetrista, Mound, Orono, Shorewood, Spring Park, Tonka Bay, Victoria, Wayzata and Woodland. The subwatershed is generally characterized by water (45%), most of which is Lake Minnetonka, and low density development (34%). The subwatershed also contains undeveloped land (13%), parks and open spaces (6%), agricultural land (2%).

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for the 2017-26 plan cycle (see Appendix for details on the public input process). This information was used to broadly characterize opportunities that existed at the time to inform the District's implementation plans. Below is a brief summary of the information received. It is meant to serve only as a guide, not to restrict collaborative efforts. As discussed in Section 3.6, the District intends to coordinate with its communities on an ongoing basis to stay apprised of new opportunities.

Given the large size of the Lake Minnetonka subwatershed, it is useful to divide the subwatershed into subunits based on similar issues and strategies. The eastern portion of the

subwatershed is the most developed, including the cities of Wayzata, Woodland, Deephaven, Greenwood, Excelsior, Minnetonka, Shorewood, Minnetonka Beach, and Tonka Bay. The water quality of Lake Minnetonka is better in this part of the subwatershed than it is farther west, but cities in this portion of the Lake are still concerned with stormwater management and low impact development and redevelopment. Other management priorities in this portion of the subwatershed are to become more flood resilient and to protect wetlands.

The northwestern portion of the watershed, which includes the cities of Orono, Minnetrista, Mound, and Spring Park, consists mostly of shoreline and large-lot residential properties. Priorities in this portion of the subwatershed include maintaining a more rural character and protecting natural resources such as naturalized shorelines of lakes. The City of Mound is interested in continuing to invest in development in the downtown area and redevelopment around Lake Minnetonka.

The southwestern portion of the subwatershed is the most rural and includes the cities of Mound, Minnetrista, and part of Victoria. The cities in this management area desire to maintain their rural character through low density development and proximity to nature and trails. They expect a need to accommodate development with investment in infrastructure such as roads and sewers, but they aim to protect and enhance natural resources.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, the Lake Minnetonka subwatershed has several issues relating to water quality, water quantity and ecological integrity. Four bays (Halsted, Jennings, West Arm, Stubbs) and Forest Lake are listed on the State's Impaired Waters List due to excess nutrients. Impairments are generally a product of large tributary drainage areas (e.g. Six

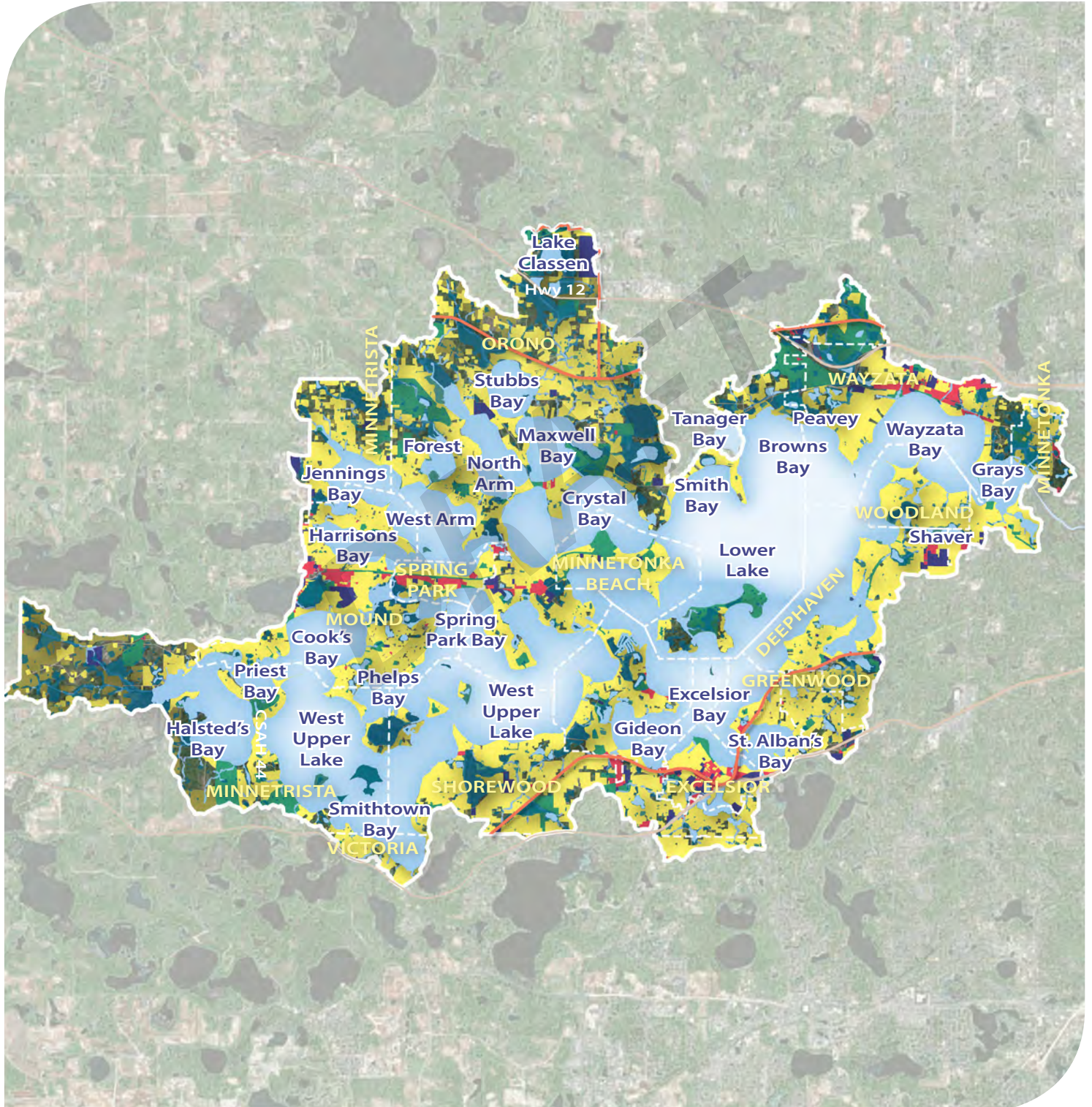


Figure 1.92 Lake Minnetonka Land Use map



Mile – Halsted, Painter – Jennings) and the level of internal loading (phosphorus into the water column from organic sediments) which can be exacerbated by the presence of common carp and some aquatic plants. There are locations in the subwatershed within Lake Minnetonka’s floodplain that are subject to localized flooding due to the volume of water received from tributary subwatersheds, which can cause lake levels to rise. Lake Minnetonka contains aquatic invasive species, but overall, the subwatershed enjoys high ecological integrity with an excellent fish community in Lake Minnetonka and exceptional vegetative diversity in wetlands.

Based on these conditions, management strategies within the subwatershed will focus on addressing impaired bays within Lake Minnetonka by reducing external loading to the lake from upstream tributary subwatersheds and by addressing internal loading within the lake; protecting existing high value natural resources; and improving ecological integrity by promoting shoreline best management through partnership with local communities, shoreline contractors and landowners.

The eastern portion of the subwatershed is mostly developed, while areas in the west and north are still undergoing development. Some investment and roads and parks is planned throughout the subwatershed. Specific opportunity areas identified include downtown Mound, Excelsior Commons, and the Wayzata lakefront. The cities in the subwatershed acknowledges the importance of stormwater management and will look for opportunities to incorporate Best Management Practices (BMPs) as redevelopment and infrastructure investment occurs.

This Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity. As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

The District manages lake levels on Lake Minnetonka through the operation of the Gray’s Bay Dam, informed by existing lake level, downstream capacity in Minnehaha Creek, seasonal variation, and precipitation predicted through partnership with the National Weather Service.

The District will continue to promote and provide education to cities and residents on the value of native shoreline plantings. The District funded the development of the Lake Minnetonka Guide to Shoreline Gardens that is a useful resource for lakeshore homeowners.

The District may pursue a carp assessment for the northwestern bays of Lake Minnetonka (Jennings, West Arm, Forest Lake) and their tributary subwatersheds (Dutch Lake and Painter Creek). The goal of the assessment would be to understand the movement and recruitment patterns of carp in the system to inform management efforts. This work will be dependent on the District’s ability to secure partner support and funding.

Invasive species are present within the lake, including zebra mussels, Eurasian watermilfoil and flowering rush. The District does not actively manage for any of these species, but will continue to monitor any impacts on water quality or ecological integrity.

Peavey Lake is impaired for excess chlorides. The District will continue to monitor chloride levels and provide education and training for public and private applicators and residents on best practices for chloride use.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. The CIP also includes a project to address Halsted Bay internal loading as part of the broader Six Mile-Halsted Bay implementation plan discussed in section 3.9.11. In the future, should a larger, more concentrated scale of capital and program implementation be determined to be needed by the District or its partners, a discrete subwatershed planning process may be initiated that:

- » Provides high resolution diagnostic of watershed issues

and drivers

- » Maps current projected land use and infrastructure changes
- » Defines a detailed and integrated capital and program implementation plan
- » Outlines a funding strategy including program costs and sources
- » The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Comprehensive Plan.

CAPITAL IMPROVEMENT PLAN

Capital projects in the Lake Minnetonka subwatershed include stormwater management projects to reduce runoff volumes and rates while addressing pollutant loading that occurs from runoff producing rainfall events and an internal load management project for Halsted Bay. These projects will progress the District and its partners toward achieving their various goals for the subwatershed. This program is not a comprehensive list of all capital needs or potential projects within the subwatershed, and is limited by available financial resources and staff capacity to manage projects.

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Lake Minnetonka, including but not limited to construction of infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Four bays (Halsted, Jennings, West Arm, Stubbs) and Forest Lake are listed on the State's Impaired Waters List due to excess nutrients. A TMDL identified a need to reduce external phosphorus loading by 60% (116 pounds) to Forest Lake, 73% (2087 lbs) to Halsted Bay, 72% (1563 lbs) to Jennings Bay, and 51% (142 lbs) to Stubbs Bay.
Outcome	Reduction of sediment and nutrients exported to Lake Minnetonka.
Estimated Cost	Capital costs: \$1,000,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

Project	Halsted Bay Internal Phosphorus Load Reduction
Description	The Halsted Bay Internal Phosphorus Load Reduction project consists of an aluminum sulfate (alum) treatment on Halsted Bay to reduce internal phosphorus loading. A dosing study was completed in 2013 to estimate the required aluminum concentration to bind 90% of mobile phosphorus. Alum will be applied to Halsted Bay in three treatment zones ranging from 60 g Al/m ² to 140 g Al/m ² .
Need	A Load Management Feasibility Study completed for Halsted’s Bay determined that internal phosphorus loading provides 40% (2,705 pounds) of the phosphorus loading to Halsted Bay. The study recommended an 84% (2,278 pound) reduction in internal phosphorus loading.
Outcome	The alum application will reduce mobile sediment phosphorus by 90% which will result in a parallel reduction in internal phosphorus loading.
Estimated Cost	Capital costs: \$1,400,000 in 2017 dollars based on a 20 year project life.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

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DRAFT

3.9.5 LAKE VIRGINIA SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Lake Virginia Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Lake Virginia is a 6.2 square mile (3,991 acre) subwatershed located in the southwestern portion of the MCWD and includes the cities of Chanhassen, Chaska, Shorewood, and Victoria. The subwatershed is generally characterized by low density development (31%), parks and open spaces (28%), water (22%), undeveloped land (12%), and agricultural uses (7%). Lake Minnewashta Regional Park and parts of the Minnesota Landscape Arboretum are within the subwatershed's boundaries. The Southwest Hennepin LRT Regional Trail also passes across the northwest corner of the subwatershed.

There are areas of high ecological value within corridors of aquatic and upland habitat. Thirty-nine percent of the wetlands in the subwatershed were classified as "preserve" by the Functional Assessment of Wetlands due to their exceptional or high vegetative diversity, or fish or wildlife habitat value.

Lakes Minnewashta and Virginia are the primary receiving waters within the subwatershed. Tamarack Lake and Lake St. Joe are additional lakes in the subwatershed. There is a small stream that conveys discharge from Lake Minnewashta to Lake Virginia known as Minnewashta Creek. The Lake Virginia subwatershed discharges by a small channel to Lake Minnetonka: Smithtown Bay.

The Lake Virginia subwatershed has several issues relating to water quality, water quantity and ecological integrity. Lake Virginia and Tamarack Lake are listed as Impaired Waters for excess nutrients and a TMDL identifying nutrient load reduction goals and suggested actions has been completed. Overall, the system has moderate ecological integrity. Low dissolved oxygen in Lake Virginia may be negatively impacting the fish community. Lakes Minnewashta and Virginia are also infested

with Eurasian watermilfoil, Curlyleaf Pondweed and zebra mussels.

Management strategies within Lake Virginia subwatershed will focus on removing promoting infiltration, reducing pollutant loading, improving biodiversity and protecting existing resources. The District will partner with local and state government, developers, lake associations, citizens' groups and other parties to increase infiltration, reduce pollutant loading, manage aquatic invasive species, promote planning for flood prevention and mitigation, protect sensitive wellhead protection areas, undertake restoration projects, create new habitat, and educate the public about best management practices and the value of connected habitat. Before this work is advanced MCWD will develop a specific systems plan for this subwatershed in partnership with local municipalities and landowners. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES:

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Lake Virginia subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality:

Lakes and Streams:

Lake Minnewashta, Lake Virginia, Lake St. Joe and Tamarack Lake are lakes within the subwatershed. Minnewashta Creek conveys discharge from Lake Minnewashta to Lake Virginia.

Lake Virginia and Tamarack Lake are listed as Impaired Waters for excess nutrients, although Tamarack Lake varies from slightly below to slightly above the state standard. Lake



LEGEND

- Painter Creek Subwatershed Boundary
- Municipal Boundary
- Streets
- Existing Regional Trails
- Streams
- Open Water
- Wetlands

Figure 1.93 Lake Virginia Base map



Minnewashta and Lake St. Joe have historically met or bettered state water quality standards, although Lake St. Joe can experience algal blooms. Both Minnewashta and Virginia are listed as Impaired Waters for excess mercury in fish tissue, and the State of Minnesota has completed a statewide TMDL for those impairments.

Minnewashta Creek outlet historically has relatively low TP concentrations and loading, although loading does show an increase during high flow years.

Wetlands:

There are wetlands in the subwatershed with excellent and high vegetative diversity that are sensitive to the quality of stormwater inputs.

Groundwater:

There are areas of aquifer sensitivity in the subwatershed. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water quantity:

Several locations may experience flooding during large rain events, according to the District's model.

There are wetlands in the subwatershed that rely on steady inflow from surficial groundwater.

Portions of the subwatershed are within city Wellhead Protection Areas and there may be restrictions on infiltration in some sensitive areas.

There are two landlocked subwatershed units that may in the future be considered for constructed outlets.

Ecological Integrity:

Lakes and Streams:

Fisheries range in health throughout the subwatershed. Lake Minnewashta is known for its fishing, but in Lake Virginia, where common carp and other rough fish are abundant, low dissolved oxygen may be impacting the fish community.

The aquatic vegetation community in Lake Minnewashta supports moderate species diversity, but contains aquatic invasive species, including Eurasian watermilfoil, Curlyleaf pondweed and Zebra mussels. Lake Virginia also contains Eurasian watermilfoil, Curlyleaf pondweed and Zebra mussels, and Tamarack Lake's aquatic vegetation community is degraded, showing low species diversity often comprised of non-native and/or intolerant species.

Wetlands:

There are wetlands in the subwatershed with exceptional to high fish and wildlife habitat and exceptional to high vegetation quality. Many of these wetlands are within the boundary of either Lake Minnewashta Regional Park and or the Minnesota Landscape Arboretum and are already protected. Opportunities exist to protect the wetlands surrounding both Tamarack Lake and Lake St. Joe.

Uplands and Natural Corridors:

There are areas of high ecological value within corridors of upland habitat. Some areas are protected within local and regional parks or the Landscape Arboretum, while other areas are privately owned.

DRIVERS:

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Lake Virginia subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Lake Virginia subwatershed are:

Water Quality

- » Excess nutrients in Impaired Waters
- » Protecting good water quality in some lakes

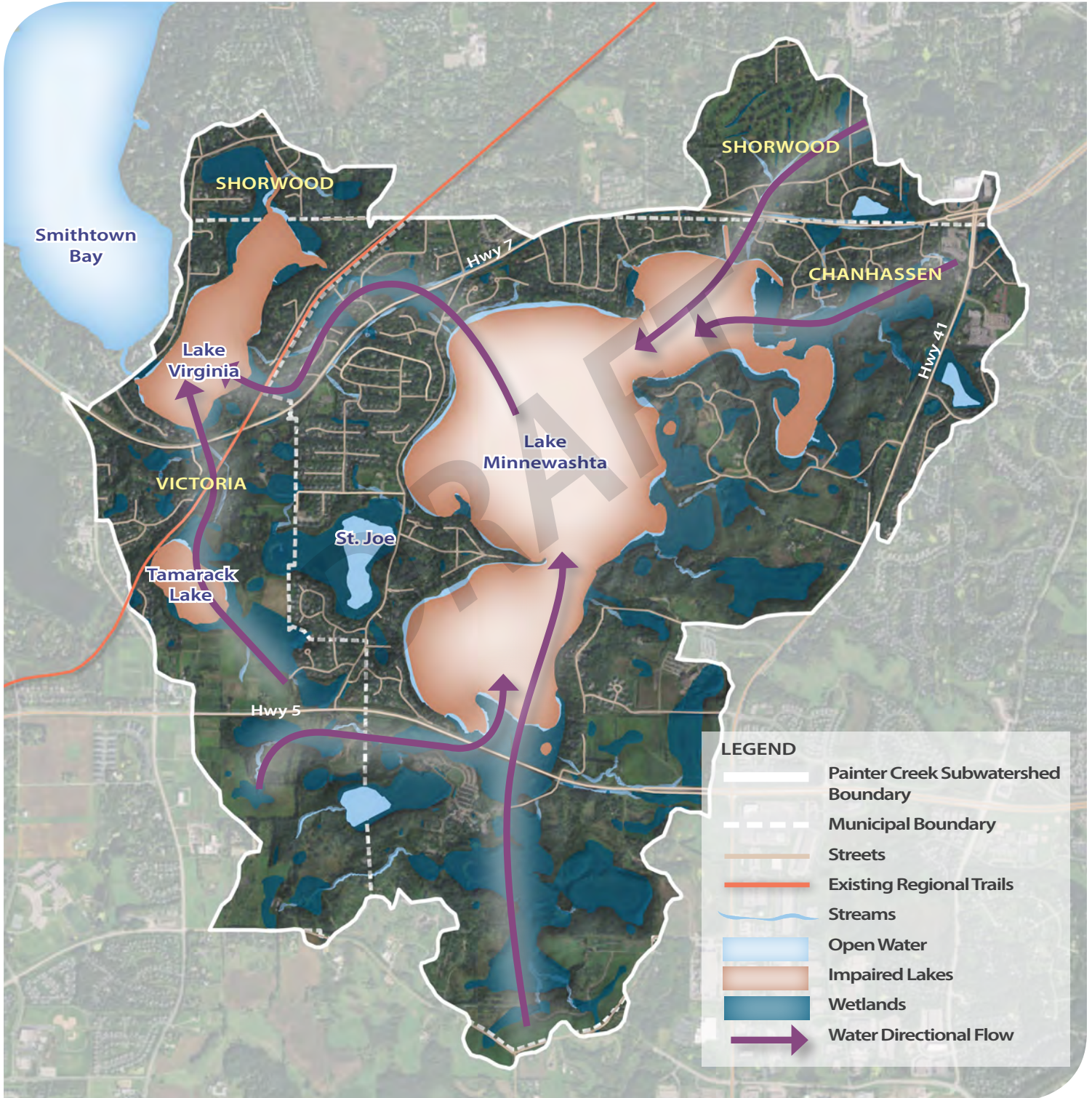
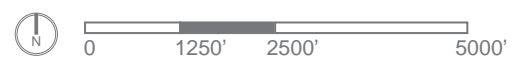


Figure 1.94 Lake Virginia Water Resources map



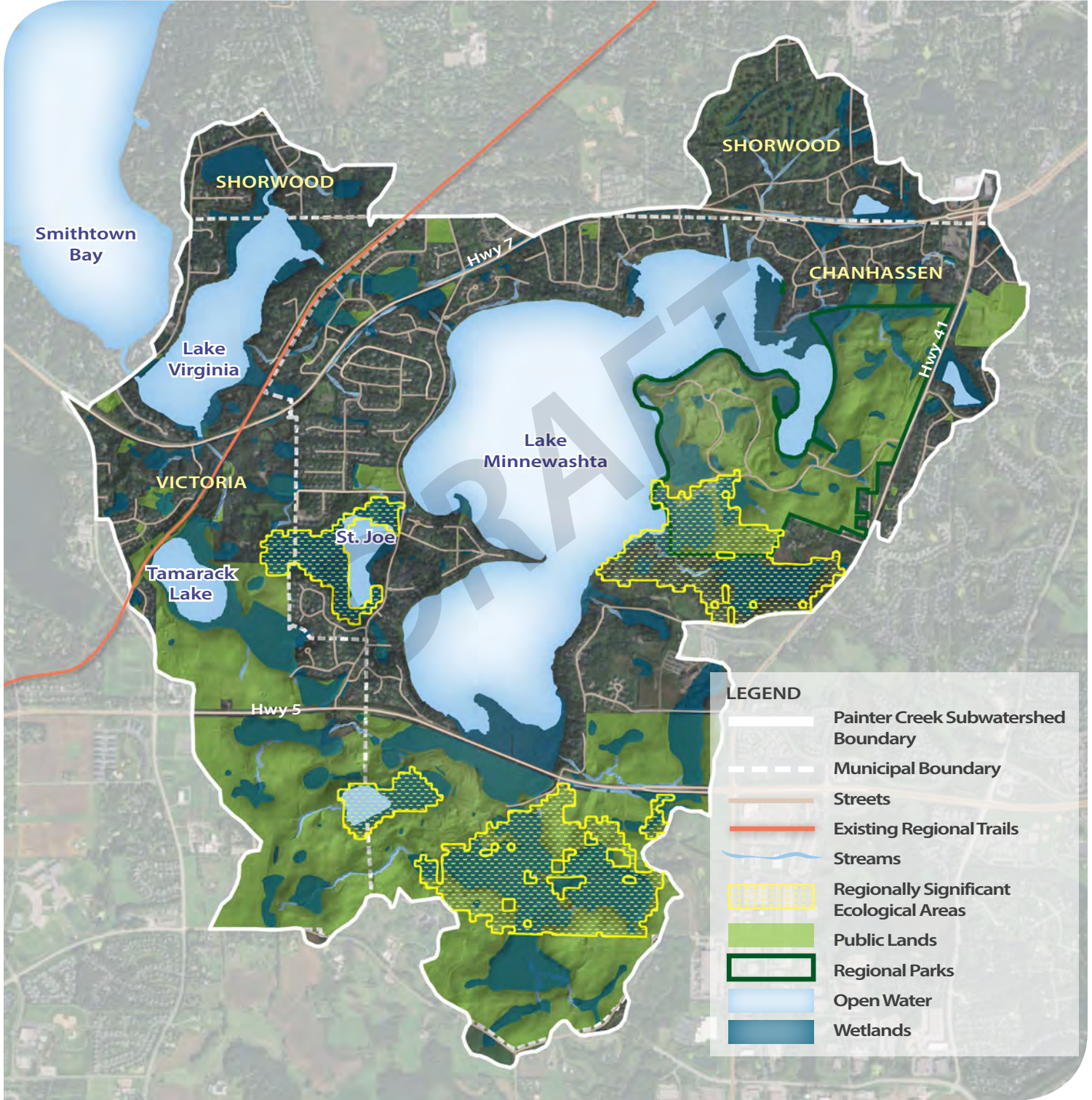


Figure 1.95 Lake Virginia Parks, Trails and Open Space map





Water Quantity

- » Localized flooding

Ecological Integrity

- » Protecting wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Common carp
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Many wetlands in the subwatershed are of high or exceptional quality, and do not appear to be significantly altered by ditching and draining. Minnewashta Creek does flow through a riparian wetland between Lakes Minnewashta and Virginia, but it is unclear whether that wetland impacts downstream nutrient loading. Several of the wetlands do receive stormwater and may be impacted in the future by that loading.

Carp:

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse

state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus from resuspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

Fish survey data is limited, but common carp appear to be abundant in Lake Virginia, where low dissolved oxygen is thought to be impacting more sensitive fish species. Carp could be partially responsible for Lake Virginia's impaired water quality, since bottom feeding by carp releases nutrients into Lake Virginia's water column. These nutrients could then be conveyed downstream to Lake Minnetonka: Smithtown Bay. The extent of the carp population and its migratory and spawning habits is not known.

Stormwater Runoff:

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally, as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Lake Virginia and Tamarack Lake are impaired for excess nutrients, and runoff from lawns, streets and agriculture in the subwatershed could be a source of nutrients and sediment to these lakes. The 2011 Lake Virginia TMDL requires a 27 percent reduction in phosphorus load from the watershed to meet state nutrient standards. The 2014 TMDL for Tamarack Lake does not require a specific load reduction, but recommends reducing nutrient loading from the subwatershed so that the lake may more consistently meet state standards.

Altered Channels:

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Minnewashta Creek flows through several culverts along its 1.2 mile course to Lake Virginia, and these culverts impair connectivity in the Creek. Some reaches of the creek have also been channelized. No data exists on the biotic communities within Minnewashta Creek, but these channel alterations likely impair biotic communities.

Internal Sediment Phosphorus Loading:

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

No sediment release data is available, but the 2011 Lake Virginia TMDL determined that internal sediment release was not a significant factor in the Lake Virginia impairment, requiring just a five percent reduction in that load.

MANAGEMENT STRATEGIES:

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Lake Virginia subwatershed. These strategies are both short- and long-term, and establish a framework for the Virginia Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

Although many wetlands in the subwatershed have exceptional to high fish and wildlife habitat and vegetation quality, there are several wetlands that have high or moderate restoration potential. This includes a wetland through which Minnewashta Creek flows on its way to Lake Virginia. If restored, this wetland could improve vegetative diversity and provide connected habitat within the watershed in addition to potentially improving the water quality of Lake Virginia.

Carp Management:

Historically, carp management focused on removal of carp populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where



activities focus not only on removal but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

While common carp are known to be present in Lake Virginia, not much is known about their extent and whether they are impacting water quality of Lake Virginia. It is necessary to perform feasibility studies which include assessments of carp and other rough fish population and their migration patterns.

Stormwater Management:

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

In the Lake Virginia subwatershed, the focus will be on installing infiltration and load reduction BMPs, requiring stormwater pretreatment before discharge into any wetland, and protecting wetland vegetation quality and diversity by limiting the hydrological bounce form inflow to the wetlands.

Stream Channel Restoration:

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and reaeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

While opportunities to restore a more natural form and function are limited, Minnewashta Creek should be investigated for

restoration potential, including need for streambank repair, buffer enhancement, and habitat enhancement.

Internal Sediment Phosphorus Control:

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Additional information is necessary to evaluate management options for Lake Virginia. While the 2011 TMDL found that sediment release is likely not a significant driver of annual lake loading, the potential impacts of rough fish and invasive aquatic vegetation should be further investigated to establish the appropriate future course of action.

Watershed Protection

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

LAND USE:

EXISTING CONDITIONS

The subwatershed includes a portion of the cities of Chanhasen, Chaska, Shorewood, and Victoria. Land use in the subwatershed is generally characterized by low density development (31%), parks and open spaces (28%), water (22%), undeveloped land

(12%), and agricultural uses (7%). Lake Minnewashta Regional Park and parts of the Minnesota Landscape Arboretum are within the subwatershed's boundaries. The Southwest Hennepin LRT Regional Trail also passes across the northwest corner of the subwatershed.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for the 2017-26 plan cycle (see Appendix for details on the public input process). This information was used to broadly characterize opportunities that existed at the time to inform the District's implementation plans. Below is a brief summary of the information received. It is meant to serve only as a guide, not to restrict collaborative efforts. As discussed in Section 3.6, the District intends to coordinate with its communities on an ongoing basis to stay apprised of new opportunities.

The subwatershed is mostly developed, and there is little anticipated for development or infrastructure investment within this subwatershed in the near-term. There are septic systems on the east side of Lake Virginia that are a potential source of nutrients to the lake. Sanitary sewer has been installed, and residents are expected to connect over time as septic inspections indicate the need.

The Lake Minnewashta Preservation Association is an active association on Lake Minnewashta. The Association plans to continue to raise funds to perform invasive species treatments (e.g. Eurasian watermilfoil management) and is also working to develop a contingency fund for unanticipated events, such as the 2016 zebra mussel infestation.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the

conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, Lake Virginia and Tamarack Lake are impaired for excess nutrients and low dissolved oxygen in Lake Virginia may be negatively impacting sensitive fish species. Common carp could be partially responsible for Lake Virginia's impaired water quality. Lake Virginia and Lake Minnewashta have been infested with Eurasian watermilfoil, Curyleaf Pondweed and zebra mussels. The subwatershed also contains wetlands with exceptional to high fish and wildlife habitat and vegetation quality.

Based on these conditions, management strategies within the subwatershed will focus primarily on stormwater management to reduce pollutant loading, promoting infiltration, improving biodiversity, protecting existing resources, and evaluating and managing the presence and impact of common carp.

The Lake Virginia subwatershed is relatively small and there is little anticipated for development or infrastructure investment within this subwatershed in the near-term, so opportunities from land use change may be limited. However, the Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity. The District will proactively coordinate the permitting of future land use change with its LGUs to explore opportunities to create public-private partnerships to address stormwater management goals in ways that exceed regulatory requirements, and will continue working with the Lake Minnewashta Preservation Association to identify local resident led implementation opportunities that align with this subwatershed plan and continue to monitor any impacts or trends related to the zebra mussel infestation.

As opportunities arise, or are identified by LGUs or other partners, to implement larger collaborative capital

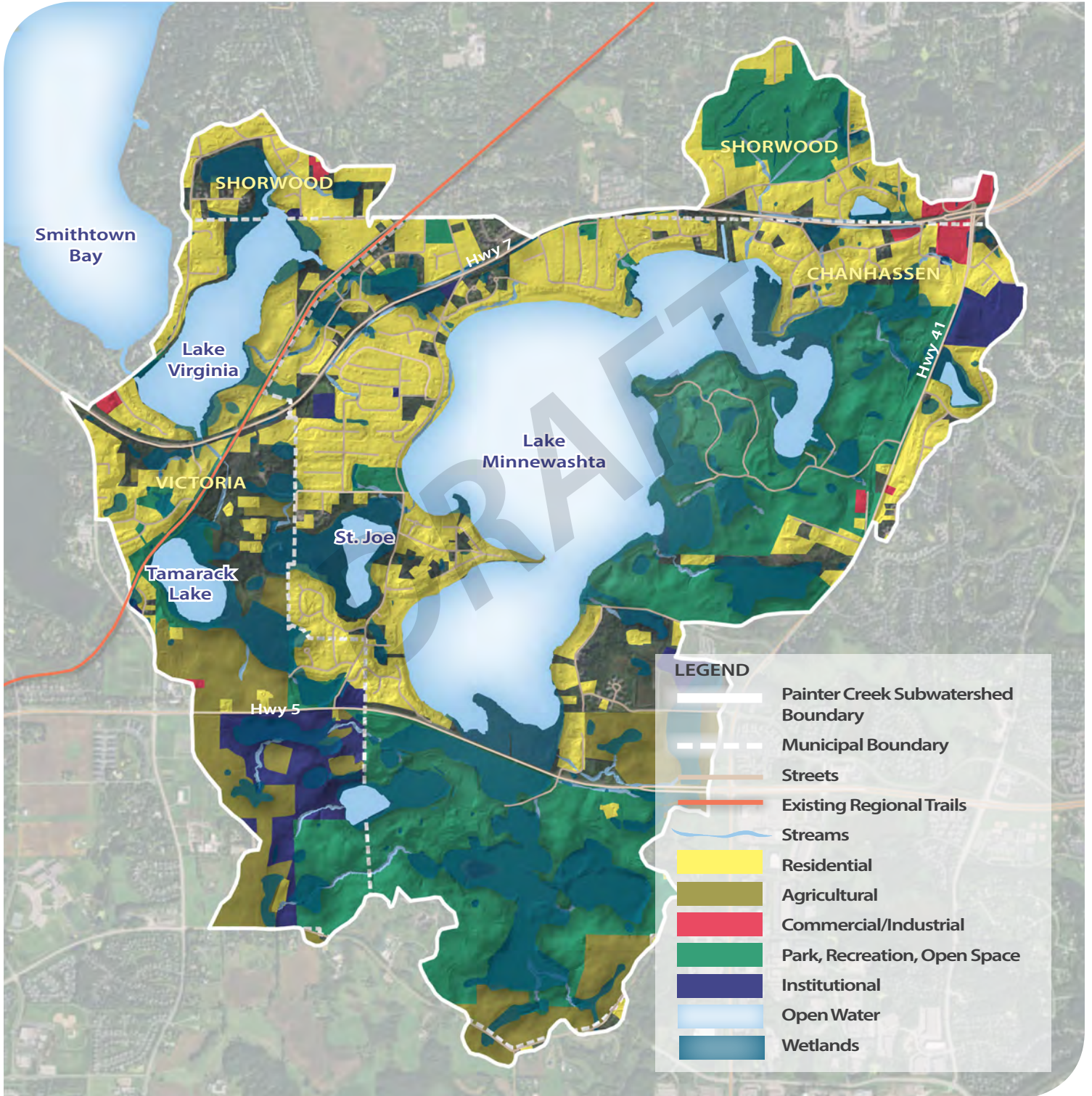


Figure 1.96 Lake Virginia Land Use map



improvements, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate level of response. To allow for this level of responsive partnership the capital improvement plan for this subwatershed, detailed in the next section, includes a project listing for stormwater management.

As outlined above, the District has a wide range of services beyond capital improvements that it can mobilize in partnership with communities to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. In the future, should a larger more concentrated scale of capital and program implementation be determined to be needed by the District or its partners, a discrete subwatershed planning process may be initiated that:

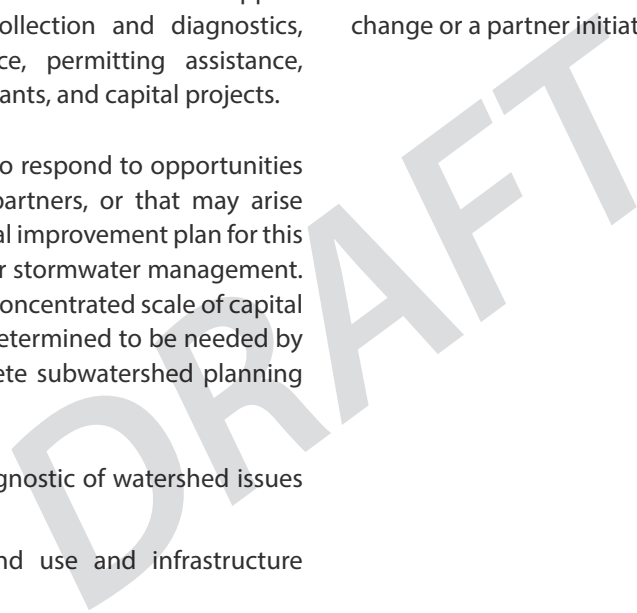
- » Provides high resolution diagnostic of watershed issues and drivers
- » Maps current projected land use and infrastructure changes
- » Defines a detailed and integrated capital and program implementation plan
- » Outlines a funding strategy including program costs and sources
- » The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Comprehensive Plan.

CAPITAL IMPROVEMENT PLAN

Capital projects in the Lake Virginia subwatershed include stormwater management projects to reduce runoff volumes and rates while addressing pollutant loading that occurs from runoff producing rainfall events. These projects will progress the District and its partners toward achieving their various goals for the subwatershed. This program is not a comprehensive list of

all capital needs or potential projects within the subwatershed, and is limited by available financial resources and staff capacity to manage projects.

Given the limited resource needs and opportunities identified within the Lake Virginia subwatershed relative to other parts of the watershed, the District does not anticipate initiating any capital improvement efforts in the subwatershed during this plan cycle. However, the District has included this project in its CIP in the event that an opportunity arises through land use change or a partner initiative.





Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Lake Virginia, including but not limited to construction of infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Lake Virginia exceeds state nutrient standards. A 2011 TMDL study identified a need to reduce phosphorus loading by 20% (77 pounds), most of which is from external sources (71 pounds).
Outcome	Reduction of sediment and nutrients exported to Lake Virginia.
Estimated Cost	Capital costs for infiltration projects: \$650,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

References

Minnesota Pollution Control Agency (MPCA). 2016. Minnesota's Impaired Waters List. pca.state.mn.us/water/minnesotas-impaired-waters-list

Wenck. 2014. Upper Minnehaha Creek Watershed Nutrient and Bacteria TMDL Study. pca.state.mn.us/water/tmdl/upper-minnehaha-creek-watershed-lakes-and-bacteria-metro-tmdl-project

3.9.6 LANGDON LAKE SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Langdon Lake Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Langdon Lake is a 1.7 square mile (1,056 acre) subwatershed located along the western boundary of the MCWD and includes portions of the cities of Minnetrista and Mound. The subwatershed is generally characterized by low density development (36%), including many single-family homes, water (22%), undeveloped land (21%), parks and open spaces (19%), and agricultural uses (2%). The Dakota Rail Trail traverses this subwatershed on the north side of Langdon Lake, and Gale Woods Regional Park occupies a portion of the western subwatershed.

The western half of the subwatershed is dominated by a mosaic of forest and woodland, wetland, and open water, including Black Lake and Saunders Lake. The largely intact open space surrounding Black Lake and the north and west sides of Saunders Lake are classified as a Regionally Significant Ecological Area.

Langdon Lake is the primary receiving water within the subwatershed. Two other receiving waters within the subwatershed carry the informal designation of lake: Saunders Lake and Flanagan Lake, both of which could be classified as wetlands. There is a small channel that conveys discharge from the outlet of Saunders Lake to Langdon Lake. Langdon Lake discharges through a culvert under Highway 110 into Lost Lake, which outlets into Lake Minnetonka: Cooks Bay. The subwatershed is bisected by a railroad corridor, which influences its hydrology.

Langdon Lake subwatershed has several issues relating to water quality, water quantity, and ecological integrity. Langdon Lake is impaired by excess nutrients, and a TMDL requires

both external and internal load reductions. Water quality may be impacting the fish community in Langdon Lake, which has not been formally assessed since 1993, but is dominated by bullheads. Recent plant surveys show a degraded aquatic plant community, which in turn limits the fishery. In addition, culverts in the subwatershed need maintenance to ensure adequate conveyance and flood storage. Overall, the system enjoys moderate to high ecological integrity, with wetlands containing high vegetative diversity and extensive connected natural corridors containing high quality habitat. These areas should be protected.

Management strategies within the Langdon Lake subwatershed will focus on nutrient reductions, while promoting infiltration, reducing pollutant loading, improving biodiversity, and protecting existing resources. The District will partner with local and state government, developers, citizens' groups and other parties to increase infiltration, reduce pollutant loading, promote planning for flood prevention and mitigation, protect sensitive wellhead protection areas, undertake restoration projects, create new habitat, and educate the public about best management practices and the value of connected habitat. Before this work is advanced MCWD will develop a specific systems plan for this subwatershed in partnership with local municipalities and landowners. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES:

This section of the Plan outlines existing conditions and water resource issues categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Langdon Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.



Figure 1.97 Langdon Lake Base map

Water Quality:

Lakes and Streams:

Langdon Lake is listed on the State's Impaired Waters list for excessive nutrients. Internal loading (potentially impacted by a historic wastewater treatment plant) and external loading coming from stormwater runoff and the upstream wetland system may be contributing to these concentrations.

At this time, no streams are listed as Impaired Waters. The Langdon Lake inlet and outlet streams are within the state river eutrophication standards.

Wetlands:

There are wetlands in the subwatershed with high vegetative diversity that are sensitive to the quality of stormwater inputs.

Groundwater:

There are areas of very high and high aquifer sensitivity in the subwatershed. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity:

Culverts in the subwatershed and outlets on Flanagan and Saunders Lakes need maintenance to ensure adequate conveyance and flood storage.

Preservation of upstream storage in Flanagan and Saunders Lakes and other wetlands is necessary to provide downstream flood protection.

There are wetlands in the subwatershed that rely on steady inflow from surficial groundwater. Groundwater recharge is important within the subwatershed to maintain wetland hydrology and stream baseflow, as well as to recharge aquifers that supply public and private drinking water wells.

Portions of the subwatershed are within city Wellhead Protection Areas and there may be restrictions on infiltration in some sensitive areas.

Ecological Integrity:

Lakes and Streams:

The Langdon Lake subwatershed is notable for its ecological

resources and large wetlands.

Langdon Lake is the primary receiving water in the subwatershed and is listed on the State's Impaired Waters list for excessive nutrients. The last fish survey was completed in 1993, but the community was dominated by bullheads at that time. The aquatic plant community is also degraded, which in turn impacts the fishery.

The Langdon Lake outlet stream has, for the most part, stayed at or above the DO standard. However, it has dipped below the standard intermittently, probably due to low flow and high summer temperatures. There are no fish or aquatic vegetation data for the Langdon Lake inlet or outlet, but there is high connectivity in these streams, with no identified barriers, such as dams, weirs, or culverts.

Wetlands:

Wetland assessments have classified a number of wetlands in the subwatershed as having excellent vegetative diversity and wildlife habitat. The highest vegetative diversity was found in the wetland complex associated with Flanagan Lake within the Gale Woods Regional Park and the wetlands riparian to Saunders Lake. These wetlands are in need of protection. Their conservation is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

Uplands and Natural Corridors:

Nearly the entire western subwatershed has been identified as important conservation corridors worthy of protection by Hennepin County and the Metropolitan Council. The wide wetland areas along the western and northern areas of Langdon Lake have also been identified. The Dakota Rail Regional Trail may act as a barrier to wildlife migration between the north and south halves of the subwatershed.

DRIVERS:

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land

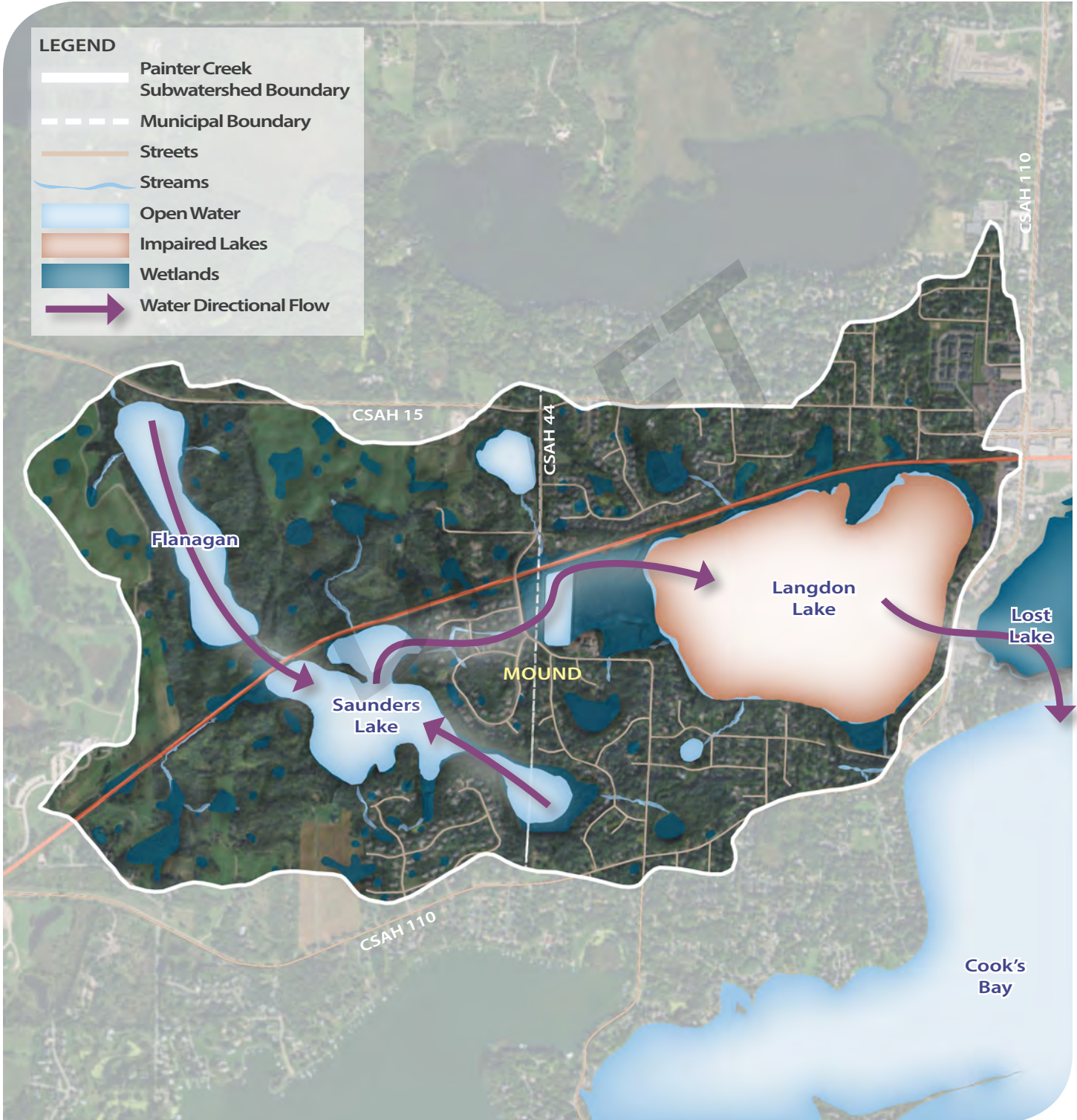


Figure 1.98 Langdon Lake Water Resources map



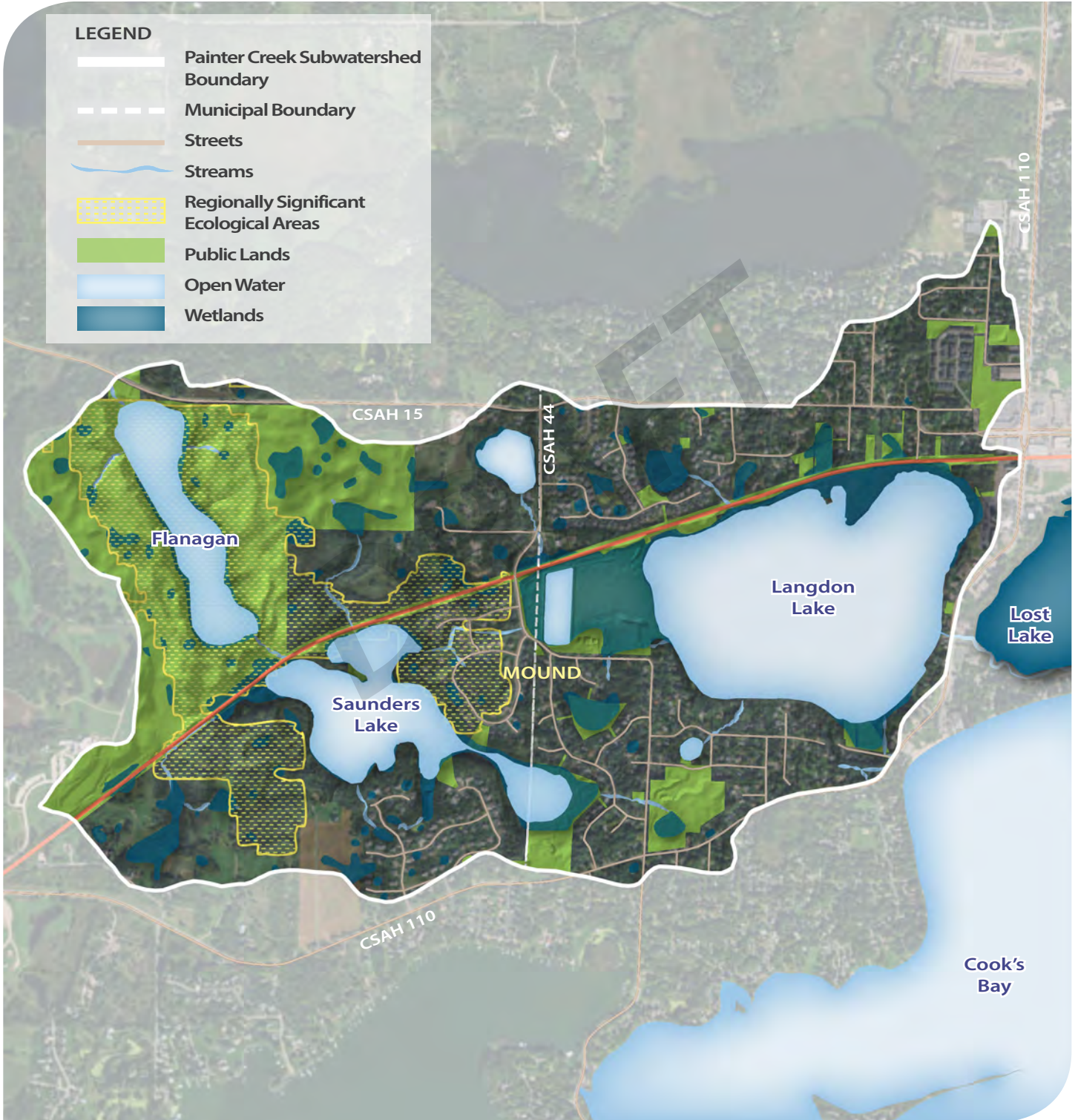


Figure 1.99 Langdon Lake Parks, Trails, and Open Space map





use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Langdon Lake subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Langdon Lake subwatershed are:

Water Quality

- » Excess nutrients

Water Quantity

- » Maintenance of upstream flood storage

Ecological Integrity

- » Protection of high quality wetlands
- » Protection of high quality upland corridors

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Stormwater runoff
- » Internal sediment phosphorus loading
- » Water quality from upstream waterbodies

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from nutrient sinks to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Many wetlands in the subwatershed are of high quality. The primary concern in the subwatershed is the impact of discharge from the old Mound Wastewater Treatment Plant pond on the riparian wetland on the west side of the lake creating a pool of phosphorus in the wetland, which is available for release into the lake.

Stormwater Runoff:

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams, and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams, and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides, and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream, or wetland. Generally, as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams, and wetlands decreases.

Langdon Lake exceeds the state standard for total phosphorus, and runoff from lawns, streets, and agriculture in the subwatershed could be a source of nutrients and sediment to the lake. The 2014 Langdon Lake TMDL requires a 27 percent reduction in nutrient loading from the subwatershed to meet state water quality standards.

Internal Sediment Phosphorus Loading:

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae

blooms, poor water clarity, and in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Langdon Lake exceeds the state standard for total phosphorus and is listed as an Impaired Water. The lake received wastewater effluent discharge from the Mound Wastewater Treatment Plant in the past (1963-1974), creating a pool of phosphorus in the sediments that is likely contributing to internal phosphorus loading. The 2014 TMDL requires a 21 percent reduction in internal load to meet state standards.

Upstream Waterbodies:

Headwater streams, lakes, and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters leading to eutrophication. Consequently, restoration of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Phosphorus export from the upstream wetland system within the watershed may be a contributing source of phosphorus to Langdon Lake, and further monitoring and investigation of conditions in Saunders Lake and its discharge should be considered.

MANAGEMENT STRATEGIES:

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Langdon Lake subwatershed. These strategies are both short- and long-term, and establish a framework for the Langdon Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to

downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology and overall needs of the subwatershed system.

Wetlands within the Langdon Lake subwatershed are not high priorities for restoration, as they are minimally disturbed and have high quality vegetation communities and wildlife habitat. However, outlet monitoring could be performed to document whether there is phosphorus export from the wetland system.

Stormwater Management:

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration, and fertilizer management.

The focus in the Langdon Lake subwatershed will be on ensuring that wetlands are adequately buffered, installing infiltration and load reduction BMPs, requiring stormwater pretreatment before discharge into any wetland, and continuing to address the legacy effects of the Mound Wastewater Treatment Plant.

Internal Sediment Phosphorus Control:

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent



sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Additional information is necessary to evaluate management options for Langdon Lake. Additional water quality monitoring data, sediment chemistry, and fish and aquatic vegetation surveys are necessary to evaluate the most appropriate techniques to improve water quality in this lake. A future alum treatment may be considered.

Restoration of Upstream Waterbodies:

Upstream water bodies that are currently impaired can discharge large nutrient loads to downstream water bodies thereby contributing to downstream water quality impairments. Therefore, prior to, or concurrent with, significant efforts to restore downstream water quality, the water quality in upstream water bodies must be improved. Nutrient impaired upstream lakes may require external and internal nutrient reductions using the strategies listed in this section.

The wetland complexes upstream of Langdon Lake, including Flanagan and Saunders Lakes, should be investigated to determine if it has an impact on the water quality of Langdon Lake. Monitoring outflow from the wetland should occur to determine whether phosphorus concentrations are elevated, suggesting the wetlands are acting as sources rather than sinks of nutrients.

Watershed Protection

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting

critical fish and wildlife corridors.

There are high quality wetlands and uplands in the subwatershed. Much of the western subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor, including areas within Three River Parks District's Gale Woods Regional Park. These natural areas are large and are part of a corridor of habitat between Dutch Lake, Long Lake/Little Long Lake and Whaletail Lake.

The focus in this subwatershed will be to preserve these high-value resources through Land Conservation where appropriate and with Three Rivers Park District as opportunities arise. In addition, the District will work with cities and developers to minimize disturbance during development and construction.

LAND USE:

EXISTING CONDITIONS

The subwatershed includes portions of the cities of Minnetrista and Mound. The subwatershed is generally characterized by low density development (36%), including many single-family homes, water (22%), undeveloped land (21%), parks and open spaces (19%), and agricultural uses (2%). The Dakota Rail Trail traverses this subwatershed on the north side of Langdon Lake, and Gale Woods Regional Park occupies a portion of the western subwatershed.

LOCAL PLANS AND PRIORITIES:

As described in the District's goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for the 2017-26 plan cycle (see Appendix for details on the public input process). This information was used to broadly characterize opportunities that existed at the time to inform the District's implementation plans. Below is a brief summary of the information received. It is meant to serve only as a guide, not to restrict collaborative efforts. As discussed in Section 3.6, the District intends to coordinate with

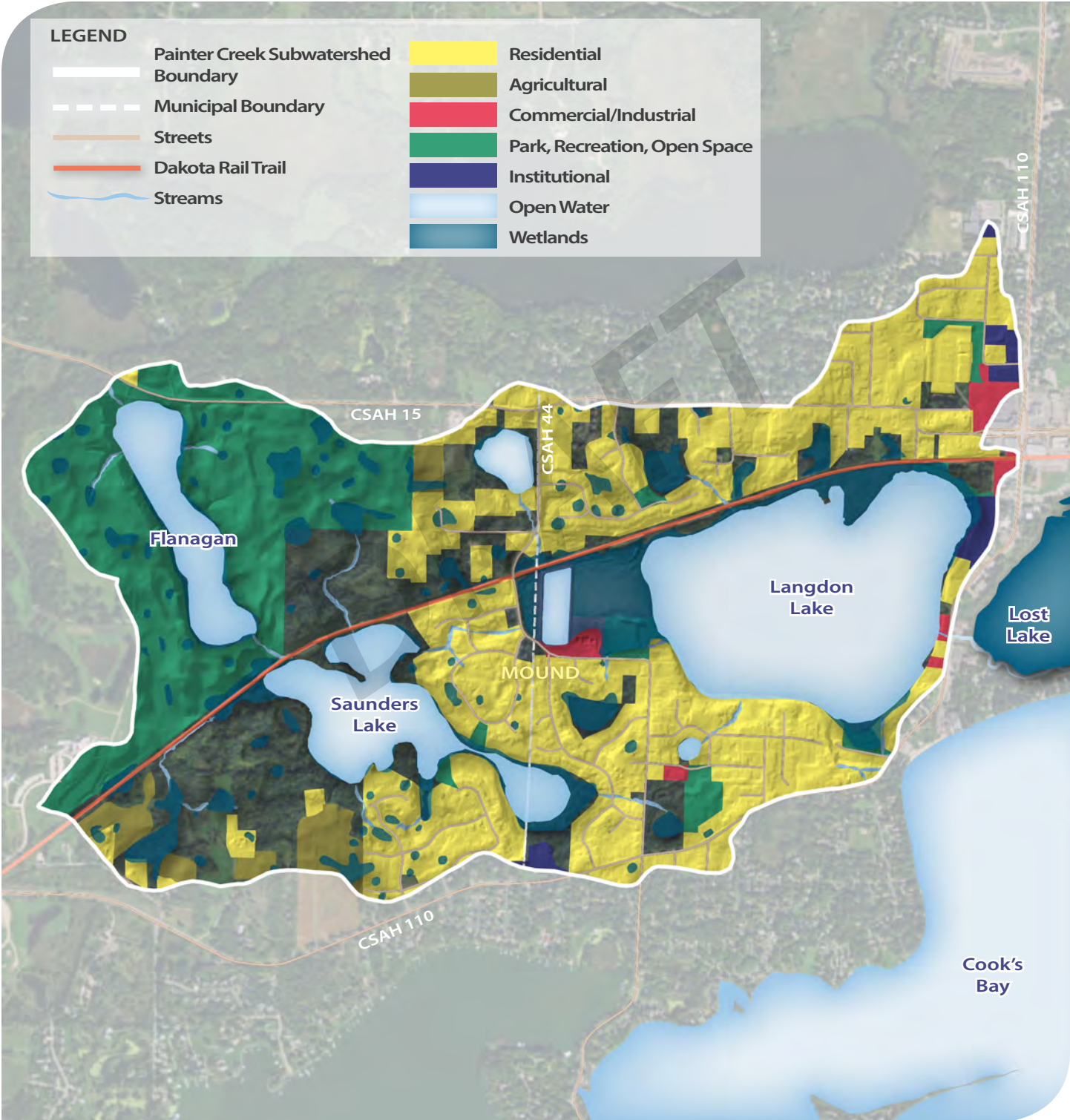


Figure 1.100 Langdon Lake Land Use map





its communities on an ongoing basis to stay apprised of new opportunities.

One of the priorities identified by cities in the Langdon Lake Subwatershed was maintaining the area’s rural character and access to natural resources. There is some redevelopment anticipated to the northwest of Langdon Lake, and the Metropolitan Council Environmental Services is planning to replace an interceptor sewer line along County Road 44. These projects may present opportunities to partner on stormwater management or other resource improvements.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, Langdon Lake is impaired by excess nutrients, however the inlet and outlet of Langdon Lake are within the state’s eutrophication standards. The fish community in Langdon Lake and its inlet and outlet may be negatively impacted by nutrient enrichment, low dissolved oxygen, and reduced water clarity. The subwatershed also contains areas of high quality wetland and upland, including a regionally significant ecological area.

Based on these conditions, management strategies within the subwatershed will focus on reducing pollutant loading, maintaining wetland diversity and stormwater storage, monitoring phosphorus release from wetlands, investigating phosphorus treatment, and protecting existing resources.

The Langdon Lake subwatershed is relatively small. There is some redevelopment anticipated to the northwest of Langdon Lake, and the Metropolitan Council Environmental Services is planning to replace an interceptor sewer line along County Road

44. The Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects. The CIP for the subwatershed, detailed in the next section, includes a project for stormwater management should an opportunity arise through land use change or a partner initiative.

There are extensive high quality wetlands and uplands in the subwatershed primarily incorporated into Gale Woods Regional Park. The focus in this subwatershed will be to preserve similar high-value resources through Land Conservation, where appropriate, and by working with cities and developers to minimize disturbance during development and construction.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. In the future, should a larger more concentrated scale of capital and program implementation be determined to be needed by the District or its partners, a discrete subwatershed planning process may be initiated that:

- » Provides high resolution diagnostic of watershed issues and drivers
- » Maps current projected land use and infrastructure changes
- » Defines a detailed and integrated capital and program implementation plan
- » Outlines a funding strategy including program costs and sources

The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules

8410, thereby updating specific subwatershed components of this Comprehensive Plan.

CAPITAL IMPROVEMENT PLAN

Capital projects in the Langdon Lake subwatershed include stormwater management projects to reduce runoff volumes and rates while addressing pollutant loading that occurs from runoff producing rainfall events. These projects will progress the District and its partners toward achieving their various goals for the subwatershed. This program is not a comprehensive list of all capital needs or potential projects within the subwatershed, and is limited by available financial resources and staff capacity to manage projects.

Given the limited resource needs and opportunities identified within the Langdon Lake subwatershed relative to other parts of the watershed, the District does not anticipate initiating any capital improvement efforts in the subwatershed during this plan cycle. However, the District has included this project in its CIP in the event that an opportunity arises through land use change or a partner initiative.

DRAFT



Project	Storm Water Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Langdon Lake, including but not limited to construction of infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Langdon Lake exceeds state excess nutrient standards. The 2014 TMDL identified a total phosphorus load reduction of 84 pounds, with 44 pounds from stormwater, for Langdon Lake to meet water quality standards.
Outcome	Reduction of sediment and nutrients exported to Langdon Lake.
Estimated Cost	Capital costs: \$225,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

References

Minnesota Pollution Control Agency (MPCA). 2016. Minnesota's Impaired Waters List. pca.state.mn.us/water/minnesotas-impaired-waters-list

Wenck. 2014. Upper Minnehaha Creek Watershed Nutrient and Bacteria TMDL Study. pca.state.mn.us/water/tmdl/upper-minnehaha-creek-watershed-lakes-and-bacteria-metro-tmdl-project

3.9.7 LONG LAKE CREEK SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Long Lake Creek Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Long Lake Creek Subwatershed is 11.9 square miles (7,619 acres) and located along the northern boundary of the MCWD and includes portions of the cities of Long Lake, Medina, Orono and Plymouth. The subwatershed is generally characterized by large areas of undisturbed land (39%), including large wetland and wooded areas, single family-residential in the central and eastern subwatershed (27%), lakes (10%), agriculture (10%), as well as park and open space (9%). The Luce Line Trail passes through this subwatershed, as well as the proposed Southwest Hennepin Regional Trail.

Several large wetlands in the subwatershed have been classified by the *Functional Assessment of Wetlands* as having exceptional vegetative diversity, including School Lake, and two DNR Scientific and Natural Areas, Wolsfeld Woods and Wood-Rill. The *Minnesota Biological Survey* has also identified both terrestrial and aquatic locations in the watershed with intact native plant communities and good biodiversity.

The headwaters of the subwatershed are Holy Name Lake in the east, and School Lake in the west. Each headwaters drain through streams that converge just north of Long Lake. Together both systems drain approximately 1600 acres into the primary inlet of Long Lake. Long Lake drains south into wetlands that discharge into Tanager Lake, which connects via a channel to Lake Minnetonka. One significant area is landlocked, Lydiard Lake.

Holy Name, School, Wolsfeld, Long, and Tanager Lakes are listed as impaired for excess nutrients, and are part of the Upper Minnehaha Creek TMDL. Upstream lakes and Long Lake's internal loading each provides around 25% of the phosphorus load to Long Lake, with stormwater runoff providing nearly

50%. Upstream lakes and stormwater provide nearly 77% of the phosphorus load to Tanager Lake, with the remaining portion mainly internal loading.

Management strategies within the Long Lake Creek subwatershed will focus on managing common carp, restoring upstream waterbodies, addressing internal loading, performing wetland restorations and managing stormwater runoff. In the past the District has worked in partnership within this subwatershed to implement regional stormwater management through a series constructed ponds, treated Long Lake for internal loading, restored natural shorelines, and restored and enhanced wetlands.

Regional partnerships are beginning to form between the Cities of Medina, Long Lake, Orono, Long Lake Waters Association and the MCWD. This partnership seeks to leverage the skills and resources of each entity, by collaborating and identifying shared priorities for the implementation of projects and programs to improve water quality in the Long Lake Creek Subwatershed. Common carp management has been identified as an initiative to prioritize in advance of internal load management, and concurrent with landscape restoration. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity and ecological integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Long Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality: **Lakes and Streams:**

Holy Name, Long, School, Tanager and Wolsfeld Lakes are listed

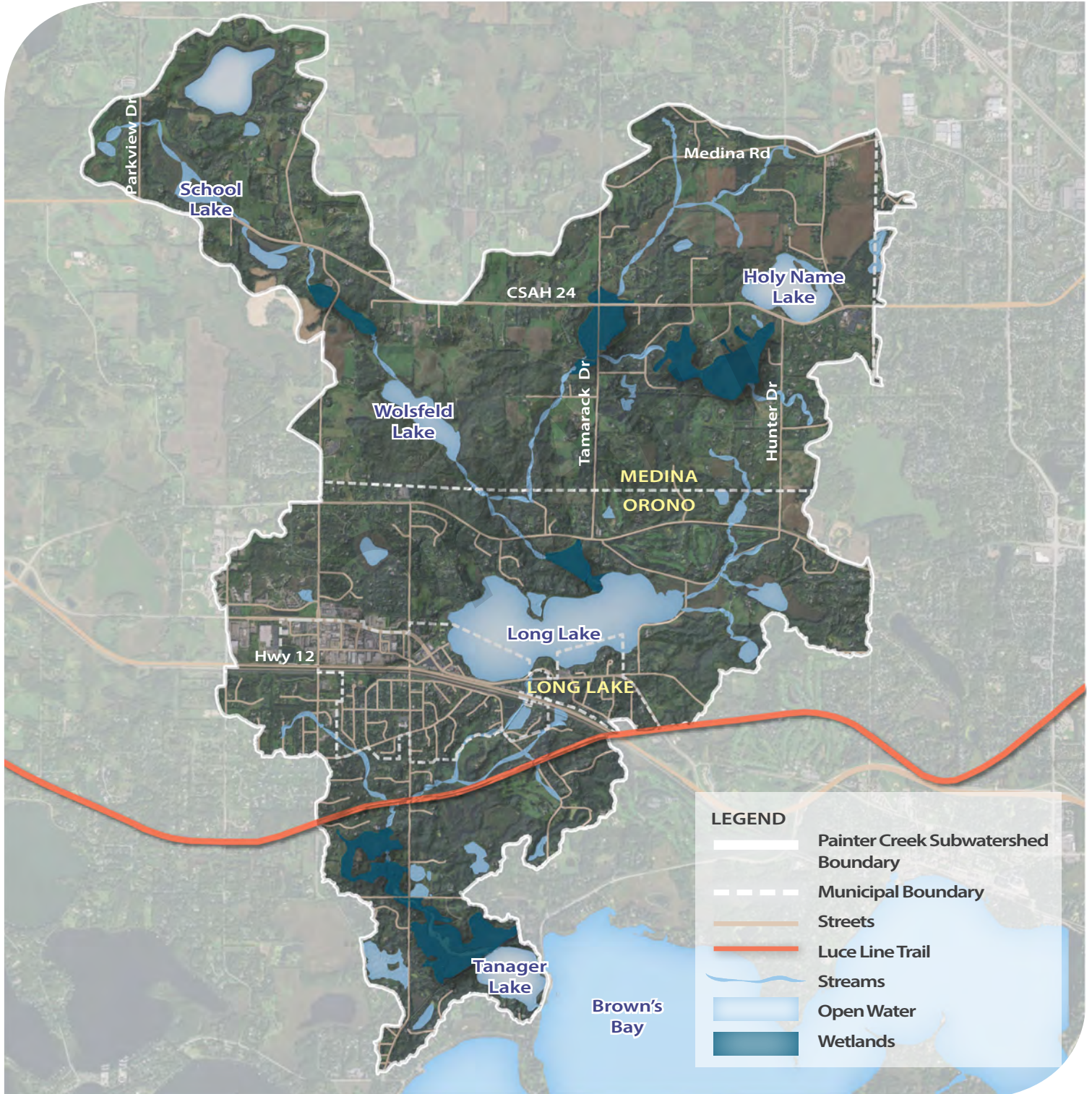


Figure 1.101 Long Lake Base map



as impaired for excess nutrients, and are part of the Upper Minnehaha Creek TMDL. While Long Lake Creek is not listed as an Impaired Water for nutrients, the stream exhibits high total phosphorus concentrations relative to the State River Eutrophication Standards.

Upstream lakes and internal loading each provides around 25% of the Phosphorus load to Long Lake, with stormwater runoff providing nearly 46%. External loading from stormwater and upstream lakes provide 77% of the phosphorus load to Tanager Lake, with the remaining portion mainly internal loading.

Wetlands:

The Long Lake Creek Subwatershed is a wetland rich system, with wetlands occupying over 22% (1,647 acres) of the subwatershed. The majority of wetlands have been altered and degraded, providing a likely source of phosphorus export into to the watershed.

Groundwater:

Many of the major wetlands in this subwatershed act as recharge-discharge wetlands. Groundwater recharge is important within the subwatershed to maintain wetland hydrology and stream baseflow, as well as to recharge aquifers that supply public and private drinking water wells.

Portions of the subwatershed have been designated by the Minnesota Department of Health (MDH) as a Drinking Water Sensitivity Management Area and Wellhead Protection Area for City of Plymouth and City of Long Lake public wells. Much of this area is designated to be of low risk to contamination of the drinking water supply, with a small area located in a till deposit being of moderate risk.

Water Quantity:

A series of channels and wetlands drain the western and eastern parts of the subwatershed, before joining together prior to discharging into Long Lake. Flow to Long Lake Creek is controlled by an outlet weir on Long Lake. Six storm sewer outfalls discharge into the creek, which flows through two large wetlands prior to discharging into Tanager Lake and then into Lake Minnetonka: Browns Bay.

Lydiard Lake is landlocked, with no natural outlet. Several locations in the system have been identified through the District's modeling and stream assessments as being vulnerable to localized flooding during large rain events.

Ecological Integrity:

Lakes and Streams:

Limited fish data exists for most lakes and streams, but a 2013 DNR survey on Long Lake found the walleye community was balanced but the low dissolved oxygen and high summer temperatures were potentially limiting growth and survival. A 2010 DNR survey on Long Lake Creek found the fish community was on the border of Poor to Good. Common carp are abundant in the subwatershed and are likely impacting water quality and ecological integrity.

Aquatic plant biodiversity, as measured by a Floristic Quality Index developed by the DNR, is borderline Poor to Good condition in Lydiard Lake, but Degraded in Long Lake, Dickey's and Wolsfeld. Eurasian watermilfoil is present in the subwatershed, but not abundant.

Wetlands:

Several large wetlands in the subwatershed have been classified by the *Functional Assessment of Wetlands* as having exceptional vegetative diversity, including School Lake, and two DNR Scientific and Natural Areas: Wolsfeld Woods and Wood-Rill. Their conservation is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

Uplands and Natural Corridors:

The *Minnesota Biological Survey* has identified both terrestrial and aquatic locations in the watershed with intact native plant communities, and those with biodiversity significance. These locations should be considered for preservation and protection to maximize habitat and biodiversity.

Two DNR Scientific and Natural Areas are present in the subwatershed in Wolsfeld Woods and Wood-Rill. Upland, wetland and stream protection and restoration may preserve and enhance connections between these two features.



Figure 1.102 Long Lake Land Use map



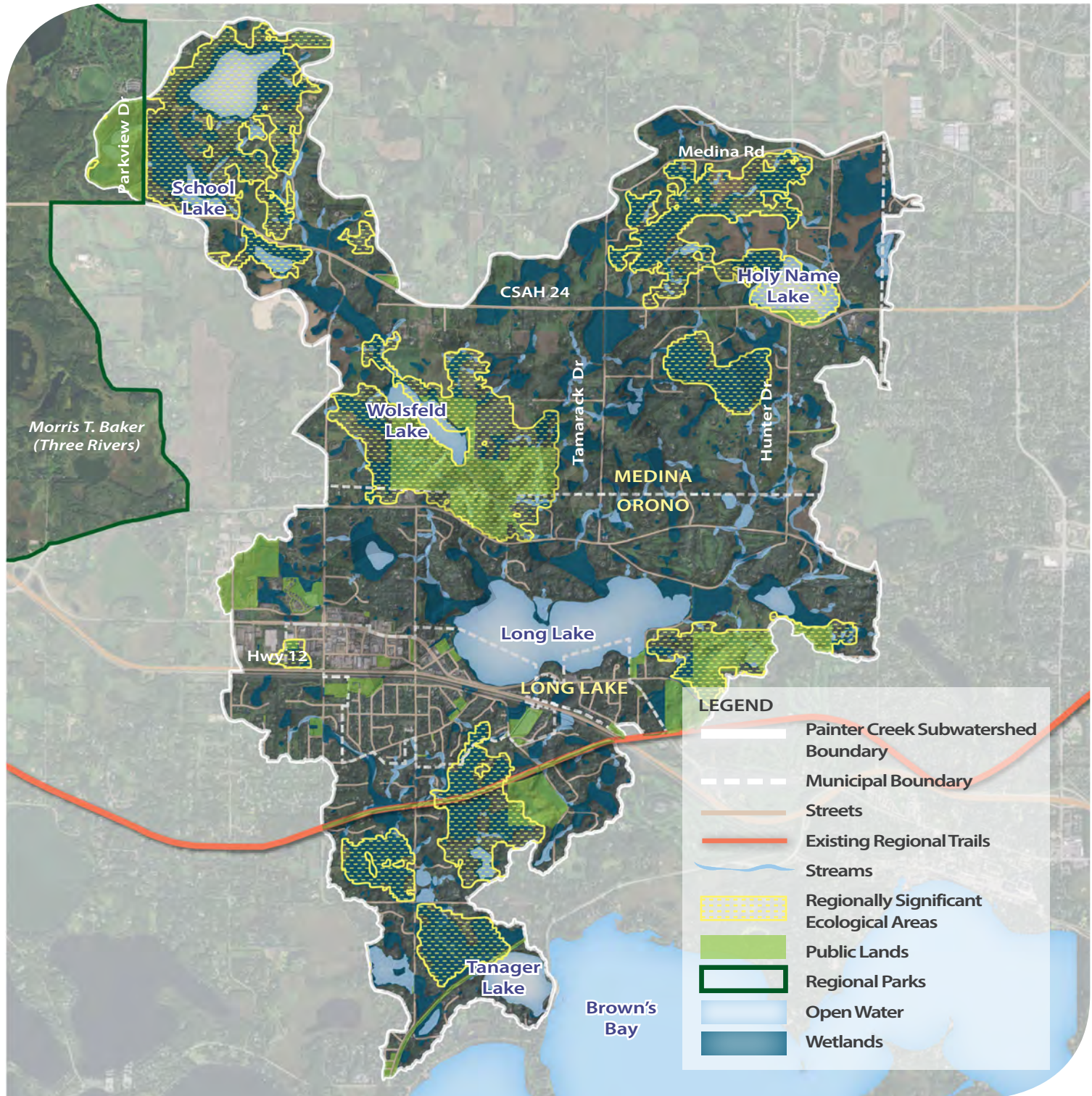
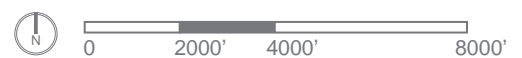


Figure 1.103 Long Lake Land Use map





DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover.

This section of the Plan outlines the main drivers of water quality, water quantity and ecological integrity issues within the Long Lake Creek subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Long Lake Creek subwatershed are:

Water Quality

- » Excess nutrients

Water Quantity

- » Localized flooding

Ecological Integrity

- » Mostly degraded aquatic plant communities
- » Degraded and disconnected wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Common carp
- » Stormwater runoff
- » Internal sediment phosphorus loading
- » Water quality from upstream waterbodies

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the

breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

There are a number of high-quality wetlands in the subwatershed. The two primary upper watershed tributary streams connect lakes and wetlands in a nearly continuous natural corridor that provides significant functions and values such as runoff storage and water quality treatment as well as habitat and natural resources values. Large wetlands riparian to Long Lake Creek attenuate flooding and provide water quality treatment upstream of Brown's Bay. Protection of these wetlands and corridors is essential to preserving their high level of functions and values and to prevent the negative impacts that follow alteration.

Carp:

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus from re-suspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

Carp have been observed throughout the system, and Tanager Lake, which is connected to the rest of the system, has been documented as having a very high abundance of carp. A subwatershed wide assessment should be conducted to determine its level of impact in each waterbody, and develop strategies for management.

Stormwater Runoff:

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate

of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Holy Name, School, Wolsfeld, Long and Tanager Lakes are listed as impaired for excess nutrients. Stormwater runoff is noted in the TMDL as providing approximately 45% of the nutrient load to Long Lake. It also accounts 15 to 51% of the loading to Wolsfeld, School and Tanager Lakes.

Internal Sediment Phosphorus Loading:

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

According to the TMDL, internal loading accounts for almost 22% of the nutrient load to Long Lake, and also contributes 53%

of loading to School Lake, 80% to Holy Name, 16% to Wolsfeld and 20% to Tanager Lake.

Upstream Waterbodies:

Headwater streams, lakes and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters that can lead to eutrophication. Consequently, restoration of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Upstream waterbodies are effecting water quality in several of the impaired lakes, contributing around 28% of the nutrient load to Wolsfeld, 25% to Long and 63% to Tanager Lake.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Long Lake Creek subwatershed. These strategies are both short- and long-term, and establish a framework for the Long Lake Creek subwatershed Implementation Plan programs and projects.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.



While higher quality wetlands are present in the upper watershed, there are several candidate wetland restoration sites in the lower watershed. These sites are riparian to Long Lake Creek, and stream stabilization and restoration could be incorporated into the restoration to reduce sediment and phosphorus loading to Tanager Lake downstream.

Carp Management:

Historically, carp management focused on removal of carp populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

A subwatershed wide carp assessment is needed to develop management strategies to sustainably control common carp in this system. Carp management is a pre-requisite before tackling other strategies to reduce internal loading.

Stormwater Management:

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

In the Long Lake Creek subwatershed, the focus will be on installing infiltration and load reduction BMPs in the developed areas of the subwatershed and agricultural BMPs to reduce nutrient, sediment, and bacterial loading from agricultural land uses in the upper watershed.

Internal Sediment Phosphorus Control:

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Once common carp have been managed to low densities, internal load reduction strategies such as alum treatment should be considered. Additional data will need to be collected to determine appropriate treatment options. The Upper Minnehaha TMDL recommended internal phosphorus control for School, Long, and Tanager Lakes to help improve water quality.

Restoration of Upstream Waterbodies:

Upstream water bodies that are currently impaired can discharge large nutrient loads to downstream water bodies thereby contributing to downstream water quality impairments. Therefore, prior to, or concurrent with, significant efforts to restore downstream water quality, the water quality in upstream water bodies must be improved. Nutrient impaired upstream lakes may require external and internal nutrient reductions using the strategies listed in this section.

Managing unique drivers in upstream waterbodies will benefit the system as a whole. Addressing internal loading in School Lake will benefit Wolsfeld Lake as well as other downstream lakes. Addressing various inputs into Wolsfeld Lake, will benefit Long Lake and Tanager. Finally, addressing various inputs for Long Lake will benefit Tanager Lake.

Watershed Protection:

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to

maintain existing resources and critical functions is to protect these areas by minimizing the impacts of development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

There are significant natural resources in the subwatershed, including high-quality wetlands, intact native plant communities with biodiversity significance, and valuable connected corridors. Some of these areas are located within two DNR Scientific and Natural Areas, but other important natural resources are privately owned. The focus in this subwatershed will be to preserve these high-value resources through Land Conservation where appropriate and by working with cities and developers to minimize disturbance during development and construction.

LAND USE: EXISTING CONDITIONS

The subwatershed includes portions of the cities of Long Lake, Medina, Orono and Plymouth. The subwatershed is generally characterized by large areas of undisturbed land (39%), including large wetland and wooded areas, single family-residential in the central and eastern subwatershed (27%), lakes (10%), agriculture (10%), as well as park and open space (9%). The Luce Line Trail passes through this subwatershed, as well as the proposed Southwest Hennepin Regional Trail.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Sections 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for the 2017-26 plan cycle (see Appendix for details on the public input process). This information was used to broadly characterize opportunities that existed at the time to inform the District's implementation plans. Below

is a brief summary of the information received. It is meant to serve only as a guide, not to restrict collaborative efforts. As discussed in Section 3.6, the District intends to coordinate with its communities on an ongoing basis to stay apprised of new opportunities.

As described throughout this plan, the philosophy and foundation of the Balanced Urban Ecology policy is defined by successful integration with all partners, emphasizing the economic and social value that healthy natural systems generate for the built environment. We understand that every one of our partners has a unique vision and goals, and that it is recognition of this individuality that creates successful partnerships.

Over the course of the next ten years, cities and agencies in the Long Lake Creek subwatershed are expecting to make various infrastructure investments, ranging from road reconstruction, sewer and water, and parks, trail and open space. There will also be planned development, in commercial, industrial and housing. The goals of our public and private partners, and the investments they are planning, serve as collaborative opportunities to not only enhance community impact, but to produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits.

It is evident that communities within the Long Lake Creek subwatershed place high value on clean water and connecting their communities to natural landscapes, and intend to leverage development to improve connections and improve natural systems. With early effort and strengthened communications, cities and private investors will find opportunities to coordinate with the District to further integrate stormwater management, natural resource restoration, and community connections into municipal infrastructure projects and ongoing redevelopment.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan.

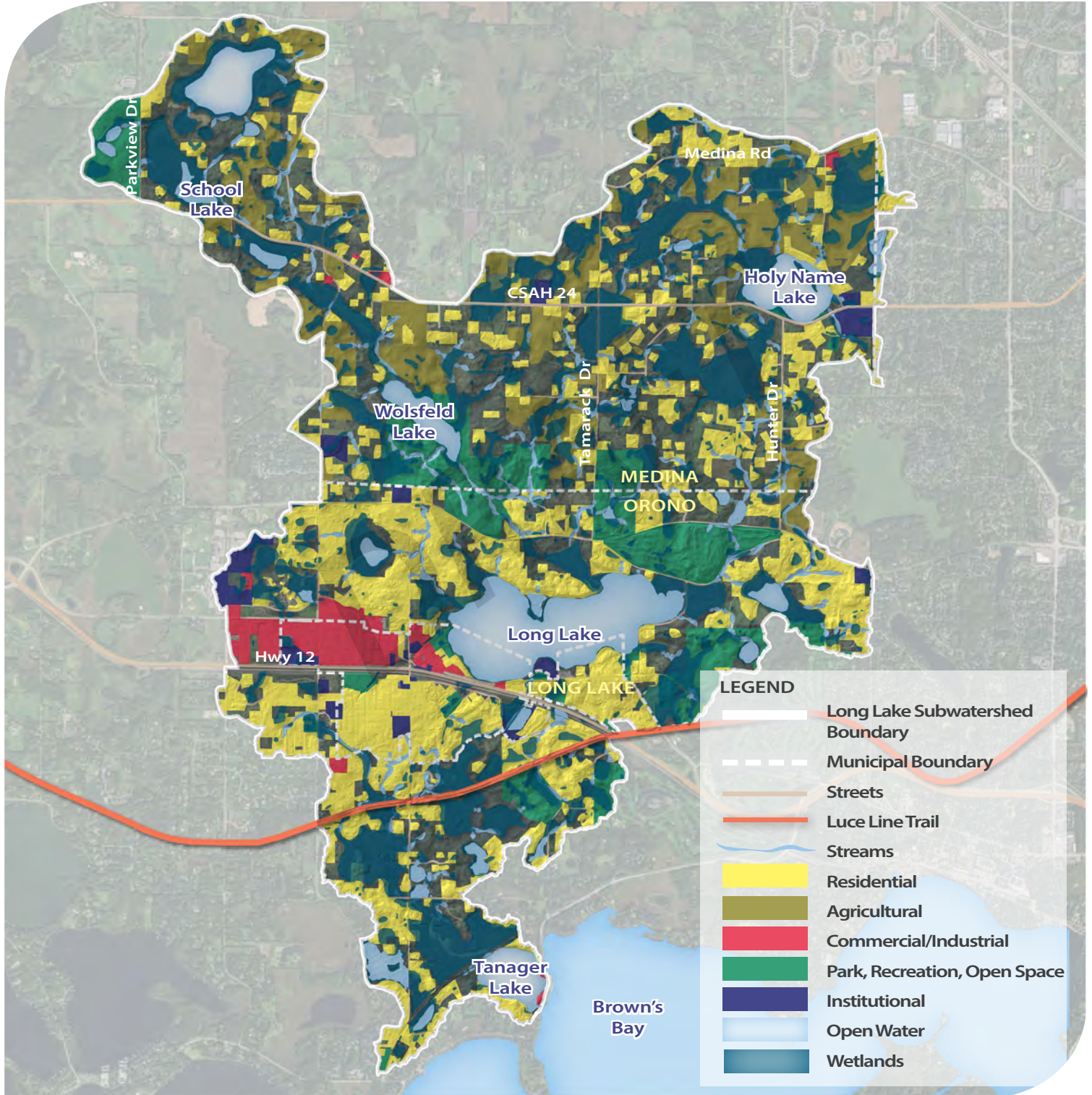


Figure 1.104 Long Lake Land Use map



The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, Long, Holy Name, School, Tanager, and Wolsfeld Lakes are listed as impaired for excess nutrients. This is driven by a combination of wetlands acting as sources of phosphorus, the presence of common carp, internal loading and runoff and loading from upstream waterbodies. Based on these conditions, management strategies within the subwatershed will focus primarily on wetland restoration, management of common carp, and internal load management.

The Long Lake Creek subwatershed will experience planned development and infrastructure investments over the next 10-15 years. Communities within the subwatershed are currently updating their own comprehensive plans, which will help guide changes across the landscape. This Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

The District will proactively coordinate the permitting of future land use change with communities within the subwatershed to explore opportunities to create public-private partnerships to address wetland restoration and stormwater management goals in ways that exceed regulatory requirements.

The District will also work with local communities and lake associations, such as Long Lake Waters, on an ongoing basis to identify opportunities for partnership and establish shared implementation priorities that align with this Plan. As opportunities are identified, the partners will define roles, responsibilities and possible sharing of costs.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, and given the scale, complexity and multi-jurisdictional nature of the geography, the capital improvement plan for this subwatershed includes project listings for stormwater management, wetland restoration, and internal load management. Carp management may be addressed on a programmatic basis and is therefore not included in the capital improvement tables. In the future, should a larger more concentrated scale of capital and program implementation be determined to be needed by the District or its partners, a discrete subwatershed planning process may be initiated that:

- » Provides high resolution diagnostic of watershed issues and drivers
- » Maps current projected land use and infrastructure changes
- » Defines a detailed and integrated capital and program implementation plan
- » Outlines a funding strategy including program costs and sources
- » The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Comprehensive Plan.

CAPITAL IMPROVEMENT PLAN

Capital projects in the Long Lake Creek subwatershed include wetland restorations that reduce nutrient export to downstream waters while improving ecological integrity and addressing localized flooding issues, stormwater management projects to reduce runoff volumes and rates while addressing pollutant loading that occurs from runoff producing rainfall events, and internal load management to address phosphorus release from inside lakes.

These projects will progress the District and its partners toward achieving their various goals for the subwatershed. This program is not a comprehensive list of all capital needs or potential projects within the subwatershed, and is limited by available financial resources and staff capacity to manage projects.



As outlined previously, the District plans to work to identify opportunities through the regional partnership that is forming between cities and lake associations to identify and prioritize opportunities, and to map roles, responsibilities and the potential sharing of costs. To accommodate opportunities that may be identified through partnership or coordination on land use change, the District has included these projects in its CIP.

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Long, School, Wolsfeld, Holy Name, and Tanager Lakes, including but not limited to construction of infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Five lakes in the subwatershed exceed state excess nutrient standards - Long, School, Wolsfeld, Holy Name, and Tanager. A TMDL identified a need to reduce external phosphorus loading by 62% (411 pounds) to Long Lake, 81% (32 lbs) to School Lake, 82% (79 lbs) to Wolsfeld Lake, 96% (31 lbs) to Holy Name Lake, and 61% (106 lbs) to Tanager Lake.
Outcome	Reduction of sediment and nutrients exported to Long, School, Wolsfeld, Holy Name, and Tanager Lakes.
Estimated Cost	Capital Cost: \$1,320,000.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

Project	Long Lake Subwatershed Wetland Restoration
Description	Wetland restoration will occur as opportunities arise to reduce phosphorus export, improve habitat diversity, improve biodiversity, and increase flood storage. Wetland restoration may include wetland channel restoration, restoring wetland hydrology, scraping and seeding, and geoen지니어ing to improve nutrient retention.
Need	Five lakes in the subwatershed exceed state excess nutrient standards. Phosphorus export from wetlands has been identified as a potential source for these lakes.
Outcome	Increase wetland biodiversity and habitat diversity, improve flood storage potential, and reduce phosphorus export.
Estimated Cost	Capital Cost: \$1,900,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

Project	Long Lake Internal Phosphorus Load Reduction
Description	Aluminum sulfate (alum) treatment on Long Lake to reduce internal phosphorus loading. A dosing study has not been completed to date, and would need to be conducted as part of project design.
Need	Long Lake exceeds state excess nutrient standards. A TMDL identified a need to reduce internal phosphorus loading by 19% (61 lb).
Outcome	Reduction of internal phosphorus loading to Long Lake.
Estimated Cost	Capital costs: \$1,025,000 in 2017 dollars based on a 30 year project life.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

References:

Minnesota Pollution Control Agency (MPCA). 2016. Minnesota's Impaired Waters List. pca.state.mn.us/water/minnesotas-impaired-waters-list

Wenck. 2014. Upper Minnehaha Creek Watershed Nutrient and Bacteria TMDL Study. pca.state.mn.us/water/tmdl/upper-minnehaha-creek-watershed-lakes-and-bacteria-metro-tmdl-project



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3.9.8 MINNEHAHA CREEK SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Minnehaha Creek Subwatershed, including existing conditions and issues, drivers, management strategies, land use information and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan. The Implementation Plan for the Minnehaha Creek subwatershed summarizes issues of water quality, water quantity, and ecological integrity. The Plan identifies what is driving these issues, and outlines a roadmap of management strategies to guide the implementation efforts of the District, and its public and private partners.

EXECUTIVE SUMMARY

The Minnehaha Creek subwatershed encompasses all of the MCWD downstream of the Grays Bay dam, and is commonly referred to as the "lower watershed." The subwatershed is 47.3 square miles (30,290 acres) in size and includes portions of the cities of Edina, Golden Valley, Hopkins, Minneapolis, Minnetonka, Plymouth, Richfield, St. Louis Park and Wayzata.

The predominant land use in the subwatershed is single family residential (51.4%), followed by parks and open space (14.2%), multi-family residential (7.5%), water (5.5%), commercial (4.8%), institutional (4.7%), and roads and highways (4.6%). The subwatershed is fully developed at typical urban and suburban densities and land uses, and contains a higher level of impervious cover on the land than any of the other ten subwatersheds in the District. Redevelopment and infill development have increased since the 2007 plan, with a notable increase in multi-family residential. Most of the remaining vacant or undetermined land is large wetland or woodland tracts.

Development in this subwatershed has left relatively few large areas of undisturbed or minimally disturbed forest and wetland in the subwatershed. Three areas, including the Grays Bay outlet wetland complex; Diamond Lake; and a portion of the creek corridor in the Mississippi River gorge have been designated Regionally Significant Ecological Areas by the DNR (Volume II). The Minnesota County Biological Survey (MCBS) did not identify any areas of biodiversity significance in the subwatershed. The

creek corridor and the Chain of Lakes in the lower subwatershed are part of a DNR-designated Metro Conservation Corridor.

Formed at the outlet of Grays Bay in Lake Minnetonka and flowing approximately 23 miles to the Mississippi River, Minnehaha Creek is the primary stream within the subwatershed and an iconic and historically significant resource that connects multiple communities and a system of urban parks, lakes and open space. As an outlet for Lake Minnetonka and the upper watershed, Minnehaha Creek must discharge large volumes of water during spring snowmelt runoff, summer and fall. Prior to its confluence at the Mississippi River, Minnehaha Creek flows through Lake Hiawatha and results in significant influence to water quality within the lake.

A significant area of the central portion of the subwatershed drains through the Chain of Lakes (Brownie, Cedar, Isles, Calhoun, and Harriet) in the City of Minneapolis, and outlets via channel to Minnehaha Creek. Lake Nokomis is physically disconnected from Minnehaha Creek by a weir to reduce the influence of the creek on the lake's water quality.

Within the Minnehaha Creek subwatershed, ditching of the stream channel, loss of wetlands, corridor fragmentation and increasing levels of impervious surfaces have disrupted fluvial processes; increased runoff volumes and pollutant loads; decreased infiltration and baseflow; and fragmented and degraded habitat; negatively impacting the ecological integrity of the stream and its riparian systems. As a result, Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha, is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved Total Maximum Daily Load (TMDL) study. Lake Nokomis also has an approved TMDL for excess nutrients and is one of four other lakes in the subwatershed that do not meet state water quality standards for nutrients.

Due to the systems altered hydrology (hard cover and altered wetlands) and upstream drainage area (Lake Minnetonka), several locations along Minnehaha Creek are known to flood during large or extended rain events. Overall, due to the size

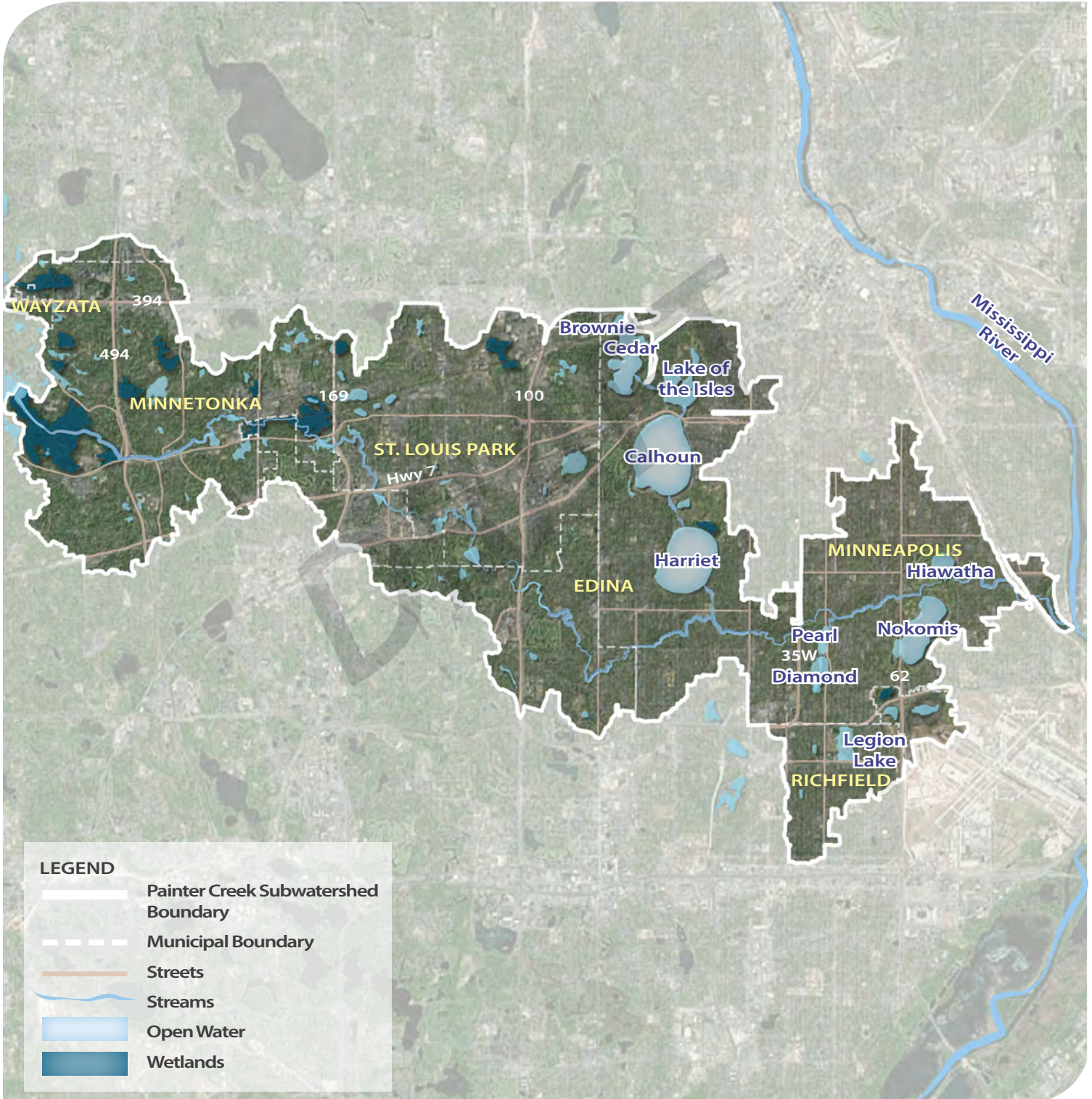


Figure 1.105 Minnehaha Creek Base map



of the subwatershed and the urban characteristics of the area (developed, fragmented and altered), ecological integrity throughout the subwatershed is highly variable and generally considered to be lacking.

Management strategies within the Minnehaha Creek subwatershed will focus on stormwater management to promote infiltration/filtration and pollutant reduction, stream restoration to stabilize streambanks and improve riparian buffers and habitat, and restoration of wetlands and ecological corridors in ways that reduce nutrient loading downstream to Lake Hiawatha while improving ecological integrity and corridor connectivity within the subwatershed.

Since 2010, the District has been working to manage regional stormwater, and expand and connect the riparian greenway in a manner mutually beneficial to the built environment. The District has been focusing on the most degraded section of Minnehaha Creek – between West 34th Street and Meadowbrook Lake in St. Louis Park and Hopkins – to implement a comprehensive corridor restoration that focuses on reducing pollutant loads, mitigating flashy hydrology, reconnecting the riparian corridor, and restoring the physical character of the stream channel.

This geography, known as the Minnehaha Creek Greenway, produced the highest pollutant loading per unit area of any other land area along the entire stream system. The effort to-date has yielded significant results, often through innovative public and private partnerships, resulting in hundreds of acres of regional stormwater management, nearly two miles of restored stream, over ten acres of wetland restoration, public access to over 50 acres of previously inaccessible green space, two miles of new trail network, and improved ecological integrity through a series vegetative restoration and invasive species management.

Building on these efforts, the district will continue its focus within the Minnehaha Creek Greenway to complete the corridor restoration while also extending its efforts to other critical areas of high need within the Minnehaha Creek subwatershed. An example of identified opportunities in the subwatershed include stormwater management and stream restoration in the cities of Edina and Minneapolis. These opportunities, and others, are summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES:

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, specialized studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Minnehaha Creek subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality: **Lakes and Streams:**

The Minnehaha Creek subwatershed includes the Chain of Lakes in Minneapolis and several other smaller lakes. Powderhorn Lake in Minneapolis does not drain to the creek, but rather is pumped to the Mississippi River.

Five lakes in the subwatershed are listed on the State's Impaired Waters list for exceeding the state standard for total phosphorus, with excessive nutrients being conveyed to them from the watershed. TMDLs have been completed for two of those lakes: Hiawatha and Nokomis. Powderhorn and Brownie had been listed previously, but meet standards and were delisted in 2012 and 2010, respectively.

Two lakes – Powderhorn and Brownie – are impaired by excess chloride, likely from road salt. Diamond Lake is classified as a wetland, but is listed as impaired for chloride in the TCMA Chloride TMDL (MPCA 2016).

Minnehaha Creek is included on the State's Impaired Waters List due to excess chloride, fecal coliform concentrations, low dissolved oxygen, as well as impaired fish and macroinvertebrate communities. Total phosphorus concentrations on Minnehaha Creek are less than the state river eutrophication standards with the primary nutrient cycling concern for Minnehaha Creek being its conveyance of phosphorus load to Lake Hiawatha.

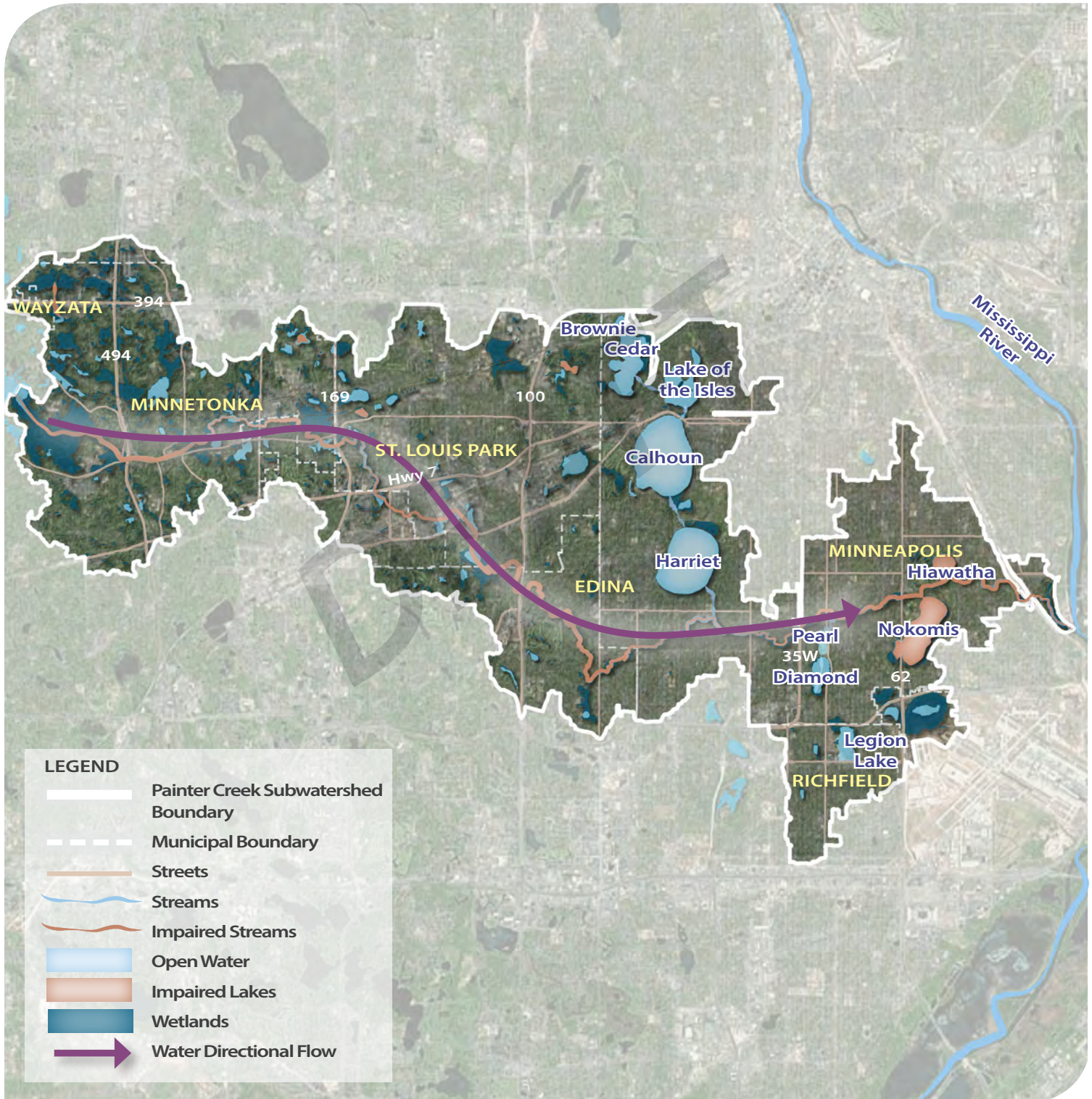


Figure 1.106 Minnehaha Creek Water Resources map



Minnehaha Creek was evaluated in-detail in 2003, and again in 2012, as part of the District's Minnehaha Creek Stream Assessment, which includes a physical inventory, erosion survey, and a fluvial geomorphic assessment to determine channel stability.

Wetlands:

The Minnehaha Creek subwatershed has a large number of wetlands of various sizes distributed across the landscape, including several very large wetland complexes through which the creek flows. Wetlands, including lake systems, cover just over 12 percent of the subwatershed's surface.

The District's Functional Assessment of Wetlands (FAW) indicates that a number of systems score highly on vegetative diversity, fish and wildlife habitat, or aesthetics. Of the wetlands assessed for restoration potential, few wetlands throughout the subwatershed were found to have moderate or high restoration potential, and most of those are small.

No data is available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients to and from the subwatershed. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands. Final results of the E-Grade evaluation will be reported in 2018.

Groundwater:

The District has identified the infiltration potential of the upland areas within the subwatershed as high to medium with some areas of variability where the soils are organic in nature. Most of the lower subwatershed is classified by the Hennepin County Geologic Atlas as being of high to very high aquifer sensitivity. The upper subwatershed is classified as being generally of low to moderate sensitivity to pollution except directly along Minnehaha Creek and in the large Grays Bay wetland complex.

There are a number of springs and seeps in the Mississippi River gorge area, including Camp Coldwater Spring, the largest limestone bedrock spring in the Metro area.

Much of the subwatershed has been designated by the Minnesota Department of Health as Drinking Water Sensitivity

Management Area (DWSMA) and Wellhead Protection Area (WHPA) for various municipal public wells. The MDH has designated areas within the DWSMAs as very high to moderate risk and vulnerability to contamination of the drinking water supply.

Water Quantity:

As an outlet for Lake Minnetonka and the upper watershed, Minnehaha Creek discharges large volumes of water during spring snowmelt runoff, summer and fall.

The District manages an operating plan for Grays Bay dam headwaters control structure that is intended to emulate the historical discharge hydrograph and the natural outlet of Lake Minnetonka. In drier periods, Lake Minnetonka typically does not discharge water, and portions of the Creek may experience low or even no flow.

Flow in the creek is controlled by numerous structures, including major weirs at the Grays Bay Dam outlet, the Browndale Dam, West 54th Street, and Hiawatha Avenue. There are more than 100 bridge crossings, some of which provide a grade control substantial enough to create a impoundments, which stagnate water upstream.

There are over 175 identified storm sewer outfalls larger than eight inches in diameter along the length of the creek. This infrastructure results in stormwater reaching the stream quickly, creating "flashy" storm discharges that quickly raise water levels in the creek. Most of these outfalls are located downstream of the Browndale Dam in Edina and Minneapolis.

Locations throughout the system have been identified through observation and the District's modeling and stream assessments as being vulnerable to localized flooding, and erosion from high velocities, causing streambank failure and erosion at outlets and culverts.

Several landlocked basins and many smaller landlocked pocket wetlands exist in the upper reaches of the Minnehaha Creek drainage area including large areas within the City of Minnetonka and portions of Hopkins, Edina and St. Louis Park.



Ecological Integrity:

Lakes and Streams:

Due to the size of the Minnehaha Creek subwatershed and the urban characteristics of the area, ecological integrity throughout the subwatershed is highly variable and generally considered to be degraded.

Fish communities throughout the subwatershed are generally characterized as poor. With the exception of Cedar Lake (good) and Lake of the Isles (good), fish assessments in all other lake and stream surveys has resulted in either poor or degraded classifications.

Approximately 15 percent of the streambank is armored by concrete or masonry retaining walls, riprap, or other protection such as gabion baskets. These are generally for the purpose of controlling erosion and meandering to prevent loss of property, stabilizing steep banks, or protecting structures such as bridges and storm sewer outfalls. Many of these stream walls were presumably constructed by the Works Progress Administration (WPA) during or following the Great Depression.

Minnehaha Creek is listed on the State of Minnesota's 303(d) list of Impaired Waters for its impaired biotic community. Assessments of fish communities along the Creek consistently return classifications of degraded and poor, indicating stream disturbance and lack of conditions that support healthy riverine fish communities. Macroinvertebrate sampling along the Creek also classifies a majority of sites as degraded, meaning they are highly disturbed, with low species diversity and dominated by pollution-tolerant species.

Many factors contribute to issues associated with degraded ecological integrity including habitat complexity, connectivity, water quality, and hydrology. Stream hydrology is a critical factor in habitat diversity since a stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, or are periodically dry, stresses aquatic organisms.

Wetlands:

Although a number of wetlands were identified in the District's Functional Assessment of Wetlands (FAW) as having exceptional to high aesthetic values, the vegetative communities within these wetlands is generally considered poor or degraded. Only

a scattering of wetlands were identified as having exceptional to high vegetative diversity, which is expected given the urbanized nature of the subwatershed and the likelihood of wetland disturbance and hydrologic impacts. Wetlands riparian to, and in-line with, Minnehaha Creek as well as several wetlands adjacent to lakes were noted as having high fish habitat potential. Only a few of the larger wetlands were assessed as having high wildlife habitat potential, primarily because wetland size is an important factor.

Uplands and Natural Corridors:

The Minnesota Biological Survey did not identify any areas of biodiversity significance in the uplands of this subwatershed.

The lower subwatershed – generally the area east of TH 169 – is developed with minimal areas of ecological significance. Regionally significant ecological areas are places where larger tracts of minimally disrupted land provide habitat complexity. The only such area in the Minnehaha Creek subwatershed is the large wetland complex at the outflow from Gray's Bay, which is the headwaters of Minnehaha Creek, and some wetlands and uplands connecting that complex to other larger wetlands in the upper subwatershed.

DRIVERS:

A driver of water quantity, water quality, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Minnehaha Creek subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Minnehaha Creek subwatershed are:

Water Quality

- » Excess nutrients
- » Increasing chloride concentrations

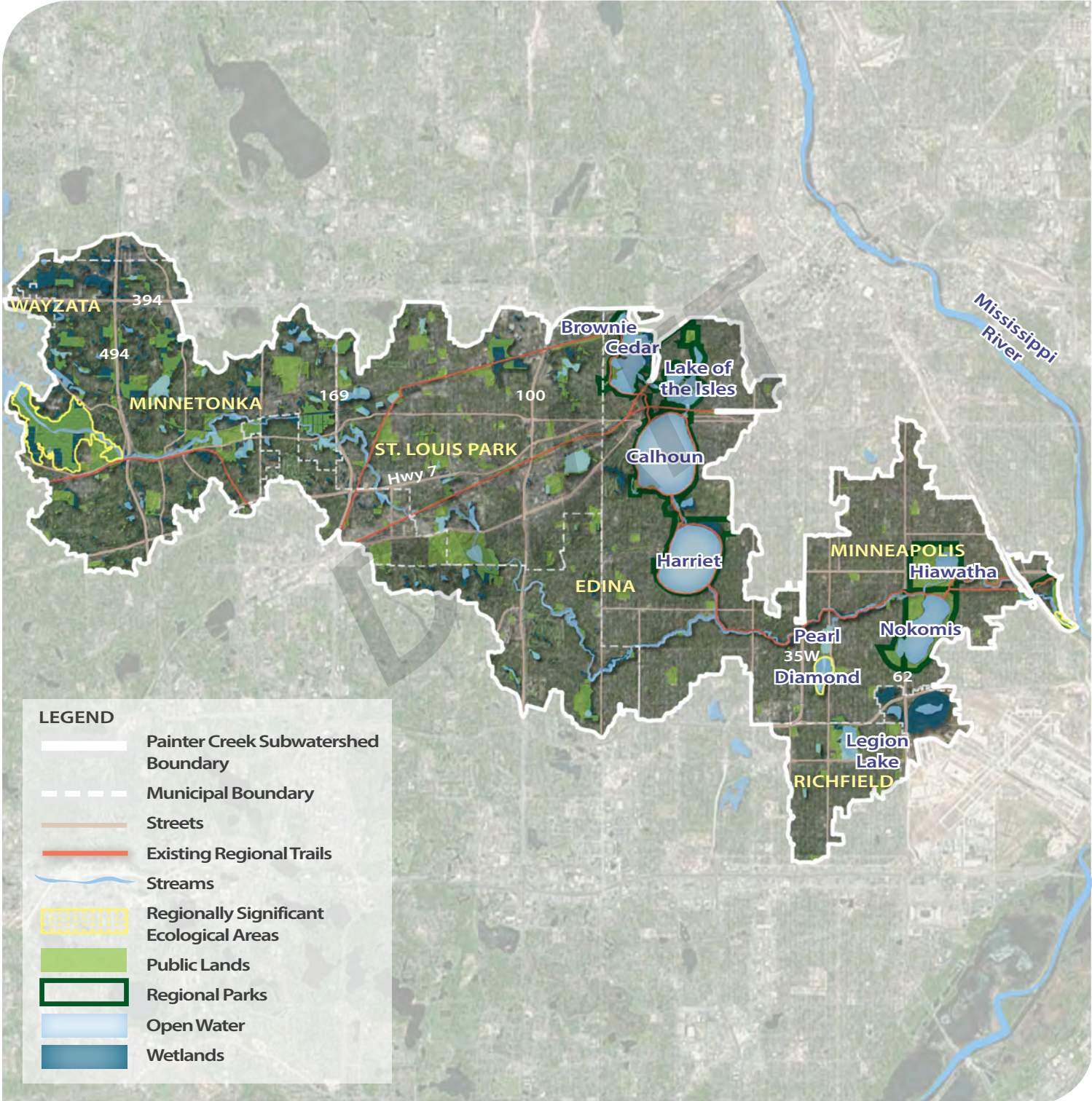


Figure 1.107 Minnehaha Creek Parks, Trails and Open Space map





- » Elevated E. Coli concentrations
- » Low dissolved oxygen

Water Quantity

- » Disrupted hydrology
- » Localized flooding
- » Stream flashiness

Ecological Integrity

- » Degraded fish community
- » Degraded macroinvertebrate community
- » Degraded and disconnected wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

- » Stormwater runoff
- » Altered channels
- » Altered wetlands
- » Internal sediment phosphorus loading

Stormwater Runoff:

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up pollutants such as excess nutrients, bacteria (e.g., E. coli), chloride from road salt, and toxic pollutants. In more rural areas, stormwater mobilizes pollutants from animal waste and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover,

altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Five lakes in the subwatershed – Hiawatha, Nokomis, Twin, Cobblecrest and Windsor – are listed on the State’s Impaired Waters list for exceeding the state standard for total phosphorus, with excessive nutrients being conveyed to them from the watershed. Two lakes – Powderhorn and Brownie – are impaired by excess chloride, likely from road salt.

Also noted earlier are the impairments that impact Minnehaha Creek including excess chloride, fecal coliform concentrations and low dissolved oxygen as well as impaired fish and macroinvertebrate communities. Total phosphorus concentrations on Minnehaha Creek are less than the state river eutrophication standards with the primary nutrient cycling concern for Minnehaha Creek being its transport of phosphorus load to Lake Hiawatha.

Altered Channels:

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Minnehaha Creek was ditched, altered and utilized as a stormwater conveyance system as urban expansion occurred throughout the western metro area. Alterations to Minnehaha Creek has resulted in a lack of natural stream processes such as sediment transport and channel migration. These unnatural stream characteristics, coupled with the impact created by in-stream impoundments – Browndale dam and Arden Park – results in habitat and ecological issues that has resulted in impairments throughout the stream system for dissolved oxygen, and fish and macroinvertebrate communities.

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved fraction) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even

as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Minnehaha Creek flows through a number of large wetland complexes between its headwaters at the outlet of Lake Minnetonka to its confluence with the Mississippi River. Historic alterations to Minnehaha Creek, as well as urbanization throughout the subwatershed, has disrupted the natural hydrology of most of the wetlands within this region. Impacts such as this result in altered wetland systems that maintain poor or degraded vegetative communities, lack high level habitat potential, have reduced storage ability during flood events, and may contribute to elevated nutrient concentrations moving throughout the system.

Internal Sediment Phosphorus Loading:

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Data suggests that all of the deep lakes within the subwatershed deal with some level of internal phosphorus loading. A variety of these regionally significant resources – Cedar, Calhoun, Harriet, Lake of the Isles and Nokomis – have received some level of internal loading treatment during the previous 20 years. Internal phosphorus loading is likely a contributing factor to the seasonal fluctuation in phosphorus concentrations within these systems as well as the other deep lakes systems within the Minnehaha Creek subwatershed.

MANAGEMENT STRATEGIES:

The District has developed general strategies to guide actions in the Minnehaha Creek subwatershed, informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources. These strategies are both short- and long-term, and establish a framework for the programs and projects utilized in the Minnehaha Creek subwatershed Implementation Plan. To better understand the strategies and efforts of the District and its partners within the Minnehaha Creek subwatershed, it is important to recognize the recent work in this subwatershed and the integration and alignment of natural resource management strategies with the goals of our communities.

Integrated Planning Approach:

As noted throughout this plan, the District’s overarching organizational strategy is founded in its Balanced Urban Ecology policy. This policy was established as the District’s fundamental philosophy and way of doing business – developed to guide all future planning and watershed management activities in order to achieve its mission of protecting and improving land and water.

The overarching strategy described in Balanced Urban Ecology is a vision of integration with government agencies, private landowners and developers, and philanthropic partners through multi-jurisdictional partnerships, emphasizing the economic and social value that natural systems generate for the built environment. It further describes how our work will be strengthened through these collaborative efforts to not only offer greater community impact, but to produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits.

The origin of the Balanced Urban Ecology policy lies within the Minnehaha Creek subwatershed, in the most urbanized section of Minnehaha Creek in Hopkins and St. Louis Park. As the landscape in this stretch was developed over the past 80 years, wetlands were filled and the creek was straightened, creating a significant tension between the natural and built environments that degraded water quality, increased flood risk and limited recreational access.



A routine permit application by Methodist Hospital in St. Louis Park sparked a series of natural resource improvements that has become one of the largest urban stream restorations in Twin Cities' history. This corridor initiative provides multiple natural resource and community benefits including restoration of the natural channel hydrology and riparian environment, removal of significant pollutant loads from the creek, Hiawatha Lake downstream and the Mississippi River, access to green space, community connections and job creation.

When Methodist Hospital approached the MCWD with a permit application for its new heart and vascular center, there was an opportunity to align goals. The MCWD restored curves to the straightened stream, improving wildlife habitat and flood storage. The hospital complemented the restoration with a boardwalk to link environmental and human health.

Just upstream, the boardwalk and trail system in the Minnehaha Creek Preserve is a natural oasis in the middle of an urban area. This restoration was achieved in partnership with the City of St. Louis Park, which approached the MCWD to address erosion issues on the creek. The MCWD leveraged state Clean Water Grant funds, obtained donated easements from private landowners and developed project agreements with the City to restore 30 acres of industrialized creek corridor into habitat and parkland, provide stormwater treatment for 80 acres of urban hard surface and connect the residents of 600 housing units to transit and local businesses.

Further upstream, the MCWD worked with the City of Hopkins to transform Cottageville Park from a hidden, troubled pocket park into an expanded playground and community space with a restored creek running through it. Subsurface facilities incorporated into the park restoration provide stormwater treatment for new low-income housing adjacent to the park. Police calls related to park activity, which previously accounted for 20 percent of all City crime, essentially ceased.

As communities' needs change, so does their landscape. What once was a satisfactory use of land often gives way to new ways of doing business. The site of a large cold storage warehouse for decades, 325 Blake Road in Hopkins is a key opportunity for the City to achieve its community development goals in the Blake Road corridor. The MCWD responded to the City's request

to collaborate by purchasing the 17-acre site. The property will be made available for redevelopment as guided by the City's vision, while providing for the restoration of another 1,000 feet of Minnehaha Creek riparian corridor along with a regional stormwater management basin that will treat 270 acres of urban stormwater previously discharged untreated directly to the creek. Through coordination among the City of Hopkins, the Metropolitan Council and the MCWD, the stormsewer work to bring this water to the Blake Road property has been incorporated into a programmed sanitary sewer project, resulting in substantial public cost savings.

For businesses to thrive, they often must grow. Japs-Olson Company, one of St. Louis Park's larger employers situated adjacent to the MCWD's Minnehaha Creek Preserve land, encountered several obstacles as it sought to expand its printing business. Rather than contribute to these growing pains with rigid application of regulations, the District worked in partnership to find innovative solutions.

As the result of a series of agreements that also involved the Cities of Hopkins and St. Louis Park, the MCWD received 3.6 acres of land to expand greenspace, and provide a trailhead connection to the Preserve and maintains a constructed wetland basin to treat stormwater from the Japs-Olson expansion along with adjacent road right-of-way previously untreated. The Japs-Olson expansion was finished ahead of schedule and allowed for the creation of 150 jobs.

For the MCWD, outcomes of these partnership efforts included restoration of a substantial length of creek sinuosity, riparian wetland and floodplain; treatment of runoff from several hundred fully developed acres of urban land that previously discharged untreated to the creek; and the creation of both passive and active recreational sites connected to the water environment and integrated with public education about the natural environment. Continued implementation of these management strategies in alignment with the goals of our local partners will continue to produce greater community impact than if pursued with a singular focus on water resource improvement.

Stormwater Management:

Stormwater management will focus on reducing runoff

volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

The most impactful driver of water quality within the Minnehaha Creek subwatershed, stormwater runoff, and its ability to transport excess nutrients and pollutants, negatively impacts lakes, streams and wetlands throughout the region. The overall strategy for protecting water quality within the subwatershed is to reduce pollutant loading and stormwater runoff volume from the landscape. This can be done in a variety of ways, such as installation and load reduction Best Management Practices (BMPs); retrofitting developed areas with BMPs as infrastructure and development/redevelopment opportunities arise; regulating freeboard required on new developments and redevelopments; encourage property owners to incorporate BMPs on their own properties; requiring stormwater pretreatment before discharge into any wetland; enhancing buffers along streambanks; and requiring local plans to discuss flood prevention and mitigation.

In highly developed area such as the Minnehaha Creek subwatershed, the disruption to the naturally occurring water cycle creates challenges in addressing runoff. Beyond treating rainfall where it falls with site specific BMPs, a proven method for stormwater management is implementation of regional stormwater management opportunities – where large areas of runoff can be directed and treated in a singular location.

In the Minnehaha Creek subwatershed, this has proven to be an effective method and will continue to be a focus for the District and its partners. In the short term, regional stormwater management opportunities have been identified in the Minnehaha Creek Greenway at 325 Blake Road, at Arden Park in the City of Edina, and at numerous locations along the Minnehaha Parkway Regional Trail in the City of Minneapolis. Efforts will be made to advance these opportunities while

continuing to work with our public and private partners to explore additional prospects that have yet to be identified.

Stream Channel Restoration:

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and reaeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Minnehaha Creek maintains a history of man-made alterations as the urban landscape changed, resulting in a lack of natural stream processes and degraded and fragmented habitat. While stormwater management is an effective tool in addressing stream flashiness and erosive velocities, stream channel restoration provides the opportunity to reinstate a more natural system design within a previously manipulated ecosystem.

Approximately one mile of Minnehaha Creek have been restored over the last decade to a meandering channel to reduce peak flows, reconnect the stream to its floodplain, limit erosion, and enhance habitat. Additional reaches of Minnehaha Creek would benefit from channel restoration, streambank stabilization, buffer enhancement, and habitat improvement. MCWD and its partners have been exploring restoration opportunities at Meadowbrook Golf Course, Arden Park in Edina, and various locations along the Minnehaha Parkway in Minneapolis, while continuing to investigate other reaches of the stream where restoration potential exists.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying



Figure 1.108 Frozen Minnehaha Creek, Aldo Abelleira

hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

Most of the wetlands within the Minnehaha Creek subwatershed have been altered and disrupted. The District, along with its many partners, have worked to restore multiple wetland systems in recent years. MCWD continues to assess and explore wetland function and ecosystems, and will target restoration efforts in ways that provide the greatest benefit to water quality, quantity and ecological integrity, while integrating these efforts within the developed community.

Internal Sediment Phosphorus Control:

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

In recent years, the District has partnered to address internal phosphorus loading through a variety of creative management strategies. In Lake Nokomis, an enhanced fish stocking program was implemented to reduce the number of rough fish (bullhead) rooting in the lake sediment by increasing predator fish (walleye) that feed on them. The Taft Lake – Legion Lake project creates a nutrient reduction treatment chain to address phosphorus loading entering upstream Legion Lake (buffers and infiltration systems) before an alum injection system directly treats Taft Lake internal nutrient loads.

MCWD will continue to assess management options for lake systems throughout the subwatershed. Additional water

quality monitoring data, sediment chemistry, and fish and aquatic vegetation surveys are necessary to evaluate the most appropriate techniques to improve water quality.

Watershed Protection:

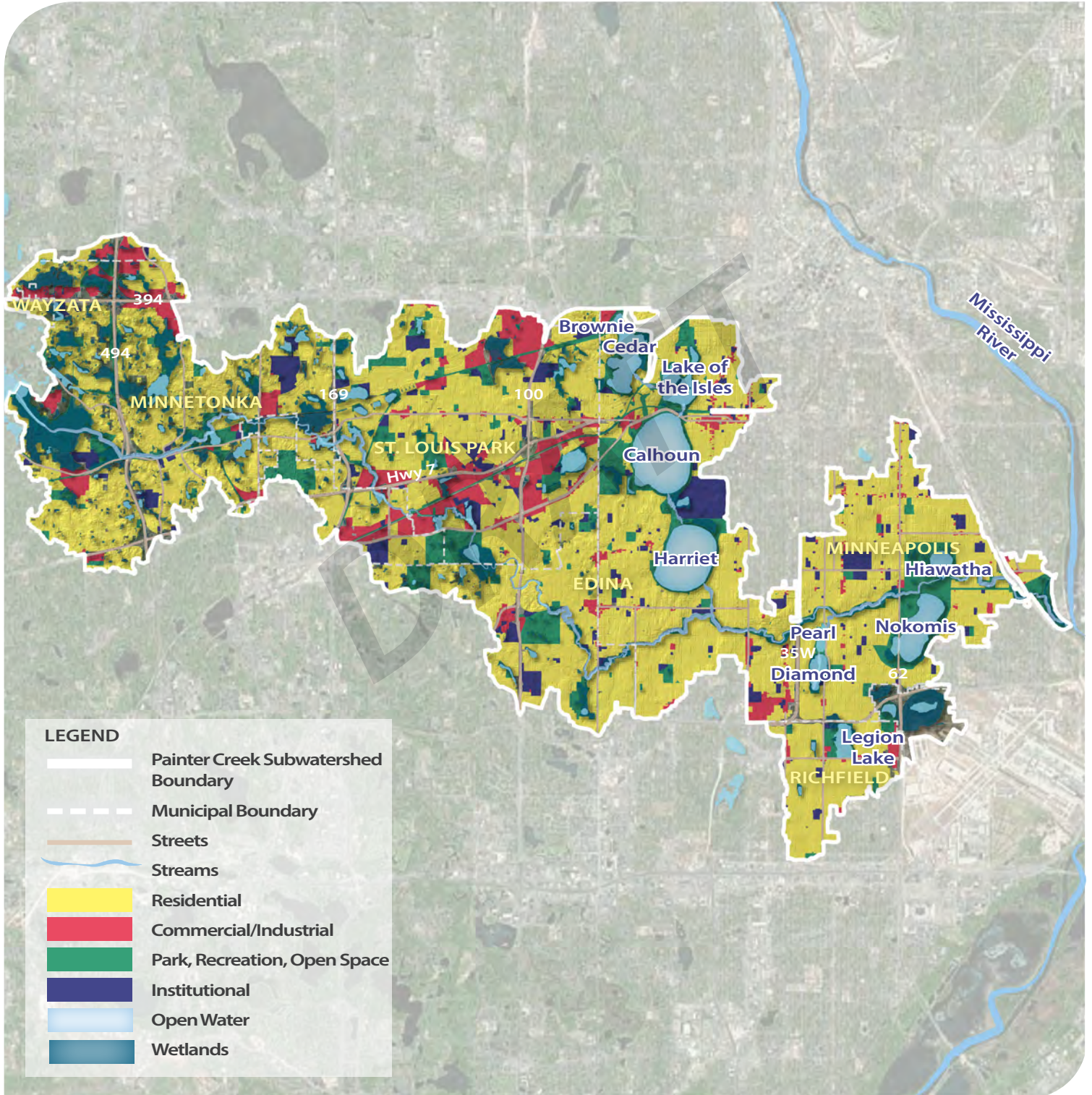
Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of the development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

Within the Minnehaha Creek subwatershed, redevelopment of urban and suburban areas provides an opportunity to address previous land use decisions and their negative impact on natural resources. Watershed protection is a critical component to ensure that change on the landscape is leveraged to find greater opportunity for the built environment while layering in water resource protection and ecological enhancement.

LAND USE: EXISTING CONDITIONS

The Minnehaha Creek subwatershed encompasses all of the MCWD downstream of the Grays Bay dam, and is commonly referred to as the “lower watershed.” The subwatershed is 47.3 square miles in size and includes portions of the cities of Edina, Golden Valley, Hopkins, Minneapolis, Minnetonka, Plymouth, Richfield, St. Louis Park and Wayzata.

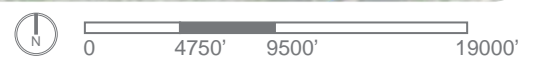
The predominant land use in the subwatershed is single family residential (51.4%), followed by parks and open space (14.2%), multi-family residential (7.5%), water (5.5%), commercial (4.8%), institutional (4.7%), and roads and highways (4.6%). The subwatershed is fully developed at typical urban and suburban densities and land uses and contains a higher level of impervious cover on the land than any of the other ten subwatersheds in the District. Redevelopment and infill development have increased



LEGEND

- Painter Creek Subwatershed Boundary
- Municipal Boundary
- Streets
- Streams
- Residential
- Commercial/Industrial
- Park, Recreation, Open Space
- Institutional
- Open Water
- Wetlands

Figure 1.109 Minnehaha Creek Land Use map



since the 2007 plan, notably with an increase in multi-family residential. Most of the remaining vacant or undetermined land is large wetland or woodland tracts.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for the 2017-26 plan cycle (see Appendix for details on the public input process). This information was used to broadly characterize opportunities that existed at the time to inform the District's implementation plans. Below is a brief summary of the information received. It is meant to serve only as a guide, not to restrict collaborative efforts. As discussed in Section 3.6, the District intends to coordinate with its communities on an ongoing basis to stay apprised of new opportunities. Below is a brief summary of the information received.

Development in this subwatershed has left few large areas of undisturbed or minimally disturbed forest and wetland in the subwatershed. Three areas, including the Grays Bay outlet wetland complex; Diamond Lake; and a portion of the creek corridor in the Mississippi River gorge have been designated Regionally Significant Ecological Areas by the DNR (Volume II). Although the Minnesota County Biological Survey (MCBS) did not identify any areas of biodiversity significance in the subwatershed, the creek corridor and the Chain of Lakes in the lower subwatershed are part of a DNR-designated Metro Conservation Corridor and will continue to influence land use investment and natural resource enhancement due to the significant value within this urban environment.

As described throughout this plan, the philosophy and foundation of the Balanced Urban Ecology policy is defined by successful integration with all partners, emphasizing the economic and social value that healthy natural systems generate for the built environment. We understand that every one of our partners has a unique vision and goals, and that it is recognition

of this individuality that creates successful partnerships.

Over the course of the next ten years, cities and agencies in the Minnehaha Creek subwatershed are expecting to make various infrastructure investments, ranging from road reconstruction and mass transportation projects to park, greenspace, trail, and stormwater management improvements. The goals of our partners, both public and private, and the investments they are planning serve as collaborative opportunities to not only enhance community impact, but to produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits.

It is also evident that throughout the Minnehaha Creek subwatershed, cities place high value on connecting their communities to parks, trails, and natural landscapes, and intend to leverage redevelopment within their communities to improve these connections. With early effort and strengthened communications, cities and private investors will find opportunities to coordinate with the District to further integrate stormwater management, natural resource restoration, and community connections into municipal infrastructure projects and ongoing redevelopment.

MINNEHAHA CREEK SUBWATERSHED IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, within the Minnehaha Creek Subwatershed, ditching of the stream channel, loss of wetlands, corridor fragmentation and increasing levels of impervious surfaces have disrupted fluvial processes; increased



runoff volumes and pollutant loads; decreased infiltration and baseflow; and fragmented and degraded habitat; negatively impacting the ecological integrity of the stream and its riparian systems. As a result, Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities.

Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved Total Maximum Daily Load (TMDL) study. Lake Nokomis also has an approved TMDL for excess nutrients (EOR 2011) and is one of four other lakes in the subwatershed that do not meet state water quality standards for nutrients.

Due to the systems altered hydrology (hard cover and altered wetlands) and upstream drainage area (Lake Minnetonka), several locations along Minnehaha Creek are known to flood during large or extended rain events. Overall, due to the size of the subwatershed and the urban characteristics of the area (developed, fragmented and altered), ecological integrity throughout the subwatershed is highly variable and generally considered to be lacking.

Based on the water resource needs that exist in the subwatershed and the opportunity to build upon our many successful partnerships with both public and private entities, the District has identified the Minnehaha Creek Subwatershed as a priority area to focus implementation efforts in this plan cycle. The focus within the subwatershed will be stormwater management to promote infiltration/filtration and pollutant reduction, stream restoration to stabilize streambanks and improve riparian buffers and habitat, and restoration of wetlands and ecological corridors in ways that reduce nutrient loading downstream to Lake Hiawatha while improving ecological integrity and corridor connectivity within the subwatershed.

As noted in previous sections, the District has been focusing on the most degraded section of Minnehaha Creek – between West 34th Street and Excelsior Boulevard in St. Louis Park and Hopkins – to implement a comprehensive corridor restoration that focuses on reducing pollutant loads, mitigating flashy

hydrology, reconnecting the riparian corridor, and restoring the physical character of the stream channel. The effort to-date has yielded significant results, often through innovative public and private partnerships, resulting in hundreds of acres of regional stormwater management, nearly two miles of restored stream, over ten acres of wetland restoration, public access to over 50 acres of previously inaccessible green space, two miles of new trail network, and improved ecological integrity through a series of vegetative restoration and invasive species management.

While the District and its partners continue implementation in the Minnehaha Creek Greenway, with projects such as 325 Blake Road and Meadowbrook Golf Course, these efforts continue to expand. Throughout the Minnehaha Creek subwatershed, collaborative opportunities are being explored in other critical areas of high need. Two examples of this are the efforts taking shape in the cities of Edina and Minneapolis.

In Edina, the City and District have been working together to vision a restored Arden Park in a way that layers multiple natural resource benefits together with community benefits. The project includes restoration of over 2,000 feet of Minnehaha Creek stream channel, including removal of one of the last two dams on the creek, and the potential to treat over 100 acres of regional stormwater runoff which currently flows untreated to the creek – all which attract and improve conditions for fish, birds and other wildlife. These efforts are layered with multiple benefits for the community: connecting people visually and physically to the creek with vegetation restoration; providing formal and informal access to new fishing throughout the park; making in-creek recreation more accessible to a larger cross section of users (tubers, kayakers, paddle boarders); providing safer, easier access to the creek; and a new, multi-purpose shelter building.

In Minneapolis, the District is working with the City of Minneapolis and the Minneapolis Park and Recreation Board (MPRB) on a multi-jurisdictional concept plan and capital improvement plan to improve the natural and built environments within the Minnehaha Creek corridor. This partnership will look to master plan future improvements of the Minnehaha Parkway Regional Trail on Minnehaha Creek – a 253 acre, 5.3 mile parkway with more than 1.4 million visits per year – with the layered goals of regional stormwater management, flood mitigation, and creek

and riparian improvements.

Reminiscent of the work throughout the Minnehaha Creek Greenway, these projects strive to correct historic impacts and balance the needs of natural resources while achieving the goals set forth by the communities, their residents, and other public and private partners. This is the pursuit of a balanced urban ecology.

The CIP in the following section includes these and other identified project opportunities. With these and all other implementation efforts, the District will bring together the municipalities, Minneapolis Park and Recreation Board, and other affected stakeholders to align goals and develop a specific systems plan. In addition to these planning and implementation efforts, the District has a wide range of services it can mobilize to address resource needs and support partner efforts as opportunities arise, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, and grants.

CAPITAL IMPROVEMENT PROGRAM

Capital projects in the Minnehaha Creek subwatershed include stream restoration projects to repair erosion, correct historic impacts and improve habitat as noted in the Minnehaha Creek Stream Assessments (2003 and 2013); wetland restoration projects to restore wetland channels and hydrology; stormwater management projects to reduce runoff volumes and rates while addressing pollutant loading that occurs from runoff producing rainfall events; and projects to maintain existing infrastructure and improvements.

These projects and others identified below will progress the District and its partners toward achieving their various goals for the subwatershed. This program is not a comprehensive list of all capital needs or potential projects within the subwatershed, and is limited by available financial resources and staff capacity to manage projects. These priority project approaches are intended to:

- » Progress improvements to water quality as identified in the TMDL for Minnehaha Creek and Lake Hiawatha.
- » Stabilize, restore and improve biotic integrity in reaches

of Minnehaha Creek and improve habitat corridors throughout the subwatershed.

- » Effectively manage urban stormwater and mitigate the impacts of land use changes and redevelopment on downstream resources.
- » Operate existing infrastructure to achieve the goals of water quantity and ecological integrity.
- » Conduct efforts in a manner that protects and enhances recreation and education opportunities on Minnehaha Creek and its surrounding watershed

These proposed projects and strategies emphasize the achievement of multiple objectives. For example, stream restoration would not only stabilize streambanks and prevent further erosion, it would provide an opportunity to improve in-stream and buffer habitat, conserve existing high-value resources, reduce sediment and nutrient transport downstream, and enhance recreation opportunities.



Project	Minnehaha Creek FEMA Flood Damage Repairs
Description	Streambank restoration and repair of streambank erosion and other flood damage resulting from 2014 flooding.
Need	The 2014 flooding along Minnehaha Creek caused flood damage in the cities of Edina and Minneapolis. The District coordinated review of the flood damage with the Federal Emergency Management Agency (FEMA). FEMA approved 35 sites to receive federal funding to implement flooding repairs. The project would repair streambank erosion and other flood damages identified by the District and FEMA in 2014.
Outcome	Stabilized streambanks with both bioengineering and hard armoring to reduce erosion;
Estimated Cost and Funding	\$500,000; Federal Emergency Management Agency (FEMA)
Schedule	2017-2018

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Project	325 Blake Road Regional Stormwater and Greenway
Description	Taking advantage of the opportunity to manage approximately 270 acres of area wide stormwater runoff at 325 Blake Road, the project requires construction of onsite stormwater management facilities to treat inflow from two diversion structures – Powell Road and Lake Street – which are already in place. The project also includes restoration of four to six acres of industrial land along Minnehaha Creek to restored greenway and riparian corridor.
Need	<p>The District has been focusing on the most degraded section of Minnehaha Creek – between West 34th Street and Meadowbrook Lake in St. Louis Park and Hopkins – to implement a comprehensive corridor restoration that focuses on reducing pollutant loads, mitigating flashy hydrology, reconnecting the riparian corridor, and restoring the physical character of the stream channel.</p> <p>In 2011 the District made a strategic acquisition of land at 325 Blake Road as part of a regional scale effort to establish the Minnehaha Greenway. This effort identified opportunities for area wide stormwater improvement, ecological restoration of the Minnehaha Creek riparian zone and corridor linkage with upstream/downstream restoration projects. Portions of the site not utilized for watershed restoration will be sold for redevelopment to capture a return on the initial investment.</p>
Outcome	<p>The site and project represent a critical piece of the District’s larger strategic initiative within the Minnehaha Creek Greenway focused on improving the quality and managing the quantity of stormwater runoff; enhancing the ecological integrity of the stream system; and facilitating broader community goals of economic development and livability by allowing the restored stream system to be integrated into the developed landscape.</p> <p>This project will implement over 270 acres of regional stormwater treatment to address water quality and quantity entering Minnehaha Creek, restore riparian and stream channel habitat, and expand the Minnehaha Creek Greenway while providing access to upstream and downstream project initiatives.</p>
Estimated Cost and Funding	\$2,747,100; District levy and Minnesota Public Facilities Authority (50%)
Schedule	2018-2019



Project	Meadowbrook Golf Course Ecological Restoration
Description	Partnership with the Minneapolis Park and Recreation Board (MPRB) to reconfigure and enhance Meadowbrook Golf Course to restore and improve the ecological integrity of the Minnehaha Creek stream corridor, and connect the Minnehaha Creek Greenway through MPRB land to the City of Edina parks and trails system.
Need	Situated within the most degraded section of Minnehaha Creek – between West 34th Street and Meadowbrook Lake in St. Louis Park and Hopkins – the project addresses historic issues such as ditching of the stream channel, loss of wetlands, corridor fragmentation, and fragmented and degraded habitat, all of which negatively impact the ecological integrity of the stream and its riparian systems and contribute to impairments of Minnehaha Creek.
Outcome	Improve ecological integrity of the stream corridor through this reach; improve ecological integrity of upland within the golf course and improve wetland function and value on site; improve water quality for Minnehaha Creek and downstream Lake Hiawatha; maintain or increase flood storage capacity to improve golf course resilience and reduce flood severity of adjacent neighborhoods; connect Minnehaha Creek Greenway trails through MPRB land to City of Edina parks and trails system in a manner that respects adjoining landowners’ interests.
Estimated Cost and Funding	\$2,200,000; District levy, Minneapolis Park and Recreation Board, and Hennepin County grant funding
Schedule	2018-2019

DRAFT

Project	Arden Park Stream Restoration
Description	Partnership with the City of Edina to restore Arden Park and the Minnehaha Creek corridor through the park. . The project includes stream restoration, including the removal of one of the last two dams on the creek, regional stormwater management, habitat improvements, and enhanced parkland to provide stream accessibility and recreation opportunities.
Need	Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. The grade control structure is a known contributor to existing impairments, acting as a barrier to fish passage and creating an impoundment that causes accumulation of sediment, thus degrading upstream aquatic habitat (Minnehaha Creek Stream Assessment 2003, 2012). The dam has altered the function and value of the creek system by removing connectivity to habitat for spawning and forage, while increasing residence time of water and surface area making the water warmer. These impediments increase algal growth and accumulation of decaying vegetation which uses oxygen and creates an environment that harmful for fish and macroinvertebrates.
Outcome	Improve ecological integrity of the stream corridor through this reach; improve ecological integrity of upland within the park; implement regional stormwater management for approximately 100 acres; expand and enhance recreation opportunities, safety, and community connections to Minnehaha Creek.
Estimated Cost and Funding	\$4,100,000; District levy, City of Edina, outside grant opportunities
Schedule	2018-2019



Project	Greenway to Cedar Trail Connection and Streambank Restoration
Description	Partnership with the City of St. Louis Park to connect the enhance Minnehaha Creek Greenway connections to the Cedar Regional trail and restore a degraded section of Minnehaha Creek through streambank stabilization and vegetative enhancement.
Need	The Minnehaha Creek Greenway is bisected by rail and regional trail, without access to upstream and downstream restoration initiatives. The rail line and train bridge crossing at Minnehaha Creek not only acts as an impediment to community connections by blocking access to the regional trail and Greenway, the stream channel at this location was historically manipulated, causing stream bank degradation and unnatural riparian structure.
Outcome	Improve ecological integrity of the stream corridor through this reach; improve stream channel stabilization; enhance riparian habitat and native vegetative communities; expand and enhance recreation opportunities, safety, and community connections to Minnehaha Creek and the Minnehaha Creek Greenway.
Estimated Cost and Funding	\$511,000; District levy, City of St. Louis Park, outside grant opportunities
Schedule	2019-2020

DRAFT

3.10.9 PAINTER CREEK SUBWATERSHED PLAN:

INTRODUCTION

This subwatershed plan contains information specific to the Painter Creek Subwatershed, including existing conditions and issues, drivers, management strategies, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Volume 3, Sections 2-8 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

This Implementation Plan for the Painter Creek subwatershed summarizes issues of water quality, water quantity, and ecological integrity. The Plan identifies what is driving these issues, and outlines a roadmap of management strategies to guide the implementation efforts of the District, and its public and private partners.

Painter Creek is a 13.5 square mile (8,667 acre) subwatershed located along the northwestern boundary of the Minnehaha Creek Watershed District (MCWD or District) and includes portions of the cities of Medina, Orono, Maple Plain, Independence and Minnetrista.

The subwatershed is generally characterized by large areas of undisturbed land (45%) including numerous large wetland systems and wooded areas, agricultural uses (17%), low density development (12%), and the 2,700 acre Baker Park (18%), owned by Three Rivers Park District. The Luce Line Trail traverses this subwatershed on the north side of Painter Marsh.

Large areas of undisturbed or minimally disturbed forest and wetland including Baker Park Reserve and Painter Marsh, have been designated Regionally Significant Ecological Areas by the DNR. Several areas have been found by the Minnesota County Biological Survey to be of moderate to high biodiversity significance, including tamarack swamp complexes east of Katrina Lake.

The headwaters of the subwatershed is Katrina Lake (202 Acres), a shallow marsh system located within Three Rivers Park District's Baker Park Reserve, which drains via Painter Creek through a series of large interconnected wetland systems into Jennings Bay on Lake Minnetonka.

This system delivers high phosphorus loads to Jennings Bay on Lake Minnetonka, which is listed as impaired for excess nutrients due to loading coming from Painter Creek and internal loading from within Jennings Bay. The lower reaches of Painter Creek are also impaired by excess *E. coli* bacteria. The subwatershed experiences some localized flooding due to the system's altered hydrology (hard cover and altered wetlands) and conveyance systems (culverts and ditches). Overall, the system enjoys moderate to high ecological integrity, with areas of high quality wetland and upland, including several regionally significant ecological areas.

Management strategies within the Painter Creek subwatershed will focus on restoring wetland and stream systems in ways that reduce nutrient loading downstream to Jennings Bay, while improving ecological integrity and corridor connectivity within the subwatershed.

The MCWD has previously established a partnership with the United States Army Corps of Engineers (USACE), which identified the potential restoration of four of the major wetland marsh systems within this subwatershed under the Federal Section 206 Program. Before this work is advanced, MCWD will develop a specific systems plan for this subwatershed in partnership with local municipalities and landowners. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Painter Creek subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

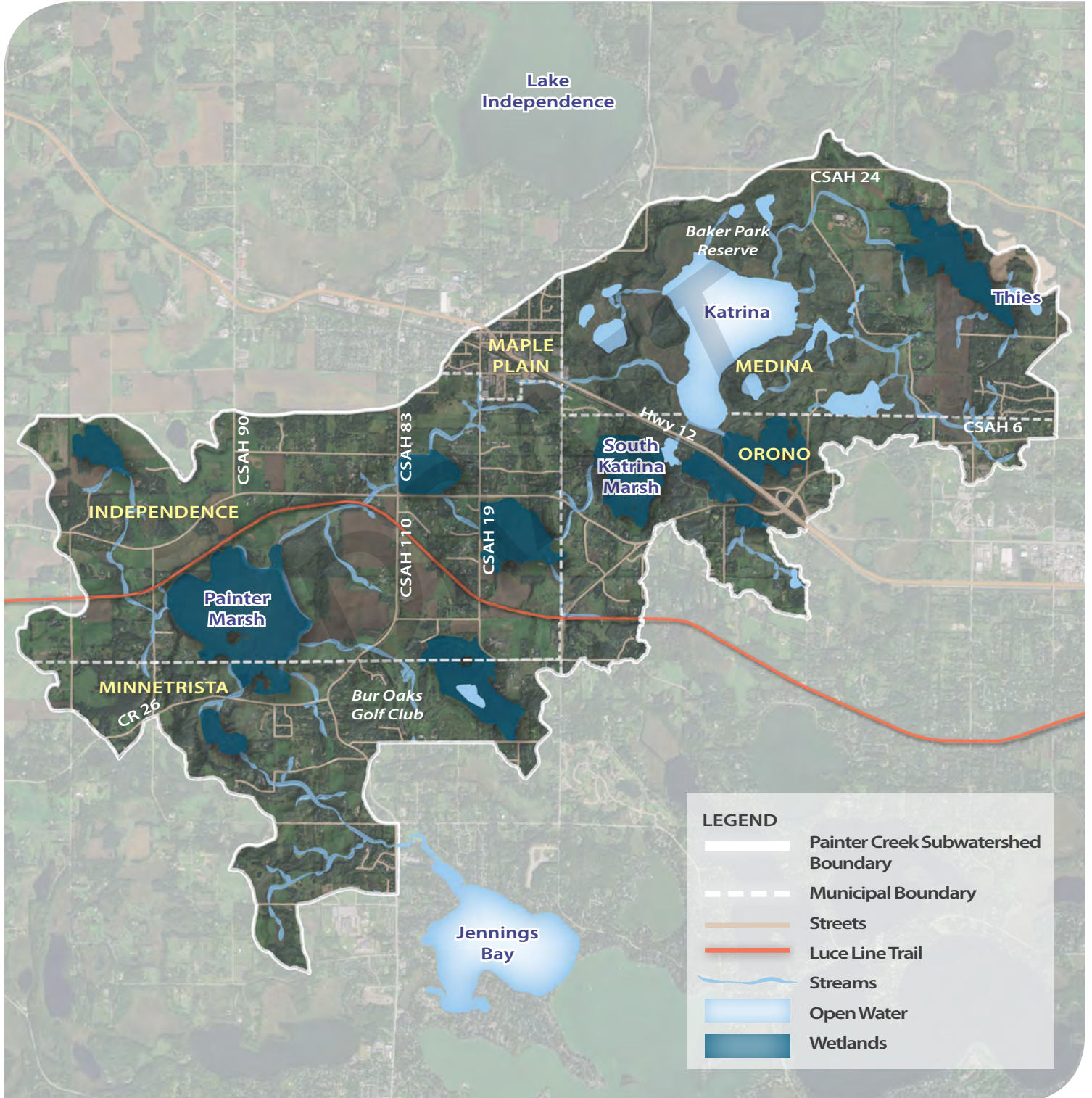


Figure 1.110 Painter Creek Base Map



Water Quality:

Lakes and Streams:

The Painter Creek subwatershed is a wetland dominated system with no lakes within the principal drainage area.

While Painter Creek is not listed as an Impaired Water for nutrients, the stream exhibits significantly high total phosphorus concentrations, and exceeds state river eutrophication standards. Phosphorus loads increase from upstream to downstream, and dissolved oxygen can fall below state standards during low flows.

Based on MCWD monitoring data, it is estimated that Painter Creek contributes between 33% - 50% of the total annual phosphorus load to Jennings Bay on Lake Minnetonka, which is listed as an Impaired Water.

Painter Creek exceeds state standards for *E. coli* bacteria concentration. A Total Maximum Daily Load (TMDL) Study was completed in 2014.

Wetlands:

The Painter Creek Subwatershed is a wetland rich system, containing approximately 2,500 acres of wetlands.

Based on monitoring data, many of the major wetland marsh systems on the main stem of Painter Creek are a source of dissolved phosphorus, due to their historic hydrologic alternation and current degraded state.

Many of the wetlands are high quality, are designated as regionally significant, and have been identified as having exceptional vegetative diversity, fish and wildlife habitat.

Groundwater:

There are a number of areas in the subwatershed that are highly sensitive to aquifer impacts, particularly the wetlands along the main stem of the Painter Creek corridor. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity:

Drainage is conveyed through the subwatershed through

culverts and small channels to wetlands, most of which are ditched and drain to Painter Creek.

Locations throughout the system have been identified through observation and the District's modeling and stream assessments as being vulnerable to localized flooding, and erosion from high velocities, causing streambank failure and erosion at outlets and culverts.

Many of the major wetlands in this subwatershed act as recharge-discharge wetlands. Groundwater recharge is important within the subwatershed to maintain wetland hydrology and stream baseflow, as well as to recharge aquifers that supply public and private drinking water wells.

Ecological Integrity:

Lakes and Streams:

Most of the subwatershed is characterized by large open areas of woodland, grassland, and wetlands punctuated by agriculture and low density development.

Limited fish data suggests the stream maintains a moderately healthy fishery, but it is likely due to colonization from Jennings Bay. The macroinvertebrate data shows a highly degraded community impacted by poor water quality, low dissolved oxygen, and lack of habitat.

Wetlands:

Wetland assessments have classified a number of wetlands in the subwatershed as having excellent to high vegetative diversity and habitat, in need of protection. Their conservation is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

Uplands and Natural Corridors:

Several areas within the subwatershed (see Figure 3.97 in Volume 2 for locations) have been found by the Minnesota County Biological Survey to be of moderate to high biodiversity significance, including tamarack swamp complexes east of Katrina Lake. Some of these are located within the Baker Park Reserve, while others are privately held. The high quality locations that are outside the regional park should be considered for preservation and protection to maximize habitat and biodiversity.

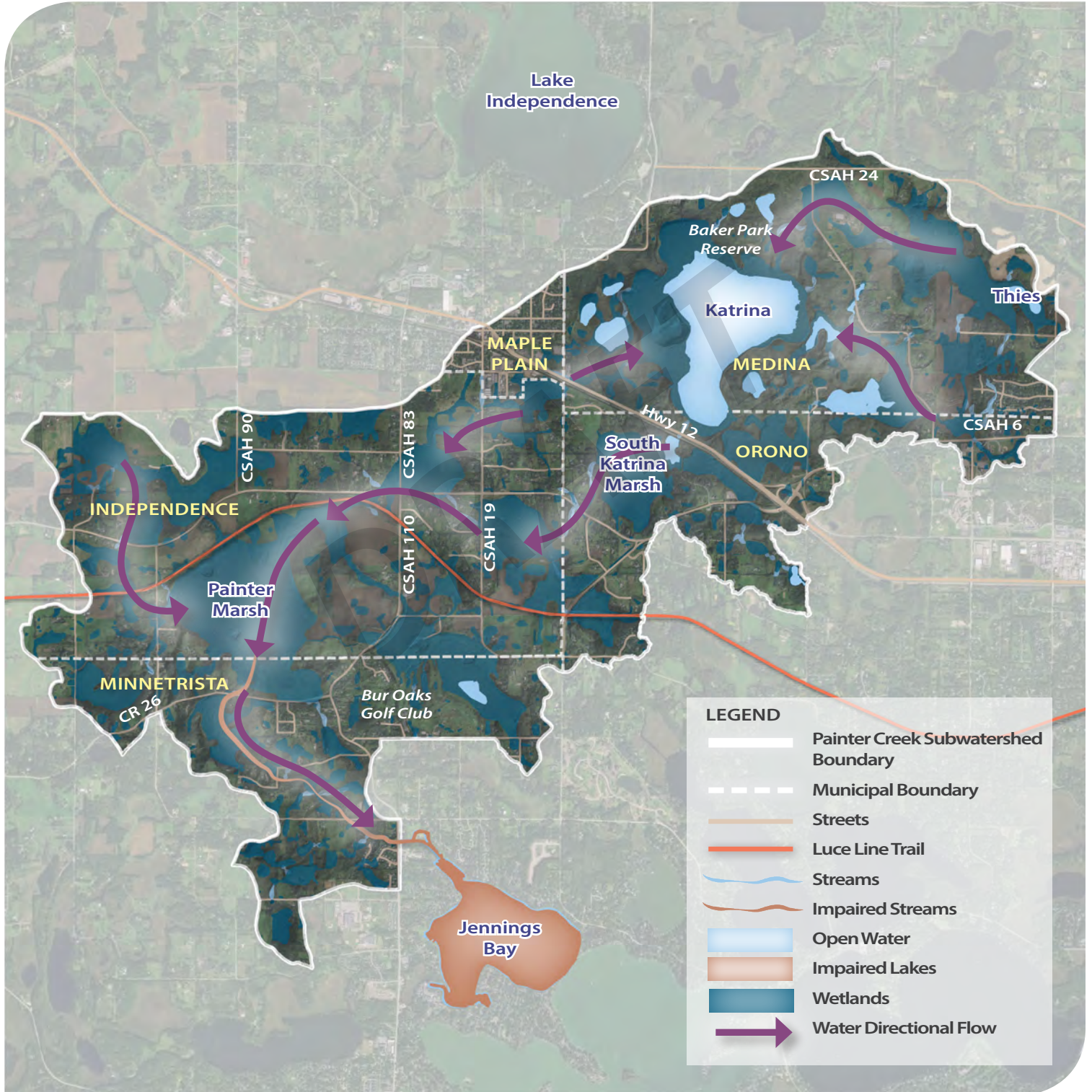


Figure 1.111 Painter Creek Water Resources Map



Large areas of undisturbed or minimally disturbed forest and wetland, including Baker Park Reserve and Painter Marsh, have been designated Regionally Significant Ecological Areas by the DNR. These two areas are connected by Painter Creek. Upland, wetland, and stream protection and restoration may preserve and enhance connections between these two features.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Painter Creek subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Painter Creek subwatershed are:

Water Quality

- » Excess nutrients/Low dissolved oxygen
- » Elevated E. coli concentrations

Water Quantity

- » Localized flooding

Ecological Integrity

- » Degraded macroinvertebrate community
- » Degraded and disconnected wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Common Carp
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading
- » Upstream waterbodies

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Painter Creek is a county ditch that flows through a number of wetlands between its headwaters at the outlet of Lake Katrina to its mouth at Jennings Bay. This ditching has partially drained and disrupted the natural hydrology of these wetlands. Water quality monitoring shows elevated concentrations of nutrients in Painter Creek, and this wetland alteration may be one of the sources of excess phosphorus in the stream, which contributes to the impairment of Jennings Bay.

Carp:

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus from resuspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

There has been only one fish survey completed on Painter Creek below Painter Marsh, and carp were found to be relatively abundant. There are weirs and culverts along Painter Creek that may function as barriers, but carp are persistent and known to travel long distances to spawn. The fish may be using Painter Creek to move between Lake Minnetonka and spawning areas in the deeper wetlands upstream. Bottom feeding in the deeper wetlands could release nutrients into the wetland

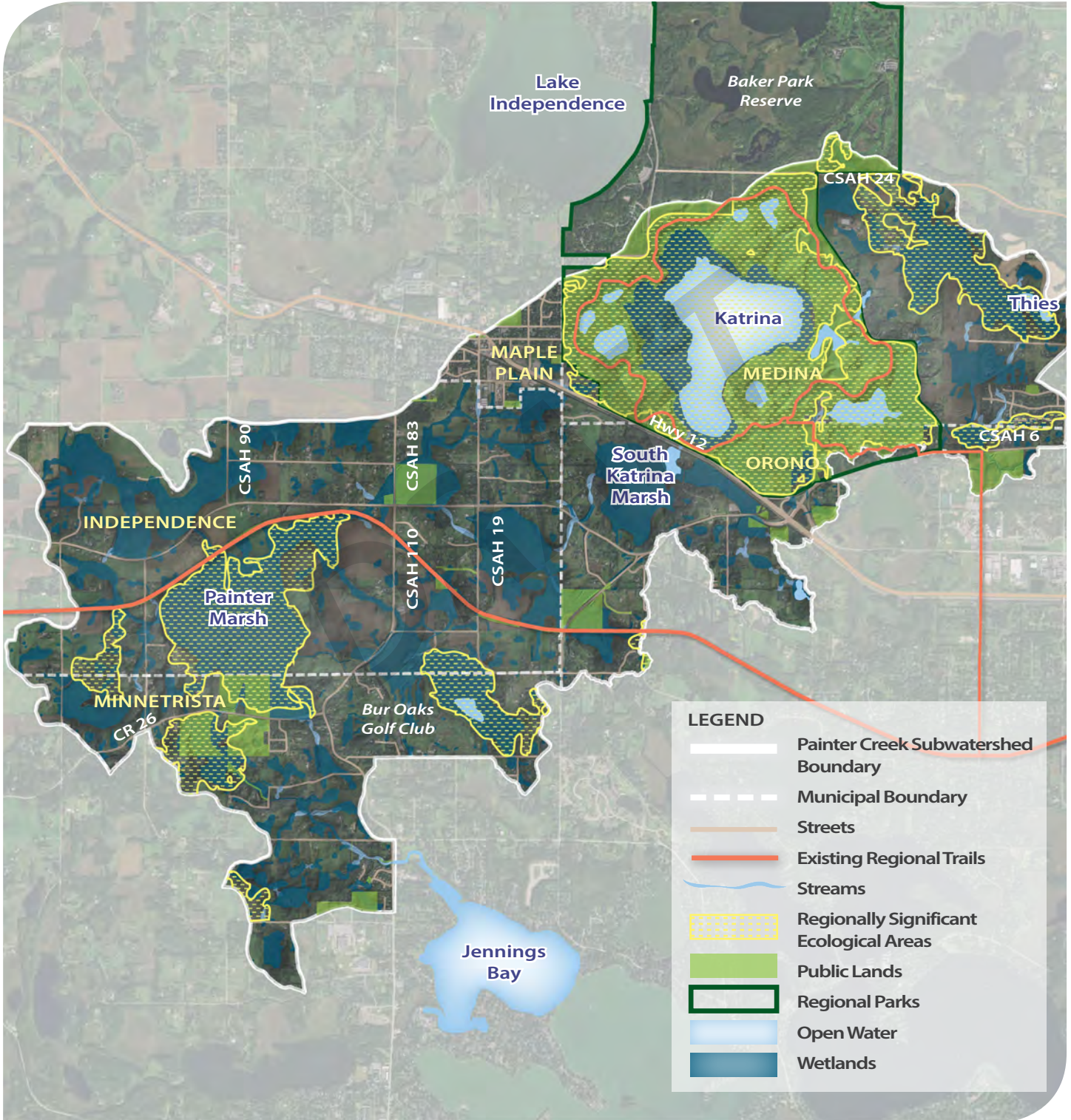


Figure 1.112 Painter Creek Parks, Trails and Open Space Map



water column, which could then be conveyed by Painter Creek to Jennings Bay. The extent of the carp population and its migratory and spawning habits is not known.

Stormwater Runoff:

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Painter Creek contains high levels of *E. coli*. The TMDL concluded that the primary source of this bacteria was fecal matter from the horses, cattle, chickens, turkeys, geese, deer, ducks and other domesticated animals and wildlife in the subwatershed. Rain and snowmelt conveys this waste to the stream, where it is a source not only of bacteria but also nutrients. Runoff from agriculture and pasture lands also conveys nutrients and sediment to the Creek, where they contribute to high phosphorus concentrations in the Creek and downstream Jennings Bay.



Figure 1.113 A prairie in Painter Creek subwatershed



Figure 1.114 Painter marsh



Figure 1.115 Painter Creek weir



Altered Channels:

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Painter Creek is Hennepin County Ditch #10, established in 1905 to provide drainage for agriculture, a function which continues today. For much of its length, it is a straight, trapezoidal channel that provides minimal fish and macroinvertebrate habitat. The macroinvertebrate communities in Painter Creek are highly degraded, and lacking the variety that would be expected in a natural, less-altered stream with better habitat. The stream is low in dissolved oxygen, and those species that are present are pollution-tolerant. The Painter Creek Stream Assessment found several locations on the Creek with streambank erosion that would benefit from stabilization.

Internal Sediment Phosphorus Loading:

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Lake Katrina has elevated levels of total phosphorus. No sediment release data is available, but as a deep wetland, it likely experiences moderate to high internal phosphorus loading.

Upstream Waterbodies:

Headwater streams, lakes and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters that can lead to eutrophication. Consequently, restoration

of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Lake Katrina has elevated levels of total phosphorus. Agriculture and large-lot residential properties contribute phosphorus and sediment to the lake. As a wetland, Katrina has not been officially listed as an Impaired Water, but its high-phosphorus discharge is likely contributing to elevated phosphorus concentrations in Painter Creek and excess phosphorus loads to Jennings Bay.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Painter Creek subwatershed. These strategies are both short- and long-term, and establish a framework for the Painter Creek subwatershed Implementation Plan programs and projects.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

In 2009, the District completed an outlet weir modification at the outlet of Painter Marsh and a stream meandering to return a portion of Painter Creek downstream of Highway 26 to a more natural shape and restore native vegetation in its surrounding wetland. This project was intended to reduce erosion and

sedimentation in the main channel, improve water quality, and improve habitat. The District has been working with the United States Army Corps of Engineers (USACE), which identified the potential restoration of four of the major wetland marsh systems within this subwatershed under the Federal Section 206 Program. Before this work is advanced, MCWD will develop a specific systems plan for this subwatershed in partnership with local municipalities and landowners.

Carp Management:

Historically, carp management focused on removal of carp populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

While carp are known to be present in Painter Creek downstream of Painter Marsh, not much is known about their extent and whether they are impacting upstream wetland complexes and Lake Katrina. As the wetland marsh system restoration projects are advanced, those feasibility studies will include an assessment of the carp and other rough fish population and migration patterns.

Stormwater Management:

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

The focus in the Painter Creek subwatershed will be on ensuring

Painter Creek and its tributaries are adequately buffered, proper manure management is practiced in the riparian areas, and stormwater runoff volume from developed areas is reduced to limit export of nutrients and sediment into Painter Creek, Lake Katrina, and Jennings Bay.

Stream Channel Restoration:

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and reaeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Approximately 2,000 feet of Painter Creek have already been restored to a meandering channel to reduce peak flows, limit erosion, and enhance habitat. Additional reaches of the stream downstream of Painter Marsh would benefit from streambank stabilization, buffer enhancement, and habitat improvement.

Internal Sediment Phosphorus Control:

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Additional information is necessary to evaluate management options for Lake Katrina. Additional water quality monitoring data, sediment chemistry, and fish and aquatic vegetation surveys are necessary to evaluate the most appropriate techniques to improve water quality in that wetland.

Restoration of Upstream Waterbodies:

Upstream water bodies that are currently impaired can discharge large nutrient loads to downstream water



Figure 1.116 Painter Creek

bodies thereby contributing to downstream water quality impairments. Therefore, prior to, or concurrent with, significant efforts to restore downstream water quality, the water quality in upstream water bodies must be improved. Nutrient impaired upstream lakes may require external and internal nutrient reductions using the strategies listed in this section.

Lake Katrina is the headwaters of Painter Creek, and its water quality influences the Creek. In addition, Painter Creek flows through several wetland complexes, each of which may be contributing to conditions in the Creek and nutrient loading into Jennings Bay. Previous studies have emphasized the need for a whole-subwatershed approach to managing water quality in these upstream water bodies. The District work with the USACE to identify the potential restoration of four of the major wetland marsh systems within this subwatershed will guide management strategies for this complex system.

Watershed Protection

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of the development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

LAND USE

EXISTING CONDITIONS

The subwatershed includes portions of the cities of Medina, Orono, Maple Plain, Independence, and Minnetrista. Land use in the subwatershed is generally characterized by large areas of undisturbed land (45%) including numerous large wetland systems and wooded areas, agricultural uses (17%), low density development (12%), and the 2,700 acre Baker Park (18%), owned by Three Rivers Park District. The Luce Line Trail traverses this subwatershed on the north side of Painter Marsh.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for the 2017-2027 plan cycle (see Appendix for details on the public input process). This information was used to broadly characterize opportunities that existed at the time to inform the District's implementation plans. Below is a brief summary of the information received. It is meant to serve only as a guide, not to restrict collaborative efforts. As discussed in Section 3.9.2, the District intends to coordinate with its communities on an ongoing basis to stay apprised of new opportunities.

One of the priorities identified by cities in the Painter Creek Subwatershed was maintaining the area's rural character and access to open space. There was little anticipated for development or infrastructure investment within this subwatershed in the near-term. The City of Medina and Three Rivers Park District expressed interest in partnering to improve manure management in the subwatershed and to address some areas of local flooding. The cities also voiced interest in continuing to utilize the District as a technical resource.

There is an opportunity for the District and the United States Army Corps of Engineers to continue a previously-established partnership to pursue the restoration of four major wetland marsh systems within the Painter Creek Subwatershed. The proposed restoration work could be eligible for funding under the federal Section 206 Program.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan.

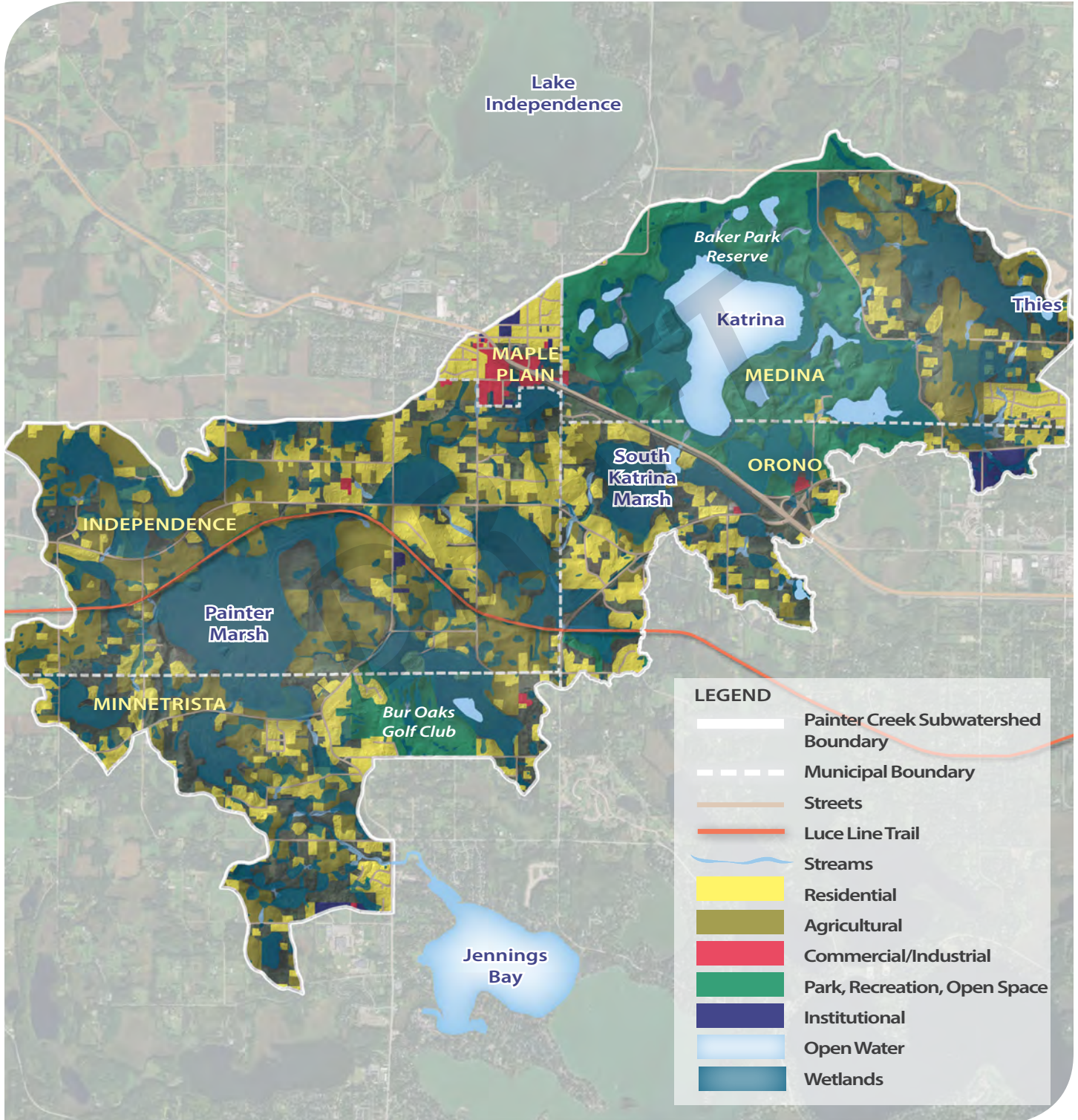


Figure 1.117 Painter Creek Land Use Map



The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, the Painter Creek Subwatershed contains a number of large wetlands, many of which have been ditched or otherwise altered, that are connected by Painter Creek. The system delivers high phosphorus loads to Jennings Bay of Lake Minnetonka, which is listed as impaired and requires the second largest load reduction in the District. Painter Creek is also impaired by excess *E. coli* bacteria. The subwatershed includes areas of high quality wetland and upland, including several regionally significant ecological areas. The MCWD has previously established a partnership with the United States Army Corps of Engineers (USACE), which identified the potential restoration of four of the major wetland marsh systems under the Federal Section 206 Program.

Based on the water resource needs that exist in the subwatershed and the opportunity to partner with and access funding through the USACE, the District has identified the Painter Creek Subwatershed as a priority area to focus implementation efforts in this plan cycle. The focus within the subwatershed will be on restoring wetland and stream systems in ways that reduce nutrient loading downstream to Jennings Bay of Lake Minnetonka, while improving ecological integrity and corridor connectivity within the subwatershed.

The CIP in the following section includes the four specific wetland restorations that have been identified by the USACE. The partnership with the USACE requires the District, as the local sponsor, to have land rights over the project areas. A number of these land rights have already been secured through easement or fee title. Part of the planning effort over the next plan cycle will be to work with the landowners around these wetlands to obtain the remaining land rights needed to complete the restoration work.

As noted in previous sections, this subwatershed contains a number of high value wetlands and uplands, including Baker Park Reserve and Painter Marsh which have been designated as Regionally Significant Ecological Areas by the DNR. These two areas, as well as the proposed USACE wetland restoration

projects, are all connected by Painter Creek, presenting an opportunity to further preserve and enhance this valuable corridor through land conservation and capital improvement initiatives. The District's CIP includes additional wetland restoration, stream restoration, and stormwater management projects beyond the four defined USACE projects in order to explore these restoration opportunities for additional water quality, water quantity, and ecological integrity benefit.

As noted previously, Painter Creek is impaired by excess *E. coli* bacteria, and has an approved TMDL. The focus for addressing this impairment will be to work with the municipalities and key landowners to ensure that Painter Creek and its tributaries are adequately buffered and proper manure management is practiced in the riparian areas.

Before any of the above work is advanced, the District will bring together the municipalities, Three Rivers Park District, and other affected landowners to align goals and develop a specific systems plan for this subwatershed. In addition to this District-led planning effort, the District has a wide range of services it can mobilize to address resource needs and support partner efforts as opportunities arise, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, and grants.

CAPITAL IMPROVEMENT PLAN

Capital projects in the Painter Creek subwatershed include wetland restoration projects to restore hydrology and vegetative diversity, stream restoration projects to repair erosion and improve habitat, and stormwater management projects to reduce volume and pollutant loading.

These projects will progress the District and its partners toward achieving their various goals for the subwatershed. This program is not a comprehensive list of all capital needs or potential projects within the subwatershed, and is limited by available financial resources and staff capacity to manage projects. These priority projects are intended to:

- » Stabilize, restore, and improve biotic integrity in reaches of Painter Creek as identified in the USACE Painter Creek Feasibility Study.
- » Utilize wetland restoration and other stormwater



management practices to decrease phosphorus loading in Jennings Bay.

These proposed projects and strategies emphasize the achievement of multiple objectives. For example, stream restoration would not only stabilize streambanks and prevent further erosion, it would provide an opportunity to improve in-stream and buffer habitat, conserve existing high-value resources, and reduce sediment and nutrient transport downstream.

Project	Potato Marsh Restoration
Description	The Potato Marsh project will consist of scraping a formerly farmed and degraded 45-acre wetland to lower its bottom elevation and create deeper pools. A new weir will be constructed at the outlet of Painter Creek with stoplogs to adjust water depth. Tamarack trees and a native wetland vegetation community will re-established through planting and seeding, and will be maintained through water-level alteration via the weir. Upstream bank erosion will be repaired, as well.
Need	The current condition of the altered wetland is a hybrid cattail and reed canary grass monoculture with sediment laden inflows due to streambank erosion. The surrounding landscape is dominated by large agricultural tracts, but the upper watershed contains large areas of undisturbed forests and high-quality wetlands. Baker Park Reserve and a large area in the lower subwatershed are also part of a DNR-designated Metro Conservation Corridor. The Minnesota Biological Survey identifies several areas outside of the project area in the subwatershed as areas of moderate or high biodiversity significance, including a tamarack swamp complex east of Lake Katrina and patches of maple-basswood and oak forest.
Outcome	The project will provide hydrologic and vegetative tamarack swamp restoration and creation of more diverse open water habitat, improved overall wetland function, reduction of sediment inflows by natural upstream erosion protection, increased stormwater and runoff retention period, groundwater filtration, and decreased sediment loads resulting from deeper wetland pools, and increased phosphorus absorption throughout the system. This project will be the first in the expansion and connection of an existing natural resource corridor connecting the upper Painter Creek subwatershed and the lower Painter Creek subwatershed.
Estimated Cost and Funding	\$870,000; District levy and USACE Section 206
Schedule	2019 with project monitoring activities and effectiveness evaluation to continue for 5 years past project completion.

Project	SOBI Marsh Restoration
Description	The SOBI Marsh project includes construction of a swale along the existing channel of Painter Creek and scraping of surrounding areas to expose the native seedbed within the 120-acre wetland. In select areas with existing erosion, natural bank erosion protection including planting and placement of scraped material will occur. Additional scraped material will be used to enlarge two existing hills. No modification of existing culverts and no weir construction is planned.
Need	The current condition of SOBI Marsh is an altered wetland with a hybrid cattail and reed canary grass monoculture and areas of bank erosion. This project location provides a vital link between the South Katrina Marsh wetland restoration and the Potato Marsh wetland restoration.
Outcome	The project will undertake a hydrologic and vegetative wetland restoration and creation of more diverse open water habitat. Sediment inflows will be reduced by natural bank erosion protection. This specific project will provide a critical hydraulic balance to upstream and downstream project components and supports the systems approach of restoration of the larger wetland complex.
Estimated Cost and Funding	\$242,000; District levy and USACE Section 206
Schedule	2020 with project monitoring activities and effectiveness evaluation to continue for 5 years past project completion.

Project	Upper and Lower Painter Marsh Restoration
Description	<p>The Upper Painter Marsh project will include construction of a swale and restoration of the streambed along the known historic channel of Painter Creek. The 65-acre wetland will be restored by scraping surrounding portions of the hybrid cattail and reed canary grass monoculture and exposing the native plant seedbank.</p> <p>The Lower Painter Marsh project includes construction of meanders along the existing channel of Painter Creek and a wetland scrape over a large area of the 430-acre wetland. Scraped material will be used to enlarge an existing island. Water levels will be controlled by the proposed replacement of the Lower Painter Marsh weir with a top elevation of 943 FASL. The weir design will include stoplogs that will initially be set to elevation 942 FASL.</p>
Need	<p>A straightened and ditched Painter Creek stream channel causes flashy storm flows and increased erosion, sediment loads, and decreased habitat integrity. Uncontrolled agricultural runoff leads to high nutrient levels and a monoculture of hybrid cattail and reed canary grass.</p> <p>The current condition of the Lower Painter Marsh is an altered wetland with a hybrid cattail and reed canary grass monoculture. The Painter Creek stream channel has been straightened and ditched, which leads to flashy storm flows and high sediment loading.</p>



Outcome	The project will undertake a hydrologic and vegetative wetland restoration and creation of more diverse open water habitat. Returning Painter Creek to its historic stream channel will mimic the historic hydro-period, slow storm flows, settle out sediments, and provide a critical hydraulic balance to upstream and downstream project components. Deeper water areas will provide vital habitat during dry and low flow conditions.
Estimated Cost and Funding	\$2,804,000; District levy and USACE Section 206
Schedule	2021 with project monitoring activities and effectiveness evaluation to continue for 5 years past project completion.

Project	South Katrina Marsh Restoration
Description	The South Katrina Marsh project includes removal of the existing weir. A new weir will be constructed in the same location with a crest elevation of 963 FASL with stoplogs initially set to 962 FASL. The existing stream channel will be converted into a swale and an additional swale will be created to direct flows to the south of the marsh into deeper water. Flows will eventually move from deeper pools to a level spreader distributing water throughout the wetland. Excavated material will be used to create two islands approximately 1-2 feet above the weir elevation. The total wetland restoration area is 134 acres.
Need	The current condition of South Katrina Marsh is an altered wetland with a hybrid cattail and reed canary grass monoculture.
Outcome	The project will provide a hydrologic and vegetative wetland restoration and creation of more diverse open and shallow water habitats. The deeper pools and level spreaders will slow flow, settle out sediments, and create greater habitat diversity. Construction of swales and scraping of cattail and reed canary grass biomass will decrease the monoculture, expose the native plant seedbed, and increase plant diversity.
Estimated Cost and Funding	\$1,265,000; District levy and USACE Section 206
Schedule	2022 with project monitoring activities and effectiveness evaluation to continue for 5 years past project completion.

Project	Wetland Restoration and Channel/Streambank Restoration
Description	The District will undertake wetland and channel/streambank restoration projects complementary to identified USACE Section 206 projects. Two reaches of the Painter Creek channel that were ditched in the early 1900's will be restored by realigning to the natural channel configuration, bio-engineering banks, and establishing a more diverse vegetative cover. Hydrology and vegetation will be restored and managed within wetlands contiguous to ditched sections of Painter Creek.

Need	The Section 206 projects present opportunities for expansion or enhancement of the identified projects or construction of additional projects creating a stronger corridor link between established and identified project sites. The hydrology of this wetland system is highly degraded with ditched and straightened stream sections creating flashy, nutrient-laden flows eventually contributing to high phosphorus in Jennings Bay. Water levels and nutrient levels lead to invasive species monocultures. MCWD concluded that significant reduction of nutrient transport will only be possible by first restoring some of the ditched wetland and straightened Painter Creek channel accompanied by projects to reduce nutrient concentrations in the water.
Outcome	Complementary projects will enhance and strengthen the planned or existing projects and create a stronger corridor connection. The stream restoration work will restore some of the natural hydrology, create open water areas, and increase wetland and habitat diversity along approximately 6,200 lineal feet of ditched channel. Wetland restoration will restore natural hydrology, increase wetland flora diversity, de-channelize flow, and improve habitat diversity.
Estimated Cost and Funding	Wetland Restoration Capital Cost: \$330,000; land costs not included. Channel/Streambank Restoration Capital Cost: \$2,985,000; land costs not included. Annual O&M: \$23,000/year.
Schedule	2018-2027

Project	Stormwater Volume and Pollutant Load Reduction
Description	Low Impact Development practices including stormwater detention will be used to reduce sediment and phosphorus discharging to Painter Creek and downstream Jennings Bay.



Need	Painter Creek has long been known to be a significant transporter of nutrient loading to Jennings Bay and the West Arm of Lake Minnetonka contributing to an excess nutrient impairment of these basins. Annual nutrient loads range in the thousands of pounds per year. Some likely reasons for high sediment and nutrient transport are ditching of wetlands and channel straightening, historical and current agricultural land use, and runoff. Stormwater from agricultural land is a significant source, along with decades of discharges from the Maple Plain Treatment Plant (1951 to 1986) into the Painter Creek subwatershed. Discharge from the plant was measured by MPCA at .24 MGD with an effluent phosphorus load in 1969/70 of 4,130 pounds.
Outcome	Reduction of sediment and nutrients exported into Painter Marsh from approximately 800 acres west of the wetland.
Estimated Cost	Capital Cost: \$980,000. Annualized O&M Costs: \$40,000.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

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SUBWATERSHED PLAN SUMMARY

The following table summarizes the proposed implementation action items and their relationship to overall District and subwatershed goals, issues and strategies identified in this subwatershed plan.

[Insert table]

References

Minnesota Pollution Control Agency (MPCA). 2016. Minnesota's Impaired Waters List. pca.state.mn.us/water/minnesotas-impaired-waters-list

Wenck. 2014. Upper Minnehaha Creek Watershed Nutrient and Bacteria TMDL Study. pca.state.mn.us/water/tmdl/upper-minnehaha-creek-watershed-lakes-and-bacteria-metro-tmdl-project

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Figure 1.118 Rolling Hills restoration in the Painter Creek subwatershed



3.9.10 SCHUTZ LAKE SUBWATERSHED PLAN

INTRODUCTION:

This subwatershed plan contains information specific to the Schutz Lake Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan. The Implementation plan summarizes issues of water quality, water quantity, and ecological integrity. The Plan identifies what is driving these issues, and outlines a roadmap of management strategies to guide the implementation efforts of the District, and its public and private partners.

EXECUTIVE SUMMARY:

Schutz Lake is a 1.5 square mile (969 acre) subwatershed located in the southwestern portion of the MCWD. Land within this geography is entirely within the City of Victoria. The subwatershed is generally characterized by low density development (40%), parks and open spaces (24%), agricultural uses (16%), water (11%), and undeveloped land (8%). The Carver Park Reserve abuts the northwesterly portion of the lake, the Southwest Hennepin LRT Regional Trail crosses the subwatershed, and portions of the southern subwatershed belong to the University of Minnesota Horticultural Research Center and Landscape Arboretum.

In one area on the west side of the subwatershed (within the Carver Park Reserve), there is a large patch of maple-basswood forest that has been designated a high-value native plant community by the Minnesota Biological Survey. The larger area within Carver Park Reserve has been designated by the DNR as a regionally significant ecological area within the Metro area.

Schutz Lake is the primary receiving water within the subwatershed. The upper watershed drains north through Schutz Creek via a series of culverts, under Highway 5 to Schutz Lake.

Schutz Lake subwatershed has several issues relating to water quality, water quantity and ecological integrity. Water quality in Schutz Lake meets state standards, but chlorophyll-a, a measure of algae, is increasing. Schutz Creek has elevated levels of total

phosphorus. Schutz Creek's annual water yield also appears to be increasing, and modeling predicts that flooding may occur at a damaged culvert during large rain events. Overall, the system has somewhat degraded ecological integrity. Schutz Lake has degraded fish and aquatic vegetation communities and Schutz Creek has degraded macroinvertebrate communities and low connectivity. However, the Schutz Creek corridor includes wetlands that with restoration could improve vegetative diversity and provide connected habitat for the subwatershed.

Management strategies within the Schutz Lake subwatershed will focus on promoting stormwater management to reduce runoff volumes and pollutant loads, stabilizing stream channels, and improving and protecting ecological integrity. The District will collaborate to implement these management strategies with local and state government, developers, lake associations, citizens' groups.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES:

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Schutz Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality: *Lakes and Streams:*

The Schutz Lake subwatershed has one major lake, one major stream, and a few riparian wetlands. While Schutz Lake is not listed as an Impaired Water for nutrients, a trend analysis suggests that algal blooms are becoming more frequent, as there has been a statistically significant increase in summer average chlorophyll-a concentration.

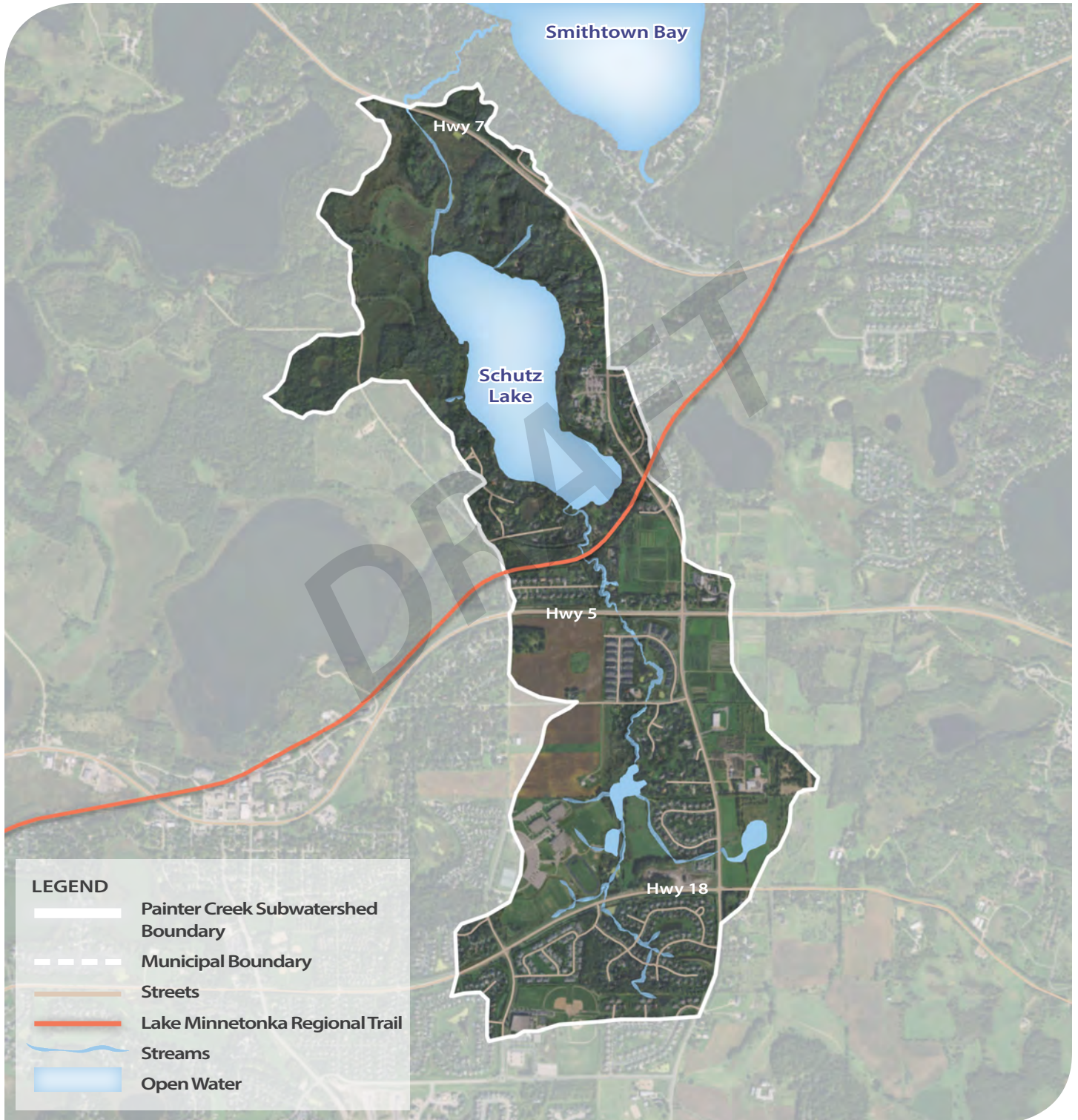


Figure 1.119 Schutz Lake Base map



While Schutz Creek does not exceed state eutrophication standards, it has elevated levels of total phosphorus that exceed the nutrient component of the state eutrophication standard.

Wetlands:

As outlined by the District's Functional Assessment of Wetlands, the subwatershed contains some large, Preserve classification wetlands that provide a high level of water quality protection for downstream waterbodies such as Schutz Lake. Several wetlands with moderate restoration potential exist within the central drainage area of the geography and may have the potential to be improved to provide enhanced ecological value and water quality treatment. Wetlands in the subwatershed are sensitive to the quality of stormwater inputs.

Groundwater:

There are areas of moderate to high aquifer sensitivity in the subwatershed. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity:

Annual water yield from the subwatershed into Schutz Lake Creek may be increasing, as a trend analysis on streamflow data in Schutz Creek showed a statistically significant increase in annual water yield.

Water quantity has caused erosion within the channels and culverts that convey flow through the system. A damaged culvert under a minor drive off Highway 7 may overtop during large rain events, according to the District's hydrologic model.

There are wetlands and streams in the subwatershed that rely on steady inflow from surficial groundwater.

Ecological Integrity:

Lakes and Streams:

Schutz Lake has degraded fish and aquatic vegetation communities. The fish community shows obvious signs of disturbance compared to other similar lakes, which may be due to the presence of common carp. The vegetation community has very low species richness and is infested with Eurasian watermilfoil.

Schutz Creek has a degraded macroinvertebrate community, which lacks certain classes of organisms and consists primarily of pollution-tolerant species. The creek also has low connectivity due to the presence of culverts at Highway 5 and at the trail crossing.

Wetlands:

The Schutz Creek corridor includes wetlands with vegetative communities that range in quality. Those of poor quality are heavily infested with buckthorn, reed canary grass, and Canadian wood-nettle, and those of better quality provide fish habitat and should be protected. Restoration of many of these wetlands could improve vegetative diversity and provide connected habitat for the subwatershed.

Uplands and Natural Corridors:

Within the Carver Park Reserve on the west side of the lake is a large patch of maple-basswood forest that has been designated on the Minnesota Biological Survey as being a high-value native plant community. The larger area within Carver Park Reserve has been designated by the DNR as a regionally significant ecological area within the Metro area. In addition, the southern subwatershed contains part of the University of Minnesota Horticultural Research Center and Landscape Arboretum.

DRIVERS:

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Schutz Lake subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Schutz Lake subwatershed are:

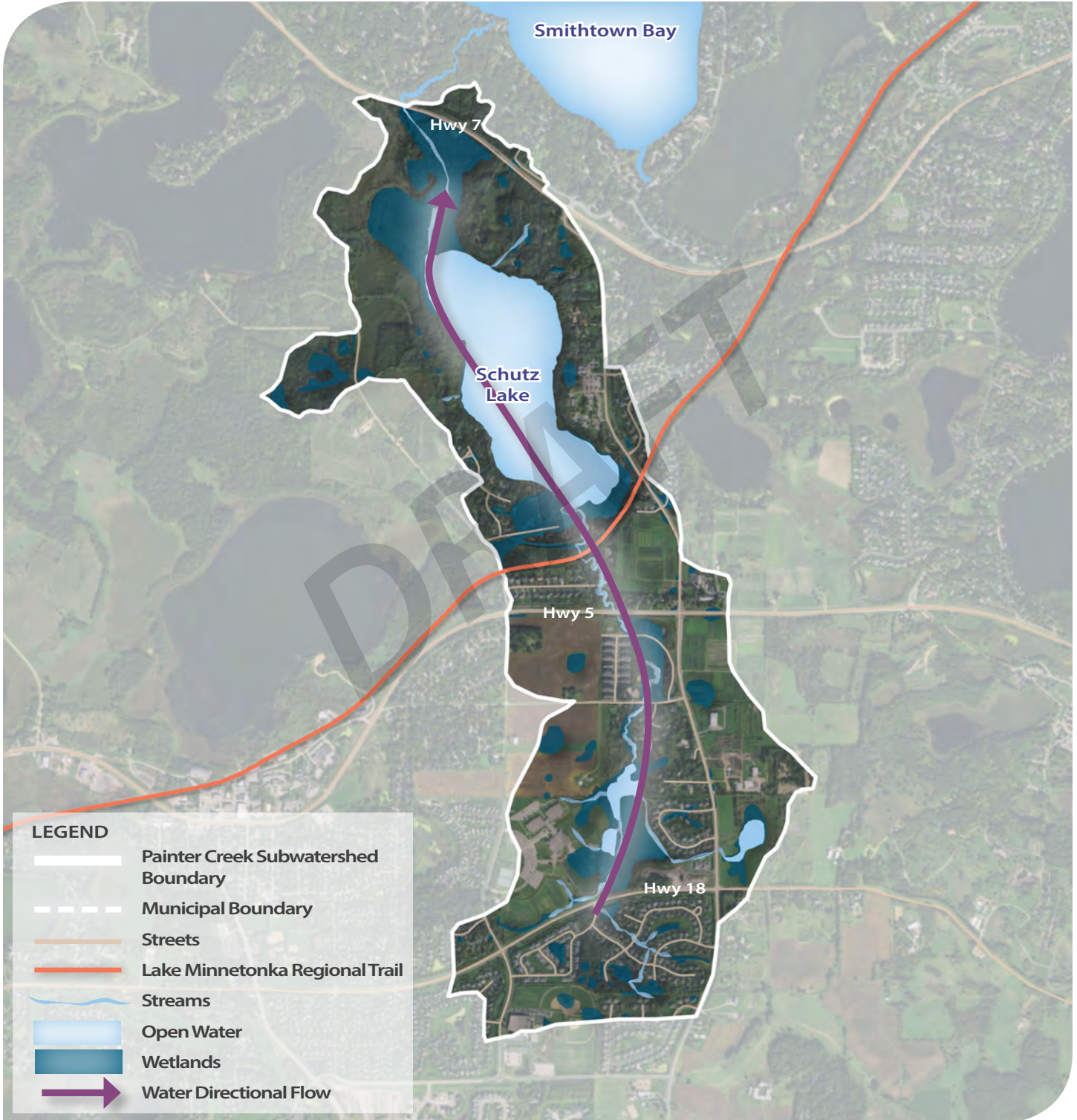


Figure 1.120 Schutz Lake Water Resources map



Water Quality

- » Excess nutrients

Water Quantity

- » Increasing annual volume from the upper subwatershed

Ecological Integrity

- » Degraded stream macroinvertebrate community
- » Degraded fish and aquatic vegetation communities

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Common carp
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

There are few wetlands in the Schutz Lake subwatershed. There is a large wetland complex that serves as the headwaters to Schutz Creek. This wetland has low to moderate vegetative diversity, which may be a legacy of historical agricultural runoff. Water quality monitoring shows elevated concentrations of total phosphorus in Schutz Creek, and elevated chlorophyll-a, indicating elevated levels of algae, in Schutz Lake. Wetland alteration may be a source of phosphorus to Schutz Creek.

Carp:

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom

feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus from resuspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

Schutz Lake has signs of potential carp impact, with its degraded aquatic plant and fish community. The status of carp in the lake is unknown, and assessing the population would be the first step towards determining the impact carp may be having on the lake.

Stormwater Runoff:

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally, as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.



Schutz Creek has elevated levels of total phosphorus and Schutz Lake has elevated concentrations of chlorophyll-a, a proxy for algae. Runoff from lawns and streets in the subwatershed conveys nutrients and sediment to surface waters. Monitoring data in Schutz Creek show a statistically significant increase in annual runoff volume conveyed from the developing upper subwatershed. Runoff from the subwatershed is a likely source of phosphorus to Schutz Creek and Lake, which can cause algae blooms.

Altered Channels:

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Schutz Creek runs through culverts at Highway 5 and at the trail crossing, impairing connectivity in the creek. The creek was also likely channelized at some point. Schutz Creek has a degraded macroinvertebrate community and elevated total phosphorus concentrations. A stream assessment found that there were multiple types of habitat present and the stream morphology was rich, indicating that the poor water quality may be the primary stressor on aquatic life in the Creek.

Internal Sediment Phosphorus Loading:

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

No sediment release data is available for Schutz Lake, but based on historical agriculture in this area, there may be pools of phosphorus in the sediments and available for release. An

increasing trend in algal blooms could be related to these legacy impacts, or to the increased nutrient loading from the subwatershed. Additional sediment release, aquatic vegetation, and fish data are necessary to determine the probable role of each in internal loading and the appropriate course of action.

MANAGEMENT STRATEGIES:

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Schutz Lake subwatershed. These strategies are both short- and long-term, and establish a framework for the Schutz Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

The wetland complex at the headwaters of Schutz Creek should be evaluated for potential nutrient export. Numerous wetlands within the subwatershed have high or moderate restoration potential, and if restored, could improve vegetative diversity and provide connected habitat.

Carp Management:

Historically, carp management focused on removal of carp populations from impacted water bodies without any

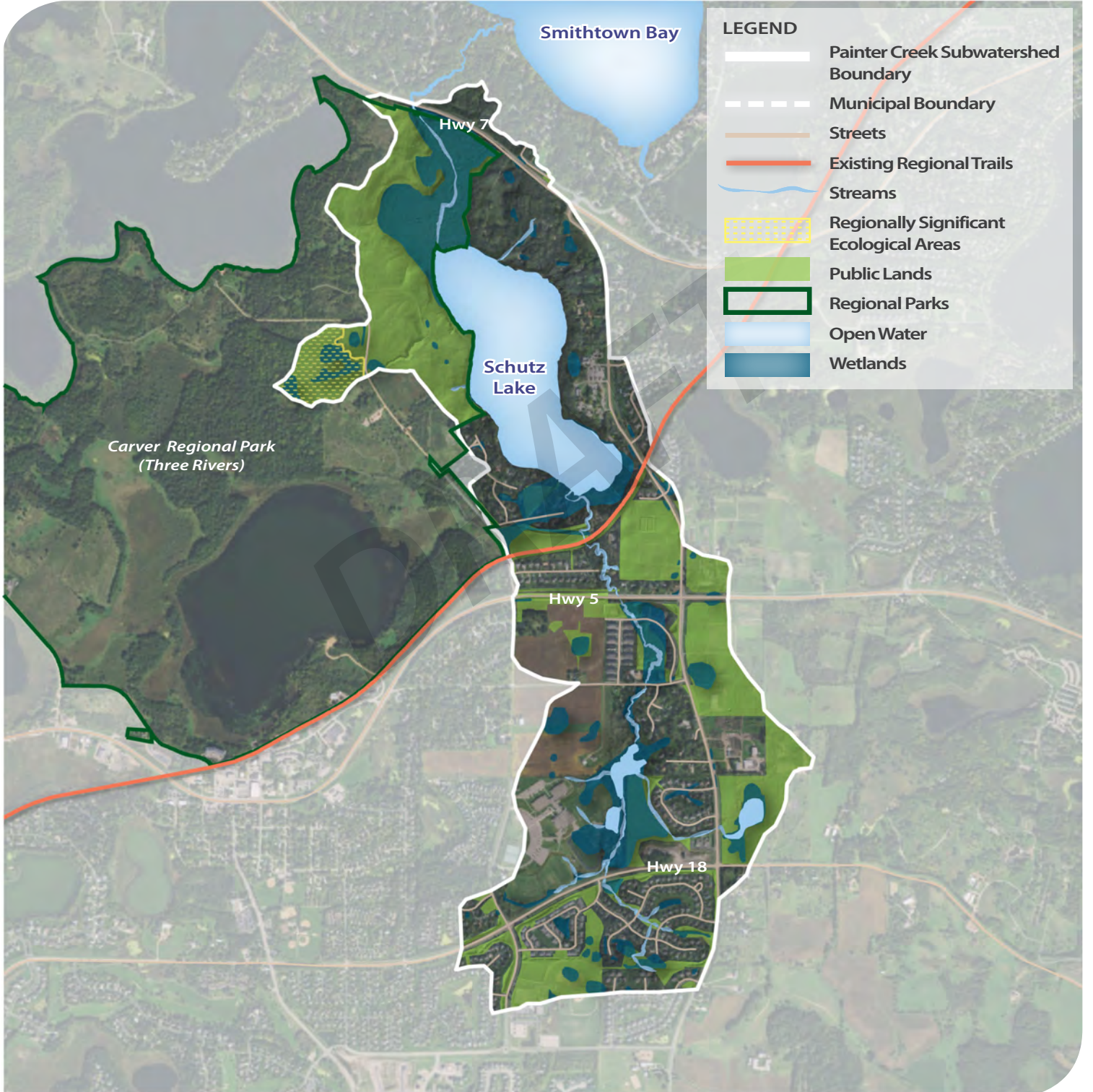


Figure 1.121 Schutz Lake Park, Trails, and Open Space map





consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

Schutz Lake has signs of potential carp impact, with its degraded aquatic plant and fish community. The status of carp in the lake is unknown, and assessing the population would be the first step towards determining the impact carp may be having on the lake. If carp are found to be impacting the system, given the small size of the subwatershed, a simple assessment could be performed that would inform management strategies.

Stormwater Management:

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

In the Schutz Lake subwatershed, the focus will be on installing stormwater management practices that reduce the volume and pollutant load being delivered from the upper watershed, primarily south of Highway 5.

Stream Channel Restoration:

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and reaeration, narrowing stream channels to improve wetted

width and ecological baseflow, and increasing stream structure.

Schutz Creek may be investigated for restoration potential to address bank erosion and issues surrounding the culverts that serve as part of the conveyance system. A partial stream assessment did not reveal significant issues and noted that there was robust habitat available. Given the elevated phosphorus levels in the stream, the entire length would benefit from assessment to determine need and opportunity for streambank stabilization, buffer enhancement, and habitat improvement.

Internal Sediment Phosphorus Control:

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Not enough data is available to determine if internal sediment phosphorus load requires management. Sediment cores should be taken to assess potential sediment release rates. Aquatic vegetation and fish surveys would also provide valuable data to determine what role biological management would play in controlling internal load.

LAND USE:

EXISTING CONDITIONS

The subwatershed includes a portion of the city of Victoria. Land use in the subwatershed is generally characterized by low density development (40%), parks and open spaces (24%), agricultural uses (16%), water (11%), and undeveloped land (8%). The Carver Park Reserve abuts the northwesterly portion of the lake, the Southwest Hennepin LRT Regional Trail crosses the subwatershed, and portions of the southern subwatershed belong to the University of Minnesota Horticultural Research Center and Landscape Arboretum.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Sections 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for the 2017-26 (see Appendix for details on the public input process). This information was used to broadly characterize opportunities that existed at the time to inform the District's implementation plans. Below is a brief summary of the information received. It is meant to serve only as a guide, not to restrict collaborative efforts. As discussed in Section 3.6, the District intends to coordinate with its communities on an ongoing basis to stay apprised of new opportunities.

There is an active lake association for Schutz Lake that has expressed interest in working with the City of Victoria and the District to address the issues outlined in this plan. The City of Victoria will be working proactively with the District to identify opportunities to manage stormwater volumes and pollutant loads, stabilize erosion within the stream and stormwater conveyance system, and to develop funding strategies to implement feasible solutions.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, Schutz Lake is not impaired but does exhibit a trend of increasing concentrations of chlorophyll-a, and increasing annual water yields – likely due to development that has occurred in the last ten years. Increased

quantities of water may also be causing erosion within the channel and around culverts which convey water through the system. These issues may be combining with the potential for internal loading, possibly exacerbated by the presence of common carp, to continue stressing Schutz Lake.

Based on these conditions, management strategies within the subwatershed will focus primarily on stormwater management to reduce runoff volumes and pollutant loads, assessing and stabilizing erosion within the stream channel and conveyance system, and evaluating and managing the presence and impact of common carp.

The Schutz Lake subwatershed is relatively small and there is little additional development or infrastructure investment anticipated within this subwatershed in the near-term, so opportunities from land use change may be limited. However, the Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

The District will proactively coordinate the permitting of future land use change with the City of Victoria to explore opportunities to create public-private partnerships to address stormwater management goals in ways that exceed regulatory requirements. The District will continue working with the Lake Association to identify local resident led implementation opportunities that align with this subwatershed plan.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. In the future, should a larger more concentrated scale of capital

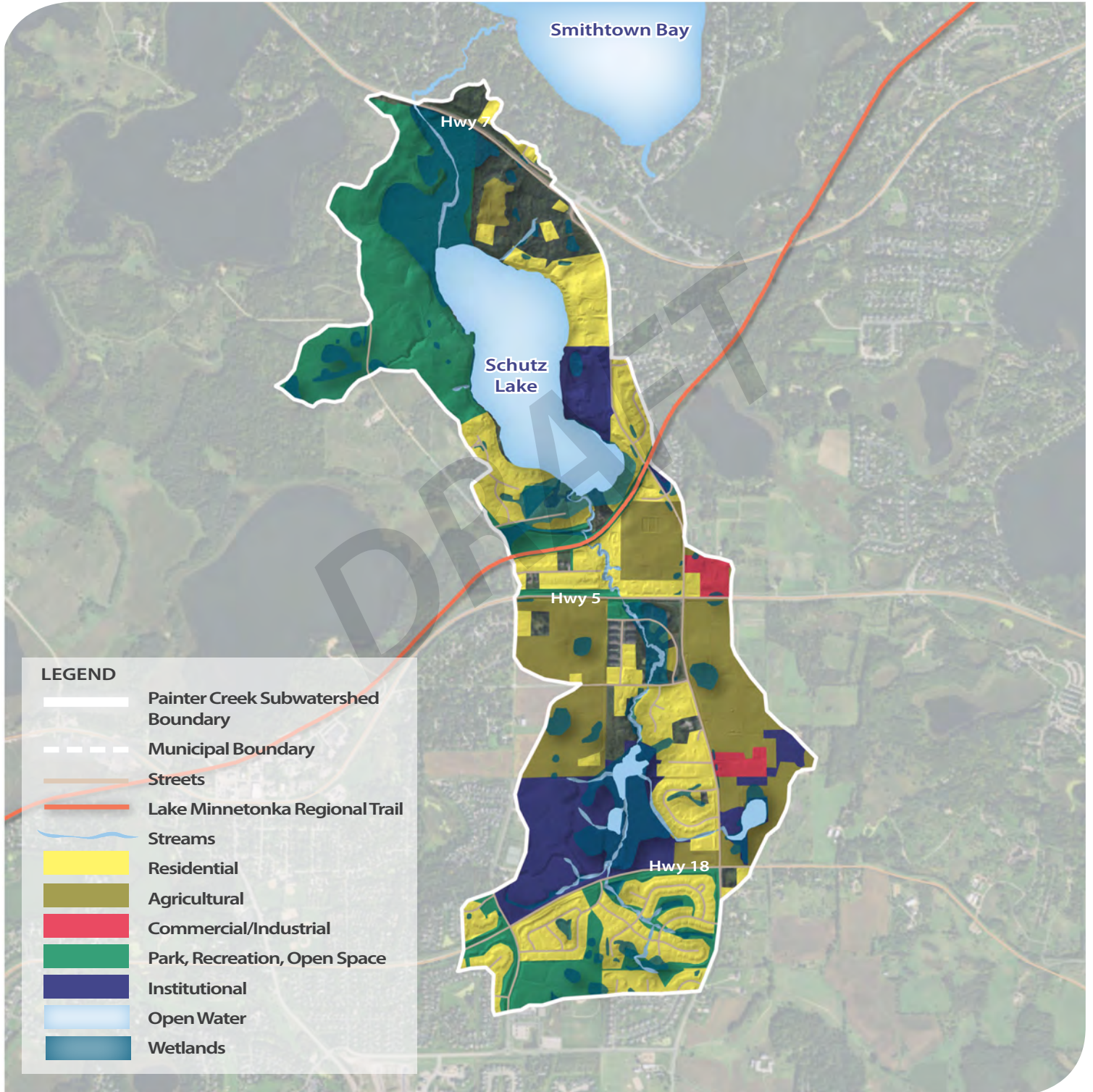


Figure 1.122 Schutzh Lake Land Use map



and program implementation be determined to be needed by the District or its partners, a discrete subwatershed planning process may be initiated that:

- » Provides high resolution diagnostic of watershed issues and drivers
- » Maps current projected land use and infrastructure changes
- » Defines a detailed and integrated capital and program implementation plan
- » Outlines a funding strategy including program costs and sources
- » The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Comprehensive Plan.

CAPITAL IMPROVEMENT PLAN

Capital projects in the Schutz Lake subwatershed include stormwater management projects to reduce runoff volumes and rates while addressing pollutant loading that occurs from runoff producing rainfall events. These projects will progress the District and its partners toward achieving their various goals for the subwatershed. This program is not a comprehensive list of all capital needs or potential projects within the subwatershed, and is limited by available financial resources and staff capacity to manage projects.

Given the limited resource needs and opportunities identified within the Schutz Lake subwatershed relative to other parts of the watershed, the District does not anticipate initiating any capital improvement efforts in the subwatershed during this plan cycle. However, the District has included this project in its CIP in the event that an opportunity arises through land use change or a partner initiative.



Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Schutz Lake, including but not limited to construction of infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	While Schutz Lake is not currently impaired for excess nutrients, total phosphorus concentrations are very near state water quality standards. Schutz Lake receives stormwater runoff from a developing area south of the Lake via Schutz Lake Creek where further phosphorus load reductions are needed to protect water quality.
Outcome	Reduction of sediment and nutrients exported to Schutz Lake.
Estimated Cost	Capital costs: \$250,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

References

Minnesota Pollution Control Agency (MPCA). 2016. Minnesota's Impaired Waters List. pca.state.mn.us/water/minnesotas-impaired-waters-list

Wenck. 2014. Upper Minnehaha Creek Watershed Nutrient and Bacteria TMDL Study. pca.state.mn.us/water/tmdl/upper-minnehaha-creek-watershed-lakes-and-bacteria-metro-tmdl-project

3.9.11 SIX MILE-HALSTED BAY SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Six Mile-Halsted Bay Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan. The Implementation Plan for the Six Mile-Halsted Bay Subwatershed summarizes issues of water quality, water quantity, and ecological integrity. The Plan identifies what is driving these issues, and outlines a roadmap of management strategies to guide the implementation efforts of the District, and its public and private partners.

EXECUTIVE SUMMARY

The Six Mile-Halsted Bay Subwatershed spans 27 square miles on the western edge of the Minnehaha Creek Watershed District. Within this large subwatershed are a numerous jurisdictions and public agencies, including the Cities of St. Bonifacius, Waconia, Victoria, and Minnetrista, Laketown Township, both Hennepin and Carver Counties, and Three Rivers Park District, who own Carver Park Reserve, a 3,700 acre park within the subwatershed.

The subwatershed is characterized by abundant and interconnected water resources, flat topography, and planned land use conversion from agriculture to suburban residential. The principal land uses within the Six Mile-Halsted Bay Subwatershed according to the MN DNR's land cover classification system (MLCCS) are agriculture (17%), developed (16%), grassland (16%) and forest (14%). Water resources (open water, emergent marsh, and wetland) are also a significant component of land use and make up 28% of the watershed.

Large areas of undisturbed or minimally disturbed forest and grassland are located within Carver Park Reserve. A majority of the land within Carver Park Reserve is designated by the DNR as a "regionally significant ecological area", as are other corridors around the large lake and wetland systems outside of the park. Areas designated as having high biodiversity significance by the Minnesota County Biological Survey include several wetland complexes in and adjacent to Carver Park.

The Six Mile-Halsted Bay Subwatershed is the headwaters of Lake Minnetonka. The area contains approximately 14 lakes and hundreds of acres of wetlands, all connected by Six Mile Creek, which has been heavily ditched and modified. The system begin at Pierson Lake in Laketown Township, and move towards Victoria through Wassermann Lake, then through a large wetland complex into East Auburn Lake, which is partially within Carver Park Reserve. Carver Park Reserve contains approximately 6 lakes and numerous marshes, all of which drain through a water control structure into Parley Lake. Water then flows through Parley and Mud Lakes, and finally through the large Six Mile Marsh complex into Halsted Bay.

The system has six lakes that do not meet federal water quality standards for nutrients, including Halsted Bay, which requires the largest phosphorus load reduction in the District. Other lakes have high phosphorus levels without being listed as impaired, either because they exhibit fluctuation around state standards or they have been designated as wetlands by the Minnesota Pollution Control Agency through the TMDL process, which designates impaired water bodies and allocates required load reductions.

Degraded water quality and ecological integrity within this system are driven by both historical land use and ongoing system stressors. Many waterbodies with elevated phosphorus are driven at least in part by internal sediment release of phosphorus stored in the lake bed. This sediment phosphorus release may be exacerbated by the presence of invasive common carp, which are abundant throughout the system. The principal source of watershed nutrient loading throughout most of the system are degraded wetlands which export phosphorus due to historic hydrologic modification. Stormwater from both agricultural and developed land uses also drive some water quality issues, though proportionately less than other sources in the watershed.

Management strategies will include carp control, wetland restoration, internal load management, and coordination with public infrastructure investment to improve stormwater management. The District will take a strategic approach to implementation of these strategies that

The subwatershed was adopted in 2015 by the MCWD

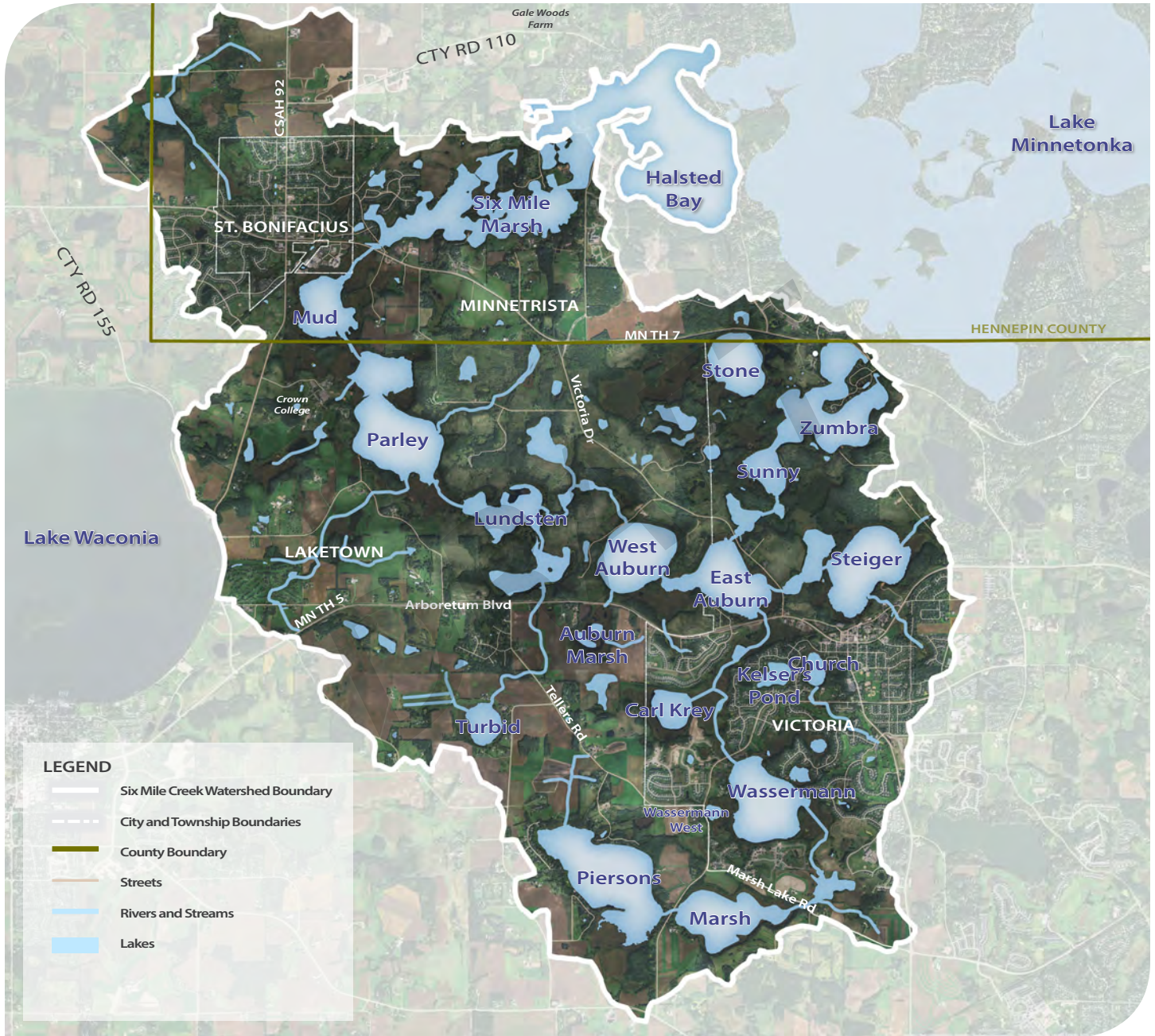


Figure 1.123 Six Mile-Halsted Bay Base map

Board of Managers as a District priority for planning and implementation. The implementation for this subwatershed plan has been developed in coordination with the Six Mile-Halsted Bay Planning Partnership, a committee composed of policy makers and staff from the public agencies within the geography including:

- » City of Victoria
- » City of Minnetrista
- » City of St. Bonifacius
- » City of Waconia
- » Laketown Township
- » Carver County
- » Hennepin County
- » Three Rivers Park District

The Partnership was convened to develop a coordinated, multi-jurisdictional plan to address complex and interconnected water resource issues in the geography. The plan integrates natural resource improvements into other, non-water public investments including parks and recreation, growth and development, and infrastructure investment. The goal of the plan is to not only improve water resource outcomes directly, but also generate secondary benefits that address local planning priorities. The Committee will continue to work together to guide and prioritize implementation after this plan has been adopted.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES:

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, specialized studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), The Six Mile Diagnostic Study, The Six Mile Creek Carp Assessment, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about

the Six Mile-Halsted Bay subwatershed may be found in Volume 2: Land and Natural Resources Inventory .

Water Quality:

Lakes and Streams:

East Auburn, Parley, Stone, Turbid and Wasserman Lakes are impaired for excessive nutrients, while Steiger, Zumbra-Sunny, and Wassermann are impaired with excess mercury in fish tissue. TMDLs exists for all these lakes. Mud Lake and South Lundsten are below state standards for nutrients but are classified as a wetland in TMDL evaluation so not listed as impaired. Several other waterbodies within the system fluctuate around state standards for water quality and clarity but remain unlisted.

In Six Mile Creek, the reach between Mud Lake and Halsted Bay is listed as an impaired water for excess nutrients. Dissolved oxygen levels frequently fall below the 5 mg/L necessary to sustain aquatic life.

Wetlands:

Abundant and interconnected wetland complexes are characteristic of the Six Mile-Halsted Bay geography. While many provide crucial ecosystem services, altered hydrology and monotypic vegetation communities lead many others to be exporters of phosphorus. These wetlands are driving degrading water quality in some of the largest lakes within the geography, including East Auburn, Wassermann, and Parley.

Groundwater:

There are areas of high and very high aquifer sensitivity throughout the watershed, some of which correspond to anticipated development areas.

Water Quantity:

Lakes and Streams:

The Six Mile-Halsted Bay subwatershed is characterized by its flat topography and extensive water resources. The lack of gradation between waterbodies generates backflow conditions between certain waterbodies when the flow pattern reverses direction, causing flooding and pollutant loading concerns.

Lakes and streams within the subwatershed have altered hydrology. Changes to inlet and outlet structures, altered rates of overland flow and recharge, and modification to stream

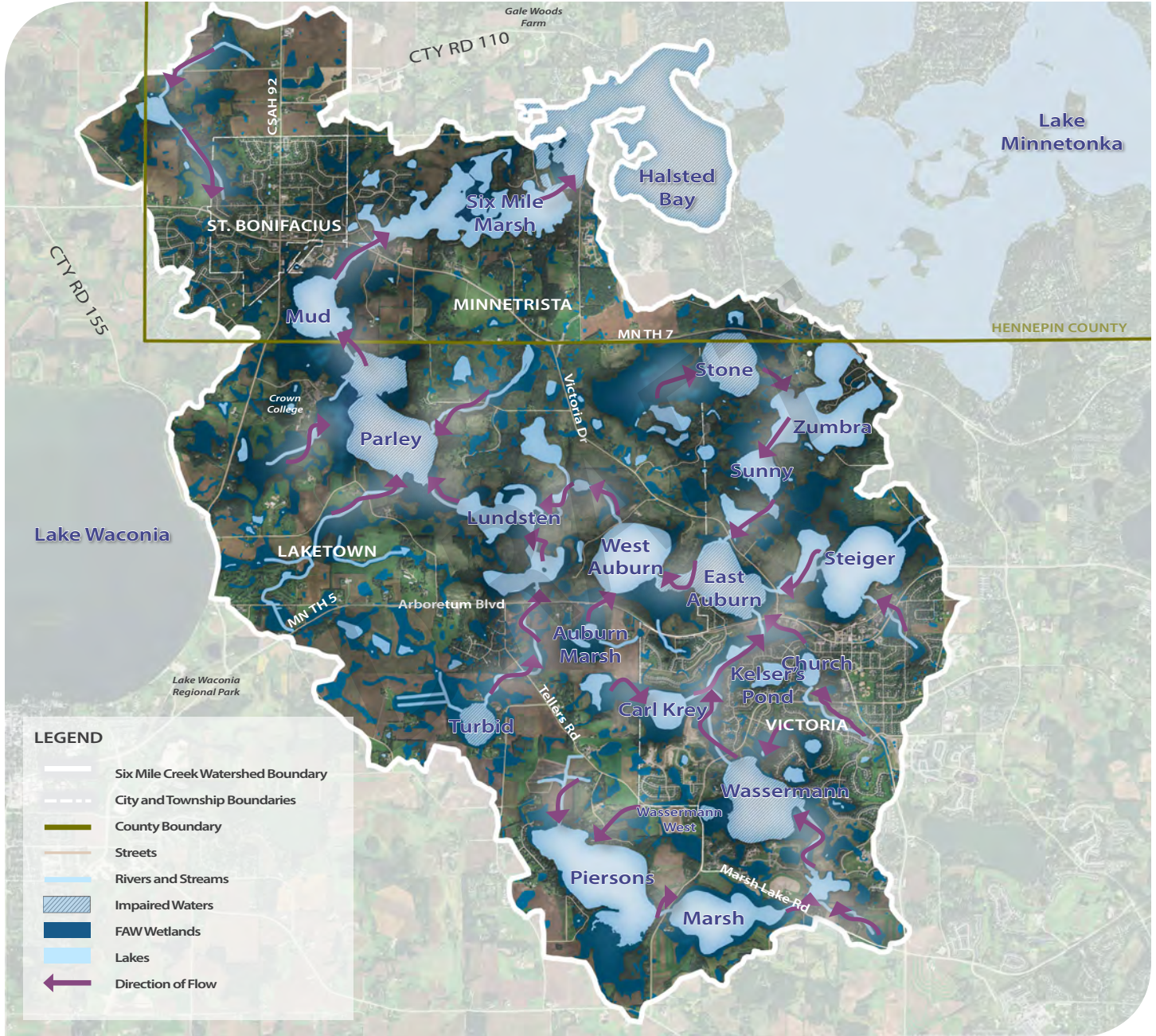
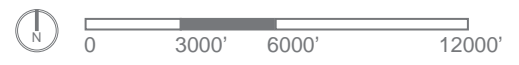


Figure 1.124 Six Mile-Halsted Bay Water Resources map



alignment and shoreland zones generate secondary impacts to water quality and ecological integrity by modifying stream flow regime and lake levels.

Wetlands:

The MCWD Functional Assessment of Wetlands (FAW) found that wetlands within the Six Mile-Halsted Bay system to generally function well for flood storage capacity and maintenance of hydrologic regime, with some exception for flood storage in the less developed areas in and around Minnetrista. However, the flow regime of many of the wetlands has been modified, driving symptoms that impact both the water quality and ecological integrity indicators for wetlands.

Groundwater:

A majority of the wetlands within the Six Mile-Halsted Bay system rely, at least in part, on recharge from surficial groundwater sources, rendering them sensitive to changes in groundwater supply.

Ecological Integrity:

Lakes and Streams:

Many of the lakes within the subwatershed have shallow lake characteristics, including large littoral areas. These characteristics can drive dense vegetation, both native and non-native. Aquatic vegetation supports habitat for aquatic species, food web interactions, and nutrient cycling, but can have adverse impacts, particularly when non-native species are present.

Aquatic plant biodiversity and habitat diversity range across the lakes in the subwatershed. These ecosystem services were recently assessed through the District's E-Grade Program, and while plant communities in some lakes provided for good conditions, several others were classified as poor or degraded. Eurasian watermilfoil and Curlyleaf pondweed are present in most lakes, but at varying abundances.

The fish community in the numerous lakes were also assessed through the District's E-Grade Program, and most were classified as poor to degraded communities.

Shoreline integrity varies widely across the subwatershed. Shoreline within the Carver Park system is largely intact given

the public ownership by a natural resources agency, but private development in the City and Township areas can impact the continuity of buffering along the shoreline, which protects lakes from erosion and preserves habitat.

Six Mile Creek is heavily altered, having been ditched and widened over time. The stream generally lacks biodiversity and has degraded habitat characteristics.

Wetlands:

With 5,127 acres of wetlands within the geography, a range of vegetative and biodiversity conditions exist within this system. Wetland assessments have identified many with low vegetative diversity and non-native species. Much of the wetland acreage still provides moderate support to wildlife and fisheries. There are a number of high- and moderate-quality wetlands in the subwatershed, many of which are situated in a nearly continuous natural corridor that provides significant functions and values such as runoff storage and water quality treatment as well as habitat and natural resources values, and should be prioritized for protection.

Upland and Natural Corridors:

The Three Rivers Park District's Carver Park Reserve covers much of the central subwatershed, preserving not only numerous lakes and wetlands, but also large swaths of forest and prairie. Large areas of undisturbed or minimally disturbed forest and wetland in the subwatershed have been designated Regionally Significant Ecological Areas by the DNR, including nearly all of the Carver Park Reserve. The Minnesota Biological Survey (MBS) identified several areas of moderate or high biodiversity significance both within and outside of the regional park. The MBS also identified both terrestrial and aquatic locations in the watershed with intact native plant communities. The Metropolitan Council has identified large areas within the subwatershed as important conservation corridors.

DRIVERS:

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either



directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Six Mile Creek-Halsted Bay subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Minnehaha Creek subwatershed are:

Water Quality

- » Excess nutrients
- » Low dissolved oxygen
- » Phosphorus export wetlands

Water Quantity

- » Modified hydrology
- » Localized flooding

Ecological Integrity

- » Degraded fish community
- » Degraded macroinvertebrate community
- » Degraded and disconnected wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

- » Common carp
- » Altered wetlands
- » Water quality from upstream waterbodies
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading

Common Carp:

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural

vegetation, harmful algal blooms, and the release of phosphorus from resuspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

For most lakes, carp densities need to be kept below 100 kg/ha to prevent declining water quality and ecological integrity. The 2016 University of Minnesota Six-Mile Creek Subwatershed Carp Assessment provides a detailed assessment of carp populations in the Six Mile system, with many waterbodies greatly exceeding the damaging threshold.

Altered Wetlands:

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

In the Six Mile-Halsted Bay Subwatershed, altered wetlands are a principal driver of degraded lake water quality for Wassermann, Turbid, East Auburn, South Lundsten, Parley, Mud, and Halsted Bay. Altered wetlands also reduce available habitat for migratory waterfowl and other bird species within the area.

Upstream Waterbodies:

Headwater streams, lakes and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters that can lead to eutrophication. Consequently, restoration of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Six Mile is particularly challenged in this regard because in several cases the upstream waterbodies are either not listed as impaired due to their waterbody characteristics or are held to shallow water body standards which allow for higher nutrient

concentrations, even if their downstream waterbodies are held to stricter standards.

Stormwater Runoff:

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as E. coli, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

The Six-Mile-Halsted Bay System experiences water resource issues from both developed areas and agricultural land uses. Areas of Victoria and most of St. Bonifacius were developed before today's more rigid stormwater standards were in place and continue to drive declining water quality in receiving waterbodies.

There are several areas in the subwatershed where ongoing agricultural land use continues to drive declining water quality in receiving waterbodies. More prominently, however, are impacts still felt today from the historic agricultural land use the subwatershed, including high concentrations of phosphorus

built up in waterbodies leading to internal sediment release and degraded and hydrologically altered wetland complexes that act as sources or transformers of nutrient pollution.

Altered Channels:

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Six Mile Creek has been heavily modified over time, likely to serve agricultural land which formerly dominated the landscape.

Internal Sediment Phosphorus Loading:

Long-term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Lakes where internal sediment release is or may be a driver in the Six Mile-Halsted Bay include Marsh, Wasserman, Church, North and South Lundsten, Turbid, Parley, Mud, and Halsted. In some of these lakes, internal release is proportionately small to other factors but still significant for achieving phosphorus reduction goals.

MANAGEMENT STRATEGIES:

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Six Mile-Halsted Bay subwatershed. These strategies are both short- and long-term, and establish a framework for the programs and projects utilized

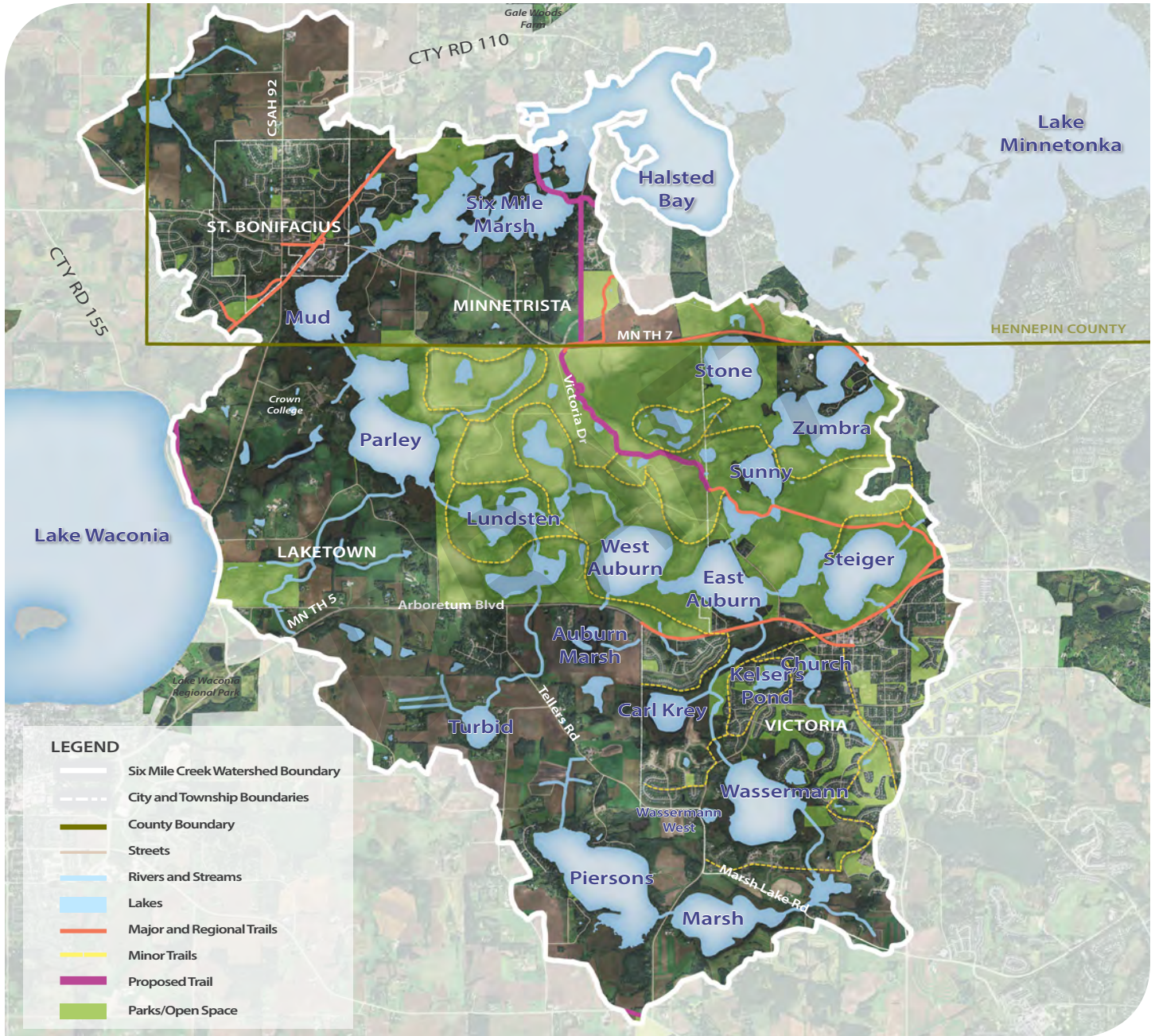
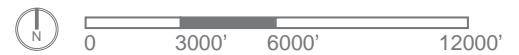


Figure 1.125 Six Mile-Halsted Bay Parks, Trails, and Open Space map



in the Six Mile-Halsted Bay subwatershed Implementation Plan. To best understand the strategies and efforts of the District and its partners within the Six Mile-Halsted Bay subwatershed, it is important to recognize the recent work in this subwatershed and the integration and alignment of natural resource management strategies with the goals of our communities.

Integrated Planning Approach:

As noted throughout this plan, the District’s overarching organizational strategy is founded in its Balanced Urban Ecology policy. This policy was established as the District’s fundamental philosophy and way of doing business – developed to guide all future planning and watershed management activities in order to achieve its mission of protecting and improving land and water.

The overarching strategy described in Balanced Urban Ecology policy is a vision of integration with government agencies, private landowners and developers, and philanthropic partners through multi-jurisdictional partnerships, emphasizing the economic and social value that natural systems generate for the built environment. It further describes how our work will be strengthened through these collaborative efforts to not only offer greater community impact, but to produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits.

Following the success in applying the Balanced Urban Ecology policy in the Minnehaha Creek Subwatershed, the District turned to The Six Mile-Halsted Bay Subwatershed in 2014 as the next geography in which to apply these lessons of partnership, integration, and flexibility. Six Mile-Halsted Bay stands in stark contrast to the Greenway – it is predominantly rural where Minnehaha is urban, the water resources issues are diffuse where Minnehaha is concentrated along a distinct stretch of the creek, and the area is still developing where Minnehaha is almost entirely built-out. However, the lesson learned in Minnehaha Creek was that certain geographies benefit from convening all watershed stakeholders to coordinate investments and develop a shared vision for the geography. Geographies benefitting from this approach are those with complex natural resource issues that cross jurisdictional boundaries, areas experiencing growth and development pressure, areas requiring a phased approach to capital project implementation, and areas with

existing support and partnerships.

Six Mile was identified as a priority geography for these reasons, as well as in part because implementation efforts following the 2007 comprehensive plan had been stilted by a lack of a comprehensive picture of the issues and drivers within the system. In 2013, the District conducted a comprehensive diagnostic assessment to gain a clearer picture of the issues and drivers within this geography. One of those drivers identified included invasive common carp, prompting the District to contract with the University of Minnesota to conduct an assessment of the recruitment, concentration, and movement patterns of carp in the system to inform subsequent management activities. These studies, along with other District wide studies and specialized assessments, serve as the backbone of understanding the interplay of issues, drivers, and management strategies in the Six Mile Creek subwatershed.

Beginning in early 2016, the District convened a group of public sector stakeholders in the subwatershed including the City of Victoria, City of Minneristra, City of St. Bonifacius, City of Waconia, Laketown Township, Carver County, Carver County Soil and Water Conservation District, Hennepin County, and Three Rivers Park District to form the Six Mile-Halsted Bay Subwatershed Partnership. As expressed in the Resolution of Support adopted by these partner agencies in March of 2017, the purpose of this Partnership is twofold:

- » Develop and adopt a subwatershed plan that identifies key water resource issues and strategies, identifies natural resource corridors, and accommodates local growth and development planning; and
- » Establish a framework for plan implementation, memorializing routine reengagement of the Partners for the purposes of aligning plans and priorities, forecasting upcoming projects, and establishing investment strategies, including sources of external funding, to be incorporated into capital improvement plans;

Because of the scope and scale of management activities within this 27 square mile geography, not all implementation opportunities can be identified in advance, rather, implementation activities will need to be prioritized and reprioritized based on the strong scientific foundation the District has established and with input from the partnership.



The Partnership has established a shared vision for the subwatershed that preserves and enhances natural resources ; wisely anticipates the growth and development of vibrant communities; promotes the preservation of distinctive areas; recognizes that natural systems can serve to underpin local identity and sense of place; builds strong community connections through transportation infrastructure, trails, parks, and schools; and integrates natural and built systems to enhance the long term social and economic value of communities. As the District prioritizes the following management strategies in real time, that vision will be the guide and the goal. The following provides a general overview of the management strategies, which are detailed with more specificity within each management unit section.

Carp Management:

Historically, carp management focused on removal of carp populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

Wetland Restoration:

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of

wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

Stormwater Management:

Stormwater management will focus on reducing runoff volume and rate, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

Whole Lake Drawdown:

One of the limiting factors for a healthy, diverse submersed aquatic vegetation community in shallow lakes is loose, unconsolidated sediments that are high in nutrients. During restoration of a nutrient enriched shallow lake, whole lake drawdown is often required if the plant community does not respond to nutrient and rough fish management. The goal of whole lake drawdown is to expose as many of the lakes sediments as possible during late summer to promote sediment consolidation and denitrification. During drawdown, the submersed aquatic vegetation seed bed is reinvigorated, resulting in significant sprouting and growth of submersed aquatic vegetation.

Stream Channel Restoration:

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and reaeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Sediment Phosphorus Control:

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes.

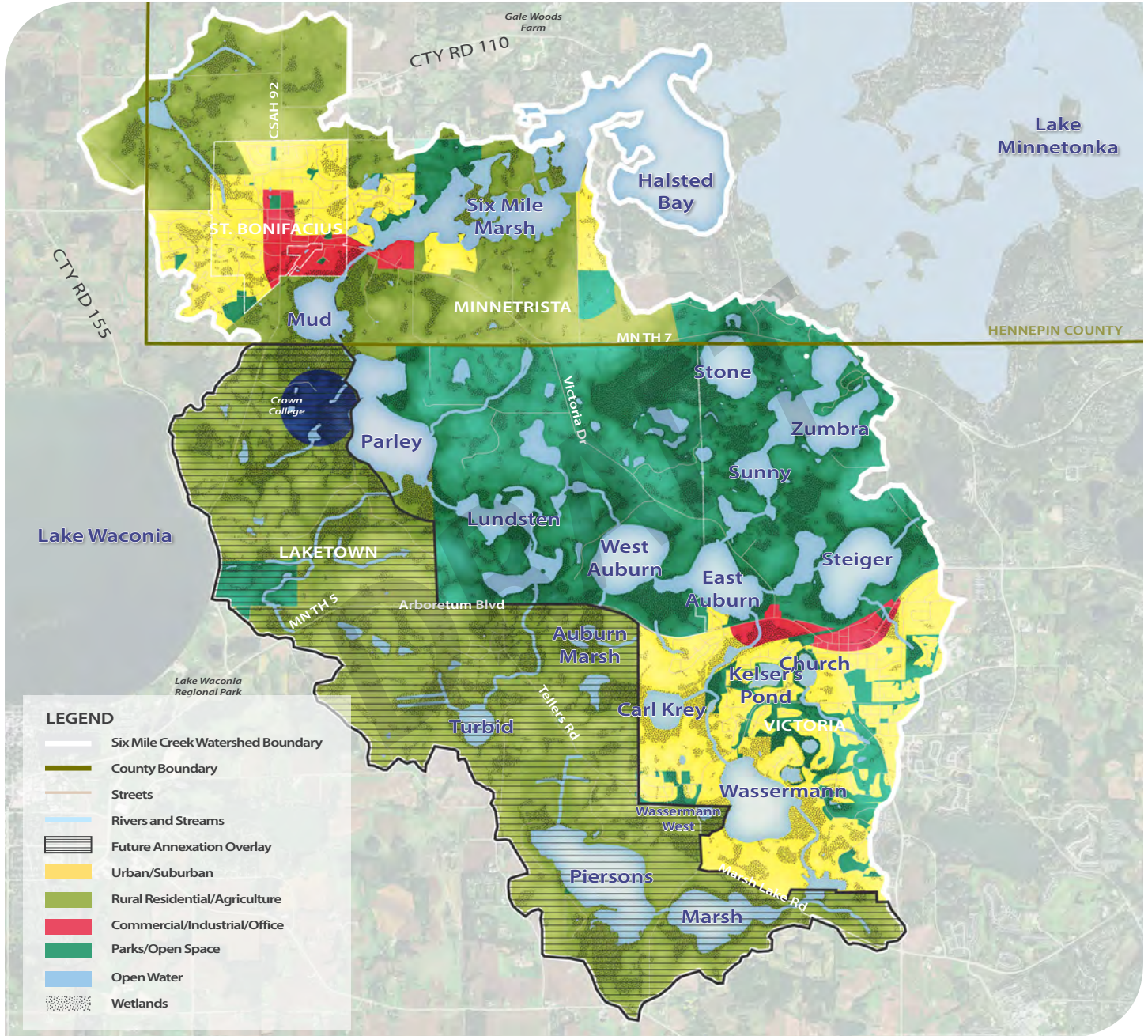
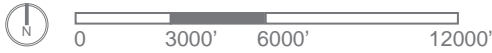


Figure 1.126 Six Mile-Halsted Bay Land Use map





There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Watershed Protection:

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

The District has a strategic interest in protecting and creating greenway corridors through the Six Mile subwatershed. According to the American Planning Association, interconnected systems of parks and open space:

- » Provide a higher level of benefit for people, wildlife, and the economy than do parks in isolation
- » Help preserve essential ecological function and protect biodiversity
- » Can help shape urban form and buffer incompatible uses
- » Can reduce costs for stormwater management, flood control, transportation, and other forms of built infrastructure

The District will proactively evaluate opportunities to acquire, through fee or easement, properties suitable for greenway connection in coordination with City and County partners. It will also support similar efforts, through acquisition or regulation, by partners that generate new and preserve existing linkages. The District will cross reference conservation corridors

developed by other agencies as properties are considered for protection.

LAND USE: EXISTING CONDITIONS

The Six Mile-Halsted Bay subwatershed contains three cities – St. Bonifacius, Minnetrista, and Victoria, and Laketown Township. These communities span two counties: St. Bonifacius and Minnetrista are in Hennepin County and Victoria and Laketown Township are in Carver County. The City of Waconia is currently outside of the District boundaries, but will be annexing land currently within the Laketown Township portion of the District. Three Rivers Park District's Carver Park Reserve, at 3,700 acres, also constitutes a large portion of the Land area of the subwatershed.

The principal land uses with the Six Mile-Halsted Bay subwatershed according to the MLCCS data set are agriculture (17%), developed (16%), grassland (16%) and forest (14%). This water resources (open water, emergent marsh, and wetland) make up 28% of the watershed.

This subwatershed is one of the least developed within the District. Historically, agriculture has been the predominant land use within the Six Mile-Halsted Bay geography, principally crop (alfalfa and corn) and dairy operations. Agricultural production has driven substantial change to pre-settlement hydrology – ditching and straightening the channel through and between wetland reaches, laying drain tiles to keep agricultural fields clear of water, creating new channels to facilitate drainage, and modifying groundwater recharge while increasing withdrawals.

Beginning in the 1950s, pockets of residential development began to emerge in the landscape, particularly in and around the area that is now St. Bonifacius and in the City of Victoria. Today, the Six Mile-Halsted Bay subwatershed is anticipated to be one of the fastest growing regions of the District. Met Council's 2030 population projections anticipated the area would add [number] constituting a [%] increase. The most recent Met Council projections reduced the expected pace of residential growth in the area to [number] [%].

The area of highest anticipated residential development is

in and around the City of Victoria in what is now Laketown Township. The Cities of Victoria, Chaska, and Waconia have an orderly annexation agreement which overtime will lead to the annexation of all of present day Laketown Township. Laketown will dissolve as a governmental unit when it is no longer economically viable.

The northern portion of the subwatershed will have less anticipated development in the near term. St. Bonifacius is approximately one square mile and is nearly entirely built out. The City of Minnetrista anticipates some growth but most of the area within Six Mile-Halsted Bay will remain agricultural under an urban reserve classification.

Parks and Trails are a dominant feature on the Six Mile-Halsted Bay landscape. The 3,700 acre Carver Park Reserve provides significant recreational opportunity while preserving high quality ecological areas and buffering many of the lakes and wetlands from development impacts. The City of Victoria is connected from the east by the Lake Minnetonka Regional Trail, and the City has a network of local trails and bike friendly roads that spur from the regional trail's termination point. In the Northern portion of the geography, the Dakota Regional Trail, which spans from New Lester to Wayzata, runs through St. Bonifacius and Minnetrista. In addition to these existing regional corridors, Three Rivers Park District has plans for a new regional trail that would connect Carver Park to Baker Park in Maple Plain. The City of Victoria's 2030 comprehensive plan anticipates the extension of the Lake Minnetonka regional trail along highway 5 towards Waconia and a regional trail spur running south-east towards Chaska.

LOCAL PLANS AND PRIORITIES

City of Minnetrista

The City of Minnetrista will experience limited development within the near term planning horizon, with the exception of possible commercial development along highway 7 and some expansion from Woodland Cove on Halsted Bay and Hunter's Crest in the northwest Mud Lake drainage area. The City also anticipates roadway expansion and improvements, which can be critical coordination opportunities as they have the potential to trigger stormwater regulations and impact wetlands.

From a water resource perspective, the City will continue to

support the identification of implementation opportunities and funding sources to address the Halsted Bay TMDL.

City of St. Bonifacius

The City of St. Bonifacius is geographically small and almost entirely built out. There is only one area with potential for new development, and otherwise the City anticipates some single parcel redevelopments, dependent upon private real estate transactions. The City has noted that the single vacant parcel would require wetland mitigation and would therefore like to have the District at the table. The City notes that new development outside of its jurisdiction will impact traffic and potentially require infrastructure investment. The City also has interest in improving its trail and sidewalk networks.

Principal water resource concerns for the City include degraded wetlands to the northwest and challenges associated with maintaining stormwater infrastructure.

City of Victoria

The City of Victoria is a fast growing community with substantial new development at the urban fringe as land is annexed into Victoria from Laketown Township. The City has two potential growth corridors: South of Marsh Lake Road towards Chaska, and West of highway 43 and Wassermann Lake, including the area around Carl Krey. The City will coordinate closely with the District to incorporate natural resource improvements with new development, particularly as much of the anticipated growth corridors correspond with Wassermann, Marsh, Pierson and Carl Krey. As the City develops, it will focus on connecting people to natural areas through the development of a trail system and green corridors around the lakes.

The City shares many of the identified natural resource priorities with the District, including addressing the Wassermann's impairment and protecting non-impaired water bodies. Additionally, the City would like to move increasingly towards regional stormwater management within new developments, in coordination with the District.

City of Waconia

The City of Waconia does not anticipate growth within the Six Mile-Halsted Bay geography for another 15-20 years. The City of Waconia is a growing community, though the growth



projections have been slowed for the upcoming planning cycle, as they have in many exurban communities. The City of Waconia prioritizes the efficient use of land and extends infrastructures service only to areas where these services can be provided in a cost effective manner. This means maintaining compact and regular growth patterns and preserving exurban farm land and natural areas. Areas outside of the current City will continue to be zoned by Carver County, but the City advises no multi-lot subdivisions should be permitted in advance of City development.

The City does not yet have specific water resource concerns within the Six Mile-Halsted Bay subwatershed, but in general the City is working to identify and execute upgrades to existing older infrastructure in the City core and implement innovative water management strategies in newer developments.

Laketown Township

The Cities of Victoria, Waconia, and Chaska have an orderly annexation agreement that would result in the complete annexation of Laketown Township over time. The Laketown Board has limited authority over land use and relies on County Zoning. As the land develops and is annexed, the Township would like to see natural resources protected and improved concurrent with or in advance of new infrastructure installation. The Township is particularly invested in protecting and improving Pierson and its drainage area, through direct capital investment and addressing potential sewerage service failures.

Three Rivers Park District

Three Rivers Park District (TRPD) is Hennepin County's regional parks authority. Carver Park Reserve is one of three parks that lies outside of Hennepin County, its taxing jurisdiction. The Property was acquired through donation. The property contains a nature center, historic farm, and extensive bike, pedestrian and equestrian trails. Many of the subwatershed's high value resources are located within park, and the park serves as an important protection role for these resources. There are no major changes to land use anticipated within the park, but TRPD does have long term plans to extend a regional trail north out of Carver Park to Baker Park in Maple Plain, which may present coordination opportunities over the coming years.

TRPD is a mission-driven organization focused on promoting

environmental stewardship through recreation and education within its nature-based park system. As such, it shares many of the District's water resource priorities, including managing carp and preserving high quality natural resources within and adjacent to its parkland.

WATER RESOURCE MANAGEMENT UNIT

Due to the Six Mile-Halsted Bay geography's size, complex drainage patterns and nutrient interactions, and mosaic of jurisdictions and authorities, the subwatershed was divided into five management units. These management units reflect both the jurisdictional boundaries and the distinguishing natural resource interactions. Each management unit walks through the issues, drivers and strategies framework in more detail and with specific reference to primary water bodies of concern and specific management strategies. Management strategies were further informed within this section by coordination with the Six Mile-Halsted Bay Planning Partnership.

PIERSON-MARSH-WASSERMANN

The Pierson Marsh Wassermann management unit begins in the south-western corner of the subwatershed in Laketown Township and runs through the City of Victoria, terminating near downtown Victoria at Carver Park Reserve. Pierson Lake is the headwaters of the system and has a small drainage area with agriculture and rural residential development. Pierson Lake outlets at its southern edge and runs into Marsh Lake, a shallow, natural-resource lake with no shoreline development. Marsh runs through several large wetland complexes into Wassermann Lake, which is also the edge of Victoria's current City line. Wassermann drains towards East Auburn through several large wetland and pond complexes. A separate drainage runs from Church Lake and Victoria's downtown into East Auburn.

EXISTING CONDITIONS AND ISSUES

The Pierson-Marsh Wassermann system is the headwaters of the Six Mile subwatershed. Pierson Lake has good water quality and is largely a protection area. Marsh exhibits elevated phosphorus at its lake outlet, indicating possible internal release. Wassermann is impaired for nutrients and requires 62% or 470 lbs/day total phosphorus reduction to meet state deep

water quality standards.

The smaller lakes along the creek north of Wassermann are generally of good water quality, with the exception of Church Lake, which has fluctuated around state standards for quality and clarity, likely associated with upstream pollutant loading.

The area contains many large wetland complexes. There are a number of complexes immediately adjacent to agricultural land use that are poor quality, likely due to altered hydrology and associated vegetation impacts. The large wetland complex running along the creek between Wassermann north of highway 43 to highway 5 is likely a significant source of external phosphorus loading to East Auburn Lake.

Marsh is a shallow lake with 100% littoral area, resulting in abundant plant growth of both native and non-native species. Its shoreline is currently fully intact and is largely wetland fringed.

Wassermann has a degraded aquatic plant community and a poor fish community.

Anecdotal evidence suggests that Pierson Lake's fishery has improved since a 20XX removal effort.

DRIVERS

Pierson has a small subwatershed and much of the phosphorus loading is from stormwater runoff from the surrounding agricultural landscapes. The agricultural drainage has been heavily modified through the introduction of drain tiles and ditches. Carp within the lake are currently below the impact threshold but it remains connected to spawning areas and needs to therefore be monitored while carp reproduction remains active.

The elevated phosphorus levels at the outlet of Marsh Lake indicate that internal loading is the likely driver of moderately elevated phosphorus levels, which could be attributed to carp or internal release. The U of M carp assessment identified Marsh as a potential carp nursery, fueling the adult carp population in Pierson and Wassermann. The properties adjacent to Marsh will likely experience suburban development in the coming decade, including a roadway improvement to Marsh Lake Road which will likely facilitate additional residential development,

potentially impacting water quality and the currently intact shoreline integrity.

Wassermann's poor water quality is driven by both internal and external phosphorus loading. The principal external sources are wetland complexes draining to the lake. Internal loading is partially driven by decades of accumulation of phosphorus-laden sediment from the surrounding drainage area, which was almost entirely agriculture and rural residential until the 1990s. The high density of carp in Wassermann further drives the internal release of phosphorus, in addition to negatively impacting the clarity and plant vegetation.

This management unit will face significant growth pressure in the coming decades as both Waconia to the east and Victoria to the west grow in population and annex land in Laketown Township under an orderly annexation agreement, which they share with Chaska. The primary growth corridors for Victoria's 2040 Comprehensive Plan are [describe 1 – Carl Krey] [describe 2 – Marsh Lake]. Development in this area will present opportunities to preserve and enhance natural resources systems and enforce District rules designed to minimize the impact of new development, in some cases resulting in improved conditions over current agricultural use.

Development will be a significant factor in natural resource protection and enhancement in the coming decades. District stormwater rules can result in improved water resource outcomes, particularly when transitioning from agriculture. Development will provide opportunities to coordinate on wetland enhancements, create contiguous natural resource corridors, and generate other water quality projects. However, development can also have adverse impacts by altering natural hydrology and creating wetland fill. Some categorical exceptions to the District phosphorus rules may cause increased pollutant loading. This drainage area will experience the most land use change in the near time of any other area of the subwatershed given Victoria's projected growth and annexation.

MANAGEMENT STRATEGIES:

Carp Management:

Carp management will be a principal strategy within this management unit. Refer to the Six Mile Carp management plan for a detailed overview of the carp management approach.



Strategies presented in the management plan will include:

- » Aeration of Marsh Lake to prevent winterkill and reduce carp recruitment
- » Temporary barrier at the outlet of Wassermann to prevent fish from reentering Wassermann from downstream lakes during management
- » Adult biomass removal in Wassermann Lake. Piersons Lake is currently below the threshold, and should be monitored periodically, but no further action is needed at this point.

Stormwater Management:

As new developments occur in the City, Victoria will increasingly work to identify regional stormwater solutions. Regional stormwater management can improve water resource outcomes over site by site management by incorporating areas that may otherwise be exempt from regulatory compliance and by treating the entire drainage area upfront, bringing the area into compliance immediately.

In the developed areas of downtown, there may be opportunities for retrofitting or enhancing existing stormwater facilities to improve treatment capacity of stormwater above existing regulatory requirements.

Agricultural best management practices will not be a strategy employed primarily by the District but it will provide technical support to agencies and landowners seeking to take advantage of existing programs.

Wetland Restoration:

There are several large wetland areas that will be targeted for phosphorus load reduction, including those north of Pierson Lake, Between Marsh and Wassermann, and along the creek between highway 43 to highway 5. Strategies may include hydrologic alteration, vegetation enhancement, soil amendments, or outlet filtration. Some of the wetland complexes that are identified phosphorus export wetlands are owned in City outlots, facilitating restoration.

Internal Sediment Phosphorus Control:

Internal phosphorus loading is a significant source of nutrient pollution in Wassermann Lake. The 2012 Six Mile diagnostic

recommends alum dosing to provide internal load control. Carp tend to stir up bottom sediments in littoral areas and can reduce the effectiveness of alum, so carp control must precede alum treatment. Marsh Lake may be a target for similar internal control.

Landscape Protection and Restoration:

Urban growth is anticipated to continue in this management unit. The District will evaluate opportunities on an ongoing basis for strategic acquisition in fee or conservation easement to ensure that natural resource protection and development goals are compatible. Priority landscape areas in this management unit may include:

- » Shoreline protection on Marsh and Pierson Lakes
- » Preserve wetland complexes in exurban areas
- » Degraded, hydrologically altered wetlands
- » Areas with steep slopes adjacent to water resources
- » Areas otherwise identified through District studies and evaluation (E-Grade, etc)

City of Victoria has interest in connecting people through development of trails, which can be strategically integrated into land use planning and acquisitions.

UPPER CARVER PARK RESERVE

Upper Carver Park includes Lakes Zumbra, Stone, Sunny, and Steiger. The management unit is almost entirely within Carver Park and all lakes exhibit good water quality. Both Zumbra and Stone are headwaters Lakes with relatively small drainage areas that drain into Sunny Lake, Zumbra directly and Stone through a wetland complex. Sunny then flows towards East Auburn through a large wetland complex. Steiger receives drainage from downtown Victoria, then drains through a separate wetland complex, also into East Auburn. Given that the land is owned almost entirely by Three Rivers Park District as a park preserve, the water quality within this drainage area can be anticipated to remain stable.

EXISTING CONDITIONS AND ISSUES

All lakes within the subwatershed have good to excellent water quality. Though Stone was listed on the state impaired waterbody list in 20XX, it has improved every year since 2000

and should be considered a protection watershed. Zumbra has excellent water quality and a small watershed which keeps it well buffered from watershed loading. Steiger does have somewhat elevated phosphorus levels, but has not seen any concerning trend over the monitoring time period and continues to be in good health overall.

Phosphorus concentrations jump significantly between both Sunny and East Auburn and Steiger and East Auburn, indicating the wetlands are contributing phosphorus to surface water. These wetlands are important target areas for nutrient pollution reduction.

This drainage area experienced localized flooding associated with the 2014 high water event. Further investigation found that in heavy rain events, Sunny Lake rises faster than Zumbra and creates backwater flooding into Lake Zumbra. The District will continue to investigate possible solutions and mitigation strategies.

The aquatic plant communities in Sunny, Steiger and Stone are in poor condition, and the Fish IBI score for Steiger is classified as poor. Sunny and Stone cannot be assessed by the Fish IBI due to their size and depth. Zumbra generally has a good aquatic plant and fish community.

Though there is some private ownership within Carver Park Reserve and a few drainages to Carver lakes that enter from outside the Park proper, overall the management unit is held almost entirely by Three Rivers Park District and there are therefore no major land use issues facing the management unit. It is possible that the agricultural legacy within the Park has some impact on existing impairments, but without land use change and with Three Rivers sharing natural resource protection as foundational to their mission, land use itself will not be a significant factor in the management unit.

DRIVERS

For the most part, water quality within this management unit is stable and good, likely in part due to the substantial natural resource buffer the Carver Park Reserve provides.

Steiger Lake's moderate water quality is likely driven in part by stormwater runoff from downtown Victoria. This area of Victoria

is fully built out, but as redevelopment occurs under more stringent stormwater rules some reduction may be achievable.

The four lakes also have relatively low carp populations. The 2016 U of M Carp Assessment confirmed that the carp populations within each lake are largely isolated from one another due to a rather complex series of water control structures. Future changes to or replacements of these structures should consider the impact on carp populations.

STRATEGIES:

Wetland Restoration:

The wetland complexes running from the outlets of Sunny and Steiger to East Auburn need to be evaluated for wetland restoration to control phosphorus export. A complementary project may be the construction of a lake outflow bypass pipe, which would circumvent the degraded wetland complex for water leaving Sunny and Steiger. However, this idea may have fish passage or wetland hydrology implications that would need to be further evaluated. There are other restorable wetlands within Carver Park Reserve that may be considered for restoration to improve habitat function and value on an opportunity driven basis.

Carp Management:

Sunny Lake is a potential carp nursery location and will be considered for winter aeration, or at least monitored annually for carp recruitment. The current barrier at the Zumbra outlet is also in need of repair, and should be fortified as it currently overtops in high water conditions. Minimal adult biomass removal is needed in Steiger, Zumbra and Sunny to bring population levels to the desired threshold. Stone Lake is already below the threshold, and requires no management actions.

Landscape Protection and Restoration:

As TRPD works to acquire land to develop the regional trail connection between Carver and Baker Parks, there may be opportunities where new trail connections correspond with resources or potential project locations within the Six Mile-Halsted Bay Geography. The District and TRPD will coordinate acquisitions in the trail corridor to identify potentially mutually beneficial acquisition opportunities.

LOWER CARVER PARK RESERVE



The lower Carver Park Reserve management unit includes East Auburn, West Auburn, and North Lundsten Lakes. East Auburn receives drainage from both the Wassermann and Upper Carver Park management units and its water quality is substantially impacted by its being a collection point for the upper watershed. North Lundsten is a very shallow lake with an average depth of 4.4 feet and a very short residence time. It receives drainage from both West Auburn and South Lundsten.

ISSUES

East Auburn is impaired for nutrient pollution and has an adopted TMDL requiring a load reduction of 546 lbs/year. Both West Auburn and North Lundsten demonstrate relatively good water quality, though North Lundsten has demonstrated some eutrophic indicators and elevated phosphorus levels.

Wetlands within this drainage area are generally high quality and classified as preserve. They are well buffered from degradation given their location within Carver Park. Auburn Marsh, a wetland draining to West Auburn, is identified by the DNR biological survey as a site of biodiversity significance. Much of the drainage area has also been identified as MLCCS regionally significant ecological areas and DNR regionally significant ecological areas.

These lakes all consist of poor aquatic plant communities, and Fish IBI scores for East and West Auburn indicate a poor fish community. North Lundsten cannot be assessed with the Fish IBI tool due to its size and depth.

The drainage area is located entirely within Carver Park Reserve and there will therefore be no development or significant land use change.

DRIVERS

East Auburn's impairment is driven largely by the phosphorus exporting wetlands in both the Wassermann and Upper Carver Park drainage areas. Upstream lakes are also a significant factor in East Auburn's impairment, with Church and Wassermann Lakes contribute approximately 36% of the load to East Auburn. These lakes will need to meet state water quality standards for East Auburn to meet state water quality.

Observations of elevated phosphorus levels in North Lundsten

are driven primarily by phosphorus export from South Lundsten, which is a highly eutrophic waterbody. There does appear to be differentially levels at the inlet and outlet of North Lundsten, which indicates some amount of internal loading driving North Lundsten's elevated phosphorus levels.

Though carp do not seem to be a principal driver of water quality issues within the Lower Carver Park drainage area, carp biomass is moderately high in both West and East Auburn and North Lundsten. North Lundsten is also a potential carp recruitment area, and warrants winter time aeration to prevent winterkill.

STRATEGIES:

Carp Management:

Adult biomass removal will be necessary to reduce the carp density below the damaging threshold in all three lakes in this system. South Lundsten is the principal nursery for this area, along with some contribution from North Lundsten, so aeration of those lakes will need to precede removal activities. Multiple removal methods could be utilized to reduce adult carp populations in these lakes, including winter or open water seining, box-net trapping and trapping of carp in channels used for migration.

Wetland Restoration:

Wetlands driving poor water quality within East Auburn are those beginning at the outlets of Wassermann, Sunny, and Steiger and draining to East Auburn. These wetland complexes will be evaluated for bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells.

Internal Load Management:

The contribution of internal loading to North Lundsten's elevated phosphorus levels should be further evaluated and alum may be employed to address downstream loading concerns. Eventually, whole lay drawdown may be used to reset the shallow lake ecology following successful carp management.

Upstream Lake Improvements:

Restoration of upstream lakes in the Pierson-Marsh-Wassermann

corridor will be critical in addressing East Auburn's impairment, with upstream lakes contributing approximately 32% of the phosphorus load into East Auburn.

It seems that the elevated phosphorus levels in North Lundsten are driven almost entirely by the highly degraded South Lundsten, which in turn drives the impairment of Parley Lake. Though South Lundsten is a wetland and therefore not subject to state water quality standards, its degraded state drives other impairments and therefore nutrient reductions need to be prioritized.

TURBID-SOUTH LUNDSTEN

The Turbid-South Lundsten management unit lies just west of Victoria in Laketown Township. Though Turbid and Pierson Lake are approximately one mile away from one another, they are hydrologically disconnected, with their tributaries flowing in opposite directions. This management unit is relatively small and contains only two waterbodies connected by a low gradient stream flowing through several degraded wetland complexes. A majority of the land in this management unit is in Laketown Township, though South Lundsten is entirely within Carver Park Reserve. Outside of Carver Park Reserve, the land is almost entirely agricultural with one single family subdivision, Rolling Meadows. The subwatershed is in the long-term growth trajectory of Victoria, though likely outside of the next 20 year plan cycle.

ISSUES

Turbid Lake is at the headwaters of the management unit. It has a large littoral area, despite being a deep lake. Turbid is impaired for nutrients and requires both internal and external load reduction. South Lundsten is a larger, shallow lake, with extremely high phosphorus concentrations. Because it is classified for TMDL purposes as a wetland there are no mandated reductions for this waterbody.

Wetlands within this drainage area are largely degraded and water quality monitoring along the creek indicates they are significant contributors to elevated phosphorus in both water bodies. Much of the land around South Lundsten and within Carver Park Reserve has been identified by DNR as having biodiversity significance or as a regionally significant ecological corridor.

The aquatic plant community in South Lundsten is considered poor, while the community in Turbid is considered degraded. Neither lake is large enough or deep enough to be assessed with the Fish IBI tool.

Land use within this management unit is agricultural and residential. The management unit is near what will eventually be the western edge of the City of Victoria, but is not anticipated to development within the near time. As such, implementation activities will likely precede development.

DRIVERS

Turbid and South Lundsten's poor water quality are driven by similar factors. Nutrient loading to Turbid Lake is dominated by internal loading, representing 65% of the phosphorus load to the lake. Watershed loading represents the other major contribution to nutrient pollution, principally from the large wetland complex to the west of the Lake.

South Lundsten experiences an extremely high internal phosphorus release rate. Watershed loading is also quite high when evaluated by concentration, though it is proportionately only 17% of the total load. Much of the watershed loading can be attributed to the degraded wetland complexes between the two waterbodies.

Carp biomass is high in Turbid and moderate in South Lundsten. Both lakes are also production areas, with South Lundsten being an active and highly productive carp nursery for the upper watershed system.

STRATEGIES:

Carp Management:

The Turbid-Lundsten Corridor is high priority for near-term carp management activities. Both lakes require aeration to prevent ongoing carp recruitment. South Lundsten, in particular has been identified as a principal recruitment area, with carp dispersing as far as Wassermann from this Lake. Once these systems are aerated, adult removal may also be prudent.

Wetland Restoration:

Two feasibility studies completed in 2010 identify a multi-phased wetland and stream restoration project to substantially reduce watershed loading to both Turbid and South Lundsten



Lakes. The project includes wetland restoration and hydrologic modification in the drainage area to Turbid Lake and in the Wetland and stream corridor between Turbid and South Lundsten. The project may have secondary benefits of restricting carp movements between the two waterbodies. The project may be implemented concurrent with or in advance of development reaching this area of the subwatershed.

Landscape Restoration and Preservation:

The proposed wetland restoration within this subwatershed will result in changes in hydrology that will increase wetland acreage, in some cases on land that is currently within agricultural production. The District may employ its land conservation program to maximize the opportunity for this project to address downstream loading concerns. These wetland areas would eventually be deeded to the City of Victoria when this area developments, so the District would not only work in close coordination with the landowners, but also the city who will eventually have jurisdiction in this area.

PARLEY-MUD-HALSTED

The Parley-Mud-Halsted management unit constitutes the whole lower watershed drainage area. With a dam between North Lundsten and Parley Lakes, this management unit is hydrologically disconnected from the upper subwatershed. In this drainage, water flows from Parley into Mud, then travels approximately 3 miles through Six Mile Marsh into Halsted Bay. The drainage area is mostly within Hennepin County in Minnetrista and St. Bonifacius, but some of the Parley lakedesh is currently in Laketown Township in an area that eventually will be annexed by the City of Waconia as they grow east.

ISSUES

Both Parley and Mud lakes are highly eutrophic shallow lakes with high total phosphorus concentrations. Parley Lake has an approved TMDL requiring a reduction of 1,270 lbs/ year, or a 44% reduction. Mud Lake has very high phosphorus, but is considered a wetland for TMDL development purposes. Both lakes have degraded and low diversity vegetative communities.

Halsted Bay has an approved TMDL requiring the largest phosphorus load reduction in the District. It routinely falls well above state standards for nutrient concentrations, Chlorophyll-a, and clarity. The plant community of Halsted Bay

is highly degraded and dominated by Eurasian water milfoil, coontail, and Curly-leaf pondweed.

This management unit contains numerous large wetland complexes, including Six Mile Marsh, which spans the three miles from Mud Lake to Halsted Bay. There are numerous other large, degraded wetlands which are likely a significant source of phosphorus pollution into the lakes.

Land use within this management unit is mostly rural residential and agricultural. The City of St. Bonifacius, a one square mile community just north of Mud Lake, is almost entirely built out with some redevelopment anticipated and a few remaining vacant parcels. The population center at St. Bonifacius also supports several residential developments just across the City line in Minnetrista. Little land use change is anticipated in the near term in the Minnetrista area except on some specific parcels adjacent to St. Bonifacius and along Six Mile Marsh.

DRIVERS

2006 monitoring observed very high levels of primarily orthophosphorus coming from the drainage directly east. Modeling of Parley Lake indicates that that it is driven by internal loading (17%), loading form the direct drainage area (38%), and loading from upstream North Lundsten Lake (41%). Several wetlands in the direct drainage area have been identified as potential sources of phosphorus loading, but require additional analysis. In total, Parley requires a 44% reduction, with the greatest reduction needed being in internal loading (61%).

Mud Lake experiences elevated phosphorus levels driven by both watershed loading and inputs from upstream Parley Lake. Internal loading is proportionately small but not insubstantial. For Mud Lake to meet water quality standards for shallow lakes, aggressive reductions in both internal (67%) and external (95%) are required.

Halsted Bay is driven principally by loading from Six Mile Creek (50%), followed by internal loading (40%). A 2017 technical evaluation provided a more in-depth analysis of the loading from Six Mile Creek to determine the respective contributions from Mud Lake itself as compared with Six Mile Marsh. The results indicate that Six Mile Marsh contributes about 4-8% of the load, which is significant for a single phosphorus source.

More significantly, the analysis found the wetland to be a significant transformer of phosphorus, settling out particulate phosphorus and releasing dissolved, which is more difficult to treat.

Carp are a significant factor in this system. Carp populations are very high in all three lakes, particularly in Halsted Bay itself, where the U of M researchers found carp concentrations higher than observed anywhere else in the Center's history. Carp move freely between the three lakes. The carp assessment identified three likely recruitment areas within the management unit: Mud Lake, Big SOB, and a pond on Crown College campus. The landowner of Big SOB has already begun aeration. Some carp are able to migrate from South Lundsten into Parley Lake, but traveling back upstream is restricted by the dam.

STRATEGIES:

Carp Management:

Managing carp in this 3-lake system will require a multi-pronged and adaptive approach. The 2017 U of Carp Assessment recommends the following approach:

- » Installation of a permanent barrier along Six Mile Marsh to create two district carp management units, Parley-Mud and Halsted Bay
- » Control recruitment through aeration or barriers to block access to Mud Lake, and either aeration or hydrologic separation of crown college pond. Continue to aerate SOB Lake.
- » Adult biomass removal following successful suppression of recruitment.

Internal Load Control:

Following successful reduction of the adult carp population, alum may be used to address ongoing internal phosphorus release in Mud and Parley.

Alum will also be a strategy for reduction of internal phosphorus release in Halsted Bay. While typically the recommendation would be to control carp populations first, it may be feasible in Halsted Bay to apply alum in the deep areas of the lake while carp populations are still high in the littoral zone.

Whole Lake Drawdown:

Following or concurrent with reductions in the adult carp population in both Mud and Parley Lakes, whole lake drawdown may be considered to restore plant vegetation and return the lakes to a clear water state.

Wetland Restoration:

Restoration of large, degraded wetlands draining to both Mud and Parley Lakes will be principal strategies for reducing watershed loading. There are several, smaller wetlands identified in the Mud Lake Drainage Assessment that will also be targeted concurrent with local development and investment.

Stormwater Management:

The 2017 Mud Lake Assessment identified existing stormwater facilities in the City of St. Bonifacius that could be retrofitted with enhanced filtration facilities to increase its effectiveness at removing phosphorus pollution. Retrofitting existing facilities will be coordinated with local priorities and infrastructure investments. The Mud Lake Assessment also provides a detailed analysis of the most cost effective retrofit opportunities.

Application of agricultural best management practices will also be an important strategy within the Mud and Parley Lake drainage areas. The District will support agency partners and landowners in identifying resources to implement agricultural best practices but will not play a direct role in implementation of agricultural practices.

Alum Injection Facility:

While the goal ultimately is to fully restore upstream Mud and Parley Lakes, the process for doing so will take years of implementation and require leveraging significant external funding. In 2012, the District evaluated the feasibility of a structure solution to phosphorus loading in Halsted Bay and identified the option to build an offline alum injection facility that would treat water moving through the creek before entering Halsted Bay, substantially reducing the large load coming through Six Mile Marsh. The lifecycle of such a solution would be approximately 30 years, providing an interim solution while the upstream system is restored.

Landscape Protection and Restoration:

Minimal urban and suburban growth is anticipated in this management unit which limits the implementation



opportunities to leverage local development growth for greater natural resource benefit. The District will continue to leverage this approach where applicable in coordination with the Cities of St. Bonifacius, Minnetrista, and Waconia, but in the near term land acquisition will be a strategy principally applied to achieve watershed load reductions and wetland restorations as outlined above.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the subwatershed. The following sections describe generally the activities that will be undertaken by various parties. Section X.X Capital Improvement Program – Implementation Tables provides; 1) an action summary of how the District's programmatic efforts work together to address issues identified within the subwatershed, and 2) a capital improvement table providing cost estimate and schedule for the District's efforts regarding new activities in the implementation program.

To better integrate our efforts with those of our partners and address the dynamic environment in which water resource management efforts are implemented, the District has adopted a partnership framework to create alignment between our goals and the goals of our partners. The Capital Improvement Program provided within this subwatershed plan highlights this evolved approach to partnership and implementation, using a series of implementation models to best integrate water resource management and land use planning in a real time setting.

IMPLEMENTATION PRIORITIES

As described in previous sections, the Six Mile-Halsted Bay Subwatershed is a large subwatershed, spanning 27 square miles, with an extensive lake, wetland and stream system. It is the headwaters of Lake Minnetonka, the most heavily used recreation lake in the State, with Six Mile Creek terminating in Halsted Bay of Lake Minnetonka, a highly impaired Bay requiring the largest phosphorus load reduction in the District.

The system upstream of Halsted Bay is a complex network of shallow and moderately deep lakes, many of which have a

high littoral area, and hydrologically altered wetlands. Five of the upstream lakes are also impaired for phosphorus, and several shallow lakes fail to achieve water quality standards but are classified as wetland by the MPCA. Each lake impairment is driven by a complex interplay of internal load, degraded wetlands, and upstream waterbody contribution, largely driven by historic agricultural land use in the area.

Given the need to address the impairment of both Halsted Bay and the upstream lake system, the abundant and interconnected natural resources, the range of jurisdictions covered by this large geography, the pace of residential growth in the area, and the existing relationships and partnerships with public and private agencies operating in this area, the District has identified Six Mile-Halsted Bay subwatershed as a priority area to focus implementation efforts in this plan cycle. The District has convened a group of agency partners in the region to identify priorities for the development of this plan as well as moving forward with implementation of the plan.

The CIP in the following section identifies projects that have undergone some level of feasibility and are anticipated for project initiation within the next five years. These include projects identified in the last plan cycle that feasibility has revealed to be a good investment, as well as several projects (East Auburn Stormwater Enhancement and Wassermann West) that have been initiated as plan development has been underway.

The scale and complexity of the Six Mile-Halsted Bay subwatershed requires that much of the implementation work completed over this plan cycle be done in a responsive manner based on, amongst other factors, available funding, land rights, opportunities to integrate the work with other agency priorities, and common sense sequencing of priorities.

As previously noted, Common Carp are very abundant within this system and exhibit high mobility between lakes. Carp can render other management activities for shallow lake restoration, including alum and vegetation management, ineffective, and carp management therefore needs to be a principal and near term implementation priority.

When carp have been brought below the ecological damage

threshold of 100 kg/ha, management of internal or sediment phosphorus release will be employed. In some lakes where high phosphorus and carp activity have caused the lake to shift from a clear to turbid lake state (including Mud and Parley), whole lake drawdown may be further employed to allow for the reestablishment of lake bed vegetation critical to support of game and non-game fish species.

The watershed has over 5,000 acres of wetlands, many of which are ecologically degraded and contribute nutrient pollution to downstream waterbodies. Restoration of any given wetland may be based on whether land rights need to be and can be acquired, available funding, and ecological lift and water quality benefit achieved by restoration. The District is currently developing a GIS-based tool in partnership with the US Army Corps of engineers that will enable the District to rapidly evaluate wetlands for multiple restoration parameters to assist in this prioritization framework.

As land converts from agricultural land use to residential, stormwater regulations will, in many cases, result in improved water quality over predevelopment conditions. However, the District will continue to work with its City and County partners through the development process to identify opportunities to surpass regulatory standards, particularly where it may address an existing TMDL or known water quality issues.

Many of the aforementioned strategies will be used to restore this headwater system. While this work will have immediate benefit within the Six Mile Creek subwatershed itself, long term this restoration should also address the 50% of the watershed load to Halsted Bay coming from Six Mile Creek. However, given the long term nature of this restoration and the current condition of Halsted Bay, an interim solution may be considered. As discussed earlier in the plan document, the District has completed preliminary feasibility for an alum treatment system that would provide immediate water quality benefit to Halsted Bay.

CAPITAL IMPROVEMENT PROGRAM

Capital projects in the Six Mile-Halsted Bay subwatershed include invasive common carp management to reduce lake turbidity and restore shallow lake ecology; internal phosphorus load control to halt sediment phosphorus release once carp

populations have been brought below the 100 kg/ha threshold; Coordination with local partners on stormwater management opportunities that achieve phosphorus reductions above regulatory compliance levels; wetland restoration to reduce phosphorus release and create valuable habitat corridors; and construction of an alum treatment facility to address upstream pollution into Halsted Bay of Lake Minnetonka.

These projects and others identified below will progress the District and its partners toward achieving their various goals for the subwatershed. This program is not a comprehensive list of all capital needs or potential projects within the subwatershed, and is limited by available financial resources and staff capacity to manage projects. These priority project approaches are intended to:

- » Restore lake ecology to reduce internal phosphorus release and support healthy fisheries and plant communities.
- » Create corridors of restored wetland complexes that provide ecosystem services including phosphorus retention and wildlife habitat.
- » Support ongoing development in the region in a way that produces a net positive impact on water and natural resources.
- » Build on the recreational legacy in the region by preserving and enhancing distinct areas and creating opportunities for public enjoyment.

These proposed projects and strategies emphasize the achievement of multiple objectives. For example, wetland restorations will not only target nutrient reductions, but can be paired with other management activities such as increasing vegetative diversity and connecting to upland buffer areas to create habitat, conserve high-value resources, enhance corridor connections, and enhance recreation opportunities.



Project	East Auburn Stormwater Enhancement Project
Description	Design and construction of stormwater enhancements to two existing ponds in the City of Victoria. Enhancements will include the installation of an Iron-Enhanced Sand Filtration Bench and a Filtration Bench.
Need	East Auburn is on the State Impaired Waters list and does not meet state standards for water quality or clarity and has an adopted TMDL. East Auburn is a collection point, receiving moderately poor water quality from many different drainage areas, resulting in a cumulative impact of high nutrient concentrations. The TMDL requires a total reduction of 626 lbs/year, 200 lbs/year from upstream water bodies. Though the contribution from Church Lake and downtown Victoria is relatively low, the water quality has been declining according to district monitoring data and this project presents an opportunity to significantly reduce that source to Auburn.
Outcome	Anticipated treatment of 39 lbs/year of phosphorus, 24lbs from downtown Victoria and 15 lbs/yr from Church Lake; native vegetative enhancements in the buffer and upland areas
Estimated Cost and Funding	Final Design and Permitting: \$40,000 Construction: \$115,000 Site planting plan design and installation: \$15,000
Schedule	2017-2018

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Project	Wassermann West External Load Reduction and Landscape Restoration
Description	Design and implementation of strategies to reduce landscape phosphorus loading from a six (6) acre pond and 22 acre wetland adjacent to Wassermann Lake, through the use of aluminum sulphate (alum), vegetative restoration, and/or hydrologic alternation; preservation and restoration of vegetative community in wetland and upland areas through land acquisition, development of restoration plan; programmed public access to Lake Wassermann for public use and enjoyment.
Need	Lake Wassermann is listed on the State Impaired Waters List and does not meet state standards for water quality or clarity and has an adopted TMDL; watershed loading is estimated to be responsible for 7% of the total lake load and this site contributes a modeled 75 lbs/yr. The site has been recognized as a restoration priority by several agencies, including the MLCCS, MnDNR, City of Victoria, and MCWD. Site features diversity of vegetative and wetland communities and steep slopes vulnerable to erosion. The site has been identified by the City of Victoria to establish public lake access on a priority water body and can be leveraged to connect regional trail, a City priority.
Outcome	Reduce phosphorus loading to Lake Wassermann by 15% or 64 lbs/year; enhanced recreation access to Lake Wassermann; preservation and enhancement of shoreline, upland, and wetland buffers; vegetative wetland restoration
Estimated Cost and Funding	Land and water restoration \$350,000 Park improvements \$1,900,000 Total Cost:\$2,250,000 This project will be funded and implemented in partnership between the MCWD and City of Victoria. Source of funding is District Levy, City of Victoria Levy, City of Victoria fees, and/or regional, state, and federal grants.
Schedule	2018-2019



Project	Pierson Lake Headwaters Restoration
Description	Removal of drain tile system; Design and construction of outlet control structures; wetland establishment/restoration including site preparation, invasive species control, seeding, and maintenance; feasibility, design, and construction of stormwater management practices; stream restoration
Need	Pierson Lake is good quality, but 85% of its nutrient pollution is attributed to the drainage area north of the Lake. The area around Pierson Lake is anticipated to develop over the coming years as the City of Victoria expands into Laketown Township. Development will include new major infrastructure development, including the extension of Marsh Lake road in close proximity to the Pierson headwaters.
Outcome	Reduced phosphorus loading to Pierson Lake; increased clarity in the North Bay of Pierson Lake
Estimated Cost and Funding	Construction and site preparation: \$170,000 Wetland seeding and installation: \$75,000 Vegetation Maintenance: 70,000 Total: \$315,000
Schedule	2019-2021

DRAFT

Project	Turbid-Lundsten Wetland Restoration
Description	Restoration of wetlands around Turbid and Lundsten Lakes through hydrologic modification, changes to storage capacity, and vegetation restoration; design and construction of soluble phosphorus filtration system; hydrologic modification to eliminate open water ditch downstream of Turbid; pond retrofit at South Lundsten Inlet
Need	Turbid Lake is on the State Impaired Waters list for quality and clarity and requires a reduction of 138 lbs/yr, or 55%. Turbid Lake drains to North Lundsten, which is considered a wetland by MPCA standards for TMDL development and therefore is not required to meet state shallow lake standards. However, water quality in South Lundsten is very poor and drives downstream water quality issues, including in Parley Lake which is impaired for water quality and clarity.
Outcome	Anticipated nutrient reductions of 43 lbs/year in Phase I and 50 lbs/year Phase II; restoration of 50 acres of wetland; secondary carp management benefits.
Estimated Cost and Funding	Phase I: \$500,000 Phase II: Open water ditch elimination, wetland restoration, pond establishment, swale improvements, upland reestablishment: \$400,000 Total Project Costs: \$900,000
Schedule	2019-2021

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Project	Mud Lake Watershed Load Reductions
Description	Addressing watershed load to Mud Lake through wetland restorations, regional stormwater treatment, and enhancement of existing stormwater facilities
Need	<p>The 2013 Six Mile diagnostic identified Mud Lake as having very poor water quality, driven by a combination of internal loading, upstream lake water quality, and watershed loading. Reductions between 78% and 95% (1,864 lbs/yr – 2,258 lbs/yr) from the direct watershed are needed to shift the ecological condition of Mud Lake and address downstream impacts to Halsted Bay. Though Mud Lake is not required to meet state standards for nutrient concentrations, Halsted Bay requires the largest phosphorus load reduction in the District and about half of its load comes from upstream Mud Lake.</p> <p>The 2017 Mud Lake Assessment evaluated watershed loading to Mud Lake and found the sources to be relative diffuse across the entire drainage area. The northwest drainage area contributes approximately 1,579 lbs/yr, the direct drainage area is approximately 595 lbs, and north drainage area contributes 385 lbs/year. The Mud Lake Assessment identifies geographically specific best management that will be implemented on an opportunistic basis.</p>
Outcome	Reduced nutrient loading to Mud Lake and Halsted Bay; Hydraulic and vegetative wetland restoration; increased aesthetic value
Estimated Cost and Funding	<p>Phase I: Wetland restoration in NW drainage: \$1,120,000</p> <p>Phase II: St. Bonifacius stormwater management and wetland restoration: \$2,130,000</p> <p>Phase III: North drainage wetland restoration: \$1,380,000</p> <p>Phase IV: Direct drainage wetland restoration: \$1,485</p>
Schedule	2019– 2025

Project	Wassermann Internal Load Management
Description	Application of alum to sediments to inactive sediment release
Need	Substantial phosphorus load reduction is necessary to achieve clean water standards in Wassermann Lake. The TMDL requires a 62% reduction in phosphorus loading, or 470 lbs/year. The 2013 Six Mile Diagnostic modeled an annual internal release rate of 374/lbs year. Alum can only be applied once the carp population has been significantly reduced and the re-cruitment is being managed through aeration or physical barriers.
Outcome	Reduction in phosphorus load from internal sources; improved water clarity; more diverse aquatic vegetation community
Estimated Cost and Funding	Design and surveys: \$40,000 Construction: \$250,000 Total Project Costs: \$290,000
Schedule	2020-2022

DRAFT



Project	East Auburn Wetland Restoration
Description	Restoration of 3 degraded wetland complexes draining to East Auburn from Steiger, Sunny, and Wassermann Lakes.
Need	East Auburn has an adopted TMDL requiring a 30% watershed load reduction. The Six Mile Diagnostic attributes 57% of the total watershed load to the drainage area, and further analysis indicates that a vast majority of the source of the drainage area loading is from these large, degraded wetland complexes. Further analysis will be required to determine the relative impact of each complex.
Outcome	Reduced nutrient loading to East Auburn; Hydrologic and vegetative wetland restoration; enhanced habitat; enhanced aesthetic value tying into a high value recreation area (Carver Park)
Estimated Cost and Funding	Reduction in wetland phosphorus loading; increased ecological function of wetlands; increased aesthetic value
Schedule	2020-2021

DRAFT

Project	Hasted Bay Watershed Load Management
Description	Off-line alum treatment facility situated adjacent to Six Mile Marsh to treat upstream phosphorus load.
Need	Halsted Bay requires the largest phosphorus load reduction in the District, and approximately 50% of the load comes from upstream lakes and Six Mile Marsh. A 2013 feasibility study found that operating an off-line alum treatment facility would provide the most cost-effective means to reduce phosphorus loading into the Bay in the short term.
Outcome	The facility will reduce phosphorus loading by approximately 1,600 lbs/year.
Estimated Cost and Funding	Capital Costs: \$7,728,000 20 year total operations and capital costs: 13,932,500
Schedule	2022-2025

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APPENDIX: PUBLIC PROCESS

1. INTRODUCTION

Accomplishing the District's mission to collaborate with public and private partners to protect and improve land and water requires an understanding of the goals and priorities of our communities. The production of the District's 2007 Plan involved an extensive, scientific analysis of the Watershed District and robust stakeholder engagement process to build a technical understanding of land and water resources. The approach for the District's 2017 Comprehensive Plan builds upon the previous plan's analyses, now emphasizing collaboration with communities within the watershed to align water resource priorities with local land use goals. The process to develop this partnership-based approach included community guidance through committees, events, publications, and special meetings for information sharing to establish the partnership framework put forth.

2. PROCESS SUMMARY

The desired partnership framework guided by the District's Balanced Urban Ecology Policy is successful through voluntary participation, information sharing of local knowledge, priorities and plans, and collaboration between the District and the LGU's. Opportunities to participate in the development of the 2017 Comprehensive Plan to build the framework for this type of collaboration was provided to LGU technical staff, policy makers, District staff, and the general public.

The formal process began with an invitation to LGU's and the public to attend a kickoff meeting and learn how to participate in the 2017 Comprehensive Plan. The invitation was delivered by direct mail, direct email, press release published in news print, District website and emailed through District list serve.

Three kickoff meetings were hosted with a total of 82 attendees representing 22 cities, Carver County, Hennepin County, Board of Water and Soil Resources, MN Department of Natural Resources, Fresh Water Society, Lake Minnetonka Conservation District, Metropolitan Council, Minneapolis Park and Recreation Board, and Three Rivers Park District, and interested members of the public. District staff presented the scope and objectives of the 2017 Comprehensive Plan and asked attendees to indicate their interest in serving on one of the advisory committees to provide their guidance, local knowledge and priorities as we developed the Plan.

As part of this initial outreach and engagement effort, self-selected policy makers, technical staff, and members of the public were appointed to the Policy Advisory Committee, Technical Advisory Committee, and the Citizens Advisory Committee, respectively. Each committee had seven meetings, facilitated by District staff, in which the committees reviewed and discussed elements of the District's Comprehensive Plan as they were being developed. The District corresponded with the committee members through email to provide updates, provide committee meeting agendas, meeting summaries, and opportunities for comment at key milestones. The meeting agendas, presentations, and minutes were posted on the website.

In addition to the advisory committee meetings, the District hosted subwatershed meetings with a new invitation to technical staff, policy makers, and interested public including Lake Association members, to gather input on local issues, priorities, and plans. Other opportunities to stay involved, track the process, and learn about the Plan as it was developed included events for municipal land use planners and policy makers, and publications.

3. STATUTORY REQUIREMENTS

As required per Minnesota Rules part [8410.0045, subpart 3](#), the District sent notification to each county, city, township, soil and water conservation district, known stakeholders, and plan review agencies of Plan initiation and an invitation to attend a kick-off meeting. The invitation was sent through mail, email, announced through a press release and posted on the District website. As part the Plan development kickoff meetings, solicitation for participation in advisory committees was made. Committee structure, notification, schedule, and addenda topics is further described below. Members of these committees were appointed as defined in Minnesota Statutes 2016, sections [103D.331](#) and [103D.337](#) and Minnesota Rule [part 8410.0045, subpart 2](#), and [part 8410.0105, subpart 1, item D](#).

As required by [8410.0045, subpart 3 and 4](#), on April 22, 2015 prior to Plan development, the District requested information on management expectations, priority issues, summaries of relevant water management goals, and water resource information from the Plan review agencies and requested information related to local water management goals, issues, official controls, programs and priorities from Hennepin and Carver County, Cities, Townships, Soil and Water Conservation Districts, MN DOT, Minneapolis Park and Recreation Board, and Three Rivers Park District. Information was requested to be submitted by June 22, 2015 and was used to guide our planning process and align efforts with local partners (Exhibit 10.1). On September 24, 2015 the District Board of Managers held a public meeting to review and discuss the input received as required by [8410.0045, subpart 5](#). The meeting was posted on the District's website and publicly noticed for two weeks. As described below, in addition to this official request for information the District hosted several other events with city/agency staff and policy makers to solicit local plans and priorities which are reflected in each subwatershed plan.

4. PUBLIC OPINION SURVEY, SELF-ASSESSMENT AND STRATEGIC PLANNING

4.1 PUBLIC OPINION SURVEY

To assess public opinion on effectiveness of District project and programs and understand general public priorities for the organization to guide future efforts, the District conducted a public opinion survey in February 2015. A random-sample of 600 District residents were contacted by telephone and asked a series of questions about their attitudes and awareness of water quality issues, the MCWD and its work.

The survey found 98 percent of residents consider protecting water quality either "very" or "somewhat" important. Seventy-nine percent said the water quality in their neighborhoods has become better or stayed the same over the past five to ten years and 65 percent rate the water quality of their local lakes, streams and wetlands as excellent or good.

Residents generally view the MCWD as an effective organization. Sixty three percent of District residents said they were aware of the MCWD and 76 percent believe it is effective in protecting water quality. Ninety-seven percent of respondents consider the MCWD a credible source for information about water quality issues and 93 percent said it is a good idea to have a single-purpose agency like the MCWD charged with protecting water quality.

4.2 SELF-ASSESSMENT

As part of the process of developing the District's 2017 Comprehensive Plan, the District contracted with Wenck Associates, Inc. to complete a self-assessment. The purpose of this self-assessment was to review the District's performance under its 2007 Plan. The findings of the self-assessment were used to inform the District's 2017 Plan draft, which seeks to address some of the challenges experienced through execution of the 2007 Plan.

The self-assessment was comprised of three phases:

- An internal assessment by the District Board and staff
- An external assessment by members of the District's Technical Advisory Committee, facilitated by Wenck Associates, Inc.
- A public opinion survey, detailed above in section 4.1

The key internal findings were that the 2007 Plan was grounded in sound science and was very technically focused. However, challenges and limitations to that Plan were identified as a lack of focus, prioritization and clarity of mission and goals. Staff identified that the Plan was too specific and prescriptive which limited the District's ability to integrate water resource priorities with land use change. The staff also noted that District programs were isolated from each other, causing lack of internal alignment and coordination. Overall, staff acknowledged that progress has been made to address these challenges and expressed excitement about the District's trajectory and future opportunity to work with the Board to cultivate increased program alignment and

focus. It was identified that District’s mission statement should be reconsidered, to communicate purpose and excitement, and that the potential for a vision statement should be considered as part of the Plan process.

4.3 STRATEGIC PLANNING

Following the staff and Board discussions to identify past accomplishments and the District’s progress over the last plan cycle the MCWD Board and staff began a strategic planning process in October of 2015. The purpose of this process was to evaluate and improve the alignment, focus, and effectiveness of the District’s programming. Beginning at the organization level the District developed and adopted new Vision and Mission statements for the organization as well as goals and guiding principles to align with the strategic direction of the 2017 Plan and the guiding policy of Balanced Urban Ecology. The process moved to a programmatic level. District staff iteratively reviewed internal functions across departments and reported their findings to the MCWD Board at publicly-noticed meetings. The 2017 Strategic Alignment Report was adopted by the Board of Managers on February 9, 2017. This Board resolution defined the MCWD organizational strategy to accomplish its mission and set strategic direction for MCWD programs to work in support of this strategy. This strategy has been further developed and defined through the development of the 2017 Plan.

5. COMMITTEE STRUCTURE

5.1 PURPOSE

Three committees were formed consisting of a Policy Advisory Committee, Technical Advisory Committee and Citizen Advisory Committee as discussed in Section 2. The primary role for the committees was to share goals, priorities, ideas, and provide input and guidance on how the District can maximize the effectiveness of its programs and capital investments to add value to partner initiatives across the watershed and cost-effectively achieve complementary public and private goals.

5.2 NOTIFICATION AND COMMUNICATION

Committee members were solicited from Hennepin and Carver Counties, Cities and Townships within MCWD, Carver Soil and Water Conservation District, Minneapolis Park and Recreation Board, Three Rivers Park District and the public through email, District website, press release, and in person at the kickoff meetings. Members were self-selected through the solicitation described. Committee members, meeting schedule, and agenda topics are listed below. All committee meetings were noticed through email. Agendas, presentations and meeting minutes were posted to the District website after the meetings.

5.3 COMMITTEES

Policy Advisory Committee

Organization	Name
City of Edina	Councilor Bob Stewart
City of Independence	Mayor Marvin Johnson
City of Medina	Administrator Scott Johnson
City of Minneapolis	Councilor Linea Palmisano
City of Minnetonka	Councilor Patty Acomb
City of Minnetrista	Mayor Lisa Whalen
City of Orono	Mayor Lili McMillan
City of Shorewood	Mayor Scott Zerby
City of Victoria	Mayor Tom O’Conner
City of Woodland	Councilor Sliv Carlson
Department of Natural Resources	Central Region Manager Terri Yearwood
Minneapolis Park & Recreation Board	Commissioner Stephanie Musich

Policy Advisory Committee Schedule

Meeting Date	Agenda Topics
2015-08-04	Summary of kickoff meetings, Plan development process and schedule, committee's role and future agenda topics
2015-10-20	Overview of the Plan development process, introduction to the District's internal strategic planning framework, outline of the proposed Plan structure. The primary purpose of the meeting was to provide additional context for the committee before delving into different elements of implementation framework over next four meetings. An update on the Six Mile Creek Halsted Bay planning process was also provided.
2015-12-15	Presentation on the topic of integrating land-use and water planning, an overview of the two-track approach as a model to improve integration, examples from guest speakers about how the approach is currently being used. Staff reiterated that a primary goal of the District's Comprehensive Plan update process is to develop a framework that continues to meaningfully integrate the District's work with that of other public and private sector partners and the District is seeking the Committee's help in developing this framework.
2016-02-23	Discussion of the District's two-track approach which is an implementation model to improve the integration of land-use and water planning. Requested committee input on how to better coordinate with Cities. Reviewed Described the planning process proposed for the Six Mile Creek Halsted Bay subwatershed. Presented new MCWD vision, mission and goals.
2016-04-26	Review of two-track approach implementation model, continued the process of developing the implementation framework for the 2017 Plan by asking committees to consider changes that could be made by the District or its partners to policies/procedures/programs to support partnership and integration. A list of ideas was provided in advance. Reviewed local Plan requirements. Reviewed outreach efforts.
2016-06-21	Discussed potential role for the District for various management topics of emerging or recurring concern, asking the committee their priority for each and what they felt the District role should be and provided a written survey regarding each.
2017-03-21	Review and discuss the District's implementation model and partnership framework, including coordination and Local Water Plans, overview of Plan structure and status, reviewed draft schedule for review.

Technical Advisory Committee

Organization	Name
City of Chanhassen	Terry Jeffery
City of Edina	Ross Bintner, Laura Adler*, Jessica Wilson*
City of Hopkins	Nate Stanley
City of Minneapolis	Lois Eberhart, Lisa Cerney*
City of Minnetonka	Liz Stout
Cities of Deephaven, Greenwood, Orono, Mound, St. Bonifacius, and Woodland	Bob Bean
City of Plymouth	Derek Asche
City of St. Louis Park	Erick Francis
City of Victoria	Cara Geheren

City of Wayzata	Mike Kelly
Carver County	Kristin Larson
Hennepin County Environmental Services	Randy Anhorn
Board of Water and Soil Resources	Steve Christopher
Department of Natural Resources	Kate Drewry
Metropolitan Council	Karen Jensen
Minneapolis Park & Recreation Board	Cliff Swenson, Adam Arvidson, Rachael Crabb, Deb Bartels*
Three Rivers Park District	John Barten, Rich Brasch

Technical Advisory Committee Schedule

Meeting Date	Agenda Topics
2015-08-05	Summary of kickoff meetings, Plan development process and schedule, committee's role and future agenda topics
2015-10-21	Overview of the Plan development process, introduction to the District's internal strategic planning framework, outline of the proposed Plan structure. The primary purpose of the meeting was to provide additional context for the committee before delving into different elements of implementation framework over next four meetings. An update on the Six Mile Creek Halsted Bay planning process was also provided.
2015-12-16	Presentation on the topic of integrating land-use and water planning, an overview of the two-track approach as a model to improve integration, examples from guest speakers about how the approach is currently being used. Staff reiterated that a primary goal of the District's Comprehensive Plan update process is to develop a framework that continues to meaningfully integrate the District's work with that of other public and private sector partners and the District is seeking the Committee's help in developing this framework.
2016-02-24	Discussion of the District's two-track approach which is an implementation model to improve the integration of land-use and water planning. Described the planning process proposed for the Six Mile Creek Halsted Bay subwatershed. Presented new MCWD vision, mission and goals.
2016-04-27	Review of two-track approach implementation model, continued the process of developing the implementation framework for the 2017 Plan by asking committees to consider changes that could be made by the District or its partners to policies/procedures/programs to support partnership and integration. A list of ideas was provided in advance. Reviewed local Plan requirements. Reviewed outreach efforts.
2016-06-22	Discussed potential role for the District for various management topics of emerging or recurring concern, asking the committee their priority for each and what they felt the District role should be and provided a written survey regarding each.
2017-03-22	Review and discuss the District's implementation model and partnership framework, including coordination and Local Water Plans, overview of Plan structure and status, reviewed draft schedule for review.

Citizen Advisory Committee

Name	City of Residence	Terms Served
Bradley Coulthart	Minneapolis	2017
Brian Girard	Orono; Deephaven	2015, 2016, 2017
Cassandra Ordway	Long Lake	2017

Chris Dovolis	Minnetonka Beach	2015, 2016
Colin Cox	St. Louis Park	2015, 2016, 2017
Craig Wilson	Hopkins	2017
Cristina Palmisano	Minneapolis	2015
David Oltmans	Minneapolis	2015, 2016, 2017
Elizabeth Crow	Minneapolis	2017
Gerald Ciardelli	St. Louis Park	2015, 2016, 2017
Jacqueline Di Giacomo	Tonka Bay	2015, 2016, 2017
John Grams	Minnetonka	2017
Joseph Lofgren	Minneapolis	2015, 2016
Joseph Lutz	Minnetonka	2016
Linda Jahnke	St. Louis Park	2017
Marc Rosenberg	Minnetonka	2015, 2016, 2017
Neil Weber	Long Lake	2015, 2016, 2017
Peter Rechelbacher	Wayzata	2015, 2016, 2017
Richard Manser	Edina	2015, 2016, 2017
Richard Nyquist	Edina; Minneapolis	2016, 2017
Sliv Carlson	Woodland	2015, 2016, 2017
Steve Mohn	Eden Prairie	2015, 2016, 2017
Valerie McGruder	Minnetonka	2016
William Bushnell	Minnetrista	2015, 2016, 2017

Citizen Advisory Committee Schedule

Meeting Date	Agenda Topics
2015-03-11	2017 Comprehensive Plan Introduction, Plan development process and schedule, committee's role advancing partnership approach, and future agenda topics
2015-08-12	Review Plan scope and objectives of improving implementation model and how the District and communities can work together, review two-track approach, public process and timeline
2015-11-18	Review of Plan development process, review organizational strategic planning framework, and plan structure
2016-01-13	Presentation on the topic of integrating land-use and water planning, an overview of the two-track approach as a model to improve integration, and MCWD vision, mission, goals
2016-03-09	Review two-track approach model, draft criteria for focal geography selection, briefing of Six Mile Creek Halsted Bay subwatershed planning as example of planning model, tools and opportunities for responsive-track planning
2016-07-13	Discuss topics of emerging or recurring concern and get committee input on appropriate role for the District
2017-04-12	Presentation and distribution of draft Plan material, request for preliminary feedback to inform process as Plan is advanced for public release.

6. SIX MILE CREEK HALSTED BAY COMMITTEE STRUCTURE

6.1 PURPOSE

Initiation for the 2017 Comprehensive Plan also initiated the development of an implementation plan for the Six Mile-Halsted Bay Subwatershed. The Six Mile-Halsted Bay Subwatershed Committee included both policy makers

and staff from all agencies operating within this geography, including The Cities of Victoria, St. Bonifacius, Minnetrista and Waconia, Laketown Township, Three Rivers Park District, Carver County Soil and Water Conservation District, and Hennepin and Carver Counties.

The objective of the Six Mile process is to improve how the District coordinates with its partner agencies in that geography by identifying their goals and missions, regulations and authorities, and plans for development and growth. The implementation plan reflects the District's goals, the existing plans of its partners, and a framework for how the participating agencies will work together to implement the plan. The lessons learned from this process will serve as the implementation model for focal geographies in the comprehensive plan.

6.2 NOTIFICATION AND COMMUNICATION

District staff reached out to each public agency operating within this geography and asked them to identify both a staff person and policy maker to serve on the committee. Committee members and meeting schedule are listed below. Agendas, presentation, and minutes were distributed to Committee members follow each meeting.

6.3 COMMITTEES

Six Mile Creek Halsted Bay Policy Advisory Committee

Organization	Name
City of Victoria	Thomas Funk
City of Victoria	Cara Geheren
City of St. Bonifacius	Sean Ruotsinoja
City of St. Bonifacius	Robert Bean
City of Minnetrista	Lisa Whalen
City of Minnetrista	David Abel
City of Waconia	Lane Braaten
Laketown Township	Mike Klingelutz
Three Rivers Park District	Angela Smith
Three Rivers Park District	Richard Brasch
Carver County	Kristin Larson
Carver County Soil and Water Conservation District	Mike Wanous
Hennepin County	Randy Anhorn

Six Mile Creek Halsted Bay Committee Schedule

Meeting Date	Agenda Topics
May 4, 2016	District planning framework overview, review of conditions in Six Mile-Halsted Bay subwatershed, planning schedule and approach
July 2016	One on one meetings with each agency to discuss they local plans and goals
November 10, 2016	Overview of principal water resource issues and drivers, preliminary mapping of subwatershed opportunities
January 19, 2017	Draft purpose statement/resolution of support to formally establish the Six Mile-Halsted Bay Subwatershed Partnership
March 2, 2017	Subwatershed plan framework, small group participatory mapping to identify opportunity areas
May 8, 2017	CIP structure and financing approach

7. SUBWATERSHED MEETINGS

7.1 PURPOSE

To further identify local issues, priorities and plans in and create a road map for functionally integrating land use and water planning with our communities, we hosted a series of subwatershed meetings with communities throughout the watershed. The enthusiasm and the depth of local knowledge that was provided was very helpful as the District works towards its goal of increased integration of regional clean water objectives with local plans and priorities. This valuable information directly influenced the general posture of the subwatershed plans within the Plan, and informed other more immediate opportunities for collaboration.

7.2 NOTICE AND COMMUNICATION

City policy makers, City staff, all committee members, Board of Managers, District staff, Lake Associations, Minneapolis Park and Recreation Board staff and Three Rivers Park District staff were invited via electronic mail. Meeting schedule and information requested is summarized below. Additionally, individual information requests were made via electronic mail to counties, Metropolitan Council, and MN Department of Transpiration.

7.3 GROUPINGS AND SCHEDULE

Subwatershed Community Meetings

Date	Subwatershed	City/Agency Invited Attendees
December 5, 2016	Dutch Lake, Langdon Lake, Lake Minnetonka	Mound, Minnetrista, Saunders Lake HOA, Dutch Lake Association
December 6, 2016	Gleason Lake, Lake Minnetonka	Plymouth, Wayzata, Gleason Lake Association, Mooney Lake Association
December 7, 2016	Lake Virginia, Schutz Lake, Christmas Lake, Lake Minnetonka	Victoria, Chanhassen, TRPD, Christmas Lake Association, Minnewashta Lake Association, Virginia Lake Association, Schutz Lake Association
December 12, 2016	Painter Creek, Lake Minnetonka	Medina, Independence, Maple Plain, Minnetrista, Orono, TRPD, Jennings Cove Neighborhood Association
December 13, 2016	Minnehaha Creek, Lake Minnetonka	Minnetonka, Hopkins, St. Louis Park, Edina, Minneapolis, MPRB, Richfield, Golden Valley, Friends of Hiawatha, Bass, Minnehaha Creek, Diamond Lake, Calhoun, Harvey, Nokomis, Powderhorn, Linden Hills Neighborhood Association

7.4 INFORMATION REQUESTED

Following a staff presentation which included an overview of the geography, resources, land use and priorities from 2007 subwatershed plans, requested information included:

- Local goals/priorities – both water and non-water related
- Plans for land use change – infrastructure, transportation, economic development, parks, development projections
- Areas of opportunity for future partnerships

The information was requested through facilitated small group discussion with each community or group, recorded on maps and shared with the subwatershed group at each meeting. Community priorities from these meetings are reflected within the subwatershed plans.

8. EVENTS

8.1 KICKOFF MEETINGS

The District hosted a series of three Plan development kickoff meetings for county, city, township, soil and water conservation district, known stakeholders, and plan review agencies to invite participation in the Plan development process. At this meeting staff reviewed Plan objectives which include increasing program

effectiveness and project implementation, and improved coordination with our communities. The meeting also included solicitation for committee participation and a review of process and schedule for Plan development.

8.2 BOAT TOUR FOR ELECTED OFFICIALS

The MCDW and the University of Minnesota Extension co-hosted an event for local policymakers August 3, 2016. The event served both as a part of the Extension's Nonpoint Education for Municipal Officials program and as an opportunity for the District to provide a preview of the District's approach for the 2017 Comprehensive Plan, illustrating the District's partnership model to local policymakers through project examples.

8.3 PLANNERS BREAKFAST

The MCWD hosted a meeting at the District offices September 22, 2016, inviting land use and water planning staff from cities, counties, Metropolitan Council, Minnesota Department of Transportation, Three Rivers Park District and Minneapolis Park and Recreation Board to hear ideas on how to integrate our planning efforts and discuss how the District can coordinate early to align plans and investments to maximize project environmental, economic and community benefits. District staff provided an introduction to the integrated planning approach of the 2017 Plan. Case studies in the Six Mile Creek – Halsted Bay and the Minnehaha Creek Greenway priority implementation areas were co-presented by District staff and city staff from Victoria and St. Louis Park, respectively. These case studies were examples of successful early coordination on redevelopment and co-planning that resulted in both natural resource and community benefits.

9. PUBLICATIONS

9.1 PURPOSE AND DISTRIBUTION

The MCWD produced three publications of professional quality as another way to share information about the 2017 Plan development. The publications were mailed to agency staff, elected officials, administrators, water resource professionals within the District, sent electronically through the District list-serve and available in electronic form on the District website. The publications provided easy to read information about the 2017 Plan process, schedule, goals, and approach.

9.2 COMPREHENSIVE PLAN KICKOFF BROCHURE, JANUARY 2015

As part of the initial outreach and invitation for county, city, agency and public participation in the 2017 Plan, the Comprehensive Plan Brochure was a 4 page color production that served as an initial notice of the Plan update, introduction to the implementation philosophy, scope and schedule and solicitation for committee involvement (Exhibit 10.2).

9.3 2017 COMPREHENSIVE PLAN PREVIEW BOOKLET, AUGUST 2016

This 26 page booklet explains the District's 2017 Plan collaborative approach to join with others to align plans and investments to maximize natural resource and community benefits. The implementation concepts of focus and flexibility are discussed in detail with project examples and testimonials from our partners (Exhibit 10.3).

9.4 2016 MINNEHAHA CREEK WATERSHED DISTRICT YEAR IN REVIEW BROCHURE

An annual communication to MCWD constituents, the 11 page 2016 Year in Review highlighted the December 2016 Comprehensive Plan subwatershed meetings and the Plan approach of information sharing, co-planning, and working in partnership with our communities. The publication also highlighted the Six Mile-Halsted Bay Planning Partnership and the focal geography approach (10.4).

10. LIST OF EXHIBITS

10.1 SUMMARY OF LOCAL PLANS AND PRIORITIES SUBMITTED PER 8410

10.2 MCWD 2017 COMPREHENSIVE PLAN KICKOFF BROCHURE

10.3 MCWD 2017 COMPREHENSIVE PLAN KICKOFF PRESS RELEASE

10.4 MCWD 2017 COMPREHENSIVE PLAN BOOKLET

10.5 MCWD 2016 YEAR IN REVIEW

10.1 SUMMARY OF LOCAL PLANS AND PRIORITIES SUBMITTED PER 8410

Summary of Information Submitted for MCWD Comprehensive Plan Update

The Minnehaha Creek Watershed District (MCWD) is in the process of updating its Comprehensive Water Resources Management Plan. As required per MN Rules Chapter 8410, on April 23, 2015 the District requested information related to local water management issues, goals and priorities from the state agencies, cities, counties, and other stakeholders. The District received submittals from several cities and agencies, and a summary of the submittals is provided below. This information will be taken into consideration as the District works to develop its Plan. The full submittals can be viewed at <http://minnehahacreek.org/8410-submittals>.

City of Edina:

- Referred to links to the City's Comprehensive Water Resources Management Plan, recent major amendment that added the Lakes and Ponds Policy, and Wellhead Protection Plan.
- City staff is considering policy options in a few related areas:
 - Education and engagement partnership agreements with local WDs to meet MS4 requirements.
 - Residential redevelopment and the increasing imperviousness of the landscape that result
 - Aging infrastructure and sanitary infiltration and inflow
 - Floodplain risk management

City of Excelsior:

- Sent the City's updated stormwater ordinance (available at <http://minnehahacreek.org/8410-submittals>).

City of Independence:

- Local Water-Related Issues:
 - Impairments of Painter Creek for *E. coli* and Jennings Bay for nutrients.
- Water Management Goals:
 - Goal 1: Preserve, maintain and improve aesthetic, physical, chemical and biological composition of surface waters and groundwater within the City.
 - Goal 2: Achieve an annual load reduction of 79 pounds of phosphorus in the Painter Creek Watershed.
- Official Controls:
 - Require infiltration of 1.0" on new impervious surface on appropriate sites
 - Sediment and erosion control ordinance
 - Stream and wetland buffer requirements dependent on quality

- SWPPP requirements for development
- Street sweeping
- Annual SWPPP inspections on storm ponds and pollution control devices
- Programs:
 - Implement the Wetland Conservation Act
 - PUD allowances
 - Capital Improvement Program
 - Pursue grant opportunities when available

City of Medina:

- Local Water-Related Issues:
 - Nutrient impairments in several lakes;
 - High water conditions on Mooney and Wolsfeld lakes;
 - Possible erosion and instability in numerous channels.
- Water Management Goals:
 - Manage land disturbance and increased impervious surfaces to prevent flooding and adverse impacts to water resources.
 - Maintain existing runoff volumes so that runoff from development does not increase volume loading to wetlands, lakes and streams.
 - Control the rate of stormwater runoff from development to reduce downstream flooding and erosion and protect water resources.
 - Provide adequate storage and conveyance of runoff to protect the public safety and minimize property damage.
 - Reduce the nutrient and sediment loads over current conditions.
 - Prevent sediment from construction sites from entering the City's surface water resources.
 - Protect the City's wetlands, lakes, streams and groundwater to preserve the functions and values of these resources for future generations.
 - Protect and preserve wetlands to maintain or improve their function and value.
 - Manage lakes to improve water quality and protect resource values.
 - Improve water quality, provide wildlife habitat and protect the resource value of streams.
 - Address target pollutants identified in TMDL studies to improve the quality of impaired waters.
- Official Controls:
 - Manure ordinance in zoning code which provides BMPs for manure management and requires no net increase in runoff from the site and setback requirements
 - Require infiltration of 1.1" on new impervious surface on appropriate sites
 - Optional volume control with irrigation

- Stream and wetland buffer requirements dependent on quality
- SWPPP requirements for development
- Programs:
 - Stormwater Utility fee to fund projects related to water quality and quantity and active grant requests.
 - Stormwater Project Capital Improvement Program
 - Medina Stormwater Design Manual: new development requires rate and volume control as well as water quality standards (20% reduction from existing conditions)
 - Erosion and Sediment Control Program
 - Implement the Wetland Conservation Act

City of Minneapolis:

- Minneapolis would like to partner with MCWD and the other stakeholders on discussions of the following:
 - Flood control/Flood mitigation -- including the topics of public safety, implications for public and private property, implications for shoreline/bank destabilization, implications for water quality degradation, issues related to aging infrastructure, opportunities for upstream storage enhancements, cost-benefit analysis of viable alternatives, and minimizing recurrence to improve quality of life
 - Outfalls -- definition of roles and responsibilities, opportunities for outfall upgrades that benefit public safety, water quality, shoreline/bank stabilization, and cost-benefit of viable alternatives
 - Water quality -- especially on cost-benefit analysis of viable alternatives that address impaired waters, and on focusing projects/policies on actual benefit to the water body
 - Stream bank restoration projects – work with municipalities to review opportunities/issues related to structural integrity of bridges and other public infrastructure
 - TAC opportunity – discuss establishment of a permanent TAC consisting of representatives of the member municipalities, that would meet regularly to discuss selected MCWD initiatives and provide feedback/expertise/concerns from the municipal perspective
 - Modeling – continue sharing of data, models, floodplain modifications, capital project information and other relevant items that promote timely and accurate H&H and water quality models

City of Minnetonka:

- Sent City's 2010 Water Resources Management Plan (Goals and Policies), 2014 MS4 permit and TMDL compliance schedule, and 2010 Stormwater Management Design Guidelines and Standards document (available at <http://minnehahacreek.org/8410-submittals>).

City of Wayzata:

- City goals and priorities:
 - Continue to provide pertinent educational materials to the general public and contractors related to stormwater management.
 - Work with MCWD to create a "laundry list" of BMPs and their treatment value to assist developers/homeowners in site design.
 - Continue to look to retrofit stormwater management into its own Capital Improvement projects to meet City and District phosphorus removal goals.

City of Woodland:

- City priorities:
 - Protection of shoreline and maintaining high quality surface waters and groundwater
 - Coordination of AIS control
 - Stormwater management and pollution prevention
 - Wetland management and protection
 - Review and clarification of wetland rules for individual properties
 - Maintaining good communication between MCWD and City
 - Shavers Lake Restoration

Hennepin County, Environment and Energy Department:

- Sent County's draft Natural Resources Strategic Plan (available at <http://minnehahacreek.org/8410-submittals>).

Metropolitan Council Environmental Services:

- Include policies related to the protection of area water resources with the end goal of water sustainability, consistent with the Council's new policy plans.
- Include quantifiable and measurable goals and policies that address water quantity, water quality, recreation, fish and wildlife, enhancement of public participation, groundwater, wetlands, and erosion issues.

- Address the issues and problems in the watershed and include projects or actions and funding to address the issues and problems. At a minimum the watershed should address:
 - Any problems with lake and stream water quality and quantity including information on impaired waters in the watershed and the District's role in addressing the impairments,
 - Flooding issues in the watershed,
 - Storm water rate control issues in the watershed,
 - Impacts of water management on the recreation opportunities,
 - Impact of soil erosion problems on water quantity and quality,
 - The general impact of land use practices on water quantity and quality
 - Policies and strategies related to monitoring of area water resources
 - Policies and strategies related to use of best management practices
 - Issues concerning the interaction of surface water and groundwater in the watershed
 - A list of the requirements for local surface water management plans
 - Erosion and sediment control standards and requirements
 - Volume reduction goals at least as restrictive as requirements in the NPDES construction general permit, and,
 - Capital improvement plan with itemized list of actions, estimated costs, and timeline.

Minneapolis Park and Recreation Board:

- Goals for the future of the MCWD system and our local issues are:
 - Recovery from 2014 flood
 - Repair previously completed reach projects
 - Repair new erosion
 - Identify and rectify incipient problem areas
 - Progress on Impairments and TMDL projects
 - Phosphorus
 - Bacteria
 - Chloride
 - Biota
 - Preserve base flow to protect stream biota
 - Plan for future floods - Preserve flood storage
 - Trash reduction
 - Preserve historic elements, while naturalizing creek
 - Retain AIS focus
- Policy-related goals for the next-generation plan are:
 - To more closely align the MPRB CIP plan with the MCWD CIP plan, in order to more effectively partner on projects that meet our common goals.
 - To have MPRB area masterplans recognized in future MCWD planning processes.

- To balance recreational use and the historic landscape of the MPRB system with environmental issues and water quality improvements to the system.
- To address illicit discharge to receiving waters that occur across jurisdictional boundaries.
- That MCWD addresses mitigating flood issues that may be exacerbated by changing rainfall patterns.
- List of MPRB water-quality-related programs and activities that take place within MCWD boundaries:
 - Canines for Clean Water (address bacteria loading)
 - WQ education tabling at Neighborhood events (annual, number of sites varies)
 - Goose control (address bacteria loading)
 - Lake Monitoring Program (chemistry, aquatic plants, phytoplankton, zooplankton)
 - Beach Monitoring Program (11 MPRB beaches within MCWD boundaries)
 - Stormwater monitoring partnership with City of Minneapolis, two annually - monitored sites within MCWD
 - Xerxes Ave stream monitoring station (rating-curve creation, flow monitoring, flow-paced sampling)
 - Vegetation management (parkland, riparian, and shoreline)
 - Periodic training for MPRB staff (pesticide applicators license, chloride applicators certification, pertinent water quality training topics)
 - Aquatic Invasive Species early detection program, Boat inspection program, Education Program (in partnership with MCWD)
 - Groundwater level monitoring

MN Board of Water and Soil Resources:

- The Total Maximum Daily Load (TMDL) studies that have been completed should guide implementation planning.
- The Plan should include reference to the Twin Cities Metropolitan Area Chloride TMDL and incorporate elements of Chloride Management Plan.
- BWSR would like to see the Plan focus on addressing impaired waters in the upper watershed. Partnership with Hennepin County Dept. of Energy and Environment, Carver Soil & Water Conservation District, and University of Minnesota Extension is encouraged.
- The District should establish a policy on its approach to in-lake treatment systems.

MN Department of Agriculture:

- Referred to MDA website and handout “Drainage Recommendations for Local Water Management Plans” (noting that recommendations are intended more for outstate areas).
 - Consider developing a Comprehensive Drainage Management Plan

- Create a permanent Drainage Advisory Committee
- Develop a system-wide inventory of culverts and open tiles
- Establish drainage co-efficients based on engineering data
- Encourage development and implementation of Drainage Water Management Plans
- Consider demonstration sites for drainage BMPs
- Consider both short- and long-term storage

MN Department of Natural Resources:

- DNR priority issues:
 - Integrated water resource management - focus on achieving healthy watersheds through a “whole-system” approach that considers hydrology, biology, connectivity, geomorphology and water quality.
 - Groundwater sustainability - would like to see the District play a stronger role in promoting groundwater use conservation.
 - Aquatic invasive species - encourage the District to continue its leadership role in this area.
 - Governor’s buffer initiative - consider what role the District could play in implementation of the new “Governors Buffer Initiative”.
 - Stream and lake bank stabilization and restoration - encourages MCWD to consider stream dynamics when planning stream stabilization or restoration projects.
 - Consideration of plant communities, rare species, and special features - recommends using assessment data relating to special natural resource features when completing long-range watershed planning efforts.