CREDIT RIVER TOWNSHIP

WATERSHED MANAGEMENT PLAN

June 2019

Hakanson Anderson

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APPENDICES

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AMC Antecedent soil Moisture Condition

BMP Best Management Practice

MnDNR Minnesota Department of Natural Resources

MPCA Minnesota Pollution Control Agency

MS4 Municipal Separate Storm Sewer System

NPDES National Pollutant Discharge Elimination System

NOAA National Oceanic Atmospheric Administration

NWI National Wetland Inventory

OHW Ordinary High Water

LiDAR Light Detection And Ranging

SCS Soil Conservation Service

SCWEP Scott Clean Water Education Program

SSA Storm and Sanitary Analysis

SWCD Soil and Water Conservation District

SWMO Scott Water Management Organization

SWPPP Stormwater Pollution Prevention Program

TMDL Total Maximum Daily Load

USFWS U.S. Fish and Wildlife Services

WCA Wetland Conservation Act

1. INTRODUCTION AND EXECUTIVE - SUMMARY

The 2019 Credit River Township Surface Water Management Plan is the first edition, as the Township previously relied on Scott County's water management plan. The 2019 plan incorporates the Scott Water Management Organization (SWMO) third generation plan (2019-2026) as well as the latest requirements from the Metropolitan Council.

1.1 Purpose of the Plan

Credit River Township is located within the Twin Cities metro area in eastern Scott County. The township has an abundance of recreational lands, wooded areas, parks, and water resources, which include numerous wetlands, and several lakes and waterways. This plan provides the framework to be followed to preserve these resources as the Township develops.

This plan was prepared to fulfill the legal requirements of the Metropolitan Surface Water Planning Rules (Chapter 8410). This plan also meets the policies and requirements of the Scott WMO and other local, state, and federal agencies.

1.2 General Approach to Planning

The general approach to water resource planning focuses on wetland protection, water quality, and flood control. Each are described below.

1.2.1 Wetland Protection

Wetland ecosystems can be greatly affected by the properties of stormwater runoff. Stormwater can flow into wetlands with varying rates and volumes and carry soil particles, nutrients, and contaminants. These factors can cause declines in water quality, animal and fish habitat degradation, introduction of invasive vegetation, and/or other issues that are able to degrade the wetland's functions and values.

The State of Minnesota has published a guidance document, which develops a methodology for determining the susceptibility of wetlands to degradation by stormwater input. This methodology relates

wetland type to a level of susceptibility as shown in Table 3-1. Wetlands such as bogs and fens can be easily degraded by changes in the stormwater inflows and are designated as highly susceptible. On the other hand, floodplain forests can tolerate relatively significant changes in the chemical and physical characteristics of stormwater inflow without degradation and are only slightly susceptible. Commonly observed shallow marshes and wet meadows dominated by cattail and reed canary grass, respectively, have a moderate susceptibility to stormwater fluctuations.

Wetland management standards were developed to determine how and when stormwater should be routed through a wetland to minimize potential impacts. These standards, shown in Table 3-1, were largely based on the state guidance document. These standards determine tolerable hydrologic change in terms of bounce (difference between the peak flood elevation and the wetland elevation), inundation period (time that flood waters temporarily stored in the wetland exceed the wetland elevation), and runout control (elevation of the outlet).

These standards provide guidance for the management of stormwater to minimize wetland impacts. It is assumed that wetland impacts will be minimized, and existing wetland functions and values will be maintained if the proposed management system and criteria meet the management standards shown in Table 5-1.

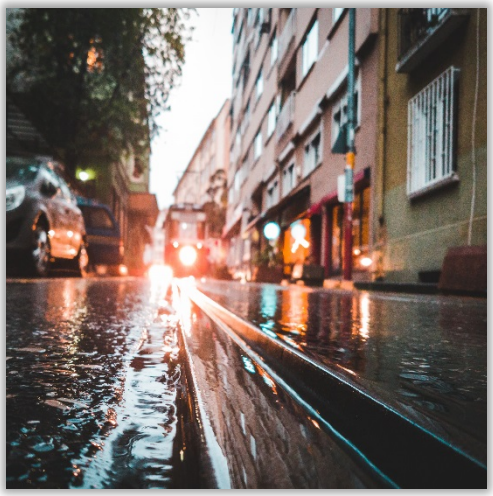
1.2.2 Water Quality Protection

Within Credit River Township, there are hundreds of water bodies ranging in size from lakes to small stormwater detention basins. Nonpoint pollution associated with stormwater runoff creates adverse impacts; the degree of impact depends on the water body's natural ability to remove, absorb, or process the pollutants through chemical, physical, or biological processes. Poor water quality usually indicates a situation where the resource receives more nutrients, or other pollutants, than can be processed naturally. Planning for water quality protection is necessary to preserve the beneficial uses of existing water bodies, as well as to evaluate wetland impacts as described above.

1.2.3 Flood Control

The 100-year flood elevation and discharge rate were estimated for the Credit River Watershed. Credit River has ample stormwater storage available in its wetlands and

lakes. This natural storage was utilized in producing the stormwater model for Credit River. The stormwater model was created based off current conditions to calculate the highest possible 100-year flood.



1.2.4 Stormwater Pollution Prevention Program

As required by the Clean Water Act, Credit River Township has prepared a Stormwater Pollution Prevention Program (SWPPP). The SWPPP is a requirement of the National Pollutant Discharge Elimination System (NPDES) General Permit No. MNR040000, which authorizes Municipal Separate Storm Sewer System (MS4) operators to discharge stormwater. The goal of the Stormwater Pollution Prevention Program is to reduce the discharge of pollutants into receiving waters to the Maximum Extent Practicable. The Township works with Scott County to meet all the SWPPP requirements.

There are six minimum control measures outlined below that are required to be included in the Stormwater Pollution Prevention Program under the requirements of the permit. Within each of the six minimum control measures, there are a number of Best Management Practices (BMPs) that are used to meet the requirements for each minimum control measure. The six minimum control measures are as follows:

1. Public Education and Outreach

   Public education and outreach is a major component of SWPPP. Residents informed of stormwater issues and ways to protect their water can greatly reduce the degradation of lakes, streams, and wetlands. The Township works with the Scott Soil and Water Conservation District (SWCD)'s Scott Clean Water Education Program (SCWEP). SCWEP hosts a number of number of workshops and events throughout Scott County.

2. Public Participation/Involvement

   Public participation is encouraged to receive input from the public on SWPPP. Public input may be used as a gauge to determine the effectiveness of the SWPPP and associated BMPs. Based on public input, Credit River Township may modify components of

the SWPPP if deemed beneficial. A public hearing is held once per year during the Township's regular meeting.

3. Illicit Discharge Detection and Elimination

The Township is required to prohibit non-stormwater discharges into the MS4 per Scott County's zoning ordinance. Annual inspections looking for illicit discharge indicators are conducted on all outfalls, structural BMPs, and one-fifth of stormwater ponds. If any possible illicit discharge is detected Credit River implements its Emergency Response Procedure, which can be found in Appendix B.

4. Construction Site Stormwater Runoff Control

All construction activities which disturb greater than or equal to 10,000 square feet of land require a grading permit from Scott County. Construction can contribute large amounts of sediment to downstream waters without proper BMPs in place. Regulations are in place to limit the quantity of sediment that would degrade water quality. Scott Count SWCD conducts inspections on these developments to ensure compliance.

5. Post-Construction Stormwater Management in New Development and Redevelopment

Scott County regulates development and redevelopment to ensure there is no increase or a net decrease, respectively, in runoff volume, total phosphorus, and total suspended solids. The Township Engineer reviews site plans for all land disturbing activities greater than or equal to 10,000 square feet insure grading plans will meet this requirement.

6. Pollution Prevention/Good Housekeeping

Credit River Township operates and maintains the storm sewer system in a manner so as to reduce the discharge of pollutants to the maximum extent practicable. Key components for good housekeeping are: inspecting the MS4 outfalls, stormwater ponds, exposed stockpiles, and material handling and storage areas, as well as ensuring all field staff are trained in recognizing and responding to stormwater issues. Records of the inspections are retained, including the date of the completion of repairs and major additional protection measures.

1.3 Management Goals and Policies

As part of the planning process, goals and policies were developed for the management of resources within Credit River. Goals propose the desired end, and policies provide the means to achieve the goals. Goals and policies are provided for wetlands, water quality, water quantity, erosion control, groundwater, public ditch systems, recreation, fish and wildlife, enhancement of public participation, information and education, floodplains, abstraction/filtration, ecological integrity, shorelines and streambanks, navigation, best management practices, public health, and regulation. The goals and policies of this plan are presented in Section 4, and Section 5 – Plan Implementation provides more specific details on how the goals and policies will be achieved.

1.4 Plan Organization

The Plan is organized as follows:

Section 1 presents the introduction and executive summary.

Section 2 presents the Township's physical and resource-related information.

Section 3 presents the wetland, water quality, and water quantity management strategies and problem areas.

Section 4 presents the Township's water resource goals and policies**.**

Section 5 presents the implementation strategies to accomplish the goals and policies.

Section 6 outlines the procedures for amending this plan.

Section 7 presents the required submittals for a development.

Section 8 presents a description of the hydrology model used for the plan.

Section 9 presents the glossary of terms.

2. PHYSICAL ENVIRONMENTAL INVENTORY

Knowledge of the landscape, natural resources, and climate can provide insight into the types of potential water issues a region may have. This section describes Credit River's natural environment in detail.

2.1 Climate

Credit River and the Twin Cities metro area have a temperate climate, characterized by wide variations in temperature, ample rainfall, and moderate snowfall. Table 2-1 shows the historical average monthly temperature, precipitation, and snowfall data.

In an average year, the freeze-free period for the area is long enough that the stable crops of the area reach maturity without much danger from frost. The 50% probability of temperatures of 32°F or lower can be expected between September 27 and May 12.

Precipitation patterns are influenced by two well-defined systems. Strong southerly winds from the Gulf of Mexico are the main source of moisture. A diffuse secondary system from the Pacific Ocean also adds to annual rain and snowfall. Precipitation occurs as rain, freezing rain, hail, and snow. Tornadoes, severe thunderstorms, and hailstorms occur occasionally and are of short duration. Measurable precipitation of 0.01-inch occurs on about 117 days per year, six of which have one-inch or more. Annual normal precipitation is approximately 31 inches, of which approximately two-thirds occurs during the summer months of May through September.

The annual snowfall in Credit River averages approximately 54 inches. Runoff from snowmelt can occur any time during the winter. The most severe snowmelt runoff conditions usually occur in March and early April, especially when rain falls on top of the snowpack.

Table 2-1
Average Monthly Temperature, Precipitation, and Snowfall Data for Minneapolis/St. Paul Metropolitan Area (1981-2010)

Month	Average Temp °F	Precip. Inches	Snowfall Inches
January	15.6	0.90	12.2
February	20.8	0.77	7.7
March	32.8	1.89	10.3
April	47.5	2.66	2.4
May	59.1	3.36	0.0
June	68.8	4.25	0.0
July	73.8	4.04	0.0
August	71.2	4.30	0.0
September	62.0	3.08	0.0
October	48.9	2.43	0.6
November	33.7	1.77	9.3
December	19.7	1.16	11.9
Annual Average:	**46.2**	**Total: 30.61**	**Total: 54.4**

Source: State Climatology Office for the Minneapolis/St. Paul Airport (1981-2010)

2.2 Precipitation Measurement Station

The State Climatology Office has a long-term precipitation station at the Minneapolis/St. Paul International Airport. This station was selected to be used as a reference for any entity conducting future water quality or quantity studies in Credit River. The current thirty-year normal (1981-2010) for annual precipitation at the station is 30.61 inches.

2.3 Topography and Landforms

The topography in Credit River was shaped by several ice advances into east-central Minnesota during the last (Wisconsin) glaciations, which occurred about 10,000 years ago. Credit River has three basic geologic units, which are as follows from top to bottom:

1. Glacial deposits
2. Bedrock formed in shallow marine sediments deposited between 480 million and 950 million years ago.
3. Bedrock of volcanic or metamorphic origin.

The material within the three units may be thought of as water bearing or as confining. The combined characteristics of the water bearing and confining geologic materials determine the location and flow of groundwater aquifers. The reworking of geologic material over time creates factors important to infiltration and recharge, affecting groundwater vulnerability. Today's topography and drainage network are the result of long acting forces that have produced features such as lakes, wetlands, streams, and rivers.

Soil properties are also affected by geologic reworking. The soils present now were originally deposited geologic material modified by five soil forming factors: parent material, climate, biota, topography, and time. The effects of the soil forming factors on the soil vary with the soil's location in the landscape (e.g.: ridge, top, slope, toe, basin, etc.).

Approximately two million years ago, the topography of Scott County, including Credit River, was formed in sedimentary rock, consisting of broad, rolling plateaus divided by sharply cut valleys. Presently that landscape is buried and referred to as bedrock. It is covered by material deposited by glaciers, known collectively as glacial drift.

A series of glacial advances and retreats deposited the drift by a combination of ice and water action. The drift thickness varies, from over 300 feet thick in the southern part of Scott County to extremely thin near the City of Savage. This glacially deposited material is very heterogeneous, ranging in size from boulders and gravel to clay. The advance and retreat of glacial ice sheets, the remnants of terminal moraines, and subsequent dissection by streams and rivers has left much of the present day topography in the Township rolling to strongly rolling. A map of the topography of Credit River is shown in Figure 2-1.

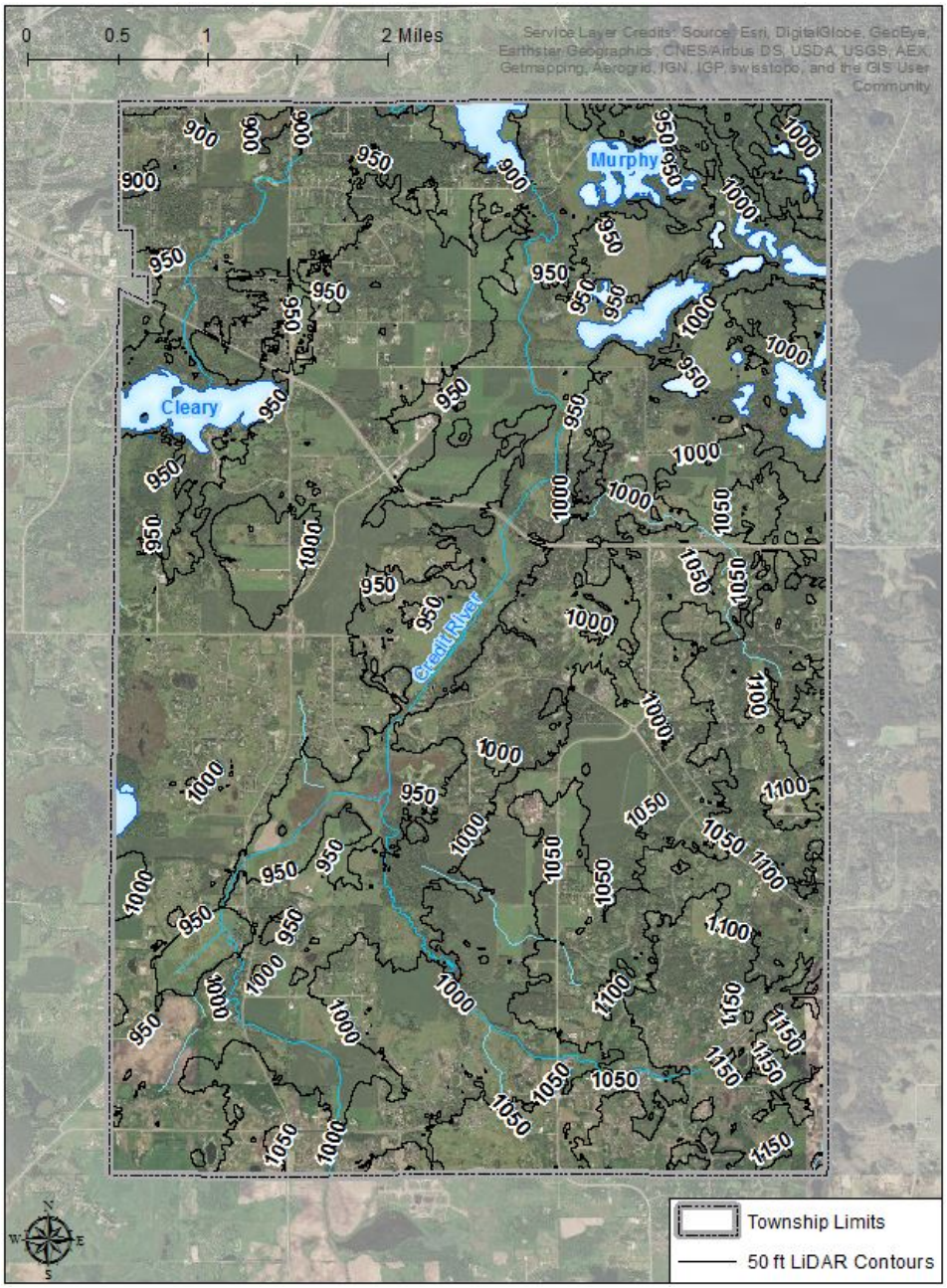


Figure 2-1. Credit River Topography

2.4 Watersheds and Drainage Patterns

Credit River Township is within the jurisdiction of Scott Watershed Management Organization (SWMO), but the Township shares a border with three other watershed jurisdictions: Prior Lake-Spring Lake Watershed District to the northwest, Black Dog Watershed Management Organization to the northeast, and Vermillion River Joint Powers Organization to the east and southeast. While all of Credit River is within SWMO's boundaries, the Township is divided by two major watersheds, as defined by the Minnesota Department of Natural Resources (MnDNR). The vast majority of Credit River lies within the Minnesota

River-Shakopee watershed, and the southeast corner of the Township falls within the Mississippi River and Lake Pepin watershed, as shown in Figure 2-2.

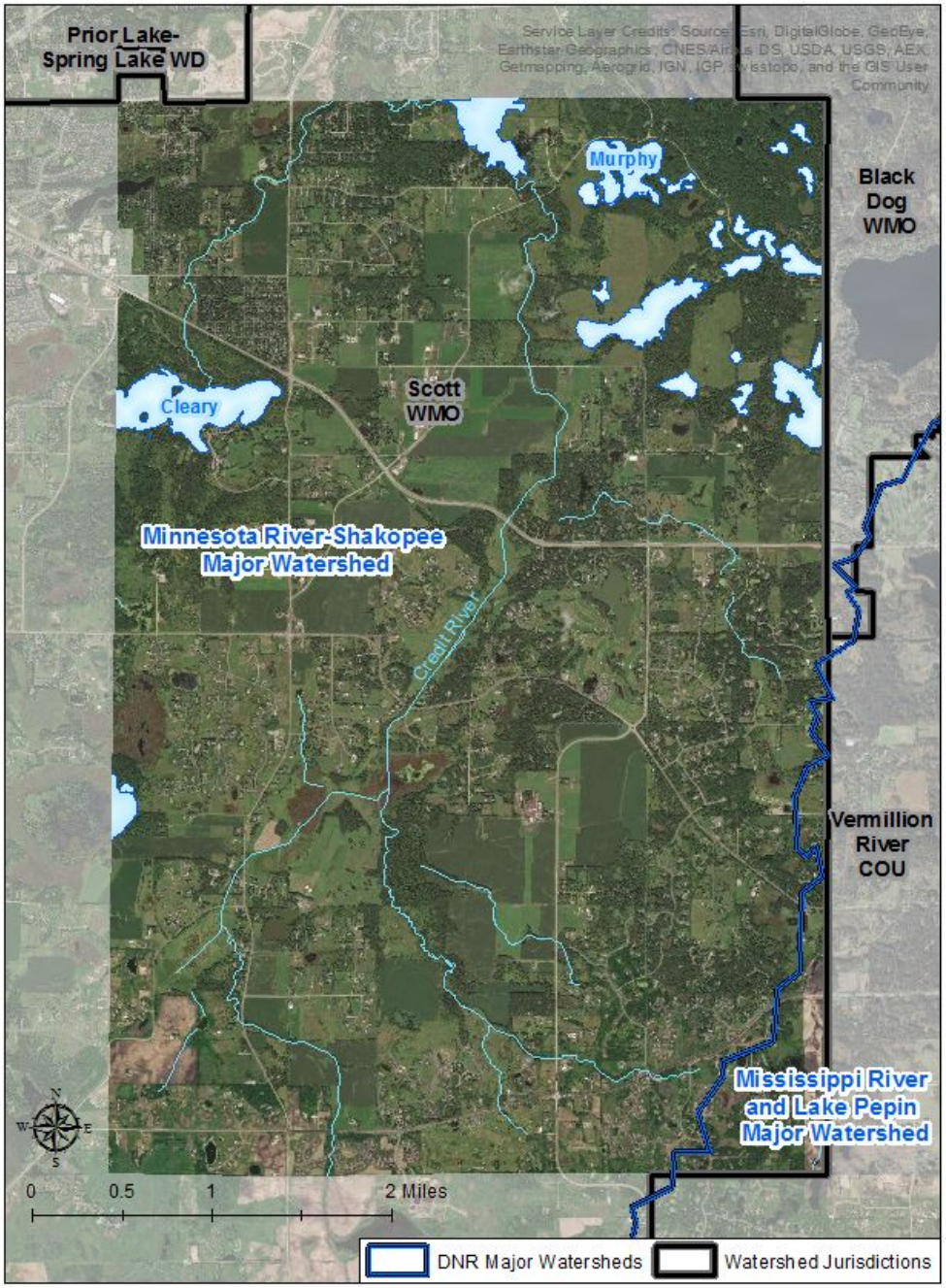


Figure 2-2. Watershed Jurisdictions and MnDNR Major Watershed boundaries within Credit River

2.5 MnDNR Protected Waters: Lakes, Wetlands, and Water Courses

The Minnesota Department of Natural Resources (MnDNR) has designated certain waters of the state as public waters (M.S. Section 103G.005, subdivision 15). MnDNR "Protected Waters and Wetlands" maps

show public waters within the Township. A MnDNR permit is required for work within a designated public water.

Figure 2-3 shows the protected waters, which includes lakes, wetlands, and water courses located within the Township. Sections 2.5.1, 2.5.2, and 2.5.3 summarize the protected lakes, wetlands, and watercourses in Credit River.

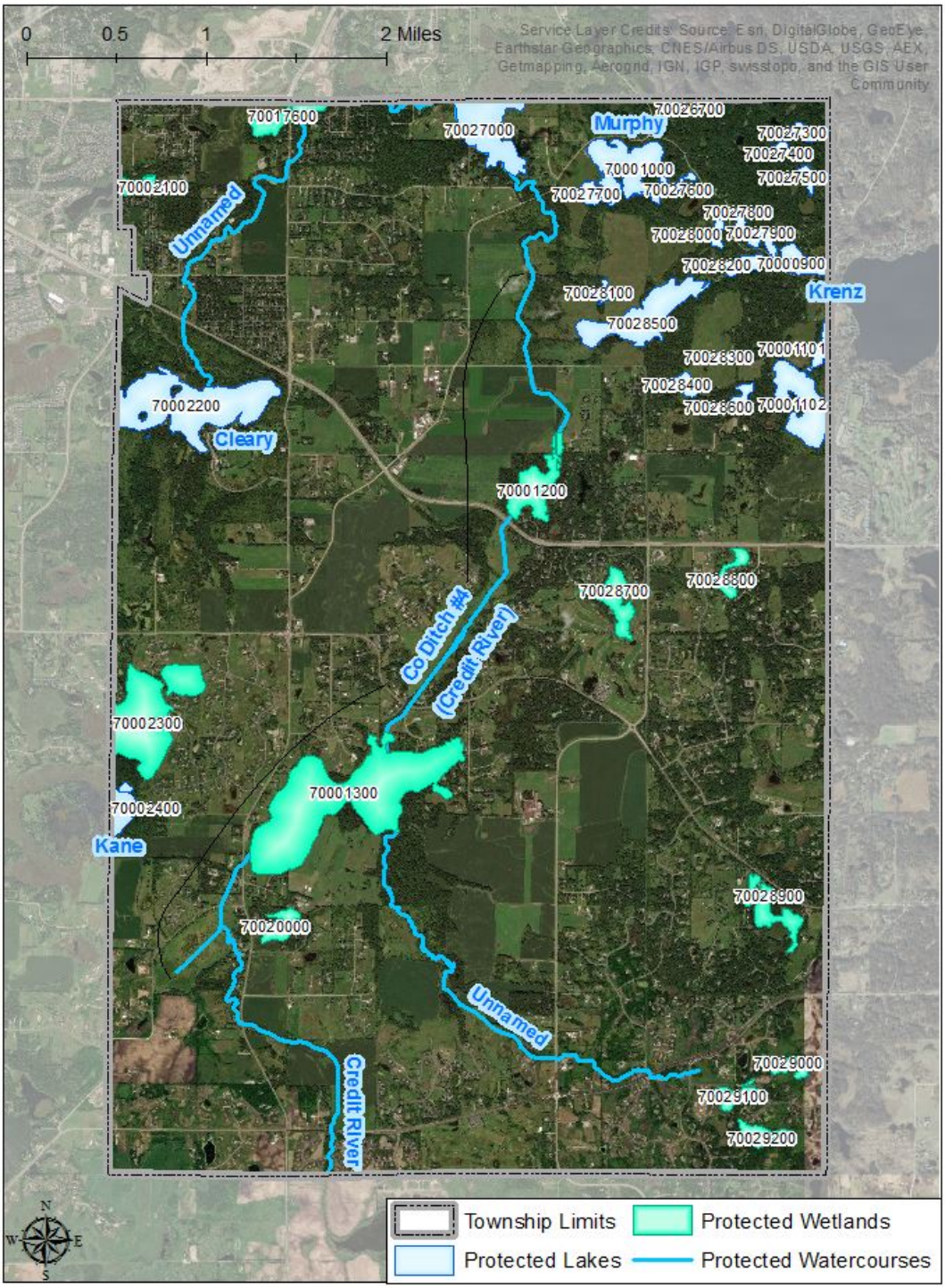


Figure 2-3. Protected Waters within Credit River

2.5.1 Protected Lakes

There are 22 protected lakes in Credit River Township. The lakes can range in size but are typically deeper than six feet. Table 2-2 lists the protected lakes within Credit River. Existing water quality data is available for Lake Murphy, Lake Cleary, and Unnamed (South Portion) through the Minnesota Pollution Control Agency (MPCA) Environmental Access Data website. Lake Cleary is considered impaired for nutrients and mercury, and Lake Murphy is considered impaired for mercury.

Table 2-2
Credit River Protected Lakes

ID	Name	Twp/Range	Section(s)	Area (ac)	DNR Shoreland Classification[1]	OHW
70-0009-00P	Krenz	114/21	3	16.8	NR	N/A
70-0010-00P	Murphy	114/21	3, 4	60.7	NE	N/A
70-1100-01P	Unnamed (North Portion)	114/21	10	15.1	NR	972’
70-1100-02P	Unnamed (South Portion)	114/21	10	55.1	NR	971.5’
70-0022-00P	Cleary	114/21	7	149.2	NE	937.8’
70-0024-00P	Kane	114/21	19, 30	279.4	NE	956.2’
70-0267-00P	Unnamed	114/21	3	3.0	NR	N/A
70-0270-00P	Unnamed	114/21	4, 5	134.1	NR	N/A
70-0273-00P	Unnamed	114/21	3	3.8	NR	N/A
70-0274-00P	Unnamed	114/21	3	3.0	NR	N/A
70-0275-00P	Unnamed	114/21	3	4.2	NR	N/A
70-0276-00P	Unnamed	114/21	3	6.0	NR	N/A
70-0277-00P	Unnamed	114/21	4	7.5	NR	N/A
70-0278-00P	Unnamed	114/21	3	4.1	NR	N/A
70-0279-00P	Unnamed	114/21	3	8.9	NR	N/A
70-0280-00P	Unnamed	114/21	3	5.1	NR	N/A
70-0281-00P	Unnamed	114/21	9	4.5	NR	N/A
70-0282-00P	Unnamed	114/21	3	10.2	NR	N/A
70-0283-00P	Unnamed	114/21	10	1.9	NR	N/A
70-0284-00P	Unnamed	114/21	10	10.9	NR	N/A
70-0285-00P	Unnamed	114/21	9, 10	68.1	NR	N/A
70-0286-00P	Unnamed	114/21	10	6.9	NR	N/A

[1] NE = Natural Environment, NR = Not regulated by DNR shoreland rules.

2.5.2 Protected Wetlands

In addition to the 22 protected lakes, there are 12 other wetlands within the Township that have been inventoried by the MnDNR. All of these wetlands are known as protected waters wetlands (M.S., Section 103G.005, subdivision 15), and therefore their beds along with the lakes are subject to regulatory authority of the MnDNR.

Protected wetlands mean all Types, 1 through 8 as defined in USFWS Circular 39 (USDI, 1971), not included within the definition of protected lakes, that are typically ten or more acres in size in unincorporated areas, or 2.5 acres in incorporated areas. Table 2-3 lists the protected waters wetlands subject to MnDNR jurisdiction.

Table 2-3
Credit River Protected Wetlands

ID	Name	Twp/Range	Section(s)	Area (ac)	DNR Shoreland Classification[1]	OHW
70-0012-00W	Unnamed	114/21	9, 16	39.4	NR	N/A
70-0013-00W	Unnamed	114/21	19, 20, 29, 30	246.0	NR	N/A
70-0021-00W	Markley	114/21	6	25.6	RD	893.2’
70-0023-00W	Unnamed	114/21	19	140.9	NE	N/A
70-0176-00W	Unnamed	114/21	5, 6	25.8	NR	N/A
70-0200-00W	Unnamed	114/21	29, 30	15.0	NR	N/A
70-0287-00W	Unnamed	114/21	16, 21	29.1	NR	N/A
70-0288-00W	Unnamed	114/21	15	12.2	NR	N/A
70-0289-00W	Unnamed	114/21	27	28.7	NR	N/A
70-0290-00W	Unnamed	114/21	34	10.3	NR	N/A
70-0291-00W	Unnamed	114/21	34	11.9	NR	N/A
70-0292-00W	Unnamed	114/21	34	13.4	NR	N/A

[1] NE = Natural Environment, RD = Recreational Development, NR = Not regulated by DNR shoreland rules.

2.5.3 Protected Water Courses

Protected waters also include all natural and altered watercourses with a total drainage area greater than two square miles. Credit River, County Ditch #4, and two unnamed creeks are the four protected watercourses in Credit River. The watercourses are discussed below.

1. Credit River

   The Township is divided by the Credit River, which begins in Goose Lake just south of the Township and travels north until it reaches the Minnesota River. Several smaller tributaries and county ditches flow into Credit River, including an unnamed creek from Cleary Lake. The 2018 proposed impaired waters list includes approximately 1.8 miles of the northern section of Credit River within the Township for *E. coli*, chloride, fishes bioassessments, and aquatic macroinvertebrate bioassessments. The entire length of Credit River was previously on the impaired waters list for turbidity from 2002-2012.

2. County Ditch #4

   County Ditch #4 overlaps with Credit River (from approximately one-mile south of MnDNR wetland 70001300 to approximately one-mile north of MnDNR wetland 70001200). There are no known water quality issues for this section of Credit River.

3. Unnamed Creek from Cleary Lake

   This creek flows from Cleary Lake and joins the Credit River approximately 0.25 miles north of the Credit River Township boundary. There are no known water quality issues for this creek.

4. Unnamed Creek to 70001300W

   This creek begins in the southeast corner of the Township and flows to the large MnDNR wetland identified as 70001300W. There are no known water quality issues.

2.6 Other Regulated Wetlands

In addition to the MnDNR waters discussed in Section 2.5, many additional wetlands within the Township are included on the National Wetland Inventory (NWI) maps but are not MnDNR water bodies. These wetlands are shown on Figure 2-4; however, the NWI does not definitively determine the accurate boundaries of a wetland.

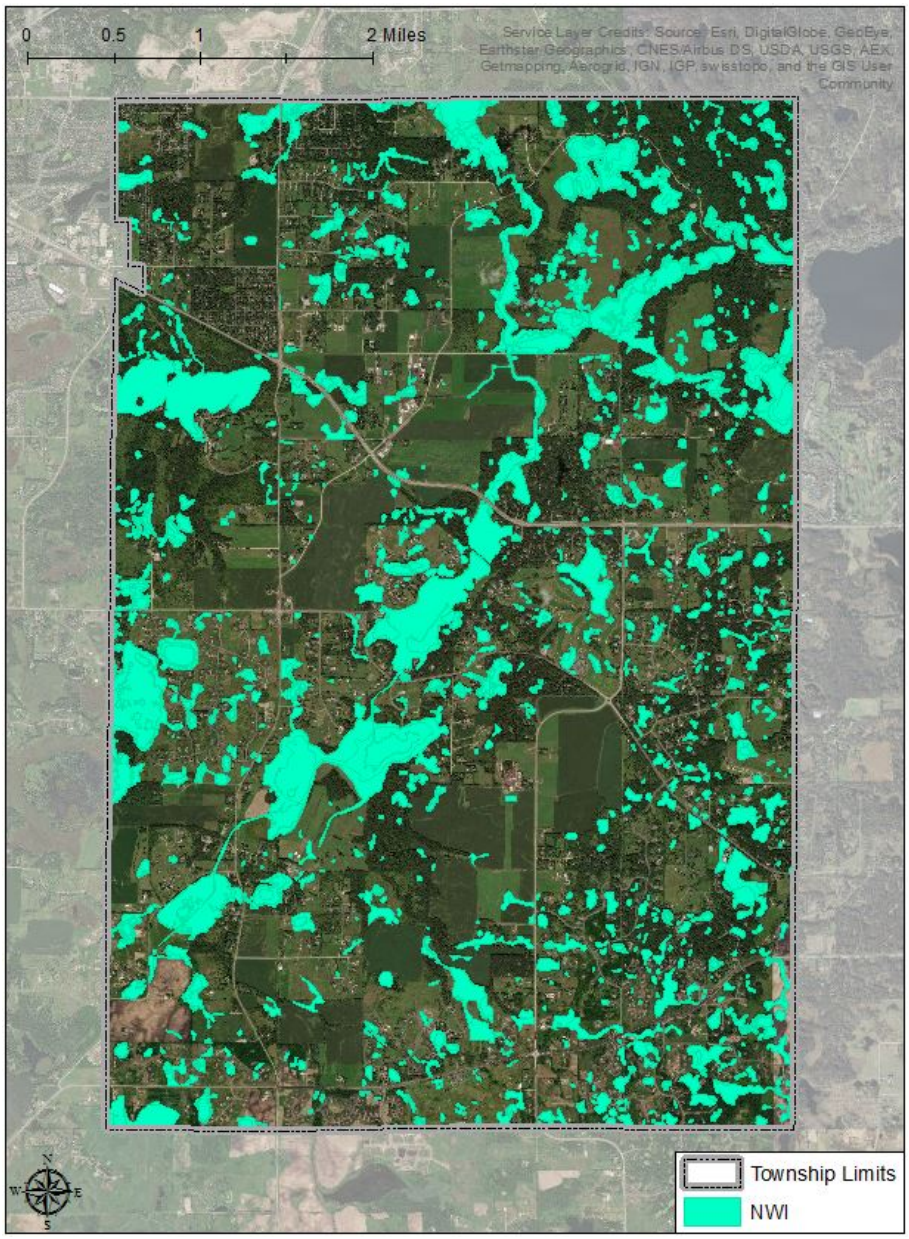


Figure 2-4. National Wetland Inventory MnDNR Update within Credit River Township

The following three characteristics make these water bodies exclusive from the MnDNR public waters:

1. An individual basin may be immediately adjacent to an inventoried MnDNR basin or watercourse yet dominated by wetland habitat (Types 1, 2, 6, and 7 [USDI, 1971] not statutorily covered by MnDNR.
2. An individual isolated wetland basin may be smaller than the minimum MnDNR size (2.5 or 10 acres) as discussed previously.
3. An individual isolated wetland basin may be dominated by habitat types (Types 1, 2, 6, and 7) not statutorily covered by MnDNR.

Excavation, filling, grading, and/or development actions which may adversely affect these resources may be subject to federal permitting authority under Sections 401 and 404 of the Clean Water Act, (33 USC 125 et. seq.) and Township approval under the 1991 Wetland Conservation Act (WCA), as amended.

2.7 Groundwater Resources

The township's drinking water is supplied by the groundwater. Two major aquifers are located within Credit River township: the surficial Glacial Drift Aquifer and the Prairie du Chien-Jordon Aquifer as shown in Figure 2-5. The surficial Glacial Drift Aquifer is present in relatively small patches and consists of St. Peter sandstone with a maximum thickness of 120 feet. Below the St. Peter sandstone is the Prairie du Chien Group, which has a thickness of approximately 140 to 190 feet. It is composed of crystalline dolostone, sandstone, and shale and has an Oneota confining layer.

Groundwater quality can be affected by a variety of land use types. The identification of areas susceptible to groundwater contamination is difficult due to the character (permeability and thickness) of the surficial material, depth to the piezometric surface, precipitation amount and duration, and other components of aquifer recharge. See section 2.14 for further discussion on groundwater contamination.

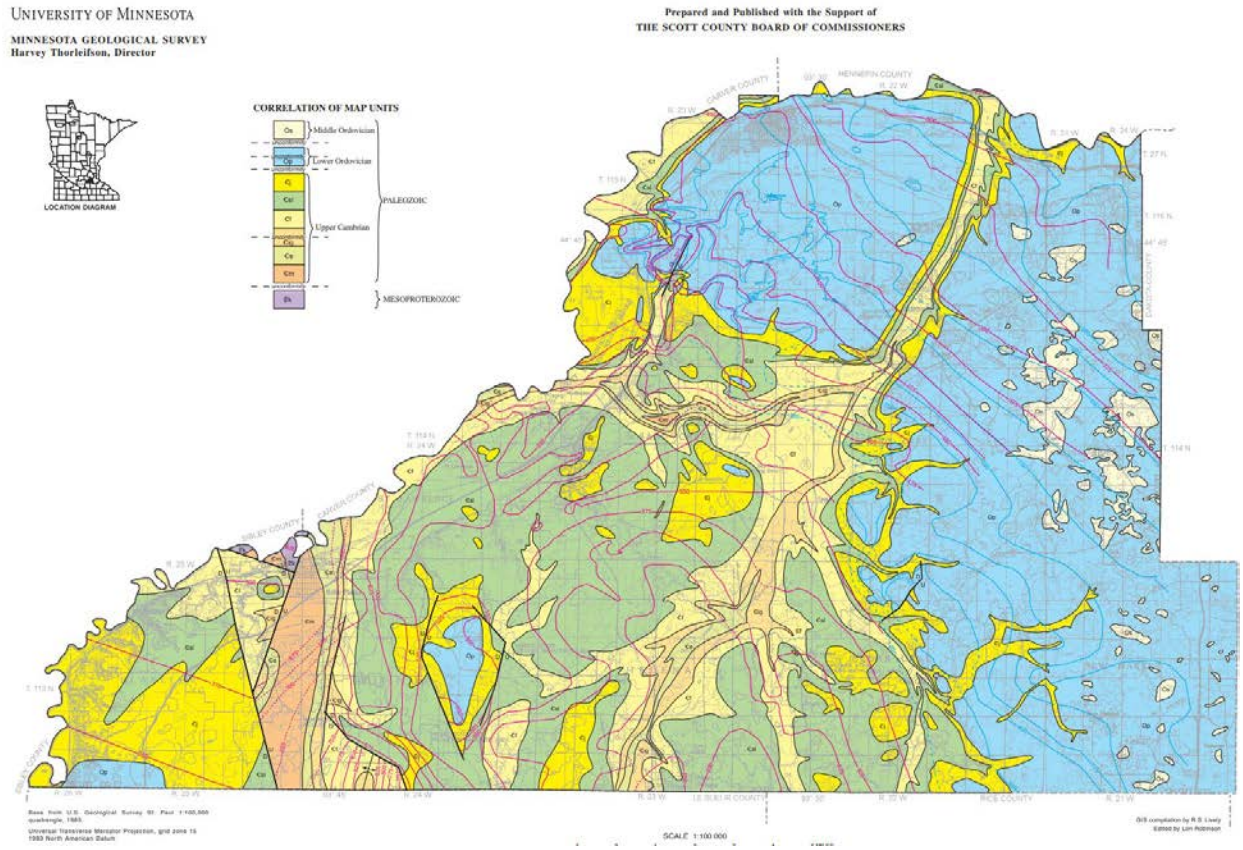


Figure 2-5. Bedrock Geology of Scott County from the University of Minnesota, Minnesota Geological Survey. Credit River is located on the eastern border near the center. The blue area consists of the Prairie du Chien formation, and the light tan color represents the St. Peter sandstone.

2.8 Soils

Five of the seven Scott County soil associations are found in the Credit River area. The soils are classified into the following associations, in order of their prominence (and approximated percent):

1. Hayden-Lester-Peat bogs Association (65 percent)
2. Burnsville-Hayden-Kingsley-Scandia Association (15 percent)
3. Lester-Webster-Glencoe Association (15 percent)
4. Webster-LeSueur-Clarion-Lester Association (4 percent)
5. Hubbard-Estherville-Dakota-Waukegan-Zimmerman Association (1 percent)

Information about each of the soil series listed above is available from the Web Soil Survey website. The following table shows the drainage characteristics of each soil series present in Credit River from the above associations.

Table 2-4
Credit River Soil Drainage Characteristics

Soil Series	Drainage Characteristics	Soil Type
Burnsville	Well Drained	A
Dakota	Well Drained	B
Estherville	Somewhat Excessively Drained	A
Glencoe	Very Poorly Drained	C/D
Hayden	Well Drained	B
Kingsley	Well Drained	C
Le Sueur	Somewhat Poorly Drained	C/D
Lester	Well Drained	C
Peat Bogs (Marsh)	Very Poorly Drained	A/D
Waukegan	Well Drained	B
Webster	Poorly Drained	B/D

The drainage nature of the soil is important for determining the surface water runoff from a given area. If the soil is well drained, a significant portion of the precipitation will be infiltrated into the ground; whereas, if a soil is poorly drained, most of the precipitation will flow from the site of impact. A map of soil type is shown in Figure 2-6.

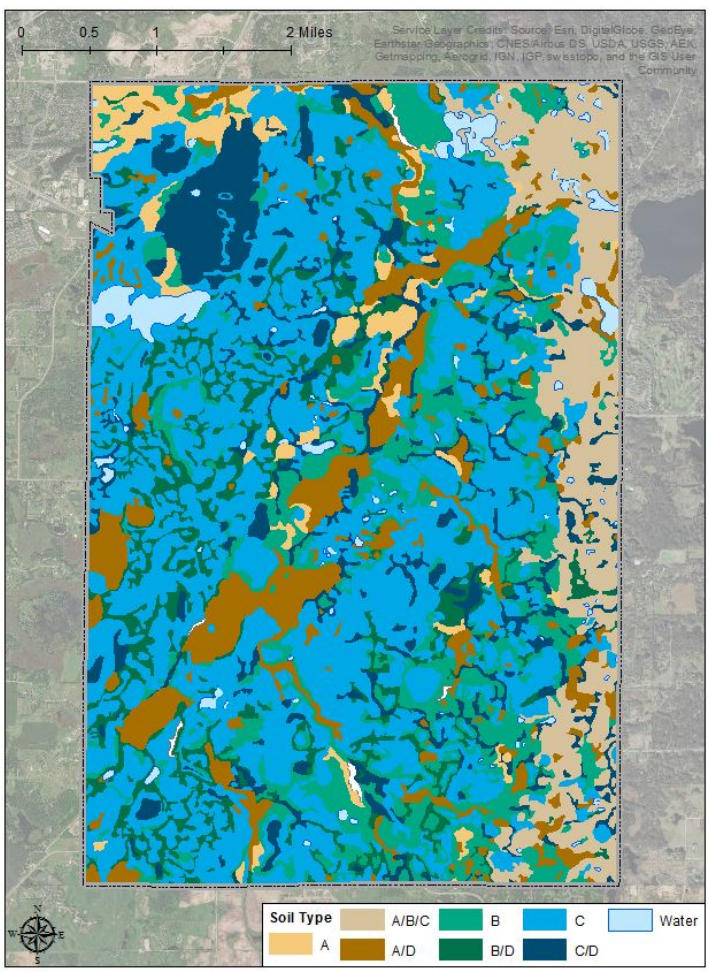


Figure 2-6. Soil Types (A-D) mapped within Credit River Township.

2.9 Native Vegetation

Credit River is within the Big Woods subsection of the Eastern Broadleaf Forest region of MnDNR's Ecological Classification System. This region was dominated by oak woodland and maple-basswood forest prior to Euro-American settlement. Within the maple-basswood forests the most common species were, in order: elm, basswood, sugar maple, bur oak, ironwood, northern red oak, and aspen. The oak woodlands were dominated by: aspen, red oak, bur oak, and white oak.

Much of the forested areas have now been cleared for cropping. However, existing forested areas still contain similar species found before settlement.

2.10 Land Use

Credit River Township is part of the Twin Cities Metropolitan area. The population growth trends for Credit River and the surrounding communities are shown in the table below.

Table 2-5
Population and Growth Trends

Local Government	1990[a]	2000[a]	2010[a]	2020[b]	2030[b]	2040[b]
Credit River Township	2,854	3,895	5,096	5,200	5,500	5,600
Savage	9,906	21,115	26,911	33,400	37,400	41,100
Prior Lake	11,482	15,917	22,796	27,500	32,500	37,600
Lakeville	24,854	43,128	55,954	64,300	74,600	83,500
Spring Lake Township	2,853	3,681	3,631	3,790	4,130	4,180
New Market Township	1,972	3,057	3,440	3,420	3,350	3,340
Eureka Township	1,405	1,490	1,426	1,450	1,570	1,670

a. U.S. Census Bureau, 2010 Census of Population and Housing, *Population and Housing Unit Counts* CPH-2-25, Minnesota, July 2012.
b. Metropolitan Council. Thrive MSP 2040. January 1, 2018. www.metrocouncil.org/Data-and-Maps/Data.aspx

2.10.1 Existing Land Use

Credit River has assembled a 2040 Comprehensive Plan to coordinate future development. The Comprehensive Plan identifies limited future rural residential development with the intent of protecting valued open space and rural character. The Comprehensive Plan will function to define the relationship of natural resources and land use development decisions as well as coordinate with zoning laws and other regulations to provide logical, efficient, and effective decision-making. The Comprehensive Plan is also an intergovernmental document, coordinating the Township's plans with regional, county, and adjacent

municipal planning activities. Land use is divided into two areas: diversified rural, adjacent and north of Eagle Creek Avenue, and rural residential for the rest of the Township.

2.10.2 Future Land Use

The northern third of the community that is currently designated as diversified rural is planned to be served by the Metropolitan Council sanitary system. Future land use is reclassifying this area as proposed suburban edge in anticipation of the extension of sewer and installation of water. Future land use is discussed further in the Comprehensive Plan.

2.11 Parks and Open Spaces

Credit River has two large parks: Cleary Lake Regional Park and Murphy-Hanrehan Park Reserve. Both of which overlay other municipalities and are operated by Three Rivers Park District. The Cleary Lake Regional Park to the northwest offers cross-country ski trails, swimming beach, picnic area, campground, and a golf course. Murphy-Hanrehan Park Reserve to the northeast is largely undeveloped with several cross-country and mountain biking trails.

2.12 Fish and Wildlife Habitat

The water bodies and open spaces throughout the Township provide habitat for fish and wildlife species including birds, mammals, and reptiles. Ducks and geese are present in large numbers at lakes, wetlands, and open water areas. Vegetative cover in the undeveloped open areas support many mammalian species such as deer, raccoon, squirrels, chipmunks, and rabbits. The numerous wetlands in Credit River provide habitat for a variety of aquatic species including snakes, turtles, and frogs.

The U.S. Fish and Wildlife Services (USFWS) lists the Rusty Patched Bumble Bee as endangered within Scott County. The bees like grasslands with flowering plants, underground and abandoned rodent cavities, and undisturbed soils for hibernating queens to overwinter.

Minnesota lists the Northern Long-Eared Bat as a threatened species within Scott County. As of April 2018, there are no documented maternity roost trees and/or hibernacula entrances within the Township, but roost trees have been found in northwestern Scott County.

2.13 Unique Features and Scenic Areas

The Murphy-Hanrehan Park in the northeastern portion of the Township is considered an important area for wildlife. The Minnesota County Biological Survey inventoried the natural communities within the park and assigned an outstanding rating for biodiversity. Figure 2-7 includes the natural communities and regional parks within Credit River.

There are no USFWS critical habitats within Scott County. There are also no scenic rivers or streams with Credit River Township.

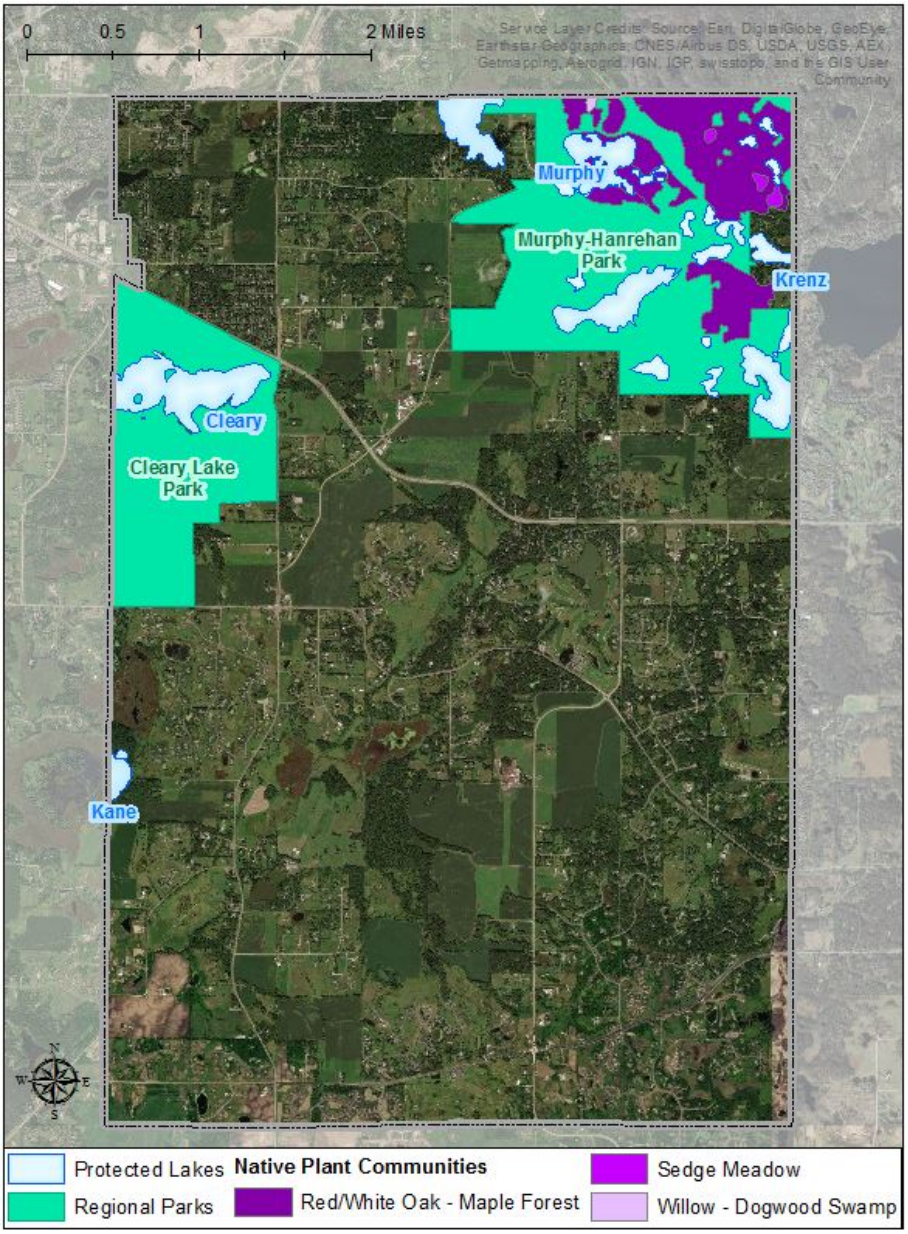


Figure 2-7. Regional Parks and Native Plant Communities in Credit River Township

2.14 Pollutant Sources

The Minnesota Pollution Control Agency maintains up-to-date data on potential sources of groundwater contamination including: sanitary landfills, dumps, hazardous waste sites, registered underground and above ground storage tank sites, feedlots, abandoned wells, and permitted wastewater discharges. This information is available through the Minnesota Geospatial Information Office.

The County Atlas-Regional Assessment Program is a joint program of the MnDNR-Division of Waters and the Minnesota Geological Survey, and it prepares map-based reports of counties and multicounty regions to convey geologic and hydrogeologic information and interpretations to governmental units at all levels,

particularly to local governments. This information and these interpretations contribute to sound planning and management of the state's land and water resources.

Susceptibility of the water table was rated based on the depth of the water table and the vertical conductivity of geologic materials. Rating groundwater susceptibility can be based on the ability of geologic material to 1) absorb and hold contaminants; 2) transform contaminants into benign substances; 3) dilute contaminants to levels below some standard; and 4) control the rate that contaminated water flows to or through aquifers. High susceptibility does not indicate that water quality has been or will become degraded; low susceptibility does not guarantee that groundwater will remain pristine. Rather, it indicates the areas at a greater risk of contamination due to high soil permeability and shallow groundwater. Figure 2-8 shows the ratings for Credit River Township.

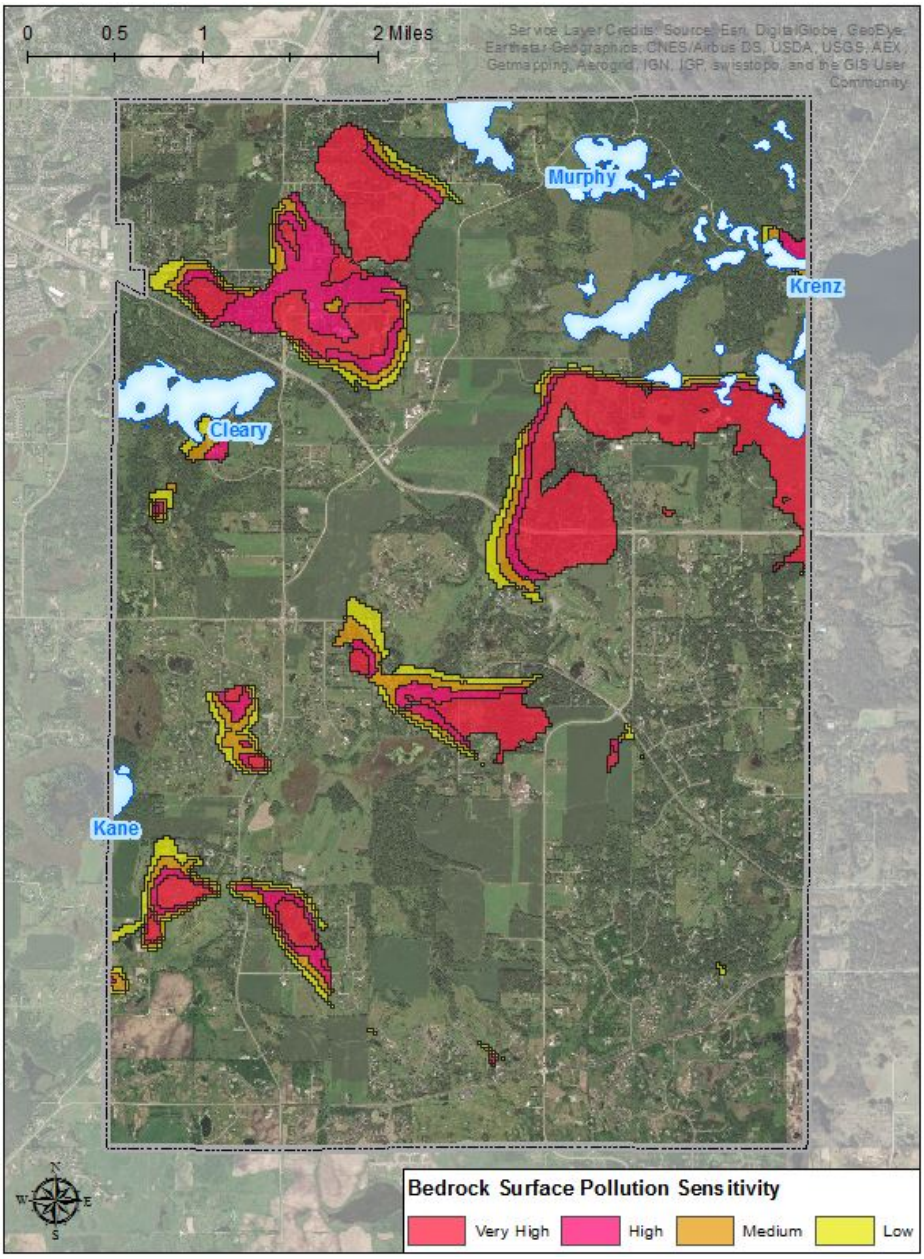


Figure 2-8. Bedrock Surface Pollution Sensitivity

2.15 Water Resources Related Agreements

Generally, Scott County is composed mostly of the Scott Water Management Organization (SWMO), but also Prior Lake-Spring Lake Watershed District and portions of the Lower Minnesota River Watershed District and Vermillion River Joint Powers Organization. Every municipality has at least a portion of its township/city with the SWMO.

The SWMO works with Scott County on water quality issues. This includes educational and outreach implementation that targets residents, students, and businesses within Scott County on water quality issues and ways to mitigate negative impacts to the water resources.

In addition, the County has adopted Rules and Standards for which all projects must adhere to. The rules and standards are applicable to stormwater management, erosion and sediment control, floodplain alteration, and wetland alteration.

The County has enacted a permit program. Activities requiring grading permits are listed in chapter six of the County's Zoning Ordinance.

2.16 Comprehensive Plan

The Township is preparing the 2040 Comprehensive Plan concurrent with the preparation of this plan. Required plan elements are Land Use, Transportation, Water Resources, Parks & Trails, Housing, and Plan implementation.

3. MANAGEMENT STRATEGIES AND PROBLEM AREAS

This section presents the process and information used to develop the management plan strategies for wetlands, water quality, and water quantity. Section 3.4 discusses the known problem areas within the Town.

3.1 Wetland Protection

This section describes the process that was used to develop a wetland management strategy. The objective of this process is to provide no net loss of wetland functions and values. Impacts to wetlands include not only direct impacts such as filling and drainage, but also indirect impacts from stormwater inputs. This process is based largely on the state guidance document "Stormwater and Wetlands: Planning and Evaluation Guidelines for Addressing Potential Impacts of Urban Stormwater and Snowmelt Runoff on Wetlands" (State of Minnesota, Stormwater Advisory Group, June 1997).

3.1.1 Wetland Susceptibility to Stormwater Inputs

Stormwater runoff carries soil particles, nutrients, and contaminants, which can change the ecological balance of the receiving water body. Changes in the volume or rate of stormwater entering or discharging from the water body can also change the ecological balance. Change in the ecological balance of a wetland often results in changes in the water quality, changes in animal and fish habitat, replacement of native vegetation with invasive and tolerant plant species, and/or other impacts to the wetland's functions and values.

The state guidance document developed a methodology for determining the susceptibility of wetlands to degradation by stormwater input. This methodology relates wetland type to a level of susceptibility as shown in Table 3-1. Wetlands such as bogs and fens can be easily degraded by changes in the stormwater inflows and are designated as highly susceptible. On the other hand, floodplain forests can tolerate relatively significant changes in the chemical and physical characteristics of stormwater inflow without degradation and are therefore slightly susceptible. Commonly observed shallow marshes and wet meadows dominated by cattail and reed canary grass (respectively) have a moderate susceptibility to stormwater fluctuations.

3.1.2 Wetland Management Standards

Wetland management standards were developed to determine how and when stormwater should be routed through a wetland to minimize potential impacts. These standards, shown in Table 5-1, were largely based on the state guidance document. These standards determine tolerable hydrologic change in terms of bounce (difference between the peak flood elevation and the wetland elevation), inundation period (time that floodwaters temporarily stored in the wetland exceed the wetland elevation), and runout control (elevation of the outlet).

These standards provide guidance for the management of stormwater to minimize wetland

impacts. It is assumed that wetland impacts will be minimized and existing wetland functions and values will be maintained if the proposed management system and criteria meet the management standards shown in Table 3-1. Specific requirements designed to implement the Township's wetland management strategies and buffer widths are outlined in Section 5.1.

Table 3-1
Susceptibility of Wetlands to Degradation by Stormwater Impacts

Exceptionally Susceptible Wetland Types:[1]	Highly Susceptible Wetland Types:[2]	Moderately Susceptible Wetland Types:[3]	Least Susceptible Wetland Types:[4]
Sedge Meadows	Shrub-carrs[a]	Floodplain Forests[a]	Gravel Pits
Open Bogs	Alder Thickets[b]	Fresh (Wet) Meadows[b]	Cultivated Hydric Soils
Coniferous Bogs	Fresh (Wet) Meadows[c,e]	Shallow Marshes[c]	Dredged Material/Fill Material Disposal Sites
Calcareous Fens	Shallow Marshes[d,c]	Deep Marshes[c]	
Low Prairies	Deep Marshes[d,c]		
Lowland Hardwood Swamps			
Seasonally Flooded Basins			

1. Special consideration must be given to avoid altering these wetland types. Inundation must be avoided. Water chemistry changes due to alteration by stormwater impacts can also cause adverse impacts. Note: All scientific and natural areas and pristine wetland should be considered in this category regardless of wetland type.
2. a., b., c. Can tolerate inundation from 6 inches to 12 inches for short periods of time. May be completely dry in drought or late summer conditions. d. Can tolerate +12 inches inundation, but adversely impacted by sediment and/or nutrient loading and prolonged high water levels. e. Some exceptions.
3. a. Can tolerate annual inundation of 1 to 6 feet or more, possibly more than once/year. b. Fresh meadows that are dominated by reed canary grass. c. Shallow marshes dominated by reed canary grass, cattail, giant reed, or purple loosestrife.
4. These wetlands are usually so degraded that input of urban stormwater may not have adverse impacts.

Notes: There will always be exceptions of the general categories listed above. Use best professional judgment. Appendix A of the State Guidance Document contains a more complete description of wetland characteristics under each category. Pristine wetlands are those that show little disturbance from human activity.

Source: "Planning and Evaluation Guideline for Addressing Potential Impacts of Urban Stormwater and Snowmelt Runoff on Wetlands" State of Minnesota, Stormwater Advisory Group, June 1997.

3.1.3 Wetland Management Classification

A wetland functions and values assessment will be required for all waters proposed to receive new stormwater discharges from private development or Township initiated projects unless a management class has already been designated for the receiving water. The latest version of the "Minnesota Routine Assessment Method for Evaluating Wetland Functions" shall be used to assess receiving waters. The Township may require, not only the water body directly receiving the discharge, but all downstream water bodies to be assessed. The assessment shall be completed by qualified wetland personnel who specialize in such work. Developers will be responsible for submitting the assessment for private projects. The assessments will be subjected to review and approval by the Township's water resource staff

The function and value assessment will be used to assign the wetlands into one of four categories – Exceptional, High, Medium, or Low. The wetlands functional assessment for vegetative diversity will be used to classify the wetland. However, if there are five or more total categories ranked as high or exceptional, then the wetland must be classified no lower than high. If two or more categories are ranked as exceptional, then the wetland must be classified no lower than exceptional. The Township's water resource staff will be responsible for assigning the wetlands into categories.

3.2 Water Quality

Within Credit River Township, there are numerous water bodies ranging in size from lakes to small stormwater detention basins. Nonpoint pollution associated with stormwater runoff creates adverse impacts; the degree of impact depends on the water body's natural ability to remove, absorb, or process the pollutants through chemical, physical, or biological processes. Poor water quality usually indicates a situation where the resource receives more nutrients, or other pollutants, than can be processed naturally. Planning for water quality protection is necessary to preserve the beneficial uses of existing water bodies, as well as to evaluate wetland impacts as described in Section 3.1. Improved water quality will be achieved with new development and redevelopment projects by the load reduction achieved by abstracting 1 inch of stormwater runoff from the net new impervious or no net increase in total phosphorus or total suspended solids, whichever is lower.

Water quality protection will also be achieved through implementation of the Township's Stormwater Pollution Prevention Program (SWPPP) as discussed in Section 1.2.4.

3.3 Water Quantity

The flood and rate control planning consist of estimating the 100-year flood elevation and discharge rate for watersheds with in Credit River. This section discusses the flood insurance study and the Town's flood and rate control process.

3.3.1 Flood Insurance Study

A Flood Insurance Study was completed in February 1987 by the Federal Emergency Management Agency and was recently updated with the revised maps becoming effective in 2020. The Flood Insurance Study maps updated the initial rate map to add floodway and cross sections to change special flood hazard

areas, base flood elevations and zone designations. There are no 100-year flood elevations provided on the rate maps with in Credit River Township.

3.3.2 Flood Protection Level

Storm drainage systems are typically designed to pass a flood of a designed magnitude called the design flood. The design flood generally balances the cost of flood damages with the cost of the storm drainage system to achieve an overall minimum public cost. The watershed classification in Credit River require protection for either the 1 or 10 percent change flood based on expected flood damages. Storm drainage systems that sever as the outlet for areas where flood damage is likely to occur must safely pass the critical-duration 1 percent change flood. Storm drainage systems for areas where no significant flood damage or disruption of infrastructure is likely to occur must safely pass the critical-duration 10 percent chance flood.

3.3.3 Hydrologic Model

Simulating the stormwater system using a hydrologic model is important in determining the adequacy of the existing system and to provide guidance in designing systems to handle surface runoff for ultimate development conditions. A hydrologic model simulates the rainfall-runoff process so that runoff rates and volumes from design storms can be estimated for different stormwater configurations and land use conditions.

As rain falls on the watershed several different processes move the water from the ground surface to one of three ultimate destinations. The stormwater will eventually end up as infiltration into the soil, runoff to a downstream waterbody, or evaporate. Initially water is stored in depressions and on the surface of the ground, and beings to infiltrate into the soil. As rainfall continues, the storage capacity of these depressions is exceeded and the excess water begins to runoff into gutters, swales, ditches, and storm sewers. In Credit River, these conveyance paths lead to public ditches, creeks, or to one of the make lakes, wetlands, or ponds within the township.

The amount of rain and the time over which the rain occurs influence the amount of runoff and the rate at which the runoff travels from the watershed. In addition to the rainfall conditions, the physical characteristics of the watershed also determine the volume of water that leaves the watershed as runoff, and the resulting flood levels in the ponds, wetlands, and lakes in the watershed.

The storm drainage system for Credit River was analyzed for the 1 percent chance flood for existing conditions. The 1 percent chance flood is used to design storm drainage systems that serve as the outlet for areas where significant damage is likely to occur.

The drainage divides for Credit River township were determined using data from the MnDNR watershed mapping project. The MnDNR used geographic information systems to map watersheds by analyzing digital data, such as surface water, topographic data, and aerial photography. The watershed boundaries were compared to light detection and ranging (LiDAR) data to ensure boundaries are accurate and up to date.

Autodesk Storm and Sanitary Analysis (SSA) software was utilized to build the hydrologic model to simulate flow through the storm drainage system in Credit River. This computer analyses rainfall for each watershed and creates hydrographs. The software then models the stormwater flow through the conveyance systems and storage areas. The peak runoff rate is the primary factor in determining storm sewer sizes. Runoff volume is utilized to design and evaluate stormwater storage areas and to assess hydrologic impacts to wetlands. A more detailed discussion about the SSA model is given in section 9.0.

3.3.4 Rate Control and Flood Storage

The Credit River watershed contains vast amounts of stormwater storage in its wetlands and lakes. The storage in the watershed was included in the SSA computer model. The volume available in the storage and the existing water elevations were gathered from LiDAR that has been made available by the MnDNR.

3.3.5 Flood Control

Flood control has been directed primarily at the management of flood levels which include the protection of structures and the safety of the residents of the Township.

It is common practice to provide a safety factor against flood. This factor of safety is typically represented as a vertical separation distance between the peak flood elevation and the flood damage elevation called freeboard. The freeboard amounts used within Credit River can be found in section 5.2.

The Credit River flood control system consists of the wetlands, ponds, and lakes for storage of stormwater runoff. Roadways, storm sewers, ditches, and streams act as conveyance of water from the watershed, and management of the water in the system. Normal levels, flood levels, flood storage, peak discharges, and proposed storm sewer pipe sizes for each watershed are tabulated in the tables in section 6.

3.4 Problem Areas

An assessment of the known problem areas and concerns is presented in this section.

3.4.1 Lake and Stream Water Quality Concerns

Cleary Lake

Cleary Lake is considered impaired for mercury, and as of 2008 it is also impaired for nutrients. There is no approved Total Maximum Daily Load (TMDL) for Cleary Lake, but there is a completion target date for 2019. Data from the MPCA's Environmental Data Access shows the phosphorus levels between 2001 and 2018 in the Figure 3-1.

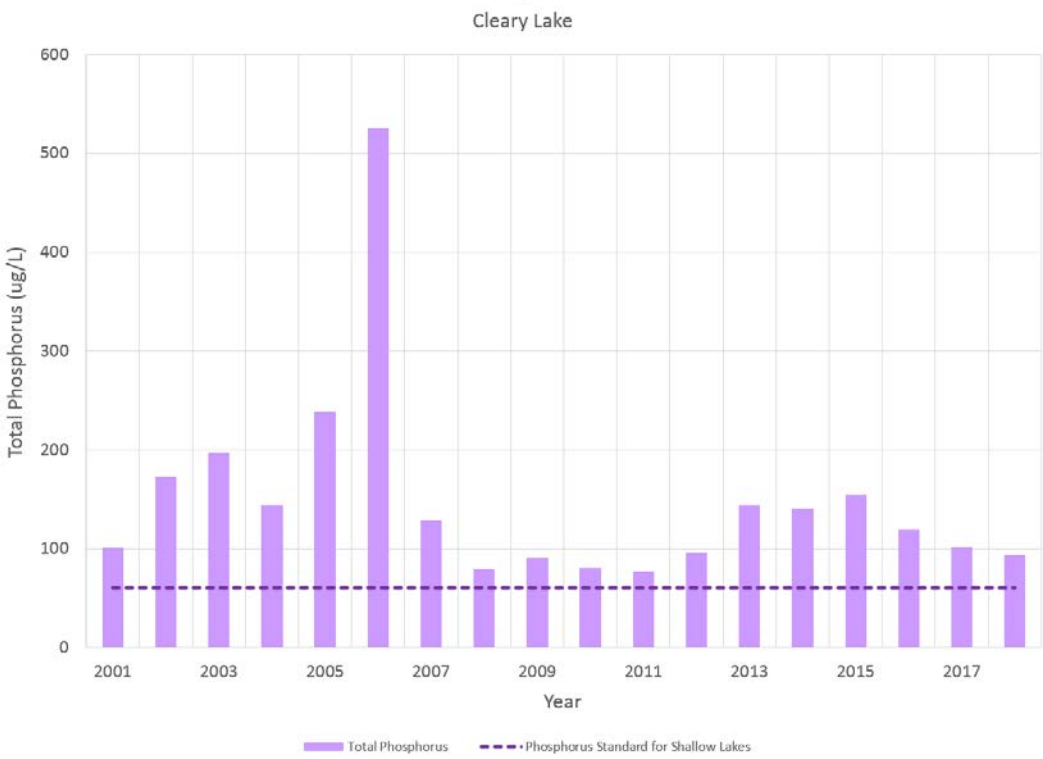


Figure 3-1. Phosphorus levels in Cleary Lake.

Murphy Lake

Murphy Lake is listed as impaired for mercury. There are no required TMDLs, and according to MPCA's data in Figure 3-2, there does not appear to be an issue with nutrients.

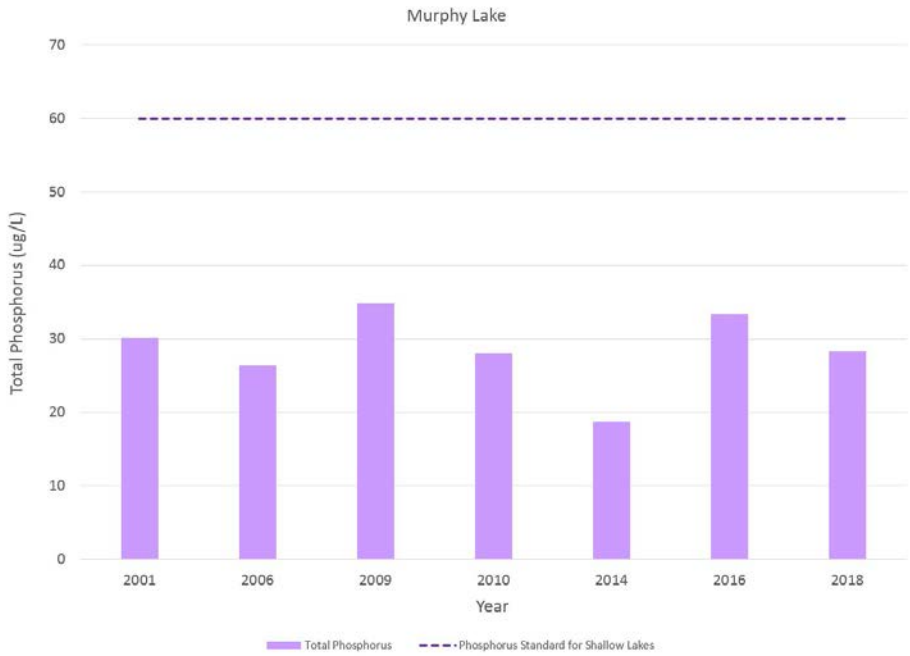


Figure 3-2. Phosphorus levels in Murphy Lake

Credit River

Credit River was delisted in 2012 for turbidity, but in 2018 Credit River was added to the proposed impaired waters for *E. coli*, chloride, fishes bioassessments, and aquatic macroinvertebrate bioassessments. There is no approved TMDL for Credit River at this time, but there is a completion target date for 2019.

Corrective Action:

A TMDL report and the accompanying Watershed Restoration and Protection Strategies report are likely to be release relatively soon. The Township will look to these reports for the best approach to restore Cleary Lake and Credit River and protect Murphy Lake.

3.4.2 Groundwater Susceptibility

As discussed in Section 2.14, the MnDNR and the Minnesota Geological Survey have developed a map that identifies the susceptibility of the water table to pollution. There are a number of areas in the Township that have been identified as highly or very highly susceptible to aquifer impacts.

Corrective Action:

The Township shall implement the groundwater policies and standards outlined within this plan through development plan review in an effort to protect existing groundwater quality. Given the proposed low density development planned for Credit River, the potential for groundwater impacts is considered low.

3.4.3 Flooding Concerns – Markley Lake

Markley Lake, partially located in the northwest corner of the Town and partially located in the City of Prior Lake, is a landlocked basin and has known flooding concerns. Specifically, three residences within Credit River have been flooded and a portion of the Whitewood Avenue cul-de-sac has become inundated. Two documents related to the flooding concerns are included in the appendix. This first is a Stipulation and Settlement Agreement which provided for an interim policy which required the City of Prior Lake to pump Markley Lake when the water reaches an elevation of 895.8 and is included as Appendix C. The second document is a study prepared in 2010, including two addendums, and is included as Appendix D.

The City of Prior Lake and the Scott WMO continue to evaluate options for a long term solution. Credit River will continue to participate in these efforts.

4. GOALS AND POLICIES

This section presents the goals and policies developed for the management of water resources within Credit River. Goals and policies are provided for wetlands, water quality, water quantity, groundwater, nonpoint source pollution, enhancement of public participation, information and education, floodplains, and low impact development. Goals propose the desired end, and policies provide the means to achieve the goals. Section 5.0 provides more specific detail on how the goals and policies will be implemented.

4.1 Wetlands

Goal: To protect and enhance wetland ecosystems by managing contributing watersheds, and to ensure/encourage a measureable net gain of wetland functions and acreage within Credit River.

Policy 1:
Achieve no net loss of wetlands, in conformance with the Minnesota Wetland Conservation Act (WCA) and associated rules (Minnesota Rules 8420).

Policy 2:
Encourage wetland avoidance for all new developments and land disturbing activities.

Policy 3:
Require mitigation of unavoidable wetland disturbance as dictated by the WCA.

Policy 4:
Require transportation projects to pursue wetland mitigation projects to the extent possible along the transportation corridor. Where this is not feasible, the transportation project manager should work with adjacent landowners, Local Government Units, Soil and Water Conservation District (SWCD), County, state, or federal agencies to identify and provide mitigation areas as close to the project area as possible (this does not preclude use of the Board of Soil and Water Resources Road Replacement Program).

Policy 5:
Identify areas within the Credit River that are conducive to wetland restoration. Work with landowners, SWCD, and appropriate agencies to accomplish wetland restoration within the identified areas.

Policy 6:
Require all identified wetland habitat impacts to be mitigated through wetland enhancement, restoration, creation, or purchasing wetland bank credits.

Policy 7:
Manage changes in volume and quality of local stormwater systems to minimize negative impacts to existing wetland functions, value, or biological diversity. This includes a proactive approach to erosion control enforcement around affected wetland areas.

Policy 8:
Identify and preserve wetlands for water retention, groundwater recharge, soil conservation, wildlife habitat, aesthetics, and natural enhancement of water quality.

Policy 9:
Require a buffer or filter strip around each wetland, commensurate with its management classification.

Policy 10:
Increase participation of property owners, developers, and contractors in wetlands and wildlife land management assistance programs, and decrease violations of wetland regulations through better education programs.

4.2 Water Quality

Goal: To preserve and enhance surface water quality in Credit River's water bodies and watersheds, commensurate with the eco-region and desired uses.

Policy 1:
Encourage expansion of existing water quality monitoring networks.

Policy 2:
Improve the quality of surface water monitoring programs and involvement, as well as the information derived from monitoring data.

Policy 3:
Target high priority water bodies for water quality projects; this includes working with those waters listed as "impaired" by the MPCA for listing under Section 303(d) of the Clean Water Act.

Policy 4:
Secure stable funding to augment water quality projects and local programs.

Policy 5:
Obtain usable, transferable data for road salt management, and provide projects and workshops for appropriate public works personnel/contractors to improve proper storage practices (less sand and proper salt management will minimize environmental impacts).

4.3 Water Quantity

Goal: To manage the quantity and to improve the quality of runoff entering rivers, streams, lakes, wetlands, and groundwater within the Township.

Policy 1:

Each development or land disturbing activity shall be responsible for managing its stormwater effectively, either on or off-site; the preference being on-site management for most non-transportation related projects. Regional off-site management shall be encouraged for linear improvements and/or previously developed areas where on-site management is not feasible/practical.

Policy 2:
Credit River will promote and encourage a reduction in runoff rates, encourage infiltration and promote increased groundwater recharge.

Policy 3:
Stormwater will be managed to minimize erosion, with an emphasis on stabilizing flow rates and velocities and prioritizing critical areas based on the landscape setting and existing vegetation.

Policy 4:
Promote development strategies, land use practices, and water management activities that decrease and desynchronize peak flows, lengthen the watershed time of concentration, and raise base flow levels.

Policy 5:
Promote development strategies to create and/or improve downstream conveyance systems. New systems shall be encouraged where such systems do not currently exist and are needed based on a detailed hydraulic analysis of the watershed and the demonstrated positive impact the system would have on the public health, safety, and welfare. Improvements to existing systems shall be encouraged where the existing system is inadequately sized, unstable, or could otherwise be modified to further other established goals and objectives of the water plan.

Policy 6:
Promote strategies which allow for the orderly transition from privately maintained drainage systems to public drainage systems as development occurs. The desired end result being a public drainage system, contained within contiguous drainage and utility easements, which is permanent, maintainable, and adequate to service the long-term drainage needs of the community.

Policy 7:
Use an overall philosophy of outcome-based analysis and resource-oriented management to recognize and avoid potential downstream impacts from stormwater due to development/re-development activities. Scott County and the Township shall be responsible for managing stormwater so as to maintain, stabilize, or improve downstream drainage ways.

Policy 8:
Identify and utilize existing, natural retention and detention areas for stormwater management while maintaining or improving the existing water quality.

Policy 9:
The construction of publicly owned, operated, and maintained regional stormwater ponds shall be encouraged, where feasible, to promote storage through the construction of an integrated

regional retention area, as opposed to multiple smaller areas of on-site ponding, to reduce public long-term maintenance costs and maintain efficiency. This policy recognizes the difference between smaller on-site stormwater ponds that are routinely maintained by property owners, and larger regional basins that will likely require public monies for creation and routine maintenance.

Policy 10:
The construction of stormwater infiltration areas shall be encouraged, where feasible and environmentally beneficial, to promote the infiltration of stormwater to recharge subsurface aquifers.

Policy 11:
The construction of publicly owned, operated, and maintained regional stormwater management systems shall be funded, in part or entirety, by development user fees.

Policy 12:
Improve the long-term and institutional management and coordination of the county judicial ditch system.

Policy 13:
Educate key audiences, including developers, consultants, contractors, builders and local units of government on stormwater best management practices and other appropriate methods, techniques, or regulations to manage stormwater quantity and quality.

Policy 14:
Runoff shall be routed to water treatment ponds or other acceptable facilities before discharging to waters of the state.

4.4 Groundwater

Goal: To protect groundwater quality and improve groundwater supplies through the effective implementation of the Scott County Water Resources Plan and the Scott County Groundwater Protection Plan.

Policy 1:
Promote ongoing evaluation of land use impacts on groundwater quality and quantity.

Policy 2:
Provide data to the general public regarding inventoried groundwater resources and incorporate information into the County's geographic information system with updates as appropriate.

Policy 3:
Support identification and reduction of groundwater contamination from both point and nonpoint sources.

Policy 4:

Continue to support programs that promote efficient and effective administration of groundwater pollution regulations.

Policy 5:
Encourage data collection, development, and consistent updating of a groundwater flow model and groundwater recharge model for Scott County.

Policy 6:
Support enforcement of County Individual Sewage Treatment System and local community septic system ordinances.

Policy 7:
Support continued management of the County Feedlot Program.

Policy 8:
Encourage an increase in well water testing by Credit River residents to identify potential aquifer contamination.

Policy 9:
Promote water conservation strategies to conserve groundwater resources and reduce per-capita water use to conserve groundwater resources.

Policy 10:
Provide education on wells, wellhead protection, groundwater/surface water interactions, and the area groundwater resources.

4.5 Nonpoint Source Pollution

Policy 1:
Update and maintain an inventory of active feedlots.

Policy 2:
Encourage the SWCD to provide technical and financial assistance to operators of feedlots causing pollution problems.

Policy 3:
Encourage demonstration projects using BMPs for feedlots and animal waste storage and utilization.

Policy 4:
Monitor downstream surface waters for signs of over-application rates of livestock wastes on land owned by feedlot operators, as well as on land leased, rented, or volunteered for application.

Policy 5:

Encourage monitoring of surface and groundwater quality in feedlot areas up-gradient from sensitive surface and groundwater recharge areas.

Policy 6:
Compile and publicize research data showing how to reduce nonpoint pollution on agricultural land through implementing practices such as integrated pest management, conservation cropping systems, biotechnology, manure utilization, filter strips, conservation tillage, nutrient management, and structural erosion control methods.

Policy 7:
Encourage the SWCD to provide technical assistance to operators of agricultural land causing nonpoint source pollution problems.

Policy 8:
Encourage farmers to conduct field by field soil testing to implement optimum nutrient and pesticide application based on soil texture, organic matter, fertility levels, subsoil, and potential for leaching.

Policy 9:
Work cooperatively with the Soil and Water Conservation District to provide educational materials on agricultural BMPs that reduce nonpoint source pollution and maintain soil productivity and sustainable production levels.

Policy 10:
Maintain contiguous agricultural areas to preserve existing agricultural drainage systems (private and public ditches).

Policy 11:
Continue ongoing educational programs provided through the Scott SWCD, SCWEP, Natural Resources Conservation Service, University of Minnesota Extension Service, and other agencies that publicize and promote land stewardship targeted at agricultural producers, rural land owners, contractors, county, and township staff and fertilizer dealers and distributors.

4.6 Enhancement of Public Participation, Information, and Education

Policy 1:
Educate key audiences, such as developers, consultants, contractors, and builders on stormwater best management practices and erosion control measures.

Policy 2:
Increase participation of property owners, developers, and contractors in wetlands and wildlife land management assistance programs, and decrease violations of wetland regulations.

Policy 3:
Encourage well water quality testing.

Policy 4:
Promote a reduction in per-capita water use.

Policy 5:
Provide educational materials on BMPs.

Policy 6:
Conduct educational programs for homeowners, renters, grounds keepers, pesticide and fertilizer dealers and distributors, and public works personnel/contractors.

Policy 7:
Cooperate with ongoing educational programs by the SWMO, SCWEP, University of Minnesota Extension Service, SWCD, and other agencies.

Policy 8:
Help facilitate and support education/public outreach activities required under NPDES Phase II.

4.7 Floodplains

Policy 1:
Manage local floodplain areas to maintain critical 100-year flood storage volumes.

Policy 2:
Ensure that on-site or downstream detention basins are designed adequately, and prevent runoff from developed areas from negatively impacting new or existing detention basins.

Policy 3:
Review floodplain zoning regulations to maintain consistency with the SWMO's Comprehensive Water Resource Management Plan.

Policy 4:
Require that new structures be constructed above the flood-prone areas to avoid causing an increase in the critical flood levels that could affect both the new construction and nearby structures.

Policy 5:
Maintain discharge rates and flood storage volumes to minimize pond overflow and reduce erosion.

Policy 6:
Maximize upstream storage.

Policy 7:
Seek ways to increase infiltration by increasing vegetated areas and reducing impervious areas.

Policy 8:
Maintain the proper function and performance of existing stormwater conveyance systems and storage facilities.

Policy 9:
Remove accumulated sediment from storage facilities when determined necessary to maintain treatment effectiveness.

Policy 10:
Support enhanced data sources, including updated Federal Emergency Management Agency Flood Insurance Rate Map.

4.8 Low Impact Development

Policy 1:
The preservation, restoration, and enhancement of shoreland and wetland environments in their natural state shall be encouraged. Where desirable and practical, developments which complement these features and are in conformance with federal, state, and local regulations shall be promoted.

Policy 2:
Examine requested land use changes in relation to adjoining land uses, site accessibility, stormwater management systems availability, and consistency with the County's most recent Comprehensive Plan Update and policies.

Policy 3:
Encourage the placement of housing units in a manner that preserves significant natural resources.

Policy 4:
Promote compatible land use patterns on shared boundaries between urban and rural uses as a means of protecting future urban expansion areas.

Policy 5:
Promote cooperative efforts to solve public health hazards when a hazard can be corrected or controlled by public resources (sewer/water service, code enforcement, inspection, sharing infrastructure costs, etc.).

Policy 6:
Establish compatible land use patterns that relate to the Credit River's environmental features.

Policy 7:
Promote area-wide identification of environmentally sensitive natural resource areas for guiding land use development decisions.

5. PLAN IMPLEMENTATION

To uphold the goals and policies of this Plan, the Township will review all proposed developments and public improvements. Approvals for BMPs relating to water quality, wetland protection, erosion and sediment control, and water quantity will be required for all developments, land disturbances, and other applications that require permitting by Township or County Ordinance.

The Township has established the following regulatory controls and criteria relating to its policies. These controls and criteria apply to the management of: wetlands; water quantity and quality; floodplains and shorelands; recreation, open space and wildlife; groundwater; soil erosion and sedimentation control; low impact development; and maintenance. While these controls and criteria relate to one of the policy areas, it should be noted that they are interrelated and may serve multiple purposes.

The criteria, as a minimum, establish the degree of performance necessary to achieve improvements in water quantity and quality management. These criteria are not intended to dictate or preempt the design process, but rather provide a guide to proper development. Section 8 outlines the development submittals required for the Township to complete the engineering review for proposed developments.

5.1 Wetlands

As discussed in Section 3.0, the Township's strategy for managing wetlands will be guided by designating wetlands into management classes.

5.1.1 Wetland Alterations

Wetland alteration will continue to be permitted and enforced through state and federal agencies. These regulatory programs are well established, and agency personnel are trained to make qualitative judgments regarding wetland values. The Township will continue to administer the Wetland Conservation Act within the its boundaries.

5.1.2 Field Delineation

Any proposed development will require a field delineation by a qualified individual using accepted methodology. The functions and values of identified wetlands shall also be analyzed according to Section 3.1.3. The Township's water resources staff will use the information described in Section 3.1.3 to determine the wetland's management class.

5.1.3 Wetland Excavation

Wetland excavation shall be in accordance with the requirements of the Wetland Conservation Act and all other local, state, and federal agencies.

5.1.4 Wetland Fill

Any filling shall not cause the total natural flood storage capacity of the wetland to fall below the projected volume that the wetland would hold following a 24-hour duration, one-percent (100-year) frequency rainfall over the fully developed drainage area.

Fill material shall not be placed below the ordinary high water (OHW) level of state public waters and public waters wetlands without obtaining appropriate permits from the Army Corps of Engineers, Minnesota Department of Natural Resources, Scott County, and the Township as required. Fill material may only be placed within the wetland limit if there are not conflicts with floodplain management policies and, if federal, state, county, and Township permits as may be required are obtained.

5.1.5 Stormwater Runoff

Stormwater runoff into wetlands shall conform to the requirements listed in Table 5-1.

Table 5-1

Hydroperiod Standards for Different Wetland Types

Hydroperiod Standard	Exceptionally susceptible wetlands*	Highly susceptible wetlands*	Moderately susceptible wetlands*	Least susceptible wetlands*
Storm Bounce 1 & 2-year events	Existing	Existing plus 0.5 feet	Existing plus 1.0 feet	No limit
Period of Inundation for 1 & 2-year events	Existing	Existing plus 1 day	Existing plus 2 days	Existing plus 7 days
Period of Inundation for 10-year event	Existing	Existing plus 7 days	Existing plus 14 days	Existing plus 21 days

* Wetland susceptibly as defined in Table 3-1

5.1.6 Sequencing Procedures

When a proposed wetland alteration(s) involves excavation, filling, or stormwater runoff, the Township will determine the applicability of the Wetland Conservation Act, as amended. Project proposers must follow the sequencing procedures described in Minnesota Rules, Chapter 8420 – Wetland Conservation.

5.1.7 Wetland Buffers

Wetland buffers are unmowed areas adjacent to wetlands, lakes, and streams that contain non-invasive vegetation, preferably dense native vegetation. Buffers filter pollutants before they can enter the water body, reduce erosion, protect vegetation diversity and wildlife habitat, and minimize human impacts to

the water body. Buffers are required around all wetlands, lakes, and streams for all new development, with the width dependent on the type and condition of the water body.

Wetland buffer width is determined by the management class of the wetland, which is further described in Section 3.1.3. Table 5-2 outlines the buffer widths.

Table 5-2
Wetland Buffer Widths

Buffer Requirement	Exceptional	High	Medium	Low	Stormwater Pond
Average Buffer Width	65 feet	50 feet	35 feet	25 feet	0
Minimum Buffer Width	25 feet	25 feet	25 feet	25 feet	0*

*Must have a building setback of 10 feet from delineated edge of wetland and elevated as necessary.

5.1.7.1 Buffer Easements

A conservation easement (preferred), or functional equivalent such as a drainage and utility easement or outlot, is required on the wetland and buffer.

5.1.7.2 Use of Existing Vegetation as the Buffer

The existing vegetation is acceptable for a buffer and must not be disturbed if:

1. It is continuous, dense perennials (can be trees and shrubs with 60% canopy cover), and
2. <30% invasive plant species, and
3. Not disturbed or mowed within the last 5 years, and
4. Topography does not channelize runoff.

5.1.7.3 Creation of New Buffers

If the required buffer is non-existing or will be disturbed during grading activities, a Buffer Establishment Plan must be provided. At a minimum, the Buffer Establishment Plan must consist of:

1. The area of buffer to be created must be clearly depicted on the plans with a hatch or shading, and
2. The proposed native seed mix must be clearly labeled on the plans, and
3. The seeding rate for the proposed seed mix must be specified, and
4. Weed free mulch must be specified

5.1.7.4 Buffer Monuments

Buffers shall be adequately marked with signage at maximum 200 foot spacing. Signs should be erected before occupation of new developments. Signs can be waived where the Township deems they would serve no practical purpose.

5.1.7.5 Buffer Maintenance

The functionality and aesthetic qualities of the buffer depend on maintenance. The following summarizes the buffer maintenance requirements:

1. During the first two full growing seasons the applicant must replant any vegetation that does not survive.
2. After the first two full growing seasons the buffer must be reseeded if the buffer changes at any time through human intervention and activities.
3. The Township may require an escrow for buffer establishment and maintenance.
4. A legally binding and enforceable maintenance plan clarifying responsible parties is required for all buffer areas.

5.2 Water Quantity and Quality Management

The following prescribe the design criteria for water quality and quantity assessment.

5.2.1 General Hydrology

Hydrologic analysis of stormwater runoff for the planning and design of flows in storm sewers, ditches, streams and channels to lakes, detention basins, and wetlands shall be made using generally accepted hydrograph methods.

Determination of total runoff volume should follow the U.S. Department of Agriculture – Soil Conservation Service (SCS) curve number method which incorporates land use and hydrologic soil groups. Specific step-by-step process can be found in the SCS publication National Engineering Handbook: Chapter 4, SCS Hydrology (1972), and Hydrology Guide for Minnesota (1992). Peak runoff rates should be determined through the use of the SCS method incorporating "time of concentration" for both pre and post development conditions.

The developed runoff hydrograph should then be routed through the drainage area, that is, mathematically the peaks and volumes are followed as they move in a wave progressively downstream.

"Design Storms" or storm volumes for hydrologic analyses shall be based upon Atlas 14, Volume 8 or most recent updated, as published by National Oceanic Atmospheric Administration (NOAA) with durations of 30 minutes to 24 hours and Return Periods from 1 to 100 years.

The rational method may be used to determine peak runoff rates for primary systems. Construction of a hydrograph should be undertaken which characterizes the movement of surface water as a function of time and precipitation.

5.2.2 Rainfall

Usually the standard 24-hour SCS rainfall distribution will be used to calculate the peak discharge rates and levels from developments. The following minimum rainfall and snowmelt values shall be used in calculations for Credit River Township:

Event	Rainfall (inches)
1 year, 24 hour	2.48
2 year, 24 hour	2.83
10 year, 24 hour	4.20
25 year, 24 hour	5.30
50 year, 24 hour	6.27
100 year, 24 hour	7.36
100 year, 2 day	7.75
100 year, 4 day	8.52
100 year, 10 day snowmelt	7.2 inches of runoff

5.2.3 Curve Numbers

Table 8-2 in Section 8 lists the allowable curve numbers which shall be used for proposed development. Existing conditions shall be modeled using the pre-settlement curve numbers listed in Table 8-3. Hydrologic soil groups shall be determined based upon the Soil Survey for Scott County, Minnesota as published by the United States Department of Agriculture Soil Conservation Service in Cooperation with Minnesota Agricultural Experiment Station.

5.2.4 Flood Protection

Consistent with state and federal regulations, Credit River requires that the level of flood protection along all ditches, detention basins, lakes, streams, and wetlands be established based upon the one-percent (100-year frequency) flood. Land use within floodplains shall be regulated in accordance with Township and County ordinances and state floodplain zoning regulations.

The following freeboard values are required for the Credit River Township:

1. Landlocked Basins (no outlet) 2.0 feet (Established high water, see 5.2.5.10)
2. Non-Landlocked Basins 2.0 feet (100-year frequency)

5.2.5 Stormwater Basin Design

It is the policy of Credit River Township to require development to control urban stormwater quantity and quality through a management approach of detention and filtration/infiltration basins. Detention and filtration/infiltration basins, whether on-site or regional in nature, shall be designed to incorporate all

requirements of the National Pollution Discharge Elimination System Application for General Stormwater Permits for Construction Activity (MN R100001) and the following:

5.2.5.1 Infiltration Required

A stormwater runoff volume equal to 1 inches from the new impervious surface must be infiltrated or abstracted, unless infeasible due to site conditions. Infiltration techniques will not be allowed in stormwater hotspots, or areas that are unable to provide adequate separation between detention basins and ground water. Potential stormwater hotspots are defined as a land use or activity that produces higher concentrations of trace metals, hydrocarbons, or pollutants not normally found in stormwater. Examples include fueling stations, vehicle service or washing areas, vehicle fleet storage areas, and facilities that generate or store hazardous materials. Infiltration basins shall be construction and designed in accordance with the Minnesota Stormwater Manual, with the following additional requirements:

1. Construction of an approved pre-treatment system shall be required prior to discharging runoff from parking lots, streets, or other impervious areas to the infiltration basin. Pre-treatment is defined as any Best Management Practice that (a) removes settleable or particulate matter and (b) removes oil and grease to a level that they do not interfere with infiltration performance. Acceptable BMPs for pre-treatment are wet sedimentation basins, pre-treatment basins sized to accommodate at least 25% of the water quality volume, or hydrodynamic separators sized to separate on a 1-year event and able to pass a 10-year event.
2. Exit velocities from the pre-treatment system shall be less than three feet per second for the 100-year storm event and flows shall be evenly distributed across the width of the outlet.
3. Infiltration rates must be determined by double-ring infiltrometer test(s) conducted to the requirements of ASTM standard D3385 at or near the proposed bottom elevation of the infiltration BMP. The test results shall be provided to the Township in a geotechnical report and shall be certified by qualified geotechnical professional.
4. The bottom of the infiltration practice must be at least three feet from the seasonal high ground water table.
5. Infiltration practices shall not have standing water longer than 48 hours following each storm event.

5.2.5.2 Infiltration Prohibited or Infeasible

Where infiltration basins are infeasible due to site conditions, biofiltration must be provided for that part of the abstraction volume that is not abstracted by other BMPs. Where biofiltration is infeasible, at a minimum filtration through a medium that incorporated organic material, iron filings, or other material to reduce soluble phosphorous must be provided.

5.2.5.3 Phosphorus Loading Reduction

Facilities shall be designed to reduce phosphorus loading at down gradient site boundaries such that there is no net increase in total phosphorous or total suspended solids as a result of development.

These standards can be achieved through the use of ponding, Low Impact Development techniques, reduction in impervious surfaces, or other Best Management Practices deemed reasonable by the Township. The Township will consider a variance or flexibility to this standard if impacts to other natural resources are demonstrated. Credit River will consider the implementation of this standard on regional/drainage area basis if this standard is deemed impractical on a site-by-site basis.

5.2.5.4 Street Sweeping

Credit River Township has approximately 50 miles of paved roads within its boundaries. The Township will sweep these streets once per year after snowmelt as needed. This will remove organic debris and sediment prior to reaching water bodies and further reduce phosphorus loadings.

5.2.5.5 Emergency Spillway

An emergency spillway (emergency outlet) adequate to control the critical one percent frequency/duration rainfall event (usually 100-year, 24-hour) shall be provided for all stormwater basins that are adjacent to principal structures.

5.2.5.6 Basin Side Slopes

Basin side slopes above the normal water level should be no steeper than 4:1 and preferably flatter. Provide a basin shelf with a minimum width of ten feet and a slope of 10:1 starting at the normal water level. Side slopes below the basin shelf shall be no steeper than 3:1 and preferably flatter.

5.2.5.7 Length to Width Ratio

To prevent short-circuiting, the distance between major inlets and the normal outlet shall be maximized.

5.2.5.8 Flood Storage

To protect downstream channels and structures the following flood control criteria are required for basin design:

1. A flood pool ("live storage") volume above the normal elevation shall be adequate so that the peak discharge rates from the 2-year, 10-year, and 100-year frequency, critical duration storms (usually the 24-hour) are no greater than the pre-settlement conditions.
2. Dead storage volume may not be utilized as live storage; dead storage shall be equal to the runoff volume from a 2.5" storm.

5.2.5.9 Skimming Structures

Skimming structures shall be utilized to remove floating debris for a 2-year storm event for each basin. Skimming structures shall be shown on the plans.

5.2.5.10 For Areas without Formal Outlets (i.e. Landlocked Areas)

Landlocked depressions that presently do not have a defined outlet and do not typically overflow may only be allowed a positive outlet provided downstream impacts are addressed and the plan is approved by the Township. Where a positive outlet is not constructed the following shall apply:

The minimum building elevation (low floor) shall be set two feet above the level resulting from two back-to-back 100-year rainfall events. The starting elevation of the pond/water body prior to the runoff event shall be established by one of the following:

1. Existing Ordinary High Water level established by the Minnesota Department of Natural Resources;
2. Local observation well records, as approved by the Township; or
3. Mottled soil.

Additionally, an assessment of water levels in the water body resulting from the contributing watershed's full annual runoff yield during a 100-year wet year using the Simplified Hydrologic Yield Method (SHYM), or more rigorous methods for back to back 100-year critical event, for both pre-settlement conditions and fully developed watershed conditions.

All areas below the established high water level shall be contained within a drainage and utility easement. Landlocked areas shall also be analyzed for the 100-year 10-day snowmelt event. The analysis shall consider a minimum of 7.2 inches of runoff. The minimum building opening shall be set a minimum of one foot above the 100-year 10-day snowmelt elevation.

Outletting landlocked areas below the 100-year flood elevations is only permitted in cases of demonstrated threat to public structures or safety.

5.2.5.11 Stormwater Discharge

Discharge must be made to a receiving stream, a ditch, another pond, or an approved discharge route as shown in this Water Management Plan. All outlet structures shall have outlet erosion control devices.

5.2.5.12 Storm Sewer

Storm sewer sizing shall be based upon the 10-year storm event. Inlet capacities and roadway spread at each inlet shall be determined. Storm sewer inlets shall be spaced to insure that not more than half the travel lane is inundated during the 10-year storm event. Manning's equation shall be utilized to determine the flow in the street at each catch basin for verification of actual spread. Additionally, grate inlet capacities shall be verified at the maximum allowable depth of flow (low point) to verify that the proposed grates will pass the 10-year flows. When appropriate, by-pass flows shall be considered in calculations.

Storm sewer systems shall also meet the following requirements:

1. Maintain a minimum velocity of three feet per second for 10-year storm event.
2. Maintain a minimum cover of two feet from top of pipe to top of casting or flow line elevation.
3. Maintain a minimum of three feet of final cover over corrugated high density polyethylene pipe.
4. Maintain a minimum of one and a half feet of final cover over reinforced concrete pipe in areas not used for vehicle traffic.
5. Storm sewer inverts, which outlet to detention basins, shall be placed at the normal level of the basin. Storm sewers may be submerged a maximum of half the pipe diameter below the basin normal level if approved by the Township Engineer.

5.2.5.13 Stormwater Facility Easements

The Township will require that all stormwater facilities be within a drainage and utility easement or outlot owned by a Homeowner's Association.

5.2.6 Total Maximum Daily Load (TMDL)

The Environmental Protection Agency has set standards for the maximum amount of a pollutant that a body of water can withstand and still be considered in good health. A TMDL report identifies water bodies that have excessive pollutants and the source of the pollutants. The TMDL is the maximum amount of a pollutant that a water body can receive without violating water quality standards. Once a TMDL report is approved by the Environmental Protection Agency, the municipality is required to reduce the identified pollutants in order to meet the TMDL.

Cleary Lake has been identified as having a nutrient (or phosphorus) impairment, and Credit River has been proposed to have an *E. coli* and chloride impairment. A TMDL report has not been approved for the watersheds within Credit River Township, but the completion target year is 2019.

5.3 Water Quality Monitoring Program

The Township will continue to cooperate with the Three Rivers Park District with regards to water quality monitoring, modeling, and planning to protect priority resources. Water quality data can be accessed through the Minnesota Pollution Control Agency's Environmental Data Access.

5.4 Floodplains and Shoreland Management

Various levels of government are involved in regulation of surface water, wetlands, and floodplains. As previously discussed, the MnDNR has inventoried and classified water bodies and wetlands in the State of Minnesota. The "protected waters and wetlands" program identifies water bodies and wetlands that require MnDNR permits for activities like draining, filling, dredging, and diverting of water. The MnDNR Shoreland Management Program has also established a classification system for lakes greater than 10 acres in size and rivers with a drainage area two square miles or greater. Floodplain and shoreland areas are governed by the County's floodplain and shoreland ordinance, which regulate activities adjacent to

water bodies classified by the MnDNR. A plan review is required for development or redevelopment if any part of the development is within or affects a 100-year floodplain.

5.5 Recreation, Open Space, and Wildlife Management

Through development review the Township shall encourage protection and/or preservation of wetlands and uplands that provide habitat for fish and wildlife.

5.6 Groundwater Management

Credit River Township contains natural characteristics which result in low to very high sensitivity for groundwater contamination. This Plan contains policies and criteria which will guide land use development to protect existing groundwater quality.

5.6.1 Well Abandonment

The Township will continue to, in cooperation with Scott County, educate residents regarding the land use control practices and proper well abandonment procedures in accordance with Minnesota Rules, Section 4725.2700.

5.6.2 Individual Sewage Treatment Systems

A principal risk of direct contamination of groundwater comes from sewage from individual sewage treatment systems. Credit River will insure protection of local groundwater through implementation of Township and County ordinances regarding private on-site sewer systems. Wetlands, floodplains, and shoreland areas also serve as important areas of groundwater recharge. Strategies to protect these areas were described in the previous sections.

5.7 Soil Erosion and Sediment Control

The control of erosion and sedimentation remains important to maintaining water quality in the Township. Of paramount importance to the maintenance of water quality in the Township is the proper enforcement of erosion and sediment controls. Enforcement will involve indirect and direct approaches.

5.7.1 Indirect Approach

The indirect approach includes incentives within the County ordinance such as the requirement for a financial surety equal to or greater than the estimated cost of the work to be performed and civil penalties.

5.7.2 Direct Approach

The direct approach involves the inspection and enforcement of the sediment control elements in this Plan to insure compliance with the principles and standards. The inspection and enforcement will be undertaken by the Scott County SWCD representative.

5.7.3 Conservation Principles

For applicable urban land disturbance activities, the developer shall prepare and implement an erosion and sediment control plan. The plan shall include the necessary erosion and sediment control practices, implementation schedule and other necessary items to conform to the General Stormwater Permit for Construction Activity (MN R100001) and Township and County ordinances.

5.7.4 Nuisance and Stream Bank Erosion

In addition to general channel erosion protection and stormwater volume reduction practices, new development or re-development shall demonstrate that increased runoff volume when compared to pre-settlement conditions on the 2-year storm event will not adversely affect downstream properties or water resources. An assessment of the potential for adverse impacts downstream of the site improvements is required except when the development or re-development is less than 20 acres and contains less than 8% impervious area or runoff volumes for the 2-year critical storm are not increased. To demonstrate that the proposed activity does not accelerate on or off-site erosion, nuisance, flooding, or damage, an evaluation must be completed downstream to the point where the proposed site is equal to 10% or less of the total drainage are (e.g. a 10 acre development must evaluate downstream to the point where the total drainage area is 100 acres).

5.8 Low Impact Development

A majority of the Credit River's proposed zoning is Rural Residential. The nature of this land use will likely reduce impacts of stormwater, as development occurs, given that much of Credit River is currently farmed.

Low impact development techniques that Credit River will focus on, as outlined in this plan, include:

1. Wetland Buffers – Section 5.1.7
2. Infiltration Basins – Section 5.2.5.1
3. Recreation, Open Space and Wildlife Management – Section 5.5
4. Land Conservation – Section 5.10

5.9 Stormwater System Maintenance Plan

The Stormwater System Maintenance Plan has been developed to assure that the system of stormwater retention/treatment basins and stormwater conveyance systems are adequately inspected and

maintained to assure that they meet their design functions. Outlined below are the inspection and maintenance activities the Township intends to implement:

1. All Township stormwater retention, infiltration, and treatment basins and outlets will be inspected, in accordance with the SWPPP, to determine if the basin's retention and treatment characteristics are adequate.
2. Portions of the Township's storm sewer system will be inspected on a rotating basis in accordance with the SWPPP.
3. Urban streets will be swept once annually in all areas and twice annually in priority areas. Priority areas are those that drain directly to high public use water bodies and/or high quality wetlands without pretreatment of stormwater runoff.
4. All public sump catch basins, sump manholes, skimmer structures, and other settling or filter devices will be cleaned and inspected every year.
5. The Township is currently evaluating and will further refine the maintenance plan in accordance with the SWPPP.

5.10 Land Conservation

The conservation of Key Conservation Areas, including high-value wetlands and uplands, will improve the characteristics of the aquatic ecosystem and the water quality within the watershed as well as areas downstream. Strategies to protect the ecological and hydrological values of these areas may include land use regulation, acquisition and management, and property owner education regarding land management strategies to maintain ecological integrity.

5.11 Stormwater Pollution Prevention Program (SWPPP)

In addition to design guidelines and strategies previously presented, the Township will implement its SWPPP. Implementation of the SWPPP will assist in maintaining or improving existing water quality through implementation of public and employee education and participation programs, illicit discharge and detection programs, and improved municipal operations.

5.12 Program Financing

Credit River has a tax levy that contributes to funding stormwater and water quality projects. The current level of funding is adequate to perform the necessary stormwater and water quality projects at this time. However, as the infrastructure ages and as the sediment ponds accumulate with sediment the required funding for the program will have to increase. Credit River should start to consider future funding methods such as stormwater utility fees.

6. PLAN AMENDMENTS

This plan will be reviewed at five to ten-year intervals to determine whether updates are required to meet changing legal or physical conditions. Amendments may be either minor or major.

Minor amendments are amendments that do not change the goals, policies, management strategies, and management processes. Minor amendments include, but are not limited to the following:

1. Updates to the storm drainage system based on construction or to correct errors or omissions.
2. Changes to watershed divides provided they do not affect major watershed divides.
3. Minor amendments as defined by Minn. Rules 8410.0020, Subp. 10 which reads as follows:
   ". . . items such as recodification of the plan, revision of a procedure meant to streamline administration of the plan, clarification of the intent of a policy, the inclusion of additional data not requiring interpretation, or any other action that will not adversely affect a local unit of government or diminish a water management organizations' ability to achieve the plan's goals or implementation program."

Minor amendments will be submitted to the Scott WMO.

Major amendments will include:

1. Modifications to the watershed divides or storm drainage system that change the projected rates and volume of flow.
2. Modifications to the goals and policies.
3. Major amendments, when required, will involve the same steps as approval of the original document.

Amendments will also be required within two years of the adoption of a watershed plan by a Watershed District or Watershed Management Organization, consistent with Minn. Rules 8410-0160.

7. DEVELOPMENT SUBMITTAL REQUIREMENTS

7.1 Purpose and Intent

This section of the plan is intended to provide Developer's Engineers with a standardized format for submittal of drainage plans, calculations, wetland delineation, and mitigation reports to the Township for review. A standardized format will provide the following:

1. Reduce preparation time for submittals by providing direct guidelines for Developer's Engineers to follow.
2. Reduce review time required by the Township by insuring that a complete and comprehensive drainage plan and calculations are submitted.
3. Insure that the Township will receive the best possible protection of its resources, which could be adversely affected by inadequate stormwater management planning.

7.2 General Requirements – Grading, Drainage, and Erosion Control Plan

Grading, drainage, and erosion control plans shall be provided by the Developer in accordance with the Township and County Ordinances. Several items critical to the review of the drainage system must be adequately depicted on the plan by the Developer's Engineer. The following key elements must be depicted on the plan:

7.2.1 Topography

Existing and proposed contours at a minimum of two-foot intervals must be shown. A one-foot contour interval or proposed spot elevations shall be used where conditions dictate. The determination of contour interval shall be made based upon clarity and readability of the plans.

7.2.2 Stormwater Basins

Basin locations as depicted by the proposed contours must be shown. Normal level and 100-year flood water levels shall be depicted on the plan for each basin. Detention basins are required at each outfall point from the proposed plat. Perimeter berm elevation and width shall be clearly labeled on plan sheets.

Permanent detention basins may be utilized as construction detention basins, provided they are cleaned after permanent erosion control measures are established. Design features of the detention ponds shall be as described in this plan.

7.2.3 Erosion Control Features

Locations of silt fence, bale barriers, wood fiber blanket, rock construction entrances, storm drain inlet protection, outlet projection, riprap, temporary seeding, permanent seeding, sod, mulch, or other erosion control features proposed to be implemented for the project shall be included.

7.2.4 Wetland Delineation

Show the field delineated boundaries of all public waters and wetlands.

7.2.5 Storm Sewer Facilities

Storm sewer facilities, when utilized, shall be adequately depicted on the drawings. At a minimum, the following must be shown on the plan:

1. Storm sewer pipe size, length, grade, and type of material between each structure.
2. Catchbasin and manhole structural data including size, flow line or rim elevations, and invert elevations. A typical section depicting each different type of catchbasin or manhole used shall be shown on the drawing. Type of casting utilized shall be referenced for each catchbasin or manhole.
3. A typical curb section for urban design streets shall be shown on the drawing.
4. If ditch sections are used, a typical section shall be shown on the drawing depicting bottom width and side slopes of the ditch.
5. Details of skimming structures proposed.

7.2.6 Maintenance Access Routes and Easements

Suitable access routes must be provided to all outlet structures, emergency overflows, and constructed stormwater basins and devices. Maintenance access routes shall adhere to the following standards:

1. Shall be clearly depicted on the plans
2. Minimum ten feet in width
3. Cross slope of 10:1 or less
4. Longitudinal slope of ten percent or less
5. Shall be within a drainage and utility easement, minimum 20 feet wide

7.3 Storm Drainage System Submittal Requirements

The stormwater drainage report shall be comprised of the following sections to provide the Township Engineer with adequate base information for which to review the report:

Title Page. The title page shall list the project name, project location, date prepared, and preparer's name, title, and company.

Table of Contents. The table of contents must provide a description of the major categories of the report, and also list each hydrograph and reservoir report presented in the report.

Summary. The summary must provide descriptions of items critical to the review of the entire report. Assumptions and results of the calculations shall be included in the summary:

1. Pre-settlement Site Conditions (Existing)
    i. Total site area
    ii. Delineation of sub-drainage areas, as appropriate.
    iii. For each drainage area, or sub-drainage area, provide the following information:
        a. Area in acres.
        b. Curve number (pre-settlement curve numbers)
        c. Time of Concentration (with justification)
        d. Runoff rate and runoff volume
2. Post-Development Site Conditions (Proposed)
    i. Total site area
    ii. Delineation of sub-drainage areas, as appropriate.
    iii. For each drainage area, or sub-drainage area, provide the following information:
        a. Area in acres
        b. Curve number (with justification)
        c. Time of Concentration (with justification)
        d. Runoff rate and runoff volume
3. Comparison of pre-settlement to post-development runoff rates and volumes.
4. Total of existing and new impervious area
5. Calculations to determine the Water Quality Volume (1" over the new impervious surface)
6. Calculations to determine that the Water Quality Volume will be infiltrated in 48 hours or less
7. Geotechnical and Double Ring Infiltrometer test within the boundary of the infiltration basin with results certified by a Geotechnical Engineer
8. If infiltration is infeasible, it must be documented in the report with references to supporting data
9. Summary of nutrient removal on site.
10. A discussion of the storm sewer system, if applicable, to include a summary of flows to each catchbasin and the depth of water over each catchbasin during the ten year event.

11. A table listing the impervious area for each sub-basin, including assumptions for impervious area from driveways and buildings.

12. An assessment of potential downstream impacts to areas surrounding landlocked lakes or ponds, or lakes or ponds with inadequate outlets where flood levels would be increased by added runoff volume, potential impacts to downstream infrastructure, public and private structures and erosion alone the drainage path and downstream public waters, potential impacts to wetlands with exceptional vegetative diversity functional value.

13. Hydrologic and hydraulic wetland analysis to ensure that wetland inundation is within acceptable limits for the type of wetland that is impacted.

Drainage maps: Drainage maps depicting pre-settlement and post-development conditions. The plans shall delineate drainage area and sub-drainage area boundaries. All areas shall be labeled and referenced to those presented in the report.

Computer Printouts: Drainage maps of all hydrograph and reservoir files shall be included at the back of the report for reference.

7.4 Wetland Delineation and Replacement

Wetland delineations and replacement regulations are outlined in the Clean Water Act and the Minnesota Wetland Conservation Act. Both federal and state regulations must be followed.

7.4.1 Wetland Delineation

When a regulated use or activity is proposed on a property which is within a wetland or wetland buffer area, a wetland delineation and report is required. The applicant shall provide a wetland report prepared by a qualified Wetland Specialist. The wetland report shall include the following:

1. Vicinity map;
2. A copy of a National Wetland Inventory Map identifying the wetlands on or adjacent to the site;
3. A site map setting forth all of the following:
    i. Aerial background image which shows existing physical features of the site, including buildings, roads, water bodies, etc.;
    ii. Boundary of assessment area;
    iii. Surveyed wetland boundaries based upon delineation;
    iv. Internal property lines, rights-of-way, easements, etc.;
    v. Contours at the smallest readily available intervals, preferably at two-foot intervals;

vi. Location of all test holes and vegetation sample sites, numbered to correspond with flagging in the field and field data sheets.

4. A report which discusses the following:
    i. Location information (legal description, parcel number, and address);
    ii. Delineation. The wetland boundaries on the site established by the delineation shall be staked and flagged in the field. If the wetland extends outside the site, the delineation report shall discuss all wetland areas within 150 feet of the site, but need only delineate those wetland boundaries within the site;
    iii. General site conditions including topography, acreage, and surface areas of all wetlands identified;
    iv. Hydrological analysis, including topography, of existing surface and known significant sub-surface flows into and out of the subject wetland(s); and
    v. Summary of MnRAM analysis of functional values of delineated wetlands.

7.4.2 Wetland Replacement

When wetland impacts cannot be avoided, the applicant shall prepare a wetland replacement plan. The wetland replacement plan components shall conform to the requirements of Minnesota Rules 8420.0530.

7.4.3 Wetland Functions and Values Assessment

A wetland functions and values assessment shall be provided in accordance with Section 3.1.3.

7.5 Wetland Review

The applicant must submit copies of all required information including the applications, including escrows and fees, to the Township for review and approval. The township will process all applications in accordance with the procedures outlined in Minnesota Statutes and Rules.

8. HYDROLOGIC/HYDRAULIC MODELS

8.1 General Overview

As development and new construction changes the land use, there becomes a larger need for stormwater modeling. For example, replacing a stand of trees with a parking lot will dramatically increase the rate and volume of stormwater runoff. This increase in rate and volume will have an impact downstream, increasing soil erosion and the chance of damaging floods. To prevent such damage, the rate and volume of runoff must be predicted before construction so that suitable steps can be taken to handle the runoff in a safe and effective manner.

Storm and Sanitary Analysis (SSA) is a hydrologic and hydraulic computer modeling program. Utilizing existing methodology, SSA is capable of determining the amount of runoff from a watershed as well as routing that water through pipes, ditches, and other structures.

To determine the critical flood levels each watershed was modeled using a composite curve number estimating impervious area based off of an average of two-acre lots. The storm duration used to determine the flood elevations was a four day 100-year event.

8.2 Hydrologic Model (SSA)

Stormwater modeling and drainage design techniques can be divided into two basic groups:

1. Steady-state (constant flow) methods, such as the Rational Method as applied to storm sewer pipe networks.
2. Hydrograph generation and routing procedures designed to simulate the time varying nature of actual runoff.

Although hydroCAD is capable of steady-state analysis, it is primarily utilized as a hydrograph generation and hydraulic modeling program. SSA is programed to utilize various methodologies, the methodology utilized for the current model is based on Soil Conservation Service (SCS) techniques that are accepted and utilized throughout the state. For any given storm these techniques are used to generate hydrographs throughout a watershed.

8.2.1 Runoff Volumes

The volume and rate of runoff from a watershed are determined by a few variables, particularly the curve number, which indicates the percentage of runoff from a watershed. The curve number is effected by the hydrologic soil group classification and antecedent soil moisture condition.

The soil group classification used for this study was a split between group B and group C. Group B soils are silty or sandy loams that when wetted have a moderate infiltration rate. Group C soils are sandy clay loam

that have lower infiltration rates when wetted. The antecedent soil moisture condition (AMC) is a measure of how much rain falls five days before a 24-hour storm. For this study, AMC II was used, so the total five-day antecedent rainfall is 1.4 inches to 2.1 inches during the growing season. This study used a curve number of 72 which balances the B and C soils and represents residential developments that contain two-acre lots or approximately ten percent impervious surface. Using the curve number, rainfall distribution, and duration information, the runoff from each subwatershed can be determined using the SCS TR-20 method.

8.2.2 Rainfall Distribution and Duration

The rainfall distribution and duration chosen for this study was the Huff 4-day storm even for areas under 50 acres. This storm distribution more accurately models larger areas to determine flood levels. The 100-year rainfall amount used was determined using NOAA Atlas 14 data for Credit River Township.

8.2.3 Flood Elevations

The hydrographs created for each subwatershed are routed through the conveyance system (ditches, streams, etc.) and storage areas (detention ponds, wetlands, lakes, etc.) and are combined with other hydrographs generated from other subwatersheds. Specific characteristics of the water body and its outlet are input into the elevation/flood storage/discharge relationship used in the routing through each water body.

The elevations reported in this plan have been derived using limited topographic information and shall not be used for the purpose of establishing flood protection standards of new or existing structures. As development/building applications are submitted, the applicants will be required to further investigate the drainage patterns in accordance with Section 8.0 to more accurately determine flood elevations.

8.2.4 Watershed Data Tables

Runoff in Credit River Township mostly flows to the credit river and out of the township to the north. Table 8-1 contains pertinent information to each subwatershed. The subwatershed drainage areas are depicted in the Watershed Map included as Appendix E.

Abbreviations

OC = Open Channel
CMP = Corrugated Metal Pipe
RCP = Reinforced Concrete Pipe
INA = Information Not Available
NA = Not Applicable
NC = Not Calculated

Table 8-1
Credit River Watershed Data Table

SUBWATERSHED ID NUMBER	SUBWATERSHED AREA (acres)	Culvert	DOWNSTREAM SUBWATERSHED	100-YEAR STORM EVENT SUMMARY		REMARKS
				FLOOD ELEV. (feet)	PEAK DISCHARGE (cfs)	
CREDIT RIVER						
WS_98	3,326.0	RCP Box 10'x8'	WS_96	940.7	595	CREDIT RIVER CROSSING CO HWY 27
WS_96	4,495.0	N/A	WS_82	939.7	957	CREDIT RIVER CROSSING CREDIT RIVER BLVD
WS_109	1,802.0	N/A	WS_96	939.4	297	CONFLUENCE OF COUNTY DITCH AND CREDIT RIVER COUNTY DITCH REPORTED
WS_82	9,097.0	RCP Box 10'x10'	WS_59	929.8	1553	CREDIT RIVER CROSSING EGALE CREEK AVENUE
WS_59	10,736.0	2x RCP Arch 12'x8'	WS_34	931.6	2265	CREDIT RIVER CROSSING 175TH STREET
WS_134	2,348.0	RCP Arch 7'x4'	WS_61	978.1	310	ORCHARD LAKE OUTFLOW
WS_61	3,889.0	N/A	WS_59	931.6	671	CREDIT RIVER TRIBUTARY FROM ORCHARD LAKE AT CONFLUENCE POINT
WS_34	23,927.0	N/A	OUT	884.3	3995	CREDIT RIVER AT CONFLUENCE WITH CLEARY LAKE TRIBURARY
WS_55	7,585.0	RCP Box 6'x7'	WS_34	895.3	1093	TEXAS AVENUE CLEARY LAKE TRIBUTARY CROSING
WS_90	5,263.0	RCP 6'	WS_55	944.8	844	EAGLE CREEK AVENUE CROSSING CLEARY LAKE TRIBUTARY TO CREDIT RIVER
WS_83	2,717.0	CMP 42"	WS_90	948.0	436	UNNAMED STREAM CROSSING PARK ROAD
WS_73	1,248.0	CMP 24"	WS_90	958.8	110	WEST INLEY TO CLEARY LAKE
WS_116	1,907.0	RCP Box 6'x6'	WS_98	974.7	352	217 STREET CREDIT RIVER CROSSING

Table 8-2
Credit River Minimum Runoff Curve Numbers

Cover Description	Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	**A**	**B**	**C**	**D**
Fully developed urban areas (vegetation established)				
Open space (lawns, parks, golf courses, cemeteries, etc.				
Grass Cover > 75%	39	61	74	80
Grass Cover < 75%	49	65	77	82
Impervious areas:				
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers (excluding right-of-way)	98	98	98	98
Paved; open ditches (including right-of-way)	83	89	92	93
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
Water Surface:	100	100	100	100
Urban Districts:				
Commercial and business	NA[1]	92	94	95
Industrial	NA[1]	88	91	93
Residential districts by average lot size:				
1/8 acre of less (town houses)	NA[1]	85	90	92
1/4 acre	NA[1]	75	83	87
1/3 acre	NA[1]	72	81	86
1/2 acre	NA[1]	70	80	85
1 acre	59	68	79	84
2 acres and greater	55	65	77	82
Developing Urban Areas				
Newly graded areas (pervious areas only, no vegetation)	77	86	91	94
Undeveloped areas				
Agricultural land (all current uses)	55	65	77	82
Pasture, grassland, or range – continuous forage for grazing	49	65	77	82
Meadow – continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush – brush-weed-grass mixture with brush the major element	35	56	70	77
Woods – grass combination (orchard or tree farm)	43	65	76	82
Woods	36	60	73	79

[1]Use of Type A soil is not allowed for this hydrologic condition.

Table 8-3
Credit River Pre-Settlement Curve Numbers

Hydrologic Soil Group	Runoff Curve Number
A	30
B	55
C	71
D	77

9. GLOSSARY

1 Percent Chance Flood: The flood event that has an annual probability of being equaled or exceeded in any given year of 1 percent. This flood is the result of the critical duration 1 percent chance storm falling on the watershed. This is also commonly called the "100-year" flood.

10 Percent Chance Flood: The flood event that has an annual probability of being equaled or exceeded in any given year of 10 percent. This flood is the result of the critical duration 10 percent chance storm falling on the watershed. This is also commonly called the "10-year" flood.

100-Year Storms: Rainstorms of varying duration (e.g. 2-, 6-, 24-hour) and intensities (inches per hour) expected to recur on the average of once every one hundred years (1% frequency probability).

Abstraction: Retention on site through infiltration, evapotranspiration, or capture and reuse.

Aquifer: Saturated permeable geologic unit(s) that can transmit significant quantities of water under ordinary hydraulic gradients.

Bedrock Aquifer: One or more saturated geologic units composed of sedimentary, metamorphic, or igneous rock that can transmit significant quantities of water under ordinary hydraulic gradients.

Best Management Practices (BMPs): Practices that can be used to control urban nonpoint source pollution.

Bounce: The vertical elevation difference between the peak flood elevation and the wetland elevation.

Buffer: An upland area adjacent to a wetland, lake, or stream that is covered with natural vegetation that experiences little to no human impact such as mowing. The buffer begins at the delineated wetland edge or top of bank of a stream.

County Ditch: An open channel to conduct the flow of water. (Minnesota Statutes, section 103E.005, Subd. 8).

Design Storm: A rainfall event of specific return frequency and duration (e.g., a storm with a 2-year frequency of occurrence and 24-hour duration) that is used to calculate the runoff volume and peak discharge rate.

Detention: The temporary storage of storm runoff used to control the peak discharge rates, and which provides gravity settling of pollutants.

Detention Pond: An impoundment that is normally dry but is used to store water runoff until it is released from the structure. Used to reduce the peak discharge from stormwater runoff.

Detention Time: The amount of time a parcel of water actually is present. Theoretical detention time for a runoff event is the average time parcels of water reside in the basin over the period of release.

Erosion: Wearing away of the lands or structures by running water, glaciers, wind, and waves.

Evapotranspiration: Water evaporated and transpired from soil and plant surfaces.

Feedlot: An area where livestock are fattened for market.

Floodplain: Lowland area adjoining water bodies which are susceptible to inundation of water during a flood.

Floodway: The channel of a watercourse and those portions of the adjoining floodplain which are reasonably required to carry and discharge the 100-year flood.

Freeboard: A factor of safety above a certain flood level. This typically is defined as the vertical separation (feet) between the design flood level (e.g., 1 percent chance flood elevation) and the lowest floor of a structure or the top of an embankment. Freeboard compensates for the many unknown factors (e.g., waves, ice, debris, etc.) that may increase flood levels beyond the calculated level.

Glacial Drift: Material which was deposited by glaciers.

Groundwater: Water underneath the ground surface that is under positive pressure.

Hydric Soils: Soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part.

Hydrograph: A graph showing variation in the water depth or discharge in a stream or channel, over time, at a specified point of interest.

Hydrology: The applied science concerned with the waters of the earth in all its states – their occurrences, distribution, and circulation through the unending hydrologic cycle of: precipitation; consequent runoff, stream flow, infiltration, and storage; eventual evaporation; and precipitation.

Impervious Area: Impermeable surfaces, such as pavement or rooftops, which prevent the infiltration of water into the soil.

Infiltration: The entrance of water into the soil or other porous material through the interstices or pores of a soil or other porous medium.

Inundation Period: Time that flood waters temporarily stored in the wetland exceed the wetland elevation. Difference between the peak flood elevation and the wetland elevation.

Invert Elevation: The vertical elevation of a pipe or orifice in a pond which defines the water level.

Judicial Ditch: A public drainage system established under Chapter 106 of the Minnesota Statutes and under the jurisdiction of the district court or a watershed management organization.

Landlocked Lake or Basin: Area which has an outlet that is significantly higher than the normal water level of the lake, pond, or wetland.

Management Strategy: The specific physical, legal or administrative actions recommended or implemented based upon the established criteria and will achieve the policies and goals.

No Net Loss: No reduction in the area and value of a wetland from existing conditions.

Nonpoint Source Pollution: Pollution from any source other than any discernible, confined and discrete conveyances, including but not limited to surface runoff from agricultural, silvicultural, mining, construction, subsurface disposal and urban activities.

Normal Level: For basins, that water elevation maintained by a natural or man-made outlet.

Nutrients: Fertilizer, particularly phosphorous and nitrogen (the two most common components that run off in sediment).

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

Peak Discharge: The maximum instantaneous rate of flow during a storm, usually in reference to a specific design storm event.

Permeability: A characteristic of soil that enables water to move downward through the profile. Measured in inches per hour.

Policies: The plans or course of action to be followed in achieving the goals.

Precipitation: The total measurable supply of water of all forms of falling moisture, including dew, rain, mist, snow, hail, and sleet; usually expressed as depth of liquid water on a horizontal surface in a day, month, or year, and designated as daily, monthly, or annual precipitation.

Primary System: The primary system conveys runoff from the more frequent events such as the 2 to 10-year events. In general, the system is composed of swales, ditches, gutters, and storm sewers.

Public Waters: Any waters as defined in Minnesota Statutes, section 105.37, subdivisions 14 and 15.

Recharge: Replenishment of the groundwater system by natural or artificial means.

Regional Detention Basin: A natural pond or wetland area, often modified by man, in which a minimum and permanent water level is maintained. During periods of stormwater runoff of various durations, the basin receives additional water, stores it temporarily, and releases it at a controlled rate(s). In addition to runoff flow equalization in reducing existing flooding problems, the basin serves pollutants from existing as well as planned development.

Retention: The holding of runoff in a basin without release except by means of evaporation, infiltration, or emergency bypass.

Runoff: That portion of the precipitation which is not absorbed by the deep strata but finds its way into the surface water system after meeting the demands of evapotranspiration.

Sediment: Solid matter carried by water, sewage, or other liquids.

Shoreland: Land located within the following distances from public water: 1,000 feet from the ordinary high water level of a lake, pond, or flowage; and 300 feet from a rive or stream, or the landward extent of a floodplain designated by ordinances on a river or stream, whichever is greater.

Soil Association: A group of soils geographically associated in a characteristic repeating pattern defined and delineated as a single map unit.

Stormwater Runoff: The flow on the surface of the ground, resulting from precipitation in the form of rainfall or snowmelt.

Structural Control: The application of construction erosion techniques including but not limited to: sediment basins, silt fences, debris dams, dikes, terracing, riprap and diversions.

Swale: A natural depression or wide shallow ditch used to temporarily store, route, or filter runoff.

Time of Concentration: The time required for surface runoff from the most remote part of a drainage basin to reach the basin outlet.

Water Bodies: Natural and man-made depressions and stormwater conveyance and storage facilities including wetlands, lakes, ponds, streams and rivers.

Watershed: A geographical area which collects precipitation and provides runoff to a particular collector such as a stream, lake, or marsh.

Wetland: Transitional land between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have a predominance of hydric soils, be inundated or saturated with water at a frequency and duration to support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions, and under normal circumstances, supports a prevalence of hydrophytic vegetation.

APPENDIX A

SCWEP 2018 Report,
(Includes 10 pages)

SCWEP
SCOTT CLEAN WATER EDUCATION PROGRAM

Prepared By:

Sarah Cotton, SCWEP Coordinator
Scott Soil and Water Conservation District

Background

The Scott Clean Water Education Program (SCWEP) started in 2010, and has been updated continually during the last eight years so the program can affectively educate and inform Scott County residents. The program's goal is to make clean water choices second nature for all who live and work in Scott County. SCWEP has incorporated the goal into the marketing materials using the theme of "Clean Water Starts with Me!"

2018 Highlights

Workshops

In 2018, SCWEP offered native prairie, shoreline, and cover crop workshops. The workshops are promoted by submitting the workshop information to city utility bill mailers and local papers' community calendars, distributing promotional flyers, and utilizing social media. Registration for the workshops is simple using the on-line registration tool, Eventbrite.com.

Due to low attendance numbers in the past few years no raingarden workshop was offered in 2018, but there are plans for the workshop to be held again in 2019.

2018 Workshop attendance: 21 participants at the Native Prairie Workshop, 6 participants at the Shoreline Workshop, 130 participants at the multi-county Cover Crop workshop.

Conservation Leaders Program

Recognizing conservation leaders each year helps to illustrate to Scott County residents that some of their neighbors are already changing their behaviors, thus beginning to create a new normal. Scott County in Partnership with Three Rivers Park District was chosen as the 2018 Conservation Leader of the Year. They were also nominated for the MASWCD Outstanding Conservationists of the Year award, and were recognized at the MASWCD Annual Convention in December.

WMO Thank You Event

In August the WMO hosted a Thank You Picnic for landowners who had done conservation practices in the WMO in the last five years. The event featured live music, a barbeque dinner and keynote speaker, with around 200 people in attendance. This event served as a way to thank landowners involved in conservation, and for them to see that their neighbors are doing conservation too.

Outdoor Education Days

2018 was the 33nd year of Outdoor Education Days. This year 1,070 students from 13 schools were part of the fall outing for Scott County fifth graders from Belle Plaine, New Prague, Shakopee, and Savage. Student numbers were down because two of the days had to be rescheduled due to rain, and three schools were unable to reschedule. The six OED stations focused on forestry, wildlife, soil health, the water cycle, pond macro-invertebrates, and conservation. The stations were taught by staff from the Scott SWCD, Scott WMO, and Three Rivers Park District. In 2018 the Conservation Station was added replacing the Plant Station. At the new Conservation Station students learned about why it is important to conserve water and how they can do so in their lives. The station was added to emphasize that each student can make a difference in conserving natural resources. At the end of each day, CLIMB Theatre put on a production about recycling and composting. Outdoor Education Day is the main activity that SCWEP utilizes to directly reach Scott County youth.

Scott WMO/SWCD Conservation Tour

This year the Scott WMO/SWCD tour focused on pollutants in our water, with an emphasis on chlorides. Chlorides from road salt are a growing concern for water quality in Scott County because chloride is a permanent pollutant. Twenty-five people attended the tour including: Scott County Commissioners; members of the Scott County Watershed Planning Commission; SWCD Supervisors; Prior Lake-Spring Lake Watershed District Managers; and WMO, PLSLWD and SWCD staff. Stops included the City New Prague Wastewater Treatment Plant, raingardens at New Prague City Hall and St. Wenceslaus Catholic Church, and a presentation on road salt reduction by Fortin Consulting. This annual event allows county officials to view conservation projects throughout Scott County first-hand and see how dollars are being spent. It is also a chance to give them a better understanding of the importance of conservation, showing them that, over time, real changes are being made in the county.

Educational Videos

To keep SCWEP current, we started creating educational videos in 2018. These video can be shared on social media and used during SCWEP workshops. In 2018 many of the videos focused on cover crops and raingardens.

Partners

Members of the SCWEP partnership believe more can be accomplished by working together toward our common goal. By collaborating, we eliminate overlapping programs, prevent inconsistent and duplicative messaging and achieve similar outcomes at lower costs. In 2018, SCWEP partners included:

- Scott Watershed Management Organization
- Scott Soil and Water Conservation District
- Prior Lake-Spring Lake Watershed District
- Vermillion River Watershed Joint Powers Board
- Lower Minnesota River Watershed District
- Spring Lake Township
- Credit River Township
- Jackson Township
- Louisville Township
- Scott County

Whenever practical, SCWEP collaborated with other agencies, organizations and clubs in implementing outreach programs with similar goals and objectives in Scott County. This collaboration achieves an even greater level of consistency, reach and cost effectiveness. In 2018, these agencies included:

- Scott County Library System
    - Libraries throughout the county posted workshop flyers
- Scott-Carver Extension Master Gardeners
    - Were available to answer questions about trees and plants at the Scott SWCD tree sale
- Prior Lake Association
    - Helped spread the word about Shoreline workshop
- Cedar Lake Improvement District
    - Helped spread the word about Shoreline workshop
- O'Dowd Lake Association
    - Helped spread the word about Shoreline workshop
- Spring Lake Association
    - Helped spread the word about Shoreline workshop
- Natural Resources Conservation Service
    - Loaned out and delivered their rainfall simulator free-of-charge for use at Outdoor Education Days
- Minnesota Department of Agriculture
    - Loaned out their rainfall simulator free-of-charge for use at Outdoor Education Days
- Three Rivers Park District
    - Allowed Outdoor Education Days to be held free-of-charge at Cedar Lake Farm Park
    - Set up tables and garbage and recycling bins, and offered use of their golf cart for Outdoor Education Days

Accomplishments

The 2018 SCWEP Work Plan targeted and customized its "Clean Water Starts With Me!" campaign to three general audiences: Agriculture/Rural Landowners, Urban and Lakeshore Residents, and Community Groups/Institutions. SCWEP utilized both passive and active marketing and outreach techniques to connect with these audiences in Scott County.

Active techniques generally consisted of activities that were targeted, hands-on and engaged with very specific audiences. They were point-in-time events that were scheduled according to seasonal relevance. They took significant time and budgeted expense to plan and implement, relatively speaking, but were also more likely to have a higher impact in terms of educational outcomes (i.e., changed attitudes and behaviors). Examples included workshops, field demonstrations, tours, and one-on-one landowner meetings. Passive activities, by contrast, were intended to reach large audiences and deliver consistent "base" messaging. They had a relatively low impact compared to active activities, but were also relatively easy and inexpensive to implement. Examples included news articles and event displays that focused on the effects of how our decisions impact water quality and the positive or negative impacts we are responsible for on Scott County water bodies.

Listed below is the suite of activities and targeted audiences SCWEP focused on in 2018:

Audience & Events	Took Place in 2018	MS4 Activity	Accomplishments
Agriculture/Rural Landowners			
Promote Cover Crop/Soil Health BMPs (news releases, fact sheets, workshops, cover crop books for sale, community events/displays, demonstration plots, success stories, cost-share incentives for cover crops)	X	X	• Staff continued to receive training on soil health and cover crops • Sent out monthly "Cover Crop Updates" emails • 130 people attended a cover crop and soil health workshop on March 15 in Le Center. The event was a collaboration with the Scott WMO, Scott SWCD, and Carver and Le Sueur SWCDs. • Hosted a Cover Crop field day June 13, and a Cover Crop tour on November 21 • Scott Conservation Center Hallway display theme: Cover Crops in Scott County • Created cover crop videos to distribute through social media and "Cover Crop Update" emails
Promote nutrient and manure management	X	X	• Provided individual producers with one-on-one assistance
Promote no-till drill rental program, reduced tillage	X	X	• Scott Conservation Center Hallway display theme: Equipment rental program and benefits of no-till • No-till equipment rental article submitted to the SCENE
Promote native grass planting	X	X	• Sent 450 invitations to targeted landowners for March 1 Planting Native Prairie Workshop • 21 residents attended Planting Native Prairie workshop on March 1st • Serviced 40 new requests for prairie restoration assistance • Certified approximately 66 acres of new native prairie • Native Prairie Success Story published in the SCENE • Workshop publicity in county newspapers, on local websites and in the SCENE • Displayed "Plant Native Prairie" banner and rack card at seasonally appropriate events.
Promote riparian buffers and filter strips	X	X	• Serviced 15 new requests for buffer technical assistance • Contacted landowners directly for targeted riparian buffer improvement projects

			• Shared relevant stories on partner social media pages
Promote tree and native seed program (buffers, windbreaks, soil savings, erosion reduction, screenings, living snow fences, wildlife habitat improvement)	X	X	• Sold 31,365 tree seedlings • Sold 162 Native Seed Mixes • Submitted news articles on tree and native seed mix annual sale (pre-, midway and post-program coverage) • Sent an email blast on tree program to customer/interest list • Tree order form insert in the Feb. SCENE • Scott Conservation Center Hallway display theme: Tree program • Shared relevant stories on partner social media pages
Promote rural residential/hobby farm conservation practices (news releases, community events, direct mailings, one-on-one meetings, success stories, community events/displays)	X	X	• Set up display booth with banners and information rack cards on pastures, manure management, cover crops, erosion, and soil loss at appropriate events including the Scott County Fair • Had "Contact Me" cards available at the Scott County Fair for anyone interested in having the SWCD contact them with more information about how conservation that could be done on their land • Shared relevant stories on partner social media pages • Sent out over 200 postcards to residents who recently purchased 2(+) acres about services: technical assistance, designing, cost-share, etc.
Promote cost-share and conservation assistance	X		• The WMO held a Thank You Event with around 200 guests in attendance. The event was put on to thank everyone who put in a conservation practice in the WMO in the last five years. • Noted that cost-share and technical assistance was available in appropriate SCENE articles • Handed out flyers to SWCD tree customers with information about technical assistance, designing, and cost-share • Created a Conservation Practice of the Month of the Scott SWCD's Facebook page highlighting different conservation practices that have technical assistance and cost-share available
Scott WMO/SWCD Fall Conservation Tour	X		• Held the annual Fall WMO/SWCD Conservation tour with 25 attendees including a Scott County Commissioner; members of the Scott Co. Watershed Planning Commission; SWCD Supervisors; Prior Lake-Spring Lake Watershed District Managers; and WMO and SWCD staff. • Stops included the New Prague Wastewater Treatment Plant, raingardens at New Prague City Hall and St. Wenceslaus Catholic Church, and a presentation on road salt reduction. • This annual event allows county officials to view conservation projects throughout Scott County first-hand and see how dollars are spent, and to better understand the challenges of conservation.
Urban and Lakeshore Residents			
Promote raingardens	X	X	• Raingarden Success Story published in the SCENE • Assisted landowners with installation of 12 new raingardens, including 3 raingardens installed by the Minnesota Conservation Corps Crew • Shared relevant stories on partner social media pages • Created a step by step video
Hold a Shoreline Restoration Workshop	X	X	• 6 residents attended the Restore Your Shoreline workshop on April 17 • Serviced 24 new requests for shoreline protection assistance • Certified 580 lineal feet of new lakeshore stabilization and protection. • Promoted the workshop in SCENE and local media outlets • Submitted workshop announcement to local cities utility bill inserts • Updated workshop packet and funding information • Shoreline Restoration Success Story published in the SCENE
Promote natural landscaping practices	X	X	• Displayed "Plant Native Prairie: Put Down Roots" and "Landscape Naturally" rack cards and banners at community events • Shared relevant stories on partner social media pages
Promote environmentally-friendly snow/ice management	X	X	• Prepared environmentally friendly snow/ice removal news release for October SCENE and other local news media • WMO held 5 smart salting workshops • Smart Salting cups distributed at the Government Center in Shakopee

			• Shared relevant stories on partner social media pages
Promote environmentally-friendly lawn care	X	X	• Prepared news releases on spring and fall environmentally-friendly lawn care BMPs for The SCENE and local news media • Five information rack cards and display banners focus on this topic • Shared relevant stories on partner social media pages • PLSLWD held two Clean Water Clean Up events. During the spring event 65 volunteers raked 1.23 tons of leaves and removed 1.78 tons of buckthorn and other woody debris. During the fall event, 50 volunteers raked 2.5 tons of leaves, pulled a truckload of buckthorn, and the Scouts planted 50 shrubs.
Promote personal stormwater management/responsibility	X	X	• Displayed "The Unfiltered Truth" and "Rain Barrel" rack cards and banners at community events • During Scott County Fair, on-site raingarden was featured with interpretative signage as part of a Scott County fair • Shared relevant stories on partner social media pages
Support Carp Contests	X		• The WMO's Watershed Stewards Grant program supported the Cedar Lake Improvement District's carp tournament.
Interpretive signage installed	X		• Installed 7 raingarden signs, 11 native prairie signs, and 1 shoreline sign at project sights • Additional signs will be installed in 2019
Promote proper disposal of hazardous waste via county HHW facility	X	X	• HHW Facility article in the SCENE • "Don't Throw it Out, Take it to the County" rack cards and banner displayed at community events • Shared relevant stories on partner social media pages
Promote "unintentional" pollution prevention	X	X	• Displayed "The Unfiltered Truth," "Salt Pollutes" and "Don't Throw it Out: Take it to the County" rack cards and banners at community events • News releases on Salt Pollutes • Shared relevant stories on partner social pages, including information on Scott County's "Take it To the Box" program for unwanted medications
Educate citizens about groundwater nitrate	X	X	• 115 water samples analyzed at SWCD tree-pickups days: May 11 and 12 • 15 wells decommissioned
Community Groups, Schools, Government			
Organize and host Outdoor Education Days	X		• Hosted 33th annual event, attended by 1,000 students from 13 schools (Belle Plaine, New Prague, Shakopee, and Savage) on September 17, 19, 21, 26 and 27. • Six student stations focused on forestry, wildlife, conservation, soil health, the water cycle, and pond macro-invertebrates. There was also a CLIMB Theatre production about recycling and composting. • Created the Conservation Station to replace the Plant Station. • Received $1,000 from MVEC Operation Roundup Grant for waters for students and lunches for presenters
Share and promote information Watershed Stewards Mini-Grants	X		• Posted the announcement and application on the county website • Emailed grant application to schools, churches, and townships • Story in the Scott County SCENE • Grant applications available at Government Center • Grants awarded to the Cedar Lake Improvement District for prize money for a carp tournament, to New Prague High School to install a raingarden and interpretative signage, and to Jordan Elementary to purchase binoculars for use in outdoor education
Continue to develop Fish Lake, New Prague, Prior Lake Sportsmen's Club and Pheasants Forever Partnerships	X		• This relationship development is ongoing with SWMO taking the lead • Sold tree seedlings in bulk to local sportsman's clubs • Donated native seed mix and tree seedlings to Scott County Pheasants Forever for a fund-raiser • Distributed 2320 lbs. of corn, 2000 lbs. of soybeans, and 500 lbs. of sorghum to 75 people to plant for food plots through Scott County Pheasants Forever partnership

Continue to educate community leaders and officials about Illicit Discharge Detection and Elimination	X	X	• Presented at Scott County's Right to Know Training about IDDE on May 10. • Displayed IDDE rack cards and banners at community events • Continued to distribute IDDE vehicle visor clips upon request to county and city public works vehicles/employees
General			
Education presentations to WPC	X		• Regular updates and reporting is shared with WPC Board on a monthly basis
Submit MASWCD Conservation Cooperator of the Year Award and Scott SWCD's Conservation Leaders Program	X		• Submitted an award application for Scott County is Partnership with Three Rivers Park District for MASWCD's Outstanding Conservationists of the Year. They were recognized at the MASWCD Annual Convention on Dec. 11. They also received Conservation Leaders Program signage.
Marketed Sand Creek Story Map	X		• The Story Map tells the story of water quality issues in the watershed and how partnerships with landowners and other agencies make a collective difference in reducing pollutant loads. • Information about the story map was available at the Scott County Fair and on the Scott County website. • The Story Map was launched in July, 2017
Set up Earth Week display at Scott County Government Center	X	X	• The Earth Week display theme was focused on teaching people about compostables and composting food.
Write/edit news articles (educational, events, success stories, testimonials, etc.) in cooperation with other partners via Cooperative Media Plan.	X	X	• SCWEP followed a comprehensive media plan with SCWEP Partners to reduce redundancy and streamline conservation topic focus/impact. • 58 relevant articles were drafted and published
Rotate Scott Conservation Center Hallway Displays	X		• Designed and utilized seasonal themes including tree program, no-till equipment rental, planting cover crops.

Media

SCWEP continues to work with partners and county agencies on a timely, cost-effective manner to market programs and activities. This involves the utilization of a Cooperative Media Plan in which news releases and other promotions are strategically outlined in advance of deadlines. The Cooperative Media Plan allows for more effective communications through timely news releases and less overlap of stormwater runoff, workshops, lawn care, landowner success stories and other topics. Media outlets include county newspapers, The Scott County SCENE, and the county, PLSLWD and SWCD websites. As an added benefit, the plan also allows for more effective cross-marketing of partner programs.

In 2018, 58 news releases were written and distributed. Topics for news releases follow SCWEP goals and objectives. Whether residents owned a business or home, lived on a lake, walked their dog, hunted in our woods or wetland areas, maintained their lawn, landscaped with native plants or raised crops in Scott County, the clean water message was tailored to them.

2018 News Releases

Local farm leads by example in conservation efforts	Boyer Trucks increases recycling efforts
Local residents have been planting trees for 30 years	Cover crop test plots planted in Scott County
Cover Crop Expert to Speak March 15	Lawn converted to prairie provides many benefits
Tree Order Form Insert	Create natural spaces with trees, shrubs
New fee charged to dispose of electronics at HHW Facility	Raingardens need to be maintained
Helping Businesses with Hazardous Waste	Sand Point Beach: Improving water quality on Lower Prior Lake
Recycling grant success story	Free Winter Deicing Applicator Trainings
Draft Comprehensive Plan announcement	HHW ReUSE
McMahon High Lake Levels	Chart Industries Recycling Grant Success Story
Let kids play outdoors	St. Wenceslaus Recycling Grant Success Story
Compost Bins for sale!	Recycle your plastic bags, film
Water Conservation tips / Be Responsible with Sprinklers	HHW accepts Eyeglasses for Recycling
Noxious Weed notice and article	Recycling in Scott County for 2017
Lunds & Byerlys Recycling Success Story	SWCD Accepting Tree Orders
SWCD Tree Pick up Announcement	Keep leaves out of gutters for water quality
Free Walk-in nitrate testing clinic for well water planned	Students learn about conservation at Outdoor Education Days
Free Restore Your Shoreline Workshop	Prior Lake homeowner stabilizes shoreline
Pheasants Forever provides free seed for wildlife food plots	2018 Fall Clean Water Clean-up
Live garden kits available for spring	Tips to Minimize Holiday Waste
Local farmer plants cover crops to improve farm	Businesses generating hazardous waste must be licensed
Volunteers Needs for Spring Clean Water Clean-up Event	Grant Helps Church Double its Recycling
Landowners may sign up for MN CREP	Septic System inspections help protect groundwater
Spiritual Center Raingarden a Success	Tips for maintaining septic systems
Green is My Favorite Color	County offers well test kits, advice on well ownership
Invasive Species Easily Spread; Caution Advised	Elected officials learn about conservation during fall tour
Successful Clean Up Event	SWCD Board Members Reelected
Applicants Sought for Award for Water Quality Improvements	Landowners improve water quality by reducing erosion
Environmental reviews look at impact of projects on resources	Aerial Seeded Cover Crops Keep Soil from Eroding
Does this go in my recycling bin?	Successful Clean Up Event held at Sand Point Beach Park

MS4 Activity

The 2018 Work Plan was designed to ensure member compliance with the educational requirements of their respective Stormwater Pollution Prevention Plans. There are six minimum control measures (MCMs) defined in the MS4 Permit, including:

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

Many SCWEP activities helped partners comply with the MS4 MCM1 requirements. Data used for MS4 reporting can be found in the appendix.

Budget

The 2018 SCWEP budget was $ 77,596.95. This includes $ 73,596.95 for staff time to plan and implement activities, and $4,000 for materials, supplies and related expenses. Of this total, Scott WMO is contributing $66,896.95, Prior Lake-Spring Lake Watershed District is contributing $5,000, Lower Minnesota River Watershed District is contributing $1,500, Vermillion River Watershed is contributing $1,200, Spring Lake Township is contributing $1,000, Jackson Township is contributing $1,000 and Louisville Township is contributing $1,000.

Outcomes, Evaluation and Reporting

The SCWEP goal – to make clean water choices second nature for all who live and work in Scott County – was reviewed throughout the year. Outcomes were evaluated primarily by number of participants and following-up with program participants. We also tracked follow-up requests for additional information and technical assistance in SWIMS database.

A large part of the Storm Water Pollution Prevention Program (SWPPP) requires identification and documentation of best management practices that will be undertaken to reduce the discharge of pollutants from the MS4 to the maximum extent practicable. A few of the metrics used to measure the impact of marketing strategies include:

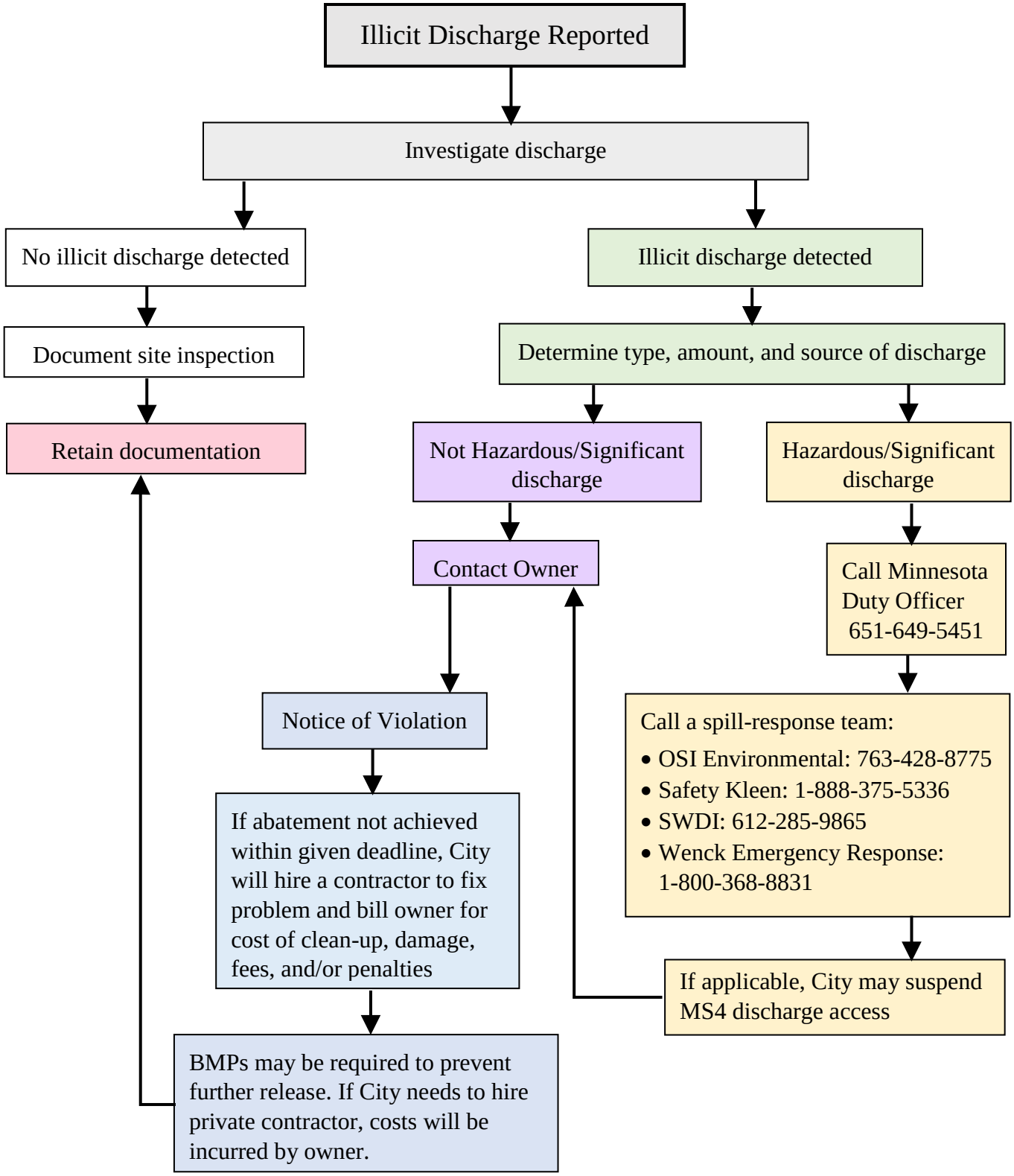
- Number of participants at specific SCWEP hosted events or workshops
- Number of direct mailings, brochures and flyers distributed
- Number of submitted press releases articles

Staff recorded and quantified the above metrics to assess the success or benefit of each marketing strategy. Additionally, staff provided evaluations after educational workshops and outreach events (when applicable) to gauge the overall performance and success of the activity, how well presented topics were understood and if adjustments to curriculum were recommended. Once results were received, staff used feedback from the surveys to modify content and presentations as needed.
Evaluation was and continues to be an important component in understanding the effectiveness of reaching our goal of the “Clean Water Starts With Me!” campaign.

APPENDIX B

Emergency Response Procedures,
(Includes 8 pages)

Illicit Discharge:
Enforcement Response Procedure Flow Chart



Illicit Discharge: Enforcement Response Procedure (ERP)

1. SCOPE AND APPLICABILITY: These methods are used to respond to known, suspected, and reported illicit discharges. In accordance with the Township's MS4 General Permit (Permit No. MNR040000), a written ERP is required to enforce and compel compliance with the Regulatory Mechanism(s) outlined in Scott County Ordinance Code 6H.

2. SUMMARY OF METHOD: If an illicit discharge is reported, Township or County staff will investigate and issue a Notice of Violation if necessary. If the spill is large enough, the Minnesota Duty Officer should be called. All investigations should be documented, even if no illicit discharge is detected.

3. ILLICIT DISCHARGE DEFINED: An illicit discharge is defined as any discharge into the Township's Storm Sewer System not entirely comprised of stormwater. Examples of illicit discharges include the following: industrial process water, commercial car wash wastewater, sanitary sewer flows, dumping of liquid waste, chlorinated pool water, water softener brine backwash, used motor oil, radiator flushing disposal, and other automotive fluids.

4. PROCEDURE:

4.1 Field Investigation. A visual inspection of the site will be done. Documentation should include pictures and/or video of the illicit discharge and location of the spill. The source of the spill should be stopped, if it can be done safely. If possible, the illicit discharge should be traced back to the source of the spill. Contact with the property owner should be made (if known).

4.2 Enforcement. In the event that an illicit discharge is found and confirmed, the Township or County shall serve a written Notice of Violation (NOV) to the owner. If the property owner or operator does not cooperate, representatives of the Township or County are authorized to take any and all measures necessary to abate the violation and/or restore the property, as set forth in Scott County Ordinance 6H-6. Payment of all expenses incurred by the Credit River Township and/or Scott County related to remediation and administrative costs will be charged to the owner. All enforcements shall be documented and include the following:

a. Name of the person responsible for violating the terms and conditions of the permittee's Regulatory Mechanism(s)

b. Date(s) and location(s) of the observed violation(s)

c. Description of the violation(s), including references(s) to relevant Regulatory Mechanism(s)

d. Corrective action(s) (including completion schedule) issued by the permittee

e. Date(s) and type(s) of enforcement used to compel compliance (e.g., written notice, citation, stop work order, withholding of local authorizations, etc.)

f. Referrals to other regulatory organizations (if any)

g. Date(s) violations resolved

4.3 Clean-Up. There are two different protocols based on the type of the illicit discharge.

a. **Not Hazardous/Significant**

Illicit discharges that are non-hazardous and/or can be contained with equipment on hand should be cleaned as follows:

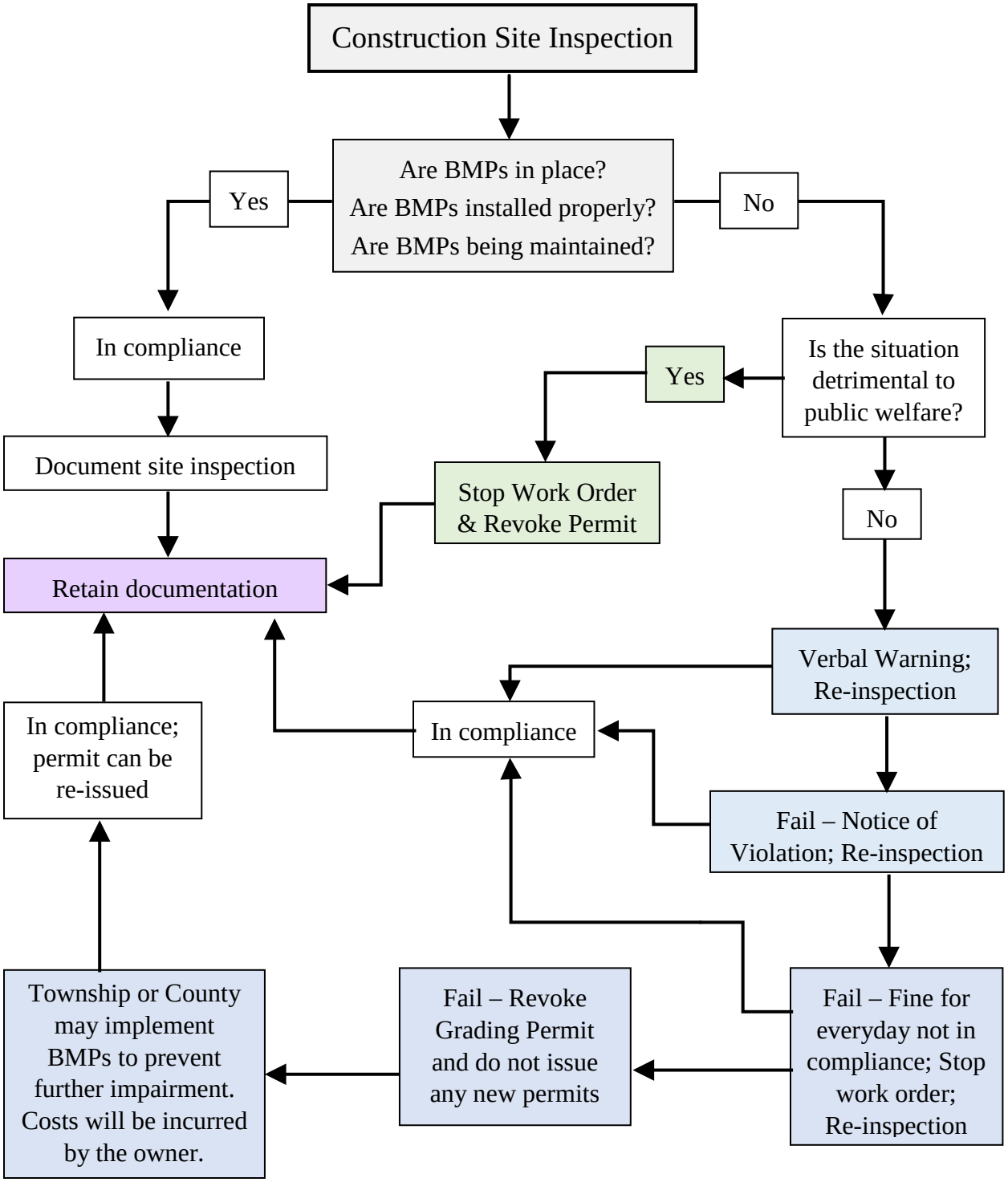
1. Immediately apply absorbent material to the spill. Preferably an environmentally friendly hydrocarbon mitigation agent. Kitty litter, powdered laundry detergent, or an absorbent pad work as well.
2. Let absorbent sit overnight or for at least 12 hours. Be aware of weather conditions that may spread the spill further with rain or flooding.
3. Sweep up absorbed material and store it in a metal bin until it can be properly disposed of by one of the following waste management companies: OSI Environmental 763-428-8775, Safety Kleen 888-375-5336, SWDI 612-285-9865, or Wenck Emergency Response: 800-368-8831.
4. DO NOT throw the absorbed material into the garbage.

b. Hazardous/Significant

Any illicit discharge that contains hazardous materials and/or is massive in size should follow the steps below.

1. Report it to the Minnesota Duty Officer at 651-649-5451.
2. Notify a spill-response team to clean up the spill: OSI Environmental 763-428-8775, Safety Kleen 888-375-5336, SWDI 612-285-9865, or Wenck Emergency Response: 800-368-8831.
3. If applicable and can be safely done, suspend MS4 discharge access.

Construction Sites:
Enforcement Response Procedure Flow Chart



Construction Inspections: Enforcement Response Procedure (ERP)

1. SCOPE AND APPLICABILITY: These methods are used to enforce erosion and sediment control for construction sites. In accordance with the Township's MS4 General Permit (Permit No. MNR040000), a written ERP is required to enforce and compel compliance with the Regulatory Mechanism(s) outlined in Scott County Ordinance 6C.

2. SUMMARY OF METHOD: Township or County staff inspects construction sites over several stages. If there is a violation, a verbal warning will be given. If the warning goes unheeded, a Notice of Violation will be issued with a deadline to fix the violation. If the site fails the inspection by the deadline, a daily fine will be incurred until it is fixed, and a stop work order may be issued. The Grading Permit may also be revoked. New permits would not be issued until the site is within compliance. If necessary, the Township or County will construct Best Management Practices (BMPs) to prevent further impairment to the watershed, and the costs will be incurred by the owner. Once in compliance and all penalties accounted for, permits can be re-issued. All actions shall retain documentation.

3. DEFINITIONS:

3.1 Erosion: The wearing away of the ground surface as a result of movement of wind, water, and/or ice

3.2 Gradinf Permit: a permit issued by the municipality for which the purpose is construction or alteration of ground.

4. ENFORCEMENT:

4.1 Stop-Work Order and Revocation of Permit. In the event that any person holding a grading permit violates the terms of the permit, or implements site development in such a manner as to materially adversely affect the health, welfare, or safety of persons residing or working in the neighborhood or development site so as to be materially detrimental to the public welfare or injurious to property or improvements in the neighborhood, a stop-work order maybe issued and/or the grading permit may be revoked or suspended.

4.2 Violation and Penalties.

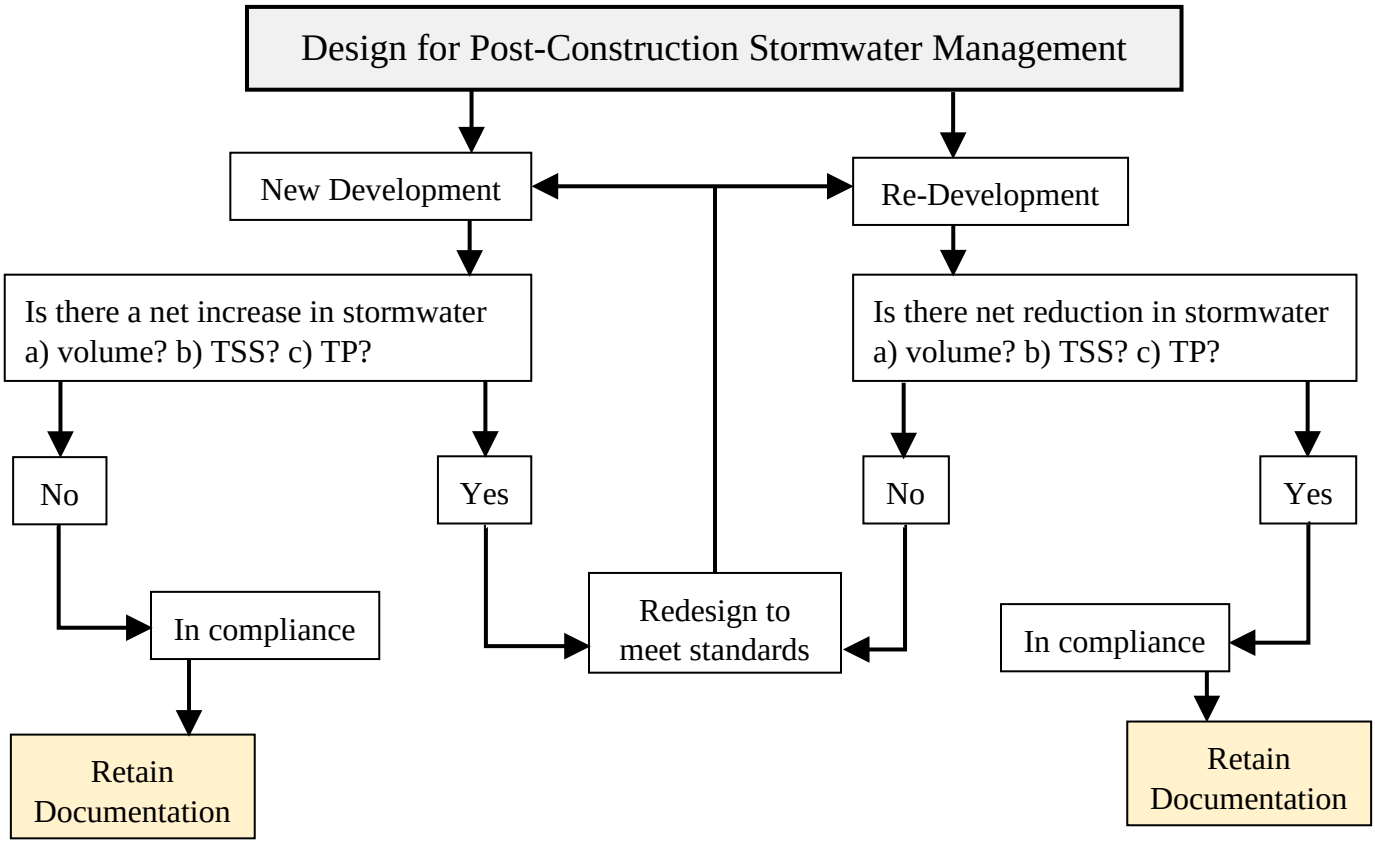
a. Verbal Warning. If a site is not in compliance, a verbal warning will be issued with the expectation that the offense will be corrected by the next inspection.

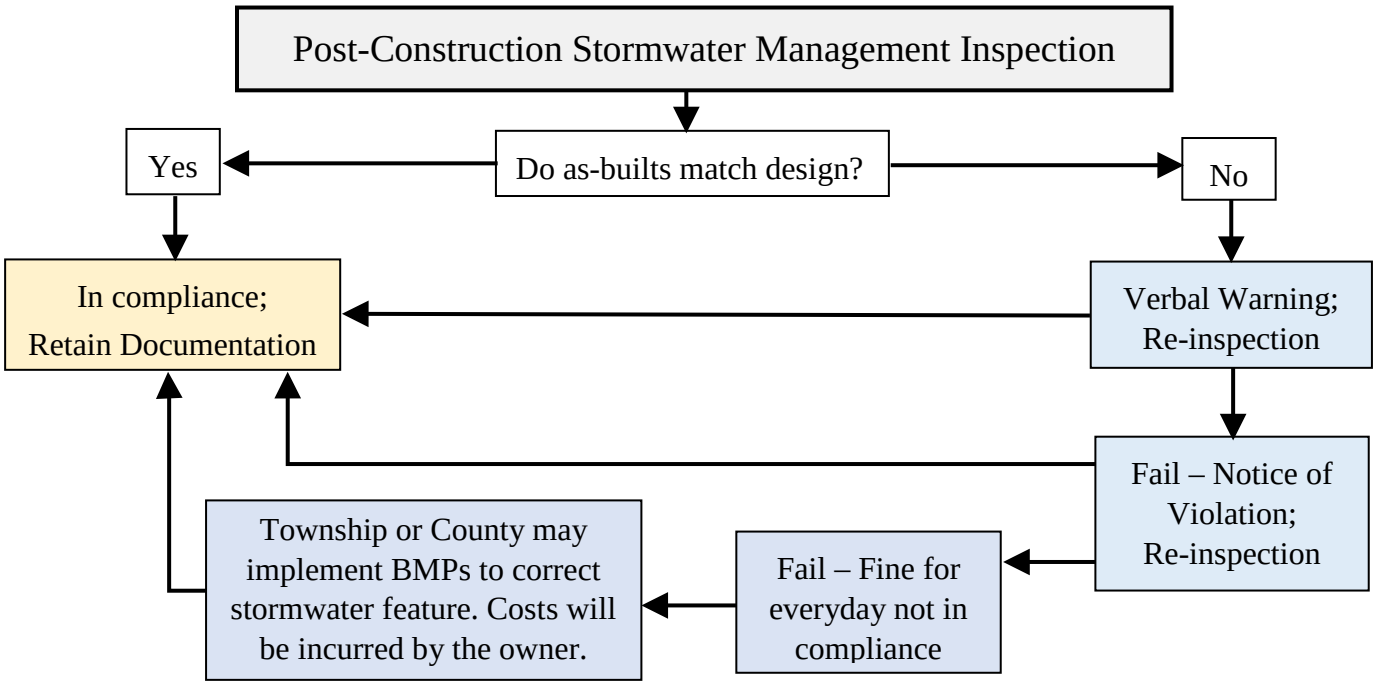
b. Notice of Violation. If the verbal warning is disregarded and the site is still not in compliance, a Notice of Violation will be issued, which will include a deadline by which the site must have all appropriate erosion and sediment control measures in place.

c. Stop-Work Order. If the site does not meet standards by the Notice of Violation deadline, the offending party shall be deemed guilty of a misdemeanor, and each day during which any violation is committed, continued, or permitted shall constitute a separate offense. Each offense may accompany a monetary fine. A stop-work order will be issued until the site is in compliance.

d. Permit Revocation. If the site continues to be in violation, the site development permit will be revoked. The Township or County may hire a private contractor to implement BMPs to prevent further impairment. The offending party shall be required to bear the expense of such restoration.

Post-Construction Stormwater Management: Enforcement Response Procedure Flow Chart





Post-Construction: Enforcement Response Procedure (ERP)

1. SCOPE AND APPLICABILITY: These methods are used to enforce the prevention or reduction of water pollution after construction activity. In accordance with the Township's MS4 General Permit (Permit No. MNR040000), a written ERP is required to enforce and compel compliance with the Regulatory Mechanism(s) outlined in Scott County Zoning Ordinance 6B.

2. SUMMARY OF METHOD: Township or County staff verifies post-construction stormwater management compliance in the design stage. After construction, the site is inspected to insure it meets the pre-approved design standards. If the site does not meet the design, a verbal warning will be given. If the warning goes unheeded, a Notice of Violation will be issued with a deadline to fix the violation. If the site fails the inspection by the deadline, a daily fine will be incurred until it is fixed, and, if necessary, the Township or County will hire contractors to correct the stormwater management features, in which the costs will be incurred by the owner. All actions shall retain documentation.

3. DEFINITIONS:

- **3.1 As-builts:** measured drawings of the site submitted by contractor upon completion of construction
- **3.2 Best Management Practice (BMP):** structural or non-structural methods to prevent or reduce the pollution of runoff, including schedules of activities, infiltration, filtration, and other management practices
- **3.3 New Development:** all construction activity that is not defined as redevelopment
- **3.4 Redevelopment:** any construction activity where, prior to the start of construction, the areas to be disturbed have 15 percent or more of impervious surface(s)
- **3.5 MS4 Permit:** Municipal Separate Storm Sewer System permit given to Credit River Township regulates the amount of sediment and pollution that enters surface and ground water from storm sewer systems to the maximum extent practicable and are subject to regulation under the National Pollutant Discharge Elimination System
- **3.5 Notice of Violation:** given to the person responsible for breaching the post-construction stormwater management, as stated in Ordinance 6B and the MS4 permit, in which the type of violation, date of violation, actions to correct violation, and deadline to perform said actions will be given
- **3.6 Site:** A parcel of land, or a contiguous combination, where construction work is performed as a single unified operation
- **3.7 Site Development Permit:** A permit issued by the municipality for which the purpose is construction or alteration of ground
- **3.8 Stormwater:** stormwater runoff, snow melt runoff, and surface runoff and drainage
- **3.9 Total Phosphorus (TP):** sum of particulate and dissolved phosphorus contained within the stormwater
- **3.10 Total Suspended Solids (TSS):** amount of solids in suspension in the water that can be treated through filtration

4. ENFORCEMENT:

- **4.1 Design.** A grading permit will not be issued until the pre-construction designs meet the post-construction stormwater management requirements outlined in the Zoning Ordinance Chapter 6 and/or Section III.D.5 of the MS4 permit, whichever is more stringent.

a. New Development. There can be no net increase in stormwater discharge volume, TSS, and TP from pre-project conditions

b. Redevelopment. There must be a net reduction in stormwater discharge volume, TSS, and TP from pre-project conditions.

4.2 Inspection.

a. Verbal Warning. If a site does not match the pre-approved design, a verbal warning will be issued with the expectation that the stormwater management feature will be corrected by the next inspection.

b. Notice of Violation. If the verbal warning is disregarded and the site is still not in compliance, a Notice of Violation will be issued, which will include a deadline by which the site must match all design requirements.

c. Fines. If the site does not meet standards by the Notice of Violation deadline, the offending party shall be deemed guilty of a misdemeanor, and each day during which any violation is committed, continued, or permitted shall constitute a separate offense. Each offense may accompany a monetary fine. The Township or County may hire a private contractor to correct the violation(s), and all costs will be incurred by the owner.

APPENDIX C

Markley Lake Stipulation
and Settlement Agreement,
(Includes 6 pages)

STATE OF MINNESOTA

COUNTY OF SCOTT

DISTRICT COURT

FIRST JUDICIAL DISTRICT

Wynn C. Sohler and Richard L. Sohler,
David Pinke and Nancy Pinke, and
Thomas J. Stanley and Ann K. Stanley,

Plaintiffs,

vs.

City of Prior Lake, a
Municipal Corporation, County of Scott, a
Minnesota County, and Town of Credit River, a
Municipal Corporation,

Defendants.

Court File No. 2000-4324
Case Type: Eminent Domain

STIPULATION AND SETTLEMENT AGREEMENT

WHEREAS, Plaintiffs Richard and Wynn Sohler are the owners of certain real estate in Scott County, legally described on the attached Exhibit A; and

WHEREAS, Plaintiffs David and Nancy Pinke are the owners of certain real estate in Scott County, legally described on the attached Exhibit B; and

WHEREAS, Plaintiffs Thomas and Ann Stanley are the owners of certain real estate in Scott County legally described on the attached Exhibit C (hereinafter the property described on Exhibits A, B and C is collectively known as the Property); and

WHEREAS the Plaintiffs brought the foregoing action against the above named Defendants alleging claims in nuisance, trespass and negligence (hereinafter Tort Claims) and a claim seeking to compel the Defendants to institute condemnation to acquire the Property (hereinafter the Condemnation Claims) based on alleged flooding and deposit of debris on the Property as a result of the development within the watershed and reconstruction of County Road 21 and based on other theories, as developed during the litigation of this matter; and

WHEREAS, the above named Court granted summary judgment dismissing the Township entirely from the action and dismissing the tort claims against the City of Prior Lake (hereinafter the City) and Scott County (hereinafter the County); and

WHEREAS, the Plaintiffs, the County and the City wish to resolve the Condemnation Claim and all other claims by payment to the Plaintiffs as more fully set forth herein;

EXHIBIT A

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NOW, THEREFORE, the Plaintiffs, the County and the City, in consideration of the covenants herein, agree as follows:

1. Incorporation. The foregoing recitals are hereby incorporated and are part of the Agreement of the parties.

2. Payment. In full and final settlement of the Condemnation Claims and all other claims, the County shall pay the Plaintiffs collectively $40,000 and the City shall pay the Plaintiffs collectively $40,000 by joint payee checks to all of the Plaintiffs and their attorneys. The Plaintiffs shall determine how to divide the $80,000 payment between them. Payment shall be made upon execution of this Agreement and all documents contemplated by this Agreement.

3. Release. The Plaintiffs on behalf of themselves, their heirs, executors, assigns, and subsequent owners of the Property, hereby release and forever discharge the County and the City, their officers, employees, agents and insurers, from any and all claims, suits and or damages, of every kind, nature and description which they had, or may have, known, or unknown, as of the date of this Agreement, specifically including, but not in any way limiting the generality of the foregoing release, all claims, now and in the future, related to the water level of Markley Lake, and any actions or inaction by the City or the County with respect to drainage into Markley Lake, whether based on theories of tort, inverse condemnation or any other theory, except as to the impact, if any, of new development occurring exclusively within the City of Prior Lake. The County shall have no liability under any theory for such new development within the City of Prior Lake except to the extent that the County affirmatively undertakes such new development itself. Subsequent to August 31, 2001

4. Interim Policy. There is an Interim Flood Prevention Plan for Markley Lake dated March 5, 1999, revised May 11, 1999. Consistent with that policy the City of Prior Lake will pump Markley Lake in the same manner and method as used by the City in 1999 when the water level of Markley Lake reaches 895.8, with the pumping activity to continue until the water level is 893.2, or the pump no longer draws a significant amount of water. The County will undertake no further duties or responsibilities under the Interim Plan. The obligation by the City to pump is contingent upon all of the following: (1) No pumping shall be done if the water level in the Lake is below the ground water level; (2) The City receives all necessary water appropriation or other permits, including but not limited to any necessary permit or permission from Credit River Township and a permit from the MnDNR; and (3) Approval of the pumping activity by the City of Savage. The City shall continue the foregoing pumping activity until such time as (1) the Water Management Organization, Watershed District, Scott County or other agency acting in a similar capacity adopts a Policy with respect to Markley Lake and, in the discretion of the City, the pumping activity should be discontinued (by agreeing to inclusion of this paragraph, the County is not agreeing that it will adopt any policy or plan); or, (2) the City in its reasonable discretion, determines that a different policy with respect to pumping should be implemented in place of the foregoing, which, in the City's judgment, will appropriately control water levels, at or below 895.8 feet or the elevation of the surrounding ground water whichever is higher. By agreeing to the foregoing the City is not guaranteeing nor assuring in any manner that the water level of Markley Lake

will be controlled, or that a water level above 895.8 constitutes an invasion or taking of Plaintiff's property, and any alleged failure by the City or the County shall not constitute a basis for any claim for damages, inverse condemnation or any other claim against the City of the County, so long as the City and the county act in a manner consistent with this paragraph, and only a party acting in a manner inconsistent with this paragraph may be subject to such a claim.

5. Dismissal with Prejudice. Upon execution of the Agreement and the payment as set forth herein, the Plaintiffs shall execute and deliver to the City and the County dismissals with prejudice, attached hereto as Exhibit D.

6. Warranty and Recording. The Plaintiffs Wynn C. Sohler and Richard L. Wohler; and Thomas J. Stanley and Ann K. Stanley hereby represent and warrant to the City and the County that they are the lawful owners of the Property as set forth on Exhibits A and C; and have full authority to enter into this Agreement with respect to the Property owned by them, bind the property and are the only parties entitled to the compensation that is paid herein. The Plaintiffs David Pinke and Nancy Pinke, hereby represent and warrant to the City and the County that they did convey the Property as set forth on Exhibit B subject to the terms and conditions of the Stipulation and Settlement Agreement; that this Agreement may be recorded against the Property set forth in Exhibit B; and that with regard to said Property, they are the only parties entitled to compensation that is paid herein. Plaintiffs further acknowledge and understand that this Agreement will be recorded in Scott County with respect to each of the Properties set forth as Exhibits A, B and C and that they shall cooperate with the recording of this Agreement against each of their properties and execute other, if any, necessary documents to effectuate the recording. If they fail to cooperate, both or either the County and the City shall be entitled to a Court Order compelling their cooperation, or directly ordering recording, in which event the Plaintiffs shall reimburse the City or the County for their reasonable attorney's fees and costs incurred in such action.

7. Legal Advice. The Plaintiffs acknowledge and warrant that they have had the opportunity to consult with the legal counsel of their choosing with respect to this Agreement and its execution.

8. Merger. This agreement is the full and complete understanding of the parties, and any oral agreements, representations and negotiations are hereby merged into this Agreement.

9. No Admission of Liability. By executing this Agreement, neither the City nor the County is admitting any liability as to the claims alleged by the Plaintiffs, and specifically disclaim any liability. This is a settlement of a disputed claim between the parties and shall not be deemed, and is not, an admission of liability on the part of either the City or the County.

Dated: 5/28/04, 2001

Richard L. Sohler

Dated: 5/28/04, ~~2001~~ 2004

Wynn C. Sohler

STATE OF MINNESOTA)
) ss.
COUNTY OF SCOTT)

The foregoing instrument was acknowledged before me this 28th day of May, ~~2001~~ 2004, by Richard L. Sohler and Wynn C. Sohler, husband and wife.

Notary Public

Notary Public
Dated: 5-28-04, ~~2001~~

David Pinke

Dated: 5/28/04, ~~2001~~

Nancy Pinke

STATE OF MINNESOTA)
) ss.
COUNTY OF SCOTT)

The foregoing instrument was acknowledged before me this 28th day of May, ~~2001~~ 2004, by David Pinke and Nancy Pinke, husband and wife.

Notary Public

Dated: 5-28-2004, ~~2001~~

Thomas Stanley

Dated: 5/28/2004, 2001

Ann Stanley

STATE OF MINNESOTA)
) ss.
COUNTY OF SCOTT)

The foregoing instrument was acknowledged before me this 28th day of May, ~~2001~~ 2004, by Thomas Stanley and Ann Stanley, husband and wife.

Notary Public

APPENDIX D

2010 Markley Lake
Study,
(Includes 23 pages)

Memo

Stantec

To:	Ross Bintner, PE City of Prior Lake, MN	From:	Phillip Elkin, P.E.
File:	193800564	Date:	March 13, 2012

Reference: Markley Lake Compensatory Storage Plan

Summary

The following report is an addendum to the previously submitted Markley Lake Study. This document outlines recommended options to manage the High Water Level (HWL) and flood risk of Markey Lake as future development in the lake's watershed is realized. Until recently it was believed that the mitigation of flood storage would require costly land acquisition and/or reducing the size of development in future land use. Upon further analysis, it is the opinion of this report that implementing compensatory flood storage in undevelopable land will minimize the flood elevation of Markley Lake to the pre-development levels of 1991 without restricting future land use.

Management Options

There are 8 homes along the south shore of Markley Lake that were studied for flood risk due to their proximity to the land locked basin. The lowest home was surveyed at the elevation 899.8 and served as the reference point, or base line for establishing a HWL and risk potential.

The lowest property does not meet the City of Prior Lake or Scott County Watershed Management Organization (WMO) freeboard standards for structures adjacent to land locked basins. In addition, our stormwater modeling efforts showed that future land development, as outlined in the City of Prior Lake's 2030 Land Use Plan, increased the volume and high water levels of Markley Lake. This meant that any further development within the watershed would increase the flood risk to homes and increase the City's exposure to liability for damages. These findings left the City of Prior Lake with the choice of stifling future development or property acquisition to reducing the flood risk to meet flood protection standards.

In subsequent discussions on the present and future flood risks of this lake, the Scott County Water Management Organization (WMO) requested the City to complete a downstream analysis and plan to mitigate future stormwater runoff volumes as to not worsen the flood risk. With this direction, City Staff referred to the previously submitted Markley Lake Study to determine a reasonable level of protection. Using these modeling results of this report, the City of Prior Lake determined that the goal of a flood mitigation plan would be to provide flood protection equal to the hydrology conditions prior to the development of the Markley Lake watershed. These conditions are highlighted in **Table 4.** Based on the study, it was determined that when the Markley Lake watershed was primarily a agricultural land use and had a starting water elevation of 893.5, a runoff event with a 1% probability would result in a HWL of 896.5. This series of events was determined to have a 0.2% probability of occurring within any given year.

The goal of the City is to develop a mitigation plan in which a fully developed watershed will match the flood risk conditions of 1991. This meant developing a mitigation plan which could counter a net increase of 23.22 ac-ft of volume into Markley Lake as the result of increased stormwater runoff.

Table 4 – 2030 Conditions Modeling Results

Storm Event	Starting Water Level	Description of Starting Water Level vs. 2000 to 2006 Period of Record	Assumed probability of starting water level (%)	Probability of Design event (%)	Cumulative Probability of Design Event and Starting Water Level (%)	Recurrence of Cumulative Probability (yr)	Undeveloped Conditions calculated (1991) HWL	Existing Conditions calculated (2006) HWL	2030 Conditions calculated HWL
100-year	891.5	100% time above	100	1	1	100	895.5	895.8	895.8
100-year	**893.5**	20% time above	20	1	0.2	**500**	**896.5**	896.7	897.3
50-year	894	10% time above	10	2	0.2	500	896.5	896.7	897.2
"back-to-back" 100-year	891.5	100% time above	100	0.1	0.1	1,000	899.6	900	900.8

Selected Condition Highlighted

As mitigation options were discussed at the City, two undeveloped areas in the watershed began to receive serious efforts towards development. One plan proposed single family home developments in the landlocked areas of ML-6, ML-1a, and ML-1b and the second, initiated by the City, looks to develop an Office/industrial Park in the City's portion of drainage area ML-2 (**see Figure 5**). The plans submitted included information on existing conditions and developability of the lots which were previously unavailable. For example, detailed land contours revealed steep slopes, and restrictive land elevations which could not be developed for single family residential use. With this new information, City Staff began to explore the idea that compensatory flood storage for Markley Lake could be met by making small alterations to the stormwater facilities on these new developments.

Eagle Creek Estates

This proposed single family residential development is located in the landlocked sub-basins ML-6, ML-1and ML-1b shown in **Figure 4**. This area, which is directly north of Markley Lake, has three landlocked low areas with very permeable soils, ideal for use as infiltration basins. These areas are also at elevations accessible to receive stormwater runoff from the pond ML8-P1, which is the primary outlet for sub-catchment areas ML-9, ML10 and ML-5. Our analysis has determined that, during the 1% rainfall event, adding a diversion structure to ML8P-1 and routing the stormwater to the basin in ML-6 (D), with some overflow to basin E, would remove 13.50 ac-ft of volume from reaching Markley Lake and not impact the existing or proposed development surrounding the basin.

Utilizing this strategy, would also require the acquisition of 0.2 acres of drainage easement from properties adjacent to the basin.

Office Industrial Development off Welcome Avenue SE
The possibilities for compensatory flood storage in the development and re-development of the sub-catchment area ML-2 are more numerous than of the proposed Eagle Creek Estates. In this sub-catchment area there are at least 6 existing wetlands and basins which have the potential to provide temporary flood storage. Under current City requirements, the fully developed area ML-2 would be required to provide 1 inch of volume control over new impervious surface, which would ultimately remove 5.78 ac-ft of stormwater volume once fully developed. In addition, because of the large tracts of land to be developed at high density (75% impervious) the water treatment pond required by the existing rules would ultimately need to have a permanent pool of 27 ac-ft which requires a water quality pond with 6-7acres of surface area. Obtaining additional flood storage in this basin could be accomplished by installing an outlet designed to control runoff at both low and high lake levels and slightly increasing the overall pond foot print.

The goal of watershed reduction is 23.22 ac-ft. Assuming that 13.5 ac-ft of the volume can be mitigated through the single family developments north of the lake and 5.78 ac-ft would be infiltrated, the remaining 3.94 ac-ft of volume could be incorporated into the proposed stormwater pond on this development.

Conclusions and Recommendations
The previous completed risk assessment of the high water levels of Markley Lake determined that future development, even with Prior Lake's stormwater development standards, will increase the 1% HWL and flood risk. The most cost effective method of reducing the flood risk to predevelopment conditions is by providing compensatory flood storage in vacant land. Utilizing a strategy of constructing compensatory flood storage as part of new development stormwater management plans significantly reduces the cost of this goal by relatively minor adjustments to required stormwater management facilities.

While the proposed Eagle Creek development has the potential to provide relief to the flood elevation of Markley Lake, runoff from this area does not increase the flood risk. It is feasible to develop this area and delay the proposed diversion pipe. Conversely, the proposed pond and storage improvements of the Office/Industrial Park should either precede or coincide with its construction.

Recommendation 1 - Construct Outlet Pipe to ML-6 Basin.
Install gate valve and diversion pipe to the proposed Eagle Creek Estates development. During the 1% storm event, this gate will divert a volume of stormwater to Markley Lake which would otherwise result in a 0.5' increase in the lake's HWL. This 0.5' is critical when the lake level is at or above 893.5, and will push the flood elevation above the expected 896.5 level. Conversely, permanently redirecting this water could be detrimental to the normal lake elevation. The following described management plan is designed to both maintain normal water levels and to divert stormwater away from Markley during conditions where the lake is susceptible to flood elevations.

Estimated cost: $ 76,820

Gate Open Conditions
The following situations would warrant a diversion of stormwater:

- Markley Lake levels at or above 893.5
- High snow accumulation during winter months – *Large amounts of snow melt along with normal seasonal rainfall could result in fast occurring, high volume runoff conditions.*

Gate Closed Conditions
The following situations should not require a stormwater diversion:

- Markley Lake levels at or below 893.0
- After June 30th – *As previously mentioned in the Markley Lake report, the lake is most at risk of high water events in the early season between April-June.*

Recommendation 2 - Increase HWL Storage at City Industrial Park Pond
The industrial site should be developed to meet the volume control requirements of the City and the live storage capacity of the future stormwater pond should be expanded. These measures, in combination with the diversion pipe described in Recommendation 1, will result in restoring the expected flood elevation of Markley Lake to 896.5.

Estimated cost: $78,000

As discussed earlier there are a number of options at this site which can accomplish the stated HWL volume reduction goals. For the purposes of this report it will be assumed that the mitigation is accomplished by providing a storage area between the elevations of 893.5 and 896.5 over a surface area of 1.5 acres and would require a specialized outlet. It is also assumed that this mitigation would occur simultaneously with the construction of a regional pond as part of future development. The above cost estimate represents the additional space and outlet structure which would normally not be required of a development of this size.

Stantec

PRELIMINARY ENGINEER'S ESTIMATE
COMPENSATORY STORAGE MANAGEMENT COST ESTIMATE
CITY OF PRIOR LAKE
March 6, 2012

No.	Item	Units	Estimated Qty	Unit Price	Total Price
	STORM SEWER -EAGLE CREEK ESTATES DIVERSION				
1	MOBILIZATION	LS	1	$3,000.00	$3,000.00
2	CONNECT TO EXISTING MANHOLE	EA	1	$1,500.00	$1,500.00
4	18" RCP STORM SEWER, CLASS 5, 0' -10' DEEP	LF	700	$26.00	$18,200.00
5	24" RCP STORM SEWER, CLASS 4, 0' -10' DEEP	LF	840	$45.00	$37,800.00
6	4' DIA STORM SEWER MH, 8' DEEP	EA	2	$1,800.00	$3,600.00
7	18-24" RCP FLARED END SECTION	EA	4	$1,000.00	$4,000.00
8	STORM DRAIN INLET PROTECTION PER STANDARD DETAIL ERO-4A	EA	4	$125.00	$500.00
16	SILT FENCE, HEAVY DUTY	LF	125	$1.75	$218.75
9	SEEDING, INCL SEED, MULCH AND DISK ANCHOR	AC	1	$2,000.00	$2,000.00
20	EASMENT ACQUISITION	AC	0.2	$30,000.00	$6,000.00
	TOTAL - STORM SEWER				$76,818.75
	STORM SEWER -INDUSTRIAL PARK POND				
1	DESIGN CONTINGENCY COSTS	LS	1	$15,000.00	$15,000.00
2	CUSTOM STORM SEWER OUTLET	EA	1	$18,000.00	$18,000.00
3	EASMENT ACQUISITION	AC	1.5	$30,000.00	$45,000.00
	TOTAL - STORM SEWER				$78,000.00

Memo

Stantec

To:	Peter Young, PE City of Prior Lake, MN	From:	Phillip Elkin, P.E.
File:	193802253	Date:	December 12, 2012

Reference: Markley Lake Compensatory Storage Plan – December 2012 Update

Summary

The following memo is the second addendum submitted as part of the 2010 Markley Lake Study. While the second memo outlined options the City could implement along with new construction projects, this memo focuses on possible limits and restrictions that have arisen as more information has been revealed in the development areas. This memo documents the changes which impact the viability and feasibility of the changes proposed in the March 2012 update.

The initial study had predicted high water elevations of Markley Lake assuming full development of contributing watershed under the planned land uses. The target elevation was determined by an assumed starting elevation and rainfall event summarized in the following table:

Table 1 – 2030 Conditions Modeling Results

Storm Event	Starting Water Level	Assumed probability of starting water level (%)	Cumulative Probability of Design Event and Starting Water Level (%)	Recurrence of Cumulative Probability (yr)	Undeveloped Conditions calculated (1991) HWL	Existing Conditions calculated (2006) HWL	2030 Conditions calculated HWL
100-year	891.5	100	1	100	895.5	895.8	895.8
100-year	**893.5**	20	0.2	**500**	**896.5**	896.7	897.3
50-year	894	10	0.2	500	896.5	896.7	897.2
"back-to-back" 100-year	891.5	100	0.1	1,000	899.6	900	900.8

Once the original report was submitted, the City of Prior Lake determined that the 1991 conditions with a starting lake elevation of 893.5 represented a fair and reasonable level of protection and decided that obtaining drainage easements to the 1991 level met the floodplain requirements of the City and Scott County Water Management Organization (WMO).

The March 2012 update was written as a result of three potential development projects which were in various stages of review by the City. Two were single family residential developments on the north edge of the watershed and the third involved the office-industrial property located on the southeastern edge of the watershed.

This update outlined a plan to reduce the 2030 HWL of Markley Lake by diverting flows west of Eagle Creek Avenue and by excavating shoreline areas to provide additional live storage areas. Using these measures each of the contributing watersheds would be able to develop to their full extent without increasing the HWL beyond the 896.5 elevation and without the need of purchasing additional drainage easements.

The recommendations presented in the March update were tied to three assumptions; One, the northern areas of the watershed have very permeable soils which could be used to mitigate volume from west of Eagle Creek Avenue SE. Secondly, that all new development would be subject to volume control and stormwater management rules more stringent than when the first study was conducted and finally, the volume of Markley Lake had been accurately calculated using the best contour data available.

December 2012 Update
Since the March 2012 update, more information has been gathered about the developable areas which has triggered the need to revisit the mitigation plan.

Significant changes include;

1) The storage area planned in Eagle Creek Estates has been determined to be a wetland and per the Wetland Conservation Act (WCA) has limits in its use as a storage area.
2) The Office Industrial Site off of Welcome Avenue was determined to be within the City's Wellhead Protection Area, where infiltrating stormwater runoff is discouraged because of the direct connection to the City's drinking water supply
3) The City has obtained more accurate contour information in which to determine the storage capacity of Markley Lake.

Using this new information, the conditions outlined in the original report were amended to determine both the new target HWL and the storage mitigation needed to lower the HWL in ultimate build out conditions. In addition to adding the increased storage capacity of the lake, the model also increased the impervious surface planned form the office/industrial site from 40% to 60% in order to accurately depict the increased volume expected. The following table outlines the new target elevations:

Table 2 – Revised Target 2030 Conditions

Storm Event	Starting Water Level	Assumed probability of starting water level (%)	Cumulative Probability of Design Event and Starting Water Level (%)	Recurrence of Cumulative Probability (yr)	**REVISED** Undeveloped Conditions calculated (1991) HWL	**REVISED** Existing Conditions calculated (2006) HWL	**REVISED** 2030 Conditions calculated HWL
100-year	**893.5**	20	0.2	**500**	**896.67**	**896.46**	**897.3**

Additional modeling showed that the target HWL of **896.5** was feasible to meet under fully developed conditions if an additional **20 ac-ft** of storage capacity was provided between the 894 and 898 contours. For the purposes of this memo the area was modeled as an additional 5 acre perimeter on the 894,895,896, 897 and 898 contours.

Reference: Markley Lake Compensatory Storage Plan – December 2012 Update

Conclusions and Recommendations

The findings of this update support the findings of the March memo, that the level of flood protection can be minimized to 1991 levels by creating approximately 20 ac-ft of compensatory storage below 896.5 elevation. This finding is solely based on providing the extended storage and not based on the availability of land. There are two locations where the expansion is feasible which were identified in the original report; along the southwestern shoreline where drainage from areas west of Eagle Creek Avenue discharge and in the middle of the south shore were runoff from the future office/industrial site discharges.

While protection of the structures on Markley Lake was the driving component of this initial study, it is also important to the City of Prior Lake to maximize the density of the office/industrial park off Welcome Avenue SE. Therefore it is our opinion that the City of Prior Lake take the following actions to meet the freeboard requirements of structures on Markley Lake:

- **Create Compensatory Storage** by utilizing existing easements, creating new storage areas with new development or secure new shoreline areas which can be excavated for additional storage.

- **Use the Wetland in Eagle Creek Estates** – Even though this area has been identified as wetland, this still remains a viable option for the City as a cost effective way of managing flood levels of Markley Lake. The Wetland Conservation Act would allow for the use of a wetland as an emergency storage area, since the City is not creating a deep water habitat or getting credit for creating a wetland.

- **Purchase Additional Drainage Utility Easements** – Based on the obstacles outlined in this memo and the availability of land near the lake, this action may be necessary to meet the Scott County WMO's freeboard standards.

Please feel free to call me with any questions.

STANTEC CONSULTING SERVICES INC.

Phillip Elkin, PE
Senior Project Manager
Phillip.Elkin@stantec.com

Markley Lake Study

City of Prior Lake

March 2010

Project Number 000566-08121-0

Bonestroo

2335 Highway 36 W
St. Paul, MN 55113
Tel 651-636-4600
Fax 651-636-1311
www.bonestroo.com

Bonestroo

March 9, 2010

Honorable Mayor and City Council
City of Prior Lake
16200 Eagle Creek Avenue Southeast
Prior Lake, MN 55372-1714

Re: Markley Lake Study
Bonestroo File No.: 566-08121

Dear Mayor and Council:

Please find the attached report outlining our assessment of the Markley Lake watershed. This report is our assessment of the potential flooding behavior of Markley Lake during both typical annual rainfall events as well as during extreme storm and runoff events. It is the intent that this study act as an important tool in implementing management practices to alleviate flooding and guiding future development.

Please feel free to call us with any questions regarding this document or stormwater management in the Markley Lake watershed.

Sincerely,

BONESTROO

Phillip A. Elkin, PE
Project Manager

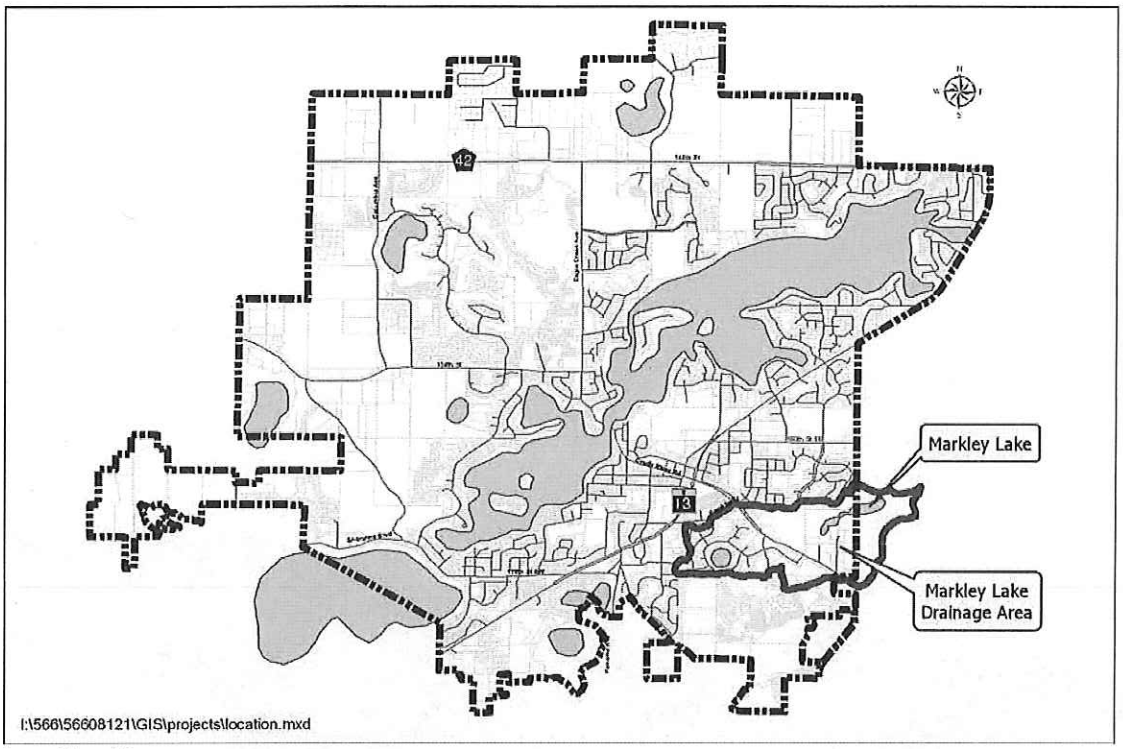
Earth Evans
Project Engineer

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Earth Evans, PE
Date: March 9, 2010 Reg. No.: 44235

Background

Markley Lake (DNR ID# 70-0021) straddles the City of Prior Lake's southeast boundary, as shown below.



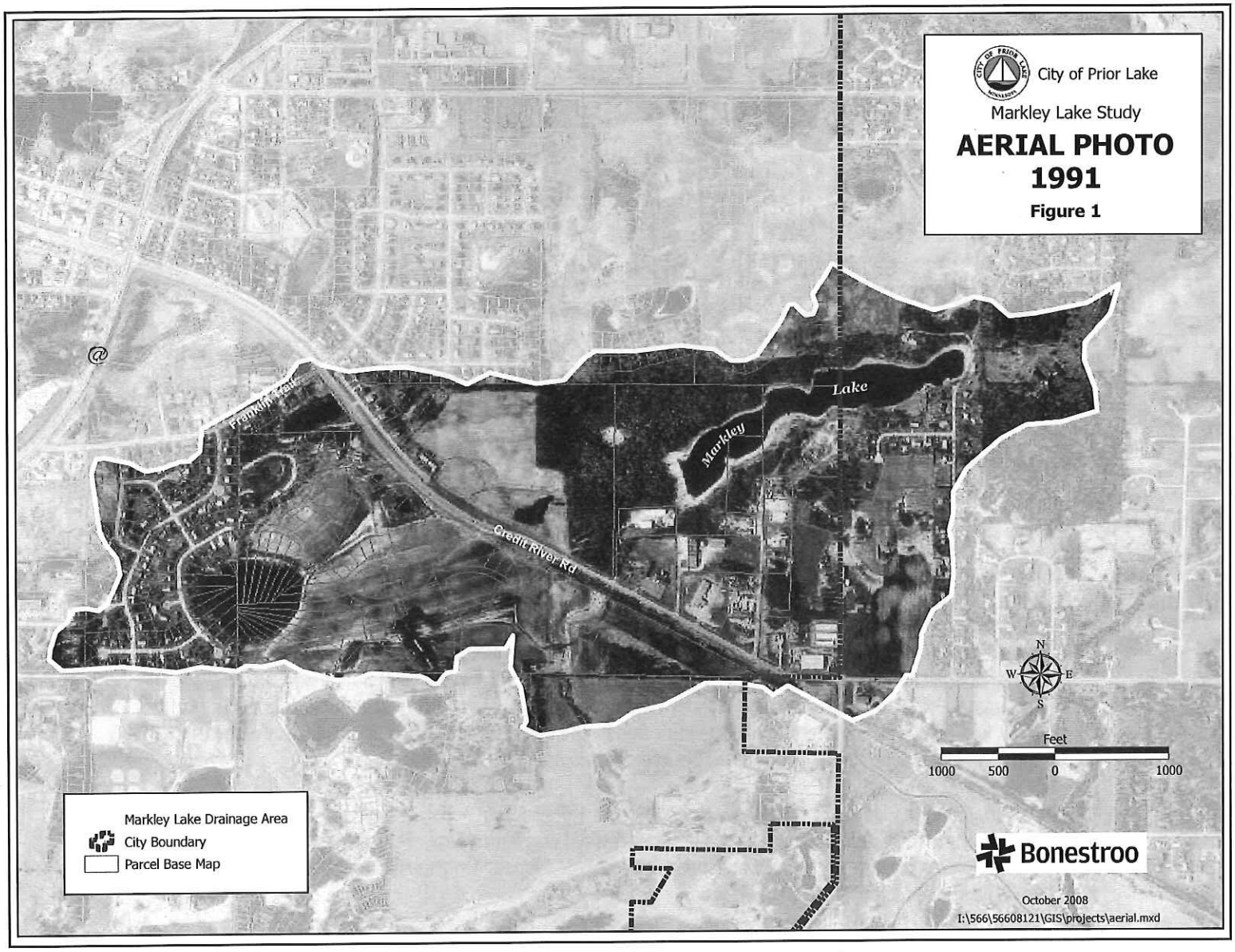
Location Map

The lake is naturally landlocked with no outlet. Runoff that reaches the lake either infiltrates or evaporates. Consequently, the lake's water level fluctuates with changes in annual runoff volume and seasonal groundwater level. Wide fluctuations in water levels have historically been a concern. For instance, high water conditions in 1998 and 1999 caused the City of Prior Lake to attempt to pump down the lake to reduce its water level out of concern for potential flooding of homes around the lake. At present 8 homes lie around the lake's southeast perimeter. Six homes on Birch Road lie above elevation 930. Two homes on Whitewood Avenue lie at 899.8 (surveyed elevation) and approximately 902. In comparison, the Markley Lake ordinary high water (OHW) elevation is 893.2. The OHW constitutes the elevation below which the lake is protected by the Minnesota Department of Natural Resources (DNR) and is generally considered the boundary between upland area and lake area.

Development around Markley Lake is relatively recent. Figure 1 provides an aerial view of the Markley Lake subwatershed from 1991 when the majority of the subwatershed was agricultural. Figure 3 at the back of this report shows that the majority of the subwatershed is currently developed. Only the eastern portion of ML-2 and ML-1, 1a, 1b and 6 remain undeveloped.

Figure 2 provides the City of Prior Lake's 2030 guided land use for the area around Markley Lake. According to this plan, land around the lake ultimately develops into low density residential, industrial and business park uses. There are limitations to developability, though, in that the steep slopes of drainage areas of ML-1, 1a, 1b and 6 probably limit development potential within these areas.

INSERT FIGURE 1 – 1991 Aerial


City of Prior Lake
Markley Lake Study
AERIAL PHOTO
1991
Figure 1
Franklin Ave
Credit River Rd
Markley
Lake
N
W
E
S
Feet
1000
500
0
1000
Markley Lake Drainage Area
City Boundary
Parcel Base Map
Bonestroo
October 2008
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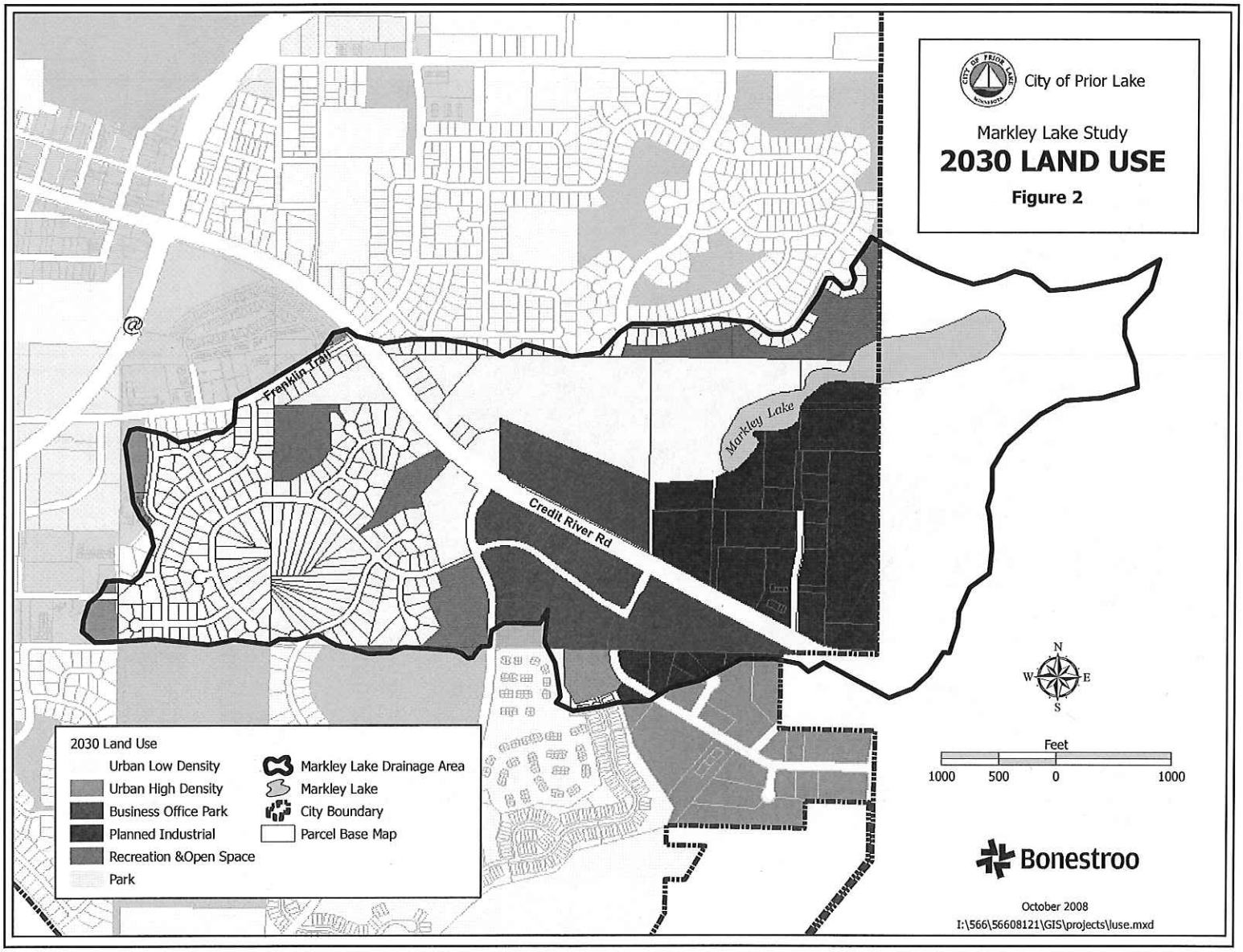
City of Prior Lake
Markley Lake Study
2030 LAND USE
Figure 2
Franklin Trail
Credit River Rd
Markley Lake
2030 Land Use
Urban Low Density
Urban High Density
Business Office Park
Planned Industrial
Recreation &Open Space
Park
Markley Lake Drainage Area
Markley Lake
City Boundary
Parcel Base Map
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Bonestroo
October 2008
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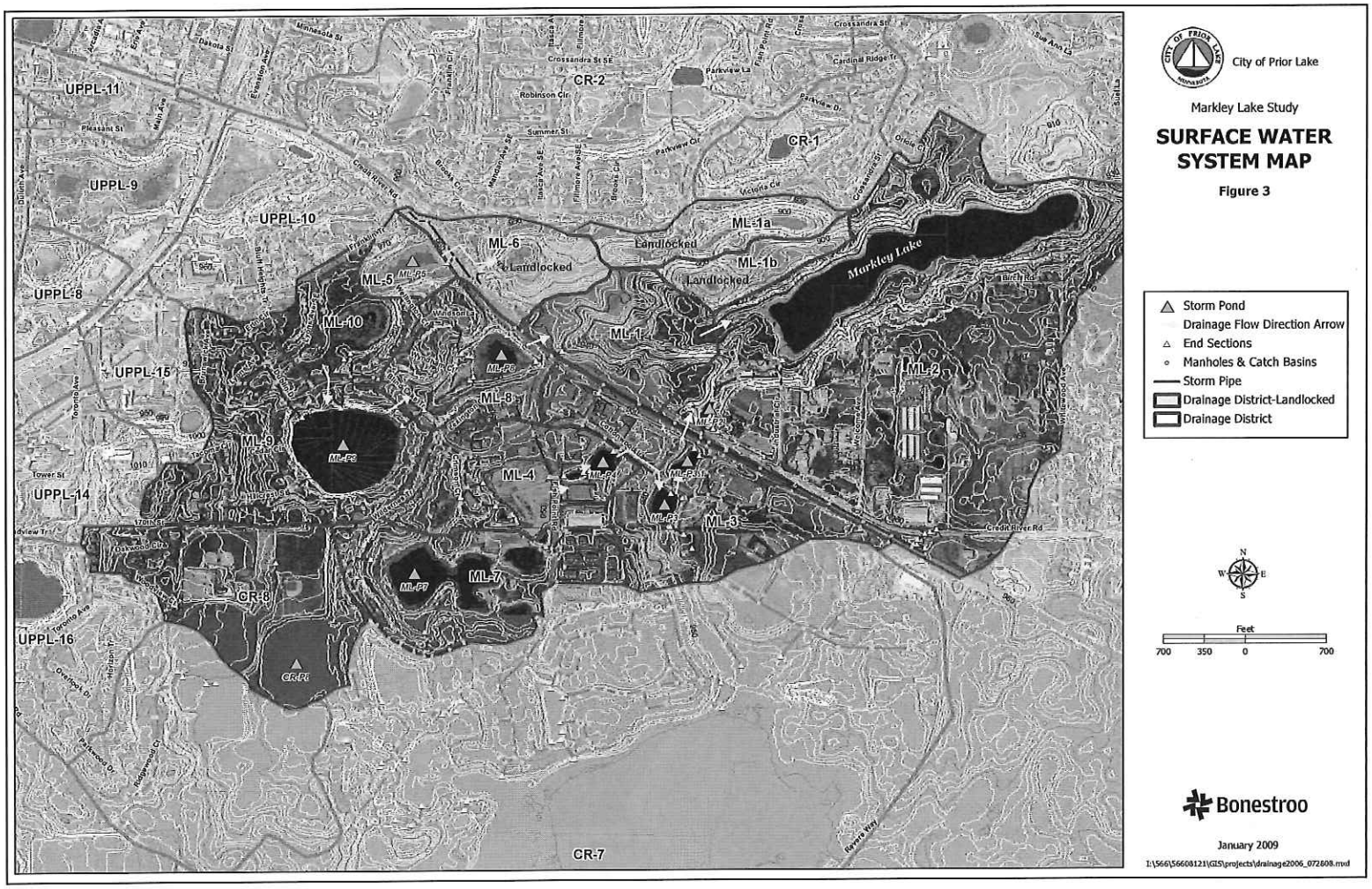

City of Prior Lake
Markley Lake Study
SURFACE WATER SYSTEM MAP
Figure 3
Storm Pond
Drainage Flow Direction Arrow
End Sections
Manholes & Catch Basins
Storm Pipe
Drainage District-Landlocked
Drainage District
Feet
700 350 0 700
Bonestroo
January 2009
I:\566\56608121\GIS\projects\drainage2006_072808.mxd
UPPL-11
UPPL-9
UPPL-10
UPPL-8
UPPL-15
UPPL-14
UPPL-16
CR-1
CR-2
CR-7
CR-8
ML-1
ML-1a
ML-1b
ML-2
ML-3
ML-4
ML-5
ML-6
ML-7
ML-8
ML-9
ML-10
Landlocked
Markley Lake
Crossandra St SE
Robinson Cir
Summer St
Parkview Dr
Parkview Cir
Victoria Cir
Cardinal Ridge Tr
Crossandra St
Pleasant St
Minnesota St
Dakota St
Creek River Rd
Tower St
Birch Rd

Past development has increased the runoff generated from the lake's subwatershed. The City of Prior Lake has partially mitigated this increased runoff by re-routing a portion of this drainage away from the lake. In the early 2000's a portion of Markley Lake drainage was diverted via a control structure between ML-P7 and ML-P4 on the southern boundary of the study area. This disconnected approximately 100 acres, the entirety of ML-7 and CR-8 from Markley Lake and rerouted these areas to a large wetland adjacent to Cleary Lake. Based on modeling, rerouting the 100 acres results in a 100-year high water level roughly 0.3 feet higher for existing (2006) conditions in comparison to 1991 when the lake's watershed was largely undeveloped. Future development in the eastern portion of ML-2, though limited, will slightly increase the runoff volume discharged to the lake over current conditions. Development in drainage areas ML-1, 1a, 1b and 6 however, should have little or no impact since each of these areas will remain landlocked in the developed condition.

The variable water levels and potential for redevelopment and development within the area tributary to the lake prompted the City to develop this stormwater management plan for Markley Lake.

This stormwater management plan includes:

- analysis of the existing conditions drainage patterns to the lake,
- calibration of a stormwater model based on the City's lake monitoring data,
- development of a proposed 2030 conditions model

Markley Lake is approximately 22 acres in size with a maximum depth of 22 feet. The characteristic feature of Markley Lake is its steep, heavily wooded slopes.

The existing (2006) tributary area to Markley Lake is approximately 434 acres. The existing land use northeast of County State Aid Highway 21 (CSAH 21) includes a partially developed industrial/business park on the lake's south side and undeveloped woods and agricultural land on the lake's north side. The majority of the area southwest of CSAH 21 is fully developed, consisting of business park along Adelmann Street and Cottonwood Lane and low density residential west of Fish Point Road. Figure 3 shows the drainage areas and 2006 aerial photograph that were used for generating impervious coverage in the hydrologic modeling performed for this study. Each area is labeled according to the City's Local Surface Water Management Plan (LSMWP) nomenclature with "ML" designating areas tributary to Markley Lake. Area ML-7 is naturally tributary to Credit River and not Markley Lake but the "ML" designation is still used to maintain consistency with LSWMP nomenclature.

The general drainage pattern is from the southwest to the northeast to Markley Lake. As mentioned above, a portion of Markley Lake drainage was diverted via a control structure between ML-P7 and ML-P4 on the southern boundary of the study area. This disconnected approximately 100 acres in ML-7 and CR-8 from Markley Lake and rerouted this area to a large wetland adjacent to Cleary Lake. Generally, existing wetlands and ponds in the developed portions of the watershed are interconnected by storm sewer. Districts ML-6, ML-1a and ML-1b are all currently landlocked.

Rainfall data is available from the Minnesota Climatology Working Group (DNR Waters) for Shakopee station 217580. The City of Prior Lake and the Department of Natural Resources (DNR) have been collecting lake level data for Markley Lake since 1996. This data was utilized for calibrating the hydrologic model.

The most prominent hydrologic soil group in the Markley Lake subwatershed is group B as shown on Figure 4. The soils designations on Figure 4 are based on the Scott County Soil Survey. The four hydrologic soil groups – A, B, C, and D – describe a soil's ability to infiltrate runoff. Group A soils infiltrate rapidly while group D soils hardly infiltrate at all. Soil group B in the Markley Lake subwatershed indicates moderate soil infiltration capacity. Areas surrounding the wetlands in ML-4, ML-8 and ML-9 are group B/D. This means that these soils do not infiltrate at all when saturated (hence the D designation). When moderately dry, however, they have moderate infiltration potential

as indicated by the B designation. Since the hydrologic analysis of Markley Lake considers longer rainfall periods and thus closely approximates average hydrologic conditions, the soils within the Markley Lake drainage areas were modeled in the group B condition reflective of average soil moisture conditions.

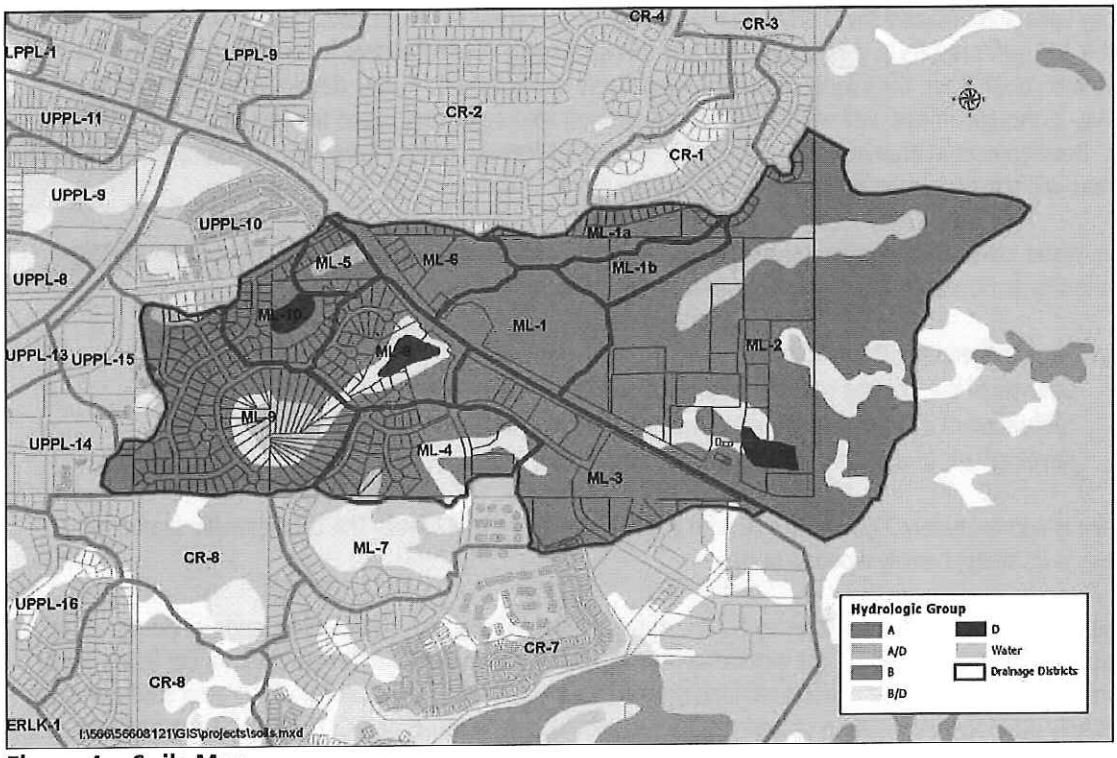


Figure 4 – Soils Map

Analysis

EXISTING CONDITIONS

To effectively measure response Markley Lake's response to historical rainfall periods under current subwatershed conditions, it is necessary to model the existing subwatershed using continuous modeling techniques, which approximate the lake's response to hydrologic conditions measured in daily time steps. The model can then be used as a planning tool to investigate management options. As part of this investigation, specific rainfall events, measured in sub-hourly time steps, can then be used to calculate the lake response to flood events using the model calibrated to historical rainfall periods.

Three continuous simulation models were developed for the years 1999, 2000 and 2006 and calibrated to the City's lake level monitoring data. These years were chosen based on the number of lake level readings, availability of land use data, and to represent major subwatershed changes. The year 1999 represents a wet year with several large rain events in May and the year 2000 data reflects a fairly dry year. In 1999 and 2000, districts ML-7 and CR-8 were still tributary to Markley Lake as described earlier. The tributary watershed was 534 acres as shown on Figure 1 versus the 434 acres in 2006, shown on Figure 3. The residential area surrounding Blind Lake Trail in ML-9 was developed in 2000, but much of ML-8 and ML-10 weren't yet developed. Impervious percentages in the model were determined by delineating the existing impervious in each drainage area. Table 1 lists the primary variations between each modeled year.

Table 1 – Existing Conditions Model Variations

Year	Watershed Characteristics	Land Use	Precipitation
1999	Drainage Area = 534 acres, includes ML-7 and CR-8 (Figure 1)	Majority of ML-3, ML-4, ML-8 and ML-10 undeveloped	Wet year
2000			Dry year
2006	Drainage Area = 434 acres (Figure 3)	Development as shown on Figure 3	Average year

Model Calibration

The City's surface water system was modeled in XP-SWMM software for the 2005 Local Surface Water Management Plan. This model included the Markley Lake area and Markley Lake itself. This model was utilized as the basis for developing the more detailed modeling for this study.

There are three primary parameters that were adjusted in the model to calibrate it with the monitored lake levels.

- Evaporation
- Infiltration in Markley Lake
- Infiltration on the land tributary to the lake

Evaporation estimates were made based on pan results from shallow lakes and reservoirs for Minnesota. These values range from 0.35 inches in January to six inches in July for Scott County. Twin Cities mean annual lake evaporation is about 30.5 inches per year. Typically, evaporation rates are the only seasonally adjusted parameter in continuous simulation. However, as the Markley Lake calibration showed it was also necessary to consider seasonal variation in runoff coefficient (infiltration on the tributary area). The other parameters are constant regardless of the season. Evaporation was modeled for the entire Markley Lake watershed, including the upstream waterbodies.

Once runoff reaches Markley Lake, evaporation and infiltration represent the only means for Markley Lake to rid itself of water. For infiltration within the lake two assumptions were made:

1. Below the OHW the lake is essentially sealed or of such a low infiltration capacity as to render infiltration negligible over the continuous modeling time frame (when compared to evaporation).
2. Above the OHW infiltration occurs in the lake's side slopes, according to the infiltration rates generally used for hydrologic soil group B soils.

Accordingly, an infiltration rate of 0.4 inches/hour was utilized in the model for the lake side slopes. This rate also generally coincides with calculations derived from the City's lake level monitoring during dry periods. A soil infiltration rate of 0.4 inches/hour is considered conservative for group B soils.

The final parameter used to calibrate the model to the monitored lake levels is the actual amount of infiltration that occurs within the subwatershed. This parameter is perhaps the hardest to accurately determine and adjust without detailed monitoring of flows within the entire subwatershed. Landscape infiltration assumptions determine how much runoff is generated for a given rainfall. Generally, where storm sewer connections exist this runoff is delivered to Markley Lake.

The soils in the Markley Lake subwatershed are generally hydrologic soil group B, characterized as moderately well drained. The method used to mimic watershed infiltration in the XP-SWMM model is to adjust Horton infiltration parameters within each of the lake's drainage areas. The maximum infiltration rate of four inches/hour was used with a decay rate of 0.00083 inches per hour per second. The decay rate reflects both the rate of decrease in the infiltration capacity due to soil wetting and the ability of the soils to dry out after a rain event. This decay rate is within the range of reported values based on XP-SWMM literature. These adjusted Horton parameters produced a runoff coefficient of 0.2 for the continuous simulation, which generally is representative of the impervious coverage

of the watershed for small storm events. The other Horton infiltration parameters were not manipulated from typical reference values.

In summary, the parameters used in the modeling are listed in Table 2.

Table 2 – Modeling Parameters

Parameter	Method
Evaporation	Pan values for Scott County
Infiltration In-lake	0.4 in/hr
Infiltration in watershed	Decay rate = 0.00083/sec Maximum infiltration rate = 4 in/hr

EXISTING CONDITIONS RESULTS

The existing conditions hydrologic models were run from ice out in early April through mid-July. Typically the most significant rainfall events occurred in this time period and historically the lake levels have been highest through the early season. For all monitored years there has been a decrease in the lake level after mid-June (except in 1997 when several large events occurred late season). Chart 1 shows the variations in seasonal lake levels for the period of record based on monitoring. Chart 2 combines the separate annual monitoring levels into one continuous picture of lake level for the years between 1995 and 2006. Note that after 2000, the lake levels fall slightly.

Chart 1 – Seasonal Markley Lake Levels

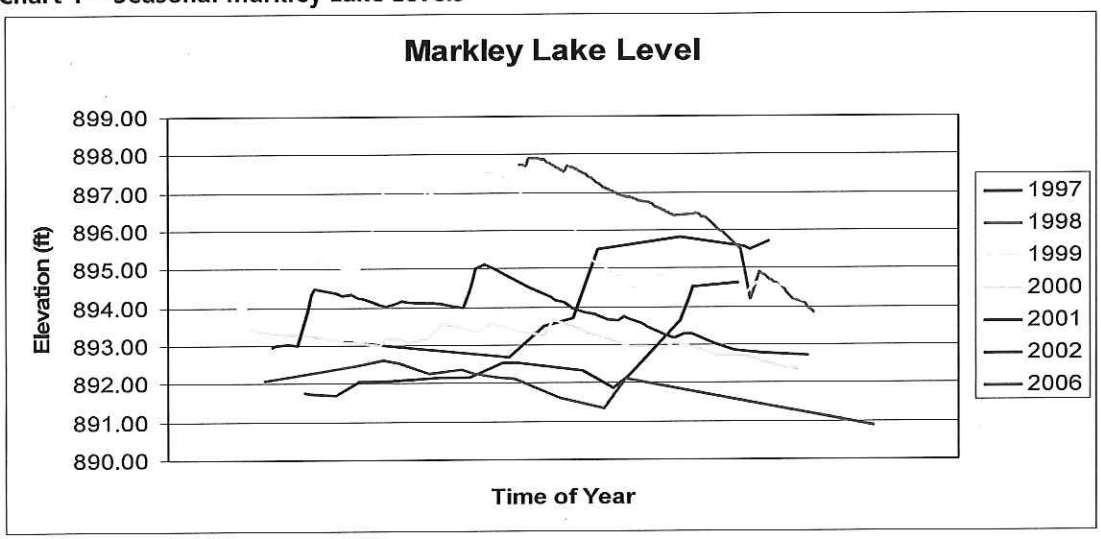
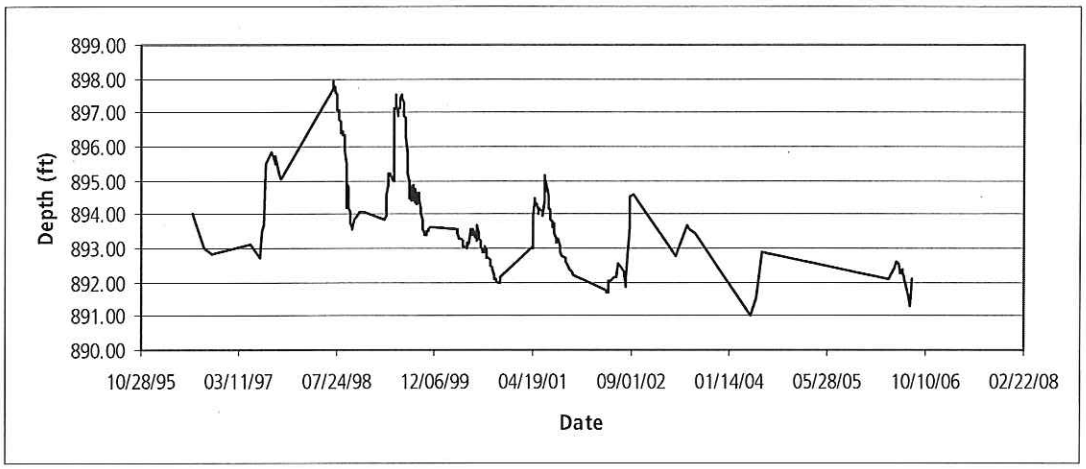


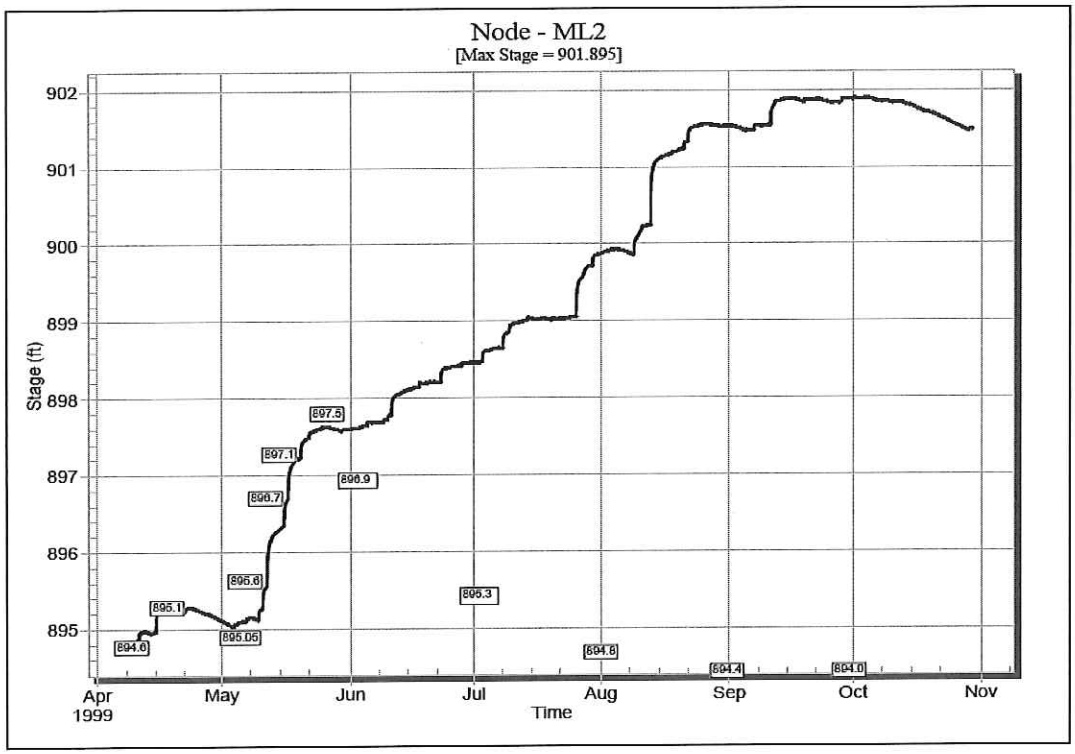
Chart 2 – Annual Markley Lake Levels



Hydrologic modeling simulations were run for the years 1999, 2000 and 2006 and the results for these models matched well with monitored levels through mid June. However, the model results and monitoring data diverged in all modeled years after mid June. The modeling parameters summarized in table 2 were kept constant in all three existing conditions simulations and only the connectedness, land use and starting water level in Markley Lake were changed. Charts 3 through 5 compare modeled Markley Lake elevations to those monitored. The monitored lake levels are shown in the yellow boxes, while the continuous model results show as the blue line.

Chart 3 shows the comparison of 1999 monitored to modeled water levels from April through November. Model results fit monitoring data through late June after which the modeled water elevation keeps rising while the monitored water elevation falls. Similar divergence between late season monitoring and model results were also seen in 2000 and 2006. However, charts 4 and 5 for these years only present the better calibrated early season comparison.

Chart 3 – 1999 Model Results



The full season comparison of monitored water levels versus those modeled reflects a hydrologic reality that cannot be captured in a single, continuous model run. Namely, in late June Markley Lake's water level has historically fallen even when rainfall does not significantly abate. The comparisons show that the model calculates rising Markley Lake water levels due to mid and late summer rains while the reality is lake levels are falling. As the rainfall season progresses from early spring to later summer actual runoff coefficients fall from a spring coefficient of 0.2 to approximately zero late in the summer. Under these conditions only large, rare late season storms create runoff that enters Markley Lake. Rather than calibrate models to both early and late season hydrologic conditions, it was decided that early season runoff conditions presented the most risk of rising Markley Lake water levels. Consequently, early season hydrology was used for the existing conditions calibration and the subsequent analysis of 2030 conditions flooding.

Chart 4 – 2000 Model Results

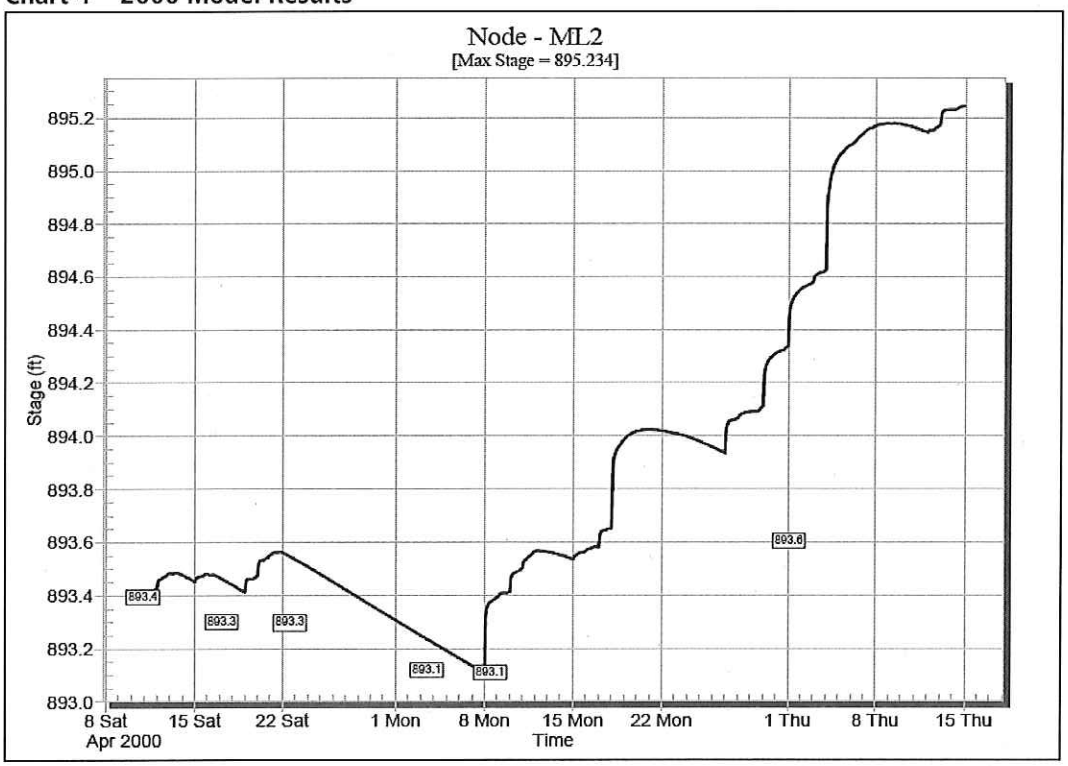
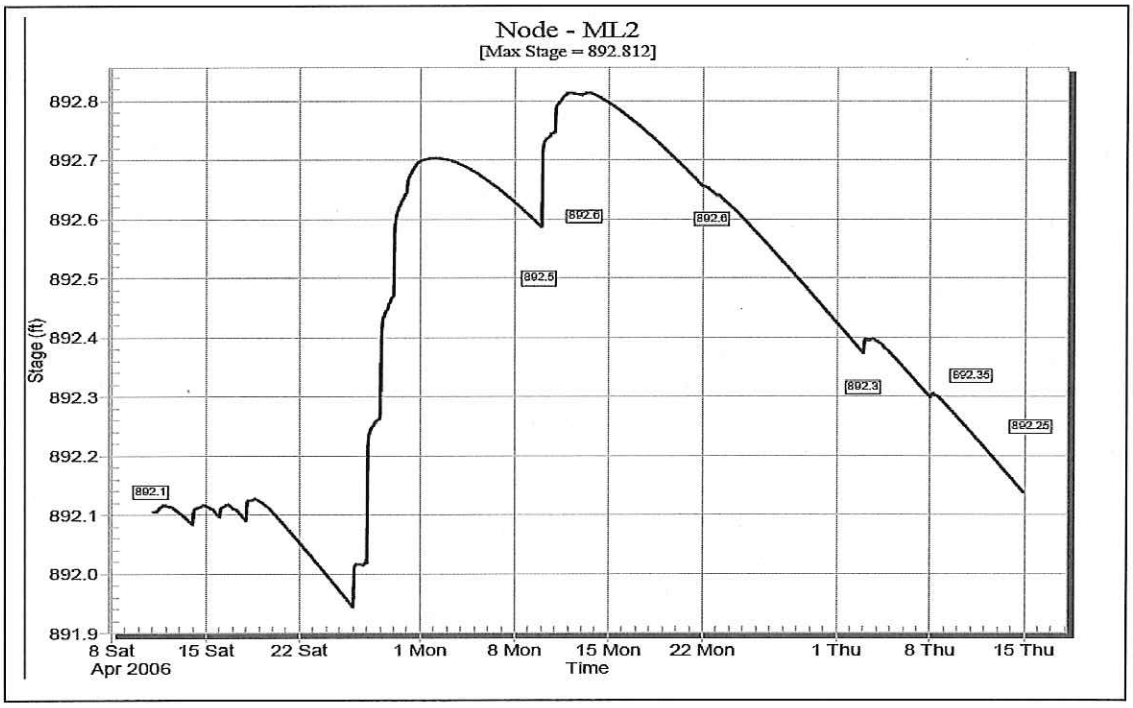


Chart 5 – 2006 Model Results



2030 MODELING

Having established the baseline conditions through continuous modeling and correlated the continuous simulation to gage readings, the next step was to update the models to incorporate the 2030 Land Use Plan. Figure 2 shows the proposed land uses within the Markley Lake subwatershed. The primary changes in land use occur south of Markley Lake in the industrial park north of CSAH 21 and in drainage areas ML-6, 1, 1a and 1b. It was assumed that the area east of the Prior Lake city limits also develops as industrial. It was assumed that the depressions in ML-6, ML-1a, ML-1b remain landlocked for proposed conditions. This assumption was based on several factors: low density residential is proposed in the three sub-districts, with low impervious coverage and lower runoff generated, the steep slopes surrounding these basins would limit development and the existing storage available in the basins makes it unlikely that they would need to be connected via storm sewer.

Another key factor to consider for 2030 conditions is the starting water level of Markley Lake as this has a significant effect on the high water level (HWL) calculated by the hydrologic model. A broad range of probable starting water levels were collected, based on Department of Natural Resources (DNR) data and City monitoring for the period of record (1997-2006). Chart 1 shows the history of monitored water levels in Markley Lake. From Chart 1 a rough probability of the lake being above a certain level can be determined. Table 3 presents the probable elevations as well as other recorded or determined water levels.

Table 3 – Probable Starting Water Level

	Water Level
DNR OHW	893.2
Highest recorded (DNR and City data 7/6/98)	897.9
10% time above	894.0
20% time above	893.5
100% time above	891.5

The table 3 water levels are based on the 2000 to 2006 period of record since 100 acres were diverted from Markley Lake in 1999. The 10%, 20% and 100% "time above" lake levels represent the percentage of time that the lake level is at or above that elevation based on the monitoring data in Chart 1 for years 2000-2006. These years represent slightly wetter (12.2 inches) than average conditions for the April-June evaluation period in comparison to the 37-year history of rainfall data (10.7 inches) from the Minnesota Climatology Working Group. Therefore the lake levels are somewhat conservative but they do generally align with probable lake levels determined through a best fit curve analysis utilizing an expanded 37-year history of rainfall data.

Markley Lake normally fluctuates between 891 and 895. Moderate to large runoff events have caused the lake to "bounce" temporarily as high as 897.9. Chart 1 shows that the large rain event that produced the highest recorded elevation in 1998 did not generate a significant increase in the long term base elevation of the lake. Rather, the base elevation has decreased over time.

The Markley Lake starting elevations are considered conservative due to the wet season conditions for the 2000-2006 period and due to assumptions in the upstream watershed. The upstream basins tributary to Markley Lake are assumed to be starting at their normal water elevation (outlet elevation) prior to any rain events. Therefore no infiltration is assumed to be occurring in the upstream waterbodies to draw the water level below the outlet elevation, although this has been observed by City staff. Any runoff that discharges to the waterbodies would immediately discharge downstream to Markley Lake.

A matrix of modeled HWLs was developed for four combinations of design storm and starting water level. As with a rainfall event, each combination of rainfall event and starting water level can be considered in terms of a recurrence period, measurable in years. High water levels for 1991 are included for comparison when the watershed was primarily agricultural. The storm events modeled were for the 24-hour recurrence probability.

Table 4 – 2030 Conditions Modeling Results

Storm Event	Starting Water Level	Description of Starting Water Level vs. 2000 to 2006 Period of Record	Assumed probability of starting water level (%)	Probability of Design event (%)	Cumulative Probability of Design Event and Starting Water Level (%)	Recurrence of Cumulative Probability (yr)	Undeveloped Conditions calculated (1991) HWL	Existing Conditions calculated (2006) HWL	2030 Conditions calculated HWL
100-year	891.5	100% time above	100	1	1	100	895.5	895.8	895.8
100-year	893.5	20% time above	20	1	0.2	500	896.5	896.7	897.3
50-year	894.0	10% time above	10	2	0.2	500	896.5	896.7	897.2
"back-to-back" 100-year	891.5	100% time above	100	0.1	0.1	1,000	899.6	900.0	900.8

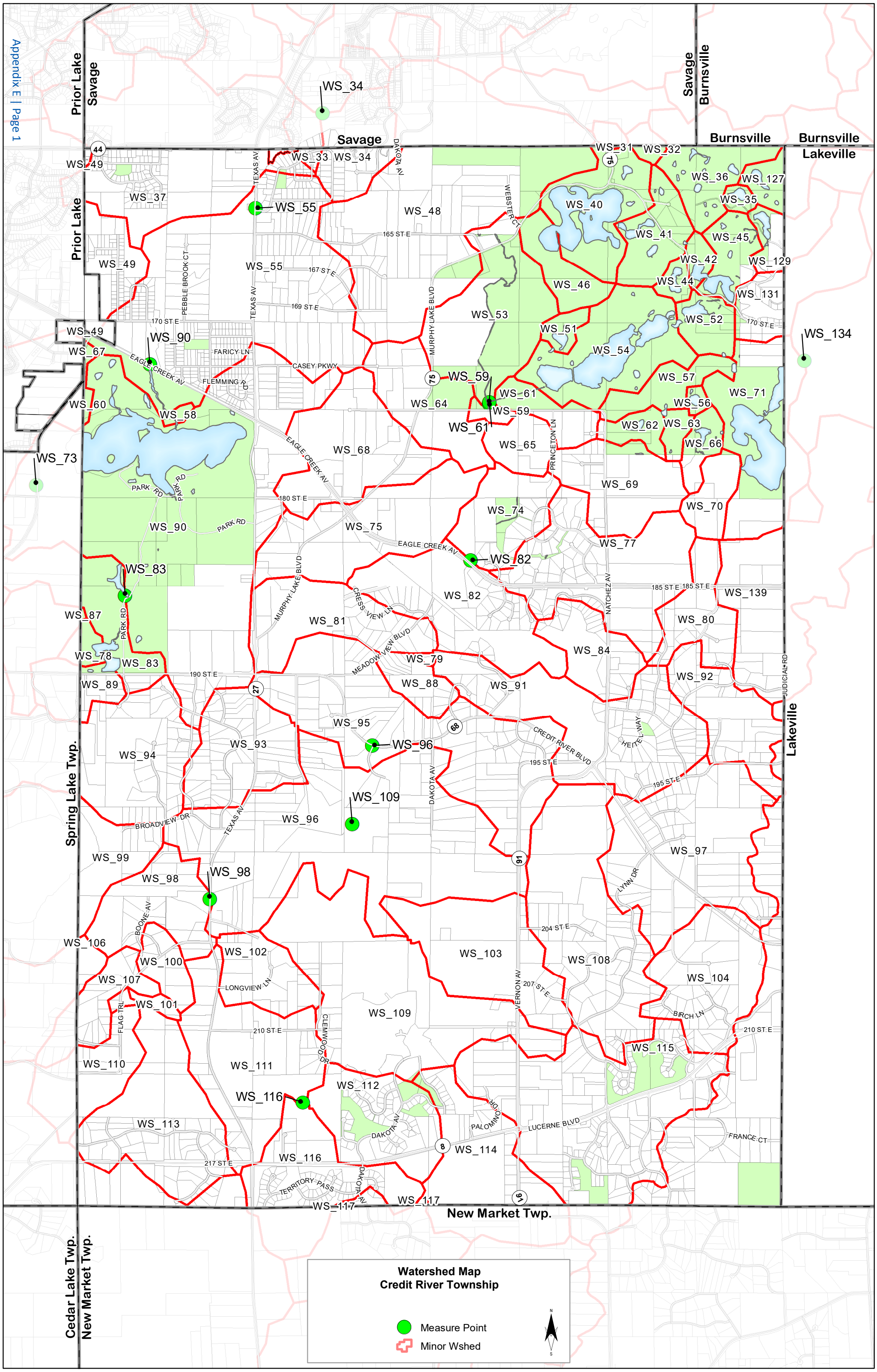
Generally, the proposed full development HWL of Markley Lake is 0.5 feet above the existing HWL of the lake regardless of the scenario. The maximum HWL is 900.0 for the "back-to-back" 1% events with a starting water level of 891.5 (100% probability). The combined probability of these conditions is 0.1%, correlating to approximately a 1,000 year event. The combination of design event and starting elevation that approximates the 100-year event results in a 2030 HWL of 895.8. The 100-year event in combination with a starting water level of 893.5 (20% probability) and the 50-year event and starting water level of 894.0 (10% probability) result in approximately the same calculated HWL. The combined probability of either of these conditions is equivalent to the 500-year event.

The 2030 conditions HWL assumes that the City of Prior Lake rate control, water quality and volume control requirements are in place as described in the City of Prior Lake Public Works Design Manual. The modeling also reflects measures the City of Prior Lake has already taken to decrease the runoff to Markley Lake by re-routing CR-8 and ML-7 to Cleary Lake.

These modeled water levels were then compared with existing structure elevations to determine the flood risk associated with the two design storms and whether this flood risk is markedly changed by assumptions regarding the basins starting water level.

APPENDIX E

Watershed Map,
(Includes 1 page)


Watershed Map
Credit River Township
Measure Point
Minor Wshed
Prior Lake
Savage
Burnsville
Lakeville
Spring Lake Twp.
New Market Twp.
Cedar Lake Twp.
WS_34
WS_55
WS_90
WS_59
WS_61
WS_82
WS_83
WS_96
WS_109
WS_98
WS_116
WS_134
TEXAS AV
DAKOTA AV
WEBSTER CT
MURPHY LAKE BLVD
PEBBLE BROOK CT
FARICY LN
CASEY PKWY
FLEMMING RD
EAGLE CREEK AV
PARK RD
PRINCETON LN
CRESS VIEW LN
MEADOW VIEW BLVD
NATCHEZ AV
CREDIT RIVER BLVD
HEITEL WAY
JUDICIAL RD
BROADVIEW DR
BOONE AV
LONGVIEW LN
FLAG TRL
CLEMWOOD DR
VERNON AV
LYNN DR
BIRCH LN
PALOMINO DR
LUCERNE BLVD
FRANCE CT
TERRITORY PASS
165 ST E
167 ST E
169 ST E
170 ST E
180 ST E
185 ST E
190 ST E
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204 ST E
207 ST E
210 ST E
217 ST E