

CITY OF CHASKA

LOCAL SURFACE WATER MANAGEMENT PLAN

APRIL 2020, UPDATED JANUARY 2024



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Executive Summary

This report provides the City of Chaska (City) with a Local Surface Water Management Plan (LSWMP) that will serve as a guide to managing the surface water system throughout the City, bring the City into statutory compliance, and serve to meet Metropolitan Council requirements. The Chaska LSWMP will serve as a comprehensive planning document to guide the City in conserving, protecting, and managing its surface water resources. This LSWMP is an update to the 2015 LSWMP, which was a major update to the 2007 LSWMP. Due to the short period of time since the 2015 LSWMP, minimal changes have been made to the plan.

The LSWMP is expected to carry the City through the end of 2028. Periodic amendments to the LSWMP will likely occur in the intervening 10 years so that the LSWMP remains current to watershed plan amendments and to the “state of the art” in surface water management.

The LSWMP has been written to meet requirements as established in Minnesota Rules 8410. In addition, the LSWMP reflects the requirements of the Carver County Watershed Management Organization (CCWMO), the Lower Minnesota River Watershed District (LMRWD), and the Riley Purgatory Bluff Creek Watershed District (RPBCWD), which have jurisdiction within the City. Meeting watershed requirements ensures the City’s compliance with local and regional expectations.

The City submits its LSWMP to the Metropolitan Council, the CCWMO, the LMRWD, and the RPBCWD for review. The watersheds have 60 days for their review after written receipt of the LSWMP. Metropolitan Council provides comments within 45 days. The Council directs its comments to the watersheds, which consider the Council’s comments when formulating their own.

Based on the guidance provided by City staff, this report addresses the City’s current surface water management needs and provides a framework for successful implementation of a comprehensive stormwater management program.

This report is organized as follows:

- **Section 1 – Introduction** provides background, population history, and the purpose and scope of the LSWMP.
- **Section 2 – Land and Water Resource Inventory** describes the physical environment including watersheds and drainage patterns, dominant land uses, and significant waterbodies within the City.
- **Section 3 – Goals and Policies** lists the City’s goals and policies along with public agency requirements affecting surface water management in the City. The goals and policies are broad statements regarding the motivation and intent of the LSWMP. The policies that follow the individual goals are specific requirements that promote attainment of the goals.
- **Section 4 – Water and Natural Resource Inventory, Assessment, and Management** presents the results of the inventory and assessment of wetlands, uplands, creeks and ravines, and the surface water system. The assessment of natural resources allows the City to identify potential restoration areas within City-owned lands and prioritize preservation and restoration opportunities during



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development. The management discussions of Section 4 are intended to provide the following benefits:

- Provide a detailed inventory of water and natural resources.
- Provide stormwater protection standards for wetlands.
- Protect natural areas and adjacent resources that provide valuable ecological support.
- Enhance wildlife values of natural areas by facilitating restoration projects.
- Provide and enhance recreational values of natural areas.
- Identify restoration/enhancement opportunities for wetlands, uplands, creeks, and ravines.

It should be noted that this inventory and assessment have been created for planning purposes only. Wetlands in particular are highly regulated by the Wetland Conservation Act. Therefore, regulation of activities potentially affecting individual wetlands must be based on a site-specific delineation of the wetland boundary as part of a proposed project.

Natural resources with good restoration potential are shown on the system maps, included as Appendix G, and descriptions are included in Appendices D and E.

The surface water system assessment catalogues the various assessments of problems that the LSWMP must address. The intent is to identify the source of problems and specific actions the City will take to address these problems either independently or in collaboration with some other organization – most commonly the CCWMO or the LMRWD. Section 4 summarizes water quality and water quantity assessments conducted by the City, the CCWMO, the LMRWD, and the Minnesota Pollution Control Agency (MPCA).

The City has eight waterbodies listed on the state's proposed 2014 impaired waters list. Known as the 303(d) list from the applicable section of the Clean Water Act, these waters are ones that do not currently meet their designated use due to the impact of a particular pollutant or stressor. This listing will potentially affect management of runoff that directly discharges to the listed waters. At some point, a strategy would need to be developed that would lead to attainment of the applicable water quality standard. The process of developing this strategy is commonly known as the TMDL process and involves the following phases:

- Assessment and listing.
- TMDL study.
- Implementation plan development and implementation.
- Monitoring of the effectiveness of implementation efforts.
- Section 5 – System Design, presents an overview of all the major drainage districts in the City. A synopsis of the modeling procedure, criteria, and assumptions is included. Guidance for developers to meet the intent of this LSWMP is included in the design standards and associated discussion.

Section 5 describes the City's surface water management system. This system is shown in the system maps, included as Appendix G. The map indicates the major drainage divides, conveyance (i.e., pipes and



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channels), and storage areas (i.e., ponds, wetlands, and lakes) that have been incorporated into the LSWMP modeling. The LSWMP area was organized into ten major drainage districts, as follows:

- Carver.
- Chaska Creek.
- Chanhassen.
- Chaska Lake.
- East Creek.
- Hickory Street.
- Lower Chaska Creek.
- Minnesota River.
- South Chaska Creek.
- Upper East Creek.
- Section 6 – Implementation Plan, covers regulatory responsibilities, priority implementation items, educational programs, operation and maintenance, and financing considerations. The Implementation Plan describes those activities and programs the City might develop toward improving its surface water management program. Current methods for financing stormwater management activities in the City are also presented. A plan amendment process is also identified.

Section 6 also includes:

- An overview of the City's NPDES permit.
- A discussion of operation and maintenance procedures and strategies.
- An outline of an education program.
- Applicable design standards for stormwater management.
- Ordinance implementation.
- Watershed implementation priorities.
- City implementation priorities.
- A discussion of the process for amending the LSWMP and preparing an annual report to council.
- Section 7 - Summary and Outcomes, contains a summary of the LSWMP and outcomes from City Council adoption of the LSWMP.



1.0 INTRODUCTION

1.1 BACKGROUND

The City of Chaska’s Local Surface Water Management Plan (LSWMP) serves as a guide to managing the City’s surface water system and brings the City into compliance with Minnesota Rules and Metropolitan Council and watershed requirements. The LSWMP is expected to carry the City through the end of 2028. Periodic amendment to the LSWMP will likely occur in the intervening 10 years so that the LSWMP remains current to watershed plan amendments and to the “state of the art” in surface water management.

The City of Chaska is located in eastern Carver County, with Chanhassen to the north and east, Victoria to the northwest, Laketown Township and Dahlgren Township to the west, Carver to the southwest, and the Minnesota River to the south, with Jackson Township across the river opposite the City to the southeast (Figure 1-1). Chaska is a well-established community that still has a substantial portion of land left to develop.

Population in the City has grown from approximately 2,000 people in 1950 to approximately 24,000 people in 2010. The population is projected to continue increasing fairly rapidly through 2030 to a population of 32,000, with a projected ultimate population of 36,600. Table 1-1 provides City populations and population projections from 2010 through 2040.

Table 1-1 Population and Households

Year	Population	Households
2010	23,770	8,816
2020	27,100	10,400
2030	32,000	12,300
2040	36,600	14,200

Source: Metropolitan Council 2040 Water Resources Policy Plan

1.2 PURPOSE AND SCOPE

The LSWMP will serve as a comprehensive planning document to guide the City in conserving, protecting, and managing its surface water resources. The LSWMP has been created to meet statutory requirements as detailed in Minnesota Rules 8410. In addition, the LSWMP reflects the requirements of the Carver County Watershed Management Organization (CCWMO), the Lower Minnesota River Watershed District (LMRWD), and the Riley Purgatory Bluff Creek Watershed District (RPBCWD). Meeting watershed requirements ensures the City’s compliance with local and regional expectations. Finally, the LSWMP addresses the Metropolitan Council’s requirements for local surface water management plans.



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Introduction

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In accordance with Minnesota statutes and rules, local surface water management plans must do the following:

- Describe the existing and proposed environment and land use.
- Provide a narrative addressing stormwater infrastructure philosophy, which details regulatory authority, and implementation and financial responsibilities.
- Identify surface water quality and quantity protection methods that meet state and watershed standards.
- Identify regulated areas and potential easements or land acquisition areas.
- Outline a procedure for submitting annual reports to agencies that document Wetland Conservation Act and monitoring program data consistent with state compatibility guidelines.
- Set forth an implementation program, including a description of official controls, inspection and maintenance, and a capital improvement plan.
- Describe official controls and the responsible unit of government in the following areas: wetlands, erosion control, shoreland, floodplain, grading, and drainage.
- Meet other requirements as outlined in watershed organization plans.

The City submits its LSWMP to the Metropolitan Council, the CCWMO, the LMRWD, and the RPBCWD for review. The watersheds have 60 days for their review after written receipt of the LSWMP. Metropolitan Council provides comments within 45 days. The Council directs its comments to the watersheds, which consider the Council's comments when formulating their own.

Beyond the statutory requirements outlined above, the Chaska LSWMP has its own particular emphasis. Some areas of emphasis include:

- Collecting and compiling the efforts of agencies and organizations including the City, its departments, and residents. This includes past reports and studies, management plans, monitoring studies, as well as completed and proposed improvement projects.
- Establishing reasonable, achievable, and affordable goals, and supporting them with a strong regulatory and management culture.
- Developing an implementation plan that includes projects and processes that derive from a thorough assessment of current City problem areas and current City surface water regulations and controls.
- Ensuring compliance with the NPDES Phase II MS4 Permit and Stormwater Pollution Control Plan (SWPPP).
- Supporting the operation of the City's stormwater utility by outlining an implementation plan.



LOCAL SURFACE WATER MANAGEMENT PLAN

Introduction

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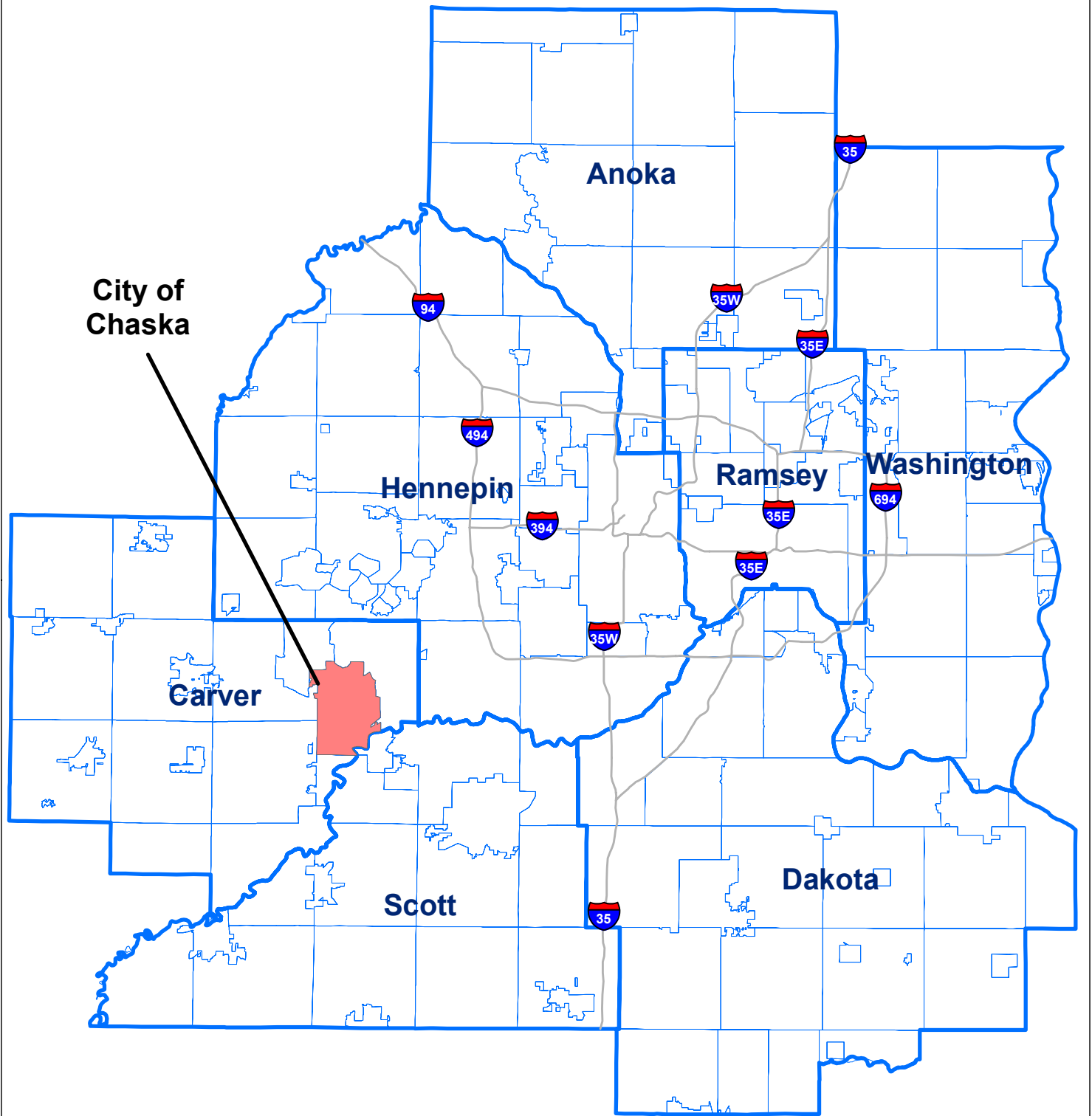
Based on the guidance provided by City staff, this report addresses the City's current surface water management needs and provides a framework for successful implementation of a comprehensive stormwater management program.

1.3 ORGANIZATION

This report is organized as follows:

- Section 2 – Land and Water Resource Inventory, describes the physical environment including watersheds and drainage patterns, dominant land uses, and significant waterbodies within the City.
- Section 3 – Goals and Policies, lists the City's goals and policies along with public agency requirements affecting surface water management in the City.
- Section 4 – Water and Natural Resource Inventory, Assessment, and Management, presents the results of the natural resource inventories. The inventories allow the City to identify potential restoration areas within City-owned lands and prioritize preservation and restoration opportunities during development.
- Section 5 – System Design, presents an overview of all the major drainage districts in the City. Guidance for developers to meet the intent of this LSWMP is included in the design standards and associated discussion. A synopsis of the modeling procedure, criteria, and assumptions is included as well.
- Section 6 – Implementation Plan, covers regulatory responsibilities, priority implementation items, educational programs, operation and maintenance, and financing considerations. The Implementation Plan describes those activities and programs the City might develop toward improving its surface water management program. A plan amendment process is also identified.
- Section 7 – Summary and Outcomes, contains a summary of the LSWMP and outcomes from City Council adoption of the LSWMP.





City of Chaska

Hennepin

Anoka

Ramsey

Washington

Carver

Scott

Dakota



Location Map

Chaska, Minnesota Local Surface Water Management Plan



Figure 1-1



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V:\1938\active\193804209\GIS\Projects\Fig 1-1 Location Map.mxd

2.0 LAND AND WATER RESOURCE INVENTORY

2.1 CLIMATE AND PRECIPITATION

Chaska, Carver County, and the Twin Cities Metro area have a continental climate because of their proximity to the middle of the North American continent. Annual normal precipitation is approximately 30.5 inches, of which about two-thirds occurs during the summer months of May through September. The annual snowfall in the Twin Cities averages approximately 54 inches, with the most severe snowmelt runoff conditions usually occurring in March and early April. Mean annual lake evaporation is about 34.6 inches per year. The average date of the last below freezing temperature (32 degrees Fahrenheit) in the spring is May 2 while the average date of the first below freezing temperature in the fall is October 2. Thus, the normal growing season length is about 166 days.

2.2 TOPOGRAPHY, GEOLOGY, AND GROUNDWATER

The history of the Chaska's landscape begins around 500 million years ago, when much of Minnesota was covered by water, and the sedimentary rock layers that lie under the City were formed. These bedrock layers are buried under glacial deposits that vary from tens to hundreds of feet thick in the City. Chaska lies on the southwestern flank of the Twin Cities artesian basin. As it is elsewhere in much of the Twin Cities area, the bedrock underlying Chaska is concealed by tens to hundreds of feet of unconsolidated Quaternary deposits. Below these deposits, the major formations that have been identified are St. Peter sandstone, Prairie du Chien Group, Jordan Sandstone, and St. Lawrence and Franconia Formations.

Glacial activity that occurred about 11,000 years ago is largely responsible for the current topography of the City and the configuration of the watersheds within the area. The Chaska area is characterized by rolling to hilly with poorly-drained depressions supporting wetlands and ponds, and more developed drainage networks. Many of the depressions were formed as a result of ice blocks deposited within the glacial drift that underlies much of the area. Much of the western and northern portions of the City exhibit fairly level topography. The steep slopes that do exist are most concentrated along Chaska Creek, East Creek, and the dissected bluff lines along the Minnesota River. Elevations vary from approximately 780 feet (all elevations in this LSWMP are North American Vertical Datum 88) along the Minnesota River to approximately 1,050 feet in the northwestern area of the City.

In general, groundwater underlying the City in both the Quaternary aquifers as well as the bedrock aquifers flows to the south and southeast toward the Minnesota River. The Prairie du Chien Group and the Jordan Sandstone together form the most heavily used aquifer in the Twin Cities area.

The depth to bedrock generally ranges between 100 feet adjacent to the Minnesota River to 500 feet in the uplands. Due to the depths to bedrock in the Chaska area, contamination of groundwater is less likely than areas with thinner confining layers. Even so, precaution should be taken to minimize the potential for groundwater contamination typically resulting from septic systems, spreading of fertilizers and chemicals, hazardous material spills, and (potentially) stormwater ponds. Due to the shallower depth to bedrock in the



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Land and Water Resource Inventory

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Minnesota River floodplain, potential for groundwater contamination should be give special consideration for projects in that area.

2.3 SOILS

Chaska is covered by soils formed from glacial materials deposited over most of the City. The several soil types that are present in Chaska can generally be found in two distinct areas within the City; within, or adjacent to, the Minnesota River floodplain, and dispersed throughout the remaining upland area to the north and west of the river. The Natural Resource Conservation Service (NRCS) prepared a soil survey for Carver County in 1966 that contains detailed information on the general soil associations and classification types, as well as erosion potential, infiltration characteristics, and suitability for a variety of land uses. The following paragraphs summarize the results of the NRCS soil survey for the City.

The majority of the soils associated with the Minnesota River floodplain can be divided into two groups. The first group consists of soils that are, in general, very deep, somewhat poorly to poorly drained soils formed in alluvium on flood plains. They range from moderate to moderately slow permeability and are classified as Fine-Silty and Fine-Loamy soils. The second group consists of soils that are generally very deep, moderately well drained to excessively drained soils formed in alluvium on floodplains and in glacial outwash sediments. They range from moderate to rapid permeability and are classified as Coarse-Loamy and Sandy soils.

The majority of the soils found in the upland area of Chaska are generally very deep, moderately well to well drained soils formed in glacial till on moraines. They have moderate to slow permeability and are classified as Fine to Fine-Loamy soils. The remaining soils are generally very deep, very poorly to moderately drained soils formed in glacial till on moraines. They have moderate to moderately slow permeability and are classified as Loamy and Fine-Loamy soils.

Table 2-1 shows the drainage characteristics of various soil series found in the City.



Table 2-1 Soil Drainage Characteristics

Location	Soil Series	Hydrologic Soil Group
Minnesota River Floodplain	Blue Earth	B/D
	Chaska	B/D
	Coland	B/D
	Oshawa	D
	Estherville	B
	Hawick	A
	Minneiska	B
	Kalmarville	B/D
	Sparta	B
Uplands	Lester	B
	Kilkenny	B
	Glencoe	B/D
	Hamel	C
	Le Sueur	B
	Terril	B
	Houghton	A/D
	Muskego	A/D

Note: Two hydrologic soil groups such as B/D indicate the drained/undrained situations.

The Hydrologic Soil Group (HSG) defines a soil's propensity to generate runoff for a given rainfall event. Four HSG groups are identified: A, B, C, and D. HSG A soils have the lowest potential to generate runoff and are typically sandy or gravelly soils. HSG D soils have the highest potential to generate runoff and typically consist of muck, peaty muck, and tight clay soils. Most of Chaska generally has soil associations of HSG B, indicating a moderate potential to generate runoff. In many cases, though, grading associated with development projects reduces the drainage capacity of the soil, increasing its runoff generating potential. Detail regarding how areas should be modeled dependent on soil type is included in Section 5.

2.4 KEY WATER RESOURCES

The City has several water resources available for the use and enjoyment of its residents. These major water resources tend to be Minnesota Department of Natural Resources (MnDNR) public waters and protected wetlands. Below is a brief summary of the major surface water resources. Public waters and protected wetlands can be seen on the system maps, included as Appendix G.



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Chaska Lake (PWI #4P)

Chaska Lake is a MnDNR protected water. The lake is located southwest of the downtown area and is located in the floodplain area of the Minnesota River. Little data is available for Chaska Lake. The lake appears to have a large wetland fringe and is likely a relatively shallow lake. Its area is approximately 68 acres. The area of its watershed is 525 acres, giving a watershed-to-lake ratio of 7.7 to 1. The lake drains via a natural overland outlet northeast to Chaska Creek just upstream of the confluence with the Minnesota River.

Firemen's Lake (PWI #226P)

Firemen's Lake is a MnDNR protected water. The lake is located just north of the downtown area and west of Highway 41. Firemen's Lake is manmade, originally mined for clay for brick manufacturing. The lake currently has a beach and is also known as the Chaska Swim Hole. The lake has a maximum depth of 23 feet. Its area is approximately 8 acres. The area of its watershed is 70 acres, giving a watershed-to-lake ratio of 8.8 to 1. For water quality purposes, a diversion manhole located east of the lake routes low flows away from the lake, resulting in a reduced watershed-to-lake ratio of approximately 4:1. The lake drains via a pipe outlet southwest to the Corps of Engineers Chaska Creek diversion channel.

Clayhole Lake (Brickyard Lake - PWI #225W)

Clayhole Lake is a MnDNR protected wetland. The lake is located just north of the downtown area and east of Highway 41. Similar to Firemen's Lake, Clayhole Lake is manmade, originally mined for clay for brick manufacturing. The lake has a maximum depth of 43 feet. Its area is approximately 17 acres. The area of its watershed is 240 acres, giving a watershed-to-lake ratio of 14.1 to 1. Similar to Firemen's Lake, a diversion manhole located north of the lake routes low flows away from the lake for water quality purposes, resulting in a reduced watershed-to-lake ratio of approximately 4:1. The lake drains via a pipe outlet southeast to East Creek.

Courthouse Lake (PWI #5P)

Courthouse Lake is a MnDNR protected water. The lake is located adjacent to and east of the downtown area. Courthouse Lake is unique in that it is one of six lakes in the metro area that are stocked with trout, including rainbow, brook, brown, and lake trout. The lake has a maximum depth of 57 feet. Its area is approximately 10 acres. The area of its watershed is 20 acres, giving a watershed-to-lake ratio of 2 to 1. The lake drains via a pipe outlet north to East Creek just upstream of the confluence with the Minnesota River.

Lake Bavaria (PWI #19P)

Lake Bavaria is a MnDNR protected water. Lake Bavaria is a natural lake located in the northwest area of the City. The lake has a maximum depth of 66 feet. Its area is approximately 162 acres. The area of its watershed is 760 acres, giving a watershed-to-lake ratio of 4.7 to 1. The lake drains via a natural overland outlet to the east. Lake Bavaria is one of the primary lakes considered the headwaters for East Creek.

Hazeltine Lake (PWI #14P)



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Hazeltine Lake is a MnDNR protected water. The lake is a natural lake located in the northeast area of the City. The lake is a shallow lake with a maximum depth of 7 feet. Its area is approximately 161 acres. The area of its watershed is 550 acres, giving a watershed-to-lake ratio of 3.4 to 1. The lake drains via pipe outlet to the northwest. Similar to Lake Bavaria, Hazeltine Lake is one of the primary lakes considered the headwaters for East Creek.

McKnight Lake (PWI #216W)

McKnight Lake is a MnDNR protected wetland. The lake is at the upstream end of a chain of manmade lakes, created using dams primarily for the purpose of downstream flood prevention. The chain of lakes includes Wallestad Lake (the IDS pond), McKnight Lake, Jonathan Lake (Upper Lake Grace), and Lake Grace. Little data is available for McKnight Lake. The lake is likely a relatively shallow lake with a maximum depth of approximately 20 feet. Its area is approximately 31 acres. The area of its watershed is 3,800 acres, giving a watershed-to-lake ratio of 123 to 1. The lake drains via pipe outlet to the south.

Jonathan Lake (Upper Lake Grace - PWI #217W)

Jonathan Lake is a MnDNR protected wetland. The lake is part of the chain of manmade lakes discussed above. Little data is available for Jonathan Lake. The lake is likely a relatively shallow lake with a maximum depth of approximately 20 feet. Its area is approximately 25 acres. The area of its watershed is 4,080 acres, giving a watershed-to-lake ratio of 163 to 1. The lake drains via pipe outlet to the south.

Lake Grace (PWI #218W)

Lake Grace is a MnDNR protected water wetland. The lake is the final lake in a chain of manmade lakes discussed above. The lake has a maximum depth of 22 feet. Its area is approximately 56 acres. The area of its watershed is 4,190 acres, giving a watershed-to-lake ratio of 75 to 1. The lake drains via pipe outlet to the south.

2.5 POLLUTANT SOURCES

The Minnesota Pollution Control Agency (MPCA) maintains up-to-date information on potential sources of groundwater contamination, including sanitary landfills, hazardous waste sites, dumps, registered underground and above ground storage tanks, feedlots, abandoned wells, and permitted wastewater discharges. This information is available through the MPCA's Property Transfer File Evaluation Service, free-of-charge for municipalities.

2.6 FISH AND WILDLIFE HABITAT

The ponds, wetlands, and open spaces interspersed throughout the area provide habitat and travel corridors for numerous wildlife species. Likewise, the Minnesota River Valley is one of the largest contiguous tracts of natural area in the Twin Cities metropolitan area and serves as a major corridor for resident and migratory wildlife species. Ducks and geese are abundant in wetlands and open water areas associated with depressional wetlands and the Minnesota River, as are reptiles and amphibians such as frogs, turtles, and



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Land and Water Resource Inventory

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snakes. Vegetative cover in the largely open areas attracts whitetail deer as well as numerous small mammals.

Likewise, the mix of forest, prairie, and cropland provides exceptional habitat for many generalist species of wildlife, including deer, raccoon, red fox, and others. Because of the alteration of much of the landscape for agriculture and development, species dependent on specialized habitats have not been documented. Although a few impounded waterbodies in the study area have deep enough water to support populations of game fish, depressional wetlands and surface streams in the area are not deep enough to support permanent populations of fish species. However, in lower reaches, the City creeks likely support smaller fish such as minnows, daces, and other similar species.

2.7 LAND USE

Figures 2-1 and 2-2 show the Present and Ultimate land uses for the City. The City has a well-established industrial park that can be seen in the northeast corner of the City on Figure 2-1. The primary areas of commercial land use are located along Highways 41 and 212. The City also has well-defined and generally interconnected open space areas that consist of parks, golf courses, and trail systems that generally follow drainage patterns along wetlands and creeks/ravines. The majority of the City's land area is dedicated to low and medium density residential development. The outer ring along the west and northwest boundaries of the City are reserved for large lot residential and intended to act as a development buffer.

The southeast and central areas of the City are largely developed. The City recently annexed the southwest corner of the City, and this area is beginning to develop.

The change over time from undeveloped land uses, like natural and agricultural, to more heavily developed land uses like low, medium, and high density residential and commercial has had a pronounced effect on hydrology. The increased impervious surface associated with the urban land uses leads to higher runoff peak flows and increased runoff volume.

2.8 SIGNIFICANT NATURAL FEATURES

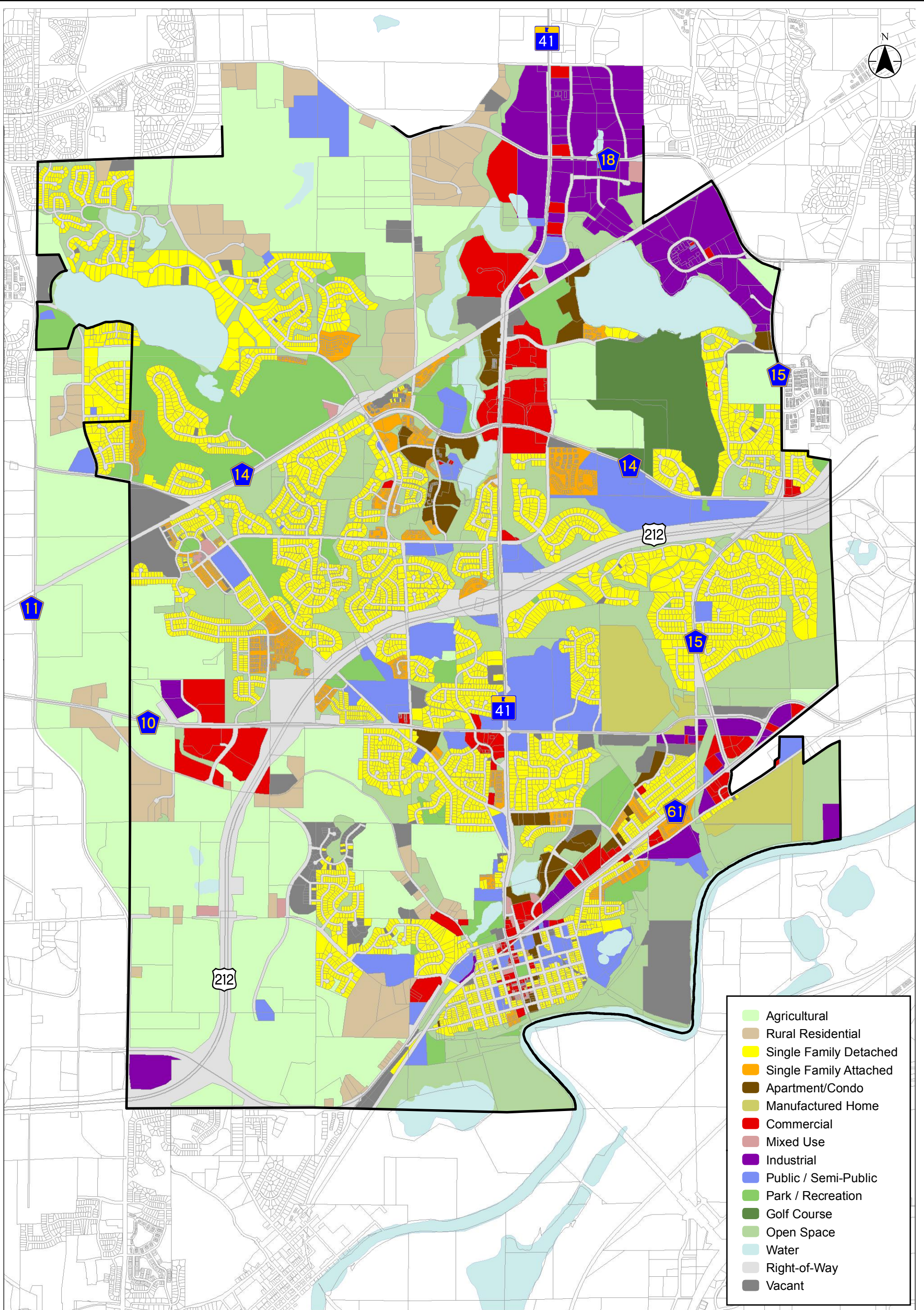
The MnDNR Natural Heritage and Non-Game Wildlife Program maintains a database of rare plant and animal species and significant natural features. The database can be reviewed to determine if any rare plant or animal species or other significant natural features are known to occur within the City. This information is available to municipalities free-of-charge.

2.9 EXISTING FLOOD INSURANCE STUDIES

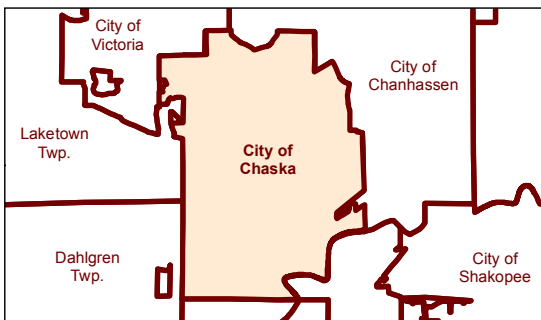
The sole Flood Insurance Study (FIS) for the City was originally created in September 1972 with the latest revision in July 1998. The study includes the Minnesota River, Chaska Creek, and East Creek.

All of the Minnesota River adjacent to the City is included in the FIS. Approximately 1,500 feet of Chaska Creek are included upstream of the Chaska Creek diversion channel, and approximately 2 miles of East Creek are included from the East Creek diversion channel to the confluence with the Minnesota River.





- Agricultural
- Rural Residential
- Single Family Detached
- Single Family Attached
- Apartment/Condo
- Manufactured Home
- Commercial
- Mixed Use
- Industrial
- Public / Semi-Public
- Park / Recreation
- Golf Course
- Open Space
- Water
- Right-of-Way
- Vacant



Present Land Use Map

Chaska, Minnesota

Local Surface Water Management Plan



Figure 2-1

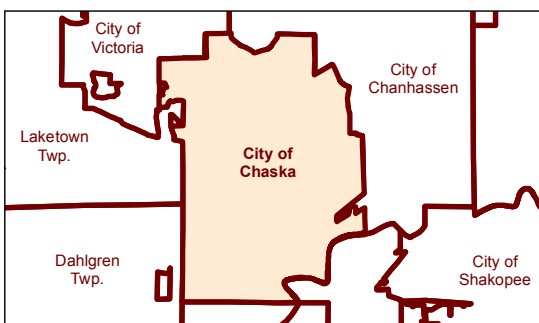
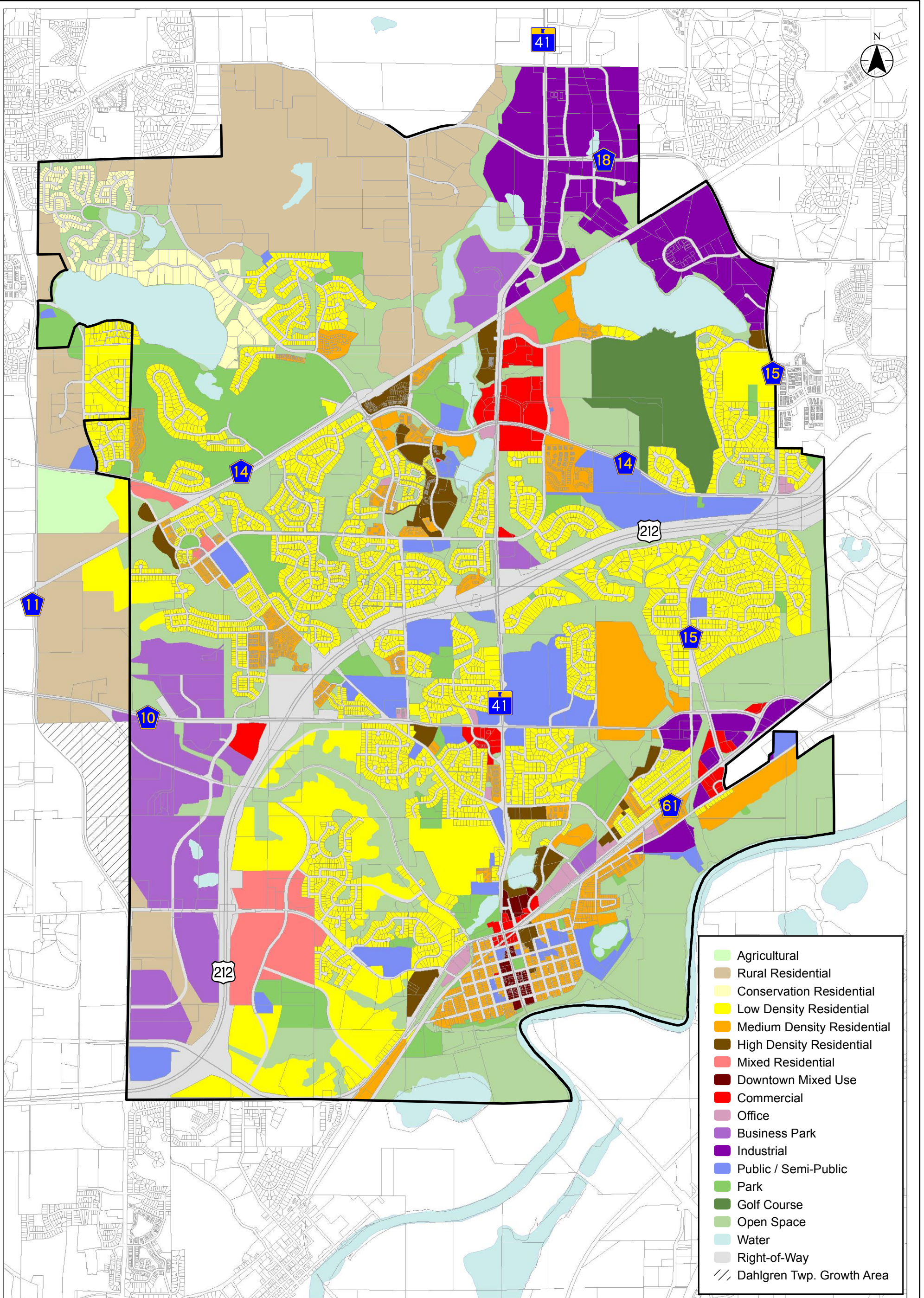
Stantec

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

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Revised: 2018-11-26 By: hduan
V:\1938\active\193804209\GIS\Projects\Fig 2-1 Present Land Use Map.mxd



Ultimate Land Use Map

Chaska, Minnesota

Local Surface Water Management Plan



Figure 2-2

Stantec

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Revised: 2018-11-26 By: hduan
 V:\1938\active\193804209\GIS\Projects\Fig 2-2 Ultimate Land Use Map.mxd

3.0 GOALS AND POLICIES

3.1 PURPOSE

The primary goals of Chaska's LSWMP are to bring the City into statutory compliance and to provide the City with a framework for effective stormwater management – primarily to guide development and redevelopment activities but also as a guide for identifying and implementing retrofits to the existing system. These retrofits may consist of projects such as storm sewer improvements and programs such as updated pond maintenance or water quality monitoring programs. Additionally, the LSWMP provides clear guidance on how the City intends to manage surface water in terms of both quantity and quality.

This LSWMP is an update to the 2007 Local Surface Water Management Plan. The LSWMP provides the City with a plan that meets the requirements of Minnesota Statute 103B and Rule 8410, which describe the content and requirements for local surface water management plans. The LSWMP is also intended to meet the requirements of the Metropolitan Council's Water Resources Policy Plan as well as watershed management organization requirements regarding local surface water management plans.

3.2 GOALS AND POLICIES

This section of the LSWMP outlines goals and policies specific to surface water management in Chaska and its environs. The goals and policies identified below are broad statements regarding the motivation and intent of the LSWMP. The policies that follow individual goals are specific requirements that promote attainment of the goal.

The City has maintained its natural drainage patterns throughout most of its development. The City's goal is to foster continued optimum use of the natural drainage system while enhancing the overall water quality entering lakes and wetlands. The intent is to prevent flooding while using identified Best Management Practices (BMPs) to enhance surface water quality while minimizing capital expenditures by the City.

The City's goals were established along the guidelines of the goals outlined in the Metropolitan Surface Water Management Act (M.S. 103B).

The purposes of the water management programs required by Sections 103B.205 to 103B.255 are to:

1. Protect, preserve, and use natural surface and groundwater storage and retention systems;
2. Correct flooding and water quality problems while efficiently managing capital expenditures;
3. Identify and plan for means to effectively protect and improve surface and groundwater quality;
4. Establish more uniform local policies and official controls for surface and groundwater management;
5. Prevent erosion of soil into surface water systems;
6. Promote groundwater recharge;



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7. Protect and enhance fish and wildlife habitat and water recreational facilities; and;
8. Secure the other benefits associated with the proper management of surface and ground water.

3.2.1 Antidegradation

Goal 1

Improve the quality of the City's and the region's surface water resources by, whenever feasible, decreasing phosphorus, total suspended solids, and water volume discharge. At a minimum, the City's antidegradation goal calls for no increase in phosphorus, total suspended solids, and stormwater volume discharge.

Policy 1.1:

The City will begin reviewing developments in the context of antidegradation and will apply such BMPs as necessary to maintain or reduce current phosphorus, total suspended solids, and stormwater volume loads.

Policy 1.2:

The City will endeavor to retrofit treatment when opportunities present themselves in public projects.

Policy 1.3:

All the City's lakes and wetlands will be managed for antidegradation.

Policy 1.4:

The City's trout waters will be managed for stormwater runoff temperature as part of the antidegradation goal.

Policy 1.5

The City will promote stormwater infiltration where feasible to reduce runoff volume and increase groundwater recharge.

Policy 1.6

The City will participate in the TMDL Studies of impaired waters within the City and adopt and enforce all requirements determined necessary to meet TMDLs applicable to the City.

3.2.2 Water Quantity

Goal 2

Prevent flooding from surface flows while reducing, to the greatest extent practicable, the public capital expenditures necessary to control excessive volumes and rates of runoff.



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Policy 2.1:

Trunk storm sewers that serve as elements of the trunk system shall be designed with capacity for 100-year ponded outflows plus 10-year directly connected flows. Channels and ravines that serve as elements of the trunk system shall be designed with capacity for 100-year ponded outflows plus 100-year directly connected flows. The City's freeboard requirements are applied to the 100-year elevations of these channels and ravines.

Policy 2.2:

In addition to the 10-year and 100-year ponded flow primary capacity, the conveyance system shall provide capacity in excess of the 100-year event in the form of overland overflow routes or adequate surface storage volume. This surface storage volume consists of storage in street low points, within ditches, or in other transient ponding areas.

Policy 2.3:

Detention ponds must be designed with capacity for the critical 100-year event. At a minimum, detention ponds must maintain existing flow rates for the 2-, 10-, and 100-year critical events.

Definition: The 100-year critical event is the 100-year event that produces the highest water level among the 24-hour, 7.3-inch rainfall event or the 10-day, 7.2-inch snowmelt runoff event.

Policy 2.4:

The net 100-year peak flow per acres from new development and redevelopment areas must meet the calculated City average of 0.2 cfs/acres. Alternative standards may be required by the City Engineer in areas where this requirement may warrant a lesser (or higher) standard for resource protection.

Policy 2.5:

The maximum duration for rainfall critical event analysis shall be 24 hours except in cases where ponds are landlocked, where back-to-back 24-hour events shall be used. In all cases, a hydrograph method of analysis shall be used. For the 24-hour rainfall event, or back-to-back 24-hour rainfall events, an Atlas 14 MSE-3 rainfall distribution should be used unless another distribution is specified by the City Engineer. For shorter duration critical events, other distributions may be used with the approval of the City Engineer.

Definition: Landlocked ponds are those where no outlet exists below proposed or existing adjacent structures.

Regarding policies 2.2, 2.3, and 2.4: For systems that were not designed and implemented to meet current City standards (i.e., older systems designed prior to current standards or systems located in annexed areas that were designed to other standards), conveyance capacity and storage requirements may not meet these requirements. These policy statements in no way imply that the City intends to unilaterally upgrade these systems.



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Policy 2.6:

All drainage system designs shall incorporate the entire area tributary to the system.

Policy 2.7:

All drainage regional system analyses and designs shall be based on proposed full development land use patterns.

Policy 2.8:

Planning for intercommunity water resource issues shall consider alternative solutions:

- a. All drainage studies or feasibility studies, whether by a watershed organization or municipality, leading to projects in a subwatershed with an intercommunity drainage issue, shall consider the impact of the project on the entire watershed area and shall consider the total intercommunity project cost.
- b. Except in emergencies, no solutions or partial solutions to intercommunity drainage issues shall be implemented without prior completion of a feasibility study of options and adoption of a preferred option by the applicable watershed organization(s).

Policy 2.9:

The following items shall be considered in the management of landlocked ponds:

- a. The flood levels established for landlocked ponds shall take into consideration the effects of water level fluctuations on trees, vegetation, erosion, and property values. Steeply sloped shorelines subject to slope failure and shoreline damage should not be in contact with floodwaters for extended periods of time.
- b. The capacity of proposed outlets from landlocked ponds should not be so small as to cause extended duration of high water levels that would result in damage to upland vegetation.
- c. Only the existing tributary area may discharge to a landlocked pond, unless a provision has been made for an outlet from the pond or the right to augmented storage within the pond has been secured through purchase or easement, except in cases where adverse impacts to vegetation would occur. The form of outlet may range from temporary pumps to gravity storm sewers. The outlet shall be implemented before increased water levels are likely to affect vegetation, slope stability, and property values.
- d. When development occurs adjacent to a landlocked pond and the pond is not provided an outlet, 3 feet of freeboard should be provided above the HWL, determined by modeling back-to-back 100-year, 24-hour events. When modeling landlocked ponds, the starting water surface elevation should be the pond's Ordinary High Water (OHW) elevation. This is typically available from the MnDNR. In cases where there is not a reasonable approximation, the OHW must be obtained by field survey and



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modeling. Additionally, continuous simulation of average annual rainfall conditions will also provide insight into whether significant, adverse impact to vegetation would occur due to development around the landlocked pond.

Definition: Freeboard is the vertical separation between the HWL of the simulated rainfall or runoff event and the lowest ground elevation adjacent to a structure.

Policy 2.10:

For ponds with a suitable outlet, freeboard will be 2 feet above the HWL, determined by modeling the 100-year critical event. Emergency overflows must be a minimum of 1 foot below the lowest ground elevation adjacent to a structure.

Policy 2.11:

Adjacent to channels, creeks, and ravines, freeboard will be 2 feet to the 100-year critical event elevation.

Policy 2.12:

Development and redevelopment projects must not exceed existing rates of discharge for the 2-, 10-, and 100-year events. Wherever feasible, the City will look for reductions over existing discharge rates for development and redevelopment projects.

Policy 2.13:

The City will review developments and manage its stormwater system so that development, redevelopment, and other infrastructure projects do not overtax the existing downstream stormwater system.

3.2.3 Water Quality

Goal 3

Maintain or improve the quality of water resources within the City.

Policy 3.1:

Wetlands and waterbodies identified on the system maps, included as Appendix G, will be protected according to standards and requirements outlined in this LSWMP and according to other applicable local, state, and federal regulations.

Policy 3.2:

The use of BMPs will be required to help minimize pollutants in stormwater runoff. The City has adopted the CCWMO rules and policies regarding controlling construction site runoff control and waste management for all construction and land disturbances throughout the City for purposes of implementing BMPs for site development.



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Policy 3.3:

New water quality ponds will be designed and constructed to provide a water quality treatment volume equivalent to the runoff from a 2.5-inch rainfall event, or the requirements of the NPDES construction site permit, whichever leads to higher treatment capacity. In some cases, other BMPs will be used in conjunction with water quality ponds. In such cases, the performance of the water quality system shall be no less than the performance of a single pond designed under the 2.5-inch criterion. Given this criterion, in general, under no circumstances shall overall treatment of a development or redevelopment site fall below 50 percent removal for phosphorus and 80 percent removal for total suspended solids. More restrictive water quality requirements may supersede for specific waterbodies (e.g., lakes and wetlands).

Policy 3.4:

Runoff abstraction (infiltration, evapotranspiration, capture and reuse) and minimization of impervious surfaces should be considered in all projects that involve stormwater management. The City will endeavor to obtain as much infiltration as possible from existing impervious surfaces when these are included in a project where infiltration is required.

Policy 3.5:

Newly constructed ponds shall include an outlet design allowing for extended detention of the 1- to 5-year rainfall event. The modeled hydrograph duration for pond discharge should extend a minimum of 24 hours for events within the 1- to 5-year range.

Policy 3.6:

Outlet skimming will be required in all ponds. Pond outlet structures shall be designed to provide skimming up to the calculated peak water level using a 10-year, 24-hour event.

Policy 3.7:

The City will share water quality data and analysis with watershed management organizations (WMOs), watershed districts, and other cities.

Policy 3.8:

Water quality retrofits in areas with no current water quality treatment will be performed in conjunction with redevelopment and City restoration projects, as appropriate.

3.2.4 Recreation and Fish and Wildlife

Goal 4

Protect and enhance fish and wildlife habitats, water recreational facilities, and water resource aesthetics.

Policy 4.1:



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The neighborhood and regional benefits to wildlife habitat and aesthetics should be considered in any proposal to alter or eliminate wetlands, understanding that wetland elimination without mitigation is precluded by state law and understanding that even mitigated wetland impacts must meet strict sequencing guidelines.

Policy 4.2:

The City will review inlets and outlets for aesthetics.

Policy 4.3:

The City will seek to coordinate with the MnDNR regarding development of MnDNR public waters and public water wetlands. Notwithstanding ordinance provisions, both existing and future, that control development of shoreland areas, the City will seek MnDNR comments on development proposals adjacent to MnDNR public waters and public water wetlands.

Policy 4.4:

Water resources shall be maintained in such a manner as to preserve or restore their intrinsic aesthetic qualities and wildlife habitat.

Policy 4.5

Water resources impacted for recreation and fish and wildlife habitat shall be restored when feasible.

3.2.5 Education and Enhancement of Public Involvement

Goal 5

Provide information and education either directly or in cooperation with other entities concerning urban stormwater management and the problems pollutants cause if allowed to enter into our water resources for all stakeholders, including City Staff, City Council, Planning Commission, developers, and the public.

Policy 5.1:

Enact an education program based on the following objectives to reduce stormwater pollution:

1. Raise awareness of the problem and solutions;
2. Promote community stewardship of the lakes, creeks, and wetlands;
3. Recognize responsible parties and actions to date; and
4. Merge feedback into program execution.

Policy 5.2:

Enact an education and outreach program to satisfy the minimum control measures identified in the City's NPDES MS4 permit. The content of this, as outlined in the City's MS4 permit, includes postings on the City



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website and in the City newsletter, stormwater events and brochures, and close coordination with outside entities.

Policy 5.3

Cooperate with the WMOs and the Carver Soil and Water Conservation District (SWCD) to broaden the amount of information and resources available for education. Each entity has valuable expertise on specific issues, such as erosion and sediment control and river management issues.

3.2.6 Groundwater

Goal 6

Maintain and improve groundwater quality, promote groundwater recharge, and prevent flooding from subsurface flows.

Policy 6.1:

To the extent that wellhead protection plans identify areas of groundwater recharge that require protection, the City shall work with the Minnesota Department of Health (MDH) and neighboring communities in developing adequate protection measures.

Policy 6.2:

Surface water management improvements located in probable recharge areas and areas of high vulnerability to chemical or petroleum spills shall be designed to promote groundwater protection. Practically, this means infiltration shall not be considered in developments that include the potential for these types of spills.

Policy 6.3:

The lowest floor or basement floor of a structure shall be 4 feet above the currently observed water table elevation or 2 feet above any known historic water table elevation.

3.2.7 Lake and Wetland Management

Goal 7

Classify the City's waterbodies and develop management goals appropriate to them.

Policy 7.1:

The City will continue performing a phased inventory of its wetlands and lakes to determine their functions and values and develop corresponding management standards that protect or enhance the City's wetlands.

Policy 7.2:

The City will share information collected on its waterbodies with the WMOs.



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3.2.8 Wetlands

Goal 8

Protect and preserve wetlands through administration of the Wetland Conservation Act.

Policy 8.1:

Act as the local government unit responsible for enforcing the most current version of the Wetland Conservation Act.

Policy 8.2:

Discourage wetland disturbance. Wetlands must not be drained or filled, wholly or partially, unless replaced by restoring, enhancing, or creating wetland areas of an equal public value, as permitted by the Wetland Conservation Act. Wetland sequencing will be strictly followed where the City protects wetlands as follows:

1. First priority is to avoid the impact;
2. Where the impact cannot be avoided, then the impact must be minimized; and
3. Where the impact cannot be avoided, then the impact must be mitigated.

Policy 8.3:

Up to one-half acre of “debit” wetland (filled or drained) will be allowed to be replaced through wetland “credit” in a bank which is located outside of Chaska’s City limits. State and County governments are exempt from this policy (M.S. 103G.222 (e)).

Policy 8.4:

Restrict clearing and grading within close proximity of the wetland boundary to provide for a protective buffer strip of natural vegetation to promote the interception of sediment and nutrients. In the event that grading occurs within the wetland buffer, native plant materials shall be reestablished as a buffer strip.

Policy 8.5:

Require that a wetland assessment be prepared for any project that includes a wetland that is currently not classified. The most current version of the Minnesota Routine Assessment Methodology for evaluating wetland functions and values is the required method of assessment.

Policy 8.6:

The City has identified wetlands that have a high potential for restoration and is looking for opportunities to work with landowners to enhance or restore these and other wetlands that, if restored, will provide rate control and water quality benefits to downstream receiving waters.



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3.2.9 Streams/Ravines

Goal 9

Protect and stabilize streams and ravines with unnatural or excessive erosion within the City.

Policy 9.1:

The City has completed assessment of a select number of ravines and creeks as part of this LSWMP. The City will look for opportunities to expand the assessment of ravines and creeks as funding becomes available.

Policy 9.2:

The City will look for opportunities to stabilize ravines and creeks that are experience unnatural or excessive erosion. A focus will be on ravines/creeks identified on the Water Resource Map in Appendix G, the Priority Project Implementation Plan in Table 6-1, as well as those that discharge to priority waterbodies. Priority waterbodies are considered lakes, high quality wetlands, and MnDNR waterways and basins.

3.2.10 Erosion and Sediment Control

Goal 10

Prevent, to the greatest extent possible, sediment from construction sites from entering the City's surface water resources and control the erosion from drainageways within the City.

Policy 10.1:

The City will maintain a partnership with the Carver SWCD for the enforcement of an Erosion and Sediment Control Ordinance as outlined in its NPDES permit. In addition, the City has adopted, in Section 5.3.2.2, Carver County Watershed Management Organization rules and policies regarding construction site runoff control and waste management for all construction and land disturbances throughout the City for purposes of implementing BMPs for site development.

Policy 10.2:

The City will identify eroding ravine areas, prioritize stabilization projects, and identify funding sources for project implementation.

3.2.11 Floodplains

Goal 11

Control development in floodplains and floodways including those subject to FEMA Studies and those that are not regulated by FEMA Studies, such as ponds, wetlands, lakes, and channels within the City limits.



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Note: Specific policies related to this goal are found in Section 3.2.2. The City's shoreland management section of the zoning ordinance (Section 6) also defines limitations to development along shoreland and non-federally regulated floodplain areas.

3.2.12 NPDES MS4 Permit

Goal 12

Operate and manage the City's surface water system consistent with best current practices and the City's NPDES MS4 Permit.

Policy 12.1:

Projects to correct existing deficiencies, to the extent they are identified, will be prioritized as follows:

1. Projects intended to reduce or eliminate flooding of structures in known problem areas.
2. Projects intended to improve water quality in the City's priority waterbodies.
3. Projects intended to retrofit water quality treatment into developed areas.
4. Projects intended to reduce maintenance costs.
5. Projects intended to improve wetlands.

Policy 12.2:

The City will actively inspect, and properly operate, maintain, and repair its stormwater system. The City will follow a regular inspection, cleaning, and repair schedule. Frequency of maintenance will be event-based and informed by experience and inspection history. The City's SWPPP outlines the frequency of these activities. Section 6 of this LSWMP provides some guidelines on pond maintenance and inspection cycles, but the SWPPP will remain the definitive source on the City's intended maintenance and inspection schedules.

Policy 12.3:

The City will follow best practices on its own lands and for its own projects including street reconstruction projects – in accordance with the NPDES construction site permit and the City's NPDES MS4 Permit.

3.2.13 Financial Management

Goal 13

Ensure that the costs of the surface water system are equitably distributed.

Policy 13.1:

The City will periodically update its storm sewer area charge and stormwater utility rate structures to accomplish the following:



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1. Meet the requirements of its NPDES permit;
2. Provide for the maintenance of ponds and outfall structures;
3. Conduct repairs to the system;
4. Update its system planning efforts; and
5. Implement water quality retrofits with downtown redevelopment.

3.2.14 Individual Sewage Treatment Systems (ISTS)

Goal 14

Ensure that ISTS that remain in the City do not constitute an environmental hazard.

Policy 14.1:

Where ISTS are known to be failing and pose an imminent environmental hazard, the City will work with the County to see that these systems are repaired or eliminated. Due to the expertise and resources Carver County has in this area, the City contracts with the County on installation, inspection, and enforcement regarding these systems.

3.3 COUNTY, STATE AND FEDERAL AGENCY REQUIREMENTS

This section of the LSWMP presents a synopsis of the current agency requirements while acknowledging the existence of other requirements that may be applicable. The City is committed to the preservation and enhancement of its wetlands and water resources through full compliance with local, state, and federal wetland regulations.

3.3.1 Minnesota Department of Natural Resources (MnDNR)

At the state level, only public waters and public water wetlands are protected by statute. Public waters are all watercourses and lakes that have been inventoried in the public waters inventory. These waters meet certain minimum basin or drainage size requirements. Public water wetlands include all Types 3, 4, and 5 wetlands in excess of 10 acres in rural areas and 2.5 acres in municipalities. These wetlands are generally characterized by open water and emergent vegetation throughout most of the year. The system maps, included as Appendix G, show the MnDNR public waters and public water wetlands within the LSWMP study area.

If an area meets the MnDNR's jurisdictional criteria but is not on the state's inventory, it is not regulated by the MnDNR. If it does not meet the statutory criteria but is listed on the inventory, it still is subject to MnDNR regulation. There is no mechanism presently for adding or deleting waters from the inventory. The inventory was begun in the late 1970s and all state inventories were completed during the early 1980s.



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The MnDNR rules specify that permits may not be issued for any project except those that provide for public health, safety, and welfare. Any private development projects are effectively excluded from permit consideration by this requirement.

The other powers and duties of the MnDNR and its commissioner are wide-ranging. As they affect surface water management within the City, they include:

- Regulation of all public waters inventory waterbodies within the City – to the extent of their Ordinary High Water Level;
- Regulation of certified floodplains around rivers, creeks, lakes, and wetlands;
- Management of the Flood Hazard Mitigation program;
- Dam safety;
- Shoreland management;
- Water appropriations; and
- Aquatic plant management control.

3.3.2 U.S. Army Corps of Engineers (USACE)

Under Section 404 of the Clean Water Act, including subsequent modifications, the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE) regulate the placement of fill into all wetlands of the United States. Wetlands of the US, as applied to the jurisdictional limits of the authority of the USACE under the Clean Water Act, are generally defined as wetlands that are contiguously connected to navigable waters via overland drainage (essentially includes all wetlands that are not landlocked). In 1993, there was a modification of the definition of "discharge of dredged material" to include incidental discharges associated with excavation. This modification of the "discharge of dredged material" definition meant that any excavation done within a wetland required the applicant to go through Section 404 permitting procedures. In 1998, however, this decision was modified so that excavation in wetlands is now regulated by the USACE only when it is associated with a fill action.

3.3.3 Board of Water and Soil Resources (BWSR)

The local and regional wetland rules are governed by the Wetland Conservation Act (WCA), which is administered statewide by BWSR. The WCA, passed in 1991, extends protection to all wetlands unless they fall under one of the exemptions of the WCA. The WCA follows a "no net loss" policy. The wetlands covered under the WCA must not be drained or filled, wholly or partially, unless replaced by restoring or creating wetland of at least equal public value under an approved replacement plan. Replacement ratio is typically 2:1 (2 acres created for every 1 acre filled) for wetland impacts.



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A designated Local Government Unit (LGU) is responsible for making exemption and no-loss determinations and approving replacement plans. Currently, the City acts as the LGU for WCA within the City's subdivision authority.

The powers and duties of BWSR also include:

- Coordination of water and soil resources planning among counties, watersheds, and local units of government;
- Facilitation of communication among state agencies in cooperation with the Environmental Quality Board; and
- Approval of watershed management plans.

3.3.4 Minnesota Pollution Control Agency

The MPCA implements provisions of Section 404 of the Clean Water Act with guidance from the EPA through a permitting process. The Section 404 permit also requires a Section 401 water quality certification before it is valid. The EPA has given Section 401 certification authority to the MPCA.

The powers and duties of the MPCA and its commissioner include:

- Fulfilling mandates from the EPA, particularly in regard to the Clean Water Act;
- Administration of the NPDES Phase II MS4 permit;
- Administration of the NPDES construction site permit program;
- Administration of the NPDES industrial site discharge permit program; and
- Development of TMDLs for waterbodies and watercourses in Minnesota (often in conjunction with other agencies or joint powers organizations such as watershed management organizations).

3.3.5 Environmental Protection Agency (EPA)

As it relates to surface water management within the City, this agency is charged with interpreting and applying aspects of the Clean Water Act. This has led to the City's need for its NPDES MS4 permit. Total maximum daily load limits also stem from the EPA's role as steward of the Clean Water Act.

3.3.6 Lower Minnesota River Watershed District (LMRWD)

The powers and duties of the LMRWD include:

- Approval authority over local water management plans;
- Ability to develop rules regarding management of the surface water system;



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- Ability to determine a budget and raise revenue for the purpose of covering administrative and capital improvement costs;
- Regulation of land use and development when one or more of the following apply:
 - The City does not have an approved local plan in place;
 - The City is in violation of their approved local plan;
 - The City authorizes the watershed toward such regulation; and
 - Other powers and duties as given in statute and joint powers agreements.

The LMRWD has developed the following standards and included them in its Watershed Management Plan:

- Erosion and Sediment Control Standard
- Floodplain and Drainage Alteration Standard
- Stormwater Management Standard
- Steep Slopes Standard

3.3.7 Riley Purgatory Bluff Creek Watershed District (RPBCWD)

The powers and duties of the RPBCWD are the same as those of the LMRWD. The RPBCWD has developed a suite of rules that include floodplain management and drainage alterations, erosion and sediment control, wetland and creek buffers, shoreline and streambank stabilization, waterbody crossings and structures, appropriation of public surface waters, appropriation of groundwater, and stormwater management for the communities within its jurisdiction.

The RPBCWD will continue to implement its regulatory program in Chaska until the City amends its LSWMP, updates its official controls, and submits the amendment to the RPBCWD for a determination that it will provide water resources protection equal to or better than the RPBCWD's rules. At that point, the RPBCWD and Chaska could enter an agreement recognizing that the City will exercise sole regulatory authority for the relevant RPBCWD rule areas. The RPBCWD will continue to implement those rules it is required to implement by statute or that are within the watershed district's sole jurisdiction.

3.3.8 Carver County Watershed Management Organization (CCWMO)

Carver County has been charged with the responsibility of managing the water resources for the portions of the County not located within another watershed district. This allows them the same statutory authority as the LMRWD, summarized in Section 3.3.6, above. The CCWMO has developed stormwater management rules for the communities within its jurisdiction.



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3.3.9 Carver Soil and Water Conservation District (SWCD)

Carver SWCD sits on the Technical Evaluation Panel for administration of the Wetland Conservation Act. Carver SWCD also conducts construction stormwater erosion control inspections for construction sites that have obtained permits for land disturbing activities.

3.3.10 State and Federal Jurisdictional Boundaries for Public Wetlands and Waters

Wetlands are delineated in accordance with the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1987). Wetlands must have a predominance of hydric soils. Hydric soils, by definition, are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, under normal circumstances, a prevalence of hydrophytic (water tolerant) vegetation typically adapted for life in saturated soil conditions. The USACE and the BWSR regulate wetlands as defined by a jurisdictional delineation.

For wetlands that fall under the MnDNR jurisdiction, the Ordinary High Water Level (OHW) determines the boundary of MnDNR jurisdiction. The OHW is established by the MnDNR. A summary of agency jurisdiction is presented in Figures 3-1 and 3-2.

3.3.11 Metropolitan Council

Metropolitan Council, through Metropolitan Council Environmental Services, serves as a review agency for local surface water management plans. They also review and approve municipal comprehensive plans.

3.4 WATER RESOURCE MANAGEMENT-RELATED AGREEMENTS

The City of Chaska is party to three joint powers agreements related to surface water management:

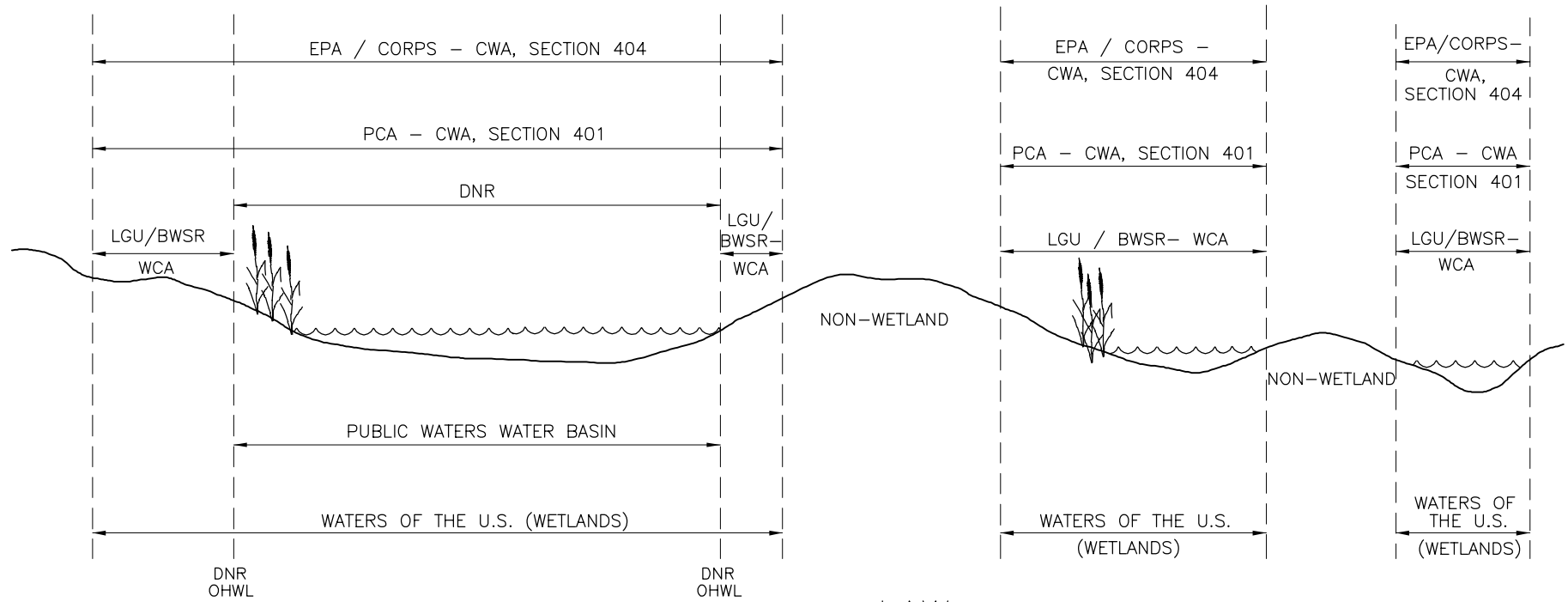
1. With Carver County Watershed Management Organization to provide stormwater-related education.
2. With Carver County to provide management of individual sewage treatment systems.
3. With the Carver Soil and Water Conservation District to provide review of erosion and sediment control (ESC) plans for developing and redeveloping sites and subsequent ESC inspection during construction.

3.5 WATERSHED GOALS AND STRATEGIES THAT AFFECT THE CITY OF CHASKA

The City of Chaska goals and policies, outlined above, are a close reflection of those of the WMOs, only presented through the municipal filter. The WMOs also have specific design standards and criteria that are required to achieve their goals.



MINNESOTA STATE AND FEDERAL JURISDICTION OVER "WATERS"



LAW

CWA = CLEAN WATER ACT
 WCA = MINNESOTA WETLAND CONSERVATION ACT

AGENCY

EPA = U.S. ENVIRONMENTAL PROTECTION AGENCY
 CORPS = U.S. ARMY CORPS OF ENGINEERS
 BWSR = MINNESOTA BOARD OF WATER AND SOIL RESOURCES
 MNDNR = MINNESOTA DEPARTMENT OF NATURAL RESOURCES
 LGU = LOCAL GOVERNMENTAL UNIT
 PCA = MINNESOTA POLLUTION CONTROL AGENCY

JURISDICTION OVER PUBLIC WATERS: WATER BASIN

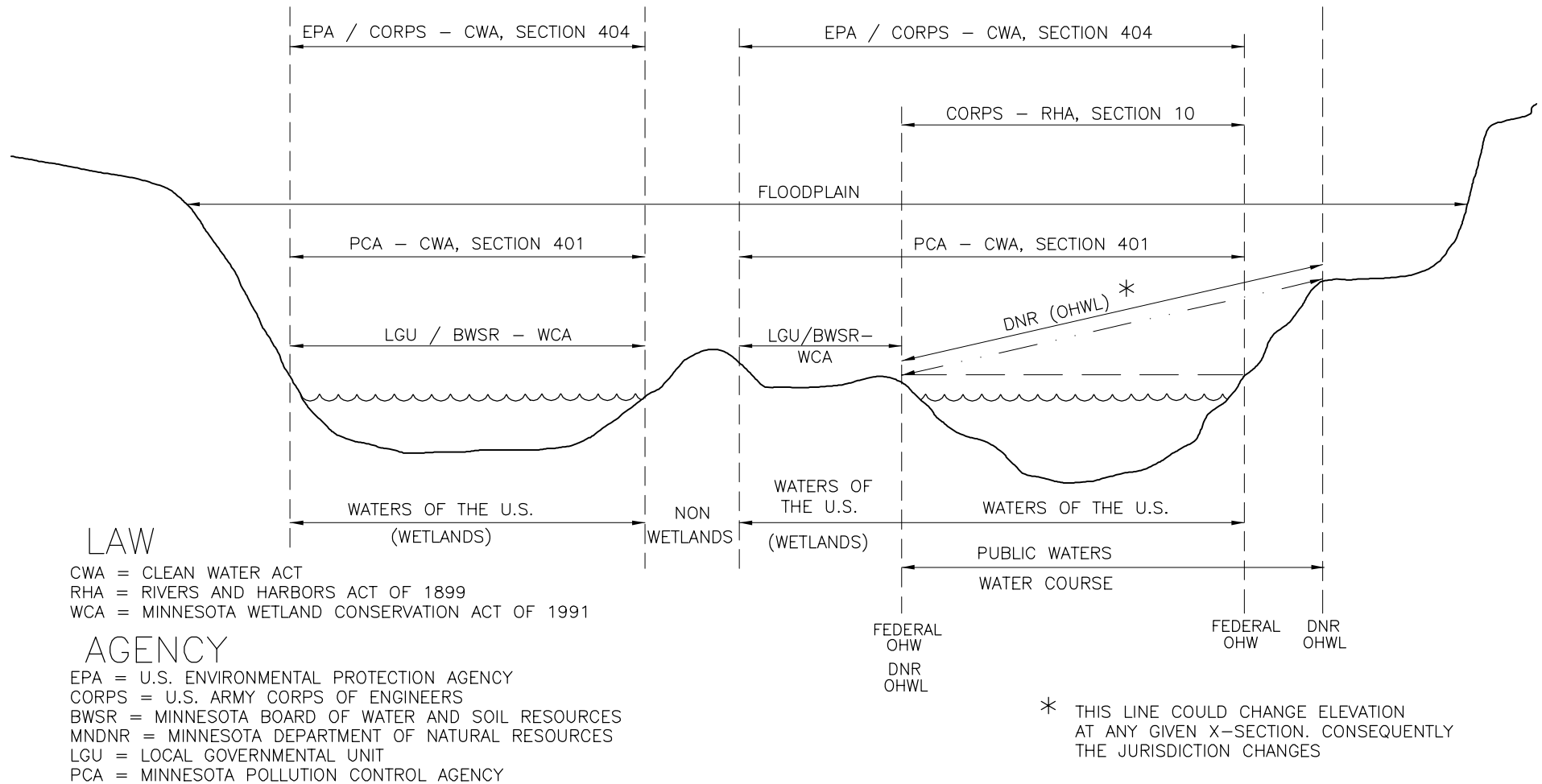
CHASKA, MINNESOTA
 LOCAL STORM WATER MANAGEMENT PLAN

FIGURE 3-1



2335 Highway 36 W
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MINNESOTA STATE AND FEDERAL JURISDICTION OVER "WATERS"



JURISDICTION OVER PUBLIC WATERS: WATER COURSE

CHASKA, MINNESOTA

LOCAL STORM WATER MANAGEMENT PLAN

FIGURE 3-2



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4.0 WATER AND NATURAL RESOURCE INVENTORY, ASSESSMENT, AND MANAGEMENT

4.1 INTRODUCTION

This section of the report contains the results of the wetland and upland natural community inventories, assessments, and management plans, as well as the surface water system assessment. The wetland and upland inventories used different methodologies and are combined into a Unified Ranking System explained below. Field work for these inventories occurred in 2000-2001, 2006, and 2013. Field work was conducted using consistent methods and with the same ecologists.

The surface water system assessment catalogues the various assessments of problems that the LSWMP must address. The intent is to identify the sources of problems and specific actions the City will take to address these problems, either independently or in collaboration with some other organization – most commonly the Carver County Watershed Management Organization or the Lower Minnesota River Watershed District.

A common theme in this report is to not only conserve natural communities, but also maintain or create connectivity between them. Linking natural communities with Greenway Corridors adds values to those areas connected. A portion of this section explains the concept of Greenway Corridors and the process of locating their alignments within the study area. Greenway Corridors can be seen on the system maps, included as Appendix G.

The wetland and upland portions of this section contain methods, results, and management recommendations for particular communities. Also listed are specific management recommendations for community types and, in some cases, the individual communities themselves.

4.2 UNIFIED RANKING SYSTEM

This inventory of natural communities considers both uplands and wetlands as part of the holistic approach to planning for their management. As explained in the Upland and Wetland inventory methods later in this section, the upland areas were classified and ranked using the methods adapted from those employed by biologists in the MnDNR Natural Heritage Program and the Minnesota Land Cover Classification System (MLCCS). The wetland communities were assessed using the Minnesota Rapid Assessment Method (MnRAM) Version 2.0, included in Appendix C.

To provide the qualitative ranking information from these two different methodologies in an easy to understand format, a Unified Ranking System was used. Wetlands were placed in the unified ranking categories of Unique, Manage 1, Manage 2, and Manage 3, using the overall Functional Ranking Flow Chart. This chart is shown in the wetland portion of this section as Figure 4-1. Upland classifications were converted to the unified ranking as shown in Table 4-1. This system makes qualitative information about upland and wetland communities available in one location.



Table 4-1 Unified Ranking System for Natural Communities

Upland Ranking ¹	Unified Ranking
A	Unique
AB	
B	Manage 1
BC	
C	Manage 2
CD	
D	Manage 3

¹ MnDNR Natural Heritage Program natural community qualitative ranking system

4.3 MINNESOTA LAND COVER CLASSIFICATION SYSTEM (MLCCS)

In Fall 2007, Carver County completed Minnesota Land Cover Classification System (MLCCS) mapping for the entire county. The MLCCS can be a very useful and powerful tool for analyzing land cover within the City. It may provide information about natural areas within the City that were not assessed during the Chaska LSWMP natural areas inventory, as well as provide information about wetland areas. When using the MLCCS data, it is important to note the degree that a site was field checked (versus checked from the edge, from a distance, or via remote interpretation), as well as the date of the visit; both variables can have implications for the accuracy of the data.

The methodology used for classifying upland areas for MLCCS is the same as that used during the upland inventory for the LSWMP. However, the MLCCS methodology for defining wetlands differs from the MnRAM methodology, and as a result there may be some differences in how wetland plant communities are named in the two systems.

4.4 GREENWAY CORRIDORS

Greenways are defined in "Metro Greenprint, Planning for Nature in the Face of Urban Growth" (MnDNR, December 1997) as: "continuous or patchy areas of vegetation that provide corridors for the movement of humans and (or) wildlife. They often follow natural waterways or land features, and they may connect natural areas or other community resources such as cultural institutions."

From an ecological perspective, a greenway is a way to connect natural areas, with the goal of improving the overall quality of each site. These greenways are intended to not only maintain or improve natural community quality, but also to provide natural amenities for the residents of Chaska and Carver County. For example, close proximity to greenspace is proven to increase property values, as well as provide buffers between built-up areas. Greenways also provide opportunities for education and recreation.

The conceptual width of the Greenway Corridors represented on the maps in this report is approximately 150 feet. Because there is a limited body of research on how greenways are used by many species of wildlife,



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there is currently no set of definitive criteria for their design. However, available research results tend to support an intuitive conclusion that wider greenway corridors are better used by more species.

The location of Greenway Corridors was derived from a consideration of factors including natural community quality and location, future land use, ownership of land, degree of slope, ecological restoration, and others. Where corridors cross significantly altered landscapes, such as crop fields or drainage ditches, reconstruction of natural communities is recommended. This includes things such as stream remeandering; prairie and savanna plantings, reforestation, and other similar activities.

It is recommended that these Greenway Corridor alignments be maintained or shifted only slightly during site planning for the study area. These alignments, although conceptual, represent what are considered by project scientists to be the best opportunity for maintaining or improving linkages between existing natural communities.

4.5 WETLAND MANAGEMENT PLAN

4.5.1 Wetland Inventory Goals

The goal of this wetland inventory is the management of wetlands based on the functions they perform. Since not all wetlands are equal in the functions they provide, an inventory and assessment of wetlands allows the City to set priorities. This plan includes a wetland inventory and ranking system that will assist the City in establishing priorities and focusing available resources for wetland protection, enhancement, and restoration.

The results of the wetland inventory and mapping effort are shown on the system maps, included as Appendix G of this LSWMP. This GIS-based wetland map will be used by the City as a planning tool for future projects that may affect wetlands.

The wetland map and the management discussions of this section of the LSWMP are intended to provide the following benefits:

- Provide a more detailed inventory of wetlands and water resources than that provided by the National Wetlands Inventory, including additional wetlands, assessment, and management information;
- Aid in administration of the Wetland Conservation Act (WCA) by providing information regarding the wetlands' functions;
- Enhance wildlife values of wetlands by facilitating restoration projects;
- Provide and enhance recreational values of wetlands;
- Designate wetland restoration/enhancement opportunities;
- Protect wetlands and adjacent resources that provide valuable ecological support;
- Provide stormwater protection for wetlands.



It should be noted that this wetland inventory has been created for planning purposes only. Regulation of activities potentially affecting individual wetlands will be based on a site-specific delineation of the wetland boundary as part of a proposed project.

4.5.2 Wetland Identification

The wetland inventory was organized within the context of the LSWMP. Wetland identification numbers used for the wetland inventory are based on the major drainage districts defined in the LSWMP. The abbreviations used for the major drainage districts are shown in Table 4-2.

Table 4-2 Major Drainage Districts

Major Drainage District	Abbreviation
Carver	CA
Chaska Creek	CC
Chanhassen	CH
Chaska Lake	CL
East Creek	EC
Hickory Street	HS
Lower Chaska Creek	LCC
South Chaska Creek	SCC
Upper East Creek	UEC

Each wetland is identified by the abbreviation of the major drainage district in which it is located, followed by a number to differentiate the wetlands.

4.5.3 Wetland Mapping

ArcView Geographic Information System (GIS) software was used to aid in the inventory and final mapping of wetlands within the study area. GIS provides the City with a map that can be easily updated and integrated with other data. The Water Resource Map at the back of the report includes the wetland locations, an estimate of the wetland boundaries, and their classifications. Appendix D contains the associated wetland classification and stormwater susceptibility rankings based on the wetland type. Preliminary layouts for future development projects should consider the wetland boundaries on the map as a guide. The wetland boundaries should be delineated early in the platting process to avoid development within the wetlands and buffer zones.

4.5.4 Wetland Evaluation Methodology

4.5.4.1 Wetland Boundary Rectification

A base map was produced that included placing the City boundary on a color aerial photograph (Metropolitan Council and Farm Service Administration). National Wetlands Inventory (NWI) polygons were then overlaid



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on the base map (USFWS, 1990). Using ArcView GIS, the NWI polygons were corrected to reflect current conditions in the City. For example, because the NWI polygons were created from 1980 aerial photographs, wetland polygons within existing roadways were removed. Field observations further refined the boundaries of the wetlands.

4.5.4.2 Minnesota Routine Assessment Method (MnRAM) Version 2.0

Wetlands are valued for a wide range of functions they perform, such as improving water quality, floodwater attenuation, and providing fish and wildlife habitat. Wetland scientists have developed methods to assess the functions of individual wetlands. The assessment evaluates characteristics such as plant community diversity and structure, connectivity to other habitat types, location in the watershed, and a wide range of other factors. The assessment is like a “report card” which evaluates the wetland’s functions and quality.

MnRAM Version 2.0 was used to assess the functions of all the wetlands inventoried for this plan. This method was developed by the Minnesota Interagency Wetland Group as a field evaluation tool to assess wetland functions on a qualitative basis. It is intended to document the field observations and interpretations of professionals who have had training and experience in wetland science. This method is not intended to be a rigid procedure but rather an aid to complement trained observation and interpretive skills with additional qualitative evaluation.

Wetlands were visited by natural resources professionals trained in using MnRAM to assess wetland functions for Floral Diversity/Integrity, Wildlife Habitat, and Aesthetic/Recreational value. A copy of MnRAM is presented in Appendix C.

4.5.5 Procedure for Wetlands Not Inventoried as Part of this Plan

If a wetland was not inventoried as part of this plan, it shall be assessed at the time that a project is proposed that may affect the wetland. MnRAM 2.0 shall be applied by a wetland professional hired by the applicant, or the City or County will complete the MnRAM assessment and bill the time back to the applicant. The City or County will determine the classification for each wetland using the completed MnRAM form submitted by the applicant and the Wetland Classification Flow Chart (Figure 4-1). The City, County, or the applicant may request the use of a Wetland Conservation Act Technical Evaluation Panel to make a decision on the ranking of the wetland’s functions.

4.5.6 Wetland Ranking Methodology

Following the assessments of wetland functions, the next step in developing this plan was the classifying of each wetland for future management. Management recommendations are closely related to the functions each wetland performs in comparison to other wetlands in the study area.

It is important to note that the comparison domain for the wetlands is the study area. It is possible that a wetland found within the study area may not be considered to be of high quality if compared to a wetland in northern Minnesota but in comparison with wetlands in the area, the wetland may be valuable for the functions it performs.



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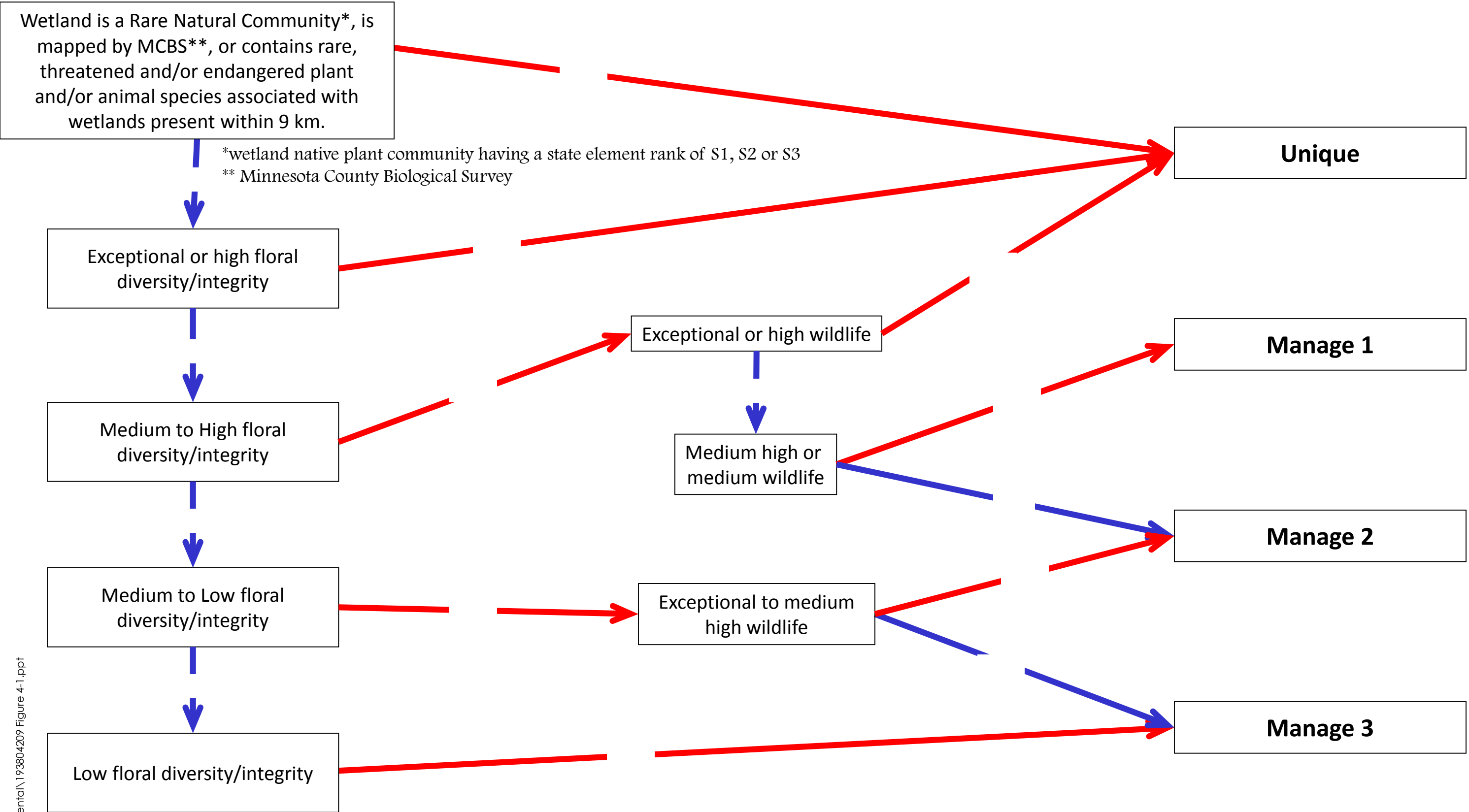
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4.5.6.1 Wetland classification

An overall classification for the wetlands within the study area categorized the wetlands into Unique, Manage 1, Manage 2, and Manage 3. These classifications are based on the wetland floral diversity/integrity combined with the wildlife habitat ranking determined from MnRAM. The process that was used to determine the overall classification is presented in detail in Figure 4-1. Wetland classifications are shown on the Water Resource Map at the back of this report.





Wetland Classification Flow Chart

Design With Community In Mind

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4.5.6.2 Stormwater Protection Ranking

One of the purposes of this wetland inventory was to determine stormwater protection standards for wetlands. There are many types of wetlands, each determined by its hydrology and vegetative composition. The two hydrologic alterations that affect wetlands the most are bounce and inundation duration.

A wetland's sensitivity to stormwater input is dependent on the wetland's community type and the quality of its plant community. Some wetlands (e.g., sedge meadows) are sensitive to disturbance and will show signs of degradation unless water quality, bounce, and duration are maintained at existing conditions. Development adjacent to hydrologically sensitive wetlands must include appropriate mitigation for potential impacts.

On the other hand, there are other wetlands (e.g., floodplain forests) that are better adapted to handle the fluctuating water levels and influx of sediment often associated with stormwater.

Site visits to wetlands for this survey included a determination of the wetland plant community type(s) and Floral Diversity using the key provided in MnRAM Version 2.0. The Guidance for Evaluating Urban Storm Water and Snowmelt Runoff Impacts to Wetlands completed by the State of Minnesota Storm Water Advisory Group was used as a guide in the determination of wetland sensitivity to stormwater. This document divides wetlands into rankings that include: highly susceptible, moderately susceptible, slightly susceptible, and least susceptible. The following are the procedures that were used to determine the wetland susceptibility ranking.

Highly Susceptible: A wetland is considered highly susceptible if:

- Forty percent or more of the wetland complex has a highly susceptible wetland community (-ities) as shown in Table 4-3 and;
- Highly susceptible wetland community(-ities) have medium to exceptional floral diversity/integrity.

Moderately Susceptible: A wetland is considered moderately susceptible if:

- Forty percent or more of the wetland complex has a moderately susceptible wetland community (-ities) as shown in Table 4-3 and;
- Moderately susceptible wetland community(-ities) have medium to exceptional floral diversity/integrity

Slightly and Least Susceptible: Wetlands with low floral diversity as determined by MnRAM were considered to be least susceptible wetlands. Wetlands that do not fall under the high, moderate, or least susceptible categories are considered slightly susceptible. (Note: This category also includes wetlands or wetland complexes that contain 40 percent floodplain forest, which is a slightly susceptible wetland community, with medium to exceptional floral diversity.)

The stormwater susceptibility rankings for each wetland are provided in Appendix D.



Table 4-3 Relative Susceptibility of Wetlands to Stormwater Impacts

Susceptibility Rating	Highly Susceptible*	Moderately Susceptible	Slightly Susceptible**	Least Susceptible***
Wetland Community	Sedge Meadow	Shrub Carr ¹	Shallow Open Water ²	Gravel Pit
	Bog	Alder Thicket ¹	Wet Meadow ⁴	Cultivated Hydric Soil
	Calcareous Fen	Wet Meadow ^{1, 2}	Shallow Marsh ⁵	Dredge/Fill Disposal Site
	Low Prairie	Shallow Marsh ^{2, 3}	Deep Marsh ⁵	Low Floral Diversity
	Coniferous Swamp	Deep Marsh ^{2, 3}	¹ These can tolerate inundation of 6-12 inches for short periods; may be completely dry in drought or late summer conditions. ² These can tolerate inundation of >12 inches, but are adversely affected by sediment and/or nutrient loading and prolonged High Water Level.	
	Lowland Hardwood	³ There are some exceptions to wet meadow and marsh communities. ⁴ Wet meadows that are dominated by reed canary grass. ⁵ Marshes dominated by reed canary grass, cattail, giant reed or purple loosestrife.		
Seasonally Flooded Basin	* Special consideration must be given to avoid altering these wetland types. Inundation must be avoided. * Water chemistry changes due to alteration by stormwater impact can also cause adverse impacts. ** Wetland community types that do not fall under Highly, Moderately, or Least susceptible ratings are generally rated as Slightly Susceptible.			

*** These wetlands are usually so degraded that input of urban stormwater may not have adverse impacts.

Note: There will always be exceptions to the general categories listed above.

4.5.7 Wetland Protection

All of the inventoried wetlands within the study area were classified for stormwater and habitat protection. Stormwater protection standards are listed in Tables 4-4 and 4-5. Wetland buffer standards designed to assist with wetland function and habitat protection are listed in Table 4-6. The stormwater protection



standards include stormwater quality and quantity protection. The habitat protection recommendations include buffer zones and no-grading requirements.

The following sections provide details of each protection strategy developed for wetlands within the City and County.

4.5.7.1 Water Quality

Water quality plays a significant role in the overall quality of a wetland. When the quality of the incoming water declines, the wetland’s plant community may change with species diversity diminishing – leaving only those species that are tolerant of high nutrient and sediment loads. Once a wetland’s plant community is changed, the wetland’s character and ecosystem will change, often to a less valuable system in terms of biodiversity, habitat for wildlife, and aesthetic enjoyment. Pretreatment requirements have been developed that, if followed, will help maintain the character of the City’s wetlands. Table 4-4 summarizes these pretreatment recommendations. BMPs can be used to accomplish the pretreatment requirements given in Table 4-4.

Table 4-4 Wetland Stormwater Quality Standards

Management Category	Stormwater Phosphorus Pretreatment Requirement ²
Highly Susceptible ¹	150 ppb ³
Moderately Susceptible	200 ppb
Slightly & Least Susceptible	NURP

¹ Includes lakes, creeks, streams, and rivers (as defined by the USGS).

² Minimum pretreatment requirement must meet NURP design standards.

³ A multi-cell configuration with lower cell being a constructed wetland or infiltration basin is recommended to achieve these levels of removal.

4.5.7.2 Water Quantity

This LSWMP addresses stormwater quantity impacts to wetlands by providing protection strategies to maintain the existing integrity of the wetland through special protection strategies for highly, moderately, and slightly susceptible rankings as described in Table 4-5.



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Table 4-5 Wetland Stormwater Quantity Standards

Hydroperiod Standard	Highly Susceptible	Moderately Susceptible	Slightly Susceptible	Least Susceptible
Storm bounce 100 year	Existing	Existing plus 0.5 ft	Existing plus 1.0 ft	No Limit
Discharge rate	Existing	Existing	Existing or less	Existing or less
Inundation period for 1 & 2 year Precipitation event	Existing	Existing plus 1 day	Existing plus 2 days	Existing plus 7 days
Inundation period for 10 year Precipitation event and greater	Existing	Existing plus 7 days	Existing plus 14 days	Existing plus 21 days
Run-out control elevation*	Note NWL on Map	Note NWL on Map	Note NWL on Map (0 to 2.0 ft above existing run out)	Note NWL on Map (0 to 4.0 ft above existing run out)

*To be verified by the engineer

Note: Existing in this chart means the existing hydrologic conditions. If there have been recent significant changes in conditions, it means the conditions that established the current wetland.

4.5.7.3 Wetland Buffer Strip and Setback Protection

A wetland buffer is an undisturbed upland area or restored native vegetation that surrounds a wetland and reduces negative impacts to the wetland from adjacent development. The needs identified for the establishment of wetland buffers are related to the functions that wetlands perform. Wetlands perform a variety of functions such as groundwater recharge, stormwater retention to improve water quality and reduce flooding, and wildlife habitat.

Wetlands are often neighborhood amenities because they can provide screening from adjacent neighbors and wildlife viewing opportunities. Wetland buffers can help mitigate potential development impacts to wetlands by reducing erosion by stormwater; filtering suspended solids, nutrients, and harmful substances; and moderating water level fluctuations during storms. Buffers also provide essential wildlife habitat for feeding, roosting, breeding, and rearing of young, and cover for safety, movement, and thermal protection for many species of birds and animals.

The City will place wetland buffers around wetlands at the time of development according to the wetland’s classification. An example of a wetland buffer for a wetland with a Manage 1 classification is presented on Figure 4-2. The City’s buffer standards are shown in Table 4-6 and on the Water Resource Map.



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Table 4-6 Wetland Buffer Standards

Wetland Classification	Permanent Buffer Zone Average Width (feet)	Minimum Permanent Buffer Zone (feet)	Minimum Building Setback from Outer Edge of Buffer (feet)
Unique	75	50	20
Manage 1	50	25	20
Manage 2	25	20	20
Manage 3	16	16	10
Streams and Lakes	50	25	10

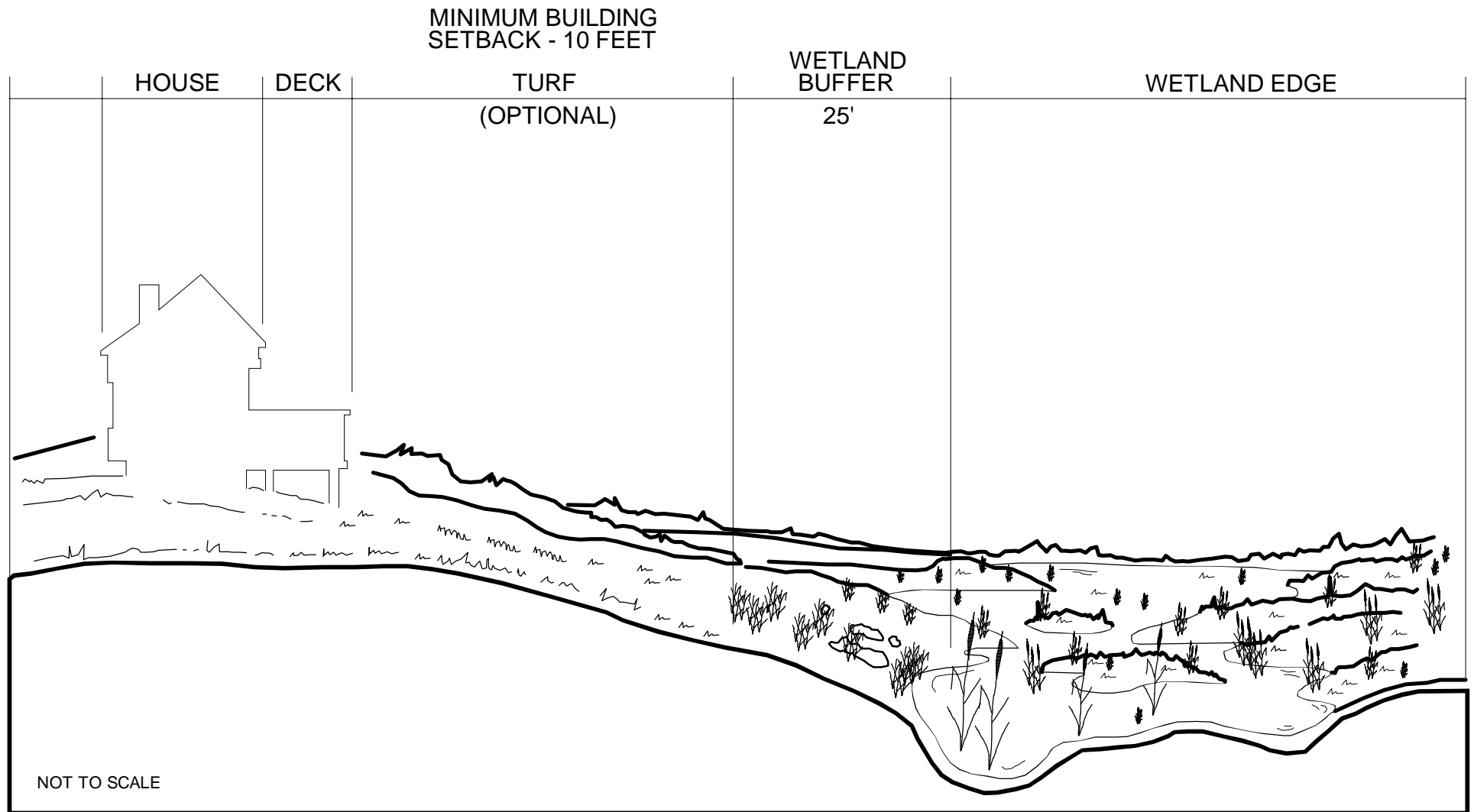
4.5.8 Wetland Restoration/Enhancement Opportunities

Wetland restoration/enhancement sites were identified during the field inventory and are located on the Water Resource Map. Typically, wetlands that were identified for restoration/enhancement had either a hydrologic impact that could easily be rectified or a plant community that was of Exceptional to High quality. The areas with Exceptional to High quality native plant populations could, with some minor management, have their ecological integrity enhanced and exotic species minimized. Restoration of the hydrology of a basin may be required by the City Engineer as part of a development proposal. Wetlands with high restoration potential are described in Appendix D. Priority wetland restoration sites are those that involve hydrologic restoration and may provide other benefits such as reducing flows to receiving waters, improving corridor connections, and providing valuable habitat if restored. Priority wetland restoration opportunities are listed in Table 6-1.

4.5.9 Wetland Stewardship

There are a number of things that residents, cities, or counties can do voluntarily to enhance wetlands and buffer strips that surround wetlands. This section describes some of these practices.





WETLAND BUFFER EXAMPLE FOR A WETLAND WITH A MANAGE 2 CLASSIFICATION

CHASKA, MINNESOTA
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FIGURE 4-2



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4.5.9.1 Enhancement

Native wildflowers, grasses, shrubs, and trees can be planted in the wetland or the adjacent buffer areas to enhance habitat and stormwater filtering/infiltration. As appropriate for an individual wetland, habitat may be enhanced by creating more vertical layers (such as adding trees or shrubs where these are absent), and by adding plants that provide food and cover, such as fruit producing shrubs. Increasing the structural and plant species diversity in the landscape provides additional habitat niches and can increase the numbers and species of animals using the area. Native plants also tend to make the landscape more aesthetically pleasing to the human eye.

Species that are native to the area will probably require the least maintenance, survive harsh Minnesota weather more easily, and provide the greatest habitat benefits. The book Landscaping for Wildlife by Carroll Henderson and other references that are available in most bookstores or from Minnesota Extension Services, can help landowners to add plants that enhance the wetland and increase the variety of attractive plants and wildlife.

4.5.9.2 Control of Invasive Exotic Species

Several invasive, nonnative species (sometimes called exotics) have become problems in Minnesota wetlands and adjacent uplands. Some of the most frequently encountered suspects include purple loosestrife, European buckthorn, Tatarian honeysuckle, reed canary grass, and leafy spurge. These plants invade native plant communities and can take over rapidly, crowding out native plants that would provide better food and habitat benefits.

Invasion by exotic species can often be controlled by simply minimizing disturbance to wetlands and buffer areas as much as possible to avoid the creation of openings for exotics to invade. When infestations are spotted early, small populations of many exotic species can be controlled by hand removal or direct application of appropriate herbicides that are licensed for use near water. The Minnesota and Wisconsin DNR web sites provide great information about identifying or controlling exotic species around wetlands.

4.5.9.3 Habitat Structures

Wetlands provide important habitat for many species of birds and other animals. Adding wood duck nest boxes and other types of nesting structures for ducks and other birds can augment nesting habitat, help birds to avoid predators, and enhance opportunities to view and enjoy wildlife. The MnDNR, Minnesota Waterfowl Association, and other habitat enhancement organizations can provide information about the types and sources of structures available. Retaining or adding stones, logs, and dead trees near wetlands and within buffers provides habitat for turtles, other reptiles and amphibians, and resting areas for birds and animals.

Habitat areas may also become refuges for large populations of deer, geese, and wildlife that may become a nuisance in urban areas. When needed, population control measures should be included in management plans for these areas. MnDNR staff can provide assistance in the development and implementation of these plans.



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4.5.9.4 Learning Opportunities

Schools and other organizations can adopt wetlands and adjacent areas for use as outdoor classrooms. Students, parents, and teachers can add native wetland and upland plants, habitat structures, and other enhancements to increase learning opportunities and encourage other landowners to make similar enhancements.

4.6 UPLAND MANAGEMENT PLAN

4.6.1 Upland Natural Communities

The following is a brief description of the major natural community types that currently exist or would have been historically significant in the Chaska inventory area. The descriptions draw from field surveys in the Chaska inventory area and from resources in Minnesota's Native Vegetation: A Key to Natural Communities (1993), and Minnesota's St. Croix River Valley and Anoka Sandplain: A Guide to Native Habitats (1995).

4.6.1.1 Prairie and Savanna Communities

Sand-Gravel Prairies – Many of the Sand-gravel prairies that exist in Chaska are associated with south-facing bluffs above creeks or the Minnesota River. Many of these have been heavily impacted by human land use and suppression of prairie burns. As a result, many have now become overgrown by cedars, prickly ash, sumac, and tree saplings.

These prairies typically occur on well-drained periglacial deposits largely composed of coarse sands and gravels, such as terraces of the Minnesota River. These communities are open grasslands with patches of forbs and exposed soil areas that are often created by a combination of wind erosion and animal burrowing and digging activities.

Sand-gravel prairie development has also been strongly influenced by periodic fires and drought. They tend to favor plant species dependent on fire for regeneration and those capable of withstanding droughty conditions. Typical woody plants include smooth sumac, wild rose, and leadplant. Characteristic graminoids and forbs include indian grass, side oats grama, prairie dropseed, and junegrass. Characteristic forbs include rough blazingstar, grey goldenrod, stiff goldenrod, large-flowered penstemon, hoary puccoon, butterfly milkweed, and large-leaved pussy-toes.

Common animal species include mourning dove, field sparrow, western meadowlark, pocket gopher, red fox, American toad, and garter snake. Threats include invasion by nonnative grasses, such as Kentucky bluegrass and smooth brome, and invasion by woody plants.

Wet Prairies – Although not currently documented in this study area, wet prairies would have historically occurred here, particularly bordering the Minnesota River and perhaps wetlands in the rolling ground in the upper portion of the watershed.

Wet prairie is an open, shallow wetland community covered with patches of grasses and sedges up to 36 inches or more in height. Forbs and shrubs occur in scattered patches. Common shrubs include slender



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willow and red-osier dogwood. Forbs include cup plant, pale-spiked lobelia, Culver's root, bedstraws, great St. Johnswort, asters, blazing star, and tall meadow rue. Common grasses include big bluestem, prairie cordgrass, blue-joint, and sedges. Common bird species include song sparrow, redwing blackbird, and American goldfinch. Animals include shrews, voles, mice, and a variety of frogs, toads, and salamanders.

Nonnative pasture grasses such as bluegrass and reed canary grass have often been introduced in these areas and become dominant in disturbed areas. In the absence of fires, shrubs may dominate some areas, and changes in hydrology or water quality associated with urban development degrade wet prairies and encourage domination by exotic and aggressive plant species.

Dry Oak Savanna (Sand-Gravel) – Many portions of the study area mapped as “oak openings” by land surveyors at the time of settlement would have actually been oak savanna. In the absence of fire, and with overgrazing by landowners with domestic cattle, these areas lose most of their native plants and later succeed to brushy oak woodland or forest after cattle are removed.

These are relatively open communities of scattered, generally short, open-grown bur oaks above a layer of grasses and forbs. Trees may be widely scattered and found in groves with hazelnut or oak brush. Natural disturbances like gopher mounds and badger excavations are common. Common plant species include the tree species bur oak and northern pin oak; the forbs prairie rose, leadplant, wild lupine, butterfly milkweed, purple prairie clover, bird-foot violet, white sage, and various asters. Common grasses include little bluestem, big bluestem, prairie dropseed, and other short grasses.

Common animal species include mourning dove, indigo bunting, sparrows, squirrels, pocket gophers, and whitetail deer. Grazing or farming activities, which reduce grass and forb species diversity and encourage exotics such as leafy spurge, European buckthorn, and sweet clovers, have often degraded these areas. Regular fires before European settlement maintained these communities, and cessation of fires encouraged the spread of woody shrubs such as sumac, prickly ash, European buckthorn, and red cedar.

Mesic Savanna – Similar to dry savanna, many portions of the study area that were mapped as “oak openings” by land surveyors at the time of settlement would have actually been oak savanna. In the absence of fire, and with overgrazing by landowners with domestic cattle, these areas lose most of their native plants and later succeed to brushy oak woodland or forest after cattle are removed. One remarkable example remains in the southwest portion of the study area, immediately adjacent to Highway 212.

Dominated by bur oak trees, mesic savanna consists of a scattering or groups of trees that total less than 70 percent in canopy cover. Oaks in this community typically occur as large-diameter trees with large lower branches resulting from growth in open surroundings, but may also occur as clumps of many small sprouts called grubs. Quaking aspen is also found in this community and can occur as a clone of trees or shrubs.

The shrub layer varies by location and influencing factors. It includes such species as chokecherry, juneberry, gray dogwood, and wolfberry. Herbaceous vegetation is dominated by species typical of mesic prairie in openings, but plants typical of Oak Woodland/Forest are found under the canopy of trees and shrubs.

Historically, mesic savannas were maintained under the influence of fire and large grazers such as bison or elk. Bird species found in savanna include northern oriole, indigo bunting, mourning dove, and blue jay.



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Common amphibians and reptiles include tiger salamander and prairie skink. Some rare species in mesic savanna include eastern spotted skunk and bullsnake.

With settlement by Europeans and the suppression of fires, savannas that escaped clearing and cultivation quickly succeeded to woodland unless consistently grazed. Currently, these grazed woodlots superficially resemble native savanna, but lack sufficient native prairie and oak woodland species typical of mesic savanna. As a result, mesic savanna is among the rarest of plant communities in Minnesota and the Upper Midwest.

4.6.1.2 Forest Communities

Dry Oak Forest, Big Woods Section – This is a deciduous forest with oaks mainly under 50 feet, few subcanopy trees, a dense shrub layer, and a patchy ground layer of moderate diversity. Typical canopy trees include northern pin oak, bur oak, and black oak, with black cherry, trembling aspen, and paper birch in the subcanopy. The shrub layer typically includes hazelnut, gray dogwood, currant, and raspberries. The ground layer includes Virginia creeper, wild grape, bracken fern, wild geranium, Pennsylvania sedge, and a variety of spring ephemeral flowers.

Typical animal species include woodpeckers, chickadees, vireos, chipmunks, squirrels, and whitetail deer.

Past logging may be indicated by absence of larger, single-stem trees and woody debris. Grazing and fragmentation by roads and trails often reduce diversity of shrub and ground species in forest communities and encourage invasion by nonnative plants. European buckthorn and tatarian honeysuckle are particular problems in dry oak communities.

Mesic Oak Forest, Big Woods Section – Canopy trees are typically taller in mesic oak forests than in dry oak forests, and northern pin oak is replaced by red oak in the canopy. Large, single-stemmed trees more than 15 inches in diameter are common, with a variety of woody plants at all heights, and a mixed ground layer of seedlings and herbs. Common tree species include white, red, and bur oak with basswood, ironwood, butternut, bitternut hickory, black cherry, birch, and sometimes muscledwood in the subcanopy. Shrubs may include chokecherry, hazelnut, silky and pagoda dogwood, and other fruiting shrubs. The ground layer frequently includes wild grape, Virginia creeper, poison ivy, wild geranium, black snakeroot, and a variety of ferns and spring ephemerals, such as round-lobed hepatica.

Animals are typical of those found in other oak communities, including songbirds, flycatchers, blue jays, chipmunks, squirrels, white-tail deer, and several species of frogs and the American toad. Past logging and grazing may have removed canopy trees and reduced diversity in ground flora. Buckthorn and tatarian honeysuckle are common invaders, and oak wilt may spread in disturbed stands, particularly in areas of active construction.

Oak Woodland-Brushland, Big Woods Section – Oak woodland communities are characterized by a somewhat open canopy (intermediate between savanna and forest) dominated by open-grown bur and northern pin oaks. They have a pronounced shrub layer containing oak seedlings and sprouts. Oak Woodland-Brushland can have a shrub layer dominated by multiple stemmed oak “shrubs” caused by frequent top-killing of the stems, often by intense fires.



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The ground layer includes herbs and other woody plants characteristic of both dry oak forests and prairie communities. Fire scars may be evident on older trees. Common plants include bur, red, and pin oaks, hazelnut, gray dogwood, and other fruit-bearing shrubs, Virginia creeper, leadplant, hog peanut, bracken fern, pointed-leaf tick trefoil, and woodland sunflowers.

Animals include mourning dove, catbird, indigo bunting, squirrels, coyotes, and white-tail deer. These communities have often been degraded by grazing, soil compaction, and suppression of fires. These activities lead to invasion by exotic species such as Kentucky bluegrass, European buckthorn, and tatarian honeysuckle. In Chaska Creek, the presence of these exotic species has significantly reduced the species diversity of Oak Woodland – Brushland communities.

Maple-Basswood Forest, Big Woods Section – This is a deciduous forest community that has a closed or nearly closed canopy (80-100%) that exceeds 65 feet in height. The canopy is dominated by sugar maple, basswood, and, prior to Dutch elm disease, American elm. Other tree species often present include northern red oak, slippery elm, bur oak, and white and green ash. It is composed of species that are not tolerant of fire. The subcanopy of Maple-basswood forests tends to be composed of several age classes of trees and tends to have patches of shrubs and tree seedlings where the most sunlight reaches the forest floor. Members of the subcanopy and shrub layer often include musclewood, ironwood, bitternut hickory, pagoda dogwood, and leatherwood.

Dominant forbs in Maple-Basswood forests are spring bloomers, which allows them to capture the greatest amount of sunlight before tree leaves emerge and the canopy closes. Common species here include trout lilies, bloodroot, wild ginger, nodding trillium, and early meadow rue.

The animal species most present in Maple-basswood forest are typical of other deciduous forests and include white-tail deer, white-footed mouse, eastern chipmunk, scarlet tanager, white-breasted nuthatch, and a number of woodpeckers. Characteristic species include cerulean warbler, gray fox, fox snake, and five-lined skink. Maple-basswood forests also host some species that require large, contiguous forest tracts, such as the red-shouldered hawk and ovenbird. The Louisiana water thrush, a bird that inhabits the edges of fast-flowing streams in forests may also be present in some of the more secluded areas along Chaska Creek.

Lowland Hardwood Forest – This is a deciduous forest with a variable canopy, with coverage from 50 to 100 percent. Lowland hardwood forests occur on mineral soils and are often located near the margins of lakes and wetlands, in ravines, and at the base of north-facing slopes. Common tree species include green ash, American elm, eastern cottonwood, basswood, and bur oak. Subcanopy trees may include ironwood, red elm, and box elder. Common shrubs include red osier dogwood, pagoda dogwood, prickly ash, hazelnut, and gray dogwood. The ground layer may include Virginia creeper, ferns, sedges, woodland horsetail, green-headed coneflower, and jack-in-the-pulpit.

A wide range of common forest animals and birds use these forests as habitats. These forests have typically been degraded first by grazing or draining and later by the subsequent invasion of exotic plant species such as European buckthorn and reed canary grass. Logging and trail development also fragments these areas and spreads exotic species.



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4.6.1.3 Other Natural Communities

Conifer Plantations – Large plantations of conifers were often planted in rural portions of the Chaska Creek area after the 1930s because they were believed to prevent erosion. Often these are single species groves of red pines, planted closely together in rows, while in other cases, a mixture of species is planted. Some of the conifers that have been commonly planted in Chaska Creek include red pine, Scotch pine, white pine, jack pine, white spruce, and Colorado blue spruce.

During the early years of a plantation, the ground cover continues as a field or prairie, as it was previously. Eventually, the shade created by the conifers and acid from needle drop eliminates most ground cover vegetation, and the community's ground layer becomes highly simplified or bare. The plantations may provide shelter from wind, cover, and breeding areas for songbirds, owls, and other species, but also create a dense monoculture with low diversity, and may require thinning with age to preserve the health of the trees.

Old Field/Old Home Site – “Old field” is a term used to describe areas that were grazed or farmed, but where active cultivation or grazing has ceased. These often have a simplified vegetation community, dominated by smooth brome or other nonnative grasses. A few prairie forbs such as yarrow and sunflowers may remain, and aggressive clonal plants such as goldenrod may form large, single-species colonies, which are characteristic identifiers for these areas.

The fields may also include red cedar individuals or glades. While these communities may provide some food and cover for birds and other animals, they have a low diversity of native plants. Regular controlled burns may help to control nonnative species and bring back some native prairie plants. These areas may be good candidates for prairie restoration.

4.6.2 Natural Resources Inventory Methodology

The Natural Resource Inventory methodology includes the following steps:

- Identification of Natural Area Sites and Delineation of Natural Communities.
- Field Inventory of Natural Communities.
- Classification of Natural Communities.
- Ecological Ranking of Natural Communities.

All natural resource inventory sites and communities are shown on the system maps, included as Appendix G.

4.6.2.1 Identification of Natural Areas

The boundaries of natural areas and natural communities were delineated using stereo pairs of 1:15,840 scale, infrared aerial photographs. All natural area and natural community boundaries as well as any other relevant information, such as other biological surveys, were then drawn on overlay maps. At this time, a review of all existing information on natural resource features was conducted. This existing information



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included such sources as National Wetland Inventory Maps, MnDNR County Biological Survey databases and maps, and cultural resource inventories.

4.6.2.2 Field Inventory of Natural Communities

The field inventory is a qualitative assessment of natural communities. The field survey included identification of major plant species in the canopy, subcanopy, shrub, and ground cover of forest and woodland natural communities. In non-forested natural communities such as wetlands or prairies, dominant grasses and forbs (other non-woody plants) were identified. The field inventory emphasized gathering data on disturbance indicators of natural communities. Disturbance indicators include invasion by exotic species, erosion, grazing, and logging activities. This information provides a solid starting point both for understanding the present condition of the natural community as well as for developing future management objectives.

4.6.2.3 Classification of Natural Communities

Minnesota's Native Vegetation, A Key to Natural Communities (Minnesota Department of Natural Resources, 1993) was used to identify and classify the natural areas sites. This key is the best available statewide guide to the classification of native plant communities and is the method used to classify natural areas in the MLCCS methodology. Field inspection indicated that some portions of the sites identified in Chaska Creek are dominated by nonnative vegetation, and are therefore not classified in the key. These areas were given common descriptive names to identify the plant community types, such as "old field" and "Conifer plantation". Appendix E summarizes the natural community types found for each site in Chaska Creek, as well as documented plant species for each community.

4.6.2.4 Ecological Ranking of Natural Communities

To provide further information to the City about the quality of natural areas that were surveyed, each natural community was assigned an ecological ranking, ranging from A to D, with "A" quality communities being the highest in ecological quality and "D" communities being the lowest. Standard ecological criteria that are used to evaluate the health of natural communities were used to determine the quality rankings.

These criteria include degree of native species diversity, age of trees, and amount of disturbance, such as invasion by nonnative plant species. The rankings reflect how closely the community area being studied resembles an intact or "pristine" community of its type in the local area – "A" quality communities are most like intact natural areas, "D" quality communities have been highly altered from this standard. Due to the high level of human activity in urbanizing landscapes, "A" quality communities are rare. The rankings used in this report are based on the same set of criteria as those used by the Minnesota County Biological Survey in their statewide rankings.

Additional factors need to be considered by the City and its residents to prioritize sites for management, such as surrounding land uses, suitability for active or passive recreational use, cost of restoration and management activities, and other criteria. This ranking is a ranking of ecological qualities only and provides a starting point for evaluating natural areas in the watershed.



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To summarize the ecological rankings found on maps in this report:

- A. Excellent quality – approaches presettlement condition.
 - B. Good Quality – minimal disturbance.
 - C. Fair Quality – significant disturbance, but restorable.
 - D. Poor Quality – high level of disturbance; restorable, but only with a great deal of effort.
- NA Ranking system does not apply/extremely difficult to restore to original condition.

Communities with excellent to good (A to B) quality generally exhibit little disturbance and are high in species diversity. For example, forest communities would be comprised of old growth trees and have a diverse group of shrub and ground cover species characteristic of the natural community type. Disturbances from human activities and invasion by nonnative shrubs such as buckthorn would be absent or minimal.

Fair quality (C quality) natural communities have been disturbed by grazing, farming, or other activities, but with proper management techniques, such as prescribed burning, could be upgraded to a higher quality. Poor quality (D quality) natural communities are severely disturbed and can only be restored to a higher quality with considerable effort and expense.

Poor quality natural communities have generally had their characteristic plant species assemblage replaced by weedy native and/or nonnative species. Communities assigned an NA do not meet minimum standards to be classified as a natural community, are extremely altered from their original composition, or are human-created environments such as conifer plantations and old fields. The ecological ranking for each community is summarized in Appendix E.

4.6.3 Procedure for Upland Natural Areas Not Inventoried as a Part of This LSWMP

If an upland natural area was not inventoried as part of this LSWMP, it shall be assessed at the time that a project is proposed that may affect the area. An “upland natural area” shall be considered to be one composed primarily of plants native to Minnesota. An inventory shall be conducted by a natural resources professional hired by the Applicant using the Minnesota Land Cover Classification System (MLCCS). Information gathered shall include at minimum:

- MLCCS Cover Type.
- Quality.
- Invasive species code(s) and cover class modifier(s).
- List of dominant plant species, by structural layer (i.e., canopy, shrub, herbaceous layer) including estimated average size of canopy trees, by species.

The Applicant may also elect that the City’s natural resources staff complete the work, with the time billed back to the Applicant.



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In some circumstances, at the City's discretion, the MLCCS information completed by Carver County may be substituted for the field review. At a minimum, the data from the existing MLCCS must be field checked to level 3 or 4, include information on community quality, and have been completed by an experienced ecologist with good working knowledge of the local plant communities and local flora. In addition, the field visit date from the County MLCCS must be within 3 years of the current project.

4.6.4 General Natural Community Management Strategies

Following are general management strategies for prairie, savanna, wetland, and forest communities. These management strategies are intended to be general; therefore, more specific management recommendations may be necessary for individual natural communities and sites.

4.6.4.1 Prairie and Savanna Management

Prior to European settlement, the health of prairie and savanna plant communities was influenced by climate, animals, and fires that probably occurred annually to every few years on most sites. Some fires occurred naturally, while most were set by Native Americans. These fires maintained the openness of prairies by controlling the growth and spread of trees and shrubs, removing accumulated plant litter, enabling earlier warming of soil in spring, and returning nutrients to the soil. With the spread of agriculture and urban development, fires have been suppressed, leading to the spread of shrubs, trees, and exotic plants in prairie and savanna communities, and loss of diversity of native grasses and forbs. The activities of large and small mammals, insects, and other organisms also helped to maintain prairie communities by spreading seeds, burrowing to loosen soils, and pollinating prairie plants.

In addition to the suppression of fires, prairies and savannas have been degraded by grazing, which reduces forb diversity and encourages the dominance of clonal plants (such as goldenrod) that are unpalatable to livestock in old field areas. Other factors responsible for the decline of prairie and savanna communities include tree planting, plowing, slope erosion, and frequent mowing.

Less than one-tenth of one percent of the prairie and savanna landscapes that once existed in the Twin Cities area remains. The goal for managing the remaining remnants should be to maintain or restore as much of the original diversity as possible, through reestablishing or mimicking the processes that helped to maintain these plant communities.

Prairie and savanna management should consider the following actions, as appropriate for each site:

- Remove exotic species with appropriate methods. Cutting and herbicide treatment are probably most appropriate for tree and shrub species such as black locust, sumac, tatarian honeysuckle, and European buckthorn. Repeated herbicide treatments or biological controls may be needed for some exotic species such as leafy spurge, black locust, caragena, and reed canary grass.
- Remedy disturbance problems where possible, by doing such things as closing trails where erosion is occurring, reducing or rotating grazing to maintain plant populations, or preventing the disposal of refuse into eroding ravines.



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- Use prescribed burns to: control cool season grasses and other exotics, remove accumulated plant litter, encourage sprouting of prairie plants from the seed bed, and maintain the health of the prairie for the long term. Burns may be scheduled annually at first, and reduced to every 3-4 years, depending on the amount of litter available to successfully support a burn. Vary the burn regime over the long-term to include both fall and spring burns.
- If elimination of exotics and prescribed burns over several seasons fail to restore desired diversity, consider plant community restoration through overseeding of cut and burned areas, or by seeding select areas. Restored prairies and savannas will require maintenance through infrequent mowing or prescribed burn regimes (burning is preferred over mowing when possible). Plantings should use native seed from local sources.
- In general, savannas should be burned less frequently than prairies and droughty sites burned less frequently than mesic or wet sites. Average burn frequency for the dry prairies and savannas that characterize Chaska Creek is approximately three years, with a range of 1-20+ years. In addition, burn frequency should be nearly annual the first couple of years in some cases when control of invasive species is a management objective.
- In general, more frequent fires favor grass species and less frequent fires favor brush, trees, and prairie forbs (flowering plants).
- Seasonal timing can have a profound effect on species composition. Past research indicates that spring fires, conducted prior to April 15 in normal years, tend to favor cool season grasses and summer-blooming forbs. Late spring fires (April 15 – June 1) tend to favor warm season (usually native) grasses and often negatively affect forbs and tree/shrub species. Summer burns would mimic lightning-set fires, and although these did occur, they appear to have been less of an influence on the presettlement landscape than human-set fires. Current information indicates that fall fires (after September 1) are most effective at maintaining a balance between grass and forb species and control brush the best. There is also reason to believe, based on historical records, that frequent fall burns most closely mimic the presettlement burning pattern used by Native Americans in the Upper Midwest.
- Mowing can also be used on sites with adequate accessibility and low risk for site disturbance. Mowing somewhat mimics the effect of grazing and can give many of the effects that prescribed burning can. Proper timing and techniques in mowing can be used to maintain a healthy balance between grasses and forbs.
- Management of native communities, especially prairie, must also consider effects on the animal populations that are dependent on the community. The influence of management activities (i.e., burning) are not completely understood on animals such as butterflies (invertebrates). To minimize the potential for devastating impacts on community obligate species and/or fire-sensitive species, management should be carried out so as not to influence the entire area upon which these species depend. An example would be not burning an entire prairie at once; this would leave refugia for the species of concern and allow for potential recolonization of burned areas.



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- Monitor the effectiveness of management activities, and changes in plant and animal species in managed areas. Adjust activities as needed based on monitoring results.

4.6.4.2 Forest Management

Most of the forest areas in Chaska Creek have been grazed for extended periods of time and, in some cases, logged over. Forest communities in Chaska Creek are generally associated with ravines, steep slopes, and sharply rolling glacial topography. They are therefore sensitive to the impacts of erosion and sedimentation. In addition, roads and trails frequently fragment forest communities. All of these activities encourage invasion by aggressive exotic species – particularly buckthorn, garlic mustard, and tatarian honeysuckle.

Fragmentation also reduces the value of the forest community for wildlife species such as migratory songbirds that require “interior” forest areas that are well buffered from human disturbances.

Following are management strategies for maintaining and restoring the diversity and health of forest communities:

- Avoid cutting trees in areas containing invasive nonnative shrub species. Where cutting trees is necessary, cut exotic shrubs and treat with a basal application of an appropriate herbicide. Where developments are proposed within or adjacent to forest areas, removal and treatment of invasive nonnative shrubs can be incorporated into the overall site preparation process.
- Mast-bearing trees such as oak and hickory should be given particular protection due to their value to wildlife. Other trees through their seeds or buds also serve as important food sources for wildlife; these include maples, elms, aspens, basswood, cherry, hackberry, and birch.
- Large trees, particularly those containing cavities, should not be removed unless necessary. Dead standing and downed trees should likewise not be removed unless they present a safety hazard. While humans sometimes perceive a forest with dead trees as messy, dead trees are important because they harbor a high diversity of plants and animals throughout their decomposition cycle. However, “sanitation cuts” may be necessary where oak wilt or Dutch elm disease are present.
- Encourage removal of weedy and/or exotic tree species such as Siberian elm, box elder, Russian olive, black locust, and eastern red cedar. Plant higher value native trees and shrubs following removal.
- Oak forest communities are adapted to fires and can often be improved through prescribed burns. Prescribed burns will generally increase species richness of grasses and forbs, encourage oak seedling germination and sprouting, and kill back exotic or invasive shrub species. Where oak forest communities occur adjacent to prairie and savanna communities, fires from prescribed burns should be allowed to burn into the oak forest. Burn more frequently in early years and less frequently as exotic species are controlled. Include both spring and fall burns in the management regime.
- Maple-basswood and lowland hardwood forest communities are generally not adapted to fires and should be burned infrequently or not at all. Prescribed burns in oak forest communities will generally discourage succession to a more mesic forest community such as maple-basswood.



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Although not a “hot spot” for oak wilt, this disease should be of particular concern in Chaska Creek due to the presence of oaks trees throughout most of the watershed. Oak wilt is spread by construction activity or other root or limb damage during the growing season. Openings created by oak wilt can augment invasion by exotic species if not replanted or managed to restore oak woodlands. Control oak wilt using methods recommended by the MnDNR, Division of Forestry.

Oak trees should not be cut, pruned, or injured during the growing season (April-October). Exposed roots injured by construction activities are just as likely to result in oak wilt infection as cut branches. If injury occurs, the wound should be treated with a tree wound dressing within 15 minutes or less to reduce the infection potential. A vibratory plow can be used to sever roots along the edge of any construction area prior to beginning work. This will prevent the transfer of oak wilt fungus from exposed roots or through root grafts between trees and allow for regeneration at the point of cutting.

Tree protection zones should be fenced to prevent entry or compaction by construction equipment. Soil and construction materials should not be stored within the tree protection zone, as this can result in contamination of the tree protection zone and/or other construction sites.

4.6.4.3 Specific Recommendations

These recommendations provide guidance on the preservation and management of natural area sites and natural communities. Specific management recommendations are given later in this section with the descriptions of each individual community.

4.6.5 Priority Natural Communities

Priority natural communities are those communities with a ranking of BC (good quality) or higher and are listed in Table 4-7. These communities should be given special consideration for future protection and management due to their quality. Some communities are recommended for follow-up survey work because of seasonal timing of the original survey or the strong likelihood of additional rare species. A listing of these communities is included in this section.

Table 4-7 Priority Natural Communities

Community ID	Community Type	Quality Rank
HS-U-2	Maple-Basswood Forest	AB
LCC-U-2	Maple-Basswood Forest	B,C
CL-U-1	Mesic Oak Forest, Big Woods Section	BC
CL-U-3	Maple-Basswood Forest	BC

4.6.6 Critical Areas for Connectivity

A common theme in this report has been the connectivity between natural communities. Linking natural communities with greenway corridors adds values to those areas connected. These values are realized



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through a greater diversity of flora and fauna and a healthier overall ecosystem. In natural systems, diversity almost always provides greater stability.

The presence of a corridor also allows genetic material to flow between otherwise isolated natural areas, maintaining the gene pool of plants and animals for future generations. Humans also realize the benefits of corridors through enhanced recreational opportunities such as expanded trail systems. However, where sensitive natural resources are present, recreational uses would need to be limited to avoid negative impacts.

The use of corridors embodies many of the specific and general recommendations and management strategies provided in this report. Corridors provide the overall framework under which these recommendations can most effectively be carried out. A considerable proportion of the land area within the study area is sensitive to development due to unsuitable soils, steep slopes, wetlands, or floodplains. For this reason, including land in corridors does not necessarily decrease land available for residential development, agriculture, or transportation. Corridors can be maintained as part of adjacent developments, construction of public infrastructure, or as part of large regional corridor projects.

Some of the key areas that could be included in corridors are:

- Bluff lines, particularly the bluff line just north of Chaska Creek.
- Chaska Creek, its natural communities, and those that radiate from the creek corridor.
- Contiguous parcels of forest, adjacent wetlands, and other natural communities.
- Where natural areas are separated by existing agricultural fields and/or future development, create corridors at least 150 feet wide along natural drainageways or other features.
- Twin Cities & Western railroad right-of-way. Expanding the width of this human-created corridor will become increasingly important for connecting natural communities as development occurs in the Chaska Creek area of Chaska.
- Use TH 212 as a corridor for natural communities, including reconstruction of Oak and Maple-Basswood Forest, as well as Tallgrass Prairie and Savanna.
- Communities with rare species should remain as connected to nearby natural areas as possible. This would allow for natural movement of genetic material between these sites over time and provide greater stability for all connected areas.
- Development should not infringe on steep or highly erodible slopes. The long-term cost of correcting slope failure problems far exceeds short-term gains made through development.

4.6.7 Natural Areas with Good Restoration Potential

Ecological restoration is the process of reintroducing processes and species to a particular natural community. It involves the management of a pre-existing natural community toward improved health and function. This process should not be confused with natural community reconstruction, a process where a



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group of native species is planted where substantial human alteration occurred. An example of a reconstruction would be the planting of prairie grasses and flowers into a crop field or construction site. Almost without exception, restoration is a far better option than reconstruction. This is because typical reconstructions rarely have the potential to reach the level of diversity and functionality found in even a poor quality pre-existing natural community (remnant).

Prior to undertaking a restoration effort, a plan should be developed that identifies the goals of the restoration and how it will be implemented. Monitoring before and after restoration should also be carried out to document success/failure of the restoration effort and to provide feedback on whether management strategies are effective. This monitoring may be as simple as taking photos from a known point in successive years or may be as involved as research-oriented quantitative data collection.

Within the body of this report, each natural community is assigned a ranking of restoration potential. It takes into account such factors as degree of past disturbance, level of exotic species infestation, physical and financial resources needed for restoration, and others. These restoration potential rankings can be summarized as follows:

Good	Little or no effort required to maintain or improve quality of natural community.
Moderately Good	Minimal effort required to maintain or improve quality of natural community. Improvement in quality could be realized in a short period of time with relatively little input.
Moderate	Some physical and financial efforts would be required to restore these communities. Substantial improvement in quality in the short-term might require an intensive restoration effort. Forested communities with a moderate restoration potential may improve in quality over the course of decades without intervention.
Moderately Poor	These communities have often experienced significant alteration through human activity. Substantial improvement of these communities in the short-term often requires substantial efforts. Recovery of forested communities in this category without active restoration may take up to 60 years or more.
Poor	These communities have had much of their composition, structure, and function altered by human activity. Restoration of these communities often involves extensive investment of physical and financial resources. Recovery without active restoration of forests in this category will typically take up to 100 years or more.

Most natural communities have some restoration potential. However, given that physical and monetary resources are often a limiting factor for restoration, the natural communities listed in Table 4-8 are suggested as most suitable for restoration efforts within the City.



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4.6.8 Recommended Upland Management Standards

The management standards outlined in Table 4-9 represent a generalized set of techniques and practices that can be applied to natural communities to protect and/or enhance their composition, structure, and function. These recommended management standards have their foundation in commonly accepted scientific principles for natural community management and ecological restoration.

The recommended strategies presented in Table 4-9 are based on the quality of a particular natural community represented by the unified rank given for each upland natural community.



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Table 4-8 Natural Community Type and Restoration Potential

Community ID	Community Type	Rank	Restoration Potential
GC-U-3	Mesic Oak Forest, Big Woods Section	C	Good
GC-U-2	Mesic Oak Forest	D	Good
GC-U-1	Oak Woodland-Brushland	D	Good
GC-U-4	Maple-Basswood Forest	C	Good
GC-U-6	Mesic Oak Forest	CD	Good
LCC-U-2	Maple-Basswood Forest	B,C	Good
SCC-U-2	Mesic Oak Forest	CD	Good
LCC-U-4	Oak Woodland-Brushland	D	Good
HS-U-2	Maple-Basswood Forest	AB	Good
CL-U-1	Maple-Basswood Forest	BC	Good
CL-U-3	Mesic Oak Forest	BC	Good
EC-U-24	Oak Woodland-Brushland	C	Good
EC-U-25	Oak Woodland-Brushland	C	Good
LCC-U-3	Lowland Hardwood Forest	C	Moderate / Good
SCC-U-1	Oak Woodland-Brushland	CD	Moderate / Good
SCC-U-4	Maple-Basswood Forest	CD	Moderate / Good
SCC-U-3	Oak Woodland-Brushland	D	Moderate / Good
HS-U-3	Mesic Oak Forest	C	Moderate / Good
CA-U-1	Mesic Oak Savanna	D	Moderate / Good



Table 4-9 Recommended Upland Management Standards

Management Classification	Management Activities
Manage 3	Minimize loss of canopy trees in forest communities, particularly species most representative of community type.
	Avoid impact to better quality portions of the site, with no permanent alteration greater than 150 feet from buildings.
	Where impacts occur, replant with native species typically found in that community type in Chaska.
	In areas of development, landscape with native species typically found in Chaska.
	Where possible, maintain or create connectivity with other natural communities.
Manage 2	Protect hardwood canopy trees in forest communities during construction activities, particularly species most representative of community type.
	Minimize total area of disturbance: no permanent alteration greater than 100 feet from building pad.
	Avoid impact to better quality portions of the site.
	Where impacts occur, replant with native species typically found in that community type in Chaska.
	In areas of development, landscape with native species typically found in Chaska.
Where possible, maintain or create connectivity with other natural communities.	
Manage 1	Community type structure should be maintained (i.e., canopy, subcanopy, ground layer).
	Avoid impact to all but the poorest quality portions of community, and no permanent alteration greater than 75 feet from building pad.
	Where impacts occur, replant with native species typically found in that community type in Chaska.
	In areas where development occurs, planning tools such as clustered housing should be strongly considered.
	Treat diseased trees in natural communities (i.e., oak wilt/Dutch elm disease) on a case-by-case basis, taking into account the surrounding ecosystem.
	Maintain and/or create connectivity with other natural communities.
Manage natural communities to maintain or improve their composition, structure, and function.	
Unique	Community type structure should remain intact (i.e., canopy, subcanopy, ground layer).
	No permanent alteration greater than 10,000 square feet and greater than 50 feet from building pad.
	Buffer plantings composed of plant species indigenous to Chaska should be created around these communities.
	If impact is to occur, replant with native species typically found in that community type in Chaska.
	In areas of development, planning tools such as clustered housing should be used.
	Developers will submit a plan that demonstrates avoidance of impacts to trees/natural communities.
	Maintain current corridors, and, if possible, create connectivity with other natural communities.
	Treat diseased trees in natural communities (i.e., oak wilt/Dutch elm disease) on a case-by-case basis, taking into account the surrounding ecosystem.
	Manage natural communities and associated buffers to maintain or improve their composition, structure, and function.
Provide neighborhood residents with information regarding the significance of natural sites near their home.	



4.7 CREEK AND RAVINE ASSESSMENTS

4.7.1 Creek and Ravine Inventory Goals

The City contains four MnDNR Protected Watercourses: Assumption Creek, South Chaska Creek, East Creek, and Chaska Creek. In addition to the creeks, there are a number of MnDNR Protected Lakes: Bavaria, Hazeltine, McKnight, Jonathan, Grace, Firemen's, Clay Hole, Courthouse, and Chaska. A number of tributaries flow to these waterbodies. For purposes of this report, we are referring to many of these tributaries as ravines, because they tend to have a cross-section with steep-sided slopes. A select number of creeks and ravines were assessed. The goal of the assessment was to determine the condition of the creeks and ravines and provide potential options for stabilization. The creeks and ravines assessed included those that had pending development in the near future and those with existing development.

The primary creeks and ravines that exist in the City are shown on the Water Resource Map.

4.7.2 Creek and Ravine Identification

The creek and ravine identifications were organized within the context of the LSWMP. If the creek was not a MnDNR Protected Water and did not have a name, it was identified as a ravine. The ravines were identified based on the major drainage districts defined in the LSWMP. The abbreviations used for the major drainage districts are shown in Table 4-2.

Each ravine is identified by the abbreviation of the major drainage district in which it is located, followed by an R to indicate it is a ravine and a number to differentiate the ravines within the same Drainage District. Lakes, creeks, ravines, and wetlands are shown on the Water Resource Map at the back of this report.

4.7.3 Creek and Ravine Evaluation

The creek and ravines that are actively eroding and discharge to a MnDNR Protect Water or Scientific and Natural Area are recommended to be a priority for improvement in the City. A number of creek sections and ravines have been located and labeled on the Water Resource Map; however, many others exist within the City. The ones located on the map either have been inventoried or have been placed on the map due to known or projected erosion issues. A select number of these ravines and creeks were assessed for their current condition, and recommended improvements are summarized below.

LCC-R4

The ravine is a tributary of Chaska Creek. Its headwaters are within a development that includes stormwater ponding. It includes two branches that combine into one drainageway before reaching the creek.

The north fork has had the drainage area disconnected with an internal development road. This has resulted in this segment receiving very little flow. The south fork has a pipe discharge and evidence of flow. In the upper segments, these channels have adequate access to a small floodplain. This has combined to create a stable upstream segment.



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Downstream of where the channels combine, a 36-inch storm sewer discharges to the channel. Downstream of this discharge, there are a number of isolated erosion sites that have resulted primarily from toe erosion causing slope failure along outside bends of the channel. At the time of the inventory, there was only one area that appeared to have an unstable bottom that potentially would require a rock riffle or drop to stabilize.

Most of the stream channel would benefit from reestablishment and protection of the toe of slope on the eroding outside bends of the channel. The woods and steep slopes make access to the eroding sites difficult without disturbance to the portions of the channel that do not require stabilization. Approaches to stabilizing the channels that do not require large equipment should be considered. Some approaches such as shrub planting to protect the toe of slope or tree revetment with live stakes that will grow into shrubs should be considered. The tree revetment approach, when there is adequate flow and sediment transport, is an excellent way to build up soil at the toe of the slope and establish vegetation to protect the toe from erosion.

South Chaska Creek (Wetland SCC-W9a to TH 212)

This creek is in a rural portion of the City and is part of a wooded corridor. The land use outside the wooded corridor is agricultural with minimal ditching in the immediate drainage area. Much of the creek meanders through an area of floodplain that contains herbaceous vegetation such as reed canary grass and shrub species. Overall, most of the channel segment is stable, and only a few areas had isolated erosion. With the exception of an erosion area that is located near the intersection of Creek Road and TH 212, most of the erosion sites would be difficult to access without significant removal of trees and disturbance to steep slope.

The focus for this stream segment should be maintaining its existing condition by protecting the wooded corridor and ensuring future development has adequate rate control requirements that include reducing the flow rates for the 1.5-year storm.

LCC-R1 (Beise Ravine)

This ravine is located in a rural setting that will soon have development. It ultimately discharges to Chaska Creek. The upstream portion of the ravine receives flows from an agricultural field. Much of the ravine bottom contains large fieldstone that is natural and has created a stable bottom. The erosion occurring in these areas is resulting from concentrated flows eroding the toe of slope causing slope failure. In the areas without a rock bottom and within the steeper segments, there is head cutting, lowering the stream bottom and causing erosion at the toe of slope and side slope failure.

As the watershed draining to the ravine develops, we anticipate flow rates will be reduced due to City and watershed rate control requirements. As a result, we anticipate the currently stable sections of the Beise channel will remain so, and the proposed approach should focus on the unstable segments rather than the entire ravine.



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Some potential methods to stabilize this ravine include:

- Rock pools, riffles, and cascades – particularly in steeper sections
- Channel reshaping – primarily at bends where bank failure is occurring. Creation of a low-flow channel with a floodplain. Locate the channel away from the outside (failing) bank, with vegetative toe protection. As needed, provide rock cross-vane weirs to redirect flows away from the banks.
- Bioengineering approaches that use vegetation to help stabilize slopes.

Chaska Creek (Engler Blvd to TH 212)

This portion of Chaska Creek exists between Engler Blvd and TH 212. The upstream section was straightened and deepened into a ditch. The ditching of the stream in the upper section eliminates access to the floodplain and has caused toe erosion of the ditch and slope failure. The downstream section just upstream of TH 212 is located in woods and has not been ditched. This section is more stable than the upstream section, and erosion appears to be limited to the higher steep outside bends of the creek.

It is recommended that the upper section of the stream be stabilized by reestablishing a floodplain to relieve the concentrated flows at the toe of the slope. This could be accomplished by excavation or a combination of excavation and raising the channel bottom. Remeandering the stream should also be considered to increase its length and reduce its slope to develop a more stable system. The lower portion of the channel that still contains meanders has localized erosion on outside bends. An approach that helps to reestablish the toe of slope and diverts flows away from the toe of slope should be considered. This could include J-hooks, tree revetments, or other similar approaches.

LCC-R5

This steep ravine receives drainage from an agricultural field. The farmer and City have created berms near the top of the slopes in attempts to reduce the flows rates; however, flows still reach this steep slope and have caused massive slope failure. The sediment is currently discharging to Firemen's Lake, which is a recreational lake with a public swimming beach. It is recommended that a regional storage pond be created at the top of the slope to reduce flow rates and treat the water prior to discharge to a pipe. The pipe would be installed to carry flows down the slope. Once the flows are contained, the slope should be reshaped and stabilized using a deep-rooting native seed mix.

CH-R1

The erosion found in this ravine is a common symptom of concentrated flow, loss of herbaceous vegetation due to shading, and increased impervious surfaces in the watershed. This increased amount of runoff routed through the ravine overcomes the natural resistance of the soils and vegetation to erosion. As the landform is eroded, steep-sided channels form with vertical head cuts that migrate upstream, further accelerating the erosion and the problem.



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This ravine ultimately discharges to the Seminary Fen. The Seminary Fen supports dozens of rare, threatened, and special concern animal and plant species that are sensitive to sedimentation stress, so a reduction of sediment is critical to maintaining the unique characteristics of this wetland.

It is recommended that a channel-pool system be created to stabilize the bottom of the ravine in the steeper sections. In some segments, the channel has migrated to the steep bluff slopes. Concentrated flow at the toe of the steep bluff slopes has caused toe erosion resulting in slope failure. The goal of the improvements in this segment should be to realign the channel away from the steep bluff slopes, stabilize the toe of slopes, reestablish access to the floodplain for smaller storm events, and establish vegetation along the slopes.

In the lower stream segment, the channel bottom slope is reduced and has a stable channel bottom. A dense tree canopy has reduced the herbaceous growth along the slopes. This, combined with historic high flows, has caused some slope instability and erosion. The focus in these areas should be to protect and stabilize the toe of slopes and establish vegetation along the slopes to reduce the slope erosion.

4.7.4 Procedure for Ravines and Creeks Not Inventoried as Part of this LSWMP

It is recommended to focus future creek and ravine inventory efforts on those that are discharging to lakes, major creeks, or rare/sensitive natural resources.

4.7.5 Creek/Ravine Stabilization Opportunities

Opportunities to stabilize and restore ravines and creeks that are experiencing unnatural erosion will be considered. The focus should be on restoring creek sections with slope failures that may result in sedimentation of pool and riffle habitat. For ravines, the focus should be on those that discharge sediment loads to sensitive natural resources or recreational waterbodies.

A Priority Project Implementation Plan, which includes the creeks and ravines that have been inventoried, is provided in Table 6-1. The priority project list is based on the severity of erosion and the resource being impacted. This is a preliminary priority project list based only on those ravines and creek sections inventoried. As other ravines and creek segments are inventoried or discovered to have issues, they may be ranked higher than those in this table.



4.8 SURFACE WATER SYSTEM ASSESSMENT

4.8.1 Water Quality and Quantity Assessments

The following is an assessment of the City's key surface water resources.

- A. Hazeltine Lake: Several water quality ponds have been constructed for protection of the lake. In addition, one of the constructed ponds was designed to route all surface flow away from the lake, thereby eliminating all nutrient and pollutant loading from that area to the lake. Ravine restorations have also been performed in the lake's watershed, reducing erosion and the associated sediment conveyance to the lake. Given the progress made in the Hazeltine Lake watershed, more protection is still required. Hazeltine Lake has been listed by the State as an impaired water due to excessive nutrient loading. The City will continue to identify opportunities and collaborate with agencies with the common goal to improve the lake's water quality.
- B. Wallestad Lake (IDS Pond): Several water quality ponds have been constructed for protection of the lake. Much of the Wallestad Lake watershed remains undeveloped. As the area develops, the City will continue to identify opportunities to improve the lake's water quality by implementing the standards laid out in this plan.
- C. McKnight Lake: No water quality ponds for protection of the lake have been constructed to date. Much of the McKnight Lake watershed remains undeveloped. As the area develops, the City will continue to identify opportunities to improve the lake's water quality by implementing the standards laid out in this plan. The lake has been added to the State 303(d) list as impaired for excess nutrients, and a TMDL study by the CCWMO is in process. This TDML, which also covers Jonathan Lake and Lake Grace, has been incorporated into a draft Lower Minnesota River WRAPS (Watershed Restoration and Protection Strategy) being prepared by the MPCA. The City will continue to identify opportunities and collaborate with agencies with the common goal to improve the lake's water quality as necessary.
- D. Jonathan Lake (Upper Lake Grace): Several water quality ponds have been constructed for protection of the lake. The lake has been added to the State 303(d) list as impaired for excess nutrients, and a TMDL study by the CCWMO is in process. See Item C above regarding the Lower Minnesota River WRAPS.
- E. Lake Grace: A number of water quality ponds have been constructed for protection of the lake. In addition, the large water quality treatment facility constructed east of T.H. 41 (associated with the highway, Cortina Woods, and the Super Target) was designed to route low flows away from the lake, thereby drastically minimizing the nutrient and pollutant loading to the lake from east of T.H. 41. Given the progress made in the Lake Grace watershed, more protection may still be required, as the lake was listed by the State as impaired for excess nutrients, and a TMDL study by the CCWMO is in process. See Item C above regarding the Lower Minnesota River WRAPS.



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- F. Lake Bavaria: The quality of Lake Bavaria is generally good. Recent development in the North Lake Bavaria Area has been required to meet the City's stormwater standards. As the area develops, the City will continue to identify opportunities to maintain and/or improve the lake's water quality by implementing the standards outlined in this LSWMP. The lake is listed for mercury in fish tissue on the State's impaired waters list.
- G. East Creek: The East Creek watershed was initially developed with little attention paid to surface water quality. Since then, some development has filled in, which have been required to provide water quality treatment for protection of East Creek and wetlands. The East Creek pond was constructed adjacent to and upstream of the Corps of Engineers flood diversion channel. The intent of the pond is to protect the Minnesota River from excessive sediment and nutrient loading. More protection of East Creek is likely necessary as the creek was listed by the State as impaired for fish bioassessments, turbidity, and fecal coliform. The City will continue to identify opportunities and collaborate with agencies with the common goal to improve the creek's water quality.
- H. Chaska Creek: The Chaska Creek watershed is largely undeveloped, and the few developments that have been constructed in the watershed provide excellent water quality treatment. The majority of the developments couple water quality pretreatment with wetland restorations to accomplish the high levels of water quality treatment. Despite the City's efforts to enhance the water quality of Chaska Creek, the creek was added to the State's impaired waters list for fecal coliform. We believe that this is largely due to the lack of water quality treatment in the large agricultural headwaters area of Chaska Creek and will likely be best addressed in that area. However, the City is committed to the water quality improvement goals for the region and will continue to identify opportunities and collaborate with agencies with the common goal to improve the creek's water quality.
- I. Minnesota River: Several water quality structures were installed in the downtown area as a portion of the City's street reconstruction program. These structures provide protection for the Minnesota River where none previously existed. The Minnesota River is one of the lowest quality rivers in the State and is listed for turbidity and PCBs in fish tissue on the State's impaired waters list. The City will continue to identify opportunities and collaborate with agencies with the common goal to improve the river's water quality.

4.8.2 Clean Water Act Assessments

Eight waterbodies in Chaska have been listed as impaired waters by the State and are summarized in Table 4-11. Known as the 303(d) list from the applicable section of the federal Clean Water Act, these waters do not currently meet their designated use due to the impact of a particular pollutant or stressor. If monitoring and assessment indicate that a waterbody is impaired by one or more pollutants, it is placed on the list. At some point a strategy will be developed that will lead to attainment of the applicable water quality standard. The process of developing this strategy is commonly known as the Total Maximum Daily Load (TMDL) process and involves the following phases:

1. Assessment and listing.
2. TMDL study.



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3. Implementation plan development and implementation.
4. Monitoring of the effectiveness of implementation efforts.

Table 4-11 contains the proposed 2014 303(d) list. Lake Jonathan and McKnight Lake were recently added to the list. TMDLs for these lakes, as part of a larger Six Lake TMDL study, were begun in 2012 by the Carver County WMO.

Responsibility for implementing the requirements of the federal Clean Water Act falls to the U.S. Environmental Protection Agency (USEPA). In Minnesota, the USEPA delegates much of the program responsibility to the state Pollution Control Agency (MPCA). Information on the MPCA program can be obtained at the following web address:

<http://www.pca.state.mn.us/index.php/water/water-types-and-programs/index.html>

The following is an excerpt from the MPCA website describing the program and its need:

The federal Clean Water Act requires states to adopt water quality standards to protect lakes, streams, and wetlands from pollution. The standards define how much of a pollutant (bacteria, nutrients, turbidity, mercury, etc.) can be in the water and still meet designated uses, such as drinking water, fishing, and swimming. A water body is “impaired” if it fails to meet one or more water quality standards.

To identify and restore impaired waters, Section 303(d) of the Clean Water Act requires states to:

1. Assess all waters of the state to determine if they meet water quality standards.
2. List waters that do not meet standards (also known as the 303d list) and update every even-numbered year.
3. Conduct TMDL (total maximum daily load) studies in order to set pollutant-reduction goals needed to restore waters.

Federal and state regulations and programs also require implementation of restoration measures to meet TMDLs.

In addition to the eight impaired waters located in the City, the TMDLs for Lake Pepin and the Lower Mississippi River may result in requirements of the City. These TMDLs are:

- Lake Pepin Excess Nutrients TMDL, and
- South Metro Mississippi River Total Suspended Solids TMDL.

The drainage areas for these TMDL studies include the City of Chaska. Both TMDL studies are currently in progress, but may be completed and approved by USEPA before the issuance of the next MS4 General Permit scheduled for 2018.



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City of Chaska Actions: The TMDL studies for the impaired waters located within the City will likely be performed cooperatively between the City, WMO(s), and the MPCA. It is likely that these TMDLs will result in Waste Load Allocations (WLAs) that will require responses from the City. Based on language in the current MS4 General Permit, the City should expect to be required to provide information related to the new WLAs in its MS4 permit submittals for the next MS4 General Permit and subsequent annual reports under that permit. The current MS4 General Permit states that each applicable WLA in every USEPA-approved TMDL constitutes a “discharge requirement” for each MS4 permittee in the TMDL drainage areas. The current MS4 General Permit requires that each permittee provide a TMDL “compliance schedule” and “demonstrate continuing progress toward meeting each discharge requirement” for the WLAs in USEPA-approved TMDLs.



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Table 4-10 303(d) List of Impaired Waters in the City of Chaska

Reach or Lake	Year First Listed	River or MnDNR Lake ID# ¹	Affected Use	Pollutant or Stressor ²	Target Start ³	Target Completion ³
Chaska Creek	2006	07020012-512	Aquatic Recreation	Fecal Coliform	2014	2018
Unnamed Creek (East Creek)	2006	07020012-581	Aquatic Recreation	Fecal Coliform	2014	2018
Unnamed Creek (East Creek)	2008	07020012-581	Aquatic Life	Turbidity	2014	2018
Unnamed Creek (East Creek)	2004	07020012-581	Aquatic Life	Fish Index of Biotic Integrity	2014	2018
Minnesota River	1998	07020012-506	Aquatic Consumption	PCB FCA	1998	2025
Minnesota River	1996	07020012-506	Aquatic Life	Turbidity	2014	2018
Hazeltine Lake	2004	10-0014-00	Aquatic Recreation	Nutrients/ Eutrophication	2014	2018
Lake Bavaria	2006	10-0019-00	Aquatic Consumption	Mercury ⁴ FCA	2006	2021
Lake Jonathan	2014	10-0217-00	Aquatic Recreation	Nutrients/ Eutrophication	2012	2015
McKnight Lake	2014	10-0218-00	Aquatic Recreation	Nutrients/ Eutrophication	2012	2015
Unnamed (Lake Grace)	2006	10-0218-00	Aquatic Recreation	Nutrients/ Eutrophication	2012	2015

¹ A river reach extends from one significant tributary river to another and is typically less than 20 miles in length. Each river reach is comprised of the USGS 8-digit hydrologic unit code, plus the three-digit assessment reach. The 8-digit code defines the location of the major watershed that the reach or lake is located in. For example, Chaska's 8-digit code indicates that it is in the Upper Mississippi River Region (07), the Minnesota River Sub region (02) and Basin (00), and the Lower Minnesota River Subbasin (12).

² Because of similarities of sources, regional TMDL reports for fecal coliform, turbidity, bio-accumulative toxics, or eutrophication may be created in lieu of reach-specific TMDL reports.

³ These dates are the estimated Start date and Completion date for creating the TMDL plan; these dates may change based on Basin Planning or budget modifications. TMDL report planning efforts can begin any time after the Start date but are expected to be complete by the estimated Completion date.

⁴ Impacts of mercury are mainly regional in expression, so the initial approach will be to complete regional or statewide mercury TMDL reports. This approach could change based on basin planning activities. U.S. EPA Region 5 understands there must be a non-state responsibility for the national and international air-borne component of these TMDL reports. "FCA" means Fish Consumption Advisory.



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4.8.3 Carver County Watershed Management Organization Assessments

The Carver County Water Resources Management Plan is general in nature and does not include specific areas of concern regarding water quality. The CCWMO is in the process of updating its plan. The City has participated in this process and will amend its LSWMP as needed to address the requirements of the watershed plan.

The County has completed its 2012 Water Quality Report and is in the process of completing its 2013 report. The 2012 report indicates that Hazeltine, Grace, and McKnight Lakes continue to show poor water quality, while Bavaria, Courthouse, Brickyard, and Firemen's Lakes continue to exhibit average to above-average water quality. E. coli bacteria levels in East and West Chaska Creeks routinely exceed the state standard.

The CCWMO plan identifies a number of projects for potential partnering with the City. These are addressed further in Section 6.

4.8.4 Lower Minnesota River Watershed District Assessments

The LMRWD has summarized the water quality of select waterbodies within its jurisdiction in its Water Resources Management Plan, which was recently updated with the City's participation. No specific water resource issues are cited for Chaska resources in the report. Instead, a discussion of general issues across the watershed is provided, including:

- Water quality.
- Flooding and floodplain management – primarily along the Minnesota River.
- Erosion and sediment control – bluff, streambank, and mainstem Minnesota River erosion.
- Groundwater management – particularly in fen and trout stream areas.

The LMRWD plan identifies a number of projects for potential partnering with the City. These are addressed further in Table 4-3 of Section 4.

The LMRWD has also prepared a 2011 Strategic Resources Evaluation, which provides an assessment and recommendations for Clayhole Lake, Courthouse Lake, Firemen's Lake, Seminary Fen, and East Chaska Creek.

4.8.5 Riley Purgatory Bluff Creek Watershed District Assessments

The RPBCWD Watershed Management Plan, which was recently updated with the City's participation, contains assessments of select waterbodies within its jurisdiction. No specific water resource issues are cited in the report for resources located within Chaska. However, portions of Chaska along its eastern boundary with Chanhassen discharge eventually to Bluff Creek. Bluff Creek is impaired for turbidity and impaired fish biota, and a TMDL has been prepared for the creek.



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4.8.6 Actions Related to Assessments

The City continues to perform wetland inventories ahead of anticipated development. By doing so, the City is able to determine the level of protection required of each wetland and identify wetlands with good restoration potential, thereby maximizing the overall surface water quality benefit that wetlands provide. The City will continue to implement the standards outlined in this plan for protection of the City's and region's surface water quality, as they have with preceding water quality planning documents. The City will continue to collect water quality data for priority waterbodies, and include new waterbodies as necessary. In older developed areas, the City will continue to look for opportunities to provide water quality treatment where it was previously not required. As TMDL studies for impaired waterbodies in the City are completed, the City looks forward to working with agencies to help remedy water quality problems in the City and region.



5.0 SYSTEM DESIGN

5.1 GENERAL

This section of the Chaska LSWMP serves two functions. The system description portion of this section describes the City's surface water management system. This system is shown on the system maps, included as Appendix G. The maps illustrate drainage divides, flow routing, storage areas, conveyance (including pipes and channels), wetlands, and lakes that have been incorporated into the Chaska LSWMP water quantity and quality models.

The system design portion of this section begins by discussing how the LSWMP modeling was accomplished and how future modeling can remain consistent with the methods of the LSWMP modeling. Following the modeling discussion is a narrative describing system design concepts for storm sewer, channels, and rate control and water quality ponds. This narrative does not describe prescriptive requirements. Rather, it reflects the City's preferred methods in the various subject areas. The design standards in Section 5.3.2, which follow the system design concepts, are the prescriptive requirements.

The goals and policies of Section 3 are also prescriptive requirements. The distinction between the goals and policies and the design standards is that the goals and policies are general while the design standards are specific.

5.2 SYSTEM DESCRIPTION

This section describes the surface water management system for the City. The LSWMP area was organized into ten major drainage districts, as follows:

- Carver
- Chaska Creek
- Chanhassen
- Chaska Lake
- East Creek
- Hickory Street
- Lower Chaska Creek
- Minnesota River
- South Chaska Creek
- Upper East Creek



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The LSWMP study area lies within three watershed management organization jurisdictional areas. Riley Purgatory Bluff Creek Watershed District encompasses a very small portion of the eastern study area. The Lower Minnesota River Watershed District generally encompasses a mile-wide swath of the study area that runs parallel to Minnesota River. The remainder, and the vast majority, of the study area is under the jurisdiction of the CCWMO.

Each major drainage district was divided into smaller subdistricts. The subdistricts are generally drawn to encompass all drainage to a particular pond, wetland, lake, or storm sewer.

The following sections describe each drainage district in detail. Appendix A includes areas for the subdistricts within each major watershed. Appendix B includes the pond data. Refer to the system maps, included as Appendix G, for topography, storm sewer, pond locations, and drainage districts.

Carver District

The Carver District is approximately 137 acres located in the southwest corner of the City. The district is currently undeveloped and consists of largely agricultural use with some natural wooded and wetland areas. The portion of this district located east of TH 212 is included in the master planning for the “Heights of Chaska” development. The entire area drains south to the City of Carver and continues south and east through that city via a large ravine and ultimately to the Minnesota River.

Chaska Creek District

The Chaska Creek District is approximately 2,879 acres located in the west-central portion of the City. Over half the district is currently located outside the municipal boundary, but has been included in the study area for modeling accuracy. The majority of the district is currently undeveloped and consists of largely agricultural use with some natural wooded and wetland areas. Residential development continues to occur in the portion of the district within the City limits. Along with the South Chaska Creek District, this district is the headwaters of Chaska Creek and drains southeast to the confluence with South Chaska Creek. From there, Chaska Creek continues to drain east and south through the Lower Chaska Creek District and ultimately to the Minnesota River. Prior to reaching the river, the creek is intercepted by the Corps of Engineers diversion channel and routed around the downtown area.

Chanhassen District

The Chanhassen District is comprised of several portions that drain out of the City to the north and east into the City of Chanhassen. The combined area of the separate portions of the district totals approximately 957 acres.

The two small portions of the district draining north are undeveloped agricultural areas. When that area of the City develops, runoff from these areas may be redirected through the City stormwater system.

Two medium-sized portions of the district that drain to the northeast are fully developed industrial areas. These areas currently use ponds and wetlands for treatment and peak flow attenuation of stormwater runoff prior to discharge to the City of Chanhassen.



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The remaining, and largest, portion of the Chanhassen District is located in the southeastern area of the City, north of CR 61. The portion of this district located within the City of Chaska is nearly fully developed and consists of mostly residential area. A large portion of undeveloped area is also located in the City of Chanhassen to the east. The remaining undeveloped area largely consists of undevelopable ravines and the Minnesota River bluffs. Nearly the entire portion of this district drains to the Seminary Fen, which outlets to the City of Chanhassen and ultimately reaches the Minnesota River.

Chaska Lake District

The Chaska Lake District is approximately 555 acres located in the southern portion of the City. Varied land characteristics dominate the two portions of the district that are divided by CR 61, generally consisting of bluffs and ravines to the north of the highway and floodplain to the south. The usable area in the district (not bluffs, ravines, or floodplain) is undeveloped and currently used for agriculture. The area drains south and east to Chaska Lake. The lake drains north and discharges to Chaska Creek, just downstream of the Corps of Engineers diversion channel outlet, and ultimately drains to the Minnesota River.

East Creek District

The East Creek District is comprised of approximately 3,458 acres. This district generally covers the entire central portion of the City and narrows at the southern end, which is generally located in the downtown area. This district covers the vast majority of the developed portion of the City.

Land use in the East Creek District includes the fully developed downtown area, generally consisting of commercial and residential land uses. The vast majority of the remaining portion of this district is also developed, comprised of mostly residential area and interspersed with commercial and public/institutional land uses.

Similar to the land use, the terrain of the East Creek District varies through the extent of the district. Again, starting at the downstream end, the downtown area is generally located in the flat floodplain area of the Minnesota River. Upstream of the floodplain area lie the steep Minnesota River bluffs. The northern area of the district is generally rolling to steep and is dissected by the ravines of East Creek and its tributaries.

Drainage of the East Creek District generally begins at Lake Grace. East Creek drains from Lake Grace south, meandering through the City prior to discharging to the Minnesota River. Several tributaries to East Creek branch into the creek in the central area of the City. Prior to reaching the river, the creek is intercepted by the Corps of Engineers diversion channel, and floodwaters are routed around the downtown area.

Hickory Street District

The Hickory Street District is approximately 320 acres located in the south-central portion of the City. The district is partially developed with ongoing residential development occurring. The eastern portion of the district is undevelopable due to the Minnesota River bluffs and a steep ravine. The remaining undeveloped area consists of largely agricultural use with some natural wooded and wetland areas. The entire area drains east to two large culverts that convey stormwater under CR 61 to the Corps of Engineers diversion channel and ultimately drain to the Minnesota River.



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Lower Chaska Creek District

The Lower Chaska Creek District is approximately 1,049 acres located in the south-central portion of the City. The district is comprised of mostly undeveloped area that consists of largely agricultural use with undevelopable ravines and some natural wooded and wetland areas, though the district is seeing residential development occurring. The upper reaches of the district have begun to develop. The entire area drains to Chaska Creek, which bisects the district draining east then southeast towards the Minnesota River. Prior to reaching the river, the creek is intercepted by the Corps of Engineers diversion channel and routed around the downtown area.

Minnesota River District

The Minnesota River District is approximately 853 acres located in the southeast portion of the City. The majority of the City drains to the Minnesota River via either Chaska or East Creeks. The Minnesota River District is the remaining portion of the City that drains directly to the river. This district is essentially comprised of the downtown area and the development located in the southeast corner of the City along the river and south of CR 61. The area generally consists of residential and commercial land uses. The topography is flat floodplain area located below the Minnesota River bluffs. As previously stated, this district drains directly to the Minnesota River, generally via small drainageways or storm sewer.

South Chaska Creek District

The South Chaska Creek District is approximately 5,449 acres located in the southwest portion of the City. The vast majority of the district is currently located outside the municipal boundary, but has been included in the study area for modeling accuracy. The district is currently undeveloped and consists of largely agricultural use with some natural wooded and wetland areas. Along with the Chaska Creek District, this district is the headwaters of Chaska Creek, and generally drains east to the confluence with Chaska Creek. From there, Chaska Creek continues to drain east and south through the Lower Chaska Creek District and ultimately to the Minnesota River. Prior to reaching the river, the creek is intercepted by the Corps of Engineers diversion channel and routed around the downtown area.

Upper East Creek District

The Upper East Creek District is comprised of approximately 4,165 acres. This district generally covers the northern third of the City and includes all areas draining to Lake Grace. The land use in this district generally includes open space and rural and low density residential to the west with industrial to the east. The area south of Lake Bavaria is mostly developed, including the Chaska Golf Course and residential development. The terrain in the Upper East Creek District is generally gradual to rolling with minor ravine cuts. Drainage of the Upper East Creek District generally begins at the district's two largest lakes, Lake Bavaria and Hazeltine Lake. Both lakes drain centrally to the Grace chain of lakes. East Creek then drains south, meandering through the City prior to discharging to the Minnesota River.



5.3 SYSTEM DESIGN

5.3.1 System Design Recommendations and Discussion

Stormwater Quantity

The main purpose of the stormwater quantity portion of the LSWMP is to serve as a guide for the expansion of the storm drainage system. This section provides standards for the design of future facilities. The application of these standards will allow for the expansion of the storm drainage system as the City develops while minimizing the cost and inconvenience of local flooding.

This LSWMP recommends a regional stormwater pond approach by consolidating individual ponds that would normally be constructed in each subdivision or development into central facilities when feasible. Regional ponds provide a cost-effective approach to stormwater management by providing the following benefits:

- Combining engineering, design, and construction cost for individual developments;
- Using naturally occurring depressions and existing topography to minimize excavation costs;
- Reducing total land required for stormwater management by providing efficiently designed central facilities in place of several individual facilities;
- Minimizing the cost to manage the system by creating fewer stormwater ponds;
- Lowering the cost of maintenance;
- Providing flexibility in design of larger central facilities to incorporate recreational opportunities, create wildlife habitat areas, and improve aesthetic benefits for area residents, and
- Integrating low areas with upland areas to improve wildlife habitat.

Ponds with oversized outlets reduce the available flow capacity in downstream pipes and tend to empty sooner than desired. This problem can be resolved with the construction of outlet control structures such as orifices and weirs, which are recommended for most ponds. Outlet control structures are designed to reduce the outflow from a pond to a level that is lower than that which is possible with a culvert.

This LSWMP also provides the design standards for the future trunk storm sewer system. Trunk storm sewers convey runoff from the upper portions of watersheds to the proposed regional pond facilities. Storm sewers that convey flows from a regional stormwater pond are also considered trunk storm sewers.

Design Criteria

Precipitation

The City of Chaska uses an Atlas 14 10-year frequency storm event (4.2 inches in 24 hours) for storm sewer design, while the greater of the Atlas 14 100-year, 24-hour frequency rainfall event (7.3 inches in 24 hours) or the 100-year, 10-day snowmelt event (7.2 inches of runoff in 10 days) is used for overland drainage and pond



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storage design. Storm sewers that overflow to erosion-prone ravines and low points in State Aid road designs require a higher level of performance and are designed using an Atlas 14 50-year frequency storm event (6.3 inches in 24 hours). For consistency, the Atlas 14 precipitation data at the intersection of TH 212 and TH 41 has been selected for use across the City.

Complete protection against large, infrequent storms with return intervals greater than 100 years are typically justified only for very large flood control projects. For most developing areas, the cost of constructing a large capacity storm drainage system is much greater than the amount of property damage that would result from flooding caused by a storm that a smaller capacity system could not accommodate.

The excess runoff caused by storms greater than that used for design will be accommodated by ponding in low spots in streets for short periods of time and providing outflow through overland drainage routes. This short-term flooding and overland drainage will minimize much of the damage to property that would occur if those facilities were not provided. Provisions should be made to provide or preserve overland drainage routes for emergency overflows. When possible, stormwater pond designs should include an emergency overflow to provide an outlet below the lowest floor elevation of any adjacent structure for added safety.

An Atlas 14 24-hour MSE-3 storm distribution is to be used for the design of ponds and drainage systems. The MSE-3 distribution is the storm event recommended for Minnesota as part of the development of updated NOAA Atlas 14 rainfall events and distributions.

An analysis of the snowmelt condition should be performed for every pond design or review. Special consideration of the snowmelt condition becomes more critical for areas with curve number values less than 70 that typically remain frozen later in the season (such as wooded areas). These areas produce low runoff rates under normal summer conditions, but can act as an impervious surface when frozen. Final pond design must consider snowmelt conditions when sizing outlet structures.

Stormwater Runoff

A number of methods have been developed to determine the expected maximum rate of runoff for an area under a certain design storm. The storm sewer design standards presented in this LSWMP are based on the Rational Method, which is the most widely used method for designing storm sewer systems. Pond design is typically performed using HydroCAD modeling software or equivalent, which is based on an enhanced version of NRCS TR-20 methodology.

The Rational Method requires the selection and/or computation of a time of concentration and a runoff coefficient. HydroCAD typically uses a time of concentration and a runoff curve number (CN). MnDOT recommends a minimum time of concentration of seven minutes. A minimum time of concentration of ten minutes is typically selected for design of the City's trunk storm sewer system.

The runoff coefficient for urban areas varies based on the design storm return period and the land cover. Assuming a 10-year return period, runoff coefficients vary from 0.22 for parks to 0.94 for asphalt and concrete surfaces. The runoff curve number varies from 61 for parks to 98 for asphalt and concrete surfaces. Under ultimate (fully developed) conditions, the values of the coefficient will increase with increases in the amount of impervious surfaces caused by street surfacing, building construction, and grading.



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Computer Modeling

Computer modeling of stormwater quantities for the drainage system was performed using the computer software HydroCAD. HydroCAD stormwater runoff hydrographs are calculated in accordance with Natural Resources Conservation Service (NRCS) TR-20 methodology. Hydrograph routing through channels and detention ponds is performed using the Storage-Indication Method. Various storm distributions are allowed in the model. All analyses performed within the context of this report have been conducted using the NRCS Type II storm distribution as well as TP-40 rainfall amounts. Results of the computer model for the system for the 2-year (2.8 inches), 10-year (4.2 inches), and 100-year (6.0 inches), 24-hour storm event are presented in Appendix B. In the future, modeling will be updated to reflect Atlas 14 rainfall amounts and the MSE-3 rainfall distribution.

Stormwater management plans are typically required with the submittal of development plans to the City. Modeling of existing and proposed conditions is included in those stormwater management plans with the intent of the proposed plans to meet existing peak flow rates exiting the site. Historically, modeling of existing and proposed conditions has been oversimplified, resulting in models that show adequate rate control while post construction observation shows increased peak flows resulting in downstream flooding and erosion.

Based on our experience, model simplification has resulted in two primary inaccuracies; overestimation of existing peak flows and underestimation of proposed peak flows.

Overestimation of existing peak flows is generally associated with land developing from agricultural areas. The NRCS publishes CN values (used for hydrologic calculations) for all major land covers that are generally accepted industry-wide. A typical agricultural CN value in the metropolitan area is 74 while a typical single-family residential (SFR) CN value is 72. The higher the CN value, the more runoff is produced. This means that using simplified modeling, developing an agricultural area with SFR will result in lower peak runoff rates. This is intuitively incorrect, as it is logical that the addition of impervious surface and concentration of runoff using streets and storm sewers will most likely result in increased peak flows.

The root of the problem is in the NRCS's development of the agricultural CN values. They create average annual CN values weighted on the entire life cycle of a crop, going from bare soil (CN value of 86) through late fall, winter and early spring, to full crop growth in early fall (CN value of 62). To be accurate, the CN value should be weighted using crop growth through the summer months, and specifically during the period that large rainfall events can historically be expected. This exercise has been performed, resulting in an average summer CN value of 65 for agricultural uses typical to the metropolitan area. This is an intuitively feasible CN value for agricultural land use, falling between lawn or meadow areas (CN value of 61) and SFR. This CN is recommended for use in estimating runoff from agricultural areas in the City.

Underestimation of proposed peak flows can likely be attributed to several factors:

- The use of composite CN values;
- Neglecting soil compaction during site grading; and
- Model defaults for pipe flow calculations.



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In reality, a large portion of a developed area includes impervious surface that typically drains directly to storm sewer. Impervious surfaces typically produce more runoff and drain more quickly than a predevelopment area. Simplified models neglect the impact of impervious area that is directly connected to storm sewer, and lumps together the entire site's pervious and impervious area into one average, or composite, CN value. To be accurate, models should include separate drainage areas for impervious area directly connected to the storm sewer system, and an average or composite CN value for the remaining pervious and impervious area. This method more accurately represents post development conditions and will typically result in higher peak flows and runoff volumes.

During construction, native soils can become compacted from heavy machinery and suffer diminished infiltration capacity. To remedy this problem, one of two actions should be taken:

1. Sites should be deep ripped to a minimum depth of 12 inches at maximum spacing of 2 feet so that the site reflects the predevelopment soil conditions; or
2. The modeled pervious CN values should be adjusted upward by lowering one hydrologic soil group from existing conditions to reflect the compacted soils.

Stormwater Conveyance

Storm sewers are the actual conduits used to transport stormwater runoff. The capacity of the storm sewer conduit is dependent on the pipe slope, pipe diameter, and the roughness of the inner surface of the pipe.

A roughness coefficient (n) of 0.013 was used for concrete and plastic (most commonly HDPE) storm sewer pipe, and 0.024 for corrugated metal pipe. These roughness coefficients take into account losses due to bends and manholes in the system as well as the roughness of the inner pipe surface over time.

Proper design of a storm sewer system requires that all sewer lines be provided with access through manholes for maintenance and repair operations. Spacing of manholes should be no greater than 400 feet for sewer lines 15 inches or less in diameter and 500 feet for sewer lines 18 inches to 30 inches in diameter. Intervals on larger diameter lines can be increased since the pipes are sufficiently large for a person to physically enter the storm sewer pipe itself for maintenance operations. Regardless of sewer size, manholes should normally be provided at all junction points and at points of abrupt alignment or grade changes. Allowable spread of storm water into the driving lane during the design storm must also be calculated and may result in the necessity of shorter manhole intervals than stated above.

Although lateral systems are designed for ten-year storm events, their performance must be analyzed for storms exceeding the design storm. It should be anticipated that surcharging of the system would occur when the design storm is exceeded. During surcharging, the system works as a closed conduit, and the pipe network becomes pressurized with different pressure heads throughout the system. Low areas that are commonly provided with catch basins may act as small detention ponds, and sometimes perform like pressure relief valves (water rushing out in some locations). For this reason, it is extremely important to ensure that these low areas have an acceptable overland drainage route (emergency overflow) with proper transfer capacity.



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Ponding on streets must meet all of the requirements of the 100-year design criterion as a minimum. For safety reasons, the maximum depth should not exceed three feet at the deepest point, and the lowest exposed building elevation should be at least two feet above the 100-year high water level (HWL) or one foot above the emergency overflow elevation, whichever is more restrictive.

The minimum elevation for the lowest exposed floor or opening elevation of buildings near ponds must be two feet above the 100-year HWL or one foot above the emergency overflow elevation, whichever is greater. The City may require additional freeboard for landlocked areas or ponds where emergency overflows cannot be provided. Overland flow routes should be incorporated into the design for ponds and maintained during development. The lowest exposed floor or opening elevation of structures that are adjacent to ponds shall be indicated on the site grading plans to ensure adequate freeboard. Hydraulic connectivity between storm sewered areas and ponds should be considered when designing to meet freeboard requirements. For example, a low point in a street draining to a pond will have a HWL equal to, or likely greater than, the pond that it discharges to. All freeboard requirements would also apply to that street low point.

All storm sewer facilities, especially those conveying large quantities of water at high velocities, should be designed with efficient hydraulic characteristics. Manholes and other structures at points of transition should be designed and constructed to provide gradual changes in alignment and grade. Pond outlet control structures should be designed to allow water movement in natural flow line patterns, minimize turbulence, provide good self-cleaning characteristics, and prevent damage from erosion or seepage.

Inlet structures should be liberally provided at all low points where stormwater collects and at points where overland flow is to be intercepted. Inlet structures are of special importance, since it is a poor investment to have an expensive storm sewer line flowing partially full while property is being flooded due to inadequate inlet capacity. Inlets should be placed and located to provide sufficient inlet capacity and minimize spread into traffic lanes. Generally, 400-foot spacing is adequate. Calculations to estimate inlet capacity and spread are necessary to justify larger spacing. Intake grates and openings should be of self-cleaning design to minimize capacity reduction when clogged with twigs, leaves, and other debris.

The following recommendations must be considered when designing storm sewers:

- All area tributary to the storm sewer must be included in the design calculations.
- Inlet and outlet pipes of stormwater ponds should be extended to the normal water level whenever possible.
- When possible, the inside top of pipe elevations between consecutive pipe segments should be designed to match.
- Where possible, outlet velocities of 5 fps should not be exceeded.
- Where outlet velocities exceed 8 fps, the design should be based on the unique site conditions present.
- Riprap is required at all inlets and outlets.



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- Stilling basins are required at all outlets.
- Riprap should be placed on a suitably graded filter material over geotextile fabric to ensure that soil particles do not migrate through the riprap and reduce its stability. Riprap should be placed to a thickness at least 2.5 times the mean rock diameter so as to ensure that it will not be undermined or rendered ineffective by displacement.

Open channels are recommended where flows and small grade differences prohibit the economical construction of an underground conduit and in areas where open channel type drainage will enhance the aesthetic, wildlife, or water qualities of an area. A minimum slope of 1.0 percent should be maintained in unlined open channels and overland drainage routes in developed areas whenever possible. Slopes of less than 1.0 percent are difficult to construct and maintain and can create problems with pocketing of water without an underdrain system. Side slopes should be a minimum of 4:1 (horizontal to vertical) with more gradual slopes being desirable.

Rock riprap must be provided at all points of juncture between two open channels and where storm sewer pipes discharge into a channel. The design velocity of an open channel should be sufficiently low to prevent erosion of the bottom. Riprap or permanent turf reinforcement mats should be provided in areas where high velocities cannot be avoided. Periodic cleaning of an open channel is required to ensure that the design capacity is maintained. Therefore, all channels must be designed to allow easy access for equipment including a 12-foot wide maintenance path with 15 percent maximum grade at storm sewer outfalls, road crossings, and connections to other channels or streams.

Both storm drainage facilities and sanitary sewer lines are designed to take advantage of natural draws and usually follow a ravine, creek, or gully. As more area develops in the City, the total runoff in natural drainageways will increase, and correspondingly the water level may rise. In certain areas, water could enter the sanitary sewer system, causing capacity problems and added costs for treatment of stormwater.

For this reason, sanitary sewer manholes that could be subject to temporary inundation should be equipped with watertight castings, and added precautions should be taken in construction of these manholes to prevent the entrance of stormwater. Sanitary manholes located near ponding areas should be raised above the 100-year HWL and the adjacent areas filled when access is required at all times. If access is not required, watertight castings should be installed. Future storm drainage construction should include provisions for improving the water tightness of nearby sanitary sewer manholes.

Water Quality

The main stormwater quality requirement of the LSWMP is to protect and improve the water quality of the City and County's wetlands and waterways for existing and future generations by meeting or exceeding State and Federal requirements and providing an efficient level of runoff treatment for future development areas. The only completely effective way to achieve this goal is to prevent undesirable sediment, nutrients, and other pollutants from entering the storm drainage system. Presently, complete interception for water treatment at the point of discharge into the drainage system is neither practical nor economically feasible.



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The four main reasons for degradation of water quality are:

- Erosion and sedimentation;
- Solids and associated chemicals (including salt) from street sanding;
- Organic matter such as leaves and grass clippings; and
- Fertilizers and other chemicals from farming practices, impervious surfaces, and lawn care.

Recognition of the problem sources and the implementation of reasonable control measures can minimize the degradation of water quality in the study area. Stormwater ponding areas used for rate control can also be an essential part of reducing the amount of pollutants being transported downstream. Water quality ponds provide locations where ponding allows sediment and many pollutants to settle out and be effectively removed from stormwater runoff.

The regional approach recommended in this LSWMP provides more efficient maintenance requirements by centralizing pond areas in fewer locations. This approach also provides cost-effective design, land acquisition, and construction expenditures for development by proposing pond facilities in locations that take advantage of natural terrain and provide the most efficient benefit for runoff water quality treatment.

Water Quality Modeling

The City uses the PondNET water quality management model for modeling a series of water quality ponds. PondNET is an empirical model developed from data collected by the Environmental Protection Agency (EPA) Nationwide Urban Runoff Program (NURP). The model predicts the phosphorus removal efficiency of a large number of hydrologically connected ponds. Phosphorus is the primary nutrient modeled because it has been found to be the nutrient most likely to promote the growth of algae in lakes. Detailed PondNET modeling was completed as part of the City's 2007 Nondegradation Review, and modeling results are contained in that report. PondNET modeling parameters to be used in the City are presented in Table 5-1.



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Table 5-1 Key Variables in PondNET*

Land Use	Hydrologic Runoff Coefficient	Phosphorus (P) Runoff Concentration	Unit P Loading	DP:TP	Total Suspended Solids Concentration	Unit TSS Loading
	Unitless	(ppb)	(lbs/ac/yr)	Ratio	(ppm)	(lbs/ac/yr)
Row Crop Agriculture	0.14	540	0.53	0.2	163	160
Large Lot Residential	0.12	350	0.3	0.5	216	188
Low/Med Density Res.	0.21	450	0.67	0.3	140	209
High Density Residential	0.43	450	1.35	0.3	140	420
Commercial/Industrial	0.46	350	1.13	0.3	140	450
Institutional	0.31	350	0.75	0.3	140	301
Open Space	0.08	200	0.11	0.6	216	121
Golf Course	0.09	550	0.36	0.7	216	142
Right-of-Way	0.28	400	0.77	0.3	140	271
Wetland	0.08	200	0.11	0.6	216	121

*P = Phosphorus, DP = Dissolved Phosphorus, TP = Total Phosphorus, TSS = Total Suspended Solids

The MPCA’s Minnesota Stormwater Manual provides estimated removal efficiencies for total phosphorus and several other pollutants. These are presented in Table 5-2. Specific removal efficiencies for total suspended solids and total phosphorus for individual ponds are to be estimated using PondNET.

Table 5-2 Typical Removal Efficiencies for Wet Detention Ponds

Pollutant	Average Reduction (%)
Total Suspended Solids	60-90
Total Phosphorus	34-73
Total Nitrogen	30
Zinc and Copper	60
Bacteria	70
Hydrocarbons	80

Stormwater Ponds

Stormwater ponds are an essential part of a storm drainage system. These areas provide locations where ponding caused by restricted flow can be allowed, thereby minimizing flood damage and streambank failure. The effective use of stormwater ponds enables the installation of outflow sewers with reduced capacities.



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Equally as important is the use of ponds to:

- Improve water quality,
- Return stormwater to the groundwater table, and
- Increase water amenities in developments for aesthetic, recreational, and wildlife purposes.

Stormwater quality is improved by allowing nutrients and sediments carried by runoff to settle below the pond normal water level and allow fringe vegetation to assimilate additional pollutants. The restriction of outflow rates from pond areas promotes groundwater recharge by increasing the detention time and allowing the runoff to infiltrate. Amenity aspects are maximized by careful planning in the initial development of an area to incorporate pond areas into recreational areas, parks, and trail systems.

Wet Storage Volume Criterion

Actual modeling of water quality ponds and their treatment capacities can be cumbersome for developers and their engineers. A simple criterion is that every water quality pond should initially provide wet storage volume (storage below the normal water level) equivalent to the post-development site runoff for the 2.5-inch rainfall event. Ponds designed in this manner will typically meet a 60 percent removal efficiency while providing excess volume for sediment storage. Models used to size water quality treatment volumes must separate out impervious area that is directly connected to the storm sewer system, as discussed in the “Computer Modeling” section above. In addition, room should be provided for potential expansion necessary to meet the City design requirements and maintenance access. The City will then review the design and determine whether expansion or other modifications are necessary to meet pretreatment requirements for downstream waterbodies.

Stormwater Abstraction

Stormwater abstraction is a reduction of the amount of overland runoff exiting an area typically by using infiltration, evapotranspiration, or capture and reuse. The goal of stormwater abstraction is to mimic the stormwater cycle of undeveloped land in a developed setting. Abstraction benefits both the quantity and quality aspects of stormwater runoff. Stormwater that is infiltrated reduces the volume of water that is passed downstream via City storm sewer, channels, creeks, and rivers. The reduction in overland runoff volume reduces that potential for downstream channel erosion and associated water quality degradation. Infiltration of stormwater also directly removes dissolved nutrients and pollutants via natural soil adsorption and microbial uptake.

The soils in Chaska have historically been shown to be unsuitable for the construction of infiltration basins. Therefore, the most feasible option for stormwater abstraction in the Chaska area is likely the method of capture and reuse. The simplest example of capture and reuse is to sprinkle lawns from stormwater ponds. Stormwater sprinkling is generally ideally suited for land uses other than single family residential (SFR). This is due to the operation and maintenance of the system; SFR areas typically consist of multiple landowners without associations, while all other land uses have one owner or association for operation and maintenance of sprinkling systems. The benefits of stormwater sprinkling include:



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- Reduction of overland runoff volumes,
- Infiltration of dissolved nutrients,
- Irrigation with nutrient-rich water, and
- Reduced burden on the City's water supply system.

The goal of this LSWMP is for the abstraction of the first 1/2-inch of runoff generated from new impervious surfaces for new development and redevelopment sites. When possible, new development and redevelopment sites should provide methods to meet the stormwater abstraction goal of the City. The City will also look for opportunities to retrofit existing sites for stormwater abstraction. Existing sites that may be well suited for retrofit capture and reuse systems might be open space areas associated with schools and parks that are located in close proximity to existing stormwater ponds.

Construction Criteria

Pond design characteristics are critical in achieving the maximum pollutant removal efficiencies. Pond design must maximize detention time by preventing short-circuiting. This can be accomplished by maximizing the distance between inflow pipes and the pond outlet. A minimum length to width ratio of 3:1 is recommended for the footprint of the pond. Ponds should be designed with multiple cells whenever possible.

A sedimentation bay, or first cell, should be provided to remove and collect large sediment particles that constitute a majority of the sediment volume. This bay must be sized to hold approximately 20 years of sediment accumulation (10 cubic yards per acre of drainage area) from the fully developed upstream land use. Maintenance access to the first cell must be provided for dredging this material from the pond.

Submerged berms should be provided to separate the ponds into multiple cells when possible. Subsurface slopes must not exceed 3:1. A minimum ten-foot aquatic bench at the normal water level of the pond must be provided with a 10:1 slope for one foot below the normal water level of the pond. Aquatic vegetation should be planted along the bench to stabilize the soil and provide for additional nutrient assimilation. Ponds should have a mean depth greater than or equal to four feet and no less than three feet. Pond maximum depths should not exceed 10 feet to prevent thermal stratification.

5.3.2 Design Standards

Design standards for stormwater management are presented in the following sections. These standards apply City-wide. In areas where there are also Watershed (or other) requirements, then the more restrictive roles are understood to govern in each case. Enforcement of the rules will be the responsibility of the governing entity. Additionally, the City is aware of other regulations governing stormwater management, such as the MPCA's NPDES Construction Stormwater General Permit, and will adhere fully to them City-wide.

5.3.2.1 Submittal Requirements

All grading, erosion control, and site restoration work must be done in accordance with the most recent editions of the MnDOT Standard Specifications for Construction, the MPCA's NPDES Construction



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Stormwater General Permit, the Minnesota Stormwater Manual, Chaska Engineering Guidelines, and this LSWMP and its updates.

An application containing the following information shall be submitted by the responsible party of a site or an authorized representative. The responsible party must sign the application and cannot transfer authority. At City discretion, less information may be required to constitute a complete application.

1. The site location with property lines in relation to surrounding roads, slopes greater than 6%, other geographic features, buildings, and other structures;
2. Existing and proposed two-foot contours for the site; this includes contours, invert elevations of existing storm sewer, or spot elevations of the conveyance system from drainage discharge points to the nearest receiving waterbody and for a minimum of 100 feet beyond the site boundary. Evidence that the natural and structural conveyance system can accommodate flows to the nearest receiving major waterbody or evidence of drainage easements on neighboring properties where runoff flows are redirected or concentrated must be submitted. This shall include submitting proposed rates, volumes, velocities, and duration of flow if needed. Documentation that drainage flowing onto the site from upstream areas is managed shall be submitted. In addition, drainage to a public ditch must meet the requirements of MN Statute 103E;
3. Finished floor elevations;
4. Identification and location of all on-site water features, including waters of the state;
5. In areas where there has been a natural resource or similar inventory, the location of trees and vegetation on site, with identification of those trees and vegetation intended to be retained;
6. For projects that are proposed adjacent to bluffs, ravine, or steep slopes; a slope stability analysis from a Geotechnical Engineer may be required upon request of the City Engineer to demonstrate an acceptable margin of safety for proposed development, homes, and stormwater pond areas.
7. Stormwater management plan. The plan shall have both existing and final proposed conditions drawn to scale and shall contain the following:
 - a. Existing subwatershed boundaries, drainage patterns, and flow directions shown on a separate figure;
 - b. Location and amount of impervious area including roads, trails, parking areas, and building areas;
 - c. Hydrologic calculations for runoff volume, velocities, and peak flow rates for the 2-year, 10-year, and 100-year, 24-hour rainfall events and the 10-day, 100-year snowmelt event;
 - d. All tributary areas must be accounted for in design calculations. Offsite drainage areas are exempt from rate control and water quality standards, however, these flows must be included in the stormwater design and allowed to pass through the project area without impacting



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- upgradient or downgradient properties. Routing of offsite areas through proposed BMPs is subject to approval from the City Engineer.
- e. CN values published by the NRCS shall be used for stormwater modeling, with the following exceptions:
 - 1) Agricultural areas will be modeled with a CN value of 65;
 - 2) Cover type “open space” will be based on the amount of topsoil as well as grass cover. Less than four inches of top soil equals poor condition; more than four inches of topsoil equals good condition;
 - f. For designs that discharge to existing City stormwater systems, calculations must be provided demonstrating sufficient capacity and show no downstream impacts.
 - g. Normal water level, 100-year high water level (HWL), and emergency overflow (EOF) elevations for the site (includes yard and street low points as well as stormwater ponds);
 - h. Stormwater treatment devices that remove oil and floatable material (for example, pond outlets with submerged entrances) shall be part of system design;
 - i. Plans, specifications, and computations for stormwater management facilities submitted for review shall be signed by a professional engineer licensed in the State of Minnesota. All computations shall be submitted with the plans.
 - j. A Stormwater Facilities maintenance agreement must be provided and recorded with Carver County for all privately owned systems.
8. Erosion and sediment control plans shall have both existing and final proposed conditions drawn to scale, shall be consistent with the latest NPDES Construction Stormwater General Permit, and shall include the following:
- a. Proposed area of grading or other land-disturbing activities and delineation of the limits of disturbance including areas of grubbing, clearing, tree removal, grading, excavation, fill, and other disturbance;
 - b. Quantify the soil or earth material to be removed, placed, stored, or otherwise moved on-site;
 - c. Locations and descriptions of proposed runoff control, erosion prevention, sediment control, and temporary and permanent soil stabilization measures;
 - d. A sequence of land alteration activity and corresponding implementation of erosion control practices, monitoring, maintenance, and removal of erosion and sediment control measures, and permanent site stabilization measures. Prior to commencing activity (following all necessary approvals), the responsible party shall provide the City with a construction schedule;



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- e. The City or County, upon the advice or request of its engineer or the SWCD, may require additional reports such as but not limited to a geologic report or a soils report. Such requirements shall be written and shall contain the specific requirements for the report.
 - f. An interim grading and stormwater drainage plan must be provided for projects that mass grade before the stormwater system is completed.
9. Wetland protection. The plan shall have both existing and final proposed conditions drawn to scale and shall contain the following:
 - a. Documentation of permits and process required under the Wetland Conservation Act (WCA);
 - b. Delineated boundaries of wetlands.
10. Floodplain and shoreland. Documentation that the application meets the requirements of the City's Floodplain and Shoreland Ordinances.
11. If an activity is subject to another permitting process that requires similar information, information developed for the other process may be used in this application to the extent it fulfills the requirements. The Stormwater Pollution Prevention Plan (SWPPP) developed for the site to meet NPDES requirements must be submitted as part of these applications.
12. Additional information as relevant and necessary to evaluate an application may be required.

5.3.2.2 Erosion and Sediment Control

1. The City of Chaska adopts by reference the erosion and sediment control design and operational standards set forth in Minnesota Construction Stormwater General Permit (Authorization to discharge stormwater associated with construction activity under the National Pollutant Discharge Elimination System, NPDES (MNR1000001).
2. Erosion and sediment control best management practices (BMPs) must be designed and maintained to prevent the deposition of sediment or construction material into waters of the state, neighboring properties, or City stormwater conveyance systems.
3. Erosion and sediment control BMPs must be installed prior to commencing any construction activity.

5.3.2.3 Stormwater Conveyance

1. Storm sewer shall be designed using the Rational Method. All calculations are subject to the City Engineer's approval.
2. All storm sewer shall be designed using 10-year return frequency storm intensities. 50-year return frequency storm intensities are required for areas that overland flow to ravines and for any additional areas determined to be flood-prone by the City Engineer.



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3. A Manning's "n" coefficient of 0.013 shall be used for the design of concrete and plastic sewer and a coefficient of 0.024 shall be used for corrugated metal pipe.
4. Discharge onto steep slopes and/or ravine is not allowed unless no feasible alternative exists. In those cases, calculations must be provided showing that runoff rates, volumes, and velocities will not result in erosion. Erosion protection (i.e., riprap, turf reinforcement mat, rock checks, drop structures, etc.) is required to protect erosion prone slopes and conveyances.
5. Provide for overflow routes to drain low points along streets or lot lines to ensure a minimum freeboard of 1 foot from the lowest exposed structure elevation. Some low points may be determined to act as ponding areas by the City Engineer and will require 2 feet of freeboard between the calculated 100-year HWL and lowest exposed structure elevation. Design criteria verifying the adequacy of the overland drainage route capacity may also be required.
6. The maximum elevation difference between a street low point and emergency overflow elevation is 3 feet.
7. Emergency overflows from all low points and stormwater ponds must be clearly shown on the plans with labeled elevations.
8. The maximum spacing between manholes is 400 feet.
9. To the greatest extent possible, manholes shall be placed in paved surfaces outside of wheel paths (3 feet and 9 feet off centerline) or other readily accessible areas.
10. Minimum pipe size shall be 12 inches diameter.
11. Aprons or flared end sections shall be placed at all locations where the storm sewer outlets.
12. All inlet/outlet flared end sections shall be furnished with hot dipped galvanized trash guards. All trash guard installations will be subject to approval by the City Engineer.
13. The last three pipe joints from the flared end section shall be tied together.
14. Riprap and filter blanket shall be placed at all outlet flared end sections in accordance with the City's standard detail.
15. The invert elevations of the pond inlet flared end sections shall match the NWL of the pond. Submerged pond inlets will only be allowed at the discretion of the City Engineer.
16. If the storm sewer is to be installed less than 10 feet deep within private property, the easement shall be a minimum of 20 feet wide with the pipe centered in the easement. If the storm sewer is 10 feet deep or greater, then the easement shall be twice as wide as the depth or as required by the City Engineer.
17. Junction manholes should be designed to limit the hydraulic head increase by matching hydraulic flow lines and by providing smooth transition angles.



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18. In the development of any subdivision or ponding area, the developer and/or property owner is responsible for the removal of all significant vegetation (trees, stumps, brush, debris, etc.) from any and all areas which would be inundated by the designated controlled NWL of any proposed ponding as well as the removal of all dead trees, vegetation, etc., to the HWL of the pond.
19. Outlet control structures from ponding areas are required as directed by the City Engineer. Location and appearance of outlet structures shall be subject to City Engineer approval and may require landscape screening.
20. Inlets should be placed and located to eliminate overland flow in excess of 400 feet. Additionally, inlets should be located such that 3 cfs is the maximum flow at the inlet for the 10-year design storm.
21. Where possible, outlet velocities should be limited to 5 fps for the design storm.
22. Open channels should be designed with longitudinal slopes of 1 percent or greater.
23. Open channel side slopes should be designed at 4:1 side slopes or flatter.
24. Riprap must be provided at points of juncture between two open channels.
25. Design velocities for open channels should be kept to a minimum for erosion prevention.
26. When high velocities are unavoidable, armament of the channel is required to prevent erosion.
27. Providing for maintenance access along open channels is required. A 12-foot wide area adjacent to the open channel should be provided at a maximum slope of 15 percent.

5.3.2.4 Stormwater Quantity

The term High Water Level (HWL), as used below, refers to the maximum water level generated by a 24-hour, 100-year rainfall event.

1. Design rainfalls must be based on the Atlas 14 MSE-3 24-hr rainfall amounts and distribution.
2. Stormwater facilities shall be designed for a 100-year frequency storm for stormwater ponds and associated trunk facilities.
3. Stormwater modeling of ponds shall have a starting elevation of the normal water level, equal to the controlling elevation (orifice, weir, pipe invert).
4. Filtration basins shall be modeled with a starting elevation of the controlling outlet (orifice or pipe) with the exfiltration rate for silty sands per the MN Stormwater Manual (0.45 in/hr).
5. Proposed runoff rates must be held to existing conditions or less for the 2-year, 10-year, and 100-year storm events for all project discharge locations.



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6. Stormwater pond designs must accommodate the 10-day, 100-year snowmelt event without exceeding the calculated 100-year HWL.

The 100-year peak flow per acre from new development and must also meet the calculated City average of 0.2 cfs/acre over the entire project area.

7. The 100-year peak flow per acre from redevelopment areas must not increase over existing. Additional all new impervious surfaces must meet the 0.2 cfs/acre standard.
8. For areas that cannot be feasibly captured and treated, the 2-, 10-, and 100-year rainfall event runoff rates shall not increase over existing conditions for the area equivalent to the proposed uncatchable area, with justification provided for why areas cannot be captured.
9. CN values published by the NRCS shall be used for stormwater modeling. One exception is for agricultural land, which shall be modeled using a CN value of 65.
10. Maximum allowable slopes are 3:1, though 4:1 slopes are preferred. Slopes steeper than 4:1 shall have erosion control blanket installed immediately after finish grading. In residential areas, slopes no steeper than 4:1 shall be allowed.
11. All constructed ponds and wetland mitigation areas shall have an aquatic safety bench around their entire perimeter. The aquatic bench is defined as follows:
 - a. Cross slope no steeper than 10:1.
 - b. Minimum width 10 feet.
 - c. Located from pond NWL to one foot below pond NWL.
12. A 12-foot wide maintenance access at a maximum grade of 15 percent to the NWL of all ponds must be provided. At a minimum, access must be provided to the pond outlet structure, all inlets to the pond, and to the first cell of a multi-cell pond. Maintenance access must be constructed to support City maintenance vehicles.
13. Elevation separations of buildings with respect to ponds, lakes, streams, and stormwater features shall be designed as follows:
 - a. The lowest ground elevation adjacent to homes and buildings must be a minimum of two feet above the calculated 100-year HWL or one foot above the EOF, whichever leads to the higher elevation.
 - b. Landlocked lakes and wetlands require a three-foot separation between the lowest ground elevation adjacent to the building and the calculated pond HWL for back-to-back 100-year rainfall events.
14. Maximum depth is 10 feet from the bottom of the pond to the NWL.



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15. All ponds shall have outlet skimming for up to the 10-year rainfall event.
16. All ponds shall be graded to one foot below the design bottom elevation. This “hold down” allows sediment storage until such time as site restoration is complete.
17. The top berm elevation of ponds shall be a minimum of 1.5 foot above the 100-year pond HWL.
18. The EOF elevation of ponds shall be 0.5' above the 100-year HWL and be stabilized with turf reinforcement mat (TRM). The EOF shall be 10' wide with TRM extending from the pond NWL to the downstream toe of slope and 0.5' vertically up the sides of the EOF.
19. Where stormwater ponding areas are proposed to be located adjacent to bluffs, steep slopes, and ravine areas, the pond shall not overtop for the 500-year rainfall event at the direction of the City Engineer. Rate control is not required for events larger than the 100-year rainfall event in these cases.
20. Grading shall not block or raise emergency overflows from adjoining properties unless some provision has been made for the runoff that may be blocked behind such an embankment.
21. Minimum grade for lot drainage swales and lot grading shall be 2 percent or greater.
22. Maximum length for drainage swales shall be the lesser of 300 feet or a total of four lots draining to a point, or as approved by the City Engineer.
23. Use of existing wetlands for stormwater management is subject to review by the appropriate regulatory agency in accordance with the Wetland Conservation Act.
24. Seeding around wet ponds should be State mix 33-261 or other as directed by the City Engineer.
25. A landscaping plan shall include details for soil decompaction to a minimum depth of 6” and provide a minimum of 6” of topsoil in all green spaces.

5.3.2.5 Stormwater Quality

1. All tributary area must be accounted for in design calculations.
2. At a minimum, the design shall provide removal rates for total phosphorus (TP) and total suspended solid (TSS) greater than 60% and 80%, respectively, unless the requirements listed in Table 4-4 call for increased treatment capacity. Modeling shall be provided that documents design removal rates.
 - a. For designs that use wet (NURP) ponding to meet water quality standards, a permanent pool equivalent to the runoff from a 2.5-inch, 24-hour rainfall event shall be provided.
3. For new development projects, there shall be no net increase from pre-project conditions for TP and TSS.



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4. For redevelopment projects, there shall be a net decrease from pre-project conditions for TP and TSS.

5.3.2.6 Stormwater Abstraction

1. Within the boundaries of the Carver County Water Management Organization (CCWMO), the City of Chaska recognizes CCWMO rules governing volume reduction and accepts their stormwater management permit approval as justification that City volume reduction standards being met. The volume reduction standards below apply to projects outside the CCWMO or do not require a CCWMO permit.
2. Within the boundaries of the Riley Purgatory Bluff Creek Watershed District (RPBCWD), the City of Chaska recognizes RPBCWD rules governing volume reduction and accepts their stormwater management permit approval as justification that City volume reduction standards being met. The volume reduction standards below apply to projects outside the RPBCWD or do not require a RPBCWD permit.
3. Proposed runoff volume retained onsite for non-linear and new linear projects shall be equivalent to 1 inch of runoff from the new or reconstructed impervious surface area. For the purpose of this section, reconstruction is defined as “full removal of existing impervious surface to a depth that exposes underlying soils and construction of new impervious surface”.
 - a. If infiltration is not feasible or allowed, supporting documentation must be provided. In those cases, the following process must be followed in the order outlined below, along with justification of why the preceding method is not feasible.
 - 1) Provide treatment onsite with other volume reduction practices; i.e., filtration/bioretenion facilities.
 - 2) Provide offsite volume control within the same LSWMP drainage subdistrict.
 - 3) Provide offsite volume control within the same LSWMP drainage district.
 - 4) Provide onsite NURP ponding.
4. Linear reconstruction projects shall capture and retain 1 inch over the net increase in impervious area or 0.5 inch from the new and reconstructed (as defined above) impervious surface area, whichever is greater.
 - a. Where the entire volume cannot be treated onsite, a reasonable attempt must be made to obtain additional right-of-way, easement, or other permission to treat stormwater during the planning phase. Volume reduction practices are not required if it is not cost-effective. In those cases, volume reduction must be maximized prior to discharge. A feasibility analysis shall be provided describing volume reduction methods that were investigated and why they were deemed not feasible.



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5. Infiltration practices are not allowed in the following areas.
 - a. Areas of predominantly Hydrologic Soil Group D soils
 - b. Areas where there is 3' or less of vertical separation from the bottom of the practice to the seasonally saturated soils or the top of bedrock
 - c. Areas that receive discharge from vehicle fueling and maintenance areas
 - d. Areas where a high level of contamination in the soil or groundwater may be mobilized
 - e. Areas where the infiltration rate exceeds 8.3 in/hr
 - f. Emergency response areas within a drinking water supply management area
 - g. Areas that receive stormwater runoff from areas that pose water contamination concerns, such as automobile scrapyards, waste recycling facilities, and hazardous water facilities, among others.
6. When designing for infiltration, the following requirements shall apply:
 - a. Infiltration rates shall be based on the least permeable soil layer as shown in soil borings within the proposed basin. As an alternative, percolation tests can be conducted at the proposed basin bottom with design infiltration rates of one-half the average test result.
 - b. The area required for infiltration is calculated using the above volume and rate with the inundation period not to exceed 48 hours. Vegetation shall be selected that tolerates the design inundation period. Wet pond areas below the NWL are not to be used in satisfying infiltration requirements unless a specific infiltration bench is designed, subject to City Engineer approval.
7. As an alternative to infiltration, a capture and reuse system may be used to satisfy volume reduction requirements, provided the systems meets the following requirements.
 - a. The system shall be privately owned and maintained. A stormwater facilities maintenance agreement including an operations and maintenance plan is provided.
 - b. Calculations demonstrating how the system will provide water reuse meeting the volume reduction requirements are provided (i.e. storage capacity, irrigation area, irrigation area, etc.)
 - c. System design include all piping, pumps, irrigation areas, and other schematics.
 - d. Water quality calculations shall not include the reuse system into the removal calculations.

5.3.2.7 MS4 Permit



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The City's NPDES MS4 Permit also contains stormwater management requirements in the following areas:

1. Site plan review.
2. Conditions for post-construction stormwater management.
3. Stormwater management limitations and exceptions.
4. Mitigation provisions.
5. Long-term maintenance of structural stormwater BMPs.

6.0 IMPLEMENTATION PLAN

6.1 GENERAL

The Implementation Plan section of the Chaska LSWMP describes those activities and programs the City might develop toward improving its surface water management system. This section also includes:

- An overview of the City's NPDES permit
- A discussion of operation and maintenance procedures and strategies.
- An outline of an education program.
- The storm sewer area charge.
- A section referencing applicable design standards for stormwater management.
- A section on Watershed implementation priorities.
- Implementation priorities for the City.
- A discussion of the process for amending this LSWMP and an annual report to council.

6.2 NPDES PERMIT

In 2003, the MPCA required the City to submit an NPDES Municipal Separate Storm Sewer System (MS4) Permit Application to minimize the discharge of stormwater runoff pollutants and authorize stormwater discharge from the City's MS4.

The City received initial MS4 Permit coverage in 2003, and a coverage renewal again in 2006. The current MS4 permit is now effective as of August 1, 2013. To comply with the new MS4 Permit, the City completed a Stormwater Pollution Prevention Program (SWPPP) Document and received an extension of MS4 Permit coverage on May 8, 2014.



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Chaska's approved SWPPP Document covers the following Minimum Control Measures:

- Public Education and Outreach.
- Public Participation/Involvement.
- Illicit Discharge Detection and Elimination.
- Construction Site Stormwater Runoff Control.
- Post-Construction Stormwater Management.
- Pollution Prevention/Good Housekeeping.

The BMPs listed in the SWPPP Document are a legally enforceable part of the Permit. The City must complete the tasks to remain authorized to discharge stormwater into waters of the state. The LSWMP Implementation Plan provides assistance and guidance for specific BMP implementation.

6.3 OPERATION AND MAINTENANCE

6.3.1 Activities

A stormwater system is a major investment for the City of Chaska – both in terms of initial capital cost and in terms of ongoing maintenance costs – with meeting ongoing maintenance costs being the City's current challenge. Typically, system maintenance is funded by the City's storm sewer area charge and through the general fund.

The City's stormwater system maintenance responsibilities include the following:

- Street sweeping.
- Cleaning of sump manholes and catch basins.
- Repair of catch basins and manholes.
- Assessing pipe condition (typically by televising).
- Inspection of storm sewer inlet and outlet structures.
- Pond mowing and other vegetation maintenance.
- Excavation of accumulated sediments from ponds.
- Inspection and repair of filtration, biofiltration, and infiltration features.

The City has maintained its pipe system for decades, and staff has a strong grasp on the costs associated with this. As new development and increasing requirements bring more ponds (and other BMPs) into the system, City staff will find that maintenance becomes an increasingly large portion of both staff time and



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maintenance budget. It is important to quantify the extent of this future commitment so that the funds necessary for pond maintenance activities can be collected via the City's stormwater funding.

The management of stormwater ponds is facilitated by creation of a GIS database for all stormwater system infrastructure. The City has mapped all storm sewers in the City as well as all ponds, outfalls, and structural stormwater BMPs that require inspection for the MS4 Permit. This infrastructure is shown on the system maps, included as Appendix G. Ultimately, via its stormwater management database, the City could reference – via interactive mapping – its maintenance records and maintenance costs for the stormwater system. A schedule of maintenance activities is being prepared by the City as part of its MS4 Permit implementation.

6.3.2 Stormwater Ponds

Stormwater ponds represent a sizable investment in the City's drainage system. General maintenance of these facilities helps ensure proper performance and reduces the need for major repairs. Periodic inspections are performed to identify possible problems in and around the pond. Inspection and maintenance cover the following:

- Pond outlets.
- Pond inlets.
- Side slopes.
- Illicit dumping and discharges.
- Sediment buildup.

Pond Outlets

A key issue with stormwater ponds is ensuring that the outlets perform at design capacity. Inspection and maintenance of pond outlets address the following:

- The area around outlets is kept free and clear of debris, litter, and heavy vegetation.
- Trash guards are installed and maintained over all outlets to prevent clogging of the downstream storm sewer.
- Trash guards are inspected at least once a year, typically in the spring, to remove debris that may clog the outlet. Problem areas are addressed more frequently, as required.
- Emergency overflow outlets are provided for all ponds when possible. These are kept clear of debris, equipment, and other materials and properly protected against erosion.

Pond Inlets

- Inspection and maintenance of pond inlets address the following:



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- Inlets are inspected for erosion.
- Where erosion occurs near an inlet, energy dissipaters or riprap are installed.
- Inlets are inspected for sediment deposits, which can form at the inlets due to poor erosion practices upstream.
- Where sediment deposits occur, these are removed to ensure design capacities of storm sewers entering the pond are maintained.

Side Slopes

- Inspection and maintenance of pond side slopes address the following:
- Side slopes are kept well vegetated to prevent erosion and sediment deposition into the pond. Severe erosion alongside slopes can reduce the quality of water discharging from the pond and require dredging of sediments from the pond.
- Noxious weeds are periodically removed from around ponds.
- Some ponds in highly developed areas require mowing. If mowing is performed, a buffer strip of 20 feet or more adjacent to the normal water level is typically maintained. This provides filtration of runoff and protects wildlife habitat.

Illicit Dumping and Discharges

Inspection and maintenance of illicit dumping and discharges into ponds address the following:

- Ponds are periodically inspected for evidence of illicit dumping or discharges. The most common of these is dumping of yard waste into the pond.
- Where found, illicit material is removed, and signs are posted as needed prohibiting the dumping of yard waste.
- Water surfaces are inspected for oil sheens. These can be present where waste motor oil is dumped into upstream storm sewers.
- Skimmer structures are installed as needed at outlet structures to prevent oil spills and other floatable material from being carried downstream.
- Skimmer structures are periodically inspected for damage, particularly from freeze-thaw cycles.

Sediment Buildup

Inspection and maintenance of sediment buildup in ponds address the following:



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- Ponds are inspected to determine if sediment buildup is causing significant loss of storage capacity from design levels. Excessive sediment buildup significantly reduces the stormwater treatment efficiency of water quality ponds.
- Sediment removal is performed where excessive sediment buildup has occurred. As a general guideline, ponds require dredging every 15 to 20 years. When effective forebays are provided, these may require more frequent cleaning (approximately 5 to 7 year cycles) but would tend to produce less material and would have the effect of extending the maintenance cycle of ponds to as much as 30 years.

6.3.3 Filtration/Biofiltration Features

Maintenance activities needed as necessary (check to see if feature is draining after storms, then perform activities as necessary):

- If filter bed is clogged or partially clogged, manual manipulation of the surface layer of sand may be required.
- Remove the top few inches of media, rototill or otherwise cultivate the surface, and replace media with like material meeting the design specifications.
- Replace any filter fabric that has become clogged.
- Ensure that contributing area, facility, inlets and outlets are clear of debris.
- Ensure that the contributing area is stabilized and mowed, with clippings removed.
- Remove trash and debris.
- Check to ensure that the filter surface is not clogging.
- Ensure that activities in the drainage area minimize oil/grease and sediment entry to the system.
- If permanent water level is present in pretreatment chamber (e.g., perimeter sand filter), ensure that the chamber does not leak, and normal pool level is retained.

Recommended annual activities:

- Check to see that the filter bed is clean of sediment, and the sediment chamber does not contain more than 6 inches of sediment. Remove sediment as necessary.
- Make sure that there is no evidence of deterioration, spalling, or cracking of concrete.
- Inspect grates (perimeter sand filter).
- Inspect inlets, outlets, and overflow spillway to ensure good condition and no evidence of erosion.
- Repair or replace any damaged structural parts.



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- Stabilize any eroded areas.
- Ensure that flow is not bypassing the facility.
- Ensure that no noticeable odors are detected outside the facility.
- Activities recommended every 3-5 years:
- Remove and replace the top 2-5 inches of media every 3 to 5 years for low sediment applications, more often for areas of high sediment yield or high oil and grease.

6.3.4 Sump Manholes and Sump Catch Basins

Sump manholes and sump catch basins are included in storm sewer systems to collect sediments before they are transported to downstream waterbodies. These structures keep sediments from degrading downstream waterbodies. Once sediments are transported to a lake or pond, they become much more expensive to remove.

Sediments originate primarily from road sanding operations, although construction activity and erosion can also contribute. Since these structures are designed to collect these sediments, they are routinely cleaned to provide capacity for future sedimentation. Suction vacuum equipment is typically used.

6.3.5 Storm Sewer Inlet Structures

To fully use storm sewer capacity, inlet structures are kept operational in order to get runoff into the system. All efforts are made to keep catch basins and inlet flared ends free of debris and sediments so as not to restrict inflow and cause flood damage. Leaf and lawn litter are the most frequent cause of inlet obstructions. On a routine basis, City staff visually inspects inlet structures to ensure they are operational.

6.3.6 Open Channels and Ravines

Overland flow routes constitute an important part of the surface water drainage system. Open channels are typically vegetated and occasionally lined with more substantial materials. The lined channels typically require little or no maintenance. Vegetated channels are periodically inspected and maintained, as high flows can create erosion within the channel.

Eroded channels can contribute to water quality problems in downstream waterbodies as the soil is continually swept away. If not maintained, the erosion of open channels would accelerate, and the repair would become increasingly more costly.

6.3.7 Piping System

The storm sewer piping system constitutes a multimillion-dollar investment for the City. The City performs a comprehensive maintenance program to maximize the life of the facilities and optimize capital expenditures. The following periodic inspection and maintenance procedures are followed:



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- Catch basin and manhole castings are inspected and are cleaned and replaced as necessary.
- Catch basin and manhole rings are inspected and are replaced and/or regouted as necessary.
- Catch basin and manhole structures are inspected and are repaired or replaced as needed. Pipe inverts, benches, steps (verifying integrity for safety), and walls are checked. Cracked, deteriorated, and spalled areas are grouted, patched, or replaced.
- Storm sewer piping is inspected either manually or by television to assess pipe condition. Items looked for include root damage, deteriorated joints, leaky joints, excessive spalling, and sediment buildup. The piping system is programmed for cleaning, repair, or replacement as needed to ensure the integrity of the system.

6.3.8 De-Icing Practices

The City receives approximately 54 inches of snow during a typical year. This requires a large amount of de-icing chemicals (primarily salt) to be applied to roads and sidewalks each winter.

Estimates indicate that 80 percent of the environmental damage caused from de-icing chemicals is a result of inadequate storage of the material (MPCA 1989). Improper storage as well as overuse of salt increases the risk of high chloride concentrations in runoff and groundwater. High chloride concentrations can be toxic to fish, wildlife, and vegetation.

Stockpiles of de-icing material and sand in the City are stored in a covered storage building or covered with polyethylene and placed on impervious surfaces. Runoff from stockpiles is managed to minimize the possibility of flowing directly into streams or wetlands where environmental damage can occur.

The City follows established snow and ice removal practices to address winter maintenance needs. Street conditions are assessed for each individual event, and ice control material application is adjusted accordingly. Equipment is maintained in good working order to place ice control material on roadways and is properly calibrated to prevent excessive application.

6.3.9 Street Sweeping

Street sweeping is an integral part of the City's effective surface water management system. It greatly reduces the volume of sediments that have to be cleaned out of sump structures and downstream waterbodies. The City sweeps streets three times each year (spring, summer, and fall). Spring sweeping begins either late March or early April after the risk of later snowfall has passed and targets sand left from winter sanding operations. Summer sweeping is focused where needed, typically the downtown area, Highway 41, and construction sites. Fall sweeping occurs after leaf fall.

The City does not allow residents to rake leaves into the street for municipal pickup. As an alternative, the City has a "cleanup day" where residents are encouraged to drop yard waste at a specific location for composting by the City. Carver County and the City also encourage residents toward composting their yard waste. If residents desire to have yard waste removed by their private hauler, then compostable bags or



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reusable containers are recommended. Alternately, there are composting sites within Carver County where yard waste can be brought for a fee. Overall, the City's approach to minimizing organic matter entering its stormwater system greatly reduces the incidence of inlet blockages and protects the water quality of downstream waterbodies.

The objective of the City's street sweeping and de-icing programs is to minimize impacts from leaf litter, sand, salt, and other debris on the surface waters of the City.

6.3.10 Detection of Illicit Connections

During routine inspection of inlet grates, outfalls, and other portions of the stormwater system, City staff also looks for evidence of illicit discharge, dry weather flow (indicating possible sanitary sewer connections), sedimentation, and other non-point source pollution problems.

The City has mapped its storm sewer outfalls and has started the process of integrating this mapping with inspection data. This effort is concurrent with the overall storm sewer mapping effort required by the City's NPDES permit.

6.4 EDUCATION

6.4.1 General

Education can play an important role in any effort to implement a stormwater management program like the one outlined in this LSWMP. The objectives of an education effort are different, depending on the target audience. In general, the target audience for this education program is City staff (including elected officials), City residents, and the development community. The City will work closely with the watershed management organizations to implement their common educational goals. The following sections describe why education of each of these groups is important and present educational methods that may be used for each audience.

6.4.2 City Staff

City staff have a wide range of responsibilities for implementing this LSWMP. These include:

- Implementing street sweeping and spill response programs.
- Maintaining stormwater pond performance and system operability.
- Planning for and management of projects to enhance pollutant removal performance, wetland quality, etc.
- Consideration of potential stormwater impacts associated with various land uses.
- Carrying out grounds maintenance of City-owned lands/facilities in a way that sets a good example for residents.
- Using BMPs in application of ice control material.



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- Application of BMP policies and regulations to new and redevelopment projects.
- Planning and delivering education programs.
- Working out cooperative arrangements with regulatory and non-regulatory organizations to achieve LSWMP objectives.
- Assisting the City Council and Planning Commission in understanding the intent and the application of the LSWMP policies.

Because these responsibilities involve many different levels of City staff and elected officials, training to have a basic understanding of the LSWMP includes:

- A description of the major stormwater management issues (including known stormwater management problem areas, stormwater management expectations for new and redevelopment projects, incorporation of stormwater mitigation into capital improvement projects, and regulatory jurisdictions).
- The objectives of the LSWMP and the general approach outlined in the LSWMP for resolution of these issues.
- The responsibilities of the different work units in implementing the LSWMP.
- The information that the LSWMP provides.
- Identification of in-house experts.

This information is disseminated in presentations at staff meetings, council meetings, planning commission meetings, coverage in internal newsletters, and issuance of internal memos.

Outside the City, other avenues for stormwater education include Project NEMO and Stormwater U, both run by the University of Minnesota. These programs provide stormwater education for staff and policymakers and include training on the development of policies and ordinances. Attendance at workshops and seminars such as the CCWMO Stormwater Workshop also provide stormwater information.

6.4.3 City Residents

In order to obtain the necessary political and economic support for successful LSWMP implementation, it is vital to inform City residents about basic stormwater management and water quality concepts, policies, and recommendations in the LSWMP, and the progress of stormwater management efforts.

Through its quarterly newsletter, the City keeps residents informed of stormwater and other environmental issues particularly regarding volunteer opportunities, proper lawn care practices, and recycling and hazardous waste management information. The City website is a clearinghouse for information on stormwater management and is periodically updated to provide relevant stormwater management articles.

As the City incorporates innovative stormwater management practices into both municipal and private development projects, it will use these projects to highlight the benefit of certain stormwater management



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practices. It is important that residents know about these projects (including how they were funded) so that they develop an awareness that the City is being responsive to the public interest in protecting high priority resources and that dedicated financial resources such as revenue from the stormwater utility are being put to good use.

6.4.4 Developers

The LSWMP is designed to provide the official policy direction that City staff and the City Council desire to guide stormwater mitigation for new and redevelopment projects.

The information contained within this LSWMP is disseminated to developers and their consulting engineers as early as possible in the development review process. In this way, developers know what is expected of them and can consider the requirements in their initial assessments of the site as well as incorporate the necessary BMPs in any subsequent designs.

While dissemination of information from this LSWMP is valuable, there is no substitute for a meeting between key City staff and the developer as early as possible in the review process. This helps define expectations for submittals, clarify regulatory compliance issues, and provide additional detailed guidance. Developers are encouraged to do this as soon as possible after they have reviewed the LSWMP information and thought about how it applies to their site.

6.5 STORMWATER FINANCING

The City uses a storm sewer area charge, water quality area charge, and stormwater utility for paying for the establishment, acquisition, construction, reconstruction, repair, replacement, depreciation, enlargement, and improvement of the total surface water drainage system. The area charge varies based on land use and has been split into three tiers:

1. Single Family Residential.
2. Medium Density Residential.
3. High Density Residential, Commercial, and Industrial.

The current area charge is summarized in Chapter 22 of the City Ordinances, Storm Drainage, included on the City website (www.chaskamn.com). The City reviews the charge rate and utility fees annually, especially as the City's maintenance and permit preparation responsibilities continue to grow.

6.6 DESIGN STANDARDS

Design standards for stormwater management pertain to design and analysis of the stormwater system. As typically conceived, they cover the following areas:

- Submittal Requirements.
- Erosion and Sediment Control.



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- Stormwater Conveyance.
- Stormwater Quantity.
- Stormwater Quality.
- Stormwater Abstraction.

Section 5 contains the design standards to be used for the City of Chaska. Design standards are also imbedded into the outline of the City's goals and policies in Section 3.

6.7 ORDINANCE IMPLEMENTATION

As part of the MS4 process, the City will review its Construction Site Runoff Ordinance that addresses both during (erosion control) and post-construction (stormwater management) conditions to see if modification of the ordinance is warranted. Section 14.4.4 of the Zoning Ordinance defines when grading permits are required. Otherwise, Chapter 22 of the City Ordinances, Storm Drainage, incorporates the standards and requirements included in the LSWMP in their entirety.

Illicit discharge requirements have been incorporated into Chapter 22 of the City Ordinances, Storm Drainage. They are intended to prohibit the following:

- Illicit connections from the sanitary sewer to the storm sewer.
- Dumping of listed chemicals into the stormwater system.
- Illegal dumping.

6.8 IMPLEMENTATION PRIORITIES

6.8.1 Carver County Watershed Management Organization

The City is committed to collaborating with Carver County on efforts to improve water resources within the City. Carver County's current stormwater-related implementation priorities can be found in the most recent version of their Water Management Plan, which can be found on the County's website (www.co.carver.mn.us). Implementation projects identified within that plan that may provide opportunities for collaboration include (project references and page numbers are from the CCWMO Water Management Plan):

1. **Urban Street Retrofits.** Collaborate with a city within the WMO to demonstrate an alternative street design for an existing downtown residential area. The alternative design would reduce impervious surfaces and add stormwater treatment for currently untreated areas (e.g., street bumpouts, rain gardens, etc.) and improve the quality of stormwater runoff reaching surface water resources in the CCWMO. (Project 8, Table 5-5, p. 5.21)



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2. **East Chaska Chain of Lakes Reclamation.** Implement methods to control carp populations and improve water quality in the East Chaska Creek Chain of Lakes. This chain includes Hazeltine, Big Woods, McKnight, Jonathan and Grace Lakes. (Project ID 25 & 27, Table 5-5, p. 5.24 & 5.25)
3. **Stream Restoration.** Restore stream reaches that have been altered by human activities to a more natural/stable state. The project(s) may involve a variety of restoration practices. The project(s) will help mitigate high volumes/flows that are degrading stream channels. (Project ID 5, Table 5-5, p. 5.20).
4. **Bank Stabilization.** Stabilize eroded and degraded streambanks to reduce erosion into streams. Projects will be prioritized that protect infrastructure and utilize natural armoring to stabilize banks. (Project ID 6, Table 5-5. P. 5.20).
5. **Wetland Restoration –** Collaborate with the City of Chaska, Laketown Township, and willing landowners to restore hydrology to priority wetlands. The project(s) would help the CCWMO meet its goal of improving the quantity and quality of wetlands in the watershed and increase flood storage in the watershed. (Project ID 16, Table 5-5, p. 5.22).

6.8.2 Lower Minnesota River Watershed District

The City is committed to collaborating with the LMRWD on efforts to improve water resources within the City. The LMRWD's current stormwater-related implementation priorities can be found in the most recent version of their Water Management Plan, which was updated earlier this year and can be found on the District's website (www.watershreddistrict.org). The City participated in the plan development as part of a Technical Advisory Committee. Capital Improvement Projects, Table E-2 of that plan, incorporates input from the City and identifies potential opportunities for collaboration.

6.8.3 City of Chaska

The City has identified implementation priorities in a number of specific areas, as described below.

1. **Priority Project Implementation Plan.** The City has prioritized projects that have been determined to have a water resource benefit. These are presented in Table 6-1. The criteria established for implementation priority are areas that: are actively eroding; discharge to MnDNR Protected Waters or Scientific and Natural Areas; or will provide another water quality benefit (e.g., rate/volume control, nutrient/sediment reduction, habitat preservation or restoration).
2. **Storm-related Damage.** Perform repair and restoration following stormwater-related damage to the system. In the recent past, this type of damage has included washed-out ponds and outlets, ravine and streambank failure, and flood damage to infrastructure and buildings.
3. **Stormwater System.** Maintain and improve the overall City stormwater system. Table 6-2 lists some specific stormwater system implementation priorities for the City. A tentative timetable is included with the table.



Table 6-1 Priority Project Implementation Plan

Project Name (LSWMP Name)	Project Description	LSWMP Drainage District	Watershed	Timeline	Cost
Lano Ravine	<p>The Lano Ravine east of TH212 and north of Chaska Boulevard (CR61). It discharges to a culvert under Chaska Boulevard, and runoff from that point is conveyed to Chaska Lake. It is uncertain when the ravine began eroding; however, erosion in recent years has been significant, resulting in a significant washout upstream of the culvert under Chaska Boulevard. TH212 was built in the Lano Ravine watershed around 2008 and increased the drainage area to the ravine from 26 to 116 acres.</p> <p>A study was completed in 2018 which assessed the existing conditions of the ravine and the hydrologic changes within the watershed area as a result of the TH212 improvements and identified seven restoration options, three of which were recommended for more in-depth review and design. Study results concluded that increased duration of runoff, combined with saturated, sandy soils, likely has led to the increase in erosion that has been observed. Additional review and follow-up field investigation indicated that erosion continues to migrate towards Chaska Boulevard, and at some point may threaten the stability of the roadway.</p>	CL	CCWMO	2023-2024	\$1,300,000-1,650,000
Beise Ravine (LCC-R1)	<p>Land use in the 98 acres of area that drain to this ravine, which ultimately discharges to Chaska Creek, is in the process of being developed. Much of the ravine bottom contains large natural fieldstone that has created a stable bottom. The erosion occurring in the ravine is resulting from concentrated flows eroding the toe of slope, causing slope failure. In the areas without a rock bottom and within the steeper segments, there is head-cutting, lowering the stream bottom and causing erosion at the toe of slope and side slope failure.</p> <p>Stormwater management practices have been implemented in the upstream residential development and will reduce peak flows to the ravine. As a result, we anticipate the currently stable sections of the Beise channel will remain so, and the restoration approach should focus on the unstable segments rather than the entire ravine.</p> <p>The total length of the ravine is 3,000 linear feet; however, the entire ravine does not require stabilization. For the construction and professional services, we estimate that 60% of the ravine (1,800 LF) will require improvements.</p>	LCC	CCWMO	2028-2029	\$650,000
Lake Grace – West Ravine	<p>An eroding ravine is located along the western shoreline of Lake Grace, a nutrient impaired lake. The upstream portions of the ravine receive runoff from Edgewater Townhomes to the north and a stormwater retention pond to the south. The ravine falls 50 vertical feet over its 800-foot length before flowing into Lake Grace. A ravine study will first be conducted. The study will determine the causes of erosion, estimate the sediment contribution from the ravine, develop stabilization options, and provide a cost range for the alternatives and a cost estimate for the chosen option.</p>	UEC	CCWMO	2030	\$75,000



Table 6-1 Priority Project Implementation Plan

Project Name (LSWMP Name)	Project Description	LSWMP Drainage District	Watershed	Timeline	Cost
Seminary Fen Ravine C-2 Study and Restoration	This 800-foot ravine is within bluffs located north of the Fen and is highly prone to erosion due to sandy soils, groundwater discharges, naturally steep slopes, and surface water flows. A ravine assessment will be conducted. The ravine assessment will determine the causes of erosion, estimate the sediment contribution to the Fen from the ravine, develop stabilization options, and provide cost estimates for a potential restoration project. Project design and restoration will follow recommendations of the assessment.	CH	LMRWD	2020-2022	\$60,000
Seminary Fen Ravine C-3 Study and Restoration	This ravine is in the bluffs located north of the Fen and is highly prone to erosion due to sandy soils, groundwater discharges, naturally steep slopes, and surface water flows. A ravine assessment will be conducted. The ravine assessment will determine the causes of erosion, estimate the sediment contribution to the Fen from the ravine, develop stabilization options, and provide cost estimates for a potential restoration project. Project design and restoration will follow recommendations of the assessment.	CH	LMRWD	2023-2025	\$60,000
Seminary Fen Wetland Area A and B Wetland Restoration	<p>The Seminary Fen is a 600-acre calcareous fen wetland complex. It is one of the rarest types of wetlands in the US. It is characterized by a substrate of peat and a constant supply of upwelling groundwater from bedrock aquifers of cold, oxygen-poor groundwater that is rich in calcium and magnesium bicarbonates. The Fen supports dozens of rare, threatened, and special concern plant and animal species and is one of the Twin Cities Metropolitan Area's last known naturally-reproducing trout streams. It is one of the most significant natural areas in the metro area and is part of the MnDNR Scientific and Natural Areas program.</p> <p>Historic ditching partially drains portions of the wetland. The project will restore the hydrology and vegetation to 21 acres of wetland as part of this project. The cost estimate includes survey, design, construction and vegetative restoration and vegetative maintenance for 5 years. The City may want to consider doing this project as a wetland bank and obtaining the resulting wetland credit. The cost estimate to do the project as a wetland bank has been included.</p>	CH	LMRWD	2026-2027	\$500,000
East Chaska Creek Ravine (EC-R2 tributary)	A tributary ravine, approximately 4,600 feet in length, to East Chaska Creek (EC-R2) is unstable and eroding. Stormwater discharge from development to the north and east contributes significant flows during large storm events. Stormwater BMPs would be beneficial to control runoff rate and volume. A desktop analysis will be performed to provide the initial assessment and ranking of all the stream segments. Following the initial ranking, up to five sites will be further assessed in the field, and cost estimates of proposed improvements will be developed.	EC	CCWMO	2027-2028	\$40,000



Table 6-1 Priority Project Implementation Plan

Project Name (LSWMP Name)	Project Description	LSWMP Drainage District	Watershed	Timeline	Cost
Liberty Heights Ravine (LCC-R4)	<p>The ravine, approximately 1,700 feet in length, is a tributary of Chaska Creek in the Liberty Heights development that includes two branches that combine into one drainageway before reaching the creek. A portion of the drainage area is treated via ponding; however, portions of the area remain untreated. Downstream of where the channels combine, a 36-inch storm sewer discharges to the channel. Downstream of this discharge, there are a number of isolated erosion sites that have resulted primarily from toe erosion causing slope failure along outside bends of the channel. At the time of the inventory, there was only one area that appeared to have an unstable bottom that potentially would require a rock riffle or drop to stabilize.</p> <p>Most of the stream channel would benefit from reestablishment and protection of the toe of slope on the eroding outside bends of the channel. The woods and steep slopes make access to the eroding sites difficult without disturbance to the portions of the channel that do not require stabilization. A ravine study will be completed. The ravine study will determine the causes of erosion, estimate the sediment contribution from the ravine, develop stabilization options, and provide cost estimates for a potential restoration project. Project design and restoration will follow recommendations of the assessment.</p>	LCC	CCWMO	2029	\$75,000
Chaska Creek Bluff Stabilization	Bluffs and steep slopes along the east side of Chaska Creek are comprised of sandy soils and are prone to erosion. A desktop analysis will be performed to provide the initial assessment and ranking of all the stream segments. Following the initial ranking, up to five sites will be further assessed in the field, and cost estimates of proposed improvements will be developed.	LCC	CCWMO	2030	\$40,000
CL-R1 Ravine	An unstable ravine section drains to Chaska Creek in Subdistrict CL-5.1. A ravine study will be conducted. The ravine study will determine the causes of erosion, estimate the sediment contribution from the ravine, develop stabilization options, and provide cost estimates for a potential restoration project. Project design and restoration will follow recommendation of the assessment.	HS	CCWMO	2023-2024	\$75,000
East Chaska Creek Tributary	There are several culverts at public trail stream crossings where streambank instability and erosion are present both upstream and downstream of the culvert crossings. The culverts pose additional concerns as restriction points during high flows that are prone to blockage with debris, which can increase flood concern to upstream areas. The project(s) propose to remove three culverts and replace them with bridges, along with streambank restoration to stabilize eroding sections. These projects are typically constructed by the Chaska Public Works Department. So, the cost estimate assumes this is a design-build project and a standard bid package is not necessary. The cost per site will increase if this is not a design-build project, and bid/quote plans need to be developed.	EC	CCWMO	2023-2024	\$120,000
Harvest West Ravine	Opportunities for stabilization efforts in an unstable 1,000-foot ravine that is tributary to Chaska Creek are possible in conjunction with the upcoming residential development within the watershed. Stormwater runoff rate control requirements for the housing development will be beneficial. A ravine study will also be completed. The ravine study will determine the causes of erosion, estimate the sediment contribution to the downstream waterbodies from the ravine, develop stabilization options, and provide cost estimates for a potential restoration project. Project design and restoration will follow recommendations of the assessment.	LCC	CCWMO	2021-2022	\$60,000



Table 6-1 Priority Project Implementation Plan

Project Name (LSWMP Name)	Project Description	LSWMP Drainage District	Watershed	Timeline	Cost
Other Creek and Ravine Restoration Opportunities	<p>Due to the unique geology and topography within the City of Chaska, there are many creeks and ravines in the City that have not been inventoried or identified on the priority project list. Only a select number of creeks and ravines that are actively eroding and discharge to MN DNR Protected Waters, Scientific and Natural Areas, or other priority resources have been identified and specifically identified for restoration and stabilization potential.</p> <p>As City development progresses, and additional information becomes apparent, additional creek and ravine restoration and stabilization opportunities may arise which have a high priority ranking.</p> <p>A desktop analysis will be performed to provide the initial assessment and ranking of all the stream segments. Following the initial ranking, up to five sites will be further assessed in the field, and cost estimates of proposed improvements will be developed.</p>	All Areas	CCWMO/LMRWD	2020-2040	\$50,000
Wetland Restoration/Enhancement Opportunities	<p>Wetland restoration/enhancement sites were identified during the field inventory and are located on the Water Resource Map and described in Appendix D. Typically, wetlands that were identified for restoration/enhancement had either a hydrologic impact that could easily be rectified or a plant community that was of Exceptional to High quality. The areas with Exceptional to High quality native plant populations could, with some minor management, have their ecological integrity enhanced and exotic species minimized. Wetlands with high restoration potential are described in Appendix D. Priority wetland restoration sites are those that involve hydrologic restoration and may provide other benefits such as reducing flows to receiving waters, improving corridor connections, and providing valuable habitat if restored. A concept plan and cost estimate for up to eight of the top sites will be prepared.</p>	All	CCWMO	2020-2040	\$150,000
Untreated/Undertreated Stormwater Retrofits	<p>There are several areas within the City where stormwater is either untreated or untreated to current design standards prior to discharge. Areas that discharge to lakes impaired for excessive nutrients (Hazeltine, Jonathan, Grace, and McKnight) have a high priority for these types of projects. Opportunities to retrofit/install stormwater BMPs that will result in additional nutrient and sediment removal in area should be investigated. An assessment will be performed that ranks potential retrofits based on estimated cost and pollutant removal.</p>	UEC	CCWMO	2020-2040	\$50,000
Upper East Creek Stream Restoration (Upstream from Big Woods Lake)	<p>East Chaska Creek, upstream from Big Woods Lake, poses an opportunity for culvert removal and stream restoration near Lyman Boulevard in conjunction with 82nd Street Reconstruction. Additional benefits within this drainage area include stormwater rate control and volume reduction and erosion repair around convert outlets. Initial work would involve a study to evaluate existing conditions and develop rate control, water quality, and stream restoration options.</p>	EC	CCWMO	2022-2024	\$50,000
82 nd Street Water Quality Improvement Opportunities	<p>As Carver County plans for the reconstruction of 82nd street, opportunities may arise for projects that have a water quality benefit in conjunction with road reconstruction. Projects that would benefit this drainage area include wetland restoration, stream restoration, nutrient reduction projects, and stormwater volume control project. Initial work would involve a study to evaluate existing conditions and develop water quality and wetland improvement options.</p>	UEC	CCWMO	2021-2022	\$50,000



Table 6-2 City Stormwater System Implementation Priorities

Implementation Priority	Total	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
O&M ¹	\$1,597,700	\$134,000	\$137,200	\$140,500	\$148,000	\$152,000	\$160,000	\$168,000	\$178,000	\$185,000	\$195,000
City CIP ²	3,360,000	330,000	300,000	200,000	400,000	400,000	400,000	250,000	280,000	350,000	450,000
Pumping stations at levee ³	705,000	37,000	166,000	35,000	33,000	48,000	56,000	100,000	65,000	75,000	90,000
Total	\$5,662,700	\$501,000	\$603,200	\$375,500	\$581,000	\$600,000	\$616,000	\$518,000	\$523,000	\$610,000	\$735,000

¹ Based on past practices, the City routinely budgets \$134,000 per year for annual operations and maintenance of the stormwater system. That amount is increased every year to keep pace with inflation.

² The City budgets a base line of \$200,000 for system upgrades and pond maintenance. Amounts above that amount account for City or partnership projects consistent with plan goals and objectives.

³ Levee expenditures cover basic maintenance activities.



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4. **Lake Preservation.** Protect and restore the quality of lakes in the City. Section 4.8.1 identifies specific lake needs.
5. **Creek and Ravine Restoration.** Protect and restore the creeks and eroding ravines in the City. Section 4.7 and Table 6-1 identify some specific creek and ravine restoration priorities. These sites are shown on Map 2, Water Resource Map.
6. **Wetland Restoration.** Protect and restore wetlands in the City. Section 4.5 and Tables 4-4, 4-5, and 4-6 present wetland protection standards and priorities. Some specific wetland restoration/enhancement sites are shown on Map 2, Water Resource Map, and included in Table 6-1. Wetlands with high restoration potential are described in Appendix D.
7. **Natural Community Restoration.** Protect and restore the natural communities in the City. Section 4.6 and Table 4-7 and 4-8 identify some specific natural community restoration priorities. These sites are shown on Map 3, Natural Areas and Rare Features Map.

6.9 OFFICIAL CONTROLS

Implementation items include ordinances as well as projects. One of the requirements of local plans is that they outline official controls, lines of responsibility, and mechanisms for enforcement in certain areas. Table 6-2 shows how existing controls and future implementation items address the need for these official controls.

Table 6-3 Official Controls

Official Control	Responsibility	Mechanism
Wetlands	City as LGU, COE, RPBCWD, TEP Members: Carver SWCD, CCWMO, BWSR, MnDNR	WCA review. Implementation of buffers and setbacks. The City is also considering a wetland ordinance for enforcement of buffers and setbacks.
Erosion Control*	Carver SWCD, RPBCWD	Sections 32S and 33 of the County's Zoning and Subdivision Ordinances, respectively.
Shoreland	City, LMRWD, RPBCWD, MnDNR	Section 6 of the Zoning Ordinance, Shoreland Management.
Floodplain	City, LMRWD, RPBCWD, MnDNR	Section 5 of the Zoning Ordinance, Flood Protection.
Grading and Drainage	City, RPBCWD, CCWMO	Chapter 22 of the City Ordinances, Storm Drainage. Site review – application of the requirements of this LSWMP.

*Carver County rules are enforced by the Carver SWCD.



6.10 AMENDMENT PROCEDURES

The Chaska LSWMP will be incorporated into the City's 2040 Comprehensive Plan update and will be applicable until 2028, at which time an updated plan will be required. This timeline marks a change from previous updates; previously, Local Surface Water Management Plan updates were done when the water districts or water management organizations updated their Watershed Management Plans. Periodic amendments may be required to incorporate changes in local practices. Changes to the local watershed management plans may necessitate revisions to this plan. Plan amendments will be incorporated by following the review and adoption steps outlined below.

Request for Amendment

Written request for plan amendment is submitted to City staff. The request shall outline the need for the amendment as well as additional materials that the City will need to consider before making its decision. The amendment process may also be initiated by staff; in fact, this is the more common method.

Staff Review of Amendment

A decision is made as to the validity of the request. Three options exist: 1) reject the amendment, 2) accept the amendment as a minor issue, with minor issues collectively added to the LSWMP at a later date, or 3) accept the amendment as a major issue, with major issues requiring an immediate amendment.

In acting on an amendment request, City staff shall recommend to City Council whether or not a public hearing is warranted. Major amendments to the LSWMP will have to be submitted to the watershed management organizations for review and approval prior to formal action by the council. Minor amendments should also be submitted to WMOs for review and to determine compatibility with their watershed plans.

Council Consideration

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

Public Hearing and Council

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

Council Adoption

Final action on an amendment is City Council adoption. However, prior to the adoption, an additional public hearing could be held to review the LSWMP changes and notify the appropriate stakeholders.



6.11 ANNUAL REPORT TO COUNCIL

A brief annual report will be made by City staff during the capital improvement planning process summarizing development changes, capital improvements, and other water management-related issues that have occurred over the past year. The review will also include an update on available funding sources for water resource issues. Grant programs are especially important to review since they may change annually. These changes do not necessarily require individual amendments.

The City's LSWMP will remain in effect through 2024. The City will then review the LSWMP for consistency with current water resource management methods. At that time, all annual reports and past amendments will be added to the document. Depending on the significance of changes, a new printing of the LSWMP may be appropriate.



7.0 SUMMARY AND OUTCOMES

7.1 SUMMARY

The Chaska LSWMP will serve as a comprehensive planning document to guide the City in conserving, protecting, and managing its surface water resources. The LSWMP meets requirements as established in Minnesota Rules 8410. In addition, the LSWMP reflects the requirements of the watershed management organizations with jurisdiction within the City.

The LSWMP has its own particular emphasis, which includes:

- Collecting and compiling the efforts of agencies and organizations including the City, its departments, and residents. This includes past reports and studies, management plans, monitoring studies, as well as completed and proposed improvement projects.
- Reviewing the current state of the City's surface water resources in the context of goals and policies, ordinances, operations and maintenance, water quality, and flood mitigation.
- Establishing reasonable, achievable, and affordable goals, and supporting them with a strong regulatory and management culture. Developing an implementation plan that includes projects and processes that derive from a thorough assessment of current City problem areas and current City surface water regulations and controls.
- Ensuring compliance with the NPDES Phase II MS4 permit and SWPPP.
- Supporting the City's stormwater utility by outlining an implementation plan.
- Providing a wetland map that reflects current conditions and is geographically accurate.

The review of the City's surface water resources begins with an evaluation of its surface water management goals and policies. Section 3 of the LSWMP provides the City's current goals and policies to achieve these goals. Some new policies have been developed to reflect the changing regulatory climate while other new policies have been developed to simply improve the City's management strategy.

The LSWMP also includes a water and natural resource inventory, assessment, and management plan. The goal of the inventory is to identify water and natural resources that currently exist within the City. A GIS-based wetland map has been developed for the City to use as a planning tool for future projects that may affect wetlands. The inventory of wetlands and natural communities allows the City to set up priority areas within City-owned lands and provide proper levels of natural resource protection during development.

The inventory and management discussions of this section of the LSWMP are intended to provide the following benefits:

- Provide a more detailed inventory of wetlands and water resources than that provided by the National Wetlands Inventory.



LOCAL SURFACE WATER MANAGEMENT PLAN

Summary and Outcomes

April 2020, updated January 2024

- Enhance wildlife values of natural areas by facilitating restoration projects.
- Provide and enhance recreational values of natural areas.
- Designate wetland and natural community restoration/enhancement opportunities.
- Protect wetlands and natural communities that provide valuable ecological support.
- Provide stormwater protection for wetlands.

It should be noted that this inventory has been created for planning purposes only. Regulation of activities potentially affecting individual wetlands will be based on a site-specific delineation of the wetland boundary as part of a proposed project.

A creek and ravine assessment has been included in the LSWMP. The goal is to provide an evaluation of creeks and ravines within the City and recommendations for restoration of these surface water resources.

The surface water system assessment catalogues the various assessments of problems that the LSWMP must address. The intent is to identify the source of problems and specific actions the City will take to address these problems either independently or in collaboration with some other organization – most commonly one of the watershed management organizations.

The system design portion of this section describes the City's surface water management system. This system is shown on the system maps, included as Appendix G. The maps indicate drainage divides, storage areas, conveyance (including pipes and channels), wetlands, and lakes that have been incorporated into the Chaska LSWMP hydrologic model.

Finally, this LSWMP develops implementation priorities for the City. The Implementation Plan section of the Chaska LSWMP describes those activities and programs the City might develop toward improving its surface water management program. Section 6 also includes:

- An overview of the City's NPDES permit.
- A discussion of operation and maintenance procedures and strategies.
- An outline of an education program.
- A discussion of the storm sewer area charge.
- A section referencing applicable design standards for stormwater management.
- A section on Watershed implementation priorities.
- Implementation priorities for the City.
- A discussion of the process for amending this LSWMP and an annual report to council.



LOCAL SURFACE WATER MANAGEMENT PLAN

Summary and Outcomes

April 2020, updated January 2024

7.2 OUTCOMES

The LSWMP, once adopted by the City Council, will accomplish the following:

1. Bring the City into statutory compliance and compliance with watershed management organization plans.
2. Set forth an implementation schedule for ordinance, waterbody assessment, restoration, education, and improvement projects.
3. Enhance current review procedures to ensure all new development or redevelopment within the City complies with the grading and stormwater management controls determined by this LSWMP.
4. Provide justification for potential future increases in stormwater funding.



APPENDICES

APPENDIX A – WATERSHED SUBDISTRICT AREAS

**APPENDIX A
WATERSHED SUBDISTRICT AREAS**

SUBDISTRICT	ACREAGE
CARVER DISTRICT	
CA-2	49.0
CA-3	13.1
CA-5	9.5
CA-6	3.7
CA-7	24.9
CA-10.1	11.3
CA-10.2	9.9
SUBTOTAL	121.4

SUBDISTRICT	ACREAGE
CHASKA CREEK DISTRICT	
CC-1	415.8
CC-2	899.6
CC-3	184.1
CC-4	61.9
CC-5.2	141.8
CC-5.3	26.3
CC-6.0	19.0
CC-6.1	10.3
CC-6.2	12.8
CC-7.0	4.2
CC-7.1	18.1
CC-7.2	18.8
CC-8	16.7
CC-9	14.1
CC-12	10.4
CC-12.1a	16.3
CC-12.1b	25.8
CC-13	1.9
CC-14a	33.2
CC-14a.1	40.8
CC-14a.2	36.4
CC-14a.3	15.1
CC-14b	20.8
CC-14b.1	11.2
CC-14b.2	29.1
CC-14c	17.5
CC-16	2.4
CC-16.1	7.3
CC-17	248.6
CC-17.1a	30.5
CC-17.1b	1.7
CC-17.2	13.7
CC-29.1	2.7
CC-29.1.1	13.9
CC-29.1.2	93.0
CC-29.2	2.8
CC-29.2.1	12.5
CC-29.2.3	19.0
CC-33.1	154.0
CC-34	9.5
CC-35	10.6
CC-35.1	9.5
CC-36.1	20.2
CC-38	124.9
CC-76.1a	13.8
CC-76.1b	0.5
CC-76.1c	5.4
CC-76.2a	9.6
CC-76.2b	8.4
CC-76a	18.9
CC-76b	9.8
CC-76c	4.3
SUBTOTAL	2,949.3

SUBDISTRICT	ACREAGE
CHANHASSEN DISTRICT	
CH-1.1	7.2
CH-1.2	1.5
CH-1.3	43.4
CH-1.20.3	2.3
CH-2	77.0
CH-2.1	2.0
CH-6	10.5
CH-6.1	8.0
CH-6.2	7.8
CH-7	36.0
CH-7.1	4.6
CH-8	10.9
CH-8.1	8.4
CH-8.2	11.1
CH-8.3	17.4
CH-10	46.6
CH-10.1	15.1
CH-11.1	123.0
CH-11.2	8.2
CH-11.3a	11.3
CH-13	30.1
CH-13.1	39.2
CH-16	8.6
CH-18	9.5
SEMINARY FEN	385.6
SUBTOTAL	925.5

SUBDISTRICT	ACREAGE
CHASKA LAKE DISTRICT	
CHASKA LAKE	316.6
CL-1.1	47.0
CL-1.2	16.0
CL-4	9.6
CL-5.1	92.5
CL-5.2	7.2
CL-5.3	0.0
CL-5.4	6.6
CL-6	3.5
CL-7	17.0
CL-9	29.5
SUBTOTAL	545.5

SUBDISTRICT	ACREAGE
HICKORY STREET DISTRICT	
HS-3	16.3
HS-8	75.7
HS-8.2	5.1
HS-9	19.2
HS-11	11.0
HS-13	58.8
HS-16.1	3.6
HS-18.1	5.6
HS-18.2	73.8
HS-19	8.5
HS-20.1	15.9
HS-20.2	26.5
SUBTOTAL	320.0

SUBDISTRICT	ACREAGE
MINNESOTA RIVER DISTRICT	
MN-1	439.3
MN-1a	23.4
MN-1b	18.0
MN-1c	43.3
MN-1d	1.2
MN-1e	0.9
SUBTOTAL	526.1

SUBDISTRICT	ACREAGE
LOWER CHASKA CREEK DISTRICT	
FIREMENS LAKE	50.1
LCC-1	5.4
LCC-1.1	57.4
LCC-1.2a	24.3
LCC-1.2b	4.4
LCC-1.3	27.6
LCC-1.4	24.8
LCC-1.5	98.0
LCC-1.6	48.0
LCC-1.7	187.5
LCC-1.7a	53.1
LCC-1.8	14.1
LCC-1.8a	30.0
LCC-1.8b	15.0
LCC-1.8c	17.0
LCC-1.9	71.0
LCC-1.10	52.6
LCC-4.1	11.4
LCC-7.0	6.6
LCC-7.1	54.8
LCC-7.2	22.6
LCC-15.1	18.4
LCC-15.2	6.5
LCC-21	10.4
LCC-22	11.7
LCC-25	30.9
LCC-32.1	5.7
LCC-32.2	6.1
LCC-33	7.4
LCC-34.2	46.8
LCC-41	12.6
SUBTOTAL	1,032.2

SUBDISTRICT	ACREAGE
SOUTH CHASKA CREEK DISTRICT	
SCC-1.1	532.9
SCC-1.2	266.9
SCC-2	800.9
SCC-4	718.6
SCC-5	375.6
SCC-6	520.7
SCC-7	414.3
SCC-8	656.4
SCC-9a	150.4
SCC-9b	341.2
SCC-11	30.2
SCC-12.1	128.5
SCC-12.2	48.9
SCC-12.3	0.0
SCC-13	36.6
SCC-14	12.0
SCC-15	17.5
SCC-16	19.7
SCC-18	13.3
SCC-19	86.8
SCC-20	12.2
SCC-22.1.1	1.6
SCC-22.1.2	4.0
SCC-22.2.1	25.8
SCC-22.2.2	18.6
SCC-22.2.3	7.8
SCC-22.2.4	2.3
SCC-24	175.0
SUBTOTAL	5,418.7

**APPENDIX A
WATERSHED SUBDISTRICT AREAS**

SUBDISTRICT	ACREAGE
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EAST CREEK DISTRICT	
CLAYHOLE LAKE	44.5
COURTHOUSE LAKE	18.7
EC-1.1	53.4
EC-1.1a	55.6
EC-1.1b	80.3
EC-1.1c	2.8
EC-1.3	6.9
EC-1.4	5.9
EC-1.5	32.6
EC-1.6	64.0
EC-1.7	12.3
EC-1.8	47.9
EC-1.9	10.4
EC-1.10	6.0
EC-1.11	0.7
EC-1.12	1.9
EC-1.13	0.9
EC-1.14	20.2
EC-1.16	15.4
EC-1.17	312.2
EC-1.18	49.8
EC-1.19	7.4
EC-1.20.1	66.5
EC-1.20.2	8.9
EC-1.21	11.4
EC-1.22	11.8
EC-1.23	0.6
EC-1.24	373.4
EC-1.24.1	7.0
EC-1.24.1a	7.0
EC-1.26	8.4
EC-1.29	18.1
EC-1.29.1	1.5
EC-1.29.2	10.5
EC-1.29.3	7.9
EC-1.29.4	9.3
EC-1.30	6.7
EC-1.31	18.5
EC-1.33	12.3
EC-1.34	4.4
EC-1.35	3.0
EC-1.36	41.3
EC-1.36.1	23.3
EC-1.37	11.2
EC-1.38	2.9
EC-1.39	19.6
EC-1.40	21.7
EC-1.41	0.7
EC-1.42	42.2
EC-1.43a	4.1
EC-1.43b	10.6
EC-1.43c	269.5
EC-1.43d	13.4
EC-1.44a	8.0
EC-1.44b	2.7
EC-1.45	10.8
EC-1.46	29.1
EC-1.47	30.5
EC-1.48	11.8
EC-1.49/1.50	32.7
EC-1.52	15.2
EC-1.53	2.7
EC-1.54	5.8
EC-2.4	66.8

SUBDISTRICT	ACREAGE
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EAST CREEK DISTRICT (CONT'D)	
EC-2.5	11.6
EC-2.6	14.2
EC-2.7	4.3
EC-2.8	19.1
EC-2.9	4.7
EC-3.2	96.8
EC-3.3	7.0
EC-13.1	3.6
EC-50	29.1
EC-50.1	12.7
EC-50.2	14.2
EC-51	24.0
EC-52	36.9
EC-52.1	2.2
EC-52.2	43.7
EC-52.3	6.2
EC-52.4	33.0
EC-53	46.9
EC-53.1	20.8
EC-53.2	12.0
EC-53.3	30.9
EC-53.4	0.5
EC-55a	14.6
EC-55a.1	9.5
EC-55b	5.8
EC-56.1	8.2
EC-56.2	27.7
EC-56a	21.8
EC-56b	46.5
EC-57	177.2
EC-57.1	15.9
EC-57.2	2.4
EC-57.3	4.1
EC-57.4	5.5
EC-57.5	17.1
EC-59	7.0
EC-61	18.0
EC-62	80.2
EC-62.1	7.0
EC-62.2	29.6
EC-62.2.1	26.0
EC-62.3	15.5
EC-62.4	8.4
EC-62.5	5.0
EC-62.6	77.0
EC-62.7	0.5
EC-62a	64.1
EC-65	48.9
EC-67a	19.3
EC-67a.1	21.0
EC-67a.2	19.8
EC-67a.3	5.9
EC-67a.3.1	3.9
EC-67a.3.2	6.2
EC-67a.4	36.5
EC-68	12.6
EC-68.1	13.0
EC-68.2	19.6
EC-69	11.3
EC-71	6.4
EC-72	65.2
EC-73	56.9
EC-74	8.4
EC-74.1	27.0

SUBDISTRICT	ACREAGE
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EAST CREEK DISTRICT (CONT'D)	
EC-74.2	10.1
EC-74.3	14.6
EC-74.4	5.9
EC-75.1	8.9
EC-75.2	27.1
EC-75a	54.2
EC-75b	2.5
EC-76a	8.5
EC-76b	11.7
EC-77	9.5
EC-77.1	13.3
EC-77.2	2.1
EC-77.3	3.3
EC-80	7.2
EC-81	28.2
SUBTOTAL	3,871.7

**APPENDIX A
WATERSHED SUBDISTRICT AREAS**

SUBDISTRICT	ACREAGE
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UPPER EAST CREEK DISTRICT

HAZELTINE LAKE	315.7
LAKE BAVARIA	304.3
LAKE GRACE	100.9
LAKE JONATHAN	98.9
MCKNIGHT LAKE	133.3
MILL POND	15.2
UEC-1	37.6
UEC-1.51	7.1
UEC-2.1	11.2
UEC-2.2	13.2
UEC-2.3	3.8
UEC-3	19.8
UEC-3.1	11.3
UEC-3b	43.3
UEC-4	6.5
UEC-5	21.6
UEC-6	16.8
UEC-6.1	6.3
UEC-6.2	7.6
UEC-8	19.5
UEC-8.1	24.8
UEC-10	19.6
UEC-10.1	16.4
UEC-10.1.1	9.0
UEC-10.2	0.7
UEC-10.3	22.1
UEC-10.3.1	2.9
UEC-10.3.2	4.5
UEC-10.3.3	3.2
UEC-10.3.4	16.0
UEC-10.4	8.2
UEC-10.5	3.2
UEC-10.6	26.8
UEC-10.7	13.2
UEC-10.9	4.2
UEC-10.10	5.7
UEC-10.11	13.2
UEC-10.12	8.2
UEC-10.13	5.6
UEC-10.14	1.7
UEC-11	17.2
UEC-11.1	17.9
UEC-11.2	11.0
UEC-12a	3.6
UEC-12b	2.4
UEC-13	9.2
UEC-13.2	6.9
UEC-13.3	12.0
UEC-13.4	3.8
UEC-14	5.0
UEC-14.1	5.9
UEC-14.2	2.6
UEC-15	23.1
UEC-16	87.0
UEC-16.1	40.3
UEC-16.2	16.7
UEC-16.3	6.0
UEC-16.4	32.7
UEC-16.5	31.6
UEC-16.5.1	7.0
UEC-16.6	7.8
UEC-16a	25.2
UEC-17	5.1
UEC-18	69.0

SUBDISTRICT	ACREAGE
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UPPER EAST CREEK DISTRICT (CONT'D)

UEC-19	41.9
UEC-20	116.5
UEC20.1	23.1
UEC-21	190.4
UEC-22	21.1
UEC-23	175.1
UEC-23.1	23.2
UEC-23.2	0.1
UEC-26	114.8
UEC-28	78.4
UEC-30	88.4
UEC-32	0.1
UEC-33	25.8
UEC-34	27.4
UEC-35	16.1
UEC-35.1	4.2
UEC-35.10	8.2
UEC-35.11	8.8
UEC-35.2	13.1
UEC-35.3	5.9
UEC-35.4	2.1
UEC-35.5	10.6
UEC-35.6a	6.7
UEC-35.6b	3.3
UEC-35.6c	51.2
UEC-35.7	4.4
UEC-35.7b	8.4
UEC-35.8	41.1
UEC-35.9	4.6
UEC-37	65.6
UEC-37.1	2.4
UEC-38	31.1
UEC-41	61.6
UEC-43	11.2
UEC-43.1	0.6
UEC-43.2	0.2
UEC-47	148.2
UEC-47.1	9.1
UEC-48	53.1
UEC-48.1	9.2
UEC-48.2	5.0
UEC-49.1	4.9
UEC-49.2	4.4
UEC-49.3	11.4
UEC-49.4	7.9
UEC-49.5	44.0
UEC-49.5.4	22.8
UEC-49.6	2.2
UEC-81	7.9
UEC-82	11.2
UEC-83	10.4
UEC-84	14.6
UEC-84.1	8.6
UEC-85.1	3.5
UEC-85.2	5.0
UEC-85.3	27.1
UEC-85.4	12.1
UEC-85.5	9.2
UEC-85.6	31.0
UEC-85.7	2.8
UEC-86.1	23.3
UEC-86.2	4.3
UEC-86.3	3.6
UEC-87.1	25.4

SUBDISTRICT	ACREAGE
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UPPER EAST CREEK DISTRICT (CONT'D)

UEC-87.2	27.6
UEC-88.1	65.5
UEC-88.2	12.1
UEC-88.3	7.4
UEC-88.4	11.9
UEC-88.5	40.1
UEC-88.6	13.5
UEC-89	2.9
UEC-89.1	16.6
UEC-90	16.7
UEC-91	1.7
UEC-91.1	5.8
UEC-91.2	1.2
UEC-91.3	0.3
UEC-98	8.1
WALLESTAD LAKE	167.5
SUBTOTAL	4,060.4
GRAND TOTAL	19,770.8

APPENDIX B – WATER QUANTITY MODELING RESULTS

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
CARVER DISTRICT												
CA-2	CA-P2	49.0	0.0	49.0	935.00	938.81	6.19	8.34	24.87	50.04	42	
CA-3	CA-W3	13.1	0.0	13.1	953.40	954.66	0.72	2.64	8.80	18.69	natural	5' Broad Crested Weir
CA-5	CA-P5	9.5	3.7	13.2	936.20	939.39	2.13	10.62	21.26	41.65	42	
CA-6	CA-P6	3.7	0.0	3.7	939.00	942.23	1.72	0.75	16.21	39.55	36	
CA-7	CA-P7	24.9	75.3	100.2	934.00	938.73	15.72	7.37	11.21	47.47	18	
CA-10.1	CA-W10.1	11.3	110.1	121.4	921.60	927.04	6.61	12.05	18.78	31.89	24	
CA-10.2	CA-C10.2	9.9	0.0	9.9	933.50	936.05	0.87	5.40	8.74	19.26	18	
CHASKA CREEK DISTRICT												
CC-1	CC-W1	415.8	0.0	415.8	922.00	926.14	84.65	1.81	2.27	2.86	10	
CC-2	CC-W2	899.6	184.1	1083.7	920.00	926.56	29.35	63.46	183.60	415.35	natural	10' Broad Crested Weir
CC-3	CC-W3	184.1	0.0	184.1	955.00	956.33	35.83	2.67	10.31	20.30	natural	5' Broad Crested Weir
CC-4	CC-C4	61.9	113.9	175.8	915.00	923.47	2.58	28.49	67.98	96.35	42	
CC-5.2	CC-W5.2	141.8	1109.9	1251.7	916.48	923.79	52.28	27.54	82.81	139.44	48	
CC-5.3	CC-W5.3	26.3	1083.7	1109.9	917.00	923.95	55.90	33.85	102.00	236.12	natural	10' Broad Crested Weir
CC-6.0	CC-C6.0	19.0	0.0	19.0	991.80	992.72	3.27	1.06	4.52	11.79	natural	5' Broad Crested Weir
CC-6.1	CC-C6.1	10.3	19.0	29.3	989.70	990.70	2.05	1.55	5.70	13.48	natural	5' Broad Crested Weir
CC-6.2	CC-C6.2	12.8	29.3	42.1	980.40	982.51	0.59	3.29	11.99	24.78	36	
CC-7.0	CC-W7.0	4.2	42.1	46.2	978.70	980.80	0.47	3.63	12.46	26.03	36	
CC-7.1	CC-W7.1	18.1	46.2	64.3	970.80	974.14	4.47	1.36	6.93	18.18	36	
CC-7.2	CC-W7.2	18.8	64.3	83.1	972.80	973.95	10.72	1.32	6.43	16.39	natural	5' Broad Crested Weir
CC-8	CC-C8	16.7	83.1	99.8	956.30	960.92	0.94	11.53	23.10	34.57	30	
CC-9	CC-W9	14.1	0.0	14.1	988.40	988.73	17.83	0.33	0.96	2.27	natural	5' Broad Crested Weir
CC-12	CC-W12	10.4	42.1	52.5	929.00	931.17	5.39	6.27	15.95	31.44	42	
CC-12.1a	CC-W12.1a	16.3	0.0	16.3	939.00	940.58	1.38	8.10	15.63	26.22	natural	5' Broad Crested Weir
CC-12.1b	CC-W12.1b	25.8	16.3	42.1	932.00	934.42	2.62	15.02	29.97	50.28	natural	5' Broad Crested Weir
CC-13	CC-W13	1.9	0.0	1.9	950.00	950.59	0.10	0.10	0.47	1.16	15	
CC-14a	CC-W14a	33.2	207.8	241.0	915.00	916.76	46.10	0.91	4.50	13.86	24	
CC-14a.1	CC-P14a.1	40.8	15.1	55.9	915.00	917.84	2.73	12.23	80.84	157.62	24	
CC-14a.2	CC-P14a.2	36.4	0.0	36.4	914.50	918.11	2.63	7.49	33.41	88.49	30	
CC-14a.3	CC-W14a.3	15.1	0.0	15.1	933.40	934.55	0.91	0.42	2.09	9.54	15	
CC-14b	CC-W14b	20.8	92.8	113.6	919.00	921.03	14.74	1.59	7.81	22.67	24	
CC-14b.1	CC-P14b.1	11.2	0.0	11.2	919.00	921.61	0.98	1.99	6.10	24.78	18	
CC-14b.2	CC-P14b.2	29.1	0.0	29.1	919.00	922.15	2.17	5.49	26.97	77.19	24	
CC-14c	CC-W14c	17.5	175.8	193.3	907.00	910.93	0.62	32.08	74.61	104.98	natural	5' Broad Crested Weir
CC-16	CC-W16	2.4	7.3	9.6	909.00	910.49	0.80	0.58	2.28	4.70	15	
CC-16.1	CC-P16.1	7.3	0.0	7.3	909.50	911.61	0.65	1.07	4.18	18.87	18	
CC-17	CC-W17	248.6	1741.6	1990.2	886.00	889.77	42.50	38.43	108.39	193.29	natural	10' Broad Crested Weir
CC-17.1a	CC-P17.1a	30.5	13.7	44.2	896.00	901.82	7.45	2.39	3.88	5.02	15	
CC-17.1b	CC-P17.1b	1.7	44.2	45.8	895.80	898.71	0.89	2.05	3.45	4.64	12	
CC-17.2	CC-P17.2	13.7	0.0	13.7	910.50	912.16	2.22	0.29	0.72	1.12	12	
CC-29.1	CC-W29.1	2.7	0.0	2.7	878.00	882.24	2.30	0.01	0.63	1.31	24	
CC-29.1.1	CC-P29.1.1	13.9	0.0	13.9	890.00	892.59	3.09	14.30	28.03	45.29	12,12	5x10' Broad Crested Weir
CC-29.1.2	CC-P29.1.2	93.0	16.6	109.5	880.00	884.00	20.74	7.84	39.01	129.87	15,12,8	
CC-29.2	CC-W29.2	2.8	12.5	15.3	882.00	882.90	1.33	3.78	8.77	17.14	natural	15' Broad Crested Weir
CC-29.2.1	CC-P29.2.1	12.5	0.0	12.5	884.50	884.69	2.41	10.86	10.86	15.02	18	
CC-29.2.3	CC-W29.2.3	19.0	15.3	34.3	881.50	881.90	2.57	2.41	7.23	16.82	30	
CC-33.1	CC-W33.1	154.0	3.9	569.8	915.00	916.08	22.64	2.12	6.63	14.94	natural	5' Broad Crested Weir

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
CC-34	CC-W34	9.5	0.0	9.5	902.50	904.37	0.13	2.93	10.11	20.62	natural	3' Broad Crested Weir
CC-35	CC-C35	10.6	19.0	29.6	895.00	900.00	0.84	8.47	23.78	37.21	30	
CC-35.1	CC-W35.1	9.5	0.0	9.5	908.50	909.70	0.30	2.64	8.70	17.51	natural	5' Broad Crested Weir
CC-36.1	CC-W36.1	20.2	157.9	590.1	897.00	899.64	1.27	3.20	10.07	21.83	30	
CC-38	CC-C38	124.9	2341.8	2878.6	867.00	874.63	4.35	137.56	292.75	557.83	120" x 120"	
CC-76.1a	CC-P76.1a	13.8	0.0	13.8	916.20	917.95	4.30	3.52	9.76	19.32	natural	5' Broad Crested Weir
CC-76.1b	CC-P76.1b	0.5	13.8	14.4	916.20	917.74	0.60	2.80	8.05	16.08	natural	5' Broad Crested Weir
CC-76.1c	CC-P76.1c	5.4	14.4	19.8	916.20	917.72	5.62	0.86	2.85	6.51	18	
CC-76.2a	CC-P76.2a	9.6	0.0	9.6	918.00	919.92	0.73	6.76	15.17	33.55	24	
CC-76.2b	CC-P76.2b	8.4	0.0	8.4	917.00	918.91	0.97	1.59	10.29	27.00	12	
CC-76a	CC-W76a	18.9	74.4	93.3	911.00	915.14	5.37	12.28	17.78	22.95	24	
CC-76b	CC-W76b	9.8	19.8	29.6	916.00	916.98	4.73	0.15	0.68	1.66	12	
CC-76c	CC-W76c	4.3	0.0	4.3	918.00	918.21	0.17	0.88	2.34	2.75	12	
CHANHASSEN DISTRICT												
CH-1.1	CH-W1.1	7.2	71.3	78.5	916.82	920.03	1.47	7.90	15.94	23.87	15	
CH-1.2	CH-W1.2	1.5	69.8	71.3	923.00	924.40	2.24	8.53	16.60	21.99	natural	5' Broad Crested Weir
CH-1.3	CH-P1.3	43.4	26.4	69.8	924.26	928.94	8.78	9.20	16.79	21.79	21	
CH-1.20.3	CH-P1.20.3	2.3	0.0	2.3	753.00	754.47	0.98	1.33	3.42	5.81	18	
CH-2	CH-W2	77.0	2.0	79.0	898.00	905.42	14.96	24.06	29.54	34.38	24	
CH-2.1	CH-P2.1	2.0	0.0	2.0	958.00	959.98	0.31	3.00	5.06	6.88	15	
CH-6	CH-W6	10.5	15.8	26.4	928.27	931.21	3.34	3.22	5.86	8.78	15	
CH-6.1	CH-W6.1	8.0	0.0	8.0	941.00	941.77	0.71	2.08	6.45	13.26	18	
CH-6.2	CH-W6.2	7.8	0.0	7.8	933.14	935.23	0.66	3.54	7.12	9.85	18	
CH-7	CH-W7	36.0	4.6	40.7	898.00	899.46	7.37	5.60	12.87	23.40	natural	5' Broad Crested Weir
CH-7.1	CH-P7.1	4.6	0.0	4.6	925.00	927.76	0.84	5.97	9.13	11.70	18	
CH-8	CH-W8	10.9	36.9	47.8	878.00	881.08	6.12	2.10	3.39	16.58	18	
CH-8.1	CH-P8.1	8.4	0.0	8.4	880.29	882.60	2.11	2.38	6.82	10.62	18	
CH-8.2	CH-P8.2	11.1	0.0	11.1	878.00	881.21	1.45	1.16	5.37	9.45	18	
CH-8.3	CH-P8.3	17.4	0.0	17.4	878.00	881.44	3.98	1.81	6.00	9.11	18	
CH-10	CH-P10	46.6	15.1	61.7	882.00	885.67	13.69	1.96	2.89	3.61	12	
CH-10.1	CH-P10.1	15.1	0.0	15.1	920.00	922.85	2.17	1.54	3.59	4.94	12	
CH-11.1	CH-W11.1	123.0	8.2	131.2	878.00	934.71	22.42	1.50	4.62	38.33	18	
CH-11.2	CH-W11.2	8.2	0.0	8.2	927.00	928.36	1.02	11.11	15.70	21.01	natural	5' Broad Crested Weir
CH-11.3a	CH-P11.3a	11.3	88.1	99.4	810.00	811.37	0.16	28.82	67.68	125.36	48	
CH-13	CH-W13	30.1	39.2	69.3	945.00	948.22	6.41	29.08	52.33	76.97	natural	5' Broad Crested Weir
CH-13.1	CH-P13.1	39.2	0.0	39.2	955.00	960.58	9.27	30.56	51.28	68.78	36	
CH-16	CH-W16	8.6	0.0	8.6	985.00	986.82	0.63	0.93	2.92	4.36	15	
CH-18	CH-W18	9.5	0.0	9.5	1005.00	1008.38	0.61	2.23	4.78	6.82	15	
SEMINARY FEN	SEMINARY FEN	385.6	280.7	666.3	740.00	747.03	55.94	38.19	82.28	123.75	48	

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
CHASKA LAKE DISTRICT												
CHASKA LAKE	CHASKA LAKE	316.6	228.9	545.5	703.70	705.27	138.91	1.37	4.79	10.99	30	
CL-1.1	CL-P1.1	47.0	0.0	47.0	935.00	938.25	4.69	6.94	23.45	88.56		24" Vertical Orifice and 20x8' Broad Crested Weir
CL-1.2	CL-W1.2	16.0	47.0	63.0	934.00	935.34	3.80	10.82	30.49	82.89	natural	20x8' Broad Crested Weir
CL-4	CL-C4	9.6	6.6	16.2	832.00	835.47	1.52	4.94	8.29	26.73	15	
CL-5.1	CL-C5.1	92.5	63.0	155.5	756.50	770.87	0.80	79.38	159.03	278.65	48x72	
CL-5.2	CL-C5.2	7.2	0.0	7.2	777.30	781.32	0.46	10.65	14.00	28.54	18	
CL-5.3	CL-C5.3	0.0	16.2	16.3	825.00	827.35	0.09	4.95	8.30	24.99	30	
CL-5.4	CL-P5.4	6.6	0.0	6.6	920.00	922.12	1.27	5.59	10.04	15.53	24	
CL-6	CL-C6	3.5	171.8	175.2	755.20	765.06	0.08	84.73	168.16	300.18	48x72	
CL-7	CL-P7	17.0	0.0	17.0	766.00	767.54	4.12	0.70	3.24	14.40	24,30	
CL-9	CL-C9	29.5	0.0	29.5	788.00	788.66	0.04	46.50	86.20	138.76	natural	100x2' Broad Crested Weir
HICKORY STREET DISTRICT												
HS-3	HS-W3	16.3	0.0	16.3	933.60	934.82	2.35	6.01	10.70	17.89	natural	5' Broad Crested Weir
HS-8	HS-C8	75.7	16.3	92.0	873.50	878.90	2.89	65.83	123.52	178.02	natural	5' Broad Crested Weir
HS-8.2	HS-W8.2	5.1	0.0	5.1	904.20	905.34	0.46	4.52	9.56	16.30	natural	5' Broad Crested Weir
HS-9	HS-W9	19.2	0.0	19.2	935.20	936.51	4.80	5.72	12.19	20.00	natural	5' Broad Crested Weir
HS-11	HS-C11	11.0	0.0	11.0	910.20	911.02	1.95	1.81	4.86	9.94	natural	5' Broad Crested Weir
HS-13	HS-C13	58.8	122.2	181.1	867.40	873.99	1.46	121.35	232.82	352.05	48	
HS-16.1	HS-W16.1	3.6	0.0	3.6	864.70	865.54	0.40	2.70	6.10	10.39	natural	5' Broad Crested Weir
HS-18.1	HS-C18.1	5.6	314.4	320.0	739.40	759.60	1.75	199.64	334.10	653.80	60	
HS-18.2	HS-C18.2	73.8	189.7	263.5	752.00	765.54	3.27	182.10	312.02	566.23	60,48	
HS-19	HS-P19	8.5	0.0	8.5	827.80	829.30	3.79	0.24	1.05	6.49	21	
HS-20.1	HS-P20.1	15.9	8.5	24.4	760.00	763.18	0.94	6.28	9.44	12.77	15	
HS-20.2	HS-P20.2	26.5	0.0	26.5	780.00	782.49	1.34	27.14	39.49	85.68	24	
MINNESOTA RIVER DISTRICT												
MN-1a	MN-T1a	23.4	0.0	23.4	710.00	711.45	0.72	27.59	53.55	83.81	18	
MN-1b	MN-T1b	18.0	23.4	41.4	693.50	700.11	0.01	78.49	134.59	209.82	72	
MN-1c	MN-T1c	43.3	0.0	43.3	710.00	710.40	1.26	47.68	92.38	316.37	30	
MN-1d	MN-T1d	1.2	0.0	1.2	702.46	711.93	0.00	2.78	5.00	7.91	15	
MN-1e	MN-T1e	0.9	44.6	45.5	697.38	711.91	0.71	48.73	94.31	127.48	24,30	

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
LOWER CHASKA CREEK DISTRICT												
FIREMENS LAKE	FIREMENS LAKE	50.1	0.0	50.1	733.50	734.92	13.41	0.00	0.00	0.60	15	
LCC-1	LCC-C1	5.4	0.0	5.4	930.50	931.41	0.95	2.85	6.68	11.70	natural	5' Broad Crested Weir
LCC-1.1	LCC-C1.1	57.4	9222.2	9279.6	711.45	718.98	3.68	746.79	1545.67	2614.00	360x120	
LCC-1.2a	LCC-T1.2a	24.3	0.0	24.3	715.15	722.74	0.95	33.34	56.77	102.29	18,30	
LCC-1.2b	LCC-C1.2b	4.4	24.3	28.7	713.40	718.36	0.43	36.90	63.55	108.95	60	
LCC-1.3	LCC-C1.3	27.6	8874.6	8902.2	728.00	734.12	1.31	532.64	1179.57	1987.09	360x114	
LCC-1.4	LCC-C1.4	24.8	8799.7	8824.5	747.00	755.33	7.29	522.80	1160.79	1956.14	168x114	
LCC-1.5	LCC-C1.5	98.0	78.6	176.6	755.00	759.98	0.20	127.50	236.43	392.88	66	
LCC-1.6	LCC-C1.6	48.0	42.6	90.6	766.00	772.51	0.29	37.33	80.30	141.25	36	
LCC-1.7	LCC-C1.7	187.5	8345.0	8532.5	760.00	774.90	6.85	372.70	884.10	1518.50	natural	10' Broad Crested Weir
LCC-1.7a	LCC-P1.7a	53.1	24.9	77.9	865.30	871.91	10.27	6.79	23.67	44.72	30	
LCC-1.8	LCC-C1.8	14.1	7973.2	7987.3	834.00	845.87	4.58	262.58	611.44	1080.22	natural	5' Broad Crested Weir
LCC-1.8a	LCC-P1.8a	30.0	0.0	30.0	898.00	902.48	6.08	4.09	6.94	10.61	28.5x18	
LCC-1.8b	LCC-P1.8b	15.0	30.0	45.0	897.00	902.47	2.14	7.58	10.84	12.39	18	
LCC-1.8c	LCC-P1.8c	17.0	45.0	62.0	896.00	899.38	3.68	6.07	9.53	16.92	18	
LCC-1.9	LCC-C1.9	71.0	7890.8	7961.8	844.00	849.44	1.41	248.73	592.97	1065.35	241x147	
LCC-1.10	LCC-W1.10	52.6	10.4	63.0	787.50	792.33	0.67	22.14	51.97	114.46	36	
LCC-4.1	LCC-C4.1	11.4	0.0	11.4	904.20	905.32	1.05	16.85	27.54	41.52	natural	10' Broad Crested Weir
LCC-7.0	LCC-W7.0	6.6	210.1	216.7	877.12	881.78	9.24	23.42	43.94	60.55	36	
LCC-7.1	LCC-P7.1	54.8	0.0	54.8	877.20	881.79	2.45	42.48	89.02	151.80	natural	10' Broad Crested Weir
LCC-7.2	LCC-P7.2	22.6	0.0	22.6	913.00	916.94	3.99	2.47	4.16	5.02	12	
LCC-15.1	LCC-W15.1	18.4	6.5	24.9	883.50	893.79	3.36	5.53	6.05	6.48	12	
LCC-15.2	LCC-P15.2	6.5	0.0	6.5	889.50	893.83	1.39	5.22	7.98	7.72	18	
LCC-21	LCC-W21	10.4	0.0	10.4	929.00	929.49	6.67	0.80	2.03	4.38	natural	5' Broad Crested Weir
LCC-22	LCC-W22	11.7	0.0	11.7	915.60	916.67	3.57	4.04	8.34	14.74	natural	5' Broad Crested Weir
LCC-25	LCC-C25	30.9	0.0	30.9	911.30	913.50	3.67	13.67	26.39	43.30	natural	5' Broad Crested Weir
LCC-32.1	LCC-C32.1	5.7	6.1	11.8	909.30	912.76	1.53	6.26	8.27	10.36	18	
LCC-32.2	LCC-C32.2	6.1	0.0	6.1	916.20	917.46	0.56	6.20	11.67	18.71	natural	5' Broad Crested Weir
LCC-33	LCC-C33	7.4	11.8	19.2	890.90	894.34	0.27	17.11	28.13	38.28	36	
LCC-34.2	LCC-W34.2	46.8	19.2	65.9	879.00	884.46	0.55	60.55	108.85	186.51	72	
LCC-41	LCC-W41	12.6	0.0	12.6	766.20	772.42	1.17	6.28	9.16	44.37	15	

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
SOUTH CHASKA CREEK DISTRICT												
SCC-1.1	SCC-W1.1	532.9	0.0	532.9	956.00	960.26	53.16	30.67	51.33	79.25	natural	5' Broad Crested Weir
SCC-1.2	SCC-W1.2	266.9	532.9	799.8	954.00	960.00	51.06	23.01	42.62	64.17	36	
SCC-2	SCC-W2	800.9	799.8	1600.6	936.00	941.24	191.17	23.18	38.42	47.18	30	
SCC-4	SCC-W4	718.6	1600.6	2319.3	915.00	921.10	92.20	31.78	61.97	135.94	60	
SCC-5	SCC-W5	375.6	0.0	375.6	925.00	930.62	30.64	32.68	76.10	123.49	54	
SCC-6	SCC-W6	520.7	2694.8	3215.5	913.00	916.28	344.39	5.28	23.10	46.09	48	
SCC-7	SCC-W7	414.3	3215.5	3629.8	905.00	907.88	36.70	16.83	79.46	133.92	132x60	
SCC-8	SCC-W8	656.4	0.0	656.4	930.00	935.07	81.70	20.41	39.46	67.60	42	
SCC-9a	SCC-W9a	150.4	4627.5	4777.8	904.00	907.54	44.27	47.98	105.25	175.62	natural	10' Broad Crested Weir
SCC-9b	SCC-W9b	341.2	656.4	997.6	905.00	910.19	36.25	27.78	62.27	112.43	60	
SCC-11	SCC-W11	30.2	0.0	30.2	915.40	916.03	8.54	0.73	3.21	10.45	natural	5' Broad Crested Weir
SCC-12.1	SCC-W12.1	128.5	79.1	207.7	909.00	913.50	30.85	5.15	7.24	8.85	18	
SCC-12.2	SCC-W12.2	48.9	0.0	48.9	914.00	917.75	5.93	3.36	5.60	7.45	18	
SCC-12.3	SCC-W12.3	0.0	0.0	0.0	967.40	967.48	0.00	0.08	0.12	0.17	natural	3' Broad Crested Weir
SCC-13	SCC-C13	36.6	0.0	36.6	916.90	917.32	10.93	0.64	2.48	7.14	natural	10' Broad Crested Weir
SCC-14	SCC-W14	12.0	36.6	48.6	910.10	912.44	2.05	1.13	3.50	6.90	18	
SCC-15	SCC-W15	17.5	0.0	17.5	918.00	919.12	2.21	0.38	1.23	2.71	18	
SCC-16	SCC-C16	19.7	0.0	19.7	927.00	927.88	1.77	1.01	4.46	11.10	natural	5' Broad Crested Weir
SCC-18	SCC-C18	13.3	0.0	13.3	923.70	924.40	8.42	1.49	3.79	7.87	natural	5' Broad Crested Weir
SCC-19	SCC-P19	86.8	25.4	112.2	908.00	917.30	19.48	23.25	57.98	95.05	36	
SCC-20	SCC-W20	12.2	0.0	12.2	925.00	926.20	3.03	3.91	9.48	17.52	natural	5' Broad Crested Weir
SCC-22.1.1	SCC-C22.1.1	1.6	4.0	5.7	929.50	929.88	0.89	0.67	1.55	2.95	natural	5' Broad Crested Weir
SCC-22.1.2	SCC-C22.1.2	4.0	0.0	4.0	935.20	935.78	1.50	1.19	2.95	5.90	natural	5' Broad Crested Weir
SCC-22.2.1	SCC-W22.2.1	25.8	141.0	166.8	906.10	908.46	10.95	2.45	11.53	55.19	18	
SCC-22.2.2	SCC-W22.2.2	18.6	122.3	141.0	906.20	908.72	17.53	4.29	23.19	68.27	18	
SCC-22.2.3	SCC-C22.2.3	7.8	0.0	7.8	917.70	918.42	0.95	0.76	3.25	8.29	natural	5' Broad Crested Weir
SCC-22.2.4	SCC-W22.2.4	2.3	0.0	2.3	929.50	930.32	0.19	2.23	3.95	5.99	natural	3' Broad Crested Weir
SCC-24	SCC-C24	175.0	5243.8	5418.7	865.00	873.74	2.76	80.32	220.96	372.16	natural	5' Broad Crested Weir

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
EAST CREEK DISTRICT												
CLAYHOLE LAKE	CLAYHOLE LAKE	44.5	38.5	83.0	726.30	729.23	43.34	4.93	6.26	8.26	15	
COURTHOUSE LAKE	COURTHOUSE LAKE	18.7	0.0	18.7	703.70	704.24	6.87	0.00	0.00	0.00	18	HWL affected by downstream Pond EC-C1.1
EC-1.1	EC-C1.1	53.4	6203.3	6256.7	700.00	709.68	38.67	159.29	279.49	413.08	84	
EC-1.1a	EC-C1.1a	55.6	6120.5	6176.1	711.00	719.68	2.89	243.90	444.73	674.98	natural	10' Broad Crested Weir
EC-1.1b	EC-W1.1b	80.3	6040.2	6120.5	721.00	728.03	3.12	174.95	323.50	492.39	natural	10' Broad Crested Weir
EC-1.1c	EC-D1.1c	2.8	0.0	2.8	733.80	737.30	0.00	5.49	10.09	16.16	15	
EC-1.3	EC-P1.3	6.9	144.1	151.0	730.16	733.96	9.27	20.95	33.58	39.73	36	
EC-1.4	EC-W1.4	5.9	32.6	38.5	737.00	739.34	4.07	5.35	21.93	40.33	21	
EC-1.5	EC-P1.5	32.6	0.0	32.6	738.00	743.23	3.18	20.12	36.40	48.42	30	
EC-1.6	EC-D1.6	64.0	80.1	144.1	755.61	773.27	0.00	76.46	165.99	285.40	21,42,15	
EC-1.7	EC-C1.7	12.3	47.9	60.2	801.45	808.19	0.60	24.16	58.30	103.51	42	
EC-1.8	EC-C1.8	47.9	0.0	47.9	827.00	830.62	0.13	20.14	49.22	92.41	natural	5' Broad Crested Weir
EC-1.9	EC-P1.9	10.4	0.0	10.4	855.30	858.12	2.71	4.83	10.92	16.15	21	
EC-1.10	EC-P1.10	6.0	3.5	9.5	894.50	897.53	2.49	3.65	8.26	20.52	24	
EC-1.11	EC-W1.11	0.7	0.0	0.7	894.50	897.53	0.38	0.39	0.39	0.39	24	HWL based on EC-P1.10
EC-1.12	EC-P1.12	1.9	0.0	1.9	904.00	906.27	0.26	3.86	5.72	7.15	15	
EC-1.13	EC-P1.13	0.9	0.0	0.9	903.00	905.04	0.08	1.95	2.76	3.63	12	
EC-1.14	EC-W1.14	20.2	5783.2	5803.4	735.00	740.71	2.43	120.97	227.56	360.35	natural	10' Broad Crested Weir
EC-1.16	EC-P1.16	15.4	0.0	15.4	758.00	761.08	2.44	1.95	3.95	5.73	12	
EC-1.17	EC-W1.17	312.2	5471.0	5783.2	743.00	748.72	29.75	119.50	224.76	361.09	natural	10' Broad Crested Weir
EC-1.18	EC-C1.18	49.8	5334.2	5384.0	760.00	765.88	3.71	61.95	100.10	147.20	48x72	
EC-1.19	EC-C1.19	7.4	98.6	106.0	717.70	722.98	4.44	401.44	830.39	1370.59		Custom Weir/Orifice
EC-1.20.1	EC-C1.20.1	66.5	32.1	98.6	732.50	741.73	8.22	401.32	829.82	1369.52		12" Vertical Orifice, Custom Weir/Orifice
EC-1.20.2	EC-P1.20.2	8.9	0.0	8.9	751.80	754.94	3.21	1.80	2.44	9.60	30	
EC-1.21	EC-C1.21	11.4	11.8	23.2	748.50	756.65	4.36	387.57	807.86	1333.64		12" Vertical Orifice, Custom Weir/Orifice
EC-1.22	EC-C1.22	11.8	0.0	11.8	766.10	774.24	2.65	386.93	806.41	1331.19		12" Vertical Orifice, Custom Weir/Orifice
EC-1.23	EC-D1.23	0.6	5333.6	5334.2	772.50	789.63	0.00	415.36	839.39	1367.65	48	
EC-1.24	EC-P1.24	373.4	4960.2	5333.6	779.12	792.38	79.65	415.33	839.32	1367.53	48	
EC-1.24.1	EC-P1.24.1	7.0	0.0	7.0	915.50	918.29	4.67	0.87	1.18	1.35	6	
EC-1.24.1a	EC-1.24.1a	7.0	0.0	7.0	911.49	915.66	0.37	0.70	0.92	1.03	6	
EC-1.26	EC-W1.26	8.4	0.0	8.4	941.00	942.15	0.37	1.11	6.33	16.46	natural	5' Broad Crested Weir
EC-1.29	EC-P1.29	18.1	25.1	43.2	909.40	911.91	5.71	3.48	12.13	27.96	42	
EC-1.29.1	EC-P1.29.1	1.5	129.8	131.3	896.16	902.01	0.54	17.47	26.29	62.40	30,144x144	
EC-1.29.2	EC-P1.29.2	10.5	119.3	129.8	902.00	909.60	4.86	17.32	26.08	63.59	18	
EC-1.29.3	EC-P1.29.3	7.9	3.0	10.9	919.00	923.66	3.07	5.19	6.56	7.88	15	
EC-1.29.4	EC-P1.29.4	9.3	55.8	65.1	924.00	926.30	0.08	7.97	12.02	17.26	24	
EC-1.30	EC-P1.30	6.7	18.5	25.1	919.00	920.20	4.44	1.22	2.98	5.63	18	
EC-1.31	EC-P1.31	18.5	0.0	18.5	921.05	924.09	7.88	1.10	2.34	2.90	12	
EC-1.33	EC-P1.33	12.3	0.0	12.3	928.00	931.97	4.27	3.61	5.25	6.70	12	
EC-1.34	EC-W1.34	4.4	48.4	52.8	933.00	933.95	1.79	3.95	7.61	12.37	natural	5' Broad Crested Weir
EC-1.35	EC-W1.35	3.0	0.0	3.0	936.00	936.97	0.34	5.91	8.96	12.81	natural	5' Broad Crested Weir
EC-1.36	EC-C1.36	41.3	253.0	294.3	844.00	849.59	1.83	37.30	88.70	166.10	60	

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
EC-1.36.1	EC-P1.36.1	23.3	0.0	23.3	880.00	884.91	3.78	2.44	16.50	38.97	15,18	
EC-1.37	EC-P1.37	11.2	0.0	11.2	907.59	913.19	1.18	4.07	6.81	24.03	12	
EC-1.38	EC-W1.38	2.9	0.0	2.9	918.00	918.36	0.26	0.22	0.92	2.70	natural	5' Broad Crested Weir
EC-1.39	EC-C1.39	19.6	103.1	122.6	897.43	899.70	0.97	5.19	15.02	29.44	36	
EC-1.40	EC-P1.40	21.7	81.4	103.1	913.00	918.62	16.22	4.19	5.71	7.02	12	
EC-1.41	EC-P1.41	0.7	23.3	24.0	914.00	918.62	4.58	13.85	27.55	40.61	30	
EC-1.42	EC-P1.42	42.2	0.0	42.2	915.04	918.64	6.10	10.34	20.99	50.10	24	
EC-1.43a	EC-P1.43a	4.1	0.0	4.1	821.00	823.31	0.43	2.03	6.41	14.92	18	
EC-1.43b	EC-P1.43b	10.6	0.0	10.6	853.50	857.50	0.93	5.28	11.35	24.60	18	
EC-1.43c	EC-C1.43c	269.5	4058.3	4327.7	850.00	858.08	18.06	316.66	629.71	1124.04	144x144, 144x144	
EC-1.43d	EC-P1.43d	13.4	0.0	13.4	908.00	912.41	1.77	15.78	22.17	27.01	24	
EC-1.44a	EC-P1.44a	8.0	0.0	8.0	896.00	897.98	1.68	0.78	1.84	10.51	24	
EC-1.44b	EC-P1.44b	2.7	0.0	2.7	888.50	890.66	0.46	2.94	5.27	7.31	15	
EC-1.45	EC-W1.45	10.8	70.9	81.7	880.00	884.79	3.07	31.17	78.06	145.09	natural	5' Broad Crested Weir
EC-1.46	EC-C1.46	29.1	0.0	29.1	889.00	892.05	0.39	16.64	38.86	70.87	natural	5' Broad Crested Weir
EC-1.47	EC-C1.47	30.5	11.3	41.8	903.66	908.54	0.64	18.89	47.86	81.97	42	
EC-1.48	EC-W1.48	11.8	0.0	11.8	885.00	887.69	0.91	2.93	5.98	8.14	15	
EC-1.49/1.50	EC-C1.49	32.7	2658.1	2690.8	875.50	878.79	2.53	22.14	52.95	102.45	120	
EC-1.52	EC-P1.52	15.2	0.0	15.2	914.00	917.59	1.19	17.18	39.96	70.92	24,27	
EC-1.53	EC-W1.53	2.7	5.8	8.5	719.00	719.88	0.91	0.39	1.34	3.41	18	
EC-1.54	EC-P1.54	5.8	0.0	5.8	721.00	722.60	2.03	1.32	4.20	7.87	18	
EC-2.4	EC-W2.4	66.8	53.9	120.7	705.00	708.68	6.30	31.01	73.46	91.21	36	
EC-2.5	EC-P2.5	11.6	18.5	30.1	726.00	726.90	13.19	0.28	1.15	2.83	18	
EC-2.6	EC-P2.6	14.2	4.3	18.5	727.00	727.81	17.19	0.27	0.92	2.35	18	
EC-2.7	EC-W2.7	4.3	0.0	4.3	728.00	729.56	0.56	2.60	4.52	6.54	18	
EC-2.8	EC-P2.8	19.1	4.7	23.8	726.00	729.28	1.11	27.86	50.69	79.29	natural	5' Broad Crested Weir
EC-2.9	EC-W2.9	4.7	0.0	4.7	739.50	742.18	0.61	3.90	6.36	8.46	15	
EC-3.2	EC-W3.2	96.8	7.0	103.8	705.00	706.61	9.90	14.22	31.24	54.11	natural	5' Broad Crested Weir
EC-3.3	EC-W3.3	7.0	0.0	7.0	717.00	718.17	1.14	0.49	1.62	3.74	18	
EC-13.1	EC-P13.1	3.6	0.0	3.6	984.50	985.51	1.55	0.15	0.41	1.11	15	
EC-50	EC-W50	29.1	27.0	56.1	979.00	981.10	2.65	12.30	25.12	40.39	natural	5' Broad Crested Weir
EC-50.1	EC-W50.1	12.7	0.0	12.7	984.80	989.76	1.73	0.45	1.50	2.71	15	
EC-50.2	EC-W50.2	14.2	12.7	27.0	984.80	989.76	0.75	3.38	7.32	10.15	18	
EC-51	EC-W51	24.0	56.1	80.0	971.70	973.88	3.19	13.10	26.31	42.64	natural	5' Broad Crested Weir
EC-52	EC-W52	36.9	165.1	202.0	951.20	953.65	13.99	19.13	53.85	101.43	natural	10' Broad Crested Weir
EC-52.1	EC-W52.1	2.2	49.9	52.0	968.50	972.28	2.40	10.53	34.65	53.13	36	
EC-52.2	EC-P52.2	43.7	6.2	49.9	971.46	976.10	8.31	15.82	39.12	60.35	36	
EC-52.3	EC-P52.3	6.2	0.0	6.2	984.50	987.27	0.59	6.06	9.57	30.33	18	
EC-52.4	EC-P52.4	33.0	0.0	33.0	962.00	966.43	1.28	14.07	36.26	73.78	24	
EC-53	EC-W53	46.9	266.2	313.1	939.00	943.32	24.47	18.07	37.83	57.52	36	
EC-53.1	EC-W53.1	20.8	202.0	222.8	943.40	946.73	11.02	16.02	42.79	81.35	natural	5' Broad Crested Weir
EC-53.2	EC-P53.2	12.0	0.0	12.0	946.00	947.62	1.43	0.73	3.07	7.47	18	
EC-53.3	EC-P53.3	30.9	0.0	30.9	943.00	945.75	1.21	13.40	23.05	48.52	natural	5' Broad Crested Weir

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
EC-53.4	EC-P53.4	0.5	30.9	31.4	943.00	945.36	0.29	7.48	22.61	48.37	natural	5' Broad Crested Weir
EC-55a	EC-W55a	14.6	15.3	29.9	944.00	946.34	0.55	27.67	27.67	30.11	24	
EC-55a.1	EC-P55a.1	9.5	0.0	9.5	944.02	951.41	0.81	4.89	7.90	9.44	12	
EC-55b	EC-W55b	5.8	0.0	5.8	950.00	950.00	5.00	32.28	32.28	32.28	15	
EC-56.1	EC-W56.1	8.2	27.7	35.9	962.50	964.41	3.60	0.40	2.69	12.57	30	
EC-56.2	EC-P56.2	27.7	0.0	27.7	964.50	965.13	0.64	3.14	15.89	40.24	natural	10' Broad Crested Weir
EC-56a	EC-W56a	21.8	425.3	447.1	936.00	938.08	2.08	11.78	22.18	39.93	natural	5' Broad Crested Weir
EC-56b	EC-W56b	46.5	343.0	389.5	938.30	941.18	49.90	7.90	20.73	38.33	42	
EC-57	EC-W57	177.2	499.1	676.3	916.11	918.58	59.06	8.65	20.91	38.94	42	
EC-57.1	EC-P57.1	15.9	12.0	27.9	948.00	1002.24	1.92	10.51	15.01	57.22	18	
EC-57.2	EC-W57.2	2.4	9.6	12.0	964.50	965.26	0.82	0.80	5.60	17.72	21	
EC-57.3	EC-P57.3	4.1	0.0	4.1	965.50	965.66	0.69	0.81	4.73	11.71	natural	10' Broad Crested Weir
EC-57.4	EC-P57.4	5.5	0.0	5.5	965.50	965.63	1.24	0.95	5.30	13.28	natural	10' Broad Crested Weir
EC-57.5	EC-T57.5	17.1	0.0	17.1	921.70	932.71	0.00	11.26	26.44	48.64	12	
EC-59	EC-W59	7.0	0.0	7.0	945.22	946.51	0.87	0.44	1.69	3.36	12	
EC-61	EC-W61	18.0	0.0	18.0	919.06	922.92	2.28	2.77	4.74	5.21	12	
EC-62	EC-W62	80.2	976.4	1056.5	877.42	885.80	17.36	90.12	162.17	218.16	48,48	
EC-62.1	EC-P62.1	7.0	0.0	7.0	885.20	888.31	1.38	4.38	14.37	19.81	24	
EC-62.2	EC-W62.2	29.6	39.4	69.0	893.50	1023.51	8.48	8.49	16.49	117.91	18	
EC-62.2.1	EC-P62.2.1	26.0	0.0	26.0	906.00	913.04	2.24	17.90	55.05	256.90	15	
EC-62.3	EC-P62.3	15.5	0.0	15.5	894.00	896.66	1.61	4.71	14.04	35.19	18,18	
EC-62.4	EC-W62.4	8.4	5.0	13.4	916.50	917.42	3.31	0.22	0.69	1.60	15	
EC-62.5	EC-P62.5	5.0	0.0	5.0	919.00	920.84	0.33	5.22	13.66	24.65	18	
EC-62.6	EC-C62.6	77.0	694.3	771.3	897.35	902.19	4.77	19.29	54.26	106.21	36,30,24	
EC-62.7	EC-T62.7	0.5	0.0	0.5	884.34	885.80	0.00	1.28	2.23	3.45	24	
EC-62a	EC-W62a	64.1	48.9	113.1	892.30	893.20	6.08	14.53	46.03	95.64	48,48	
EC-65	EC-W65	48.9	0.0	48.9	927.70	929.30	5.72	5.05	13.56	26.82	42	
EC-67a	EC-W67a	19.3	1056.5	1075.9	876.90	883.05	1.78	93.76	166.31	219.58	natural	5' Broad Crested Weir
EC-67a.1	EC-P67a.1	21.0	19.8	40.7	858.00	862.71	3.38	7.76	13.41	31.54	18	
EC-67a.2	EC-W67a.2	19.8	0.0	19.8	874.00	877.94	1.39	5.00	9.22	33.43	15	
EC-67a.3	EC-W67a.3	5.9	10.2	16.1	875.00	876.16	0.74	3.80	10.15	16.60	natural	5' Broad Crested Weir
EC-67a.3.1	EC-P67a.3.1	3.9	0.0	3.9	887.00	888.10	0.43	0.43	1.72	4.10	15	
EC-67a.3.2	EC-P67a.3.2	6.2	0.0	6.2	880.00	880.96	0.33	4.59	6.57	8.21	15,12	
EC-67a.4	EC-C67a.4	36.5	1177.9	1214.4	850.00	859.64	2.71	110.32	209.38	291.99	96x72	
EC-68	EC-W68	12.6	32.7	45.2	891.72	895.13	8.46	4.00	7.00	8.93	15	
EC-68.1	EC-W68.1	13.0	0.0	13.0	899.00	902.14	1.70	1.91	4.20	6.15	12	
EC-68.2	EC-W68.2	19.6	0.0	19.6	899.42	903.22	1.22	22.17	44.44	71.07	12	
EC-69	EC-W69	11.3	0.0	11.3	915.00	916.37	0.51	4.44	11.54	21.25	natural	5' Broad Crested Weir
EC-71	EC-W71	6.4	0.0	6.4	896.28	900.73	1.44	1.44	4.40	6.58	15	HWL based on EC-P72
EC-72	EC-P72	65.2	6.4	71.7	888.24	900.73	16.77	5.55	7.15	8.02	12	
EC-73	EC-W73	56.9	0.0	56.9	942.00	949.27	6.33	2.41	3.80	4.69	12	
EC-74	EC-W74	8.4	207.2	215.6	900.00	904.45	7.49	10.12	21.22	32.69	15,24	
EC-74.1	EC-P74.1	27.0	0.0	27.0	904.50	907.57	4.93	2.38	7.65	35.98	18	

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
EC-74.2	EC-W74.2	10.1	77.5	87.6	905.50	908.48	1.43	16.80	41.76	61.24	30,30	
EC-74.3	EC-P74.3	14.6	0.0	14.6	905.60	909.25	2.06	6.86	17.09	22.03	30	
EC-74.4	EC-P74.4	5.9	0.0	5.9	906.00	908.77	0.65	2.96	9.85	18.27	12	
EC-75.1	EC-P75.1	8.9	27.1	36.0	938.00	941.74	3.85	6.77	17.04	25.06	24	
EC-75.2	EC-P75.2	27.1	0.0	27.1	945.63	949.25	3.75	5.61	20.10	36.01	30	
EC-75a	EC-P75a	54.2	36.0	90.1	913.85	921.21	24.52	2.15	3.12	8.66	8	
EC-75b	EC-P75b	2.5	90.1	92.6	911.80	917.61	5.08	0.12	0.12	0.12		Exfiltration
EC-76a	EC-W76a	8.5	0.0	8.5	934.00	936.10	1.22	0.00	0.24	7.83	natural	20' Broad Crested Weir, HWL based on EC-W76b
EC-76b	EC-W76b	11.7	8.5	20.2	934.00	936.10	1.22	0.43	3.13	9.51	21	
EC-77	EC-W77	9.5	38.9	48.4	933.00	935.12	7.33	3.39	3.75	6.13	15	
EC-77.1	EC-W77.1	13.3	5.4	18.7	935.00	937.83	2.98	2.84	11.07	20.47	24	
EC-77.2	EC-W77.2	2.1	0.0	2.1	943.88	944.16	0.11	0.56	2.41	4.64	12	
EC-77.3	EC-W77.3	3.3	0.0	3.3	943.02	943.35	0.25	0.69	2.90	5.79	12	
EC-80	EC-P80	7.2	0.0	7.2	881.75	881.75	0.00	12.75	24.72	40.86	36	
EC-81	EC-P81	28.2	0.0	28.2	892.00	897.44	4.57	5.20	14.67	97.05	15	

UPPER EAST CREEK DISTRICT

HAZELTINE LAKE	HAZELTINE LAKE	315.7	632.2	947.9	916.60	917.81	309.843	5.38	7.77	9.67	48	
LAKE BAVARIA	LAKE BAVARIA	304.3	456.1	760.4	972.70	973.65	171.933	0.32	1.18	2.89	15	
LAKE GRACE	LAKE GRACE	100.9	2557.2	2658.1	899.38	900.73	234.233	21.58	51.56	98.89	96	
LAKE JONATHAN	LAKE JONATHAN	98.9	2451.2	3310.5	899.38	900.97	286.696	77.6	77.6	85.95	144x144	
MCKNIGHT LAKE	MCKNIGHT LAKE	133.3	2116.2	5559.9	902.00	904.71	318.208	13.67	38.45	61.57	36	
MILL POND	MILL POND	15.2	0.0	15.2	941.30	944.70	2.528	3.92	8.43	8.75	18	
UEC-1	UEC-W1	37.6	0.0	37.6	994.90	995.48	10.755	0.59	2.13	5.95	natural	5' Broad Crested Weir
UEC-1.51	UEC-P1.51	7.1	0.0	7.1	1030.00	1033.42	0.842	10.14	17.08	23.51	24	
UEC-2.1	UEC-P2.1	11.2	61.1	72.3	984.50	986.30	9.21	1.79	8.8	21.96	42	
UEC-2.2	UEC-W2.2	13.2	47.9	61.1	986.00	987.11	0.672	6.32	12.72	26.02	42	
UEC-2.3	UEC-W2.3	3.8	6.5	10.3	1005.60	1,006.90	0.106	2.48	6.25	11.76	natural	3' Broad Crested Weir
UEC-3	UEC-W3	19.8	83.5	103.3	982.00	983.56	7.302	1.87	6.73	17.63	42	
UEC-3.1	UEC-W3.1	11.3	72.3	83.5	982.50	984.68	2.461	2.85	11.06	26.8	42	
UEC-3b	UEC-P3b	43.3	103.3	146.6	977.00	981.51	2.469	20.99	63.22	123.6	72	
UEC-4	UEC-W4	6.5	0.0	6.5	1011.00	1,011.36	1.325	0.14	0.78	2.71	natural	5' Broad Crested Weir
UEC-5	UEC-W5	21.6	0.0	21.6	988.00	989.17	1.566	2.41	8.24	16.92	natural	5' Broad Crested Weir
UEC-6	UEC-W6	16.8	6.3	23.0	973.50	974.59	2.244	0.4	1.36	3.27	15	
UEC-6.1	UEC-C6.1	6.3	0.0	6.3	986.7	987.58	0.217	1.64	5.5	11.06	natural	5' Broad Crested Weir
UEC-6.2	UEC-W6.2	7.6	0.0	7.6	975.00	976.24	0.677	3.34	9.46	18.25	natural	5' Broad Crested Weir
UEC-8	UEC-W8	19.5	24.8	44.2	973.50	974.01	11.427	0.48	1.84	4.91	24	
UEC-8.1	UEC-P8.1	24.8	0.0	24.8	974.00	976.39	0.963	2.36	11.39	30.82	natural	3' Broad Crested Weir
UEC-10	UEC-W10	19.6	135.9	155.5	990.80	992.8	42.774	0.37	1.76	3.15	12	
UEC-10.1	UEC-P10.1	16.4	0.0	16.4	992.89	994.39	1.453	1.88	3.28	4.56	12	
UEC-10.1.1	UEC-P10.1.1	9.0	0.0	9.0	1016.00	1017.06	0.181	4.63	12.44	23.55	24	
UEC-10.2	UEC-C10.2	0.7	57.5	58.3	1,003.50	1,004.35	0.026	1.65	9.16	17.32	15	
UEC-10.3	UEC-P10.3	22.1	35.4	57.5	1005.93	1010.88	4.003	1.63	9.07	17.12	18	
UEC-10.3.1	UEC-P10.3.1	2.9	32.6	35.4	1010.00	1011.58	1.925	2	10.43	26.8	30	

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
UEC-10.3.2	UEC-P10.3.2	4.5	3.2	7.6	1011.00	1012.38	0.403	0.72	2.13	4.54	15	
UEC-10.3.3	UEC-P10.3.3	3.2	0.0	3.2	1016.00	1018.10	0.258	0.76	0.84	0.96	12	
UEC-10.3.4	UEC-P10.3.4	16.0	0.0	16.0	1020.50	1024.51	0.409	4.72	12.01	34.55	18	
UEC-10.4	UEC-P10.4	8.2	0.0	8.2	995.00	998.76	0.533	0.07	0.95	15.85	filtration	5' Broad Crested Weir
UEC-10.5	UEC-W10.5	3.2	26.8	30.0	993.80	994.81	0.117	3.16	8.66	17.18	21,18	
UEC-10.6	UEC-P10.6	26.8	0.0	26.8	997.50	1000.64	4.563	2.82	6.5	10.26	15	
UEC-10.7	UEC-P10.7	13.2	0.0	13.2	992.50	994.52	3.154	1.25	4.12	6.98	15	
UEC-10.9	UEC-P10.9	4.2	5.7	9.9	992.50	993.14	1.24	0.46	2.24	4.26	15	
UEC-10.10	UEC-P10.10	5.7	0.0	5.7	993.00	995.69	0.579	0.1	0.21	2.48	filtration	5' Broad Crested Weir
UEC-10.11	UEC-P10.11	13.2	0.0	13.2	996.00	998.03	1.868	1.61	6.18	9.27	18	
UEC-10.12	UEC-P10.12	8.2	0.0	8.2	991.00	991.75	2.198	0.66	2.74	4.67	15	
UEC-10.13	UEC-P10.13	5.6	0.0	5.6	994.50	995.42	0.761	1.11	3.89	7.01	18	
UEC-10.14	UEC-W10.14	1.7	182.5	184.2	989.00	990.88	1.032	2.21	8.13	16.53	27	
UEC-11	UEC-W11	17.2	760.4	777.6	968.30	970.26	0.602	4.14	18.39	29.84	30	
UEC-11.1	UEC-W11.1	17.9	11.0	28.9	991.00	991.66	2.678	0.6	2.14	5.38	12	
UEC-11.2	UEC-W11.2	11.0	0.0	11.0	994.00	995.48	1.197	0.63	2.32	4.72	15	
UEC-12a	UEC-W12a	3.6	0.0	3.6	998.88	999.68	0.633	0.11	0.6	2.14	15	
UEC-12b	UEC-W12b	2.4	3.6	6.0	996.00	997.01	0.211	0.19	1.09	3.63	15	
UEC-13	UEC-W13	9.2	26.2	35.4	980.50	981.17	4.883	0.76	3.08	8.37	24	
UEC-13.2	UEC-W13.2	6.9	12.0	18.8	987.00	988.31	1.123	0.52	2.72	6.37	18	
UEC-13.3	UEC-W13.3	12.0	0.0	12.0	998.00	999.36	2.652	0.33	1.76	5.05	15	
UEC-13.4	UEC-P13.4	3.8	0.0	3.8	984.50	985.58	1.239	0.4	0.41	1.24	15	
UEC-14	UEC-W14	5.0	43.9	48.9	969.00	970.45	6.645	0.59	2.55	5.36	15	
UEC-14.1	UEC-P14.1	5.9	0.0	5.9	970.50	972.42	1.486	0.4	1.2	2.15	15	
UEC-14.2	UEC-P14.2	2.6	0.0	2.6	969.50	970.44	1.102	0.2	0.41	0.93	15	
UEC-15	UEC-P15	23.1	0.0	23.1	915.00	920.25	1.536	12.78	24.81	68.93	24	
UEC-16	UEC-W16	87.0	1099.0	1186.0	908.00	915.96	78.919	7.02	19.21	23.64	natural	5' Broad Crested Weir, HWL based on UEC-C21
UEC-16.1	UEC-W16.1	40.3	74.1	114.4	940.50	944.52	7.767	0.68	3.21	7.09	12	
UEC-16.2	UEC-P16.2	16.7	6.0	22.7	968.50	972.31	2.226	0.55	2.04	3.93	12	
UEC-16.3	UEC-W16.3	6.0	0.0	6.0	967.00	967.56	0.481	0.45	1.97	5.64	natural	5' Broad Crested Weir
UEC-16.4	UEC-C16.4	32.7	895.6	928.3	927.23	932.13	0.036	26.2	85.41	159.76	78	
UEC-16.5	UEC-C16.5	31.6	856.2	887.8	949.11	954.62	1.677	11.27	41.84	71.86	42,54	
UEC-16.5.1	UEC-P16.5.1	7.0	0.0	7.0	959.50	961.67	1.948	0.44	1.44	2.34	21	
UEC-16.6	UEC-P16.6	7.8	0.0	7.8	941.50	944.10	1.622	0.46	1.6	2.63	18	
UEC-16a	UEC-W16a	25.2	0.0	25.2	910.00	915.19	5.294	6	8.43	10.44	18	
UEC-17	UEC-W17	5.1	0.0	5.1	976.53	977.86	0.336	0.4	2.3	6.79	24	
UEC-18	UEC-P18	69.0	5.1	74.1	970.00	972.72	18.509	0.35	2.32	8.52		30 deg. Sharp-Crested Vee/Trap Weir
UEC-19	UEC-W19	41.9	0.0	41.9	991.00	991.67	25.095	0.08	0.51	1.58	12	
UEC-20	UEC-W20	116.5	65.0	181.5	980.00	980.69	20.164	0.66	2.86	7.73	natural	5' Broad Crested Weir
UEC20.1	UEC-P20.1	23.1	41.9	65.0	985.06	988.95	2.129	0.88	2.15	7.18	15	
UEC-21	UEC-C21	190.4	1921.5	2111.9	905	915.96	30.003	21.95	36.42	47.73	24	
UEC-22	UEC-W22	21.1	0.0	21.1	998.00	998.88	1.64	0.94	4.23	10.97	natural	5' Broad Crested Weir
UEC-23	UEC-W23	175.1	44.4	219.4	975.00	977.34	25.51	7.51	21.33	43.14	natural	5' Broad Crested Weir

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
UEC-23.1	UEC-P23.1	23.2	0.1	23.3	1009.00	1011.97	6.275	3.64	12.39	21.26	24	
UEC-23.2	UEC-W23.2	0.1	0.0	0.1	1025.00	1,025.01	0.012	0	0	0	15	
UEC-26	UEC-W26	114.8	0.0	114.8	977.00	979.01	11.945	5.36	17.35	37.68	natural	5' Broad Crested Weir
UEC-28	UEC-W28	78.4	515.8	594.2	975.00	977.32	65.457	0.95	4.24	7.59	18	
UEC-30	UEC-W30	88.4	27.4	115.8	975.00	977.66	5.853	9.83	35.39	57.84	natural	5' Broad Crested Weir
UEC-32	UEC-W32	0.1	0.0	0.1	986.82	986.82	0.025	0	0	0	15	
UEC-33	UEC-W33	25.8	0.0	25.8	950.65	953.34	7.209	2.28	3.16	3.89	12	
UEC-34	UEC-W34	27.4	0.0	27.4	977.00	978.12	3.104	0.41	1.61	3.98	15	
UEC-35	UEC-W35	16.1	0.0	16.1	910.00	913.02	3	5.4	9.44	12.81	18	
UEC-35.1	UEC-W35.1	4.2	0.0	4.2	958.00	958.76	0.364	1.23	4.1	8.94	natural	5' Broad Crested Weir
UEC-35.10	UEC-P35.10	8.2	0.0	8.2	900.30	903.52	1.507	6.09	12.21	17.81	21	
UEC-35.11	UEC-W35.11	8.8	17.1	26.0	938.50	942.79	2.648	4.09	5.92	7	12	
UEC-35.2	UEC-C35.2	13.1	115.1	128.2	917.43	926.33	1.268	22.96	48.83	134.64	48	
UEC-35.3	UEC-P35.3	5.9	0.0	5.9	937.00	939.01	1.467	3.99	9.39	15.17	24	
UEC-35.4	UEC-P35.4	2.1	0.0	2.1	936.00	937.33	0.703	1.7	3.87	6.53	18	
UEC-35.5	UEC-P35.5	10.6	0.0	10.6	898.00	902.13	2.024	5.36	17.38	40.37	15	
UEC-35.6a	UEC-P35.6a	6.7	108.4	115.1	933.76	937.89	5.074	14.25	43.03	105.74	36	
UEC-35.6b	UEC-P35.6b	3.3	105.1	108.4	933.76	937.89	3.813	40.19	62.73	123.76	natural	5' Broad Crested Weir
UEC-35.6c	UEC-P35.6c	51.2	54.0	105.1	933.76	937.97	7.98	61.4	106.99	167.64	natural	5' Broad Crested Weir
UEC-35.7	UEC-W35.7	4.4	0.0	4.4	947.00	947.72	0.988	1.61	4.19	8.14	natural	5' Broad Crested Weir
UEC-35.7b	UEC-W35.7b	8.4	45.6	54.0	940.60	944.02	0.64	8.62	18.22	29.32	30	
UEC-35.8	UEC-P35.8	41.1	0.0	41.1	946.00	948.72	6.342	0.96	4.9	10.15	18	
UEC-35.9	UEC-P35.9	4.6	0.0	4.6	900.30	902.54	1.278	2.52	6.42	10.09	18	
UEC-37	UEC-W37	65.6	2.4	67.9	941.00	944.5	9.44	29.66	55.06	87.68	natural	5' Broad Crested Weir
UEC-37.1	UEC-P37.1	2.4	0.0	2.4	982.00	983.90	0.312	3.61	6.76	12.41	18	
UEC-38	UEC-W38	31.1	80.0	111.1	936.65	941.59	25.988	16.45	29.69	30.81	30	
UEC-41	UEC-W41	61.6	111.1	172.6	935.00	940.94	19.408	12.71	18.63	20.01	21	
UEC-43	UEC-W43	11.2	0.8	12.1	958.52	963.31	2.003	6.51	9.69	12.05	15	
UEC-43.1	UEC-P43.1	0.6	0.0	0.6	968.80	971.43	0.075	0.06	2.12	4.28	filtration	6' Broad Crested Weir
UEC-43.2	UEC-P43.2	0.2	0.0	0.2	978.80	981.21	0.027	0.01	0.63	1.4	filtration	6' Broad Crested Weir
UEC-47	UEC-W47	148.2	181.8	330.0	917.11	920.15	35.591	12.8	23.4	35.46	36	
UEC-47.1	UEC-P47.1	9.1	0.0	9.1	960.00	961.44	4.381	1.07	4.05	9.88	24	
UEC-48	UEC-W48	53.1	397.2	450.2	915.94	918.9	58.55	7.11	17.07	21.61	30,30	
UEC-48.1	UEC-W48.1	9.2	5.0	14.2	919.14	920.42	2.269	2.36	5.91	11.04	36	
UEC-48.2	UEC-W48.2	5.0	0.0	5.0	925.00	927.38	0.833	3.14	4.92	5.8	1	
UEC-49.1	UEC-W49.1	4.9	0.0	4.9	915.00	917.53	1.876	5.85	8.62	12.98	36,36,15	
UEC-49.2	UEC-W49.2	4.4	74.7	79.1	915.41	917.57	4.787	2.05	5.83	8.32	36	
UEC-49.3	UEC-W49.3	11.4	0.0	11.4	914.20	917.59	12.713	5.47	7.75	9.44	36,48	
UEC-49.4	UEC-P49.4	7.9	0.0	7.9	920.44	923.31	2.983	2.53	4.37	5.83	12	
UEC-49.5	UEC-W49.5	44.0	22.8	66.7	920.00	921.96	15.109	2.32	6.16	8.05	18	
UEC-49.5.4	UEC-P49.5.4	22.8	0.0	22.8	920.00	923.15	3.497	9.96	56.19	94.56	natural	10' Broad Crested Weir
UEC-49.6	UEC-P49.6	2.2	0.0	2.2	918.00	920.06	0.388	2.5	4.5	5.75	15	
UEC-81	UEC-W81	7.9	44.8	52.7	928.40	930.95	3.837	1.03	3.23	5.41	12	

**APPENDIX B
WATER QUANTITY MODELING RESULTS**

AREA ID	BASIN ID	TRIBUTARY AREA (AC)			WATER LEVEL (FT)		100-YR FLOOD STORAGE VOLUME (AC-FT)	PEAK FLOW (CFS)			OUTLET CONTROL	
		DIRECT	PONDED	TOTAL	NWL	100-YR HWL		2-YR	10-YR	100-YR	SIZE (IN)	COMMENTS
UEC-82	UEC-P82	11.2	33.6	44.8	937.50	939.50	3.485	1.07	3.91	6.94	15	
UEC-83	UEC-P83	10.4	23.2	33.6	939.00	942.06	1.646	1.31	5.41	8.94	18	
UEC-84	UEC-W84	14.6	8.6	23.2	940.27	942.41	1.679	0.74	3.58	9.32	21	
UEC-84.1	UEC-W84.1	8.6	0.0	8.6	943.00	944.49	0.613	0.25	1.52	4.16	15	
UEC-85.1	UEC-W85.1	3.5	87.3	90.8	934.00	937	0.535	0.87	2.47	3.05	10	
UEC-85.2	UEC-W85.2	5.0	82.3	87.3	936.00	939.68	1.141	0.85	2.46	3.05	10	
UEC-85.3	UEC-W85.3	27.1	55.2	82.3	942.00	945.46	4.983	0.8	2.38	3.3	10	
UEC-85.4	UEC-W85.4	12.1	0.0	12.1	946.00	948.94	0.859	0.49	2.06	3.01	10	
UEC-85.5	UEC-W85.5	9.2	33.8	43.1	944.00	946.62	4.087	0.44	1.71	2.1	10	
UEC-85.6	UEC-W85.6	31.0	2.8	33.8	945.00	948.13	2.591	0.9	3.44	4.75	12	
UEC-85.7	UEC-W85.7	2.8	0.0	2.8	961.00	961.38	0.252	0.02	0.11	0.38	10	
UEC-86.1	UEC-W86.1	23.3	0.0	23.3	917.00	918.17	4.071	0.43	1.47	3.7	18	
UEC-86.2	UEC-P86.2	4.3	0.0	4.3	920.00	922.58	0.514	6.49	12.64	18.76	24	
UEC-86.3	UEC-P86.3	3.6	0.0	3.6	954.00	956.49	0.322	7.55	13.23	18.49	24	
UEC-87.1	UEC-W87.1	25.4	27.6	53.0	917.00	920.15	6.04	29.38	49.63	74.68	natural	5' Broad Crested Weir
UEC-87.2	UEC-W87.2	27.6	0.0	27.6	918.00	921.53	2.065	28.96	48.97	77	natural	5' Broad Crested Weir
UEC-88.1	UEC-W88.1	65.5	110.8	176.4	920.00	923.65	13.978	14.89	40.67	93.64	natural	5' Broad Crested Weir
UEC-88.2	UEC-W88.2	12.1	0.0	12.1	990.00	991.5	0.297	3.55	11.87	24.46	natural	5' Broad Crested Weir
UEC-88.3	UEC-W88.3	7.4	0.0	7.4	990.00	991.32	0.376	0.83	4.49	11.99	natural	3' Broad Crested Weir
UEC-88.4	UEC-P88.4	11.9	0.0	11.9	955.00	958.83	3.497	5.4	7.59	9.51	15	
UEC-88.5	UEC-C88.5	40.1	13.6	53.6	939	942.02	0.419	30.22	56.4	138.89	natural	10' Broad Crested Weir
UEC-88.6	UEC-P88.6	13.5	0.0	13.5	985.50	990.96	2.892	1.67	7.99	41.03	24	
UEC-89	UEC-W89	2.9	16.6	19.5	950.00	951.33	0.732	0.82	1.79	6.5	18	
UEC-89.1	UEC-P89.1	16.6	0.0	16.6	950.00	954.25	3.033	0.95	1.73	10.24	15	
UEC-90	UEC-P90	16.7	0.0	16.7	924.50	927.48	5.92	9.09	20.48	35.13	36	
UEC-91	UEC-P91	1.7	0.0	1.7	926.30	927.41	0.733	1.56	3.63	6.46	24	
UEC-91.1	UEC-P91.1	5.8	0.0	5.8	965.32	967.70	0.567	0	0.7	5.18	15	
UEC-91.2	UEC-P91.2	1.2	0.0	1.2	968.00	969.77	0.038	0.02	0.72	3.49	natural	3' Broad Crested Weir
UEC-91.3	UEC-CB91.3	0.3	7.0	7.4	964.35	965.28	0.033	0.12	2.6	26.92	21	
UEC-98	UEC-P98	8.1	0.0	8.1	915.30	918.68	0.89	8.84	16.46	23.34	24	
WALLESTAD LAKE	WALLESTAD LAKE	167.5	292.4	467.9	913.50	915.78	79.706	9.76	20.7	35.78	30	

APPENDIX C – MINNESOTA ROUTINE ASSESSMENT
METHOD (MNRAM) VERSION 2.0

MINNESOTA ROUTINE ASSESSMENT METHOD (MnRAM) FOR EVALUATING WETLAND FUNCTIONS - Version 2.0

USER ADVISORIES:

Prerequisites

This primary purpose of this qualitative method is to provide an organized and consistent procedure to document observations and conclusions about wetland processes. It may be modified to fit special circumstances provided justification for the modifications is developed as part of the evaluation. This method requires training and experience in wetland science before it can be accurately applied. Professional judgement incorporated into the evaluation is intended to affect the outcome.

This method is intended for routine applications; for very complex or controversial sites a more elaborate method may be required. When possible (and especially for difficult or controversial sites) it is recommended that a diverse team of trained and experienced wetland professionals conduct the evaluation together. As with any method relying on professional judgement, the results will improve with training, practice and experience.

Several of the assessment items will be easier to complete with less field time if a preliminary office review of references such as the USGS topographic maps, stormwater management maps and plans, the county soil survey, NWI maps, aerial photography, and other off-site resources are checked to establish the history and setting of the wetland under evaluation. An evaluation for a small wetland (<10 acres) with normal circumstances in an area familiar to the evaluator(s) can be usually be completed in about 2 to 3 hours.

Size and Scale

If all other factors are the same, a wetland's total functional capacity is proportional to its size -- thus, size must be a consideration in the evaluation and any subsequent comparisons. Evaluations based on a unit size (e.g., per acre) may allow for a more direct comparison of wetlands of different sizes. However, there is importance in dispersion of wetlands as a wetland can only perform a function where it is located. Cumulatively then, smaller wetlands may provide functional benefits on a broader basis than larger wetlands. Thus, it is important to complete the evaluation with both landscape scale and site specific perspectives in mind.

Reference Standard Wetlands

A REFERENCE STANDARD WETLAND is a wetland judged to have the highest level of overall sustainable functional capacity for its type -- based on a classification system such as Circular 39, the Cowardin/National Wetland Inventory system or the Hydrogeomorphic system (HGM) -- within the Wetland Comparison Domain (see page 4 for definition). Reference Standard Wetlands will be the least disturbed/altered wetlands within the Wetland Comparison Domain. NOTE: In rare circumstances where the Wetland Comparison Domain is too small to include a high quality wetland, Reference Standard Wetlands may be identified in similar areas adjacent to the Wetland Comparison Domain. Functional evaluation of wetlands requires that Reference Standard Wetlands be designated prior to the evaluation to establish a common base of comparison. Ideally, Reference Standard Wetlands of each wetland type should be established in each Wetland Comparison Domain. However, for purposes of expediency, evaluations without Reference Standard Wetland sites may be conducted if the characteristics of Reference Standard Wetlands can be established and agreed to based on previous experience and familiarity with the wetlands in a particular Wetland Comparison Domain.

Functions vs. Values

A wetland function is a physical, chemical, or biological process or attribute of a wetland - simply something a wetland does. For example, the process of retaining surface water is a commonly cited wetland function. A wetland value is the extent to which a wetland function is perceived as beneficial to an individual or society. Reduced flood damages to downstream properties is a value generally associated with the function of surface water retention.

While it's important to understand the distinction between functions and values, land use decisions involving wetlands typically involve consideration of both. Therefore, in the interest of practicality and to provide more useful information for making decisions about wetlands, this assessment method addresses a variety of wetland functions along with some of the related values. An attempt was made to separate the evaluations of functions and values, to provide the user a more clear understanding of how a proposed activity may affect a wetland's ability to perform a particular function, as compared to the function's relative importance (or value) resulting from its location on the landscape or socio-economic influences. This was not always possible, however. Some of the assessment parameters are difficult to assign as functions or values, and are thus combined in the same section. For instance, the assessment of water quality protection includes some purely functional aspects (geomorphological features of the wetland) and some value-related aspects (presence/absence of recreational waterbodies downstream). Other points to remember in conducting and applying the results of this assessment are:

- Wetland functions are closely linked to the long-term sustainability of the assessment wetland as a viable ecosystem.
- Generally, wetland functions can be measured more objectively than values, which are culturally derived. The wetland values included in this wetland assessment method are those that are more easily evaluated and generally thought to be positive.
- There are values associated with all of the assessed functions; some of them are just not explicitly evaluated by this method. In applying the results of this method, decision-makers must consider the relative value of each of the functions and the potential trade-offs involved. The results of this method are intended to provide objective information to aid the decision making process.

Wetland Ranking

A commonly asked question is: "If MnRAM does not use a numerical rank or rating system, who will decide which combination of functions is/are the most important? How can you compare wetlands?" The answer to the first question is the same as always -- people will decide. Functional assessment methods cannot make such decisions. By treating the various functions separately, MnRAM gives decision makers a more complete understanding of the tradeoffs associated with their land use decisions involving wetlands. The results are that MnRAM provides people with much better information for comparing wetlands than methods that somehow integrate all wetland functions into a single number. Such methods obfuscate, rather than illuminate the role that wetlands play in the landscape.

While a need for wetland functional analysis exists, it can lead to the perception of a wetland as a bundle of functions that can be teased apart and scattered around, rather than an integrated ecological system. There is also the risk that, having performed a functional assessment, we think we know all there is to know about a particular wetland, when in fact our understanding may be limited.

Value judgements about which wetland functions are to be given the greatest emphasis are left to the entity conducting or sponsoring the assessment and are best applied in the context of a comprehensive wetland protection and management plan so that decisions about wetlands are made on a landscape, watershed or community basis before an action or proposal necessitates a judgement about use priorities on a case-by-case basis. *Rankings or ratings cannot be used to compare wetlands in different Wetland Comparison Domains.* Before assigning numerical rankings or qualitative ratings, it is necessary to establish Reference Standard Wetland sites for each wetland type in the Wetland Comparison Domain.

Definitions

Major watershed = 81 major watershed units as defined by the U.S. Geological Survey and listed in MN Rule Chapter 8420.0110.

Local watershed = subwatershed area within major watershed.

Immediate Watershed = direct surface drainage area into the wetland.

References

"Wisconsin Department of Natural Resources Rapid Assessment Methodology for Evaluating Functional Values" (David R. Seibert, November 1992).

"A Hydrogeomorphic Classification for Wetlands" (US Army Corps of Engineers, Report WRP-DE-4, Mark Brinson, August 1993).

"A Conceptual Framework for Assessing the Functions of Wetlands" (US Army Corps of Engineers, Report WRP-DE-3, Daniel Smith, August 1993).

"Wetland Plants and Plant Communities of MN and WI", 2nd Ed.; (USACOE - St. Paul District; Eggers & Reed).

"City of Plymouth Wetland Inventory and Ordinance Project"; developed by Peterson Environmental Consulting, Inc.

"City of Bloomington Wetland Inventory Project" as developed by Shelly Peterson and Scott Thureen, City of Bloomington, MN.

"Hydrology of Wisconsin Wetlands. Information Circular 40, U.S. Geological Survey"; Novitski, R.P., 1982.

Developed by Minnesota Interagency Wetlands Group

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U.S. Fish and Wildlife Service: Nick Rowse, Loyd Mitchell, Jack Arnold

St. Louis County Highway Department: Tom Tri

For more information or to receive a copy contact John Jaschke at the Minnesota Board of Water and Soil Resources at (651)296-3767.

C:\WINNT\Profiles\brpelli\Desktop\mnram.wpd September 11, 1998

MINNESOTA ROUTINE ASSESSMENT METHOD FOR EVALUATING WETLAND FUNCTIONS (MnRAM) - Version 2.0

GENERAL INFORMATION:

Project Number or Name:	Wetland Number:
Name of Wetland Owner (if necessary):	
Location: County : Section _____ : ¼ ¼ ¼ Township Range	
Major Watershed:	Minor Watershed: Local Government Unit:
Evaluator(s):	Date(s) of Site Visit(s):

SCOPE AND LIMITATIONS:

1. Description of **temporal factors** of this assessment due to seasonal considerations and/or existing hydrologic and climatic conditions (e.g., after heavy rains, snow or ice cover, frozen soil during drought period, during spring flood, during bird migration). Circle those that apply and list others (use back of page if necessary):

2. Description of the **Wetland Assessment Area**: the project site, the wetland, wetland portion or wetland complex being evaluated. (If the evaluation area consists of more than one wetland type it may be necessary to complete an assessment for more than one **Wetland Assessment Area**.) (Use back of page if necessary):

3. Description of the **Wetland Comparison Domain**: the geographic area (e.g., the political boundary, major or local watershed boundary or ecoregion subsection) used for functional comparison. Briefly explain the reason(s) for the choice of the Wetland Comparison Domain. The Wetland Comparison Domain should generally be of a size so as to include some relatively undisturbed Reference Standard Wetlands. (Use back of page if necessary.):

4. Describe the **purpose** of this assessment: i. regulatory/impact determination ;ii. replacement/mitigation design ;iii. restoration ;iv. monitoring ;v. inventory/planning/classification ;vi. educational;vii. other _____

WETLAND CLASSIFICATION:

Regulatory Jurisdictions (if relevant): USACOE/404 _____ LGU/WCA _____ DNR/PWI _____ USDA _____ local zoning _____

NW I/Cowardin classification(s):	Circular 39 Classification(s):
<p><u>Wetland Type(s)</u>: (see "Wetland Plants and Plant Communities of MN and WI", 2nd Edition ;USACOE - St. Paul District;Eggers and Reed) shallow open water, deep marsh, shallow marsh, sedge meadow, wet meadow, wet to wet-mesic prairie, calcareous fen, open bog, coniferous bog, shrub-carr, alder thicket, hardwood swamp, coniferous swamp, floodplain forest, seasonally flooded basin (circle those that apply)</p>	
Estimated size(s) of entire wetland(s) in acres or square feet:	

Based on the results of the attached functional assessment and best professional judgement, rate the significance of each of the functions for the subject wetland and check the appropriate box. **Complete the table as a summary after doing the functional assessment and consulting the user guidance.**

Indicate whether the evaluation is for "actual" or "projected" conditions. Place a check mark in the box indicating the estimated functional level. If the functional level is determined for "projected" rather than "actual" conditions put the check mark in parentheses (x). The functional level for "actual" conditions is the highest level of functioning possible given the local constraints of disturbance history and current land use. For certain applications of the assessment it may be relevant to evaluate for both "actual" and "projected" conditions. If the evaluation is done for "projected" conditions, describe the "projected" conditions and the reasons for and timelines of the expected changes in the space immediately below the summary table.

CONDITIONS actual___ projected___	FUNCTIONAL LEVEL*					Comments
	N/A	Low	Medium	High	Exceptional	
FUNCTIONS (and Related Values)						
Vegetative Diversity/Integrity^ Plant Comm. #1						
Plant Comm. #2						
Plant Comm. #3						
Plant Comm. #4						
Maintenance of Hydrologic Regime						
Flood/Stormwater/Attenuation						
Water Quality Protection						
Shoreline Protection						
Ground-water Interaction						
Wildlife Habitat						
Fishery Habitat						
Aesthetics/Recreation/Educ./Cultural						
Commercial Uses						

^ if there are distinct plant communities rate each of them separately

Projected conditions (if applicable):

List any **Special/Unique Features** of the wetland as compared to others in the Wetland Comparison Domain (from pg. 9):

* Functional level is based on a comparison with a REFERENCE STANDARD WETLAND. A REFERENCE STANDARD WETLAND is a wetland judged to have the highest level of overall sustainable functional capacity for a particular type (based on

a classification system such as Circular 39, Cowardin/NWI or HGM) within the Wetland Comparison Domain. See page 1 for more information about Reference Standard Wetlands.

SITE DESCRIPTION

I. HYDROLOGIC SETTING

A. Describe the hydrogeomorphology of the wetland (check those that apply):

- Depressional
- Riverine (within the river/stream banks)
- Lacustrine Fringe (edge of deepwater areas)
- Extensive Peatland
- Slope
- Floodplain
- Other _____

B. The hydrology source is primarily: Ground water only Surface water only
See Appendix B Both (Surface and Ground water) Unknown

Additional Observations/Descriptions: _____

C. Has the hydrology of (a.) the wetland, or (b.) the wetland's immediate watershed, been substantially altered by excavation, ditching, tiles, dams, culverts, pumping, diversion of surface flow, or changes to runoff within the immediate watershed (circle those that apply)?

- a.) Yes ___ No ___ **If Yes; when and how?**
b.) Yes ___ No ___ **If Yes; when and how?**

D. Does the wetland have discernable inlets or outlets? ___ If Yes, describe each inlet and outlet.

inlets: _____

outlets: _____

E. Does the wetland have standing water? _____ If yes, maximum depth (if known)? _____
Approximately how much of the wetland is inundated? _____% Date of observation ___/___/___

F. What is the predominant hydroperiod (seasonal water level pattern) of the wetland(s)?

- Permanently Inundated (surface water present all year in every year)
- Intermittently Exposed (surface water present all year, except during severe droughts)
- Semi-Permanently Inundated (surface water present throughout growing season in most years)
- Seasonally Inundated (surface water present for extended periods in early growing season but absent by end of the growing season in most years)
- Temporarily Inundated (surface water present for brief periods during the growing season, water table usually below soil surface)
- Permanently Saturated (surface water seldom present but substrate permanently saturated except during severe drought)
- Saturated (surface water seldom present but substrate saturated for extended periods during the growing season)
- Artificially Inundated (surface water controlled or induced by pumps/dikes/dams, etc.)

G. List any waters or wetlands in close proximity to the wetland. Note approximate distance from the wetland and if

there is a surface water connection to other surface waters or wetlands.

II. VEGETATION

A. Identify the type and amount of vegetation species present by dominant species in each stratum (can be >100%).
% cover

%	floating leaved dominants:
%	submerged aquatic dominants:
%	herbaceous ground layer:
%	emergent dominants:
%	shrub dominants:
%	deciduous tree dominants:
%	coniferous tree dominants:
%	other (including altered conditions):

Natural vegetation altered: _____ % of area

Is the method of alteration _____ and frequency of occurrence _____

Invasive/Exotic species: _____ % of area

List species:

III. SOILS

General Description of Soil(s) from Soil Survey and on Site:

	Adjacent UPLAND Area	WETLAND Area
Soil Survey Classification(s): Is the area an inclusion? Y N U		
Soil texture and drainage characteristics		
Soil disturbed? If yes, describe below.		
Field Observations:		

V. SURROUNDING LAND USES

A. What is the estimated area of the wetland's immediate watershed in acres (*optional*)? _____

B. Describe the surrounding land uses in the table:

LAND-USE	Estimated % of Wetland's Immediate Watershed (Can be >100%)
Developed (Industrial/Commercial/Residential)	
Agricultural: cropland	
Agricultural: feedlots	
Agricultural: grazing	
Forested	
Grassed (without grazing)	
Recreation areas/parks	
Highways/Roads	
Mining (specify type)	
Water and wetlands	
Other (specify)	

VI. SITE SKETCH or Photograph

FUNCTIONAL ASSESSMENT

The following assessment requires the evaluator to examine site conditions and document that a particular wetland function or related value is present and to assess the capability of the wetland to perform those functions or related values. Positive answers to questions generally indicate the presence of factors important for a function or related value. The questions are only provided to guide and document the evaluation. After completing each section, the trained evaluator should consider the factors observed and use best professional judgement to rate their capability as compared to a Reference Standard Wetland in the same wetland comparison domain. The ratings should be recorded on the page 5 summary.

Special Features

1. Is the wetland part of, or directly adjacent to, an area of special natural resource interest? Check those that apply:
 - ___a. Designated trout streams or trout lakes (see MNDNR Commissioners Order 2450 Part 6262.0400 subparts 3 and 5);
 - ___b. State or Federal designated wild and scenic river (see MN Rule Ch. 7050);
 - ___c. Calcareous fen (see MN Rule Ch. 7050)
 - ___d. Scientific and natural area or rare natural community (see MN Rule Ch. 7050);
 - ___e. A high priority wetland, environmentally sensitive area or environmental corridor identified in a local water management plan,
 - ___f. Federally identified special area management plan, special wetland inventory study, or an advanced delineation and identification study;
 - ___g. Public park, forest, trail or recreation area;
 - ___h. State or Federal fish and wildlife refuges and fish and wildlife management areas;
 - ___i. State or Federal designated wilderness area;
 - ___j. An archeological or historic site as designated by the State Historic Preservation Office.
 - ___k. Federal or state listed endangered, threatened or species of concern in or using the wetland or known adjacent lands. If yes, list the species of concern:
 - ___l. A State Coastal Zone or Shoreland Management Plan area.
 - ___m. A shoreland area identified in a zoning ordinance (generally within 1000 feet from a waterbasin and 300 feet from a watercourse).
 - ___n. A floodplain area identified in a zoning ordinance or map.
 - ___o. A wetland restored or preserved under a conservation easement.
 - ___p. A wetland restored or created for mitigation purposes;
 - ___q. A Wellhead Protection Area;
 - ___r. A sensitive ground-water area;

Vegetative Diversity and Integrity

Step 1: Key out wetland plant community(-ities) within the evaluation area using the following key: **Page 19 - 22 of "Wetland Plants and Plant Communities of MN and WI"; (USACOE - St. Paul District; Eggers and Reed). Copies of the Second Edition (1997) can be purchased from the St. Paul District, U.S. Army Corps of Engineers, Army Corps of Engineers Centre, ATTN: Library/Sales Agent, 190 5th Street East, St. Paul, MN 55101-1638, phone: (612)290-5680.**

- 1A. Mature trees (dbh of 6 inches or more) are present and form closed stands (more than 17 trees per acre; more than a 50 percent canopy cover) on wet, lowland soils (usually floodplains and ancient lake basins) .
- 2A. Hardwood trees are dominant; usually alluvial, peaty/mucky, or poorly drained mineral soils.
- 3A. Silver maple, American elm, river birch, green ash, black willow and/or eastern cottonwood are dominant; growing on alluvial soils associated with riverine systems. FLOODPLAIN FOREST
- 3B. Black ash, yellow birch, silver maple and/or red maple are dominant; northern white cedar may be subdominant; growing on poorly-drained mineral or peat/muck soils, often associated with ancient lake basins. HARDWOOD SWAMP
- 2B. Coniferous trees are dominant; soils usually peaty.
- 4A. Tamarack and/or black spruce are dominant; growing on a continuous sphagnum moss mat and acid, peat soils. CONIFEROUS BOG
- 4B. Northern white cedar and/or tamarack are dominant; continuous sphagnum moss mat absent; usually growing on neutral to alkaline peat/muck soils. CONIFEROUS SWAMP
- 1B. Mature trees are absent or, if present, form open, sparse stands; other woody plants, if present, are shrubs or saplings and pole-size trees (dbh less than 6 inches) less than 20 feet high and growing on wet, lowland, or poorly-drained soils, or in ground-water seepage areas.
- 5A. Community dominated by woody shrubs.
- 6A. Low, woody shrubs usually less than 3 feet high; sphagnum moss mat layer may or may not be present.
- 7A. Shrubs are ericaceous and evergreen growing on a sphagnum moss mat layer; peat soils are acidic. OPEN BOG
- 7B. Shrubs are deciduous, mostly shrubby cinquefoil, often growing on sloping sites with a spring-fed supply of internally flowing, calcareous waters; other calciphiles are also dominant; sphagnum moss mat layer absent; muck/poorly-drained mineral soils are alkaline.CALCAREOUS FEN
- 6B. Tall, woody deciduous shrubs usually greater than 3 feet high; sphagnum moss mat layer absent. SHRUB SWAMPS
- 8A. Speckled alder is dominant; usually on acidic soils in and north of the vegetation tension zone. ALDER THICKET

8B. Willows, red-osier dogwood, silky dogwood, meadowsweet and/or steeplebush are dominant on neutral to alkaline poorly-drained muck/mineral soils; found north and south of the vegetation tension zone.

..... SHRUB-CARR

NOTE: Buckthorns (*Rhamnus* spp.) may occur as dominant shrubs or small trees in disturbed shrub-carrs.

5B. Community dominated by herbaceous plants.

9A. Essentially closed communities, usually with more than 50 percent cover.

10A. Sphagnum moss mat on acid peat soils; leatherleaf, pitcher plants, certain sedges, and other herbaceous species tolerant of low nutrient conditions may be present. OPEN BOG

10B. Sphagnum moss mat absent; dominant vegetation consists of sedges (Cyperaceae), grasses (Gramineae), cattails, giant bur-reed, arrowheads, forbs and/or calciphiles. Soils are usually neutral to alkaline poorly drained mineral soils and mucks.

11A. Over 50 percent of the cover dominance contributed by the sedge family, cattails, giant bur-reed, arrowheads, wild rice, and/or giant reed grass (*Phragmites*).

12A. Herbaceous emergent plants growing on saturated soils to areas covered by standing water up to 6 inches in depth throughout most of the growing season.

13A. Major cover dominance by the sedges (primarily genus *Carex*). SEDGE MEADOW

13B. Major cover dominance by cattails, bulrushes, water plantain, *Phragmites*, arrowheads, and/or lake sedges. SHALLOW MARSH

12B. Herbaceous submergent, floating and emergent plants growing in areas covered by standing water greater than 6 inches in depth throughout most of the growing season. DEEP MARSH

11B. Over 50 percent of the cover dominance contributed by grasses (except wild rice and *Phragmites*), forbs and/or calciphiles.

14A. Spring-fed supply of internally flowing, calcareous waters, often sloping sites; calciphiles such as sterile sedge, wild timothy, Grass-of-Parnassus and lesser fringed gentian are dominant.

..... CALCAREOUS FEN

14B. Water source(s) variable; calciphiles not dominant.

15A. Soils saturated to inundated during the growing season; prairie grasses such as big bluestem, prairie cordgrass and/or Canada bluejoint grass are usually dominant, and various species of lowland prairie forbs are present. WET TO WET-MESIC PRAIRIE

15B. Site rarely inundated, but soils are saturated for all or part of the growing season; dominated by forbs such as giant goldenrod and/or grasses such as reedtop and reed canary grass.

..... FRESH (WET) MEADOW

9B. Essentially open communities, either flats or basins usually with less than 50 percent vegetative cover during the early portion of the growing season, or shallow open water with submergent, floating and/or floating-leaved aquatic vegetation.

16A. Areas of shallow, open water (< 6.6 feet in depth) dominated by submergent, floating and/or floating-leaved aquatic vegetation. SHALLOW, OPEN WATER COMMUNITIES

16B. Shallow depressions or flats; standing water may be present for a few weeks each year, but are dry for much of the growing season; often cultivated or dominated by annuals such as smartweeds and wild millet. SEASONALLY FLOODED BASIN

Step 2: Consult the high, moderate and low quality descriptions for the appropriate plant community. Read the descriptions in that order before making a decision as to which is most applicable. Also, read the following description for "exceptional" quality plant communities applicable to all communities.

Exceptional Quality:

Plant communities undisturbed, or sufficiently recovered from past disturbances, such that they represent pre-European settlement conditions. Non-native plant species are absent or, if present, constitute a minor percent cover of the community. Rare, threatened and/or endangered species (consider both State and Federal listings) may be present. Unique features (e.g., patterned peatlands, virgin prairie, old growth forests) may also be present. Page numbers below refer to "*Wetland Plants and Plant Communities of MN and WI*", 2nd Edition, (USACOE - St. Paul District; Eggers and Reed).

I. SHALLOW, OPEN WATER COMMUNITIES (page 28)

High Quality: Diverse aquatic bed communities dominated by 3 or more species of native aquatic plants such as pondweeds, water lilies, bladderworts, wild celery, duckweeds, water crowfoots, native milfoils, etc.

Moderate Quality: Dominated by 1 or 2 species of native aquatic plants.

Low Quality: Dominated by Eurasian water milfoil; or no aquatic vegetation present.

II.A. and B. DEEP AND SHALLOW MARSHES (page 51-53)

High Quality: Dominated by a diverse assemblage (3 or more species) of native aquatic plants (e.g., bur-reeds, bulrushes, arrowheads, cattails, sweet flag, pondweeds). Cattails comprise less than 40 percent cover. Purple loosestrife absent or comprises less than 5 percent cover.

Moderate Quality: Dominants include at least 2 species of native aquatic plants, often arranged in a band or interspersed as patches. Purple loosestrife, if present, comprises less than 25 percent cover. Cattail, if present, comprises 40 to 85 percent cover.

Low Quality: Purple loosestrife comprises more than 25 percent cover; or cattail comprises more than 85 percent cover.

III. A. SEDGE MEADOWS (page 86)

High Quality: Stands of sedges with 5 or more species of native forbs. Grazing, haying, artificial drainage, stormwater input, excavation and/or impoundment absent or minimal. Reed canary grass, purple loosestrife and/or stinging nettle absent or cumulatively comprise less than 5 percent cover. Buckthorn absent or comprises less than 10 percent cover.

Moderate Quality: Stands of sedges subjected to moderate degree of the disturbances listed above. Two to 4 species of native forbs present. Reed canary grass, purple loosestrife and/or stinging nettle cumulatively comprise less than 40 percent cover. Buckthorn absent or comprises less than 30 percent cover.

Low Quality: Stands of sedges highly impacted by grazing, haying, artificial drainage, stormwater input and/or cropping. Reed canary grass, purple loosestrife and/or stinging nettle cumulatively comprise more than 40 percent cover; and/or buckthorn, if present, comprises greater than 30 percent cover.

III.B. **WET MEADOWS** (page 105)

High Quality: Composed of a diverse assemblage (10 or more species) of native grasses, sedges, rushes and/or forbs. Reed canary grass, if present, comprises less than 20 percent cover. Purple loosestrife absent or comprises less than 5 percent cover. Buckthorn absent or comprises less than 10 percent cover.

Moderate Quality: Community moderately impacted by disturbances (e.g., haying, grazing) and composed of 5 to 9 species of native grasses, sedges, rushes and/or forbs. Reed canary grass comprises less than 40 percent cover. Purple loosestrife, if present, comprises less than 20 percent cover. Buckthorn, if present, comprises less than 30 percent cover.

Low Quality: Community highly impacted such that reed canary grass comprises more than 40 percent cover; and/or purple loosestrife comprises greater than 20 percent cover; and/or buckthorn, if present, comprises greater than 30 percent cover; and/or vegetation is frequently removed by cropping.

III.C. **WET to WET-MESIC PRAIRIES** (page 125)

High Quality: Community composed of native grasses (e.g., prairie cord-grass, Canada bluejoint grass), sedges, and forbs characteristic of wet to wet-mesic prairies. Site is undisturbed or minimally disturbed by cropping, grazing, haying, and/or artificial drainage. Reed canary grass, purple loosestrife, quack grass and/or Canada thistle absent or cumulatively comprise less than 5 percent cover. Buckthorn absent or comprises less than 10 percent cover.

Moderate Quality: Community subjected to moderate degree of disturbances listed above. Reed canary grass, purple loosestrife, quack grass and/or Canada thistle cumulatively comprise less than 40 percent cover. Buckthorn absent or comprises less than 30 percent cover.

Low Quality: Community highly disturbed by activities listed above and reed canary grass, purple loosestrife, quack grass, Canada thistle and/or other undesirable species cumulatively comprise more than 40 percent cover; and/or buckthorn, if present, comprises greater than 30 percent cover; and any frequently cropped wet to wet-mesic prairie.

III.D. **CALCAREOUS FENS** (page 141)

High Quality: Composed of the characteristic assemblage of calcium tolerant or opportunistic species. Community undisturbed or with minimal disturbances such as artificial drainage, ground-water pumping, grazing, filling, excavation, etc. Rare, threatened or endangered species often present. Reed canary grass, *Phragmites*, purple loosestrife and/or stinging nettle absent or cumulatively comprise less than 5 percent cover. Buckthorn absent or comprises less than 10 percent cover.

Moderate Quality: Community moderately impacted by disturbances listed above. Reed canary grass,

Phragmites, purple loosestrife, stinging nettle and/or cattail cumulatively comprise less than 40 percent cover. Buckthorn absent or comprises less than 30 percent cover.

Low Quality: Community highly impacted by the disturbances listed above. Reed canary grass, *Phragmites*, purple loosestrife, stinging nettle and/or cattail cumulatively comprise more than 40 percent cover; and buckthorn, if present, comprises greater than 30 percent cover.

IV.A. OPEN BOGS (page 161)

High Quality: Composed of the characteristic assemblage of sphagnum mosses, sedges and heath family shrubs, often with carnivorous plants and various orchid species. Community undisturbed or with minimal disturbances such as artificial drainage, peat mining, filling, impoundment, stormwater input (especially salt), etc.

Moderate Quality: Community moderately impacted by the disturbances listed above.

Low Quality: Community highly impacted by the disturbances listed above. Indicators could include die-out of sphagnum mosses and/or invasion by buckthorn, aspen, stinging nettle, dewberry, cattail, etc.

IV.B. CONIFEROUS BOGS (page 175)

High Quality: Stands of tamarack and/or black spruce undisturbed or minimally disturbed by artificial drainage, peat mining, logging, filling, impoundment, stormwater input, etc.

Moderate Quality: Stands of tamarack and/or black spruce moderately impacted by disturbances listed above.

Low Quality: Majority of stands of tamarack and/or black spruce dead or dying due to highly disturbed condition. Substantial invasion by buckthorn, aspen, stinging nettle, dewberry, cattail, etc.

V.A. SHRUB-CARRS (page 180)

High Quality: Community undisturbed or minimally disturbed by artificial drainage, grazing, filling or impoundment. Dominated by native shrubs (e.g., dogwoods, willows) with a groundlayer stratum composed of five or more species of native grasses, sedges, rushes and/or forbs. Buckthorn, honeysuckle and/or box elder, if present, cumulatively comprise less than 10 percent cover. Reed canary grass, if present, comprises less than 10 percent cover.

Moderate Quality: Community moderately impacted by the disturbances listed above. One of two types: (1) shrub canopy composed of native species with a nearly monotypic reed canary grass groundlayer; or (2) shrub canopy composed of up to 50 percent non-native or disturbance indicator species (e.g., buckthorn, honeysuckle, box elder) with a groundlayer stratum composed of less than 5 species of native grasses, sedges, rushes and forbs; reed canary grass may be present but comprises less than 50 percent cover.

Low Quality: Community highly impacted by the disturbances listed above. Buckthorn, honeysuckle and/or box elder comprise more than 50 percent canopy cover and the groundlayer stratum is composed of greater than 50 percent cover of reed canary grass or non-native grasses/forbs.

V.B. ALDER THICKETS (page 192)

High Quality: Community undisturbed or minimally disturbed by artificial drainage, grazing, filling,

impoundment, etc. Non-native shrubs (e.g., buckthorn), if present, comprise less than 10 percent cover. Groundlayer stratum may be depauperate or composed of native grasses, sedges, rushes, ferns and/or forbs. Reed canary grass, if present, comprises less than 10 percent cover.

Moderate Quality: Community moderately impacted by the disturbances listed above. Non-native and/or disturbance indicator shrubs (e.g., buckthorn, box elder, honeysuckle) cumulatively comprise less than 40 percent cover. The groundlayer stratum, if present, has less than 50 percent cover of reed canary grass.

Low Quality: Community highly impacted by the disturbances listed above with greater than 40 percent cover contributed by buckthorn, box elder and/or honeysuckle; and/or reed canary grass comprises more than 50 percent cover of the groundlayer stratum.

VI.A. HARDWOOD SWAMPS and VI.B. CONIFEROUS SWAMPS (pages 197 to 213)

High Quality: Stands undisturbed or minimally disturbed by artificial drainage, grazing, logging, impoundment, filling, etc. Seedlings and/or saplings of native tree species evident indicating regeneration. Groundlayer stratum composed of native grasses, sedges, rushes, ferns and/or forbs. Box elder, buckthorn and/or reed canary grass, if present, each comprise less than 10 percent cover.

Moderate Quality: Stands moderately impacted by the above disturbances. Disturbance indicator species such as box elder, quaking aspen and/or eastern cottonwood comprise up to 50 percent cover of tree and sapling strata. Shrub stratum has less than 40 percent cover of buckthorn. Groundlayer stratum has less than 50 percent cover of reed canary grass.

Low Quality: Stands highly impacted by the disturbances listed above. Box elder, quaking aspen, eastern cottonwood, buckthorn and/or reed canary grass comprise more than 50 percent cover in 2 or more strata (e.g., tree, sapling, shrub, groundlayer). Few to no indications of regeneration of native tree species.

VII. FLOODPLAIN FORESTS (page 214)

High Quality: Stands undisturbed or minimally disturbed by artificial drainage, grazing, logging, diking, impoundment, filling, catastrophic flood events, etc. Groundlayer stratum, if present, composed of native forbs/graminoids characteristic of floodplain forests: wood nettle, jewelweed, Virginia rye, cut-leaf coneflower, etc.

Moderate Quality: Stands moderately impacted by the disturbances listed above.

Low Quality: Stands highly impacted by the disturbances listed above. Indicators include high proportion of dead and/or dying native tree species.

VIII. SEASONALLY FLOODED BASINS (page 227)

High Quality: Located within an area of permanent vegetative cover (e.g., forest, prairie, non-agricultural settings) undisturbed or minimally disturbed by artificial drainage, haying, grazing, plowing, stormwater input, or other disturbances.

Moderate Quality: Moderately impacted by the above disturbances -- e.g., partially drained, infrequently cropped, subject to some stormwater input, etc.

Low Quality: Located in frequently cropped agricultural fields or subjected to substantial inputs of stormwater, or other disturbances.

Step 3: Based on the results from Step 1 and Step 2, complete the summary items below.

1. **Y N** Is the wetland plant community scarce or rare within the wetland comparison domain?
2. **Y N** Is an additional plant survey necessary at another time? List reasons.
3. Based on the determination from Step 2; note below the functional level of the plant community(s) present within the Wetland Assessment Area? (Also record on the page 5 summary.)

Plant community #1 = _____
 % of Wetland Assessment Area (*can be >100%*) = _____ functional level = _____

Plant community #2 = _____
 % of Wetland Assessment Area (*can be >100%*) = _____ functional level = _____

Plant community #3 = _____
 % of Wetland Assessment Area (*can be >100%*) = _____ functional level = _____

Plant community #4 = _____
 % of Wetland Assessment Area (*can be >100%*) = _____ functional level = _____

if more than 4 plant communities are present list them on the back of this page

Maintenance of Characteristic Hydrologic Regime

Wetlands with a natural outlet and mostly undisturbed conditions in the wetland and its local watershed would be rated as **exceptional** for this function.

1. Describe the wetland outlet characteristics:

- High = Lacks constructed outlet; or the watercourse/stream has not been ditched/channelized.
- Med. Hi. = Constructed outlet is at or above temporary wetland zone or outlet is managed to duplicate natural conditions;
- Medium = Constricted or managed outlet; outlet lowered to significantly reduce temporary (• 7 days) and/or long-term (• 7 days) storage; evidence of ditched/channelized watercourse.
- Low = Excavated or enlarged outlet; outlet removes most/all long-term storage, no/little/some temporary storage remains.

2. Describe the dominant land use and condition of the upland watershed that contributes to the wetland:

- High = Watershed conditions essentially unaltered; e.g., land use development minimal, idle lands, lands in hay or forests or low intensity grazing on gentle (• 3%) to moderate (3 - 9%) slopes in good to excellent condition.
- Medium = Watershed conditions somewhat modified; e.g., moderate grazing or recent logging on steep (• 9%) slopes; conventional till with residue management on moderate slopes, no-till on steep slopes

Low = Watershed conditions highly modified; e.g., intensive agriculture or grazing, no residue management on moderate or steep slopes, urban semi-pervious or impervious surface, intensive mining activities.

3. Describe the conditions of the wetland itself:

High = No evidence of recent tillage, temporary wetland zone intact; e.g., idle land, hayed or lightly to moderately grazed or logged. No compaction, rutting, or trampling damage to wetland.

Medium = Temporary wetland zone tilled or heavily grazed most years. Zones wetter than temporary receive tillage occasionally. Some compaction, rutting, or trampling in wetland is evident.

Low = Wetland receives conventional tillage most (• 75%) years; or otherwise significantly impacted (e.g., fill, cleared). Severe compaction, rutting, or trampling damage to wetland.

4. For flow-through wetlands, describe the functional level of the wetland in retarding surface water flow in relation to primary wetland vegetation cover type:

High = Abundance, density and interspersion very similar to Reference Standard Wetland

Med.= Abundance, density and interspersion somewhat dissimilar to Reference Standard Wetland

Low = Abundance, density and interspersion differs considerably from Reference Standard Wetland

N/A = not applicable; wetland is not a flow-through type.

USER GUIDANCE -Maintenance of Characteristic Hydrologic Regime

The ability of a wetland to maintain a hydrologic regime characteristic of that expected for the wetland type represented is evaluated based upon wetland characteristics, land use within the wetland, and land use within the upland watershed contributing to the wetland.

Use the predominant rating of **high**, **medium**, or **low** for all factors to identify the wetland's functional level.

Wetlands with unaltered outlet conditions and mostly undisturbed conditions in the wetland and its local watershed would be rated as **exceptional** for this function.

Question Rationale

1. Outlet Characteristics. The ability of a wetland to maintain a hydrologic regime characteristic of the wetland type is somewhat dependent upon whether or not a natural outlet is present, and largely dependent upon whether or not an outlet has been constructed by humans. Constructed outlets can significantly affect the ability of a wetland to provide temporary and long-term water retention, and thus its ability to maintain its characteristic hydrologic regime.

Wetlands with no constructed outlet are functioning at the highest level possible for the type within the wetland comparison domain, and should be rated **high**. Wetlands with managed outlets that maintain the characteristic hydrologic regime should be rated **medium high** (e.g., restored wetlands with watersheds that have been altered). Constructed outlets above the temporary wetland zone are rated **medium high** if managed to mimic natural conditions. Constructed outlets, either surface or subsurface, below the top of the temporary wetland zone reduces the ability of the wetland to provide temporary and long-term water retention; if a constructed outlet is present below the top of the temporary wetland zone, but is such that the wetland is able to provide significant temporary and long-term water retention (i.e., the wetland is only partially drained), the rating should

be **medium**. Constructed outlets, either surface or subsurface, which remove most or all temporary and long-term retention capabilities, significantly reduce the ability of the wetland to maintain its characteristic hydrologic regime; the rating should be **low**.

Constructed outlets that keep open water wetlands open water or keep saturated wetlands saturated are rated **medium**. If the constructed outlet changes the wetland to non-wetland or to deepwater habitat or from saturated conditions to open water or from open water to saturated then it is rated **low**.

2. Dominant upland land use. Upland land use within the watershed contributing to the wetland has a significant influence on the flow of runoff and sediments to the wetland, and thus the ability of the wetland to maintain its characteristic hydrologic regime. The more developed and intensively the watershed is used, the greater the delivery of runoff and sediments to the wetland is likely to be, and the more likely the ability of the wetland to maintain its characteristic hydrologic regime will be reduced.

3. Dominant wetland land use. The land use of the wetland itself affects the soils and vegetation within the wetland, and thus the relationships affecting ground-water discharge and recharge and evapotranspiration. The more developed and intensively the wetland is used, the more likely these relationships are to be impacted, and the more likely the ability of the wetland to maintain its characteristic hydrologic regime will be reduced.

4. Water/Vegetation Proportions and Interspersion. Flow-through wetlands with relatively low proportions of open water to vegetation and low interspersion of water and vegetation are more capable of altering floodflows. Vegetation slows floodwaters by creating frictional drag in proportion to stem density. Flow-through wetlands with dense stands of vegetation and with little open water are more capable of slowing flood water than open water alone.

Functional Level of Maintenance of Characteristic Hydrologic Regime = _____ (record on page 5 summary)

Flood and Stormwater Storage/Attenuation

1. Describe the functional level of the wetland outlet characteristics in providing flood and stormwater storage/attenuation:

High = No outlet or outlet (natural or constructed) above the temporary wetland zone

Moderate = Natural outlet at or below the temporary wetland zone

Low = Excavated or enlarged outlet

2a. Estimate the flood damage potential within the **major** watershed in which the wetland is located.

High = History of flood damages

Moderate = Potential future flood damages

Low = No flood damage history and low potential in the future

2b. Estimate the flood damage potential within the **local** watershed in which the wetland is located.

High = History of flood damages

Moderate = Potential future flood damages

Low = No flood damage history and low potential in the future

3a. Describe the functional level of the wetland in providing flood and stormwater storage/detention in relation to the land cover in the **major** watershed:

- High = Watershed runoff conditions highly modified due to existing development
- Moderate = Watershed runoff conditions reflect moderate development
- Low = Watershed runoff conditions essentially unaltered

3b. Describe the functional level of the wetland in providing flood and stormwater storage/detention in relation to the land cover in the **local** watershed:

- High = Watershed runoff conditions highly modified due to existing development
- Moderate = Watershed runoff conditions reflect moderate development
- Low = Watershed runoff conditions essentially unaltered

4. Describe the functional level of flood and stormwater storage/attenuation based on the predominant upland soils within the local watershed:

- High = Clays or shallow to bedrock
- Moderate = Silts or loams
- Low = Sands

5. For flow-through wetlands, describe the functional level of the wetland in providing flood or stormwater storage/attenuation in relation to primary wetland vegetation cover type:

- High = Dense vegetation
- Moderate = Combination of vegetation and open water
- Low = Primarily open water
- N/A = not applicable, wetland is not a flow-through type

6. Describe the functional level of the wetland in retarding or altering flood flows:

- High = No channels present
- Moderate = Channels present, but not connected
- Low = Channels connecting inlet to outlet

7. Describe the flood/stormwater management level of the wetland.

- High = Receives directed stormwater and water level managed to maximize flood/stormwater retention
- Moderate = Receives directed stormwater and water level unmanaged for flood/stormwater retention
- Low = Receives no directed stormwater and water level unmanaged for flood/stormwater retention

8. Describe the history of wetland losses in the major watershed. Estimate percentage of wetlands lost:
_____ %

- High = Most wetlands drained or filled (more than 50% lost).
- Moderate = Some wetlands drained or filled (20 - 50% lost).
- Low = Few wetlands drained or filled (less than 20% lost).

9. Describe the location of the wetland within the watershed:

local watershed: upper mid lower

major watershed: upper mid lower

USER GUIDANCE - Flood/Storm Water Attenuation

Flood/storm water detention is evaluated based upon wetland characteristics, adjacent land uses, and the wetland location within the watershed. When this method is being used in conjunction with the review of a specific project proposed to take place in the wetland, the focus should more specifically concentrate on determining wetland changes due project construction. Use a predominance of high, medium or low functional levels to identify **high, medium, or low** significance. **Exceptional** functional level is achieved if the wetland is managed to maximize stormwater retention in an area prone to or with the potential for flood damages.

Question Rationale

1. **Outlet Characteristics.** Wetlands with no outlet or an outlet above the temporary wetland zone (fringe) will store water for a longer period of time than wetlands with well-defined outlets. A natural outlet at or below the temporary wetland zone will store some water depending on antecedent climate conditions. Wetlands with excavated or enlarged outlets will store less water than would be expected of a particular wetland type or hydrogeomorphic setting.
2. **Flood Damages.** Wetlands providing floodwater attenuation in watersheds with known or future potential for flood damages take on a higher level of importance for storing flood/stormwater as compared to watersheds where flood damages are unlikely.
3. **Land Cover of the Watershed.** Greater volumes of runoff and quicker and higher flood peaks are produced in watersheds with significant amounts of impervious surfaces, bare soils, and little natural vegetation. A wetland located in a watershed with these characteristics has a greater potential benefit in storing or attenuating floodflows than a wetland subject to natural hydrologic conditions.
4. **Watershed Soils.** Greater runoff and higher flood peaks occur in watersheds having primarily impermeable soils. These types of soils impede infiltration of water and therefore produce increased runoff. Wetlands located downslope in watersheds supporting these conditions are more likely to provide flood attenuation.
5. **Water/Vegetation Proportions and Interspersion.** Wetlands with relatively low proportions of open water to vegetation and low interspersion of water and vegetation are more capable of altering floodflows. Vegetation slows floodwaters by creating frictional drag in proportion to stem density. Wetlands with dense stands of vegetation and with little open water are more capable of slowing flood water than open water alone.
6. **Sheet Flow.** Sheet flow, rather than channel flow, offers greater frictional resistance. The potential for floodflow desynchronization is greater when water flows through the wetland as sheet flow.
7. **Stormwater Management.** Wetlands that are managed to maximize stormwater control -- for example, by manipulation or drawdown of the outlet, by receiving directed stormwater from developed areas, or by increasing the drainage area -- generally provide a higher functional level for flood/stormwater storage than do similar unmanaged wetlands.
8. **Wetland Losses.** Watersheds with high losses of wetlands generally experience greater flooding problems and potential than watersheds where most of the pre-settlement wetlands remain. Thus, the remaining wetlands in areas with high losses become potentially more important for floodwater attenuation.

9. Location in the Watershed. The location of the wetland in the watershed will determine the benefits it provides downstream. Wetlands higher in the watershed will benefit a broader downstream area while wetlands lower in the watershed may provide greater benefits to a specific area.

Function 1 Level of Flood/Storm Water Attenuation = _____ (record on page 5 summary)

Water Quality Protection

1. **Y N** Does the wetland receive direct discharge of managed water (e.g. municipal or road stormwater drainage, agricultural drainage outlet, industrial or municipal wastewater)?
2. **Y N** Do the surrounding or upstream land uses have the potential to deliver significant nutrient and/or sediment loads to the wetland?
3. **Y N** Does the wetland shape, flow inputs, and outlet configuration allow adequate residence time so that sediments are able to settle?
4. **Y N N/A** For non-isolated wetlands, does the wetland have significant vegetative density to decrease water energy and allow settling of suspended materials?
5. **Y N** Does the wetland have significant vegetative material to potentially increase uptake of dissolved nutrients?
6. **Y N** Does the wetland have a vegetative buffer area on upland adjacent to its boundary which slows and filters overland flow? If yes, describe buffer area width and slope:
7. **Y N** Are there recreational lakes, watercourses or water supply sources down gradient in the local watershed?
8. **Y N** Is the position of the wetland in the landscape such that run-off is held or filtered before entering a downstream surface water?
9. **Y N U** Are there signs (or historical reports) of excess nutrient loading to the wetland (e.g. algal mats, excessive submergent macrophyte growth or monotypic vegetation)?

USER GUIDANCE - Water Quality Protection

Water quality protection is evaluated according to the wetland's primary water source, the potential impact of surrounding land uses, estimated storage capacity, vegetation and detritus density, position with respect to other surface waters and evidence of excess nutrient loading. The water quality function of wetlands include numerous chemical, biological and physical processes. When any of these processes are disrupted sufficiently to change the character of the wetland, the wetland water quality is diminished. Wetland water quality should be preserved when possible, and only when no other options are reasonable should a wetland be degraded in order to maintain other downstream waters.

Wetlands can significantly reduce impact from several pollutants through the natural processes of adsorption and entrapment. Background levels of nutrient assimilation by wetlands can reduce excessive plant growth in

downstream lakes, rivers and wetlands. The nutrients of principal concern are phosphorus and nitrogen. Common sources of nutrients are urban storm water and runoff from cultivated fields and feedlots. Forested wetlands retain ammonia during seasonal flooding and wetland environments are effective at denitrification. Wetlands take up metals both by adsorption in the soils and by plant uptake via the roots. They also allow metabolism of oxygen demanding materials and can reduce fecal coliform populations. These pollutants are often buried by deposition of newer plant material, isolating them in the sediments. When the narrow channel of a stream widens into a wetland, stream velocity slows. This allows the sediments to drop out and settle in the wetland. However, excessive sediment deposition resulting from artificially conveyed waters discharged into wetlands or erosion from bare soils adjacent to wetlands can smother wetland benthic organisms which adversely impacts wetland functions. It should also be noted that it is possible for sediments to be resuspended causing increased turbidity in wetland waters which are typically very clear as sediment settling does not necessarily mean it is permanently stabilized.

The water quality function wetlands provide help ameliorate the physical, chemical and biological impacts of pollution in downstream waters. However, wetlands should not be used as "Band-Aid" to mask symptoms of a larger problem such as poor land use practices.

A wetland is rated as **exceptional** if it contributes significantly to the water quality protection of a recreational water or potable water supply source down gradient within the local watershed. A wetland is rated as **high** if it is in the local watershed of a water supply source, waterbody or watercourse and directly contributes to it's water quality. A wetland is rated as **medium** if it is in the local watershed of any other surface water and contributes indirectly or potentially to it's water quality. A wetland is rated as **low** if it performs minimal water quality functions (e.g. ditched flow-through systems that have minimal detention times).

Function 1 Level of Water Quality Protection = _____ (record on page 5 summary)

Shoreline Protection

1. **Y N** Is the wetland a fringe area of a lake or watercourse? If NO, enter "not applicable" for this function in the page 5 summary and skip to the next section. If YES, answer the applicable questions.
2. **Y N** Is the shoreline exposed to frequent wave action caused by a long wind fetch or boat traffic?
3. **Y N** Is the shoreline wetland vegetated with submerged or emergent vegetation in the wash zone that decrease wave energy or perennial wetland species that form dense root mats and/or species that have strong stems that are resistant to erosive forces?
4. **Y N** Is the stream/lake bank prone to erosion due to unstable soils, land uses, or ice flows?
5. **Y N** Is the stream/lake bank vegetated with densely rooted shrubs that provide upper bank stability?
6. **Y N** Does the fringe wetland intercept storm event overland flow before reaching the open water area?

USER GUIDANCE - Shoreline Protection

Shoreline protection is evaluated based on the wetland's proximity to lakes, streams or open water basins and whether the wetland is positioned to absorb erosive forces (i.e. wave action, land uses, unstable soils). Wetlands

are rated as **exceptional** if they are positioned adjacent to lakes, rivers or perennial streams such that they commonly absorb erosive energy. They are rated **high** if they are similarly positioned adjacent to intermittent streams or large open water wetland basins or if they provide interception of storm event overland flow to open water areas. They are rated **medium** if they are adjacent to open water areas but are not strategically positioned so as to warrant a higher rating. They are rated **low** only if they are located in a shoreline area but provide no obvious benefits to the open water area.

Function 1 Level of Shore Line Protection = _____ *(record on page 5 summary)*

Ground-Water Interaction

The ground water interaction function is probably the most difficult to assess, and usually requires additional hydrologic and geologic data. Lack of time and data available may more often than not preclude an assessment of the ground water interaction function. It is included in this method for continuity, and for those instances when more detailed investigation is required or more data are available.

The basic presumptions for assessing the ground water interaction function of wetlands are:

The primary ground water interaction function for **ground-water** supported wetlands is the **discharge** function.

The primary ground water interaction function for **surface-water** supported wetlands is the **recharge** function.

Procedure:

Using the information in Appendix B, characterize the wetland in terms of predominant water source (surface water or ground water), and topography (depression, slope, or extensive flat). Appendix B describes six basic wetland hydrologic conditions. Use the appropriate section below to assess the ground water interaction functional level.

Section I : Ground-Water Supported Wetlands

- " Ground-Water supported Depression wetlands • • • Table 1
- " Ground-Water supported Slope wetlands • • • Table 1
- " Ground-Water supported Extensive Flat Wetlands • • • Table 1

Section II: Surface-Water Supported Wetlands

- " Surface-Water supported Depression wetlands • • • Table 2
- " Surface-Water supported Slope wetlands • • • Table 3
- " Surface-Water supported Extensive Flat Wetlands • • • Table 2

I. Ground - Water Supported Wetlands

The primary ground water interaction function for **ground-water** supported wetlands is the **discharge** function.

A. Look for **discharge indicators:**

1. Primary
 - a. water table slopes toward the wetland (*hydrogeologic atlases, observation well data, piezometer data, water well logs, field investigation*).
 - b. Visible springs, seeps, or up-welling flow areas in wetland.
 - c. Increasing hydraulic head with depth (*piezometer data*).
2. Secondary
 - a. Presence of wetland areas above the primary wetland area readily noticeable by vegetative patterns on areal photos (*air photos, field observation*).
 - b. Flow into the wetland in periods not preceded by large storms.
 - c. Flow out of the wetland during periods not preceded by large storms.

B. Use **Table 1 to assess the ground water recharge function level.**

C. Special Concerns

1. **Calcareous fens** (a special case of ground-water slope wetland) have been designated as having exceptional value.

II. Surface - Water Supported Wetlands

The primary ground water interaction function for **surface-water** supported wetlands is the **recharge** function.

A. Look for **recharge indicators**

1. Primary
 - a. water table slopes away from the wetland (*hydrogeologic atlases, observation well data, piezometer data, water well logs, field investigation*).
 - b. water table in adjacent uplands is below the wetland water level or the wetland is located on or near a ground water flow divide (*hydrogeologic atlases, observation well data, piezometer data, water well logs, field investigation*).
 - c. decreasing hydraulic head with depth (*piezometer data*).
2. Secondary
 - a. wetland has no defined outlet, or outlet restricts outflow (*topographic maps, field investigation*).
 - b. topography slopes steeply below wetland (*topographic maps, field investigation*).

B. Use the appropriate table to assess the ground water recharge function:

Table 2: Surface-Water Supported Depression Wetlands
Surface-Water Supported Extensive Flats Wetlands

Table 3: Surface-Water supported Slope Wetlands

C. Special Concerns

Wherever ground water recharge is indicated in an area such as a sensitive ground water area, a

contribution area to a public water supply, or a wellhead protection area, it should be recorded as a **special/unique** feature. There should be special concern about water quality in the wetland.

Table 1: Ground-Water Supported Wetlands				
Criteria	Info. Source	High	Medium	Low
PRIMARY*:				
Discharge Indicators	see description of discharge indicators above	1 or more Primary Discharge indicators	Only Secondary Recharge and/or Discharge indicators	Discharge indicators NOT present
Degree of Hydrologic Modification (drainage, pumping, diversion, etc.)	field investigation, air photos, maps	ground water discharge NOT affected by hydrologic modifications	ground water discharge altered by hydrologic modifications, but still significant	ground water discharge substantially altered or removed by hydrologic modifications
Substrate Texture	field investigation, soils maps, geologic and hydrogeologic maps, test borings	Gravel, Coarse Sand, Sand	Silty sand, silts, fibric peat	silty clays, clays, sapric peat
SECONDARY*:				
Water Quality	Sampling and analysis	Similar to ground water chemistry: (e.g. pH• 7 conductance • 200-500 µmhos, alkalinity • 50-150 mg/l)	<----->	More like surface water chemistry: (e.g. pH <5, conductance < 100 µmhos, alkalinity < 50 mg/l)

* The criteria listed as **Primary** override the criteria listed as **Secondary** if they differ in assessment of functional level.

Table 2: Surface -Water Supported Depression and Extensive Flats Wetlands

Criteria	Info Source	High	Medium	Low
PRIMARY*:				
Water Level Declines after Rainfall	water level monitoring	Rapid water level declines (below outlet level if any) after rainfall events	<----->	Slow water level declines (below outlet level if any) after rainfall events
Recharge Indicators	see description of discharge indicators above	1 or more Primary Recharge indicators	Only Secondary Recharge indicators	Recharge indicators NOT present
Degree of Hydrologic Modification (from drainage, pumping, diversion, etc.)	field investigation, air photos, maps	ground water recharge NOT affected by hydrologic modifications	ground water recharge diminished by hydrologic modifications, but still significant	ground water recharge substantially diminished or removed by hydrologic modifications
Hydraulic Head	hydrogeologic atlases, piezometer data, water well records, field investigation	Water table is lowered by drought cycles or excessive ground water extraction	Perched or multi-aquifer system	Water level in wetland is close to level of local water table.
Texture of Substrate or Confining Layer	field investigation, soils maps, geologic and hydrogeologic maps, test borings	Gravel, Coarse Sand, Sand	Silty sand, silts, fibric peat	silty clays, clays, sapric peat
SECONDARY*:				
Wetland Size & Configuration	Field investigation, USGS 7½ min topo maps	drainage area / wetland area ratio large	<----->	drainage area / wetland area ratio small
Evapo-transpiration	Estimation techniques, evaporation pan methods; published climate data	ET < potential ET	<----->	ET • potential ET
Vegetation	Field reconnaissance	Sparse vegetation - grasses, etc	<----->	Mixed hardwood, spruce, fir, dense vegetation
Water Quality	Sampling and analysis	TDS • 500 mg/l	<----->	TDS • 1500 mg/l

* The criteria listed as **Primary** override the criteria listed as **Secondary** if they differ in assessment of functional level.

Table 3: Surface -Water supported Slope Wetlands

Criteria	Info Source	High	Medium	Low
Primary*:				
Recharge Indicators	see description of discharge indicators above	1 or more Primary Recharge indicators	Only Secondary Recharge indicators	Recharge indicators NOT present
Degree of Hydrologic Modification (from drainage, pumping, diversion, etc.)	field investigation, air photos, maps	ground water recharge NOT affected by hydrologic modifications	ground water recharge diminished by hydrologic modifications, but still significant	ground water recharge substantially diminished or removed by hydrologic modifications
Hydraulic Head	Hydrogeologic atlases, piezometer data, water well records, field investigation.	River (or lake) is influent to ground water	<----->	River (or lake) is effluent to ground water
Frequency and degree of Water Level Fluctuations	Observation, interviews with cognizant individuals, hydrologic monitoring data.	Frequent or large fluctuations	Occasional fluctuations	Infrequent or small fluctuations
Substrate Texture	Field investigation, soils maps, geologic and hydrogeologic maps, test borings.	Gravel, Coarse Sand, Sand	Silty sand, silts, fibric peat	silty clays, clays, sapric peat
Frequency of Floodplain Inundation	Observation, interviews with cognizant individuals, hydrologic monitoring data.	Regular occurrence with large storm events	Occasional	Seldom
Secondary*:				
Size & Configuration	Field investigation, USGS 7½ min topo maps.	Broad, flat floodplain	<----->	Narrow, steep fringe
Evapo-transpiration	Estimation techniques, evaporation pan methods; published climate data.	ET < potential ET	<----->	ET • potential ET
Vegetation	Field reconnaissance.	Sparse vegetation	<----->	Dense stands
Floodplain Age (Rivers)	Topo maps, soil surveys, geologic maps, field investigation.	Mature, well-developed flood plain with buried ox-bow lakes, etc.	<----->	Young stream channel with relatively high flow velocities.
Origin of Basin (Lakes)	Topo maps, soil surveys, geologic maps, field investigation.	Solution basin (in karst topography areas)	Glacial basin; Stream action (oxbow lakes, fluvial dams)	Tectonic basins

* The criteria listed as **Primary** override the criteria listed as **Secondary** if they differ in assessment of functional level.

User Guidance: Ground - Water Interaction

Information Sources

Wetland assessments for ground water interaction are strengthened with information on the geologic and hydrogeologic setting of the wetland. Information sources include publications and maps (surficial geologic and hydrogeologic maps and atlases, soil surveys, hydrologic atlases, topographic maps), air photos, water well records, engineering boring records, observation well data, piezometer data, field observations and investigation, water quality analyses, and water budget analyses.

Minnesota Geological Survey (MGS)/DNR County Geologic Atlases - where available these are a highly valuable information resource on surficial geology and hydrogeology at the county scale. Contact MGS at 612-627-4782, or <http://geolab.geo.umn.edu/mgs>.

MGS/DNR Regional Hydrogeologic assessments - at the multi-county scale, so are less detailed than the county geologic atlases, but are still a valuable source of information on surficial geology and hydrogeology. Other MGS geologic maps, publications, open file reports - contact MGS for a current list of publications. Soil surveys are a valuable source of information on surficial geology, particularly the descriptions which identify parent material.

USGS Hydrologic Atlas (HA) Series - while getting dated, these are still a good place to start on a regional scale. Available from MGS.

USGS Water Resource Investigations and Reports - if one of these covers the area of investigation don't leave home without it. USGS Minnesota District telephone 612-783-3100; Earth Sciences Information Center in Denver, CO: 303-202-4200; Geologic Information - <http://geology.usgs.gov>; Water Resources Information - <http://h2o.usgs.gov>; National Mapping Information - <http://www-nmd.usgs.gov>

USGS 7½ minute Topographic Maps - the standard base map for any field investigation. Available through MGS or USGS.

Aerial Photos are available at SWCD and USDA local offices and at some cities and library systems.

Water Well Records ("Drillers Logs") - still the basic geologic information source in the state. These include located and verified logs as well as unverified logs. The MGS has the most current set of water well records. Water well records are usually available at SWCD offices. The MGS also maintains the County Well Index (CWI) data base of water well and bore hole records. Many Counties also maintain a local copy of CWI. The MGS Water Well Records Line is 612-627-4784. There is a charge for MGS staff to do a well record search. Highway Engineering Borings - Another valuable source of subsurface information is local and state highway department offices. MNDOT has borehole records for highway alignments and may have greater detail for wetland crossings, bridge sites, and aggregate exploration sites. The latter may include static water level measurements and is included in the Aggregate Source Information System (ASIS). These data can be obtained by calling 612-779-5611.

Observation Well Data are valuable for regional static water levels and for putting wetland water levels in a historical perspective. Available from DNR Waters Division: 612-296-4800.

Field Investigation - there is no substitute for some time spent digging with a shovel or hand auger.

Water Level Records - Wetland water level records (from aerial photos or from direct observations) when used in conjunction with climate data, may be key to assigning the wetland to one of the hydrologic classes.

References - Novitzki, R.P., 1982. Hydrology of Wisconsin Wetlands. Information Circ. 40, U.S. Geological Survey.
- Novitzki, R.P., 1989. Wetland Hydrology. Chapter 5 of Wetlands Ecology and Conservation: Emphasis in Pennsylvania. Ed. by S.K. Majumdar, R.P. Brooks, F.J. Brenner, and R.W. Tiner. Penn. Academy of Science.

Functional Level of Ground-water Interaction = _____ (record on page 5 summary)

Wildlife Habitat: Maintenance of Characteristic Animal Communities

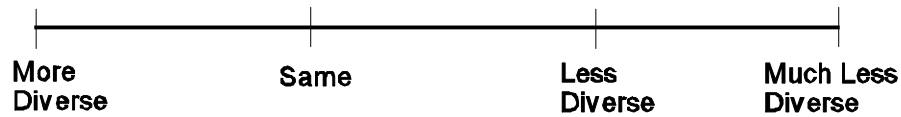
The following questions are designed to help ensure that the various factors involved in assessing the quality of fish and wildlife habitat are considered. There may be site-specific factors affecting the quality of habitat that are not incorporated into the questions or User Guidance. Users must have at least a basic understanding of fish and wildlife habitat requirements to properly employ this method. After answering these questions, consult the User Guidance to assign a functional rating.

Rare/Unique Species and Specialized Habitat

1. Y N Is the wetland known to be used by locally rare species or species that are state or federally listed? (A list of state and federally listed species is attached in Appendix B.) If yes, wildlife habitat functional level rating = exceptional.
2. Y N Is the wetland known to provide specialized habitat components for particular species or groups of species that are not generally available elsewhere (e.g. colonial waterbird nesting colonies, significant amphibian breeding sites, deer wintering yards). If yes, wildlife habitat functional level rating = exceptional.
3. Y N Does the wetland provide seasonal or intermittent habitat components (e.g., amphibian breeding, resting/feeding by migratory waterfowl/shorebirds)?

Habitat Structure

4. Indicate below how the plant species diversity of the evaluation wetland compares with a reference standard wetland of the same type and similar size within the wetland comparison domain.



5. What is the maintenance of characteristic hydrologic regime functional level from the Hydrology Section (on page 18)?
 Exceptional High Medium Low

Habitat Interspersion and Connectivity

6. Describe the dominant land use and condition of the immediate watershed that contributes to the wetland:

 High = Watershed conditions essentially unaltered, e.g., land use development minimal, idle lands, low intensity grazing or haying, forests.
 Med. = Watershed conditions somewhat modified, e.g., moderate intensity grazing or haying; dispersed rowcrop agriculture; low density residential.
 Low = Watershed conditions highly modified, e.g., intensive rowcrop agriculture; urban semi-pervious or impervious surface, high density residential, intensive mining activities.
7. For depressional wetlands, describe the relative abundance (no. of basins/sq. mi.), relative density (acres of wetlands per sq. mi.) and interspersion of various wetland types within a 1 mile radius from the center of the assessment wetland:

- High = Abundance, density and interspersions very similar to Reference Standard Wetland
- Med. = Abundance, density and interspersions somewhat dissimilar to Reference Standard Wetland
- Low = Abundance, density and interspersions differs considerably from Reference Standard Wetland

8. Indicate below the extent to which the wetland either by itself or in conjunction with other habitat types provides a connection between larger wetlands or other habitat types that would otherwise be isolated by intensive agricultural or urban land use.

- High = The wetland provides an important connection for a variety of species, including herpetofauna; other travel corridors are few or non-existent.
- Med = The wetland is likely to be used as a corridor by wider ranging species such as furbearers, deer, and birds; other avenues for wildlife movement may be available.
- Low = The wetland does not provide an obvious connection between other wetlands or habitats; i.e., the wetland is highly isolated or wildlife movement in the area is not limited by available cover.

Maintenance of Regional Biological Diversity

- 9. Y N Considering general habitat characteristics, is the wetland of a type that has been lost or experienced a significant decline within the wetland comparison domain, relative to other wetland types?
- 10. Y N Does the wetland represent the only, or nearly the only wetland habitat within the wetland comparison domain?
- 11. List any wildlife species observed or in evidence (e.g., tracks, scat, nest/burrow, calls, viewer reports), including birds, mammals, reptiles, and amphibians: *(Note: This list is for documentation only and is not necessarily an indication of habitat quality.)*

USER GUIDANCE --Wildlife Habitat: Maintenance of Characteristic Animal Communities

"Wildlife" refers to all animal species, including mammals, birds, reptiles, amphibians, and invertebrates that depend on or utilize wetland habitats within the reference domain. This method assumes that the quality of the wildlife habitat provided by a wetland is related primarily to the level of disturbance or degradation compared to an undisturbed or least disturbed reference standard wetland of the same type *within the wetland comparison domain*. ["Disturbance," as used here refers to human activities or human-induced conditions that tend to reduce natural diversity or disrupt natural processes. Management activities designed to mimic natural processes (e.g., burning, water level management) or to restore natural diversity (e.g., exotic species control) would not be considered "disturbances" in this context.] The functional level of the habitat can also be influenced by the size of the wetland and its position in the landscape relative to other wetlands and habitat types. The method assumes that all wildlife species are ecologically important and that low species diversity is not necessarily a sign of poor wildlife habitat. Some wetland types naturally support a lower diversity of wildlife species or numbers. The assessment of fish and wildlife habitat quality should account for the fact that some wetlands are used only seasonally or intermittently by certain species but are nonetheless important or even critical for those species.

Wetlands with **exceptional** wildlife habitat value are those that represent relatively undisturbed, pristine conditions, and/or are inhabited or frequented by unique or rare species, including those that are state or federally listed (see Appendix B) or species that are rare locally (Question 1). (Note that the presence of

rare, endangered, or threatened species is also addressed under the "Special Features" section of this method.) Wetlands that provide critical habitat components *that are not generally available elsewhere*, even if the species dependent on them are not particularly rare (e.g. colonial waterbird nesting colonies, amphibian breeding sites) should generally be rated exceptional (Question 2). A wetland of a type that has been substantially eliminated within the reference domain would generally warrant an exceptional or high rating if it supports or contributes to the support of wildlife species that may not otherwise be present in the reference domain (Question 9).

A wetland should be rated as providing **high** quality wildlife habitat if it is relatively undisturbed and exhibits nearly the full range of flora and fauna that would be expected to be present in a wetland of that type and size within the wetland comparison domain (Question 4). Such wetlands would typically, though not necessarily, be surrounded by undeveloped uplands or be components of larger wetland complexes (Questions 6,7) and the hydrologic regime would generally be intact (Question 5). Wetlands that provide important connections between other habitat areas may be rated high, even if the habitat quality of the wetland itself is low (Question 8). Similarly, it may be appropriate to assign a high functional rating to wetlands that comprise the only, or nearly only available wetland habitat in the comparison domain, even though the habitat quality of the wetland may be low (Question 10).

Wetlands should be rated as **medium** for wildlife habitat quality if they exhibit some evidence of disturbance or degradation, such as invasion by exotics, extensive monocultures typical of altered hydrologic regimes or degraded water quality, or largely surrounded by developed areas (Questions 4-7). Such wetlands would typically be missing many of the wildlife species that would normally be expected for that type of wetland, and population densities may be reduced. In some instances, a wetland may be so small (either naturally or as a result of previous filling/drainage) that its use by wildlife is limited. However, even very small wetlands may provide important habitat for certain species, such as amphibians, which should be taken into account. Some wetlands that are significantly disturbed or degraded may be considered to have *at least* medium habitat quality if they provide seasonally important habitat components (Question 3). For example, temporary, saturated, or seasonally flooded wetlands that may be cultivated in most years often provide important habitat in the spring and fall for migrating waterfowl and shorebirds.

Low quality wetlands are those that have been so degraded by human activity that they are seldom, if ever used by wildlife. Examples include: i. wetlands that are so polluted that vegetation is absent, ii. extremely small, degraded, isolated wetland remnants, and iii. wetlands exhibiting extremely low vegetative diversity *compared to similar type wetlands within the wetland comparison domain* (Questions 4-7). This may include early stage or failed wetland restorations or creations. Note: Wetlands that have been partially drained such that the wetland type has been altered should be compared to a reference standard wetland of the type that is currently present.

Functional Level of Wildlife Habitat = _____ (*record on page 5 summary*)

Fishery Habitat

1. **Y N** Is the wetland contiguous with a permanent waterbody or watercourse such that it provides spawning/nursery habitat for native fish species?
2. **Y N** Does the wetland intermittently support native fish populations as a result of colonization during flood events?

3. **Y N** Does the wetland support native populations of minnows?
4. List any fish species observed or evidenced: *(Note: This list is for documentation only and is not necessarily an indication of habitat quality.)*

USER GUIDANCE - Fishery Habitat

Generally, the value of a wetland for fish habitat is related to its connection with deepwater habitats. A wetland should be rated as having **high or exceptional** value for fish if it provides spawning/nursery habitat, or refuge for *native* fish species in adjacent lakes, rivers or streams. Some isolated deep marshes may intermittently support populations of sunfish and northern pike as a result of colonization during flood events. Such wetlands should be rated **high to moderate** for fish habitat. Permanently flooded isolated wetlands that support native populations of minnows should be rated as **moderate**. Wetlands with exclusive, high carp populations should be rated as **low** value for fish habitat because carp cause extreme degradation of the wetland. Isolated wetlands that are not permanently flooded do not generally support fish populations. It is important to note that most wetlands indirectly contribute to the maintenance of fish populations in lakes, streams and rivers as a result of their influence on water quality and hydrology.

Functional Level of Fishery Habitat = _____ (record on page 5 summary)

Aesthetics/Recreation/Education/Cultural and Science

1. **Y N** Is the wetland visible from any of the following kinds of vantage points: roads, waterways, trails, public lands, houses, and/or businesses? (Circle all that apply.)
2. **Y N** Is the wetland in/near any population centers so as to generate aesthetic/recreation/educational/cultural use?
3. **Y N** Is any part of the wetland in public or conservation ownership?
4. **Y N** Does the public have direct access to the wetland from public roads or waterways?
5. Is the wetland itself relatively free of obvious human influences, such as:
 - a. **Y N** Structures?
 - b. **Y N** Trash/pollution?
 - c. **Y N** Filling/dredging/drainage?
 - d. **Y N** Invasive vegetation?
6. Is the area surrounding the wetland relatively free of obvious human influences, such as:
 - a. **Y N** Buildings?
 - b. **Y N** Roads?
 - c. **Y N** Other structures?
 - d. **Y N** Altered land uses?
7. **Y N** Does the wetland provide a spatial buffer between developed areas?
8. **Y N** Is the wetland and immediately adjacent area currently being used for (or does it have the potential to be used for) the following recreational activities? (Check all that apply.)

ACTIVITY	CURRENT USE	POTENTIAL USE
Education/cultural/scientific study		

Hiking/biking/skiing		
Hunting/fishing/trapping		
Boating/canoeing		
Food harvesting		
Wildlife observation		
Exploration/play/photography		
Others (list)		

USER GUIDANCE - Aesthetics/Recreation/Education/Cultural and Science

The aesthetics/recreation/education/cultural and science function and value of each wetland is evaluated based on the wetland’s visibility, accessibility, evidence of recreational uses, evidence of human influences (e.g. noise and air pollution) and any known educational or cultural purposes.

Accessibility of the wetland is key to its aesthetic or educational appreciation. Thus, proximity to population centers may increase its perceived importance. However, proximity to population centers and locations in public areas may have associated noise and/or pollution factors that could degrade the aesthetic and educational functional level.

While dependent on accessibility, a wetland's functional level could be evaluated by the view it provides observers. Distinct contrast between the wetland and surrounding upland may increase its perceived importance. Also, diversity of wetland types or vegetation communities may increase its functional level as compared to monotypic open water or vegetation.

A wetland is rated as **exceptional** if it provides unique or rare educational, cultural or recreation functions or values (e.g. it is located in an outdoor learning area or park focused on wetland study or appreciation). A wetland is rated as **high** if it provides any educational use or if it has public access and appreciation, or if it is an undisturbed wetland with visual diversity located in a natural setting. A wetland is rated as **medium** if it is relatively undisturbed with some diversity and is frequently viewed. A wetland is rated **low** if it has minimal visual diversity or recreational use.

Functional Level of Aesthetics/Recreation/Education/Cultural and Science = _____ (record on page 5 summary)

Commercial Uses

1. **Y N** Is or has (circle one) the wetland used to provide a commercial crop, agricultural commodity, or a non-commercial consumptable use? If **NO**, enter "not applicable" for this function in the page 1 summary. If **YES**, list the products the wetland provides:
2. **Y N** Is the hydrology or vegetation artificially permanently or temporarily controlled or modified to sustain the commercial use (circle those that apply)? Describe any alterations.

3. **Y N** Is or has (circle one) the commercial use permanently or temporarily (circle one) diminished the wetland's functional level? If temporary, for how long? _____?

USER GUIDANCE - Commercial Uses

The wetland is rated **exceptional** if it provides a commercial crop, product or agricultural commodity without hydrologic or vegetative modification. A **high** rating is assigned if the wetland produces a commercial crop, product or agricultural commodity with seasonal or temporary modifications. The rating is **medium** if the wetland is used frequently for non-commercial consumptable uses or if production of the commercial crop or product requires permanent or frequent hydrologic or vegetative modification to the wetland. The rating is **low** if the wetland is used for infrequent non-commercial consumptable uses. The rating is **N/A** if the wetland provides no commercial uses.

Functional Level of Commercial Use = _____ (record on page 5 summary)

APPENDIX A

MINNESOTA'S LIST OF ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES 7/1/96

FOR MORE INFORMATION, CONTACT:

Natural Heritage and Nongame Research Program
Section of Ecological Services, Minnesota Department of Natural Resources
500 Lafayette Rd., Box 25
St. Paul MN 55155
Phone: 1-800-766-6000 (or 612-296-6157 in the metro area)
Fax: 612-296-1811

MAMMALS

Threatened

Spiogale putorius eastern spotted skunk

Special Concern

Canis lupus gray wolf (Fed. Status: T)
Cervus elphus elk
Cryptotis parva least shrew
Felis concolor mountain lion
Microtus ochrogaster prairie vole
Microtus pennsylvanicus woodland vole
Mustela nivalis least weasel
Myotis septentrionalis northern myotis
Perognathus flavescens plains pocket mouse
Phocaena inermis leatherhead
Pipistrellus subflavus eastern pipistrelle
Sorex fumeus smoke shrew
Synaptomys borealis northern bog lemming
Thomomys talpoides northern pocket gopher

BIRDS

Endangered

Ammodramus bairdii Baird's sparrow
Ammodramus henslowii Henslow's Sparrow
Anthus spragueii Sprague's Pipit
Cathartes aura chestnut-collared falconet
Charadrius melanotos piping plover (Fed. Status: T)
Rallus elegans king rail
Speotyto cunicularia burrowing owl

Threatened

Cygnus buccinator trumpeter swan
Falco peregrinus peregrine falcon (Fed. Status: E)
Lanius ludovicianus boghead shrike
Phalaropus tricolor Wilson's phalarope
Podiceps auritus horned grebe
Sterna hirundo common tern

Special Concern

Ammodramus neotomi Neotoma sharp-tailed sparrow
Asio flammeus short-eared owl
Buteo lineatus red-tailed hawk
Coturnicops noveboracensis yellow rail
Dendroica cerulea cerulean warbler
Empidonax virens acadian flycatcher
Gallinula chloropus common Moorhen
Haliaeetus leucophthalmus bald eagle (Fed. Status: T)
Larus pipixcan Frank's gull
Limosa fedoa marsh godwit
Pelecanus erythrorhynchos American white pelican
Seiurus motacilla Louisiana water thrush
Sterna forsteri Forster's tern
Tympanuchus cupido greater prairie-chicken
Wilkonia citrina hooded warbler

AMPHIBIANS AND REPTILES

Endangered

Acris crepitans northern cricket frog
Sistrurus catenatus massasauga

Threatened

Clemmys insculpta wood turtle
Crotalus horridus timber rattlesnake
Emydoidea blandingii Blanding's turtle

Special Concern

Apalone mutica smooth softshell
Chelydra serpentina snapping turtle
Coluber constrictor racer
Ehlersia obsoleta ratsnake
Eumeces fasciatus five-lined skink
Hemidactylus scutatum four-toed salamander
Heterodon nasicus western hognose snake
Pituophis catenifer gopher snake
Tropidoclonion lineatum lined snake

FISH

Threatened

Polyodon spathula paddlefish

Special Concern

Acipenser fulvescens lake sturgeon
Alosa chrysochloris skipjack herring
Ammocrypta asprella crystal darter
Aphredoderus sayanus pirate perch
Coregonus kiyi kiyi
Coregonus zenithicus shortjaw cisco
Cyprinella bingatus blue sucker
Erimys taxipunctata grave chub
Etheostoma microperca least darter
Fundulus sciadicus plains topminnow
Icthyomyzon fossor northern brook lamprey
Icthyomyzon gagei southern brook lamprey
Ictiobus niger black buffalo
Morone mississippiensis yellow perch
Notropis amnis pallid shiner
Notropis anogenus pugnose shiner
Notropis nubilus Ozark minnow
Notropis topeka Topeka shiner
Noturus exilis slender madtom
Percina vidua gizzard darter

MOLLUSKS

Endangered

<i>Arcidens confragosus</i>	rock pocketbook
<i>Elptio crassidens</i>	elephant-ear
<i>Fusconia ebena</i>	ebonyshell
<i>Lamprolaima gigas</i>	gigas eye (Fed. Status: E)
<i>Lamprolaima terebra</i>	terebra sandshell
<i>Novasuccinea n. sp.</i> Minnesota B	low paleistocene ambernai I
<i>Pleurobema cyphus</i>	sheepnose
<i>Quadrula fragosa</i>	winged maple leaf (Fed. Status: E)
<i>Quadrula nodulata</i>	wartyback
<i>Vertigo ubrichti ubrichti</i>	Midwest paleistocene vertigo

Threatened

<i>Actinonaias igamentina</i>	mucket
<i>Amblyostoma arginata</i>	elton
<i>Cumbeania monodonta</i>	spectacle case
<i>Cyclobaia tuberculata</i>	purple wartyback
<i>Elipsaria lineolata</i>	butterfly
<i>Epiobasmatia triquetra</i>	snuffbox
<i>Megabasmatia nevada</i>	washboard
<i>Novasuccinea n. sp.</i> Minnesota A	Minnesota paleistocene ambernai I
<i>Pleurobema coccineum</i>	round pigtoe
<i>Quadrula metanvra</i>	monkeyface
<i>Simpsonia ambigua</i>	sandammer mussel
<i>Tritogonia verrucosa</i>	pisgrip
<i>Venustaconcha elpsiformis</i>	elipse
<i>Vertigo ubrichti variabilis</i> n.subsp.	variable paleistocene vertigo
<i>Vertigo meyeri</i>	huffvertigo

Special Concern

<i>Elptio diatata</i>	spike
<i>Lamprolaima compressa</i>	creek-heel
<i>Lamprolaima costata</i>	fluted-shell
<i>Ligumia recta</i>	black sandshell
<i>Obovaria ovata</i>	hickorynut

JUMPING SPIDERS

Special Concern

<i>Abronnatus texanus</i>	a species of jumping spider
<i>Marpissa grata</i>	a species of jumping spider
<i>Megadiplocephalus arizonensis</i>	a species of jumping spider
<i>Paradiplocephalus fontana</i>	a species of jumping spider
<i>Phidippus apacheanus</i>	a species of jumping spider
<i>Phidippus pusillus</i>	a species of jumping spider
<i>Sasacus papilio</i>	a species of jumping spider
<i>Tutilla formicaria</i>	a species of jumping spider

LEAFHOPPERS

Special Concern

<i>Aftisia rubranura</i>	red-tailed prairie leafhopper
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DRAGONFLIES

Special Concern

<i>Ophiogomphus anoma</i>	extra-striped snake tail
<i>Ophiogomphus susbechti</i>	St. Croix snake tail

BUTTERFLIES AND MOTHS

Endangered

<i>Erynnis persius</i>	persius dusky wing
<i>Esperia comata assiniboia</i>	assiniboia skipper
<i>Esperia uncas</i>	uncas skipper
<i>Lycaeides melissa samuelis</i>	Karner blue (Fed. Status: E)
<i>Oeneis uhleri varuna</i>	Uhler's arctic

Threatened

<i>Esperia dactyla</i>	dakota skipper
<i>Esperia ottoe</i>	ottoe skipper
<i>Oarisma garita</i>	garita skipper

Special Concern

<i>Atrytone arogos</i>	arogos skipper
<i>Erebia disa minor</i>	disa pine
<i>Esperia leonardus</i>	leonardus skipper
<i>Lycaeides idas nabokovi</i>	Nabokov's blue
<i>Oarisma poweshieki</i>	poweshie skipper
<i>Pyrgus centaureae freija</i>	grizzled skipper
<i>Schinia indiana</i>	phlox moth
<i>Speyeria idalia</i>	regal fritillary

CADDISFLIES

Endangered

<i>Chironomus tentans</i>	headwaters chironomid
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Special Concern

<i>Agapetus tomus</i>	a species of caddisfly
<i>Asynarchus rossi</i>	a species of caddisfly
<i>Cerata brevis</i>	a species of caddisfly
<i>Cerata vertres</i>	a species of caddisfly
<i>Hydropsyche meyeri</i>	a species of caddisfly
<i>Hydropsyche novico</i>	a species of caddisfly
<i>Hydropsyche tortosa</i>	a species of caddisfly
<i>Oxyethira cornuta</i>	a species of caddisfly
<i>Oxyethira itasca</i>	a species of caddisfly
<i>Polycentropus micha</i>	a species of caddisfly
<i>Procladius taylori</i>	a species of caddisfly
<i>Setodes guttatus</i>	a species of caddisfly

TIGER BEETLES

Endangered

<i>Cicindela fulvipes fulvipes</i>	a species of tiger beetle
<i>Cicindela limbatula nympha</i>	a species of tiger beetle

Threatened

<i>Cicindela denigata</i>	a species of tiger beetle
<i>Cicindela fulvipes wesbournei</i>	a species of tiger beetle
<i>Cicindela laticollis</i>	a species of tiger beetle

Special Concern

<i>Cicindela hirticollis rhodensis</i>	a species of tiger beetle
<i>Cicindela maculata maculata</i>	a species of tiger beetle
<i>Cicindela patula patula</i>	a species of tiger beetle
<i>Cicindela septentrionalis cyanocephala</i>	a species of tiger beetle

VASCULAR PLANTS

Endangered

<i>Aga Inis auriculata</i>	eared false foxglove
<i>Aga Inis gattingeri</i>	round-stemmed false foxglove
<i>Asclepias stenophylla</i>	narrow-leaved milkweed
<i>Astragalus pinus</i>	pine milk-veitch
<i>Bartonia virginica</i>	Virginia bartonia
<i>Botrychium gallicomontanum</i>	frenchman's bliff moonwort
<i>Botrychium oneidense</i>	blunt-leaved grapefern
<i>Botrychium pallidum</i>	pale moonwort
<i>Cacalia suaveolens</i>	sweet-smelling Indian-paintain
<i>Calhannata</i>	flabating marsh-marigold
<i>Carex formosa</i>	handsome sedge
<i>Carex pallescens</i>	pale sedge
<i>Carex pentaginea</i>	paintain-leaved sedge
<i>Castilleja septentrionalis</i>	northern paintbrush
<i>Cheranthès hirsuta</i>	hairy lip-fern
<i>Chrysopsisium iowense</i>	low-growing saxifrage
<i>Cristatella jamesii</i>	James' pothosia
<i>Dodecatheon meadia</i>	prairie shooting star
<i>Draba norvegica</i>	Norwegian whiteb-w-grass
<i>Eloch aris wolffii</i>	Wolf's spike-rush
<i>Empetrum americanum</i>	purple crowberry
<i>Empetrum nigrum</i>	black crowberry
<i>Erythronium propullans</i>	dwaf trout lily (Fed. Status: E)
<i>Escobaria vivipara</i>	barilcactus
<i>Fimbristylis puberula</i> var. <i>interior</i>	hairy fimbristylis
<i>Glaux maritima</i>	sea milkwort
<i>Hydrastis canadensis</i>	goldenseal
<i>Iodanthus pinatifidus</i>	purple rocklet
<i>Isotria medeoloides</i>	blackfoot milkwort
<i>Lechea tenuifolia</i>	narrow-leaved pinweed
<i>Lesquerella lidoviciana</i>	bladder pod
<i>Listera auriculata</i>	auricle tw ayb hde
<i>Mahonia repens</i>	bog adder's-mouth
<i>Marsilea vesiculata</i>	hairy watercress
<i>Montia chamissoi</i>	montia
<i>Oryzopsis hymenoides</i>	Indian rice grass
<i>Osmorhiza breteri</i>	Chickweed sweetcice
<i>Oxytropis viscida</i>	sticky broomweed
<i>Paronychia fastigiata</i>	forked chickweed
<i>Parthenium integrifolium</i>	white quinine
<i>Phacelia fraxinea</i> var. <i>herbifolia</i>	tuberclad rein-orchid
<i>Phacelia fraxinea</i>	western prairie fringed orchid (Fed. Status: T)
<i>Polygonum occidentale</i> ssp. <i>hacustris</i>	western Jacob's-ladder
<i>Polygala cruciata</i>	cross-leaved milkwort
<i>Polytrichum braunii</i>	Braun's holy fern
<i>Potamogeton bicupulatus</i>	snailweed pondweed
<i>Potamogeton diversifolius</i>	diverse-leaved pondweed
<i>Psora lilioides</i>	sunder-leaved scurf pea
<i>Sagina nodosa</i> ssp. <i>lobata</i>	knotty pearlwort
<i>Saxifraga cernua</i>	nodding saxifrage
<i>Scirpus triglochin</i>	taillnut-rush
<i>Sedum integrifolium</i> ssp. <i>eddyi</i>	Leedy's roseroot (Fed. Status: T)
<i>Sehlgeneia selaginoides</i>	northern spike moss
<i>Senecio canus</i>	gray ragwort
<i>Talinum rugospermum</i>	rough-seeded faneflower
<i>Tofieldia pusilla</i>	small false asphodel
<i>Xyris torta</i>	twisted yellow-eyed grass

Threatened

<i>Achillea sibirica</i>	Siberian yarrow
<i>Allium cernuum</i>	nodding wild onion
<i>Allium schoenoprasum</i> var. <i>sibiricum</i>	wild chives
<i>Amphiphys brevis</i>	beach grass
<i>Arabis hoboensis</i> var. <i>retrofracta</i>	hobo rock cress
<i>Arnica montana</i>	berg-leaved arnica
<i>Arnoglossum pentagineum</i>	tuberous Indian-paintain
<i>Asclepias lirioides</i>	prairie milkweed
<i>Asclepias sullivanti</i>	Sullivan's milkweed
<i>Asplenium trichomanes</i>	maidenhair spleenwort
<i>Aster shortii</i>	short aster
<i>Aureolaria pedicularia</i>	fernleaf false foxglove
<i>Besseyia bullii</i>	kit-ten-tail
<i>Botrychium lanceolatum</i>	triangular moonwort
<i>Botrychium lunaria</i>	common moonwort
<i>Botrychium rugosum</i>	St. Lawrence grapefern
<i>Carex careyana</i>	Carey's sedge
<i>Carex conjuncta</i>	jointed sedge
<i>Carex davisi</i>	Davis' sedge
<i>Carex flaccida</i>	flexuous sedge
<i>Carex garberi</i>	Garber's sedge
<i>Carex jamesii</i>	James' sedge

Threatened (cont'd)

<i>Carex katahdinensis</i>	Katahdin sedge
<i>Carex hexaginata</i>	smooth-shaded sedge
<i>Carex hirsuta</i>	spreading sedge
<i>Carex stricta</i>	strict sedge
<i>Crassula aquatica</i>	pignut
<i>Crataegus douglasii</i>	blackhaw thorn
<i>Cyperus acuminatus</i>	sharp-pointed umbrell-sedge
<i>Cypridium arietinum</i>	ram's-head lady's-slipper
<i>Diphysium pycnocarpon</i>	narrow-leaved spleenwort
<i>Dryopteris marginata</i>	marginata lily-fern
<i>Eloch aris nitida</i>	neat spike-rush
<i>Eloch aris ovata</i>	ovate spike-rush
<i>Eloch aris rostrata</i>	beaked spike-rush
<i>Eupatorium sessilifolium</i>	upland boneset
<i>Ferberia proserpinacoides</i>	false mermaid
<i>Illecebraria imosa</i>	mountain
<i>Illecebraria porophylla</i>	rock clubmoss
<i>Lespedeza leptostachya</i>	prairie bush-clover (Fed. Status: T)
<i>Meibomia nitens</i>	three-flowered meibomia
<i>Moehringia acrophylla</i>	brake-leaved sandwort
<i>Napaea dioica</i>	golden meadow
<i>Nymphaea elbergii</i>	small white water lily
<i>Paronychia canadensis</i>	Canadian forked chickweed
<i>Phlegmaria hexagonoptera</i>	broad beech-fern
<i>Phacelia fraxinea</i>	sunder-paintain
<i>Poa pedunculata</i>	bog bluegrass
<i>Polytrichum acrostichoides</i>	Christmas fern
<i>Rhynchospora capitata</i>	hair-like beak-rush
<i>Rotula ramosior</i>	tooth-cup
<i>Rubus chamaemorus</i>	cherry
<i>Salicornia rubra</i>	red saltwort
<i>Saxifraga paniculata</i>	encrusted saxifrage
<i>Scirpus verticillatus</i>	whorled nut-rush
<i>Scutellaria ovata</i>	ovate-leaved skullcap
<i>Shinnersia rostrata</i>	annual spike-rush
<i>Silene nivea</i>	snowy campion
<i>Subularia aquatica</i>	awwort
<i>Sullivantia sullivanti</i>	reniform sullivantia
<i>Vaccinium uliginosum</i>	pineberry
<i>Vaccinium edule</i> var. <i>dilatatum</i>	vacarian
<i>Vicia hirsuta</i>	hairy vetch
<i>Vicia nuttallii</i>	yellow prairie vetch
<i>Woodsia glabella</i>	smooth woodsia
<i>Woodsia scopulina</i>	Rocky Mountain woodsia

Special Concern

<i>Adoxa osculata</i>	mouth-at-1
<i>Agrostis geminata</i>	twinned grass
<i>Androsace septentrionalis</i> ssp. <i>puberulenta</i>	northern androsace
<i>Antennaria parvifolia</i>	small-leaved pussytoes
<i>Aristida purpurea</i> var. <i>dingii</i>	red thimble
<i>Aristida tuberosa</i>	sea-beach needgrass
<i>Asclepias purpurascens</i>	purple milkweed
<i>Asplenium platyneuron</i>	ebony spleenwort
<i>Astragalus flexuosus</i>	sunder milk-veitch
<i>Astragalus missouriensis</i>	Missouri milk-veitch
<i>Bacopa rotundifolia</i>	water-hyssop
<i>Baptisia alba</i>	white wild indigo
<i>Baptisia bracteata</i> var. <i>elucophylla</i>	prairie wild indigo
<i>Botrychium campyloides</i>	prairie moonwort
<i>Botrychium mormon</i>	goblin fern
<i>Botrychium missouriense</i>	Missouri moonwort
<i>Botrychium simplex</i>	east moonwort
<i>Buchnera dactyloides</i>	buffaloberry
<i>Calamagrostis hacustris</i>	marsh reedgrass
<i>Calamagrostis montana</i>	prairie reedgrass
<i>Calamagrostis purpurascens</i>	purple reedgrass
<i>Callitriche heterophylla</i>	larger water-starwort
<i>Carex annectens</i>	yellow-fruited sedge
<i>Carex crus-galli</i>	raven's foot sedge
<i>Carex exilis</i>	coastal sedge
<i>Carex flacca</i>	yellow sedge
<i>Carex hirsuta</i>	hairy sedge
<i>Carex michauxiana</i>	Michaux's sedge
<i>Carex obtusata</i>	blunt sedge
<i>Carex praticola</i>	prairie sedge
<i>Carex scirpoides</i>	northern single spike sedge
<i>Carex supina</i> var. <i>spaniocarpa</i>	weak arctic sedge
<i>Carex typhina</i>	cattail sedge
<i>Carex woodii</i>	Wood's sedge
<i>Carex xerantica</i>	dry sedge
<i>Chamaesyce missurica</i>	Missouri spurge
<i>Cirsium hirsutum</i>	hairy thistle
<i>Chydium mariscoides</i>	twig-rush

Specia lConcern (continued)

<i>Chytônia caro liniana</i>	Caro lna spring-beauty
<i>Cymopterus acaulis</i>	wild parsnip
<i>Cypripedium candidum</i>	small white lady's-slipper
<i>Dactyla candida</i> var. <i>oligophylla</i>	white prairie-clover
<i>Decodon verticillatus</i>	waterwillow
<i>Deschampsia flexuosa</i>	sunder hairgrass
<i>Desmodium illinoense</i>	prairie mimosa
<i>Desmodium cuspidatum</i> var. <i>brngifolium</i>	big tick-trefoil
<i>Desmodium nudiflorum</i>	stemless tick-trefoil
<i>Diarrhena obovata</i>	American beakgrain
<i>Dicentra canadensis</i>	squirrel-corn
<i>Draba arabisans</i>	rock whitew-grass
<i>Drosera anglica</i>	English sundew
<i>Drosera inermis</i>	inert-leaved sundew
<i>Dryopteris gothiana</i>	Goethe's fern
<i>Erechtis parvula</i>	dwarf spike-rush
<i>Erechtis quinquefolia</i>	few-flowered spike-rush
<i>Eryngium yuccifolium</i>	rattlesnake-master
<i>Euphrasia hudsoniana</i>	Hudson Bay eyebright
<i>Fimbristylis autumnalis</i>	autumn fimbriated
<i>Gaiardium aristata</i>	bank-tuff-weed
<i>Gentiana affinis</i>	northern gentian
<i>Gentiana lamarckii</i> ssp. <i>acuta</i>	few-flowered
<i>Gentiana virginiana</i>	witch-hazel
<i>Gentiana nuttallii</i> ssp. <i>nydergii</i>	Nuttall's sunflower
<i>Glechoma hederifolia</i>	oat-grass
<i>Glycyrrhiza lewisii</i>	beach-heather
<i>Glycyrrhiza americana</i>	American water-pennywort
<i>Glycyrrhiza diphylla</i>	twined leaf
<i>Juncus cinereus</i>	butternut
<i>Juncus marginatus</i>	marginated rush
<i>Juncus stygius</i> var. <i>americanus</i>	bog rush
<i>Juniperus horizontalis</i>	creeping juniper
<i>Leersia enticulis</i>	catchfly grass
<i>Limosila aquatica</i>	mudwort
<i>Listera convallarioides</i>	broad-leaved twayblade
<i>Littorella uniflora</i>	American shore-pantain
<i>Luzula parviflora</i> ssp. <i>menocarpa</i>	small-flowered woodrush
<i>Lysimachia quadriflora</i>	whorled boston trifoliate
<i>Machaeranthera pinnatifida</i>	cutleaf ironplant
<i>Machix monophylla</i> var. <i>brachypoda</i>	white adder's-mouth
<i>Minuartia dawsonensis</i>	rock sandwort
<i>Muhlenbergia uniflora</i>	one-flowered mulberry
<i>Najas gracillima</i>	sunder naiad
<i>Najas marina</i>	sea naiad
<i>Oenothera rhomboides</i>	rhomboid evening primrose
<i>Opuntia macrocarpa</i>	prickly pear
<i>Orobanchefasciculata</i>	clustered broomrape
<i>Orobancheludoviciana</i>	Louisiana broomrape
<i>Orobancheflora</i>	one-flowered broomrape
<i>Osmorhiza depauperata</i>	blunt-fruited sweetcicely
<i>Panax quinquefolium</i>	American ginseng
<i>Peltandra purpurea</i>	purple cliff-brake
<i>Phacelia frankii</i>	Franklin's phacelia
<i>Pinguicula vulgaris</i>	butternut
<i>Phytanthera chrysantha</i>	club-spur orchid
<i>Poa waltii</i>	Walt's bluegrass
<i>Polygonum careyi</i>	Carey's smartweed
<i>Polygonum viviparum</i>	pine bistort
<i>Polytaenia nuttallii</i>	prairie-parsnip
<i>Potamogeton vaginatus</i>	sheathed pondweed
<i>Potamogeton vaseyi</i>	Vasey's pondweed
<i>Prenanthes crepidinea</i>	nodding rattlesnake-root
<i>Pyrola minor</i>	small lily-of-the-valley
<i>Ranunculus lapponicus</i>	Lapland buttercup
<i>Rhynchospora fusca</i>	sooty-cocklebur
<i>Rorippa sessiliflora</i>	sessile-flowered cress
<i>Rudbeckia triloba</i>	three-leaved coneflower
<i>Ruppia maritima</i>	ditch-grass
<i>Saxifraga acclivata</i>	Macca lily
<i>Saxifraga peplata</i>	satiny willow
<i>Sanicula trifoliata</i>	beaked snake-root
<i>Scheuchzeria palustris</i>	tumblers
<i>Scirpus cintonii</i>	Cinton's bulrush
<i>Senecio indecorus</i>	elegant grouse-lily
<i>Silene drummondii</i>	Drummond's campion
<i>Solidago mollis</i>	soft goldenrod
<i>Solidago sciaphylla</i>	cliff goldenrod
<i>Sparganium angustifolium</i>	clustered bur-reed
<i>Stellaria bngipes</i>	bng-staked chickweed
<i>Symphyocarpus orbiculatus</i>	cora berry
<i>Tephrosia virginiana</i>	goat's-rue
<i>Torreya balfouriana</i>	Torrey's sassafras
<i>Trillium nivale</i>	snow trillium
<i>Trimorphia acris</i> var. <i>astroides</i>	bitter flabane
<i>Trimorphia bcnchophylla</i>	shortray flabane

Specia lConcern (continued)

<i>Tripsacis purpurea</i>	purple sand-grass
<i>Tsuga canadensis</i>	eastern hemlock
<i>Utricularia purpurea</i>	purple bladderwort
<i>Utricularia resupinata</i>	hanging bladderwort
<i>Verbenasimpliciflora</i>	narrow-leaved vervain
<i>Vitis aestivalis</i>	sikey grape
<i>Waltheimia fragarioides</i>	barren strawberry
<i>Woodсия a pina</i>	pine woodsia
<i>Xyris montana</i>	montane yellow-eyed grass

LICHENS

Endangered

<i>Buellia nigra</i>	a species of lichen
<i>Calobryella parvula</i>	a species of lichen
<i>Deirmatocarpus mougei</i>	a species of lichen
<i>Leptogium apothecense</i>	a species of lichen
<i>Lobaria scrobiculata</i>	a species of lichen
<i>Parmelia stricta</i>	a species of lichen
<i>Pseudocypha lobia crocata</i>	a species of lichen
<i>Umbilicaria torrefacta</i>	a species of lichen

Threatened

<i>Cetraria oakesiana</i>	a species of lichen
<i>Coccocarpia palmarum</i>	a species of lichen
<i>Parmelia stipitata</i>	a species of lichen

Specia lConcern

<i>Anaptychia serotina</i>	a species of lichen
<i>Cetraria aurea</i>	a species of lichen
<i>Chondria pseudorangiformis</i>	a species of lichen
<i>Lobaria rufizans</i>	a species of lichen
<i>Peltigera venosa</i>	a species of lichen
<i>Stictia fuliginosa</i>	a species of lichen

MOSSES

Endangered

<i>Schistocarpus pennsylvanicus</i>	limon moss
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Specia lConcern

<i>Bryoxiphium norvegicum</i>	sword moss
<i>Tomentypnum fasciculatum</i>	a species of moss

FUNGI

Endangered

<i>Fuscobolus weaveri</i>	a species of fungus
<i>Psathyrella cystidiosa</i>	a species of fungus
<i>Psathyrella rhodosporea</i>	a species of fungus

Specia lConcern

<i>Laccaria trillisata</i>	a species of fungus
<i>Lactarius fuliginosus</i>	a species of fungus
<i>Lysurus cruciatus</i>	a species of fungus

Wetland Hydrologic Conditions

Wetland conditions can be categorized hydrologically based upon landscape position and water source. Wetlands occur in depressions , on slopes, or on extensive flats. They are supported by surface water or ground water. The wetland's interaction with surface water and ground water, and its location either in a depression, slope, or extensive flat account for the major hydrologic differences. Based on this principle there are six basic wetland hydrologic conditions (Richard P Novitzki, personal communication, 1988). Individual wetlands may be influenced by more than one of these conditions.

- III. Depression Wetlands (occur in a topographic depression)**
 - A. Ground Water (GW) supported Depression wetlands**
 - B. Surface Water (SW) supported Depression wetlands**

- IV. Slope Wetlands (occur on a slope such as a river floodplain or lake fringe)**
 - A. Ground Water (GW) supported Slope wetlands**
 - B. Surface Water (SW) supported Slope wetlands**

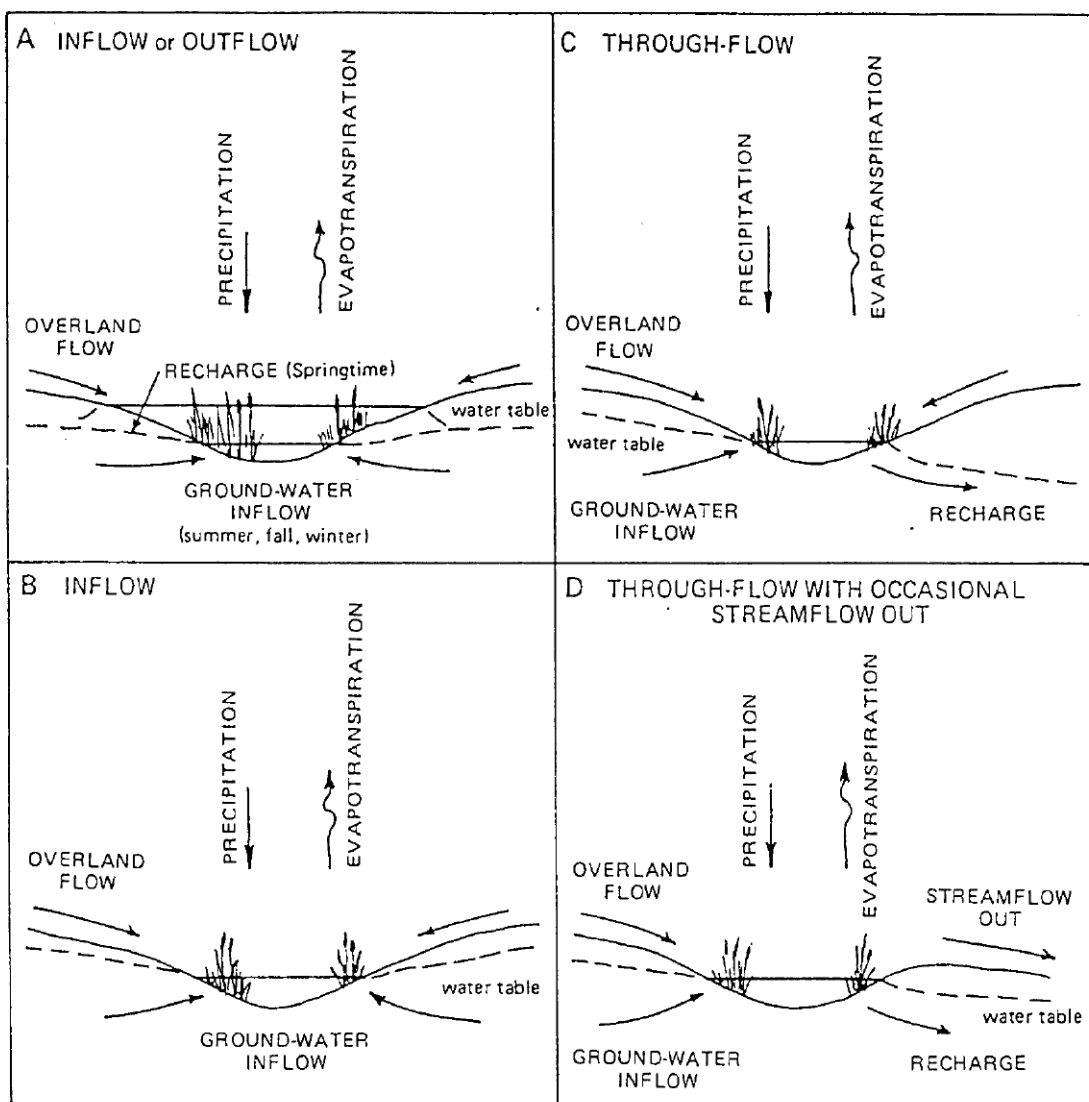
- V. Extensive Flat Wetlands (occur on large, flat plains)**
 - A. Ground Water (GW) supported Extensive Flat Wetlands**
 - B. Surface Water (SW) supported Extensive Flat Wetlands**

I. Depression Wetlands

A. GW Supported Depression Wetlands

Characteristics (& information sources):

1. Topographic depression intercepts the regional water table. Usually indicated if the water table in adjacent uplands is at or near the same elevation as the water level in the wetland (*geologic maps, hydrologic atlases, topographic maps, observation well data, piezometer data, water well records, field investigation*).
2. In most cases, lack of surface drainage away from site. (*topographic maps, field observation*)
3. Smaller watershed-to-wetland area ratio (*topographic maps*)
4. Relatively constant water quality - conductance, alkalinity, pH vary substantially less with time than in surface water depression wetlands (*water quality analysis*).



Flow Components of Ground Water Depression Wetlands (Novitzki, 1982)

B. SW supported Depression Wetlands

Characteristics (& information sources):

- 1. Occurs where precipitation and overland flow collect in a depression. (*topographic maps, field observation*).**
- 2. Receives precipitation and overland flow and loses water by evapotranspiration and ground water recharge (*water budget analysis*).**
- 3. Bottom of depression usually above local water table, or water level in wetland is consistently above local water table (*geologic maps, hydrologic atlases, topographic maps, observation well data, piezometer data, water well records, field investigation*).**
- 4. Water levels are typically high in spring and decline throughout the rest of the year, with smaller scale fluctuations due to single rainfall events (*air photos, water level records, field investigation*).**
- 5. Larger watershed-to-wetland area ratio (*topographic maps*).**
- 6. Water quality varies between spring high water and fall low water. Conductance, hardness, alkalinity lower in the spring and higher in the fall (*water quality analysis*).**

II. Slope Wetlands

A. GW Supported Slope Wetlands

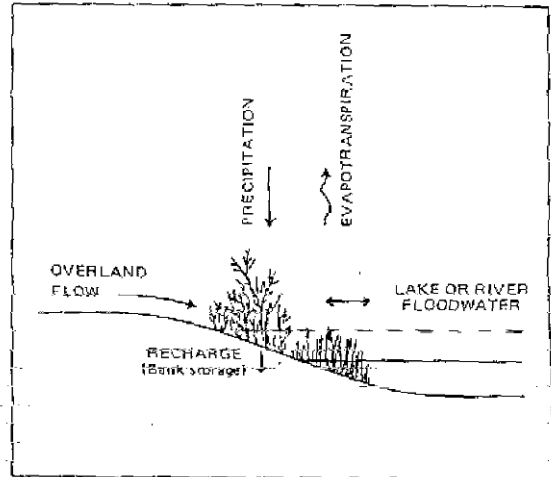
Characteristics (& information sources):

- 1. Ground water discharges as springs or seeps at the land surface.**
- 2. Continuous ground water inflow.**
- 3. Drainage away from the site eliminates permanent ponding.**
- 4. Usually occur at the bottoms of slopes, breaks in slopes, or on hillsides where ground water discharges to the land surface.**
- 5. Increasing hydraulic head with depth (*piezometer data*).**
- 6. Water quality reflects local ground water quality - relatively stable. pH• 7-9, conductance • 150-500 µmhos, alkalinity • 100 -200 mg/l (*water quality analysis*).**

B. SW Supported Slope Wetlands

Characteristics (& information sources):

1. Margins of lake or stream.
2. Include shallow part of lake or river and extends up slope to periodically flooded areas.
3. Water source predominantly lake or river water.
4. Water level usually above local water table (*observation well data, piezometer data*).
5. Drain as river or lake stages fall.



Flow components of Surface Water Slope Wetlands

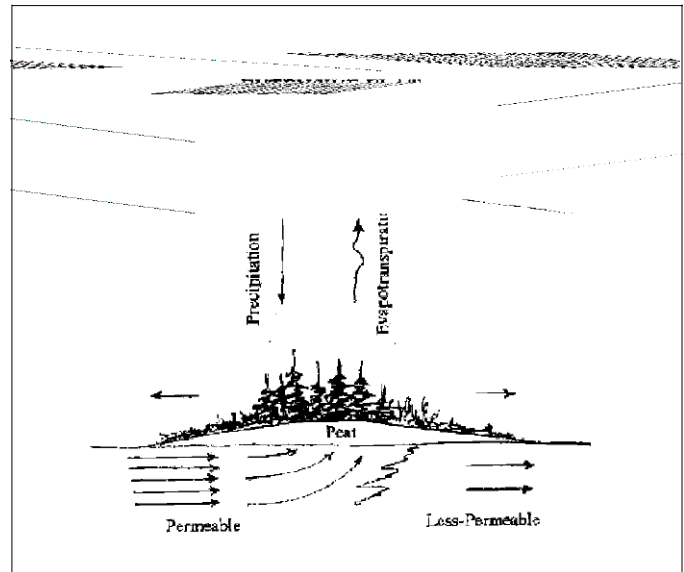
III. Extensive Flat Wetlands

It may be difficult or impossible to distinguish between surface-water supported and ground-water supported extensive flats wetlands. There is probably a continuum between the two, with the degree of surface and ground water support determined by climate, geology, peat accumulation, and other factors. In each the soils are likely saturated to the surface during much of the year. The functions of the two systems are similar, and it may be more appropriate to consider the extensive flats as a single category. However, the continuous wetness associated with the ground-water supported systems may cause the accumulation of organic soils sufficient to constitute "peat deposits", whereas the organic soils associated with surface-water supported systems do not, suggesting a difference in the function of the two systems (R.P. Novitzki, personal communication, 1998).

A. GW supported Extensive Flat Wetlands

Characteristics (& information sources):

1. Typically occur on large, relatively flat plains (*topographic maps, field observation*).
2. Origins due to subsurface stratigraphy or where other physical phenomenon cause ground water to flow to the surface (*geologic maps, hydrologic atlases, topographic maps, observation well data, piezometer data, water well records, field investigation*).
3. Accumulation of organic soils sufficient to constitute “peat deposits” (*geologic maps, soils maps, field investigation*). (Continuing peat accumulation can separate the plant community from the ground water source, changing the water balance from predominantly ground water to predominantly precipitation, as well as changing the plant community).
4. Probably have spread outward from an original ground-water supported wetland area. (As the wetland enlarged the available ground water discharge was spread over a larger area and eventually the wetland area stabilized at the size where the water needed by the plant community balanced the water supplied by ground water discharge and direct precipitation).
5. Relatively flat and can drain from edges. Rarely flooded by more than a few inches. Remain at or near saturation throughout most of the year (*air photos, water level records, field investigation*).
6. During prolonged periods of deficient precipitation, the surface may become dry, and during extreme drought, the peat may become so dry as to support fires.
7. Likely wettest at the center and plant community zones may radiate out from the center.
8. More likely to show relatively long term responses caused by drought cycles (*air photos, water level records, field investigation*).

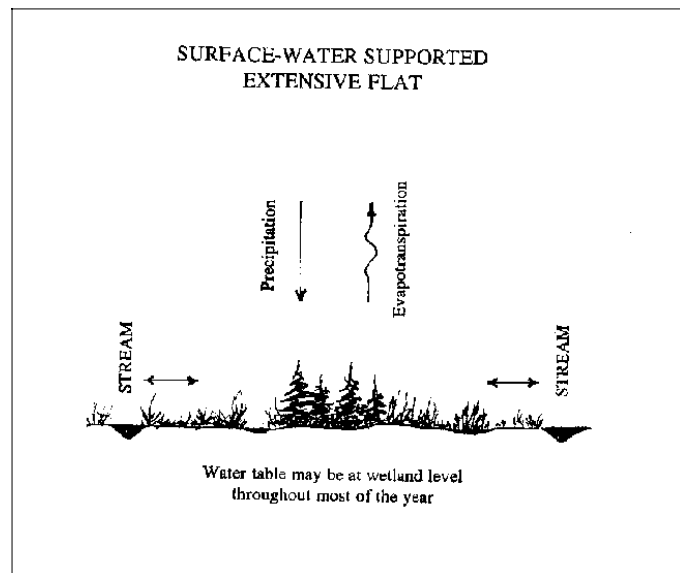


Example of ground-water supported extensive flat wetland. (R.P. Novitzki, personal communication, 1998)

B. SW supported Extensive Flat Wetlands

Characteristics (& information sources):

1. Typically occur on large, poorly drained flat areas (*topographic maps, field observation*).
2. Any streams that pass through such areas are typically of very low gradient and do not effectively drain the area (*topographic maps, field observation*).
3. During snowmelt and early spring rains, may be flooded. In early summer water may slowly drain from storage in the wetland back into streams.
4. Soils beneath the wetland may be saturated for much of the year. Water movement through the soil is slow, inhibited by the low gradients and lack of drainage (*air photos, water level records, field investigation*).
5. Accumulation of organic soils may not be sufficient to constitute “peat deposits” (*geologic maps, soils maps, field investigation*).
6. Likely wettest near streams and plant community zones may parallel the stream network.
7. More likely to show relatively short term responses caused by variations in annual precipitation (*air photos, water level records, field investigation*).



Example of surface-water supported extensive flat wetland. (R.P. Novitzki, personal communication, 1988)

APPENDIX D – WETLAND INVENTORY AND RESTORATION POTENTIAL

APPENDIX D
SUMMARY OF WETLAND FUNCTIONAL VALUE RANKINGS AND CLASSIFICATIONS

Wetland Identification	Unified Wetland Ranking	Wetland Stormwater Susceptibility Classification	Floral Diversity /Integrity	Wildlife Habitat	Approximate Wetland Area (acres)	High Restoration Potential (Yes/No)
CA-W1	Manage 3	Least	Low	Medium/Low	0.75	No
CA-W3	Unique	Highly	Medium/High	Medium/Low	0.3	Yes
CA-W4.1	Unique	Slightly	High	High	0.2	No
CA-W4.2	Unique	Moderately	Medium/Low	High	0.4	No
CA-W8	Manage 3	Least	Low	Medium	0.2	No
CC-W4.1	Manage 1	Moderately	Medium	Medium/High	1.1	No
CC-W5.1	Manage 3	Least	Medium/Low	Medium	1.5	No
CC-W5.2	Manage 3	Least	Low	Medium	4.2	No
CC-W5.3	Unique	Moderately	Medium/High	High	6.2	No
CC-W5.4	Manage 3	Least	Low	Low	1.5	No
CC-W7.1	Manage 3	Slightly	Medium/Low	Medium	6.2	No
CC-W7.2	Manage 3	Least	Low	Low	1.4	No
CC-W9	Manage 3	Least	Low	Low	7.0	No
CC-W12	Unique	Moderately	Medium	High	2.6	No
CC-W12.1a	Manage 3	Least	Low	Medium/High	1.2	No
CC-W12.1b					1.8	No
CC-W14a	Manage 2	Least	Medium/Low	Medium/High	24.9	No
CC-W14b					13.6	No
CC-W14c					6.3	No
CC-W16	Manage 3	Slightly	Medium/Low	Medium/Low	0.6	Yes
CC-W17	Manage 3	Slightly	Medium/Low	Medium/Low	17.5	Yes
CC-W29.2.1	Manage 3	Least	Low	Low	0.1	No
CC-W29.2.2	Manage 1	Moderately	Medium	Medium	1.3	No
CC-W29.2.3	Manage 1	Moderately	Medium	Medium	3.1	No
CC-W33.1	Manage 3	Least	Low	Medium/Low	20.9	Yes
CC-W33.2	Manage 2	Moderately	Medium	Medium/Low	1.1	No
CC-W33.3	Manage 1	Moderately	Medium/High	Medium/High	0.5	No
CC-W34	Manage 3	Slightly	Medium/Low	Medium	0.4	No
CC-W36.1	Manage 3	Least	Low	Medium/Low	1.3	Yes
CC-W37.3.1	Manage 3	Least	Low	Medium	2.5	No
CC-W76a	Manage 3	Least	Low	Medium/Low	1.9	Yes
CC-W76b					0.1	Yes
CC-W76c					0.5	Yes
CH-W1.1	Manage 3	Moderately	Medium/Low	Medium	0.4	No
CH-W6	Manage 3	Least	Medium/Low	Medium	1.0	No
CH-W6.1	Manage 1	Moderately	Medium/High	Medium	0.8	No
CH-W6.2	Unique	Moderately	Medium	High	0.9	No
CH-W8	Manage 3	Least	Low	Medium	4.0	No
CH-W13	Unique	Moderately	High	High	3.4	No
CL-W1.1	Manage 3	Least	Low	Medium	0.4	No
CL-W1.2	Manage 1	Highly	Medium	Medium	0.1	No
CL-W1.3	Manage 3	Least	Low	Medium	0.2	No
CL-W1.4	Unknown	Highly	Exceptional	High	1.0	No
CL-W2	Manage 1	Highly	High	High	0.5	No
EC-W1.14	Unique	Slightly	Medium	High	10.9	No
EC-W1.17	Manage 2	Slightly	Medium/Low	High	52.0	No
EC-W1.34	Manage 3	Least	Low	Low	0.5	No
EC-W1.45	Manage 2	Slightly	Medium/Low	High	0.6	No
EC-W1.48	Manage 3	Least	Low	Low	0.7	No
EC-W50	Manage 3	Least	Low	Medium/High	4.5	No
EC-W50.1	Manage 3	Least	Low	Medium	1.4	No
EC-W51	Manage 1	Moderately	Medium	Medium	3.5	No

Wetland Identification	Unified Wetland Ranking	Wetland Stormwater Susceptibility Classification	Floral Diversity /Integrity	Wildlife Habitat	Approximate Wetland Area (acres)	High Restoration Potential (Yes/No)
EC-W52	Manage 1	Moderately	Medium	Medium	8.5	No
EC-W53	Manage 1	Moderately	Medium	Medium	16.2	No
EC-W53.1	Manage 1	Moderately	Medium	Medium	5.1	No
EC-W55a	Manage 3	Least	Low	Medium	6.0	No
EC-W55b	Manage 3	Least	Low	Medium	1.6	No
EC-W56a	Manage 1	Slightly	Medium	Medium	2.2	No
EC-W56b	Unique	Moderately	Medium	High	27.8	No
EC-W57	Unique	Moderately	Medium	High	48.8	No
EC-W62	Manage 2	NE	NE	NE	26.7	No
EC-W62.1	Manage 2	NE	NE	NE	1.5	No
EC-W62.2	Manage 3	NE	NE	NE	4.7	No
EC-W62.4	Unique	Moderately	Medium	High	2.3	No
EC-W62a	Unique	Least	Medium	High	10.7	No
EC-W65	Manage 3	Least	Medium/Low	Medium	10.6	No
EC-W67a	Manage 3	Least	Low	Low	4.3	No
EC-W67a.2	Manage 3	Least	Low	Low	0.7	No
EC-W69	Unique	Moderately	Medium	High	2.7	No
EC-W74	Manage 2	Least	Medium/Low	High	3.0	No
EC-W74.2	Manage 3	Least	Medium/Low	Low	0.6	No
EC-W76a	Manage 3	Least	Low	Low	1.6	No
EC-W77	Manage 1	Moderately	Medium/High	Medium	2.8	No
UEC-W1	Manage 1	Moderately	Medium	Medium	5.3	No
UEC-W3	Manage 3	Least	Low	Medium	5.6	No
UEC-W3.1	Manage 3	Least	Low	Medium	0.3	No
UEC-W4	Manage 3	Least	Low	Medium/Low	0.8	No
UEC-W5	Unique	Moderately	Medium	High	1.9	No
UEC-W6	Manage 2	Moderately	Medium/Low	Medium/High	6.4	Yes
UEC-W6.2.1	Manage 3	Least	Low	Low	0.2	Yes
UEC-W6.2	Manage 3	Least	Medium/Low	Medium	0.3	No
UEC-W6.3	Manage 3	Least	Low	Medium	0.1	No
UEC-W6.4	Manage 3	Least	Low	Medium	0.7	Yes
UEC-W10	Manage 3	Slightly	Medium/Low	Medium	12.2	Yes
UEC-W10.1	Manage 3	Least	Low	Medium	0.2	No
UEC-W11	Manage 3	Least	Low	Medium	7.7	No
UEC-W13	Manage 1	Moderately	Medium/High	Medium/High	2.2	No
UEC-W13.1	Manage 3	Least	Low	Medium	0.1	Yes
UEC-W14	Manage 3	Slightly	Medium/Low	Medium	1.5	Yes
UEC-W14.1	Manage 3	Least	Low	Medium	1.9	Yes
UEC-W16	Unique	Moderately	Medium/High	High	29.1	No
UEC-W16.1	Manage 3	Least	Low	Medium	0.5	Yes
UEC-W16.2	Manage 3	Slightly	Medium/Low	Medium	0.2	No
UEC-W16.3	Manage 1	Moderately	Medium	Medium/High	2.2	No
UEC-W19	Manage 3	Least	Low	Medium/Low	6.9	No
UEC-W20	Unique	Highly	Exceptional	Exceptional	28.8	Yes
UEC-W22	Manage 3	Least	Low	Low	1.2	Yes
UEC-W23	Manage 3	Least	Low	Medium	37.4	Yes
UEC-W26	Manage 3	Least	Medium/Low	Medium	22.4	Yes
UEC-W28	Manage 3	Moderately	Low	Medium	11.0	Yes
UEC-W31	Manage 3	Least	Low	Medium	1.6	Yes
UEC-W32	Manage 3	NE	NE	NE	8.5	No
UEC-W37	Unique	Moderately	High	High	5.1	No
UEC-W38	Manage 3	Least	Low	Medium	5.1	No
UEC-W43	Unique	Highly	Exceptional	High	1.2	No
UEC-W89	Manage 3	Slightly	NE	Medium	0.8	Yes
HS-W3	Manage 1	Moderately	Medium	Medium/High	1.4	Yes

Wetland Identification	Unified Wetland Ranking	Wetland Stormwater Susceptibility Classification	Floral Diversity /Integrity	Wildlife Habitat	Approximate Wetland Area (acres)	High Restoration Potential (Yes/No)
HS-W3.1	Manage 1	Moderately	Medium	Medium/High	0.4	No
HS-W4.1	Manage 1	Moderately	Medium	Medium	1.0	Yes
HS-W8.2	Manage 1	Moderately	Medium/High	Medium/High	0.3	No
HS-W8.2.1	Unique	Moderately	High	Medium/High	0.2	Yes
HS-W8.2.2	Manage 3	Slightly	Medium/Low	Medium	0.2	No
HS-W16.1	Manage 3	Least	Low	Medium	0.4	No
LB-W1	Unique	Moderately	Medium	High	11.9	No
LB-W2	Manage 3	Least	Low	Medium	0.1	No
LB-W3	Manage 3	Least	Low	Medium	0.9	No
LCC-W2	Manage 3	Least	Low	Medium	1.4	Yes
LCC-W7	Manage 3	Slightly	Medium/Low	Medium	2.8	Yes
LCC-W15.1	Manage 2	Moderately	Medium	Medium/Low	0.3	No
LCC-W21	Manage 2	Moderately	Medium	Medium/Low	1.9	Yes
LCC-W22	Manage 1	Moderately	Medium/High	Medium	1.3	No
LCC-W34.2	Manage 3	Slightly	Medium/Low	Medium	0.1	Yes
LCC-W36.1	Manage 3	Least	Low	Medium	0.1	Yes
SCC-W9a	Manage 2	Moderately	Medium/Low	Medium/High	42.0	No
SCC-W10	Manage 1	Moderately	Medium/High	Medium/High	1.0	No
SCC-W11	Manage 1	Slightly	Medium	Medium	6.5	Yes
SCC-W12.1	Manage 2	Moderately	Medium/Low	Medium/High	20.5	Yes
SCC-W12.4	Manage 3	Least	Low	Medium	1.1	No
SCC-W13	Manage 3	Least	Medium/Low	Medium	1.2	Yes
SCC-W14	Manage 3	Slightly	Medium/Low	Medium	1.4	No
SCC-W20	Manage 3	Slightly	Medium/Low	Medium	1.0	Yes
SCC-W20.1	Manage 1	Moderately	Medium	Medium/High	0.2	Yes
SCC-W22.2.1	Manage 1	Slightly	Medium	High	4.0	No
SCC-W21.1	Manage 3	Least	Low	Medium	0.4	Yes
SCC-W22.2.2	Manage 1	Slightly	Medium	High	5.7	No
SCC-W22.2.4	Manage 2	Highly	Medium/High	Medium/High	0.5	No
SCC-W24	Manage 1	Highly	Medium	Medium	NE	Yes

NE= Needs further evaluation.

DISTRICT CC**Unified Rank: Manage 3****Wetland CC-W16****Stormwater Susceptibility: Slightly**

CC-W16 is a potential wetland restoration that could provide mitigation or wetland banking credit. The wetland portion west of the property line has been tilled and run underground. It was subsequently dozed and is now a hayed waterway. Water is currently flowing into a tile inlet located on the property line. Potential restoration of this basin would involve creating a berm at the property line to restore the wetland to the east.

DISTRICT CC**Unified Rank: Manage 3****Wetland CC-W17****Stormwater Susceptibility: Slightly**

CC-W17 is a potential wetland restoration that could provide mitigation or wetland banking credit. A stream entering from the NW and tile lines entering from the north and northeast provide the primary hydrology for this wetland. This wetland appears to have had the water level lowered by as much as 6-feet by ditching. As discussed in the Critical Storage Pond Descriptions, restoration of this basin will occur with the new proposed water level at the 888' elevation.

DISTRICT CC**Unified Rank: Manage 3****Wetland CC-W33.1****Stormwater Susceptibility: Least**

CC-W33.1 is a potential wetland restoration that could provide mitigation or wetland banking credit. This wetland has been partially drained by a ditch. At its deepest the ditch is approximately 7-feet below the existing ground elevation. Restoration of this basin would involve raising the water level to the 912.5' elevation.

DISTRICT CC**Unified Rank: Manage 3****Wetland CC-W36.1****Stormwater Susceptibility: Least**

CC-W36.1 is a wetland that could be enhanced but would likely not provide any wetland mitigation or banking credit. The wetland is currently dominated by reed canary grass. Enhancements to this basin would involve flooding out the reed canary grass to reestablish emergent vegetation. This wetland has been listed as an enhancement opportunity due to the low cost of the required activity to raise the water level. An existing driveway forms a natural berm. A 24-inch CMP is located under the driveway to provide for the wetland drainage. Placing a structure around the existing CMP and raising the water to approximately 909' (depending on the driveway elevation) will enhance this wetland.

DISTRICT CC**Unified Rank: Manage 3****Wetland CC-W76****Stormwater Susceptibility: Least**

CC-W76 is a potential wetland restoration that could provide mitigation or wetland banking credit. This wetland has a ditch outlet and has been partially drained. Restoration will occur by raising the outlet elevation to the 916' elevation, as discussed in the Critical Storage Pond Descriptions.

DISTRICT LCC

Unified Rank: Manage 3

Wetland LCC-W2

Stormwater Susceptibility: Least

LCC-W2 is a potential wetland restoration that could provide mitigation or wetland banking credit. The outlet for this wetland is an intermittent stream. DOWNCUTTING (approximately 10-feet) has occurred that has resulted in a loss of wetland hydrology. It has been converted from a shallow marsh to a wet meadow dominated by reed canary grass with remnant pockets of blue vervain and green bulrush. Install berm with outlet to raise water level approximately 2-feet.

DISTRICT LCC

Unified Rank: Manage 3

Wetland LCC-W7

Stormwater Susceptibility: Slightly

LCC-W7 is a potential wetland restoration that could provide mitigation or wetland banking credit. The current property owner has indicated that this wetland has a ditch outlet to aid in draining the wetland. Restoration could be accomplished if a ditch block was installed with an outlet raised to pre-ditch elevations. Property owner also indicated that water flow through his property has increased from development located east County Road 11.

DISTRICT LCC

Unified Rank: Manage 2

Wetland LCC-W21

Stormwater Susceptibility: Moderately

LCC-W21 is a wetland that could be enhanced but would likely not provide any wetland mitigation or banking credit. This wetland is a medium quality basin with a diverse assemblage of plants within the deeper portions of the wetland and reed canary grass dominating the fringe of this basin. Enhancement would involve eliminating the reed canary grass along the fringe. Due to the vegetative diversity of the majority of the wetland being high it would likely qualify for a DNR partnership grant.

DISTRICT LCC

Unified Rank: Manage 3

Wetland LCC-W34.2

Stormwater Susceptibility: Slightly

LCC-W34.2 is a small basin that could be restored for wetland mitigation or banking credit. This site has been listed because restoring this basin would help minimize down cutting occurring in a creek downstream: Steep slopes to the stream limit wetland to a narrow fringe along the stream. There is a small depression located near the culvert under County Road 140. Restoration just downstream of the culvert with a berm and structure would reduce discharge to creek and create a small wetland.

DISTRICT LCC

Unified Rank: Manage 3

Wetland LCC-W36.1

Stormwater Susceptibility: Least

LCC-W36.1 is a wetland that could be restored for wetland mitigation or banking credit. This site may not have sufficient hydrology to be delineated as jurisdictional wetland. A driveway has diverted drainage from the west. It appears as though the diversion of drainage has resulted in a lack of hydrology to the basin. There may also be a tile line that contributes to the removal of hydrology in this basin. This site was shown on the National Wetland Inventory map and also showed open water on the 1994 aerial photograph. At the time of the field visit there were no indications of recent inundation and it was not dominated by wetland vegetation.

Hydrology is likely not sufficient to be a jurisdictional wetland. Restoration could be accomplished if drainage is allowed to flow to the depression. Low priority restoration due to location next to road and small size if restored.

DISTRICT SCC

Unified Rank: Manage 1

Wetland SCC-W11

Stormwater Susceptibility: Slightly

SCC-W11 is a basin that could be restored for wetland mitigation or banking credit. A ditch near the outlet under County Road 140 is approximately 8 feet deep and partially drains this basin. It runs parallel to County Rd 147. The greatest effect of the ditch can be observed in the north end of the wetland. Further south it runs along an upland area and therefore does not affect the wetland. Raising the outlet elevation would restore the north portion of this wetland.

DISTRICT SCC

Unified Rank: Manage 3

Wetland SCC-W20

Stormwater Susceptibility: Slightly

SCC-W20 is a wetland that could be enhanced but would likely not provide any wetland mitigation or banking credit. This wetland is a medium quality sedge meadow. Redtop is the species that is non-native but is easily managed with prescribed burning. Due to the vegetative diversity of the majority of the wetland being high it would likely qualify for a DNR partnership grant.

DISTRICT SCC

Unified Rank: Manage 3

Wetland SCC-W21.1

Stormwater Susceptibility: Least

SCC-W21.1 is a wetland that could be restored to provide wetland mitigation or banking credit. The National Wetland Inventory map indicates a Shallow Open Water basin. This wetland has been drained, likely by tile, to reduce the size of the basin and hydrology to a Wet Meadow. Manipulation of the tile would restore this wetland basin.

DISTRICT HS

Unified Rank: Manage 1

Wetland HS-W3

Stormwater Susceptibility: Moderately

HS-W3 is a wetland that could be restored for wetland mitigation or banking credit. A swale has been created to lower wetland historic water elevations. A low berm at the swale to restore the natural overflow of this wetland would enhance the basin. The center portion of the wetland that continues to be an emergent marsh has high floral diversity. A large fringe area of reed canary grass surrounds the emergent marsh. If restored this wetland would serve as a valuable storage area to reduce rates to downstream wetland and stream channel. It also provides a link to a high quality oak forest.

DISTRICT HS

Unified Rank: Manage 1

Wetland HS-W4.1

Stormwater Susceptibility: Moderately

HS-W4.1 is a wetland that could be enhanced but would likely not provide any wetland mitigation or banking credit. This wetland has been periodically plowed, but more recently allowed to regenerate to a sedge meadow. Overall, the quality of this community is excellent, given the level of past disturbance by farming. Due to the vegetative diversity of the majority of the wetland being high it would likely qualify for a DNR partnership grant.

DISTRICT HS

Unified Rank: Manage 1

Wetland HS-W8.2.1

Stormwater Susceptibility: Moderately

HS-W8.2.1 is a wetland that could be enhanced and has potential to provide wetland mitigation or banking credit. Small outlet ditch, maybe hand-dug. Hydrology would be very easy to restore to this basin. Overall, this wetland is of high to exceptional quality for the study area. This is a good quality depressional wetland in nice oak woodland. This woodland would make a good park/natural area that offers passive and active restoration opportunities.

DISTRICT CA

Unified Rank: Unique

Wetland CA-W3

Stormwater Susceptibility: Highly

CA-W3 is a wetland that could be enhanced but would likely not provide any wetland mitigation or banking credit. This wetland is a partially excavated cattle pond. The portion of the basin that has not been excavated is a sedge meadow. Restoration of this wetland would involve regrading the sides of the excavated portion to the original contours and restoring it to a sedge meadow. This project would likely not be done unless the adjacent upland is restored.

DISTRICT UEC

Unified Rank: Manage 2

Wetland UEC-W6

Stormwater Susceptibility: Moderately

UEC-W6 is a wetland that has high restoration potential. This wetland has a culverted outlet to Lake Bavaria. Raising the water level would enhance wetland vegetation. Further evaluation of this wetland is required to determine restoration strategies to be implemented and potential to provide wetland mitigation or banking credit.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W6.2.1

Stormwater Susceptibility: Least

UEC-W6.2.1 is a wetland that has high restoration potential. This wetland is an isolated excavated pond that primarily receives hydrology from surface flow. Further evaluation of this wetland is required to determine restoration strategies to be implemented and potential to provide wetland mitigation or banking credit.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W6.4

Stormwater Susceptibility: Least

UEC-W6.4 is a wetland that has high restoration potential. This wetland is located adjacent to a golf course and has a tile line outlet. A prescribed burn rotation as part of the golf course management plan could be established. Further evaluation of this wetland is required to determine restoration strategies to be implemented and potential to provide wetland mitigation or banking credit.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W10

Stormwater Susceptibility: Slightly

UEC-W10 is a wetland that has high restoration potential. This wetland outlets via a ditch or swale to Lake Bavaria. Previous enhancement of this wetland has been conducted since 2008. Further evaluation of this wetland is required to determine current elevation of the outlet, additional restoration strategies that may be implemented, and potential to provide wetland mitigation or banking credit.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W13.1

Stormwater Susceptibility: Least

UEC-W13.1 is a wetland that has high restoration potential. This wetland is a small isolated that primarily receives hydrology from surface flow. Further evaluation of this wetland is required to determine restoration strategies to be implemented and potential to provide wetland mitigation or banking credit.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W14

Stormwater Susceptibility: Slightly

UEC-W14 is a wetland that has high restoration potential. This wetland is depressional and primarily receives hydrology from surface flow. Wetland hydrology could likely be restored by creating a berm across an existing swale. Further evaluation of this wetland is required to determine restoration strategies to be implemented and potential to provide wetland mitigation or banking credit.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W14.1

Stormwater Susceptibility: Least

UEC-W14.1 is a wetland that has high restoration potential. Down cutting at the outlet has reduced hydrology. An Intermittent stream is located downstream of the wetland. This wetland is a valuable storage area that helps reduce flow rates to the stream. If surrounding land use develops without utilizing this wetland for storage, erosion along the stream will be accelerated. The wetland is currently dominated by reed canary grass and could have its vegetative and wildlife habitat improved with construction of a berm at the outlet to restore the hydrology of the wetland. The wetland is also an important part of a wildlife corridor.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W16.1

Stormwater Susceptibility: Least

UEC-W16.1 is a wetland that has high restoration potential. A creek/channel located east of the wetland has water elevations below the wetland. A natural upland ridge is located between the wetland and the channel. Some low spots have been created along the natural upland ridge. Restoration of the wetland would involve filling in the low spots along the upland ridge and creating a more stable pipe outlet or reinforced rip rap outlet from the wetland to the channel.

DISTRICT UEC

Unified Rank: Unique

Wetland UEC-W20

Stormwater Susceptibility: High

This wetland represents perhaps the best quality and most intact sedge/wet meadow in the north Bavaria study area. Despite this, it appears that there were past attempts to drain the wetland, particularly at its lower end (east side), where a channel was dug and some chaotic excavation conducted, lowering the quality of the wetland. The entire wetland basin would benefit from installing a small berm/control structure at the narrow outlet for this wetland. This represents a good opportunity for restoration because of the narrowness of the outlet and the good benefits from a small amount of effort. Restoration of this wetland would also benefit the two surrounding upland forests by improving the quality of native habitats in the area.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W22

Stormwater Susceptibility: Least

This relatively small, farmed wetland (1.2 acres) represents a good opportunity to vegetatively restore a wetland basin. Under the current (2006) mitigation allowances, vegetative restoration of previously farmed wetlands can receive 100 percent new wetland creation credit.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W23

Stormwater Susceptibility: Least

At nearly 40 acres in size, this prior-drained wetland represents perhaps the best opportunity in the north Bavaria NRI area to restore a large wetland, with a minimal amount of effort. The ditch outletting this wetland is narrow, with hills on either side, enabling a small berm and outlet structure to be installed. The greatest challenge in restoration of this wetland basin would be managing the nonnative reed canary grass that currently dominates the site. Because of the large size of this site, it has the potential to improve water quality across a large portion of this area, as well as improve the overall quality and quantity of native habitats for wildlife and plants. This wetland appears to be an outstanding banking opportunity.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W26

Stormwater Susceptibility: Least

This wetland has been ditched and outlets through a narrow ditch to wetland UEC-28 to the south. The outlet is narrow and lends itself well to berming and the installation of some type of control structure to allow for restoration of hydrology and vegetation in this wetland. Reed canary grass is a substantial component of the vegetation here and may represent the larger effort for restoration. This wetland appears to be a good mitigation/banking opportunity.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W28

Stormwater Susceptibility: Moderately

This wetland represents a modest opportunity for restoration of a wetland. It has already been partially excavated and an outlet structure installed (berm and outlet corrugated metal pipe outlets). In unexcavated portions, the wetland vegetation is dominated by the nonnative reed canary grass. This could be managed to the benefit of native plants, or potentially shallowly excavated (~6-12 inches) to remove reed canary grass, with subsequent seeding of native species.

DISTRICT UEC

Unified Rank: Manage 2/3

Wetland UEC-W30

Stormwater Susceptibility: Least/Moderately

This wetland is actually two basins separated by a shallow ditch. Collectively, these two basins appear to be good opportunities for restoration. However, the shallow relief in the area requires that a more detailed topographic survey of the area be completed to better understand the most strategic location for placing appropriate berms/structures and the extent of hydrologic restoration that would occur.

DISTRICT UEC

Unified Rank: Manage 3

Wetland UEC-W89

Stormwater Susceptibility: Slightly

UEC-W89 is a wetland that has high restoration potential. Further evaluation of this wetland is required to determine restoration strategies to be implemented and potential to provide wetland mitigation or banking credit.

WETLANDS LOCATED OUTSIDE THE CITY

The wetlands below are located outside the City and generally comprise the headwaters of Chaska Creek, named the Upper Chaska Creek area. The Upper Chaska Creek area consists of mostly agricultural land use. The Upper Chaska Creek area has a large impact on the stormwater quantity and quality in Chaska Creek and has been included for modeling accuracy. The wetlands located in the Upper Chaska Creek area were visited in the field, although MNRAM was not used to determine the functions and values of the wetlands. Therefore, the wetland summaries below are generally less detailed than those for the wetlands located in the City and do not include rankings or stormwater susceptibilities.

DISTRICT CC

Restoration Priority: 4

Wetland CC-W1

CC-W1 is a potential wetland restoration that could provide mitigation or wetland banking credit. This wetland has a ditch outlet to aid in draining the wetland. Restoration could be accomplished if a ditch block was installed with an outlet raised to pre-ditch elevations.

DISTRICT CC

Restoration Priority: 2

Wetland CC-W2

DNR Protected Water ID: 204W

CC-W2 is a DNR protected wetland. The quality of this wetland could possibly be improved by the construction of an outlet to raise the normal water level, but would likely not provide any wetland mitigation or banking credit. A detailed classification of the wetland and coordination with the DNR would be required prior to raising the water level of this wetland.

DISTRICT CC

Wetland CC-W3

The quality of CC-W3 could possibly be improved by the construction of an outlet to raise the normal water level, but would likely not provide any wetland mitigation or banking credit.

DISTRICT SCC

Wetland SCC-W1.1

SCC-W1.1 is a potential wetland restoration that could provide mitigation or wetland banking credit. This wetland has a ditch outlet to aid in draining the wetland. Restoration could be accomplished if a ditch block was installed with an outlet raised to pre-ditch elevations.

DISTRICT SCC

Wetland SCC-W1.2

SCC-W1.2 is a potential wetland restoration that could provide mitigation or wetland banking credit. This wetland has a ditch outlet to aid in draining the wetland. Restoration could be accomplished if a ditch block was installed with an outlet raised to pre-ditch elevations.

DISTRICT SCC

Restoration Priority: 3

Wetland SCC-W2

SCC-W2 is a potential wetland restoration that could provide mitigation or wetland banking credit. This wetland has a ditch outlet to aid in draining the wetland. Restoration could be accomplished if a ditch block was installed with an outlet raised to pre-ditch elevations.

DISTRICT SCC

Wetland SCC-W4

SCC-W4 is a low quality wetland that could possibly be improved by the construction of an outlet to raise the normal water level, but would likely not provide any wetland mitigation or banking credit.

DISTRICT SCC

Wetland SCC-W7

DNR Protected Water ID: 22W

SCC-W7 is a DNR protected wetland. The quality of this wetland could possibly be improved by the construction of an outlet to raise the normal water level, but would likely not provide any wetland mitigation or banking credit. A detailed classification of the wetland and coordination with the DNR would be required prior to raising the water level of this wetland.

DISTRICT SCC

Wetland SCC-W8

SCC-W8 is a potential wetland restoration that could provide mitigation or wetland banking credit. This wetland has a ditch outlet to aid in draining the wetland. Restoration could be accomplished if a ditch block was installed with an outlet raised to pre-ditch elevations.

APPENDIX E – UPLAND COMMUNITY DESCRIPTIONS

DISTRICT GC
Community GC-U-1

Unified Rank: Manage 3

Oak Woodland-Brushland

NHP Method Rank: D

This community is similar to the preceding community, but has less canopy cover and covers a substantially larger area. It is composed of two separate wooded pastures. This community is of poor quality. The dominant tree species in the canopy are white and bur oak, which average about 24 inches in diameter. There is substantial tree cutting for lumber in the southern parcel of this community with a portable sawmill set up within the pasture and numerous stacks of oak boards. One cored 30-inch bur oak in this community was estimated to be 139 years of age. Another tree, a 34-inch cut bur oak was found to be 159 years of age. Large basswoods are also occasionally found in the canopy and average about 22 inches. Smaller trees include green ash, Siberian elm and ironwood.

The shrub layer is generally sparse to absent as a result of long-term moderate grazing. Eastern red cedar, wolfberry, gooseberry, and prickly ash are most common. All of these species indicate moderate to heavy grazing. The ground layer is dominated by nonnative pasture grasses such as bluegrass, with the native Pennsylvania sedge more common in shaded areas. Flowering plants that were less common included Canada goldenrod, bergamot, and Virginia waterleaf.

Disturbance indicators: Grazing and tree cutting are the most influential activities on this site. Both are currently taking place. Alteration of species composition and community structure by grazing has significantly lowered the overall quality of this community.

Restoration potential: Good

Similar to the preceding community, this area has the potential to be seeded with native grasses and forbs if it is retired from pasture. This, along with periodic prescribed fire would help to maintain the quality of this oak dominated community. Like community GC-U-2 area has the potential to become a good quality natural area or light recreational park, providing an important corridor of connectivity for wildlife.

Community GC-U-2

Unified Rank: Manage 3

Mesic Oak Forest

NHP Method Rank: D

This oak forest is currently grazed. The nearly closed canopy was composed solely of bur oak that average about 22 inches in diameter. One 20-inch bur oak was cored and estimated to be 131 years of age. Elm trees, averaging 6 inches in diameter occur occasionally under the oak canopy and are beginning to intrude into the crowns of oaks. The shrub layer is very sparse because of the pressure placed on small trees and shrubs by moderate long-term grazing. The most common shrubs include European buckthorn and ironwood, with black raspberry and gooseberry being less frequent. The ground layer is composed largely of nonnative pasture grasses, particularly in the more open areas. Under canopy areas commonly have Pennsylvania sedge. The most frequently encountered forb was Canada goldenrod.

Despite the lack of ecological richness on this site, it is very picturesque. The large oak trees and gently rolling landscape form a visually pleasing and shaded setting. This site presents an excellent opportunity for a semi-natural community park or a natural area if it is someday retired from pasturing.

Disturbance indicators: The presence of moderate to heavy grazing has significantly altered this community.

Restoration potential: Good

This area would require only a moderate investment in seeding of native plants and the regular application of fire in recovering to substantially better quality. It provides one of the best opportunities in the area for a low cost restoration of a natural community. Restoration potential of this site is given added value due to the adjacent wetlands and oak forests.

Community GC-U-3

Unified Rank: Manage 2

Mesic Oak Forest, Big Woods Section

NHP Method Rank: C

This formerly grazed oak forest occurs on gently rolling hills. It has a canopy cover that averages about 70% and is dominated by bur and red oak averaging 14 inches in diameter. One 18.5-inch bur oak was cored and found to be 131 years of age. Sugar maple is common in the canopy on the south and west sides with white birch, white oak, and black cherry also occurring occasionally. There were a number of trees that were toppled by wind during the growing season of 1998. Also, some woodcutting has taken place in the past with wood piled in one of the two small wetlands that occur in the community.

The shrub layer varies in thickness from sparse to moderate and is dominated by prickly ash. Other common members of the shrub layer include European buckthorn, wolfberry, and ironwood. The codominance of these species suggests at least moderate grazing for an extended period of time. The southernmost segment of this community has been grazed more recently and intensely with a shrub layer dominated by sugar maple seedlings and a sparser ground cover.

The ground layer of this community is moderately rich in species with at least 22 species present. However the ground layer is generally dominated by just a few species that are indicative of disturbance. These include Pennsylvania sedge, rough avens, and nonnative pasture grasses.

Disturbance indicators: The dominance of the shrub layer by the species ironwood, wolfberry, buckthorn, and prickly ash indicate grazing for an extended period of time. Also, woodcutting and piling of wood in wetlands has taken place.

Restoration potential: Good

Activities would include nonnative brush removal, limited seeding of native grasses and forbs, and periodic prescribed fires. Substantial recovery of this forest could be accomplished with consistent, active management.

Community GC-U-4

Unified Rank: Manage 2

Maple-Basswood Forest

NHP Method Rank: C

This forest is one of the few maple-basswood communities in the study area with an intact canopy with a good species composition. It is dominated by white oak and sugar maple that average 22 and 12 inches, respectively. Red oak was also a co-dominant in the canopy in the past, but plays a secondary role following selective logging of red oak in the past 10 or 20 years. Cut red oaks ranged from 20 to 30 inches in diameter,

with ages from 137 to 151 years seen. American elm is the dominant member of the subcanopy with average size being about 10 inches.

The shrub layer of this forest is sparse, a function of both past grazing and the dense shade cast by the closed canopy. The most common members of the shrub layer are sugar maple seedlings which are found in patches where sunlight reaches the forest floor in greater amounts. Also scattered throughout are bitternut hickory seedlings. The ground layer is variable, but appears to have been strongly influenced by grazing. The most common members of the ground layer include sweet cicely, Virginia waterleaf, bedstraw, and Pennsylvania sedge. No spring flowering plants were noted during the field visit. Later documentation of spring flowers would raise the rank of this community slightly. A number of wildlife species seen during the survey include several species of songbirds and a red fox indicate the community is used frequently by wildlife. Overall, the largest factors affecting this community are a past history of logging and grazing, and the fragmentation of the site by a road splitting the site. These influences lower the quality of an otherwise good site.

Disturbance indicators: Grazing and logging have both strongly influenced this community, although logging has been less of an influence on the overall species composition. A field road was also cut through this community in the past, fragmenting it.

Restoration potential: Good

Reintroduction of a few native grasses and forbs, rest from agricultural disturbance, and planting of local ecotype native trees to close the canopy where the field road exists are all activities that would improve the quality and function of this site. Since this is one of the better quality remnants of Big Woods in the study area, this community takes on added significance and should be considered for protection and restoration as part of a network of natural area corridors within Chaska and adjoining communities.

Community GC-U-5

Unified Rank: Manage 3

No Community Classification

NHP Method Rank: NA

This area does not have enough natural community characteristics to be classified or ranked under the MN DNR Natural Heritage Program guidelines. This rolling upland area has scattered brush and trees about 9 inches in diameter. It is dominated by nonnative grasses, including smooth brome and reed canary grass. The most common native forb is Canada goldenrod. It appears to have a long history of agricultural use, especially grazing.

Disturbance indicators: The dominance of this area by nonnative, cool season grasses indicates a long history of moderate to heavy grazing. This area also has an electrical utility line crossing east-west near the south end.

Restoration potential: Poor

This site would require significant investments of time and plant materials to improve in quality. This site could be planted to native trees to develop a forest of oaks or maple/basswood. It could also have prescribed fire applied on a regular basis (in concert with native grass/forb planting) to maintain the currently open character.

Community GC-U-6

Unified Rank: Manage 2

Mesic Oak Forest

NHP Method Rank: CD

This relatively small oak forest occurs on a gentle north-facing slope just south of Victoria Drive. It is characterized by large bur and white oak, which form a nearly closed canopy. These tall, straight trees average about 26 inches in diameter, with some reaching 36 inches. One 26-inch bur oak was cored and determined to be 129 years of age. American elm about 5 inches in diameter dominates the subcanopy and in some cases is beginning to interfere with normal growth of the oaks. There are several locations in this community where windfalls have toppled oaks and left openings in the canopy.

The shrub layer varies from thin to moderately thick with the most common shrubs being prickly gooseberry, European buckthorn, prickly ash, and common elderberry. The ground layer exhibits moderate species richness with the most common species being Virginia waterleaf, shining bedstraw, common violet and false nettle. The general composition of this community, especially the presence of thorny species in the shrub layer tends to indicate a history of grazing. There is some storing of equipment and use of the woods as a bone yard to store discarded materials and items, as well as a number of often used ATV trails.

Although highly unlikely given the recent history of this site, there are some small mounds distributed in a regular pattern on the south side of this community. It would be recommendable to have these inspected by a person qualified to assess cultural resources in the unlikely event that they are Native American earthen structures.

Disturbance indicators: The presence of thorny shrubs and lack of species richness in the ground layer indicate a history of grazing. There is also some storage of equipment, discarded materials and stockpiles of various items within this community. ATV trails also negatively impact the quality of this small, isolated site.

Restoration potential: Good

This site would require a relatively small amount of resources to improve in quality. This area is part of a corridor of connected wetlands, woodlands and waterways extending to the south and west. If restoration of this forest community is carried out, it is recommendable to restore the composition and function of the adjacent wetlands at the same time. Suitable restoration activities for this forest site include removal of nonnative/invasive species, regular prescribed fires to stimulate native grasses, and oak reproduction, and some reintroduction of native plant species to the site.

Community GC-U-7

Unified Rank: Manage 3

Maple-Basswood Forest

NHP Method Rank: D

This forested community occurs on a gentle north-facing. Quarrying to the west and in the forest, as well as a past history of intense grazing make the overall quality poor. The canopy of this forest is dominated by open-grown bur oak and sugar maple, which average about 18-inches. One open-grown 32-inch sugar maple was cored and found to be 109 years old, while a 20.5-inch bur oak was found to be 109 years of age. Other canopy trees that were less common include basswood, butternut, boxelder, and green ash.

The shrub layer of this community varies from relatively open to thick and is dominated by prickly ash, with ironwood being common as well. Overall, the shrub layer is composed of thorny species, which become established with heavy grazing. The ground layer is variable, but generally made up of nonnatives, or natives

that colonize disturbed areas. These include the natives Virginia waterleaf and honewort, and the nonnatives catnip, smooth brome and stinging nettle.

Disturbance indicators: The presence of several hollowed out areas indicates past quarrying in this forest. Dominance of the shrub and ground layer by species that follow heavy grazing indicates a long history of that activity. The presence of some refuse and a field road through the forest also contributes to indications that this forest was heavily disturbed.

Restoration potential: Poor

This site would require substantial input to recover to improved quality. Brush cutting, and seeding of native grass, flower and tree species would need to be accomplished for the area to improve. The area should recover to slightly better quality if left undisturbed. However, substantial improvement would require active restoration.

Community GC-U-8

Unified Rank: Manage 3

No Community Classification

NHP Method Rank: NA

This area may have been an old home site or a stockyard at one time. It is located near the top of a rise with on a gentle north slope. There are indications that it was released from mowing or grazing in the past few decades. It has a few large trees composed of bur oak, sugar maple, basswood and others. Growing under canopy and between these larger trees are pole-sized trees of elm and other species. The most common species in the shrub layer is smooth sumac, which can be thick at times. The ground layer is composed of a number of native and nonnative species that indicate disturbance. These include motherwort, Virginia waterleaf and reed canary grass. Located on the southwest side of this site is a small depressional wetland, which may be natural, or possibly excavated for cattle watering if the area was used as a stockyard.

Overall, this site is characterized by indicators of disturbance and does not have enough natural community characteristics to be classified or ranked under the MN DNR Natural Heritage Program guidelines.

Disturbance indicators: This site is largely defined by past disturbance from use for a home site and/or agriculture. So much so, not enough natural community character remains to classify or rank under MN DNR NHP guidelines.

Restoration potential: Poor

This site would require a significant amount of restoration work to recover to a moderate quality natural community. Suitable restoration activities could include the cutting/removal of invasive and/or exotic species followed by planting of native trees and shrubs, as well as native grass and forb seeding.

Community GC-U-9

Unified Rank: Manage 3

No Community Classification

NHP Method Rank: NA

This area appears to be mostly wetland that has been partially drained. It is dominated by the non-natives reed canary grass and stinging nettle, with native species playing a secondary role in the ground layer. There is about 20% canopy cover of young trees, with the invasives Siberian elm and boxelder most common. These average about 8 inches in diameter. Other woody species include American elm, wolfberry, common

elderberry, and prickly ash. This area does not have enough native/natural community characteristics to be classified or ranked under the MN DNR Natural Heritage Program guidelines.

Disturbance indicators: The dominance of this entire area by aggressive and/or nonnative species indicates some form of past disturbance. This likely included altered hydrology caused by ditching/drainage of the wetland, as well as possibly being grazed, hayed, or plowed.

Restoration potential: Moderately poor

Because of the lack of native composition and function, this area would require substantial inputs to improve in quality. Potential activities for improvement include restoring historic water regime, prescribed burning to control the reed canary grass/stinging nettle and reintroduction of desirable native species.

Community GC-U-10

Unified Rank: Manage 2

Lowland Hardwood Forest

NHP Method Rank: CD

This community occurs along a small tributary of Chaska Creek just north of County Road 10. It is composed of a small riparian area and adjacent upland, both of which were grazed in the past. It appears that the portions of this community that could be reached with farm machinery were planted to nonnative cool season grasses such as Kentucky bluegrass and smooth brome. As a result, the majority of native species are immediately adjacent to the waterway.

The canopy of this community is patchy with just a few large trees scattered and many younger, even-aged trees between them. The largest trees are American elm, eastern cottonwood, bur oak and ironwood. Second growth is dominated by basswood and elm. The shrub layer varies from absent to dense. It is composed of several species which are codominant, but most of these have thorns. Common shrubs include prickly ash, box elder, European buckthorn, and wild plum.

The ground layer is variable but is generally of poor quality. Dominant species include the nonnatives smooth brome and Kentucky bluegrass as well as the natives Virginia waterleaf, common blue violet and kidneyleaf buttercup. Because of the strong influence of past grazing, this community was given the low rank of CD.

Disturbance indicators: Fences and species composition of this site indicate a long history of grazing. Likewise, several portions of this site have been seeded to nonnative, cool season pasture grasses that reduce its functionality as a natural community. Although wetlands upstream have been partially ditched and drained sending increased flows through this community, it does not appear that there has been any significant recent erosion as a result.

Restoration potential: Moderately poor

The small size of this site would require less effort to restore than many other areas. However, because it lacks significant natural community integrity, this site would rank low in priority compared with others in the study area. This site should continue to transition to a better quality forested area over the next several decades.

Community GC-U-11

Unified Rank: Manage 3

No Community Classification

NHP Method Rank: NA

This community is an old field being colonized by a few species of native and nonnative trees and brush. The site is dominated by the non-natives smooth brome, reed canary grass, and white sweet clover. Colonizing woody species include prickly ash, smooth sumac, elm, and to a lesser degree European buckthorn, box elder and oak seedlings. Because this community lacks enough natural community character to be classified under the MN DNR NHP guidelines, it did not receive a classification or ranking.

Disturbance indicators: The dominance of nonnative grasses and forbs, as well as colonization of the site by a handful of woody species indicates a history of use for agriculture. This site may have been row cropped in the past and/or hayed prior to retirement.

Restoration potential: Moderate.

Planting of native grasses and flowers on this site, along with the application of prescribed fire to this site and the adjacent wetlands, would substantially improve the quality. An alternative path for restoration would be the planting of native trees as part of a reforestation of the Big Woods. This community is part of a north-south natural corridor, and improvement of this community would enhance its overall value to wildlife.

DISTRICT LCC

Community LCC-U-1

Unified Rank: Manage 2

Maple-Basswood Forest

NHP Method Rank: CD

This forest is of generally poor quality. Most of the area is currently grazed or were grazed in the past. It also has small inclusions of Oak Woodland-Brushland on the steepest ridges and south-facing slopes. It was given a low rank due to the past influence of grazing and the more recent impacts of development and the related degradation of slopes.

The canopy of this community is nearly closed. It is generally composed of scattered large trees that have an open-grown form, with smaller, second growth trees filling in the remaining area. The most common large trees are sugar maple, basswood, and red and white oaks. These species generally average 14-16 inches in diameter. Smaller, second growth trees are dominated by sugar maple and basswood. Small inclusions of Oak Woodland-Brushland tend to be dominated by bur and pin oak with eastern red cedar and prickly ash forming nearly impenetrable thickets.

The subcanopy layer varies from somewhat sparse to dense and is generally dominated by saplings of sugar maple and basswood, with ironwood being locally dominant. True shrubs found in more shaded areas in this community include pagoda dogwood, raspberry, and Missouri gooseberry. The Oak Woodland-Brushland areas commonly have prickly ash, smooth sumac, wild plum, and wolfberry.

The ground layer is dominated by a handful of species indicative of closed canopy forests. These include white trout lily, which is in large carpets, false rue anemone, wood anemone, yellow bellwort, toothwort, and wild geranium. Pennsylvania sedge is the most common grass-like plant. Species found most often in the dry, Oak Woodland-Brushland areas include horse gentian, tall anemone, pussytoes, and columbine.

Disturbance indicators: This area appears to have been used as pasture in the past. Following release from grazing, there was a second growth of sugar maple and basswood seedlings. Some areas along this ridge were heavily impacted by grazing and some others were moderately impacted. There are a few scattered locations where European buckthorn is common, particularly in the southeast portion. Buckthorn infestation is generally quite low throughout the community.

The greatest current threat to this community comes from erosion problems. Most of these appear to pre-date residential development, and some are slowly stabilizing. However, several are in close proximity to houses with residents disposing of lawn and structural refuse into them. This slows recovery and further threatens the long-term stability of the ravines. Some of these may have the potential to threaten structures in the next 20-30 years if left unmanaged.

Restoration potential: Moderately Poor

In general, this community is in transition from a more open woodland with scattered trees to a closed canopy forest dominated by maples and basswoods. Stabilization of eroding ravines and protection from unnecessary human impacts will allow this community to stabilize and improve in quality.

Community LCC-U-2

Unified Rank: Manage 1

Maple-Basswood Forest

NHP Method Rank: B and C

Found along the east- and northeast-facing slopes of the Chaska Creek valley, this community varies in quality from moderate to good. Better quality portions of this community are found along the south-facing slope of a lateral ravine (near the quarry) and also along the northernmost portion of the community.

Dominant trees in this community are generally sugar maple and basswood, many of which exceed 24 inches in diameter. The better quality areas typically have a closed canopy composed of forest grown trees. The moderate quality areas tend to have several scattered large, open-grown trees with dense secondary growth of sugar maples. The ridge tops, particularly the more south-facing areas, have a greater composition of red oak. One red oak 17 inches in diameter was cored and found to be 72 years of age. Although there are no signs of widespread logging, there are some locations where tree cutting took place.

The shrub layer was variable in thickness, from sparse in drier areas and those with closed canopy to thick in areas with scattered large trees. Sugar maple seedlings were the most common shrub with chokecherry, pagoda dogwood, ironwood and others also found.

The ground layer was also variable with very good representation of species in the better quality areas. Moderate quality areas had many of these same species present, but they tended to be less common, or widely scattered. Common species here include white trout lily, woodland sedge, wood anemone, zigzag goldenrod and wild ginger.

This community also contained a hillside seep found about half way uphill along the south-facing slope opposite the quarry. At the time of visit, the seep was approximately 100 feet wide. The vegetation here was dominated by pale touch-me-not and horsetail.

Disturbance indicators: This community has experienced long-term grazing, evident by the scattered large trees and altered ground layer composition in the moderate quality area. There has also been some limited

tree cutting and clearing on the hill tops. Also, there has been some piling of household waste and appliances in a small ravine approximately in the center of the community. Some ravines in this community are experiencing excessive erosion from increased upstream runoff.

Restoration potential: Good

This community has very good potential for further improving in quality if allowed to recover. Disturbance by human activity, both within the forest and on the uplands above, should be limited. The amount of runoff the ravines receive should be limited and the slope erosion monitored. Areas that do not show adequate progress in self-stabilization should be managed through methods such as bioengineering.

Community LCC-U-3

Unified Rank: Manage 2

Lowland Hardwood Forest

NHP Method Rank: C

Found along the floodplain of Chaska Creek, this Lowland Hardwood Forest is of moderate quality. Species found here include those typical of Lowland Hardwood Forest, as well as species typical of the surrounding upland forest. The relatively small valley and close proximity with surrounding communities allows for this overlap of species.

This community is varied in both canopy cover and species composition. It shows indications of being more open in the past, as indicated by the large number of trees under ten inches in diameter. The most common tree found in the canopy is American elm, which average about 10 inches in diameter. Other canopy trees found occasionally include eastern cottonwood, sugar maple, ash, basswood, and to a lesser degree, butternut. One ten-inch green ash was cored and found to be approximately 25 years of age.

The shrub layer of this community is moderately thick to sparse with many tree saplings present. The most frequently encountered shrub species include Missouri gooseberry, black raspberry, and pagoda dogwood. Common saplings include basswood, black cherry, hackberry and box elder. Young trees compose the greatest portion of the shrub layer and are thick enough in some places to slow a walker's progress.

Graminoids and forbs include species of both this community and the surrounding Maple-Basswood Forest. Noted species here include Virginia waterleaf, wild goldenglow, Virginia wildrye, Dutchman's breeches, and enchanter's nightshade.

The overall quality of this community is moderately good. It has surprisingly little nonnative species invasion and an apparently stable group of native species, despite past disturbances of road construction and possibly grazing.

Disturbance indicators: The large number of small trees that are of nearly even-age indicates that this site was more open in the recent past. It is possible that it was used for grazing. This would also explain some of the excessive erosion taking place on adjacent uplands. This community has also been disturbed by activities associated with road building, utility lines and their maintenance, as well as some minor channelization.

Restoration potential: Moderately good

Because the overall quality of this site is moderately good and should improve on its own, no active restoration is recommended at this time. This site should be monitored in the future for infestations of

nonnative species such as buckthorn. Also, as development occurs in the upper portion of the watershed, management of upstream storm water should guard against adverse changes in hydrology of Chaska Creek to protect the quality of this community.

Community LCC-U-4

Unified Rank: Manage 3

Oak Woodland-Brushland

NHP Method Rank: D

This community is a pasture with numerous paddocks. It is composed of scattered, open-grown bur oaks with moderately thick brush in some paddocks, and almost none in others. The bur oaks average approximately 28 inches and have relatively few other trees of younger age between them. These younger trees include green ash, basswood and others.

The most common shrubs are black raspberry and prickly ash, which are found in dense patches in a few locations. The ground layer is dominated by nonnative cool season pasture grasses, especially Kentucky bluegrass and orchard grass. The most common native species are Pennsylvania sedge and Virginia waterleaf, species that are both tolerant of moderate grazing pressure.

There are several small depressional wetlands in these paddocks that are seasonally flooded, probably in the spring and fall. Like the upland areas, these are dominated by nonnative grasses or grazing-tolerant native species. Common species here include reed canary grass and foxtail sedge

Disturbance indicators: The long history of grazing is the primary reason for alteration of this plant community. The lack of many thorny or unpalatable species in some paddocks indicates that they were not too heavily grazed. The grazing level has prevented native species from persisting, but has not significantly weakened the nonnative pasture grasses.

Restoration potential: Good

This site, although highly impacted by grazing, provides a very good opportunity for restoration. If actively managed, this site could be restored to a Dry-Mesic Oak Savanna, one of the rarest of all plant communities in Minnesota and the Upper Midwest. This would take relatively little effort and mostly involve the reintroduction of native grasses and forbs through seeding, as well as the reintroduction of periodic fires.

The reintroduction of native species would also be very compatible with the current practice of rotational grazing among fenced paddocks. Using warm season native grasses as the forage source for mid-summer grazing would help to boost weight gain/productivity of livestock and allow cool season grasses the opportunity to recover during a period when they grow the least.

Community LCC-U-5

Unified Rank: Manage 2

Maple-Basswood Forest

NHP Method Rank: C

This moderate quality community follows a drainage ravine oriented from southwest to northeast. It is characterized along the ridge tops and upper reaches by scattered large trees with many saplings between them. Other areas, including steeper, inaccessible slopes have a more intact canopy of forest grown trees that have tall, straight trunks. Dominant trees include red and bur oak, sugar maple and basswood.

The most common members of the shrub layer are sugar maple seedlings and saplings. Other members of the shrub layer include ironwood, eastern red cedar, and pagoda dogwood. The ground layer varies in quality from poor to moderate. The most common species here include stellate sedge, wild ginger, Virginia waterleaf, and jack-in-the-pulpit.

The ravine in this forest has the appearance of a deeply entrenched meandering stream, with steep sides and a bed composed of sand, cobbles and small boulders. This setting is very picturesque and, because of its quickly meandering nature, provides new and interesting views often.

Disturbance indicators: This community appears to have been grazed, as evidenced by the numerous barbed wire fences and the overall species composition. The ravine has experienced moderate erosion within its ephemeral stream bed, and also along the steep slopes. Most of this community appears to have been either oak woodland or forest in the past. The disturbance of grazing and later the removal of grazing has allowed sugar maple and basswood to quickly colonize most of this area. As a result, this forest is transitioning to dominance by a Maple-Basswood association.

Restoration potential: Moderate

If no additional disturbance of this area occurs, it will transition to a better quality Maple-basswood forest. It has the potential for full recovery within 100 years without disturbance. Water resources should be managed in the upstream area of this ravine to reduce flow, and thus erosion. This will allow for recovery of the community along the steep slopes adjacent to the ravine.

DISTRICT SCC

Community SCC-U-1

Oak Woodland-Brushland

Unified Rank: Manage 2

NHP Method Rank: CD

This community is a pastured oak woodland that is being overtaken by young, even-aged trees. It includes both the riparian area along Chaska Creek as well as the surrounding slopes. The dominant large tree species in this community is bur oak, some of which exceed 40 inches in diameter. Other large trees in this community include scattered green ash and black willow along the stream and an occasional basswood in upland areas. One large basswood is 46 inches in diameter.

The shrub layer is moderately sparse, with a few dense areas. The most common members of the shrub layer include black raspberry and box elder. Oak seedlings are also common in patches. The ground layer has a collection of species that are found both in woodland edge and in forest, with nonnative grasses common in areas with adequate sunlight. Common species here include Kentucky bluegrass, dandelion, yellow honewort and common violet.

This community contains several seeps on the north side of the stream near County Rd. 10. These had minimal flow at the time of the field visit and may be negatively impacted by tiling of adjacent crop fields to the west. Chaska Creek has also been channelized in several locations in this community. As a result, several meanders have now become stranded oxbows about six feet above the current streambed.

Disturbance indicators: The most significant disturbance to this community has been the influence of grazing. Dominant grass and flower species are either able to persist in grazing or were introduced

(Kentucky bluegrass). The scattered large trees with even-aged second growth trees between them indicates a period of rest from grazing that coincided with a flush of tree seedling establishment.

Restoration potential: Moderately good

Without intervention, this oak dominated community will likely become a closed canopy Maple-Basswood forest. In the absence of canopy gaps or some type of influence such as fire, wind storms or tree removal, the oak species will play only a minor role in the community. Nonnative and invasive shrub species are not a significant problem in this community and will diminish in presence the more the canopy closes.

Restoration of the original stream channel could also be accomplished in areas that were channelized. This would help to reconnect the stream with its oxbows and former meanders and provide a greater diversity of habitat as well as reduce the impacts of storm events on downstream areas.

Community SCC-U-2

Unified Rank: Manage 2

Mesic Oak Forest

NHP Method Rank: CD

This community occurs on both sides of Chaska Creek. It has a nearly closed canopy dominated by tall, bur oaks that average over 24 inches in diameter. Some of the largest oaks reach 36 inches. One bur oak, cut 10-20 years ago was 128 years of age. Other less common trees in the canopy include sugar maple, basswood, red elm and green ash. The oak dominated canopy of this forest is very picturesque, with the tall, arching branches giving a cathedral-like appearance.

The shrub layer is moderately thick to thick and dominated by thorny species, a result of the long history of grazing on this site. Common shrub species include prickly ash and gooseberry. Less common are European buckthorn, eastern red cedar, American hazel and chokecherry. Basswood and black cherry seedlings also occur occasionally.

The ground layer, like the shrub layer, has been strongly influenced by the practice of grazing. Common species here include nonnative pasture grasses, common blue violet, Pennsylvania sedge, honewort, cleavers and Virginia water leaf. Despite the overall poor quality of the ground layer, there are many native species present, some of which are characteristic of better quality oak forest.

Chaska Creek and a small tributary flow through this community. This section of the stream has not been channelized and retains some wonderful meanders. The area has topography that changes quickly and provides a new, appealing view frequently. The pleasing aesthetic character of this area, along with the quality of the natural communities make it a good candidate for a park or environmental corridor. Likewise, there are several depressional wetlands in this community that are appealing and have potential for restoration.

Disturbance indicators: The presence of fences, nonnative pasture grasses, and the dominance of thorny species in the shrub layer indicate an extended period of grazing. There has also been some limited tree cutting. One wetland has been partially impacted by grazing and cut stumps that were dragged into the wetland and left. More recently there has been a network of trails mowed which have minimal impact on existing species.

Restoration potential: Good

This site has very good potential for both restoration and as an environmental corridor/park. Restoration of the oak forest would include activities such as nonnative species removal, selective cutting and reintroduction of periodic prescribed fire, and possibly some reintroduction of native species. The community would recover quickly under active management. Efforts to manage upstream water and/or re-meander channelized upstream sections of the stream would also likely benefit the dynamics and character of Chaska Creek in this area.

Community SCC-U-3

Unified Rank: Manage 3

Oak Woodland-Brushland

NHP Method Rank: D

This community appears to have been heavily impacted by long-term grazing, and to a lesser degree activities such as tree cutting. The dominant large tree species in this community is bur oak, most of which are about 18 inches in diameter. These are widely scattered and have a large number of smaller trees and shrubs between them, including eastern red cedar, chokecherry, prickly gooseberry and European buckthorn.

The ground layer is variable in quality and often dominated by nonnative cool season pasture grasses such as Kentucky bluegrass. Common native species include heart-leaved aster, Pennsylvania sedge, common blue violet, wood anemone and American vetch.

Chaska Creek has been heavily channelized within this community. A straight 10-15 feet wide channel was constructed, stranding the existing meanders on either side of 3-5 foot high spoil piles.

Because of the overall poor quality and composition of this community, and the history of disturbance, it received a low qualitative ranking.

Disturbance indicators: Past grazing of moderate to heavy intensity as well as some tree cutting are the greatest disturbance indicators. The introduction of nonnative pasture grasses and the absence of periodic fire necessary to maintain oak communities have also disturbed this site.

Restoration potential: Moderately good

Although this community is of relatively poor quality, it could benefit from active management and has a moderate restoration potential. Examples of restoration activities that could be carried out in the upland areas are: nonnative and invasive species control, reintroduction of native grasses and forbs, and the reintroduction of prescribed fires.

Most important for ecological restoration of this site is Chaska Creek itself. This stretch of Chaska Creek would benefit greatly by being re-meandered. Reconnecting meanders would help improve wildlife habitat of the stream and reduce impacts from periods of peak flow. This project would be an excellent candidate for cost-sharing with the Watershed or with the MN DNR, Division of Fisheries.

Community SCC-U-4

Unified Rank: Manage 2

Maple-Basswood Forest

NHP Method Rank: CD

Found mostly on a north-facing slope adjacent to Chaska Creek, this community has a canopy dominated by sugar maple and basswood. These tend to be scattered, very large trees. Several of the large basswood exceed 40 inches in diameter. Between the larger trees is a second growth of smaller, even-aged trees

dominated by sugar maple and basswood as well. Other canopy members include white oak, and white birch, as well as a few butternuts. One white oak, 22.5 inches in diameter was cored and found to be 155 years of age.

Scattered dead or declining sumac and eastern red cedar indicate that this community tended to be more open in the past. There is some evidence of scattered tree cutting approximately 40-50 years ago. The tree cutting may have been to provide lumber or firewood, or to open the canopy to provide additional grazing. It is unlikely that this hill was commercially logged.

The shrub layer is moderate to sparse and dominated by tree seedlings. A period of relaxed or absent grazing likely allowed the recruitment of so many tree seedlings. Here too, sugar maple and basswood are the dominant species. The ground layer is of moderately poor composition, a result of long-term grazing. Common species here include Pennsylvania sedge, Virginia waterleaf, wood anemone and zigzag goldenrod. Some open woodland species such as heart-leaved aster, tall anemone and Solomon's seal are also present.

Chaska Creek, as it flows through this community, varies from relatively disturbed to moderately good in natural community character. In most places meanders appear to be intact, however the stream substrate may indicate excessive deposition of sediment from upstream activities associated with channelization and other land disturbance.

Because this community has been under the influence of grazing for such a long period of time it has lost part of its natural community integrity. As a result, it was given a moderately poor rank of CD.

Disturbance indicators: The primary influence on the composition and quality of this community was extended grazing of at least moderate intensity. Scattered cutting of mature trees also played a secondary role. The introduction of nonnative pasture grasses in some upland areas and of the nonnative reed canary grass along the stream has also negatively impacted this community. There are a few ravines along the south side that show signs of excessive erosion.

Restoration potential: Moderately good

Despite a long history of grazing and the introduction of some nonnative species, this community has the potential to recover without significant human input. The eroding ravines should be checked periodically to monitor their condition and corrective action taken if they continue to actively erode. Overall, this community has the potential to recover to a C quality or better if left undisturbed for the next several decades.

DISTRICT HS

Community HS-U-1

Unified Rank: Manage 3

No Community Classification

NHP Method Rank: NA

This area is a retired pasture dominated by nonnative cool season grasses. Shrubs and small trees have begun to colonize this site. These include eastern red cedar, elm and honeysuckle. Because of the magnitude alteration to this area, it does not fit well with any recognized natural community type within the community classification system used.

Restoration potential: Poor

This area, although having potential for restoration to several different community types, is a poor candidate for ecological restoration due to the amount of resources required. Some potential activities to improve the site could include the planting of native grasses and forbs and/or the planting of native hardwood trees.

Community HS-U-2

Unified Rank: Unique

Maple-Basswood Forest

NHP Method Rank: AB

This high quality forest occurs on a generally south-facing slope below a cemetery. The canopy of this forest is nearly closed and primarily made up of sugar maple and basswood that average approximately 24 inches in diameter. Other tree species that are found occasionally include red oak and elm. Canopy trees are tall and forest grown, with no lower limbs. Canopy trees appear to be nearly of the same age, with more tree age differences noticeable in the subcanopy.

There are few snags or downed logs which would tend to indicate that trees were harvested at some point in the past, or that the forest is of recent origin (last 100 years). There are some stumps in this community indicating logging approximately 50 years ago. The relative absence of red oak in this setting suggests that red oak was selectively cut during the logging.

The shrub layer is sparse and patchy. The dominant member of the shrub layer is sugar maple seedlings with basswood, chokecherry, and ironwood less common. The ground layer is of generally good quality and dominated by species characteristic of Maple-basswood Forest. The most common species here include white trout-lily, which forms large carpets, wood anemone, false Solomon's seal, and Sprengell's sedge. The duff layer of the forest floor is intact and does not appear to have been invaded by nonnative earthworms.

Because of the lack of significant disturbance, the intact canopy, and the species rich ground layer, this community was given the high rank of AB.

Disturbance indicators: There is some influence of cemetery management on this community with stockpiling of soil and the discarding of grave decorations on the edge of the forest. At current levels, this disturbance is not degrading the entire forest. The greatest influence on this community was logging which took place in the last 50 years.

Restoration potential: Good

Because this community demonstrates good integrity, it does not require restoration at this point. Because of its quality it should, however be considered for some type of permanent protection through a landowner agreement, easement, or some other means.

Community HS-U-3

Unified Rank: Manage 2

Mesic Oak Forest

NHP Method Rank: C

This formerly pastured community is dominated by scattered, large bur and pin oak and sugar maples. Second growth between the larger trees includes sugar maple, and to a lesser degree American elm, hackberry and ironwood. A bur oak, 21.5 inches in diameter was cored and found to be 140 years of age. The shrub layer is moderately thick to thick and, like the canopy, is dominated by sugar maple seedlings and saplings. Other members of the shrub layer include ironwood, European buckthorn, chokecherry.

The ground layer is of moderate quality with species indicative of better quality being scattered. The most common species in the ground layer indicate a history of grazing and include Virginia waterleaf and cleavers. Because of the history of grazing in this community and the current transition to Maple-Basswood forest, this community was given a moderate rank of C.

Disturbance indicators: The presence of fences and old cattle paths, as well as the dense second growth of trees between large scattered trees indicate a history of grazing in this community. The strong presence of European buckthorn indicates a more open environment in the past.

Restoration potential: Moderately good

Although this community was likely an oak dominated one in the past, it is currently transitioning to a Maple-basswood Forest. Preventing significant disturbance in the next 50 years will allow this transition to take place and the quality of the community to rise quickly. The European buckthorn will diminish in presence as the canopy of this community continues to become more closed. The ravine currently has little erosion; minimizing upstream water inflow will ensure that the ravine remains stable.

Community HS-U-4

Unified Rank: Manage 3

No Community Classification

NHP Method Rank: NA

This area occurs on a south-facing slope adjacent to an inactive quarry. It is highly disturbed and has approximately 50% brush cover made up of eastern red cedar, sumac and prickly ash. The ground cover is primarily composed of nonnative cool season grasses including Kentucky bluegrass and smooth brome. It was likely used as a pasture in the past. Because of the profound alteration of this area, it does not fit well with any recognized natural community type recognized within the methodology used.

Restoration potential: Poor

Although highly disturbed, this area has potential for recovery. Some potential activities for restoration include planting of appropriate hardwood seedlings, especially oaks. This would help to serve as a buffer for the adjacent high quality Maple-Basswood Forest as well as provide guidance toward the development of a dry oak forest.

DISTRICT CL

Community CL-U-1

Unified Rank: Manage 1

Mesic Oak Forest

NHP Method Rank: BC

This scenic forest varies from mesic to dry-mesic in character. It is dominated by bur and red oak, with a nearly closed canopy. Other members of the canopy that occur occasionally include sugar maple, basswood and pin oak. A red oak, 24-inches in diameter was found to be 110 years of age. The shrub layer is moderate to sparse with the most common member being sugar maple seedlings and saplings. Other infrequently occurring shrubs include prickly gooseberry and ironwood.

The ground layer is variable, but is of generally good composition with a large number of species documented. Common species seen include downy yellow violet, sedges, enchanters nightshade, lopseed, and woodland phlox. Despite the recent disturbance of earthmoving, this community was given the moderately good ranking of BC.

Disturbance indicators: The presence of fences, as well as the overall species composition indicate that this community was probably grazed in the past, although not severely. There has also been some tree cutting, but not likely commercial logging. The most recent disturbance is in the form of earthmoving along the southeastern edge of the forest. It appears that a dozer, or more likely a tractor with a bucket scraped off the top layer of soil in a low-lying area.

Restoration potential: Good

This community has good potential for recovery. Many of the species characteristic of oak forest are present, although in lowered numbers. Withholding disturbance from this forest would allow these species to once again become a more significant component of the forest, and improve the quality of the area. Along with the adjacent Maple-basswood forest, this contiguous forest would make a good City or Regional Park with opportunities for passive and active recreation and would prevent fragmentation of the forest that would severely diminish its function as a natural community.

Community CL-U-2

Unified Rank: Manage 2

Oak Woodland-Brushland

NHP Method Rank: C

Formerly grazed, this oak dominated community is characterized by a canopy that varies from approximately 60% to nearly closed. Second growth of smaller trees has nearly filled in gaps between the large oaks. The most common canopy tree is bur oak, which average about 28 inches in diameter. A cored bur oak tree 21.5 inches in diameter was found to be 112 years of age. Another common tree species occurring as second growth in the canopy is American elm, averaging 10 inches in diameter.

The shrub layer varies from moderately sparse to very thick and is dependent on the amount of canopy cover. Some canopy gaps have nearly impenetrable thickets of prickly ash. Other occasional shrubs include hawthorne, wolfberry, ironwood, chokecherry and nannyberry. The ground layer varies considerably in composition and quality. Open areas frequented by cattle are dominated by nonnative cool season grasses while other open areas and those under tree canopy are better in quality. Common native species in the ground layer include woodland sedge, heart-leaved aster, hedge nettle, honewort, Sprengell's sedge, and bottlebrush grass.

This community also includes several wetland depressions of moderately good quality. Two of these are open sedge meadows with a good representation of native species. The wetlands within this parcel of forest, as well as the forested area to the northeast are significant for the study area and contribute to their high functional value of these areas as native communities.

Disturbance indicators: This site has been grazed extensively in the past, as evidenced by fences and the alteration of plant community composition. The area appears to have been released from grazing at least 20 years ago. There has also been limited tree cutting, but it was not substantial enough to impact the overall community composition.

Restoration potential: Moderate

With limited management including nonnative and invasive species removal, as well as potential reintroduction of prescribed fire this community would recover quickly to a better quality oak community.

Without active management, this site will likely transition to a more closed canopy forest with elm becoming codominant with oak in the canopy.

Community CL-U-3

Unified Rank: Manage 1

Maple-Basswood Forest

NHP Method Rank: BC

This very scenic closed canopy forest is a mix of sugar maple and oak, with scattered depressional wetlands and wet swales. The landscape is sharply rolling in the south near a drainage ravine and gently rolling elsewhere. Because of the past influence of grazing, it has a somewhat lowered qualitative rank of BC. Along with the adjacent Mesic Oak Forest, this contiguous parcel represents one of the largest intact quality forest parcels within the City of Chaska. The variety of topography, community types, aesthetically pleasing vistas offered within the forest are exceptional for the study area. As such, it would be ideally suited for a City or Regional Park offering passive and active recreational opportunities.

The canopy of this community is variable in composition. In some areas it is dominated by forest grown trees, while in others it has scattered open-grown trees that are being overtopped by second growth trees. Bur and red oak are the most dominant canopy trees, with sugar maple, basswood, and pin oak being important in some areas. The second growth trees are dominated by elm and sugar maple. One red oak, 24 inches in diameter was cored in an adjacent community and found to be 110 years of age. Many of the open grown bur oaks in this community are likely decades older.

The shrub layer is also variable in composition, from sparse to moderately thick, depending on the canopy cover. The most common member of the shrub layer is sugar maple seedlings with ironwood, hackberry and butternut also being present. The ground layer dominated in small areas by nonnative cool season pasture grasses, while most of areas have a good representation of native graminoids and forbs. Included among these are Virginia waterleaf, Sprengell's sedge, zigzag goldenrod, lady fern, bottlebrush grass and broad-leaved panic grass.

The depressional wetlands and swales found in this community are in overall good quality and contribute to the overall integrity of this forest. The ravine on the south side of the community hosts the greater diversity of native species and has an intermittent stream running through it. The water for this originates in the gently rolling upland areas to the west.

This community has many components characteristic of an oak forest or woodland. Because of the increasing presence of sugar maples and the predicted dominance of the canopy by sugar maple and basswood in the next 50 years, this community was classified as a Maple-Basswood Forest.

Disturbance indicators: Grazing by cattle has been the most important influence on this community since settlement. Some minor tree cutting has been done, but was not significant enough to influence the community composition. There is some slope erosion along the ravine on the south side of this community. Some dumping of branches, yard waste and appliances has taken place along the upper reaches of the ravine.

Restoration potential: Good

This forest community requires little intervention to improve in quality. Water resources in the upstream area of the ravine should be managed to minimize erosion of slopes in the ravine. Likewise, existing eroded slopes in the ravine should be monitored for recovery and restored through bioengineering or a similar technique if needed.

DISTRICT CA
Community CA-U-1
Mesic Oak Savanna

Unified Rank: Manage 3
NHP Method Rank: D

This community is a pasture that superficially resembles an oak savanna. Although it retains the structural character of a savanna, it lacks the characteristic species at every level except the canopy. Because it has been impacted so heavily it was given the minimum grade of D.

The canopy trees of this community are bur oak, some approaching 40 inches in diameter. One large basswood, 42 inches in diameter is also found in the pasture. In most areas of this community the branches of the oaks do not intermingle. A bur oak, 27 inches in diameter was cored and found to be approximately 157 years of age. This indicates that most trees found in the pasture had their origin prior to significant white settlement of this area.

The shrub layer is nearly absent with common elderberry, basswood, Missouri gooseberry, and European buckthorn found only rarely. The ground layer is dominated by nonnative cool season grasses including Kentucky bluegrass, timothy, and orchard grass. In some areas native sedges and flowering plants tolerant of grazing are co-dominant. These species include Virginia waterleaf, blue violet, heart-leaved aster, and Solomon's seal. One uncommon member of the ground layer is garlic mustard. This nonnative species is very aggressive and has the potential to invade the surrounding forested areas displacing native species. This process will be hastened in the wake of development, which disturbs additional areas for this problem species to colonize.

This pasture also contains several small ponds that were slightly deepened through excavation. These are used as cattle watering holes and have lost much of their native diversity. However, a small portion of the south wetland and a larger sedge meadow swale associated with the north wetland have good representations of native sedges and forbs including turk's cap lily.

Disturbance indicators: Moderately heavy long-term grazing has been the defining influence on this community.

Restoration potential: Moderately good

Although this community has been heavily impacted it has the potential for quick recovery. Restoration activities on this site would include control of the nonnative cool season grasses present, planting of native prairie and woodland edge species, and the control of invasive species garlic mustard and European buckthorn. This site provides a relatively inexpensive opportunity to restore one of Minnesota's rarest ecosystems.

Community CA-U-2

Unified Rank: Manage 2

Maple-Basswood Forest

NHP Method Rank: CD

This previously grazed forest has a patchy canopy composed primarily of sugar maple and basswood. Some logging took place in the past and may have selectively removed oaks since oaks are the only tree present in the community to the east. Sugar maple and basswood average approximately 17 inches in diameter. White ash, butternut, American elm and oak comprise a smaller portion of the canopy and average 10-14 inches in diameter.

The shrub layer is generally thick and dominated by seedlings of sugar maple, and to a lesser degree ash. Overall, the ground layer is of poor quality and indicates heavy past grazing. Despite the overall poor ranking, this community does have moderately good potential for recovering to better quality in the next 50 years without additional disturbance.

Disturbance indicators: The presence of fences and species tolerant of grazing indicate that grazing has been conducted on this site for an extended period of time. Also, the presence of cut stumps indicates the removal of trees, likely oaks, from this community.

Restoration potential: Moderate

Because of significant past impacts this site will take several decades to recover to better quality. But, this site would require few resources other than time for recovery.

Community EC-U-24

Unified Rank: Manage 1

Oak Woodland-brushland

NHP Method Rank: BC

This scenic oak woodland is found on rolling, irregular ground. The large, open-grown bur, white and pin oaks and interspersed with younger oaks, aspen, ironwood, and other trees. At the time of the field inventory there was a network of narrow trails through this woodland adding to the aesthetic appeal. The nonnative, invasive shrub European buckthorn is very common here and is the primary contributor to the lowered quality. The ground layer includes a mix of native sedges, grasses and flowers that occur at somewhat lower densities than would be found in a less disturbed woodland. Despite this, the species richness is fair to moderately good. This area is an outstanding candidate for a natural area park as it is too steeply rolling to readily accommodate residential development, or a highly maintained park. This site was given an elevated rank due to the good prospect for restoration and the intact landscape/plant community it supports.

Disturbance indicators: Grazing appears to have taken place here in the past, although the presence of native ground layer plants would tend to indicate that it was not excessively heavy. The largest disturbances to this area are the lack of periodic fire and the lack of grazing – a moderate amount of grazing is generally beneficial, however too much or too little can be harmful.

Restoration potential: Mod-high

Despite the abundance of European buckthorn, this area is a good candidate for active restoration. The presence of mature (possibly old growth) trees, wildlife habitat value, connectivity with adjacent natural areas, and the remarkable aesthetic quality of the site make restoration well worth the effort here.

Community EC-U-25**Unified Rank: Manage 2****Oak Woodland-brushland****NHP Method Rank: C**

This woodland includes areas with older, open-grown bur, white and red oak and some with more even-aged mature oak trees. There is a moderately dense second growth of trees more common to lowland hardwood forest, including green ash, hackberry, elm, boxelder, and others. Together these older and more abundant younger trees form a generally closed canopy across the site. The shrub layer varies from moderately dense to completely open. The latter situation occurs where small trees have been cut closer to the driveways and homes on the crest of the modest hill here. The north portion of the community includes other shrub species such as prickly ash and plum, found in thickets. The ground layer varies from moderate to moderately poor quality, likely as a result of heavy and prolonged grazing.

Disturbance indicators: The abundance of prickly shrubs, buckthorn and grazing tolerant species indicates a prolonged history of grazing of at least moderate intensity.

Restoration potential: Moderate-high

The areas here that have already been cut over to be opened up could be restored quite easily and offer a great opportunity for savanna restoration. The remainder of the area would take some effort due to the thick nonnative shrub layer and the moderately poor quality of the existing ground layer.

Community EC-U-26**Unified Rank: Manage 3****Oak Woodland-brushland****NHP Method Rank: CD**

This oak woodland is characterized by scattered, open-grown bur and pin oak trees that are in an advanced stage of decline. There is a moderate to dense second-growth of pioneer trees, including ash, boxelder, elm, and others. The shrub layer varies from moderately thick to nearly impenetrable with a combination of native species such as prickly ash and the nonnative European buckthorn. Sumac and gray dogwood are also common. The ground layer includes a mix of early successional native forbs and nonnative pasture grasses, especially Kentucky bluegrass. Overall, the quality of this area is lowered due to past disturbance and lack of active management at this time.

Disturbance indicators: Grazing appears to have been carried out on this area for a substantial length of time and the primary disturbance issue here.

Restoration potential: Varies (Moderately good to Moderately poor)

Areas that have been previously cleared of invasive brush and trees are an excellent candidate for restoration to an open oak woodland/savanna. Areas with dense growth of invasive, nonnative brush would require a more substantial effort of cutting and seeding native grasses and forbs.

Community EC-U-27**Unified Rank: Manage 3****Lowland Hardwood Forest****NHP Method Rank: D**

This oak woodland is characterized by boxelder and other pioneer tree species in groves and scattered. The ground layer is disturbed and dominated by a handful of nonnative and/or weedy species in most areas. Because this is a pioneering assemblage of plant species and also because of past disturbance, this area received a low rank.

Disturbance indicators: Grazing appears to have been carried out on this area for a substantial length of time and the primary disturbance issue here.

Restoration potential: Poor

This area would require substantial work to control pioneer/weedy species and restore appropriate assemblages of native plants. Therefore, this area ranks low compared with other nearby sites when considering where to prioritize restoration efforts.

Community EC-U-28**Unified Rank: Manage 3****Oak Woodland-brushland****NHP Method Rank: D**

This small oak woodland has a few open-grown bur and pin oak on the east end, while the remainder is dominated by second growth trees of elm, ash and other species. The ground layer is generally dominated by nonnative pasture grasses and weedy native forbs. Overall, this is a relatively poor quality site compared to others in the vicinity.

Disturbance indicators: Signs of past grazing, and colonization by weedy, pioneer tree species.

Restoration potential: Poor

This area would require a substantial investment of resources to reach a level approximating that of a quality native plant community. Compared to restoring other nearby natural areas, this area ranks low.

APPENDIX F – AGENCY COMMENTS

The City of Chaska falls under the jurisdiction of the Metropolitan Council and three watershed management organizations for LSWMP review and approval. The watersheds include the Carver County Watershed Management Organization (CCWMO), the Lower Minnesota River Watershed District (LMRWD), and the Riley Purgatory Bluff Creek Watershed District (RPBCWD).

The LSWMP was submitted for formal agency review on 2/6/2018. Comments from the Metropolitan Council and each WMO are summarized below with City responses following.

METROPOLITAN COUNCIL

1. The plan provides a good framework for managing the City's water resources, and is consistent with Council policies and the Council's *Water Resources Policy Plan*.

City Response:

No response necessary.

2. Table 6-1, capital improvement program, should be extended by year through 2028.

City Response:

The time frame for Table 6-1 has been extended to 2028 by year.

3. When TMDLs for the City's impaired waters are prepared or WMO plans are updated, it is highly recommended that the City perform a thorough plan update.

City Response:

Understood.

CARVER COUNTY WATERSHED MANAGEMENT ORGANIZATION

1. No comments have yet been received from the CCWMO.

City Response:

None at this time.

LOWER MINNESOTA RIVER WATERSHED DISTRICT

1. Table 6-1, capital improvement program, should be extended by year through 2028.

City Response:

The time frame for Table 6-1 has been extended to 2028 by year.

2. The LSWMP should acknowledge the Lower Minnesota River WRAPS and recommend that the plan be updated once the WRAPS is finalized.

City Response:

This has been included in Section 4.8.1.

3. The LSWMP should reference the LMRWD plan amendment.

City Response:

This has been included in Section 6.8.2. The amendment language in Section 6.10 has also been updated.

RILEY PURGATORY BLUFF CREEK WATERSHED DISTRICT

1. Table 6-1, capital improvement program, should be extended by year through 2028.

City Response:

The time frame for Table 6-1 has been extended to 2028 by year.

2. The RPBCWD's conditional approval is premised on reading Sections 3.3.7 and 6.9, as well as Table 6-2, to authorize RPBCWD to continue to exercise regulatory authority in Chaska.

City Response:

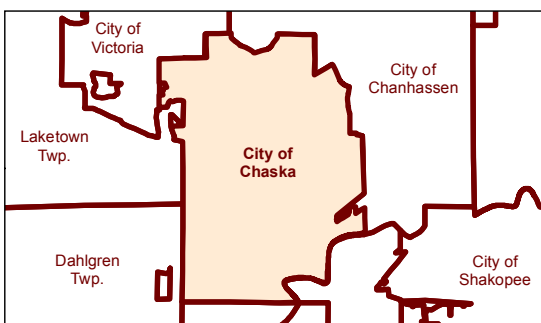
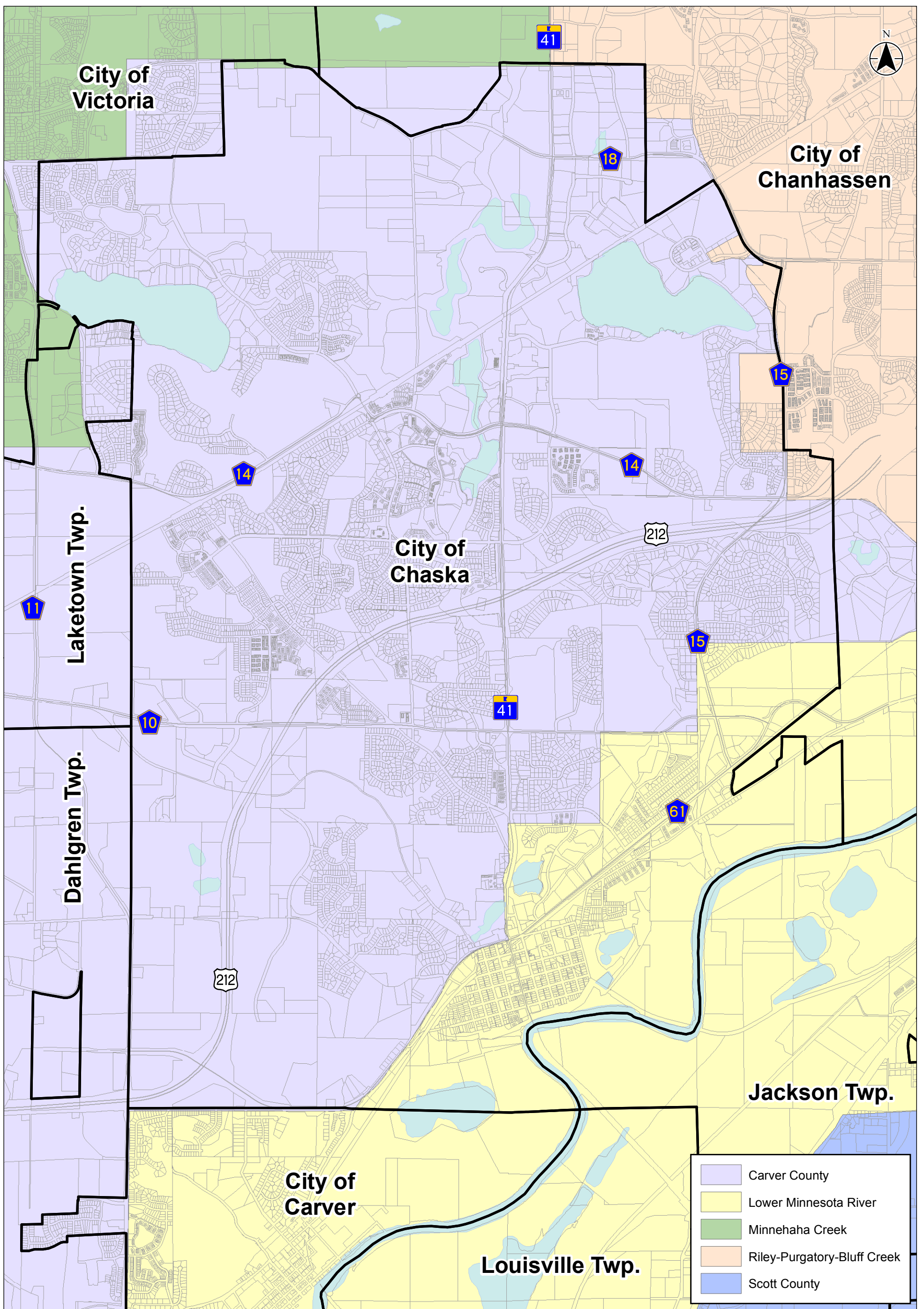
This is a correct reading of the LSWMP.

3. The LSWMP should acknowledge the Lower Minnesota River WRAPS and recommend that the plan be updated once the WRAPS is finalized.

City Response:

This has been included in Section 4.8.1.

APPENDIX G – SYSTEM MAPS



**Watershed Management Organization
Jurisdictional Boundaries
Chaska, Minnesota
Local Surface Water Management Plan**

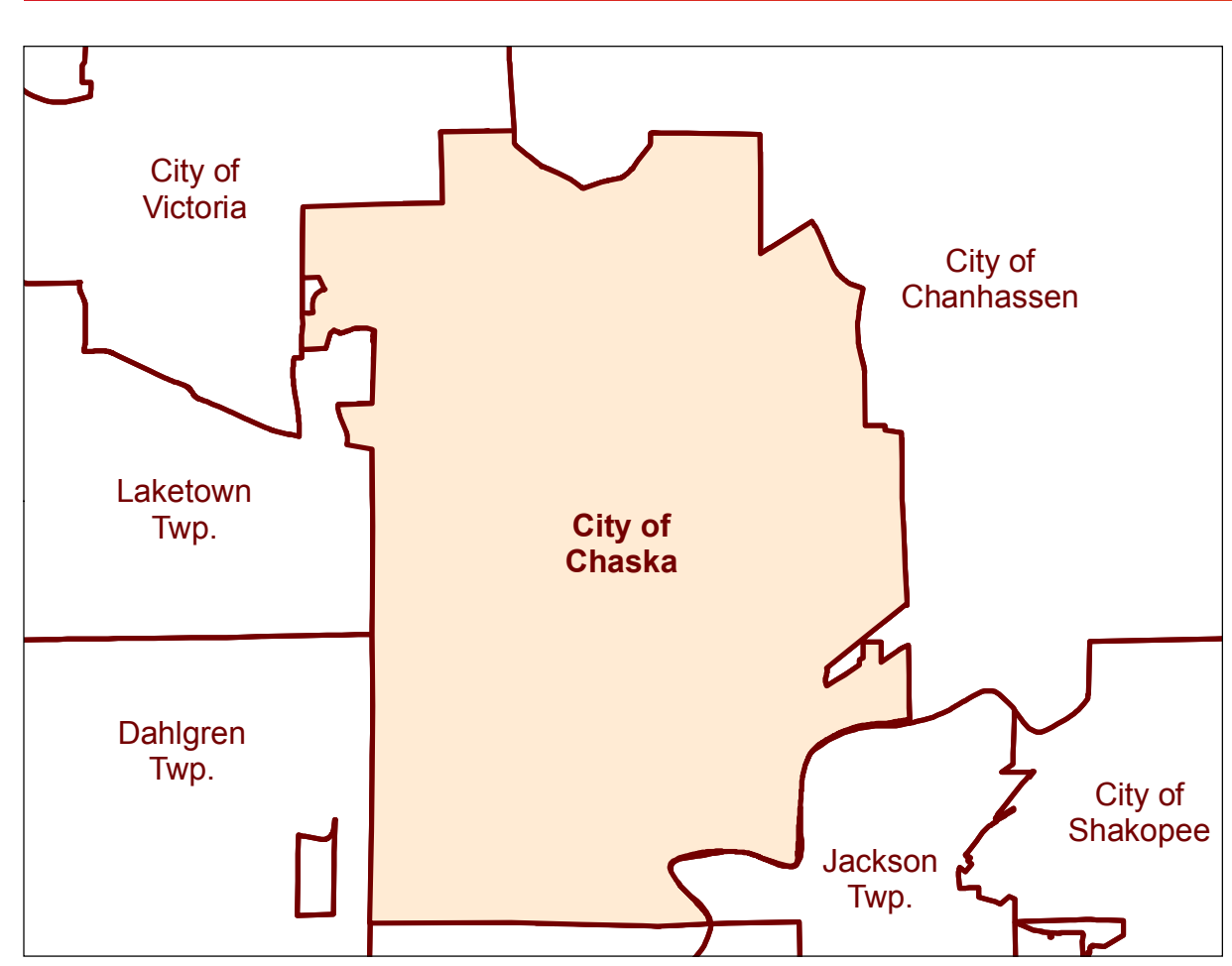
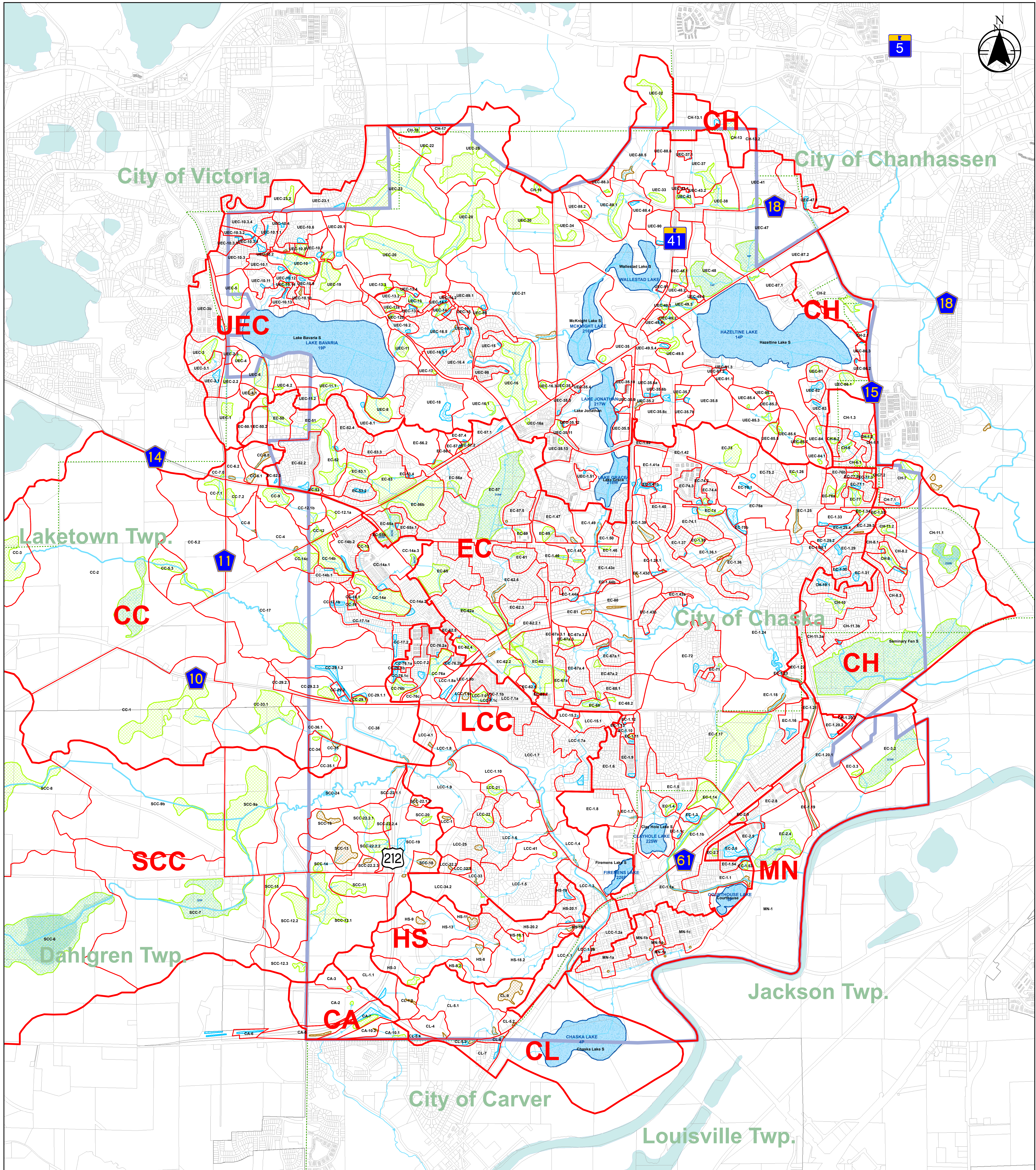


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Revised: 2018-11-26 By: hduan
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- DNR Protected Watercourse
 - Flow Direction
 - WMO Boundaries
 - Lake
 - Wetland
 - Pond
 - Creek/Channel*
 - Major Drainage Districts
 - Drainage Subdistricts
 - Chaska City Limits
 - Open Water Outside of City
 - DNR Protected Water or Wetland
- * For purposes of this study, basins designed as creek/channel typically include all non-wetland basins determined to provide flood storage and negligible water quality benefit (no standing water).

City of Chaska

Local Surface Water Management Plan

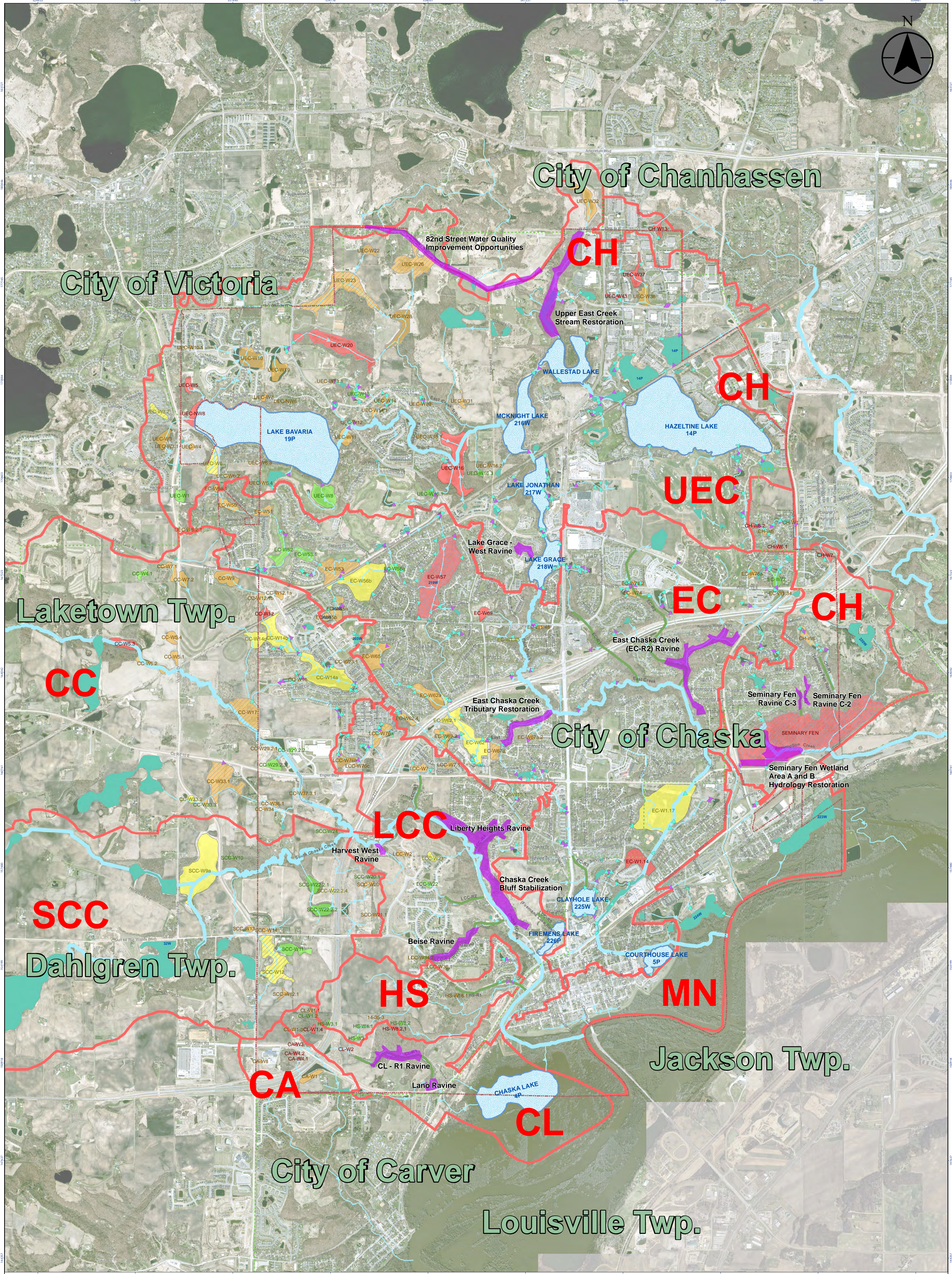


Map 1

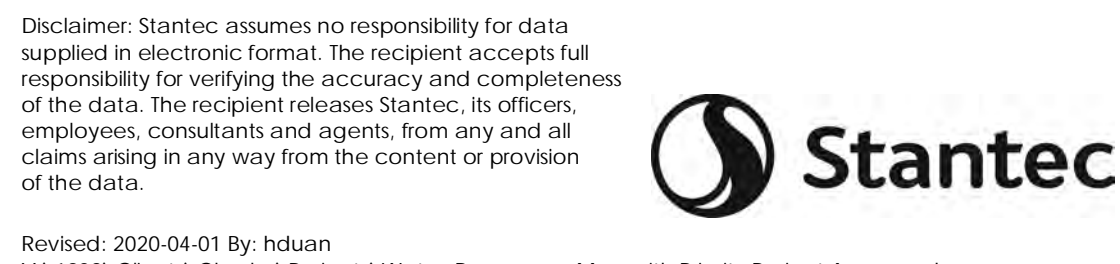
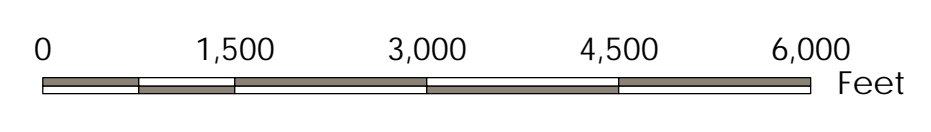
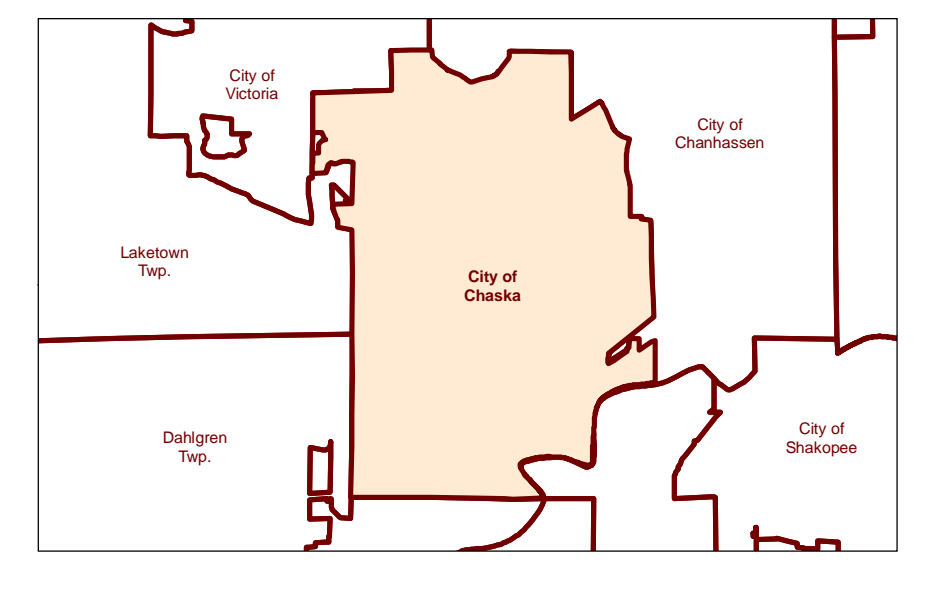
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Revised: 2018-11-27 By: hduan
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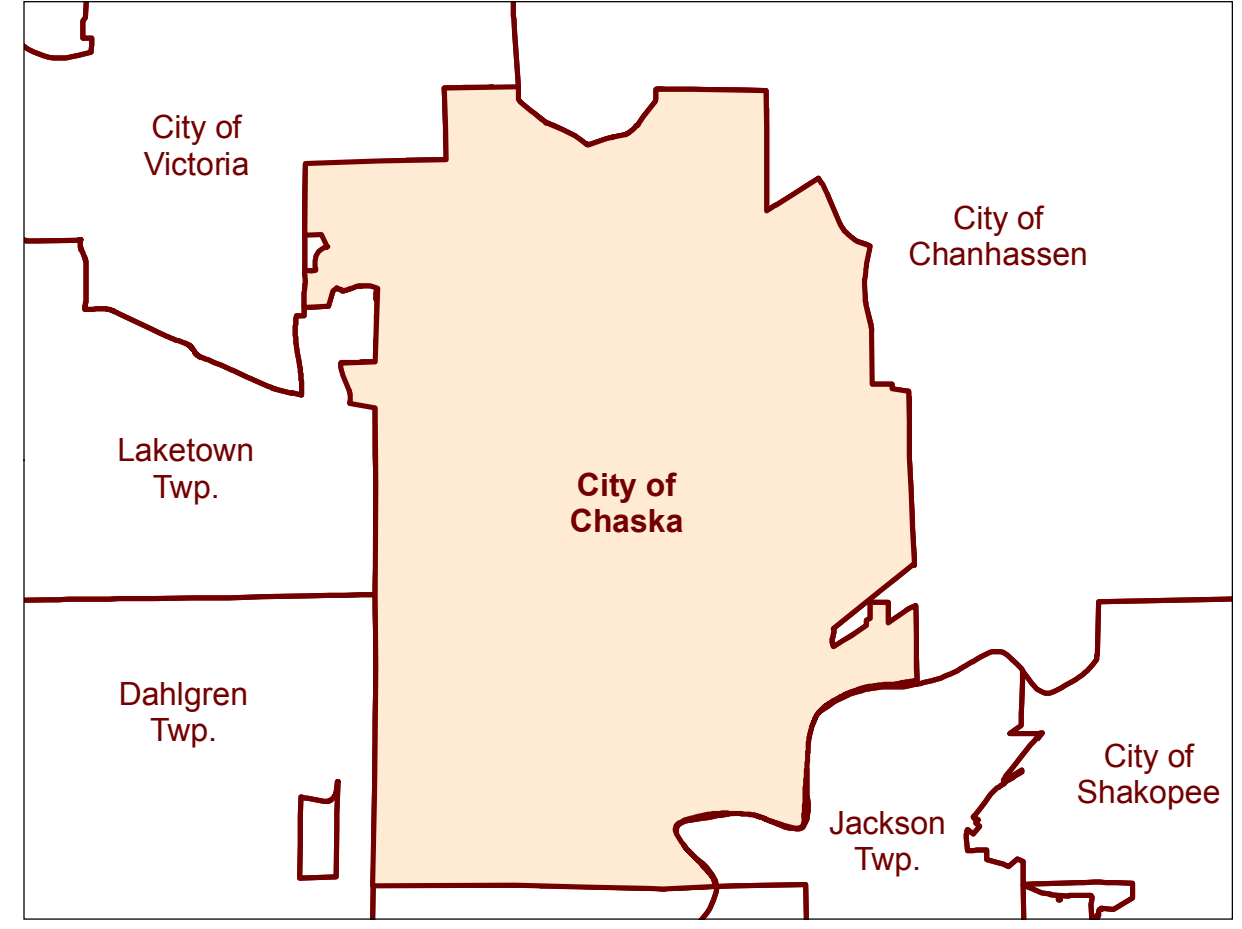
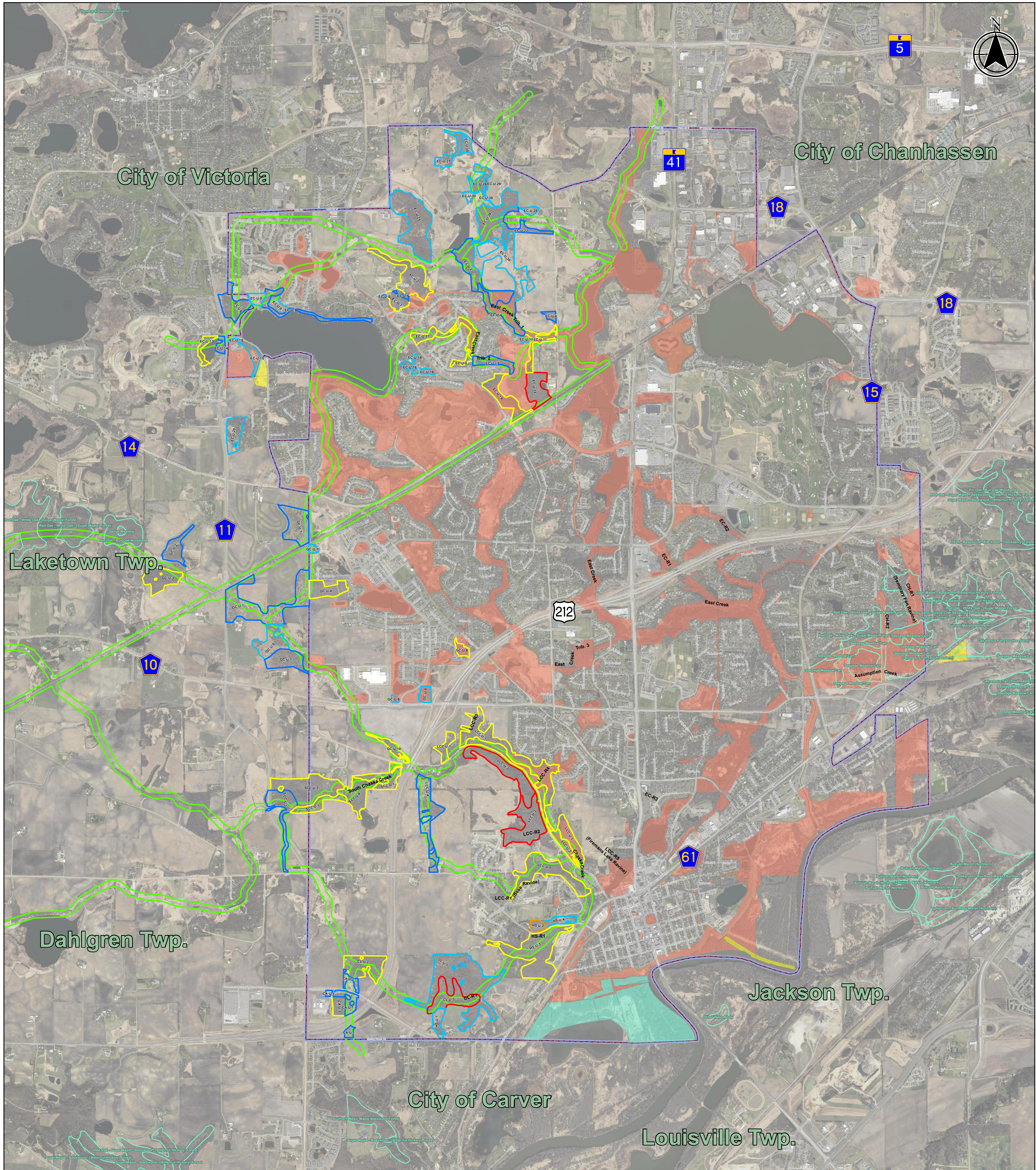


City of Chaska Water Resource Map Map 2



Revised: 2020-04-01 By: hduan
V:\1938\Clients\Chaska\Projects\Water_Resources_Map with Priority Project Areas.mxd

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- Chaska City Limits
- MNDNR MCBS Mapped Areas
- Greenway Corridor
- Upland - Unified Rank**
- Manage 1
- Manage 2
- Manage 3
- Unique
- NA
- Public Lands**
- City of Chaska Owned
- State of MN (Wildlife Management Area) Owned
- US Fish and Wildlife Services Owned

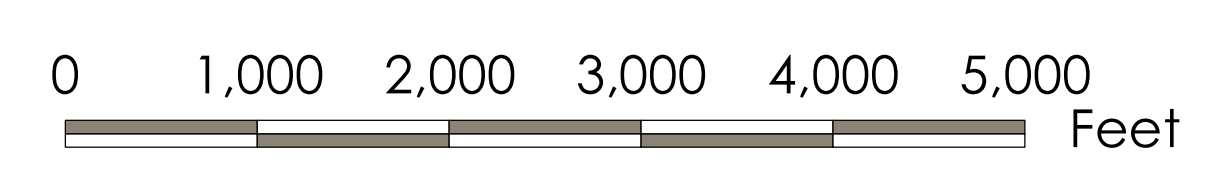
City of Chaska

Natural Areas Map

Map 3



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Revised: 2018-11-27 By: hduan
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