SURFACE WATER MANAGEMENT PLAN

For the

CITY OF NORTH OAKS

SAMBATEK #07763

Prepared by

Sambatek, Inc.

Updated February 2018

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

3/12/19
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CITY OF NORTH OAKS
SURFACE WATER MANAGEMENT PLAN

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SECTION I – EXECUTIVE SUMMARY

A. Introduction and Policy Statement

The City of North Oaks (City) has prepared this Surface Water Management Plan (SWMP) to provide the City and its residents with direction concerning the administration and implementation of surface water management activities within the community. The SWMP inventories the City's land and water resources and presents water management policies and goals, which address both existing surface water-related concerns and guidelines for future development activities. The SWMP also presents the information needed to comply with the requirements of the Federal, State and Local regulatory agencies involved in surface water management. This SWMP was drafted in accordance with MN Statute 103B.235 for Local Water Management Plans.

Policy Statement: The City of North Oaks is committed to a goal of no adverse impact or non-degradation for area surface waters. To accomplish this goal, the City will demonstrate through this SWMP:

- Performance measures for all proposed stormwater treatment devices;
- Proposed plans that will require stormwater management, rate and volume control, and erosion control Best Management Practice (BMP) protection measures that will require City and Vadnais Lake Area Watershed Management Organization (VLAWMO) approval before work can commence;
- Public education on water resource management;
- Construction site enforcement of stormwater Best Management Practices (BMPs); and
- Providing the necessary funds to implement stormwater management plans, erosion control plans, public education, and construction site enforcement.

B. Purpose

The general purposes and objectives of the North Oaks SWMP are as follows:

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

C. Regulatory Requirements

In 1982, the Minnesota Legislature adopted The Metropolitan Surface Water Management Act requiring all watersheds within the Twin Cities seven county metropolitan area to be incorporated into watershed management organizations (WMOs) and the preparation and adoption of watershed management plans by each of the WMOs. The Act also requires that Local Governmental Units prepare local surface water management plans, which include the official controls and capital improvements necessary to bring each local surface water management into conformance with its respective WMO plan.

The City of North Oaks is located within the VLAWMO political boundary. Surface runoff generally drains from north to south and eventually discharges into the adjacent Capitol Region and Ramsey Washington Metro watershed districts. The VLAWMO has jurisdiction over all drainage basins within the city. The SWMP is intended to meet the requirements of the following regulatory documents:

- Metropolitan Surface Water Management Act - Minnesota Statutes Chapter 103B
- Metropolitan Area Local Water Management - Minnesota Rules Chapter 8410
- Minnesota Wetland Conservation Act of 1991 and subsequent rules and amendments
- State and Federal laws pertaining to National Pollution Discharge Elimination System (NPDES) permitting for stormwater outfalls to designated drainage ways
- Erosion Control Guidelines and BMPs prepared by the Minnesota Pollution Control Agency
- VLAWMO Watershed Management Plan (WMP), Adopted 2007 and subsequent rules and amendments
- Met Council 2030 Water Resources Management Policy Plan, Adopted 2005

D. Water Resource Management Related Agreements

The City of North Oaks, along with portions of White Bear Lake, Gem Lake, Vadnais Heights, Lino Lakes, and White Bear Township, is a member City of the VLAWMO Joint Powers Agreement, formed in 1983. The City incorporates by reference the current VLAWMO Watershed Management Plan (WMP).

E. Surface Water Management Plan Content

The City of North Oaks SWMP has been developed to meet the needs of the community and address the management planning requirements of the Metropolitan Surface Water Management Act. The SWMP has been prepared in general accordance with Minnesota Rules Chapter 8410 and follows the plan outline identified in the rules.

The following summaries identify the major sections of the SWMP and where information can be located in the plan document:

SECTION I - EXECUTIVE SUMMARY

This section presents an introduction for the local SWMP and provides a summary of all of the sections, including strategic recommendations for consideration by the City in implementing the SWMP.

SECTION II - LAND AND WATER RESOURCE INVENTORY

This section categorizes a wide range of information under the subsections entitled Physical Environment, Human Environment, Surface Water System, and Groundwater Resource Data. The subsections provide information and references regarding water resources and physical factors within the City of North Oaks including the following:

- Location
- Precipitation data for hydrologic/hydraulic review and design
- Geologic and topographic information
- Surface soils and groundwater information
- Land erosion (runoff) susceptibility
- Unique features and scenic areas
- Land use and public utility services
- Water-based recreational areas and land ownership
- Potential pollutant sources
- Public waters and wetlands
- Flood Insurance Studies (FIS) and surface water drainage information
- City subwatersheds and stormwater modeling data, limitations, and results
- Flood problem areas and surface water quality
- Specific City ordinances pertaining to stormwater management
- Groundwater resource data

SECTION III - ESTABLISHMENT OF POLICIES AND GOALS

This section outlines goals and policies addressing water resource management needs of the City and its relationship with Regional, State, and Federal goals and programs. Goals and policies relating to the following issues are presented:

- Water quantity
- Water quality
- Erosion and sedimentation
- Wetlands
- Groundwater
- Recreation, fish and wildlife
- Enhancement of public participation

SECTION IV - ASSESSMENT OF PROBLEMS AND CORRECTIVE ACTIONS

This section provides an assessment of existing or potential water resource related problems within the city. This section also describes potential structural, nonstructural and programmatic solutions or corrective actions to the identified problems.

SECTION V - IMPLEMENTATION PROGRAM

This section identifies the regulatory controls, management programs, stormwater design and performance standards, and capital improvements to be utilized by the City in implementing this SWMP.

SECTION VI - IMPLEMENTATION PRIORITIES AND FINANCIAL CONSIDERATIONS

This section presents improvement priorities and financial considerations that can be funded and implemented by the City in the near and longer-term future. This section also identifies the estimated costs and potential funding sources for implementing the proposed regulatory controls and programs.

SECTION VII - STORMWATER MANAGEMENT AND EROSION CONTROL PLAN STANDARDS

This section addresses stormwater management and erosion control standards the City reviews and enforces when new development or redevelopment occurs. Implementation of these standards will help minimize the impact of stormwater runoff from the site and to receiving downstream areas.

SECTION VIII - AMENDMENT PROCEDURES

This section presents the expected longevity of the SWMP and the process for making amendments consistent with future VLAWMO WMPs.

SECTION II – LAND AND WATER RESOURCE INVENTORY

A. Introduction

This section provides a generalized description and summary of land and water resource factors affecting the water resources within the City of North Oaks. The Physical Environment subsection presents local information on precipitation, geology, topography, soils, fish and wildlife habitat and unique features and scenic areas. The Human Environment subsection identifies local land use, public utility services, water based recreational areas and existing pollution concerns. The Surface Water Systems subsection presents information on the City's drainage patterns, hydrologic systems, public waters and wetlands, floodplain areas, flood studies, shoreland management, and water quality. The Groundwater Resource Data subsection presents the information necessary for the City to address groundwater issues.

Much of the information contained within this section was compiled from available governmental sources. Whenever possible, the location of the information or additional resources has been identified or referenced.

B. Physical Environment

1. Location

The City of North Oaks occupies approximately 8.97 square miles in northern Ramsey County as shown on **Map 1**. The communities adjacent to North Oaks are Shoreview, Lino Lakes, White Bear Township and Vadnais Heights. Stormwater runoff from North Oaks ultimately drains south to the Capitol Region and Ramsey Washington Metro watershed districts. Additional information on the City's water resources is contained in the following sections.

2. Precipitation

For purposes of this SWMP and for the enforcement of citywide and individual stormwater management plans, the City will rely on synthetic storms based on a 24-hour duration.

Stormwater calculations must include the 24-hour, 2-, 10-, and 100-year Atlas 14 rainfall events, or most recent National Oceanic and Atmospheric Administration (NOAA) data. The USDA Natural Resource Conservation Service (NRCS) temporal storm distribution region Midwest and Southeast US (MSE 3) rainfall distribution is required for the modeling of Atlas 14 rainfall events.

The 10-year rainfall is typically used for the design of lateral storm sewers. The 100-year event is used for the analysis and design of pond and lake outlet structures and trunk storm sewer systems. For pond areas with no outlet structures, the 100-year, 10-day runoff event (9.94 inches) is used.

The use of synthetic storms and the cumulative rainfall amounts are consistent with VLAWMO WMP standards. Further documentation regarding these storms is available on the NOAA website.

Table 1. NOAA Atlas 14 Rainfall Data

Rainfall Frequency	Rainfall Depth (in)
1 Year	2.44
2 Year	2.80
10 Year	4.18
100 Year	7.25

3. Geology

The Minnesota Geological Survey in a document titled Geologic Atlas of Ramsey County Minnesota (L. Swanson and G. Meyer, Editors, 1992) has compiled the general geology of Ramsey County and the City of North Oaks.

The surface geology of the city is illustrated on Map 2. The pink and red shaded areas indicate a predominance of sand and quartz deposits as a result of glacial outwash. The green and pink shaded areas are indicative of glacial till deposits with higher concentrations of clays and organic materials. The light blue shading indicates higher concentrations of sands.

The depth to bedrock within the city varies from 50 to 300 feet. The area of greater depths (>200 feet) to bedrock lies in the southwest parts of the city. A small pocket of shallow bedrock depths (less than 50 feet) is located on the southeast part of the city by the Hwy 96 railroad crossing. The remainder of the city has depths of 100 to 200 feet to bedrock.

The water table elevation varies from 920 to 895. The subsurface water movements are generally from east to west with the higher water tables found on the east side of the city. Water table elevations at any location fluctuate seasonally and are influenced by climate trends and pumping.

The surface geology has been shown to have only isolated areas of low permeability. The water table is therefore sensitive to surface pollution. An illustration of pollution sensitivity is shown on **Map 3.**

4. Topography

The City of North Oaks topography can be classified as gently rolling to level. Surface elevations range from 884 feet above mean sea level (msl) on the southern part of the city to 1004 feet above msl on the northern part. Lakes and natural wetlands are abundant, especially in the more rolling eastern parts in the city.

5. Soils

The USDA NRCS (formerly the Soil Conservation Service) completed the most recent Soil Survey for Ramsey County in 2006. This reference document maps the location of specific soil types

throughout the City of North Oaks and provides detailed data on the typical characteristics of each soil type. All NRCS soils information is available online in a convenient, easy-to-read format. If any proposed development involves significant grading operations, the City will require verification of the NRCS soil classifications by soil borings and a soil analysis.

6. Land Erosion (Runoff) Susceptibility

Areas that are located on steeply sloping land and those that have been previously developed have a greater likelihood of generating more runoff than areas that have not been developed or are located on flat slopes. **Map 4** shows the different areas and their likelihood of generating runoff.

Areas in medium or high susceptible zones have a greater chance of producing runoff with high silt concentrations and/or urban pollutants. Great caution is necessary in highly sloped areas, especially if grading or constructing is taking place. Disturbed soils have a greater chance of erosion, especially those with high sand and fines content. Establishing and maintaining vegetation on exposed soil in areas of medium to high susceptibility is critical to keep silt and urban pollutants from washing into the City's natural drainage ways, wetlands, and lakes. BMPs for erosion and sediment control are to be a part of all new development and redevelopment projects in all susceptibility areas.

7. Unique Features and Scenic Areas

The Minnesota Department of Natural Resources (MDNR) Natural Heritage and Non-game Research Program has identified the potential for several rare plant and animal species, as well as other significant natural features, within and near the City of North Oaks, as shown on **Map 5.** Per MDNR records, there are no occurrences of any rare plant or animal species within the city limits. However, proper inspections and actions are taken in conjunction with the MDNR guidelines before any land alteration or grading is scheduled to occur to ensure development will not affect rare plant or animal species.

The City does not contain any State- or Federally-owned wildlife and waterfowl management areas or any state or federal owned scientific and natural areas. However, there are large conservation areas that have dense forested cover and those areas are shown on **Map 6**. These areas have significant value and care is taken to maintain and preserve these areas.

C. Human Environment

1. Land Use

The City's Comprehensive Plan describes both existing Land Use, as shown on **Map 7**, and the proposed Land Use (extending to the year 2030). The majority of the developable area of the city has been fully developed to allowed densities. Approximately 7 percent of the developable lands are

vacant. Some potential for re-development at similar densities does exist. The information on future development and re-development is found in the City's Comprehensive Plan.

2. Public Utilities Services

The City of North Oaks is located entirely within the former Metropolitan Urban Service Area (MUSA). While sanitary sewer service was available, the core part of the city developed primarily with large lots and the use of Individual Sewage Treatment Systems (ISTS). However, recent developments along the outer edges of the city have made use of private collection systems that discharge directly or indirectly into the metropolitan system.

The center part of the City of North Oaks is served by individual private wells. There are private water distributions systems along the edges of the city, which connect to the systems of abutting cities. Water is supplied in the eastern portion of the city from White Bear Township, and water on the west side of the city is supplied by the City of Shoreview. These systems are maintained by private contractors and the public works operations of those cities. The parcels served by private wells are shown on **Map 8**; **Map 15** shows the areas served by municipal sewer; and **Map 16** shows existing water systems.

3. Public Areas for Water Based Recreation

There are no public areas for water-based recreation on any of the lakes in the City of North Oaks. Some of the lakes are classified as recreational lakes, but due to their role as a part of the St. Paul Regional Water Services (SPRWS), all recreational use is restricted, e.g. no fishing, no motorized craft and restricted access. There is a swimming beach on Pleasant Lake with docks and raft, boat landing, sailboat mooring, and canoe storage for the use of North Oaks residents.

4. Potential Pollutant Sources

In the City of North Oaks, there are few land use practices that have the potential to contaminate either surface waters or groundwater. There are no open or closed landfills, dumps, hazardous waste sites, or underground or aboveground storage tanks. All in-place wells have been constructed in accordance with MDH standards and abandoned wells have been properly taken out of service.

There are a large number of private septic systems within the city. All ISTS sites are considered potential pollution sites by the City and the City has a program in place that monitors all systems.

D. Surface Water System

This section summarizes the available surface water data within the city. Additional information is available from VLAWMO and SPRWS.

1. Public Waters and Wetlands

The MDNR currently lists nine waterbodies within the City of North Oaks as protected waters. Those protected waters are listed in the table below. Minnesota Chapter 103G provides specific criteria for protected status and the MDNR Protected Waters and Wetlands (PWI) Map identifies the protected water. **Map 9** is a compilation of public waters and public water wetlands from the MDNR maps and the U.S. Fish and Wildlife maps.

Waterbody	DNR ID	Acreage
Pleasant Lake	62004600	690
Lake Gilfillan	62002700	102
Deep Lake	62001800	78
Charley Lake	62006200	38
Wilkinson Lake	62004300	105
Black Lake	62001900	11
North Mallard Pond	62002000	17
South Mallard Pond	62002000	7
Teal Ponds	62002601,2,3	13

The various wetland inventories identify and classify wetlands based on two primary systems; Circular 39 and the Cowardin. The U.S. Fish and Wildlife Service (USFWS) developed their maps using both systems. The MDNR classified their protected waters by using the Circular 39 system, and the NWI maps were defined by the Cowardin System. The Minnesota Board of Water and Soil Resources (BWSR) has prepared a brochure that gives a brief explanation of the two classification systems including photos of the different types of wetlands. It also provides translations between the two systems. The classification systems were developed for a wide variety of purposes and to assist in meeting differing water resource management goals. Although not comprehensive, these inventories can both be utilized in determining whether wetlands are present on a specific property and how land uses may be affected.

The City of North Oaks has no near-term plans to inventory the functional values of wetlands within the community, but will review the functional values of impacted wetlands on a case-by-case basis in accordance with Minnesota Statute, Section 103B.3355 during City review of individual project proposals. The City has delegated its responsibility as the Local Government Unit (LGU) under the Minnesota Wetlands Conservation Act (WCA) to VLAWMO and VLAWMO reviews all projects, including those that may impact wetlands, in accordance with State wetland laws and rules.

2. Flood Insurance Studies

FEMA Flood Insurance Rate Map (FIRM) Number 27123C0030G was mapped June 4, 2010, showing areas mapped as Zone A floodplain for the six lakes within the City of North Oaks. See **Map 10** for FEMA floodplain. VLAWMO, in conjunction with MDNR, provides 100-year flood elevations within the city. The City requires new construction to provide flood protection from adjacent waterbodies. The lowest floor of new buildings shall be constructed a minimum of three

feet above the project 100-year high-water elevations or MDNR OHW (whichever is higher) of nearby surface water bodies or stormwater ponds. The lowest opening elevations must be two feet above the emergency overflow elevations for adjacent water bodies or stormwater ponds.

3. Surface Water Drainage Information

Surface water in the City of North Oaks primarily drains via natural drainage patterns and drainage ways. Historically, development within the city has comprised large lots and minimal grading to minimize alteration of the natural topography. Most site grading related to development projects is restricted to that necessary for rural roadways with drainage swales. Recent development projects around the perimeter of the city have included clusters of more dense land use and piped surface water collection systems. VLAWMO, acting as the appointed LGU for North Oaks, has closely regulated the design of those systems.

4. City Sub-watershed Districts

The following six sub-watershed districts encompass the city: TH 96 Sub-watershed, Gilfillan Lake Sub-watershed, Wilkinson Lake Sub-watershed, Deep Lake Sub-watershed, Charley Lake Sub-watershed and Pleasant Lake Sub-watershed. **Map 11** illustrates the sub-watershed districts and their boundaries. A brief description of each sub-watershed is given below.

- **TH-96 SUB-WATERSHED**

  This sub-watershed district is a part of the VLAWMO East Vadnais/Sucker watershed district. It lies in the southwest corner of the city and includes the Village Center commercial area. The drainage from this sub-district is landlocked and is directed to ponds scattered throughout the sub-district. The commercial area drainage is served by a piped system to a central pond. The central pond has an overflow, which discharges to a second pond, which has been used infrequently. An emergency pumping station exists beyond the second pond which has never been used. The soils in this area are highly permeable. The other ponds are located in residential or golf course areas.

- **GILFILLAN LAKE SUB-WATERSHED**

  This sub-watershed district is a part of the VLAWMO Tamarack/Wilkinson watershed district. It lies in the southeast part of the city and includes North Mallard Pond, South Mallard Pond and the Teal Ponds as a part of the surface drainage system. This is an older area of the city and has been fully developed into low-density residential lots. It has a rolling terrain with several perched wetlands which ultimately discharge to Gilfillan Lake. Gilfillan Lake is landlocked but does not maintain appreciable water levels.

  Historically, attempts were made to augment lake levels with pumping, but that practice has been discontinued. Gilfillan Lake has been identified as an impaired water for nutrient/eutrophication biological indicators. In April of 2014, VLAWMO published

'Vadnais Lake Area WMO Total Maximum Daily Load (TMDL) and Protection Study' outlining pollutant sources and reduction opportunities for Gilfillan Lake.

- **WILKINSON LAKE SUB-WATERSHED**

This sub-watershed district is part of the VLAWMO Tamarack/Wilkinson watershed district. It lies along the east side of the city and includes Black Lake and Wilkinson Lake. Most of the recent development activities in the city have occurred in this sub-district. The City and VLAWMO have required stormwater modeling and the use of BMPs as a part of each development. VLAWMO has acted as the LGU for regulation of this development. Wilkinson Lake has been identified as an impaired water for nutrient/eutrophication biological indicators. In April of 2014, VLAWMO published 'Vadnais Lake Area WMO Total Maximum Daily Load (TMDL) and Protection Study' outlining pollutant sources and reduction opportunities for Wilkinson Lake.

- **DEEP LAKE SUB-WATERSHED**

This sub-watershed district is a part of the VLAWMO Pleasant/Charley/Deep watershed district. Approximately 70 percent of the area in this district is designated as a permanent conservation district. The rest of the district is either developed as or planned for low-density residential use. Natural drainage patterns and drainage ways are predominantly used for surface water flows. Wilkinson Lake discharges to Deep Lake and is controlled by a flow control structure in the connecting channel. Flows are monitored and regulated by the SPRWS.

- **CHARLEY LAKE SUB-WATERSHED**

This sub-watershed district is a part of the VLAWMO Pleasant/Charley/Deep watershed district. This district lies along the northwest part of the city and contains Long Marsh, which extends the length of the sub-watershed and ends at Charley Lake. Approximately half of this district is marshland and the rest is developed as low density residential lots. There is a small landlocked portion of the district, which abuts Hodgson Road (CR-47) along the west side of the city. This landlocked drainage area was modeled by Ramsey County as a part of a road reconstruction project. The drainage from this area flows into a pond constructed by Ramsey County on the Chippewa School site. Charley Lake has been shown to contain zebra mussels, an aquatic invasive species.

- **PLEASANT LAKE SUB-WATERSHED**

This sub-watershed district is a part of the VLAWMO Pleasant/Charley/Deep watershed district. This district lies in the center of the city and includes Pleasant Lake, the largest waterbody in the city. Pleasant Lake, along with Charley and Deep Lakes, are an integral part of the SPRWS water system and are closely monitored and maintained by that agency.

The lands in the district that surround Pleasant Lake are fully developed as low-density residential lots. The district utilizes natural drainage patterns and drainage ways for surface flows. Pleasant Lake has been shown to contain zebra mussels, an aquatic invasive species.

5. Stormwater Modeling Information

As part of the SWMP preparation, a review was made of the hydrologic analysis conducted by VLAWMO. The hydrologic model utilized the BATHTUB computer program and included the following lakes: Black (2013), Deep (2014), Charley (2014), Gilfillan (2009), Pleasant East and Pleasant West (2011), and Wilkinson (2010). A water budget was developed for Gilfillan as a part of VLAWMO's Sustainable Lake Management Plan.

The City requires stormwater modeling on all developments and projects and submits the data to VLAWMO for review.

6. Modeling Limitations

Modeling is based on assumed rain events consistent with VLAWMO criteria. When necessary, the analysis will model bodies of water extending beyond the city limits. Models do not establish official 100-year HWL elevations of specific waterbodies or pond areas. However, the analysis does provide a technical tool to assess risk and a mechanism to consider various stormwater-related alternatives.

7. Modeling Results

The VLAWMO model provides pertinent hydrologic data taken for each of the sub-districts in North Oaks. The analysis results for peak discharge rates, types of flow routing (i.e. pond, storm line, etc.) 100-year HWL elevations, and ultimate overflow elevations are available from VLAWMO. The analysis evaluated existing conditions. Since land uses will remain constant throughout the time span of this plan, the analysis of future conditions is not warranted. Documentation on the BATHTUB model and complete input parameters and results are available for review at the VLAWMO offices.

If the establishment of a 100-year flood elevation is required for any specific flooding source, VLAWMO will establish the elevation using appropriate vertical datum, surveys of existing topography and review of all flooding OHW data resources.

8. Flood Problem Areas

Historically there have been few flooding problems associated with stormwater runoff. The City and VLAWMO will continue to apply acceptable stormwater and surface water management practices for current properties and potential development areas. The lowest floor of new buildings shall be constructed a minimum of three feet above the project 100-year high-water elevations or MDNR OHW elevation (whichever is higher) of nearby surface water bodies or stormwater ponds. The

lowest opening elevations must be two feet above the emergency overflow elevations for adjacent water bodies or stormwater ponds.

9. Surface Water Quality Data

The Minnesota Pollution Control Agency (MPCA) has water quality monitoring data on all six lakes in the city. The SPRWS has water quality monitoring sites on Pleasant Lake and the channels leading to Pleasant Lake from Deep Lake and Charley Lake. VLAWMO has included water quality monitoring of all other North Oaks lakes in its budget and work plan. The VLAWMO monitoring program involves local participation in the collection of samples. The results of those monitoring sites are available from the respective agency.

E. Groundwater Resource Data

1. Groundwater and Surface Water Appropriations

The City of North Oaks domestic water needs are satisfied mainly by individual wells. The few municipal water supply systems that do exist are along the eastern side of the city and are extensions of the White Bear Township water supply system. **Map 15** shows the location of the existing water distribution systems. The City does not plan to convert existing well users to a single municipal distribution system nor create a City supply source. Therefore, all future installations will be regulated and permitted by the Minnesota Department of Health and the White Bear Township Public Works Department.

2. Groundwater Plan

Ramsey County is nearing completion of its Groundwater Protection Plan. The plan, which includes North Oaks, represents a variety of information on groundwater-related issues including an inventory of groundwater resources, potential contaminant sources, management of the resource, and local groundwater protection strategies. Many of the recommended protection strategies and actions are directed toward local levels of government (i.e., Cities and Townships). This SWMP includes goals and polices which are consistent with the Ramsey County Groundwater Protection Plan.

SECTION III – ESTABLISHMENT OF GOALS AND POLICIES

The City of North Oaks has developed the goals and policies contained in this section to conform with the water resource purposes specified in Minnesota Statute Section 103B.201. They have also been developed to be consistent with existing State, Regional, and County goals and policies. The general purposes of the goals and policies are as follows:

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

The goals and policies developed by the City address water quality, water quantity, erosion and sediment control, wetlands, groundwater, recreation, fish and wildlife, and enhancement of public participation. Outlined below are the goals and policies developed for each of the above topics.

A. Water Quantity

Goal: **To limit public capital expenditures necessary to control excessive volumes and rates of runoff.**

Policies:

1. The City will require that proposed stormwater discharges as a result of development be equal to or less than existing conditions. Increase in discharge rates and volumes in areas of development may be considered provided the downstream facilities can handle the increases.
2. Where practical and feasible, stormwater facilities will be developed on a regional basis, rather than on an individual site basis. For land development projects, the City will determine whether regional stormwater facilities are required and the level of City participation in planning and construction.
3. The City will review downstream stormwater-related impacts (within the community) of development proposals and proactively address water resource-related concerns.

4. The design of trunk and lateral lines will accommodate the 10-year storm event. Design of BMP outfalls will accommodate the 100-year rainfall event. Additional information on stormwater design standards is contained in Sections V and VII.

5. Stormwater facilities receiving discharges from adjacent communities will be designed to accommodate those existing runoff rates and anticipated volumes.

6. Peak stormwater rates discharging from the city into an adjacent community will not exceed pre-development discharge rates without notifying and obtaining approval from the adjacent community or communities.

7. The lowest floor of new buildings shall be constructed a minimum of three feet above the project 100-year high-water elevations or MDNRR OHWL (whichever is higher) of nearby surface water bodies or stormwater ponds. The lowest opening elevations must be 2' above the emergency overflow elevations for adjacent water bodies or stormwater ponds.

8. The City will consider the development of positive outlets for landlocked areas to control water levels on the site or areas adjacent to the developing property. The outlets shall incorporate stormwater volume controls where feasible and shall not significantly impact downstream flooding.

9. The City will encourage the minimization of the amount of direct impervious surface planned for any development. The City will also encourage the use of natural drainage ways for conveying stormwater, provided the drainage ways can properly channel the stormwater flows and volumes before ultimately reaching an existing or proposed waterbody.

10. Enhanced infiltration practices will be encouraged in areas where the present or future land use does not have a significant potential to contaminate either stormwater runoff flows or groundwater infiltration.

11. Private stormwater facilities will be regularly inspected and maintained by the North Oaks Home Owner's Association (NOHOA) public works officials to ensure that the facilities continue to perform per design.

12. Wetlands within the city will be protected to ensure that the wetland's values for providing water quantity benefits will not be significantly impacted.

B. Water Quality

Goal: **To maintain or improve water quality of City waterbodies and wetlands.**

Policies:

1. In the design and construction of new stormwater conveyance systems, or modification of existing systems, pretreatment of stormwater runoff will be required prior to discharge to a waterbody or wetland. Pretreatment methods shall include wet detention basins and other BMPs identified in the current MPCA NPDES Construction Stormwater General Permit or equivalent performance standards. Additional information on design standards are provided in Sections V and VII.

2. Ponding areas constructed for water quality improvements shall include a skimmer at the pond outlet to prevent migration of oil and other floating materials in stormwater runoff to downstream receiving waters.

3. The City will continue its program of regularly inspecting stormwater management facilities to ensure that the facilities continue to perform per design and per NPDES Municipal Separate Storm Sewer System (MS4) requirements. Inspections will be coordinated with and performed by the NOHOA.

4. NOHOA will continue to sweep paved public streets within the community at least one time per year. Areas directly discharging to wetlands and rivers will be given first priority.

5. The City will require ISTS to conform to the City's On-Site Sewage Treatment Systems Code. **Map 13** shows locations of potential pollution sources including SSTS.

6. The City will enforce elimination of illicit (illegal) connections to piped stormwater systems. The City will also coordinate on illicit connection removal efforts with Ramsey County.

7. The City will require the implementation of erosion and sediment control plans and BMPs for construction and land development activities in accordance with the developer's Storm Water Pollution Prevention Plan (SWPPP) for construction activity requirements as required by the MPCA.

8. The City will require proposed land development projects adjacent to lakes and wetlands to adhere to the VLAWMO Wetland Replacement Criteria for wetland buffers. **Map 12** shows wetland management classifications as determined by VLAWMO.

9. The City will protect wetlands within the community to ensure that the wetland functions are maintained and that the wetlands' values in providing water quality benefits will not be significantly impacted.

10. The City will continue implementation of the public education program to foster responsible water quality management practices by City residents and businesses. The public information will include proper lawn fertilizing and other lawn chemical use, disposal of lawn waste, and disposal of solid, liquid, and household hazardous waste products. The City will work to accomplish these tasks through partnerships with other organizations such as VLAWMO, businesses, and private citizen groups.

11. The City will support VLAWMO, the SPRWS and the MPCA on water quality monitoring programs proposed within the community.

C. Erosion and Sedimentation Control

Goal: **To prevent erosion and sedimentation to the maximum reasonable extent.**

Policies:

1. The City will require the preparation and implementation of erosion and sediment control plans and BMPs for construction and land development activities in accordance with the

developer's approved SWPPP for construction activity requirements as required by the MPCA. The City will obtain a financial surety from the proposed project to ensure compliance.

2. The City will enforce the erosion and sediment control plan and BMPs on construction sites to prevent erosion and soil loss and control sediment migration. Areas adjacent to waterbodies and wetlands, or to have known high erosion potential will receive highest priority.

3. The City will cooperate with State and Federal requirements for stormwater permits on land alteration activities.

4. The City may prohibit work in areas having steep slopes and/or high erosion potential when the impacts of significant erosion cannot be controlled or mitigated. The City will not allow work to commence in areas that have greater than 18 percent slopes.

5. NOHOA will sweep paved streets within the community at least one time per year. Areas with direct discharge into wetlands and rivers will be given first priority.

D. Wetlands

Goal: **To protect wetlands in conformance with the requirements of the Minnesota Wetland Conservation Act rules and other State, Federal and Local regulations.**

Policies:

1. The City will continue to designate VLAWMO as the LGU responsible for wetland management and VLAWMO will manage these wetlands in conformance with the Minnesota Wetland Conservation Act (WCA) of 1991, its amendments and rules (i.e. MN Rules Chapter 8420).

2. The City will refer applicants to MDNR, MPCA, U.S. Army Corps of Engineers (USCOE), and VLAWMO for permits required for land disturbing activities (e.g. altering, dredging, filling, and draining) in wetlands.

3. The City will coordinate with the permitting programs of the MDNR, MPCA, USCOE and VLAWMO for proposed activities within jurisdictional wetlands.

4. The City will utilize available wetlands inventory information developed by the USFWS, MDNR, Metropolitan Mosquito Control District and VLAWMO preliminarily to identify the location of wetlands on properties where land alteration is proposed.

5. The City will require a wetland delineation report identifying jurisdictional wetlands as part of the City approval process for land development. If wetland encroachments are proposed as a part of the development, wetland values and impacts will be evaluated on a case-by-case basis in accordance with the requirements of the WCA and VLAWMO rules.

6. The City will require pretreatment of stormwater runoff prior to discharge to any waterbody or wetland. Pretreatment methods shall include wet detention basins or other BMPs

identified in the current MPCA NPDES Construction Stormwater General Permit or equivalent performance standards.

7. The City will cooperate with interested private or governmental parties on wetland restoration projects and may participate in the State's wetland banking program.

8. Buffer strips shall be managed to maintain a dominance of native plant species and removal of non-native plant species. The width of the buffer strips will be in accordance with VLAWMO standards. **Map 12** shows wetland management classifications as determined by VLAWMO.

E. Groundwater

Goal: **To protect groundwater by prudent management of surface waters.**

Policies:

1. The City will cooperate with County and State agencies to inventory and seal abandoned wells and notify its residents of State standards on well abandonment.

2. The City will require ISTS to be in conformance with the City's On-Site Sewage Treatment Systems Code.

3. The City will consider the significance of sensitive geologic areas when making land use decisions, when reviewing development proposals, or when proposing construction of stormwater facilities. Activities that may have significant contamination potential will be required to include groundwater protection measures.

4. The City will encourage the use of infiltration methods to promote groundwater recharge where groundwater will not be significantly impacted by the land use or stormwater runoff.

5. The City will eliminate known illicit (illegal) connections to stormwater systems. The city will also cooperate with the illicit connection removal efforts of Ramsey County.

F. Recreation, Fish and Wildlife

Goal: **To protect and enhance recreational facilities, and fish and wildlife habitat.**

Policies:

1. The City will support the efforts of Local, State, and Federal agencies promoting public enjoyment, and the protection of fish, wildlife, and recreational resource values in the city.

2. The City will protect wetlands in accordance with the goals and policies of this plan.

3. The City will require native buffer zones around wetlands and ponding areas in new developments and restrictive easements for areas adjacent to the waterbodies and streams. The width of the buffer zones will be in accordance with VLAWMO standards. **Map 12** shows wetland management classifications as determined by VLAWMO.

4. The City will encourage its residents to retain existing wetlands, vegetative buffers, and open spaces for the benefit of wildlife habitat.

5. The City will guide future land planning activities and encourage community development actions to include agricultural preserves and to protect existing wooded areas.

G. Enhancement of Public Participation, Information and Education

Goal: **To educate and inform the public on water resources management issues, and to increase public participation in water management activities.**

Policies:

1. The City will continue the current public education program to foster public participation in responsible water quality management practices by residents and businesses. The public education topics include: fertilizer use and the limited need for phosphorus in fertilizer; lawn care and lawn chemical use; solid, liquid and household hazardous waste disposal; and natural water resource systems and protection methods.

2. The City will coordinate public information and education programs with information and activities from State and Federal agencies and VLAWMO.

3. The City currently distributes water resource and water quality-related information to residents at least once annually. The City will also have water resource protection information available at City Hall and on the City's website for review by its residents.

4. The City will have water resource and water quality information available for public review at City Hall. The library will contain resources referenced in this SWMP, public information on water quality practices and activities, the North Oaks MS4 General Permit and associated SWPPP, and other water resource-related documents and information.

5. The City will use its Environmental Commission to address water resource-related public education and information, solicit public concerns and issues, and develop further water resource management strategies as issues arise.

6. The City will require lawn care companies operating in the community to have phosphorus-free fertilizer available for lawn applications and prohibit phosphorus to be used as fertilizer unless if allowed under Minnesota Statute 18C.60.

7. The City will utilize the programs developed by VLAWMO and the Ramsey Conservation District (RCD) in local education programs, including notifying residents and officials of educational opportunities, airing programs on local cable television and distributing informational pamphlets.

SECTION IV – ASSESSMENT OF PROBLEMS AND CORRECTIVE ACTIONS

This section contains an assessment of existing and potential water resource-related problems presently known within the city and a description of structural, non-structural, or programmatic solutions that could be used to address or correct the problems. Additional problems and concerns may be included in this SWMP by City staff at a later date. Some of the topics discussed herein are repetitive because they are presented according to the State rules and outline for local management plan preparation. VLAWMO has completed a work plan for a TMDL in the impaired waters of Gilfillan Lake and Wilkinson Lake. VLAWMO has prepared Sustainable Lake Management Plans for Lake Gilfillan, Wilkinson Lake, and Black Lake that will address numeric water quality goals. Additionally, VLAWMO has prepared an Urban Stormwater Retrofit Analysis for the Pleasant, Charley, and Deep Lake Watershed, which includes recommendations and retrofits for water quality improvements.

A. Surface Water Quality

1. Assessment:

    a. Failing on-site sewage treatment systems may be located adjacent to wetlands, waterbodies, drainage ways and streams.

    b. The quality of surface water discharge is impacted due to sediment build-up in stormwater ponds.

    c. Sediment-laden runoff discharged directly into waterbodies from roadway areas and storm sewer outfall pipes without prior pretreatment. **Map 14** shows the existing storm sewer systems within the city.

2. Corrective Action:

    a. The City shall continue to enforce on-site sewage system maintenance and replacement programs.

    b. The City will continue to implement its stormwater facility inspection and maintenance program.

    c. The City will continue to stringently enforce erosion control standards for land development and home building activities; prioritize street sweeping for areas draining directly into waterbodies; require new storm sewer outfalls to incorporate stormwater treatment prior to discharge; incorporate stormwater treatment in system upgrade projects; require regular maintenance of stormwater ponding and piping facilities and construct natural or structural sediment control buffers at the end of roadways draining into waterbodies.

B. Flooding and Rate Control Issues

1. Assessment:

a. Based on the 100-year, 24-hour storm event modeling, there are no places in the city that experience flooding if drainage ways and drainage systems are properly maintained.

b. Flooding may be caused by the receiving storm sewer facility being plugged by debris.

2. Corrective Action:

a. The City shall ensure that peak discharge rates from any new construction site does not exceed existing rates.

b. The City will work with NOHOA to develop a regular inspection and maintenance program for all drainage ways and culverts to ensure that they are free from obstructions on a yearly basis.

C. Impacts of Water Quantity or Quality Management Practices on Recreational Opportunities

1. Assessment:

a. Existing land use activities and land development within the city may adversely impact water-related recreational activities.

2. Corrective Action:

a. Water-related recreational activities will be considered in land use decisions and in reviewing land development proposals.

b. Future parks and trails will be designed to protect the natural character of adjacent waterbodies or watercourses.

c. The City's stormwater management practices and the implementation of erosion prevention and sediment control practices will maintain and improve water quality in the City's waterbodies, increasing their value as recreational resources.

D. Impacts of Stormwater Quality on Fish and Wildlife Resources

1. Assessment:

a. Sediment, nutrients and urban pollutants in untreated stormwater discharges adversely impact water quality and fish and wildlife resources.

b. Manicured lawns immediately adjacent to lakes and wetlands allow lawn chemicals to discharge directly into waterbodies and encourages habitation of lawns by Canadian geese with the resulting deposition of waterfowl waste.

2. Corrective Action:

a. Stormwater discharges will be pre-treated prior to release into City-owned waterbodies and wetlands.

b. A buffer zone will be required around natural or constructed waterbodies natural, unmaintained as part of future development proposals and buffer zones will be established around all waterbodies, wetlands and watercourses.

E. Impacts of Soil Erosion on Water Quality and Quantity

1. Assessment:

   a. Construction-related soil erosion can occur on small and large-scale construction projects. Sediment can be discharged off-site or into City-owned waterbodies by direct runoff or by construction equipment tracking sediment off-site.

   b. Erosion of steep slopes due to natural causes or construction activities can adversely impact waterbodies or watercourses.

   c. Shoreline erosion may occur due to natural causes, lakeside activities, or lack of natural vegetation adjacent to the waterbody.

2. Corrective Actions:

   a. Erosion prevention and sediment control plans will be prepared, implemented, and enforced on construction projects to prevent adverse water quality impacts.

   b. Existing eroding steep slopes will be addressed and corrected as part of development proposals. Development on slopes steeper than 18 percent will not be allowed.

   c. The City will partner with NOHOA on shoreline inventory and maintenance programs.

F. General Impact of Land Use Practices, and in Particular, Land Development and Wetland Alteration on Water Quality and Water Quantity

1. Assessment:

   a. Land use practices, land development and wetland alterations may have a significant impact on water quality and water quantity. Impervious surfaces are often the receiving source of urban pollutants and contribute more runoff volume than natural land and vegetation. Increased development in the city has the potential to increase downstream flooding and degrade water quality.

   b. Land development in adjacent communities could increase the flooding potential within the city and future land development in North Oaks, without proper planning, may increase the flooding potential in neighboring communities.

2. Corrective Actions:

   a. Implementation of the stormwater management practices within this SWMP will address potential negative impacts of land development. The City will work with new development proposals to remedy existing drainage problems. Implementation and enforcement of

erosion control BMPs will protect the quality of surface waters. In addition, the City will also continue to monitor lot coverage amounts for newly developing areas.

b. Continuing communications and cooperation with adjacent communities and VLAWMO will reduce unanticipated impacts of land development impacting other communities and improve joint water resource planning and improvement efforts.

G. Adequacy of Existing Regulatory Controls to Manage or Mitigate Adverse Impacts on Public Waters and Wetlands

1. Assessment:

a. Public waters and wetlands are currently regulated by programs administered by the USCOE, MDNR. and Minnesota's WCA. The City has designated its responsibilities of the LGU to VLAWMO and VLAWMO currently partners with the City in administering the WCA requirements. The City has and enforces the provisions of a Shoreland Ordinance.

2. Corrective Action:

a. It is the City's position that the existing regulatory programs and the implementation of this SWMP will adequately manage or mitigate adverse impacts on public waters and wetlands.

H. Adequacy of Programs to Limit Soil Erosion and Water Quality Degradation

1. Assessment:

a. As part of the land development or alteration, the City requires the qualified preparation of stormwater management plans which include erosion and sediment control plans to address temporary and permanent water quantity and quality issues and erosion concerns. If stormwater management facilities are not properly constructed or if erosion prevention practices are not implemented or maintained, the result may be the degradation of water quality.

2. Corrective Action:

a. The City will continue to enforce compliance with approved plans and require verification that permanent stormwater management facilities have been constructed. If requested, VLAWMO will provide comment on erosion control plans and may provide site inspection comments in specific instances.

I. Adequacy of Existing Programs to Maintain the Tangible and Intrinsic Values of Natural Storage and Retention Systems

1. Assessment:

a. Waterbodies within the city contain varied and diverse wildlife. Land use activities and future land development have the potential to reduce recreation and wildlife opportunities and the natural values of the City's waterbodies.

2. Corrective Action:

a. It is the City's position that the existing State, Federal, VLAWMO and other Local regulatory controls will maintain the tangible and intrinsic values of the City's waterbodies.

b. VLAWMO will maintain flood storage volumes below the 100-year elevations of all waterbodies. The City will require protective easements below 100-year flood elevations for the protection and maintenance of the waterbodies and require natural buffer zones adjacent to waterbodies on future development proposals.

c. The City will support the on-going water quality analysis and diagnostic feasibility studies of its lakes to further determine conditions of the waterbodies, potential expanded uses, and long-term impacts of existing or future land activities.

J. Ability to Correct Problems Related to Water Quality, Water Quantity Management, Fish and Wildlife Habitat, Public Waters and Wetland Management, and Recreational Opportunities.

1. Assessment:

a. The City does not currently include any locally-funded stormwater related improvements.

2. Corrective Action:

a. The City will partner with VLAWMO to identify and prioritize stormwater-related improvements and the need for the City to be involved with project financing. The VLAWMO TMDL study addressing State-listed impaired waters will help set improvement priorities. In addition, the City will address a variety of water quality and quantity issues in conjunction with land development proposals as they occur.

K. Future Potential Problems Anticipated to Occur Within Next 20 Years Based on Growth Projections and Planned Urbanization

1. Assessment:

The 2018 Comprehensive Plan identifies staged growth areas within the City to the year 2030. Projected development is primarily in the northeast part of the city, in the Wilkinson Lake and Deep Lake sub-watershed districts. The following are potential stormwater related problems and issues anticipated to occur from development.

a. General – Development with an associated increase in impervious surfaces has the potential to decrease water quality and increase flooding potential both during construction and after development is complete. During construction, erosion and sedimentation can degrade water

quality and in the longer-term, additional phosphorus and other pollutants may be discharged to waterbodies due to urbanization.

b. Roadways – Private roads in the city have the potential to degrade water quality by roadway erosion, insufficient culvert size or length, and road encroachment into wetlands.

c. Pond and Stormwater Maintenance – Development will increase the number of private stormwater ponding and drainage facilities. For the facilities to adequately and effectively function, routine inspection and maintenance will be required. Private funds will need to be expended for stormwater-related inspections and maintenance.

d. Minor Storm Sewer and Water Quality Improvements – There may be occasional public pressure to address minor storm sewer or drainage problems and water quality issues within the City. The projects are often difficult to fund and to obtain wide community support due to perceived limited benefit.

2. Corrective Action:

a. General – To maintain water quality and protect against flooding, development will need to follow an orderly process of site evaluation, design, and construction inspection. Construction activities will need to include erosion prevention practices and site development will need to incorporate stormwater ponds and storm drainage facilities for the control of surface waters.

b. Roadways – Private road maintenance and improvement projects will need to address stormwater quantity and quality issues such as wetland protection, slope stabilization, culvert capacity, erosion, and pretreatment of stormwater.

c. Pond and Storm Sewer Maintenance – A citywide pond and storm sewer maintenance program is implemented (per MS4 Phase II requirements) and funded to regularly inspect, clean, and maintain private stormwater facilities. Maintenance agreements should be established identifying maintenance programs, responsible parties, and consequences for non-compliance. **Map 14** shows existing storm sewer systems within the city.

d. Minor Storm Sewer and Water Quality Improvements – Minor stormwater-related improvements should be identified and prioritized as they occur.

SECTION V – IMPLEMENTATION PROGRAM

This section identifies the various methods, programs and official controls available to the City for the implementation of this SWMP. Many of these items are already in place and currently utilized by the City.

A. City Regulatory Controls

The City has various regulatory controls to manage and protect water resources and reduce stormwater-related impacts in the community. The following presents each of the official controls:

Wetland Regulation

The City has designated its responsibility as the LGU under the Minnesota WCA to VLAWMO and VLAWMO will review wetland impacts in accordance with the State wetland law and rules and the VLAWMO Water Management Plan.

Subdivision Ordinance

The City has adopted a Subdivision Ordinance controlling the land use and development of property within the community. In addition to other items, the ordinance addresses City project review and approvals, development of steep slopes, the necessity of erosion and sediment control plans, design standards for stormwater facilities and required drainage and utility easements.

Stormwater Management and Erosion Control Plans

The City will perform its role as the Local Water Planning Authority (LWPA) in its partnership with VLAWMO and through the City permitting process will enforce compliance with VLAWMO standards and rules as well as with the MPCA NPDES Construction Stormwater General Permit.

Wetland Protection

The City will coordinate with VLAWMO as the permitting authority for wetlands protection in conformance with the State WCA laws and rules.

Dredging

The City will not assume responsibility for permitting this activity. This permitting responsibility will be administered by VLAWMO, State and Federal agencies.

Shoreland and Streambank Improvements

The City will assume responsibility for permitting this activity through its Shoreland District Ordinance.

B. Management Programs

The City will implement or encourage the following water resource-related management protection programs.

Buffer Requirements

The City will require natural, unmaintained wetland buffers consistent with VLAWMO standards riparian to lakes, wetlands and waterways in development proposals. In addition, the City will encourage the placement of natural buffers around all City-owned waterbodies.

Best Management Practices

NOHOA will sweep paved roadways at least one time per year with highest priority given to roadways draining directly to waterbodies untreated.

NOHOA will perform stormwater facility inspections and maintenance for the City per NPDES MS4 permit requirements.

Public Education

The City will continue its public education program to foster sound water resource protection practices within the community and to develop additional strategies necessary to protect the City's water-related amenities.

Water Quality Monitoring

The City will support the efforts of VLAWMO, SPRWS, MPCA and other agencies collecting water samples in the city.

C. Stormwater Design and Performance Standards

The City will use the following design and performance standards to manage stormwater, reduce flooding impacts, and plan for future development.

Maximum Flow Rates

1. General Standards - Maximum stormwater discharge rates will be controlled on a sub-watershed district basis to not exceed the existing sub-watershed district flow rates.
2. Exception – Sub-watershed district discharges may exceed existing conditions provided the stormwater conveyance system in the downstream district is adequate to convey the additional discharges and will not adversely affect receiving waterbodies.
3. Roadway culverts - During roadway maintenance operations or improvements, sub-district outlet culverts will be sized to accommodate identified discharge flow rates and be at least 15-inches in diameter.

Ponding Facilities

If stormwater ponding facilities are proposed, they shall be designed and constructed in accordance with the water quantity and quality requirements of this SWMP and the VLAWMO WMP. Detention ponds shall be designed for the 100-year critical design storm event with multi-staged

outlets to control the 2-, 10-, and 100-year, 24 hour storm events. Privately-owned water quality ponds shall meet the MPCA's recommendations or equivalent performance standards. Stormwater ponds shall include a skimmer to prevent migration of oils and other floating pollutants to downstream receiving waters. Additional pond design standards are provided in Section VII.

Stormwater Conveyance Systems

Trunk storm sewer and conveyance systems downstream of ponds or other stormwater storage areas shall be capable of conveying the 100-year storm event discharge from the storage facility. Lateral storm sewers within site developments shall be designed for the 10-year storm event. Roadway culverts shall be designed to convey the 10-year storm event with a minimum of 1-foot of freeboard between the street and surcharged culvert high water level. **Map 14** shows existing storm sewer systems. Natural drainage ways used for trunk or lateral storm drainage shall be bio-engineered or structurally armored to prevent erosion.

Floodplain Standards and Minimum Building Floor Elevations

Storage volumes below floodplains and projected 100-year HWLs shall be maintained. Fill which displaces storage volumes below floodplains, if allowed, shall be mitigated within the same floodplain. Filled and excavated areas below the floodplain shall be protected to prevent erosion. The lowest floor of new buildings shall be constructed a minimum of three feet above the project 100-year high-water elevations or MDNR OHW (whichever is higher) of nearby surface water bodies or stormwater ponds. The lowest opening elevations must be two feet above the emergency overflow elevations for adjacent water bodies or stormwater ponds.

Incorporation of Additional Stormwater Best Management Practices

The City will encourage the use of infiltration practices, where feasible. Where infiltration is infeasible, the City will encourage use of alternative BMPs in place of, or in addition to, stormwater ponds. All BMP designs shall adhere to the guidance provided by the MPCA Minnesota Stormwater Manual and will be subject to the same flood protection requirements as stormwater ponds. Additional alternative BMP design standards are presented in Section VII.

D. Phase II MS4 General Permit Program

The MPCA has issued permit coverage to the City to discharge stormwater as defined in the MS4 General Permit (MNR040000). The intent of the Phase II NPDES MS4 Program is to help municipalities to reduce or control the amount of stormwater runoff, both in the form of water quality and rate control. Another key component is to educate businesses and the public about proper stormwater management. The program is comprised of six minimum control measures (MCMs). Those measures are:

1. Public education and outreach
2. Public participation/involvement
3. Illicit discharge, detection, and elimination

4. Construction site runoff control
5. Post-construction site runoff control
6. Pollution prevention/good housekeeping

To obtain the MS4 permit coverage, the City must develop a SWPPP that contains BMPs for each MCM. These MCMs must have attainable goals for each BMP. BMPs are defined by the MPCA as practices to prevent or reduce the pollution of the waters of the state, including schedules of activities, prohibitions of practices, and other management practices, and also includes treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge, or waste disposal or drainage from raw material storage.

The current Phase II NPDES MS4 General Permit (MN R 040000) is available online to view and is located on the MPCA website. The website also contains additional information on the MS4 Phase II program including guidance and further explanations. The City has submitted yearly annual reports showing compliance to permit requirements. The current permit will be in effect until August 1, 2018. At that time, the MPCA will re-issue the permit for a period of five years. The City SWPPP is available for review at the City offices.

SECTION VI – IMPLEMENTATION PRIORITIES AND FINANCIAL CONSIDERATIONS

A. Implementation Priorities

This SWMP has presented an implementation program identifying those various regulatory controls, management programs and potential capital improvements that are necessary to address City surface water resource-related needs and funding capabilities. Table 2 below prioritizes the implementation program. It is the City's position that regulatory controls and management programs will be effective once this SWMP is adopted by the City Council. Capital improvements will need to be implemented and funded by private parties or the City based upon city growth, demand, and available resources.

Table 2. Implementation Program Priorities

Ranking	Implementation Program Description
1	Adequate planning and engineering review of all new development or redevelopment sites and roadway improvements for conformance with goals, policies, and management objectives of this SWMP.
2	Inspection and enforcement of erosion prevention measures for site development and agricultural land uses.
3	Inspection of stormwater facilities and providing adequate maintenance as required.
4	Acquire easements for ponding areas, stormwater facilities, and for access to outlet control structures.
5	Continued implementation of the public information and education plan.
6	Construct or require construction of capital improvements to address future stormwater-related problems.

B. Financial Considerations

Implementing this SWMP will have financial impacts on the City. The paragraphs below describe the implementation item and the anticipated cost of the associated regulatory control or management program. These are not necessarily new costs to be budgeted by the City since many of these costs are already being charged back to developments or included within current City programs. The anticipated costs of future capital improvements are not included in this SWMP since none are needed at this time. The subsection to follow identifies estimated funding the City requires to implement these programs and future capital improvements.

1. The City will review site plans and other proposed projects for conformance with this SWMP. The estimated cost for this item is $5,000-10,000 per year. These costs will generally be recouped from new developments.
2. The City will inspect and enforce erosion control measures identified in this SWMP. The estimated cost for inspection is $15,000-20,000 per year. Permit fees associated with building activities will recover portions of these costs.
3. The City will inspect stormwater basins, ponds, and outfalls every other year at a minimum. The City will also inspect all structural pollution control devices every year. Structural devices include trap manholes, sump manholes, floatable skimmers and traps, and separators. The estimated cost for this task is $5,000-7,000 per year.
4. Acquisition of easements around ponding areas, stormwater facilities or for access to outlet control structures will be identified during the City project review process. Some easements can potentially be obtained during the project review process. The additional cost for this item will vary greatly based on project approval conditions and the value and use of property within the easement areas.
5. Funding needed to provide the public information and education plan. The plan is part of Phase II NPDES MS4 permit requirements. The estimated cost to provide education mailings is $1,000 to $5,000 per year. The City will work to share educational resources with other concerned parties such as VLAWMO, the RCD and other parties concerned with stormwater management.
6. Construction of capital improvements addressing future surface water problem areas or anticipated problems due to development will require detailed engineering feasibility studies, construction documents and property easements. The specific improvements will need to be determined based on need, cost, and availability of funds.

C. Funding Sources

The City currently uses general tax revenues and development fees to fund the programs identified in this SWMP. While the general tax revenues and fees can likely fund the regulatory and management programs, alternative resources will generally be required to fund larger capital improvement projects.

Other revenue sources available to the City include the use of special assessments and existing homeowner association funds. A watershed management tax is used by VLAWMO as its funding source. The City will review each potential funding source and determine the most appropriate and acceptable course of action for each program or project.

SECTION VII – STORMWATER MANAGEMENT PLAN AND EROSION CONTROL STANDARDS

All new construction or redevelopment projects generating or disturbing over 1.0 acres of impervious surfaces will be required to prepare and submit a stormwater management plan and erosion control plan for review to VLAWMO and City meeting the following standards. All construction sites, regardless of size, will be required to provide and maintain minimum erosion prevention and sediment control measures during construction. The VLAWMO TMDL may include waste load allocations.

A. Stormwater Management Plan Standards:

1. The City of North Oaks has adopted performance goals consistent with those outlined by the MPCA Minimal Impact Design Standards (MIDS). For new, nonlinear development, these standards require retention of 1.1 inches of runoff from proposed impervious surfaces. Nonlinear, redevelopment projects are required to retain 1.1 inches of runoff from all new and/or fully reconstructed surfaces on site. Linear projects are required to retain the greater of either 0.55 inches of runoff from fully reconstructed impervious surfaces or 1.1 inches of runoff from the net increase in impervious surfaces.

2. The 'MIDS Design Sequence Flow Chart' outlines flexible treatment options should the site contain any design restrictions such as, but not limited to, poor quality soils, shallow bedrock, or groundwater contamination.

3. The rate of runoff from a developed site shall not exceed peak direct runoff discharges that existed prior to development. The rate of runoff from a redeveloped site shall not exceed peak direct runoff discharges that exist at the time of redevelopment. In cases where peak direct discharge rates are not identified, the developed peak rates shall not exceed existing conditions for the 2-,10-, and 100-year storm events.

4. All proposed stormwater BMPs shall be required to maintain or improve stormwater quality prior to discharge from the site. BMP's shall be designed in accordance with MPCA Minnesota Stormwater Manual standards or equivalent performance standards.

5. All ponding facilities (wet detention basins, dry ponds, infiltration basins, etc.) shall be located at or above the 100-year flood elevation at the site and shall provide easement areas for future access, vegetative buffers and prevention of future encroachments or filling. Ponding outlets on wet detention basins shall include skimmer devices to remove oils and other pollutants. Skimmer device inlets must be placed at least 1 foot below the treatment pond's established NWL.

6. The volume of site runoff may not increase due to the proposed project when the receiving area downstream is landlocked and not capable of accommodating the increased volume of runoff. In landlocked areas, the City will encourage construction of a stormwater outlet system and will require easements around ponded water areas and the downstream conveyance systems. A 100-

year, 10-day runoff event (9.94 in.) shall be used to determine flood impact to any landlocked area when no outlet can feasibly be provided.

7. Runoff draining onto a site must be accommodated in the analysis and design of new stormwater management facilities.

8. The lowest floor of new buildings shall be constructed a minimum of three feet above the project 100-year high-water elevations or MDNRR OHWL (whichever is higher) of nearby surface water bodies or stormwater ponds. The lowest opening elevations must be 2' above the emergency overflow elevations for adjacent water bodies or stormwater ponds. Emergency overflows shall be provided and identified on plans to protect structures against flooding.

9. Stormwater design analysis shall utilize an industry standard hydrograph, routing method and time of concentration determination. Storm sewer lateral systems for individual sites shall be analyzed utilizing the rational method. Stormwater pond areas and downstream conveyance systems shall be designed for the 100-year, 24-hour storm event with a multi-staged outlet to control the 2-, 10-, and 100-year, 24 hour storm events to pre-development levels. Lateral storm sewers shall be designed to accommodate the 10-year storm event. Runoff "C" values and IDF curves used for the rational method shall be in accordance with MnDOT Drainage Manual, dated September 27, 2005, as revised herein.

10. BMPs will be required to comply to all MPCA standards regarding infiltration/filtration and will be subject to approval by the VLAWMO and the City Engineer. Example BMP's include:

- infiltration basins
- organic filters
- filtration basins with underdrain discharge
- proprietary filters
- disconnected impervious
- rainwater gardens
- bioretention areas
- off-line retention areas
- green roofs
- underground (in)filtration systems
- sand filters
- enhanced swales
- natural depressions
- rainwater reuse
- pervious pavement
- tree trenches

If basins are approved, the owner must provide a maintenance agreement for each basin constructed. The City will not maintain private infiltration basins.

11. Alternative stormwater BMPs will be allowed where practicable and feasible. Each individual BMP downstream conveyance system shall be designed for the 100-year, 24-hour storm event and at the point of ultimate discharge, the flow-rates must be below existing conditions for the 2-, 10-, and 100-year events. The alternative BMP's must also have emergency overflows provided. The BMP or the series of BMP's must show treatment levels that meet or exceed MPCA standards and must use acceptable engineering methods. Once approved by the City, the developer must provide a copy of the MPCA Stormwater Permit pertaining to the Permanent Stormwater Management System before construction can begin.

B. Erosion Control Standards

1. Proposed erosion control plans shall show location and type of all temporary and permanent erosion control BMP's on the plan. Detail plates shall be provided for all structural BMPs that are used for either temporary or permanent erosion control.

2. The plan shall show proposed methods of retaining waterborne sediments on-site during the construction period and proposed restoration, covering or re-vegetation after construction.

3. The plan shall show locations of any temporary sediment basin(s). Temporary Sedimentation Basins shall be designed in accordance with Part III.C of the MPCA "Stormwater Discharge associated with Construction Activity" (MN R100001) permit.

4. Sites with high erosion potential characterized by steep slopes or erodible soil will be required to provide site-specific construction recommendations by a Soils Engineer for City review. Steep slopes shall be defined as areas of 18 percent or more slope. In addition, a financial surety may be required to ensure performance.

5. If work is being done inside the "Critical Areas" as defined by the MNRRA, the plan shall show no proposed grading in areas equal to or greater than 18 percent slope.

6. If infiltration basins are proposed for the construction site, a note must appear on the plan stating; "The infiltration basin area(s) cannot be used to treat construction site runoff, and shall not be constructed to final grade until the contributing drainage area achieves final stabilization and is approved by the City Engineer." In addition, the following statement shall also appear; "The proposed infiltration basins shall be roped off as not to allow heavy construction site traffic to enter any basin and the basins shall be staked off before any construction can begin."

7. If any disturbed soil is located within 200 lineal feet of a "surface water" as defined by the MPCA, and the area has a continual positive slope to the "surface water", the exposed area must provide temporary erosion protection, or permanent cover according to Part IV.B.2 of the MPCA MN R100001 Permit. Those areas requiring temporary erosion protection or permanent cover shall be identified on the plans.

    a. All sediment control practices shall be installed according to Part IV.C 'Sediment Control Practices' portion of the MPCA MN R100001 Permit.

    b. The erosion control plan shall provide rock construction entrances for all entrances where heavy construction traffic will enter. Those entrances must be clearly identified on the plan.

8. Proposed design, suggested location and phased implementation of effective, practicable erosion control measures for plans shall be designed, engineered and implemented to achieve the following results

    a. Prevent gully and bank erosion: and,

b. Limit total off-site permissible annual aggregate soil loss for exposed areas resulting from sheet and rill erosion to an annual, cumulative soil loss rate not to exceed 7.5 tons per acre annually.

9. The City shall receive documentation that the NPDES General Stormwater Permit for Construction Activity application has been approved from the MPCA, as well as any other approved applications, as required, for the construction site, such as the Subdivision Registration form, Permit Transfer/Modification form, and the Notice of Termination form

SECTION VIII – AMENDMENT PROCEDURES

It is the City's intention to have this SWMP reviewed by VLAWMO and the Met Council in accordance with Minnesota Statutes, Section 103B.235. After approval from VLAWMO, it will be adopted by the City Council and incorporated into the City's Water Resource Library.

This SWMP has been prepared to extend through the year 2020. The SWMP may need to be updated on occasion to conform to the VLAWMO WMP and this SWMP may need to be updated on occasion for conformance with the Ramsey County Groundwater Protection Plan.

If the City proposes changes to this SWMP before year 2020, the changes and their impacts will be determined by the City to be either a "minor" change or a "major" change. The general descriptions of minor or major changes and the associated review and approval requirements are presented as follows:

Minor Changes would include small adjustments to sub-watershed district boundaries or other minor changes that would not significantly affect the rate or quality of stormwater runoff discharged across the municipal boundary or significantly affect high-water levels within the city. For proposed minor changes, the City will prepare a document, which defines the change and includes information on the scope and impacts of the change. The document will be forwarded to VLAWMO for their records. The minor change will be implemented after the document is adopted by the City Council.

Major Changes are those that could have significant impacts on the rates, volumes, water qualities and water levels of stormwater runoff within the city or across its municipal boundaries. For proposed major changes, the City will prepare a document which defines the change and includes information on the scope and impacts of the change. The document will be forwarded to VLAWMO for their review and approval. VLAWMO shall have 60 days to comment on the proposed revisions. Failure to respond within 60 days will constitute approval. After VLAWMO approval, the City will adopt the amendment as part of the SWMP.

APPENDIX A

STORMWATER AND SURFACE WATER ACRONYMS

BFE – Base Flood Elevation *http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/base_flood_elevation.shtm*

BMP – Best Management Practice

BWSR – Minnesota Board of Water and Soil Resources *www.bwsr.state.mn.us*

CERCLIS – Comprehensive Environmental Response, Compensation, and Liability Information System *http://www.epa.gov/superfund/sites/cursites/index.htm*

CIP – Capital Improvements Program

CN – Curve Number *http://directives.sc.egov.usda.gov/17752.wba*

DWSMA – Drinking Water Supply Management Area *http://www.health.state.mn.us/divs/eh/water/swp/whp/index.htm*

EPA – Environmental Protection Agency *www.epa.gov*

FEMA – Federal Emergency Management Agency *www.fema.gov*

FIRM – Flood Insurance Rate Map *http://www.fema.gov/library/viewRecord.do?id=1480*

FIS – Flood Insurance Study *http://www.fema.gov/library/viewRecord.do?id=1480*

FWS – Fish and Wildlife Service *www.fws.gov*

HEC – RAS-Hydrologic Engineering Centers River Analysis System *www.hec.usace.army.mil*

HSG – Hydrologic Soil Group *http://directives.sc.egov.usda.gov/viewerFS.aspx?hid=21422*

HWL – High Water Level

IDF – Intensity Duration Frequency

ISTS – Individual Sewage Treatment Systems *www.pca.state.mn.us/programs/ists/*

LOMR – Letter of Map Revision *http://www.fema.gov/library/viewRecord.do?id=1480*

LGU – Local Government Unit *www.bwsr.state.mn.us/wetlands/wca/index.html*

LWMP – Local Water Management Plan (i.e. Surface Water Management Plan)

MCM – Minimum Control Measure *www.pca.state.mn.us/water/stormwater/stormwater-ms4.html*

MDNR – Minnesota Department of Natural Resources *www.dnr.state.mn.us*

MNDOT – Minnesota Department of Transportation *www.dot.state.mn.us*

MPCA – Minnesota Pollution Control Agency *www.pca.state.mn.us*

MS4 – Municipal Separate Storm Sewer System *www.pca.state.mn.us/water/stormwater/stormwater-ms4.html*

NFRAP – No Further Remedial Action Planned *www.pca.state.mn.us/backyard/neighborhood.html*

NPDES – National Pollutant Discharge Elimination System *http://cfpub.epa.gov/npdes/*

NRCS – National Resource Conservation Service *www.nrcs.usda.gov*

NWI – National Wetland Inventory *www.nwi.fws.gov*

NWL – Normal Water Level

OHWL – Ordinary High Water Level *www.dnr.state.mn.us/waters/watermgmt_section/pwpermits/ohw.html*

PWI – Protected Waters Inventory *www.dnr.state.mn.us/waters/watermgmt_section/pwi/index.html*

RCRA – Resource Conservation and Recovery Act http://www.epa.gov/epawaste/inforesources/online/index.htm

SCS – Soil Conservation Service *(see Natural Resource Conservation Service)*

SPRWS – St. Paul Regional Water Services

SSTS – Subsurface Sewage Treatment Systems (*see ISTS*)

SWPPP – Storm Water Pollution Prevention Plan or Program

TR-20 – Technical Release 20 *http://www.wsi.nrcs.usda.gov/products/w2q/H&H/docs/other/TR20_user_man.pdf*

TMDL – Total Maximum Daily Load www.pca.state.mn.us/water/tmdl/index.html

USCOE – United States Corps of Engineers *www.mvp.usace.army.mil*

USDA – United States Department of Agriculture *(see Natural Resource Conservation Service)*

VIC – Voluntary Investigation and Cleanup *www.pca.state.mn.us/cleanup/vic.html*

VLAWMO – Vadnais Lake Area Water Management Organization www.vlawmo.org

WCA – Wetland Conservation Act *www.bwsr.state.mn.us/wetlands/wca/index.html*

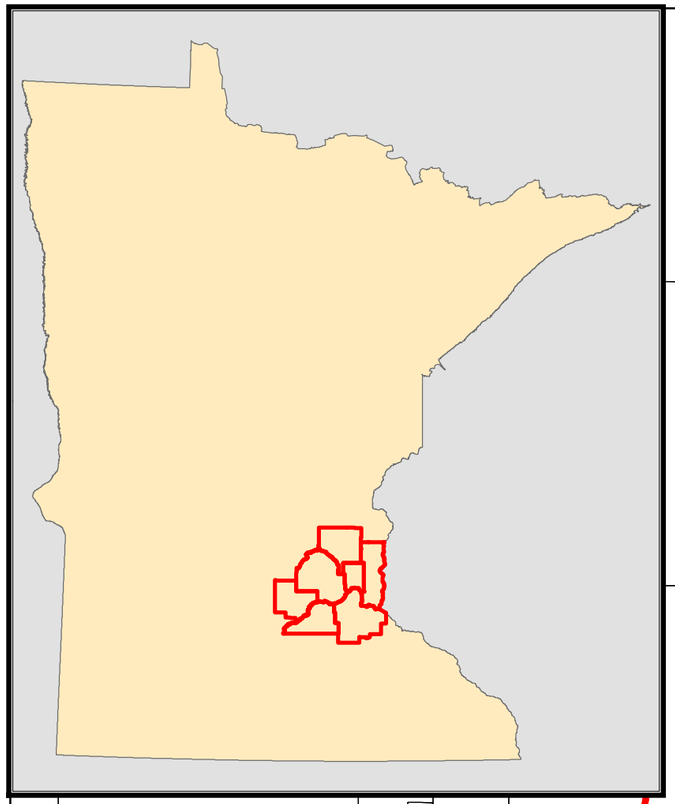
WMO – Watershed Management Organization(s) *(see MN State Statute 103B.205)*

APPENDIX B

MAPS

City of North Oaks Local Water Plan

MAP 1: Location Map



Ham Lake
Columbus
Forest Lake
Scandia
ANOKA
Lino Lakes
Marine on St. Croix
Blaine
Centerville
Hugo
May Twp.
Lexington
Circle Pines
Spring Lake Park
Mounds View
North Oaks
White Bear Twp.
Dellwood
WASHINGTON
Stillwater Twp.
Fridley
Grant
Shoreview
New Brighton
Arden Hills
White Bear Twp.
White Bear Lake
Mahtomedi
Birchwood Village
Willernie
Vadnais Heights
Gem Lake
Stillwater
Hilltop
Columbia Heights
Medina
New Hope
Crystal
Pine Springs
Oak Park Heights
Plymouth
Robbinsdale
St. Anthony
Little Canada
Roseville
Maplewood
North St. Paul
Bayport
Baytown Twp.
HENNEPIN
RAMSEY
Medicine Lake
Lauderdale
Falcon Heights
Orono
Golden Valley
Oakdale
Lake Elmo
Wayzata
Minneapolis
West Lakeland Twp.
Woodland
St. Louis Park
St. Paul
Landfall
Deephaven
Minnetonka
Hopkins
Lilydale
Shorewood
West St. Paul
Woodbury
Afton
Edina
Mendota
South St. Paul
Fort Snelling (unorg.)
Mendota Heights
Richfield
Sunfish Lake
Newport
DAKOTA
Chanhassen
Eden Prairie
Inver Grove Heights
Bloomington
Eagan
St. Paul Park
Cottage Grove
Denmark Twp.

North Oaks
Counties
Cities and Townships

N
W
E
S

0 1.5 3 Miles

Sambatek

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City of North Oaks Local Water Plan

MAP 2: General Surface Geology

City Boundary

HOLOCENE

sh — **Stream sediment**—Sand and gravel with areas of fine sediment and organic material (slack-water deposits)

oh — **Organic sediment**—Includes peat, shallow lakes, and marshes. Some deposits, identified from older maps and air photographs, may now be excavated and/or artificially filled. Highly organic soil delineated in more detail in Ramsey County soil survey (Vinar, 1980)

hh — **Hillside sediment**—Deposits on and at base of steep slope. Angular bedrock fragments, with silt and clay where bedrock is exposed, slumped till where till

PLEISTOCENE

sw — **Stream sediment of Glacial River Warren**—Sand and gravel with some fine sediment (silt and clay). Forms terraces of the Mississippi River. Generally less than 20 ft thick but as much as 40 ft over Paleozoic bedrock and 100–200 ft thick in part of terrace in downtown St. Paul (the site of the initiation of River Warren falls) (see Plate 5, Depth to bedrock)

Deposits Associated with the Grantsburg Sublobe

lcg — **Clayey lake sediment**—Clay and silt, with fine sand; locally rhythmically bedded (silt-clay-silt-clay). Offshore deposits of a former lake that may have been partially confined by stagnant ice; rare dropstones

lsg — **Sandy lake sediment**—Fine to medium sand; silt and clay; scattered dropstones. Offshore and some nearshore deposits of a former lake that may have been partially confined by stagnant ice

sg — **Meltwater stream sediment**—Medium to coarse sand with pebbles. Sand predominantly quartz; distinguished from Superior lobe sand by presence of Cretaceous shale, limestone, and rare lignite grains. Shale and lignite common in coarse-sand fraction; may be concentrated in layers. In channels and outwash plains

tg — **Till**—Typically loam-textured till; ranges from loamy sand to clay. Gray, oxidizes to yellow brown. Commonly banded with reddish-brown Superior lobe till or sand. Thick yellow-brown (or gray) bands, with thin red stringers, near land surface; with depth, yellow bands thin as red layers thicken

tmg — Till with stream-modified surface—Till topography modified by running water; locally fluvially eroded and streamlined. Covered in some places with thin, discontinuous sand and gravel. In other respects, texture similar to map unit tg

tsg — Till beneath stream sediment—Till beneath as much as 20 ft of stream sediment (map unit sg)

tpg — Collapsed till—Till deposited on or with ice that then melted, resulting in collapse

tlg — Till beneath sandy lake sediment—Till beneath as much as 20 ft of sandy lake sediment (map unit lsg)

Deposits Associated with the Superior Lobe

ss — **Meltwater stream sediment**—Medium to coarse sand with pebbles. Predominantly quartz sand; red and black igneous and metamorphic pebbles and sand-size grains. In channels and in a remnant of an outwash plain in southeastern part of county

cs — **Coarse meltwater stream sediment**—Medium to coarse sand and gravel with cobbles and boulders. In eskers; also near the former ice margin, commonly in fans at the mouths of tunnel valleys. Combined with map unit ss on cross section (Plate 4)

cbs — **Buried, coarse meltwater stream sediment**—Buried by as much as 40 ft of Grantsburg till (map unit tg)

lis — **Sediment of ice-walled-lake plains**—Deposited in lakes surrounded by stagnant ice of the Superior lobe; coarse sediment (sand and gravel) along former lake rims, finer sediment (sand, silt, and clay, rhythmically layered in some places) near former lake centers. Forms flat-topped uplands in moraine complexes in southeastern and east-central Ramsey County

ts — **Till**—Texture commonly sandy loam; in some places, clay loam to silty clay. Reddish brown. Locally compact. Fabric visibly expressed by clast orientation. Till surface not extensively or deeply pitted, although difficult to judge in highly urbanized areas

tps — Collapsed till and supraglacial sediment—Deposited on or with ice that then melted; possibly resedimented; texture similar to map unit ts , or sandier. As a result of local ponding may include clay and organic sediment in depressions

tms — Till with stream-modified surface—Till topography modified by flowing water. Till prominences commonly form low, streamlined hills (former bars in channels).

PREGLACIAL DEPOSITS

b — **Exposed or nearsurface Paleozoic bedrock**—Typically on steep slopes and terraces along the Mississippi River. See Plate 2, Bedrock geology, for first bedrock unit

tb — **Shallowly buried Paleozoic bedrock**—Buried by as much as 20 ft of Grantsburg till (map unit tg)

0 0.3 0.6 Miles

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City of North Oaks Local Water Plan

MAP 3: Sensitivity of Water Table System to Pollution

City Limits

Sensitivity Rating

- Very High sensitivity
- High sensitivity
- Moderate sensitivity
- Low sensitivity
- Lake

N W E S

0 0.15 0.3 0.6 Miles

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City of North Oaks Local Water Plan

MAP 4: Land Erosion Runoff Susceptibility

- City Limits
- No Limitations
- Moderate Limitations Slopes/Soils
- Moderate Limitations Groundwater
- Severe Limitations Slopes/Soils
- Severe Limitations Groundwater
- Water

N
W E
S

0 0.15 0.3 0.6 Miles

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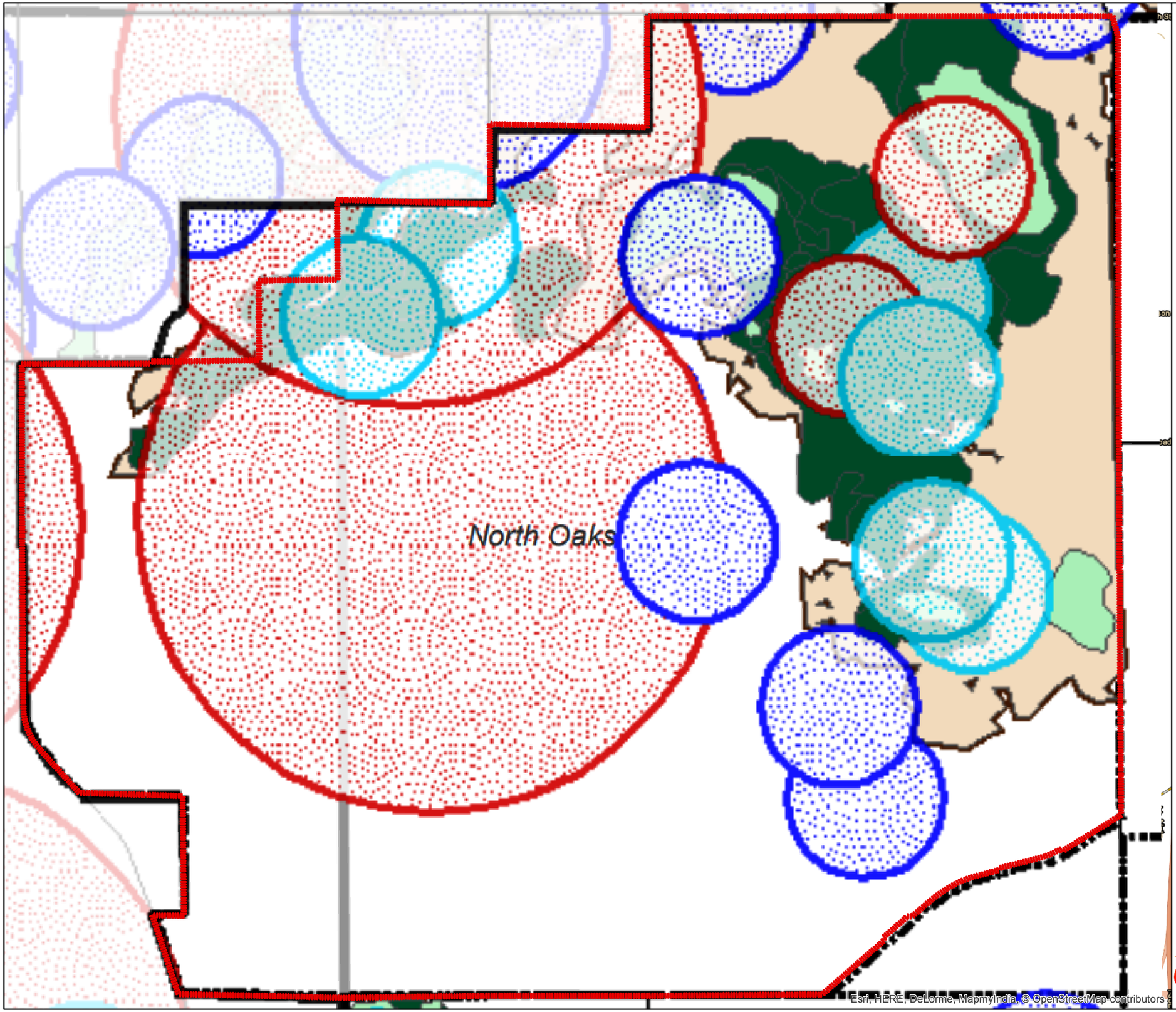
City of North Oaks Local Water Plan

MAP 5: Rare Natural Features



City Limits

2030 Framework Regional Natural Resource Areas

- Moderage
- High
- Outstanding
- MCBS_Native Plant Communities
- MCBS_Sites of Biodiversity Significants
- Minnesota State Parks

Rare Natural Features

- Vertebrate Animal
- Community
- Invertebrate Animal
- Nonvascular Plant, Fungus
- Vascular Plant
- Animal Assemblage
- Geologic

N
W E
S

0 0.15 0.3 0.6 Miles

Source: Vadnais Lake Area Water Managment Organization Water Management Plan

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City of North Oaks Local Water Plan

MAP 6: Scenic Areas

- City Limits
- Aquatic Management Area
- Fish Management Area
- Other Forest Land
- Scientific and Natural Area
- State Forest
- State Park
- State Recreation Area
- State Trail
- State Wayside
- Water Access
- Wildlife Management Area
- Native Plant Communities

Areas of Biodiversity Significance

- Outstanding
- High
- Moderate
- Below

N W E S

0 0.15 0.3 0.6 Miles

Source: MPCA, What's In My Neighborhood Database

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City of North Oaks Local Water Plan

MAP 7: 2016 Existing Land Uses

- City Limits
- Single Family Residential
- East Oaks PUD
- Multi Family Residential
- Mixed Residential
- Mixed Use
- Commercial
- Limited Industrial
- Institutions
- Historic Preservation
- Golf Course
- Recreation
- Conservation Open Space
- Water

N
W E
S

0 0.15 0.3 0.6 Miles

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City of North Oaks Local Water Plan

MAP 8: Well Locations & Wellhead Protection Area Map

City Limits

Well Locations

Wellhead Protection Area

N

W E

S

0 0.15 0.3 0.6 Miles

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City of North Oaks Local Water Plan

MAP 9: DNR Waters & NWI Wetlands

- City Limits
- Major Water Bodies
- Wetlands (NWI)
- Public Waters Inventory

N W E S

0 0.15 0.3 0.6 Miles

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City of North Oaks Local Water Plan

MAP 10: FEMA 100-Year Floodplain

FLOOD_ZONE

- A
- AE
- City Limits

N
W E
S

0 0.175 0.35 0.7 Miles

*Alignments as shown are approximate. Please refer to record drawins for actual utility locations.

Sambatek

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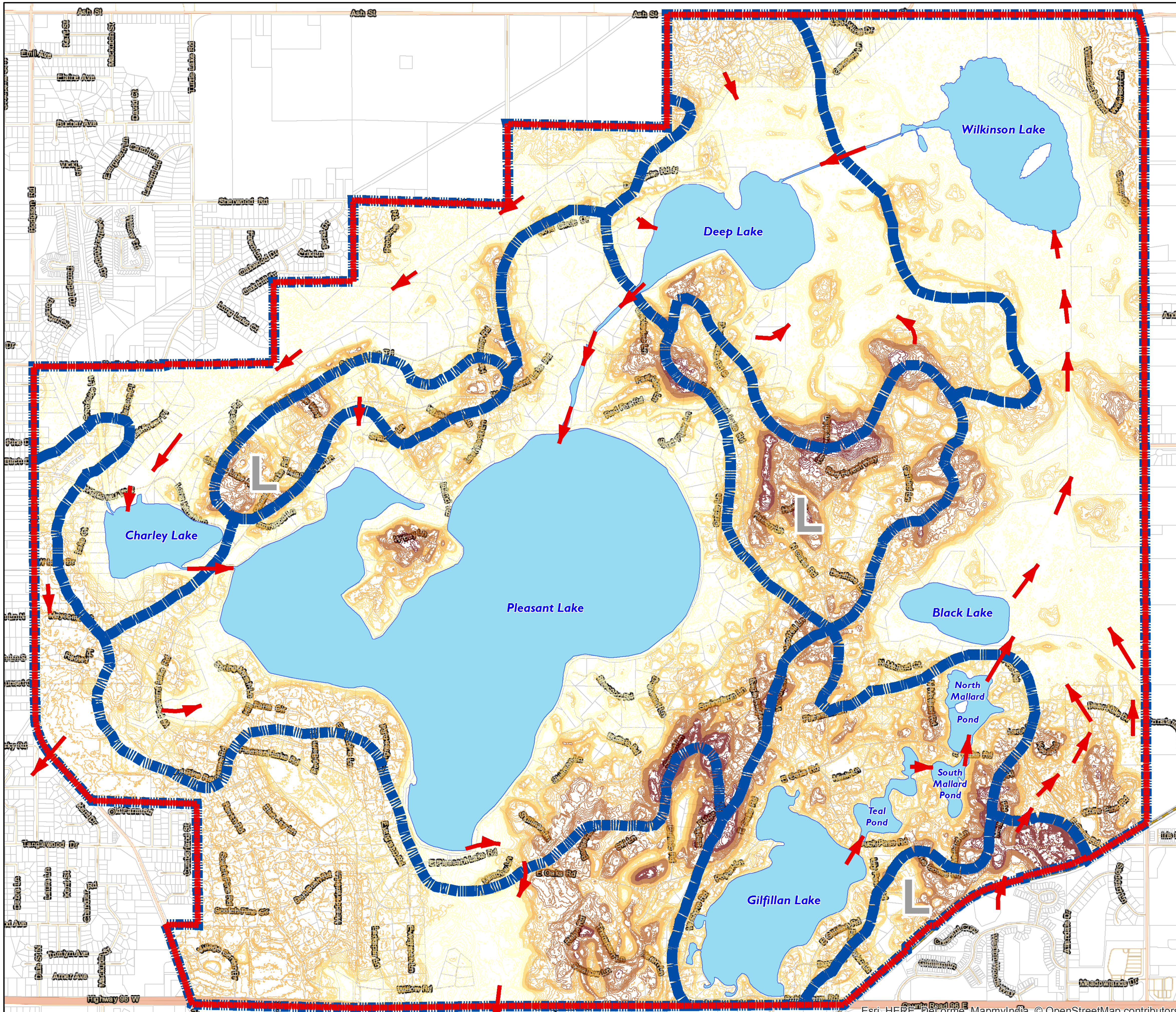

City of North Oaks Local Water Plan

MAP 11: Sub-Watershed Boundaries

City Limits
General Direction of Drainage
Water
Major Watersheds

Elevations

884 - 906
907 - 920
921 - 938
939 - 962
963 - 1004

Landlocked

N E S W

0 0.15 0.3 0.6 Miles

*Alignments as shown are approximate. Please refer to record drawins for actual utility locations.

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City of North Oaks Local Water Plan

MAP 12: VLAWMO Wetlands Map

RAMSEY

White Bear TWP

Wilkinson (62-43 P)

Deep (62-18 P)

North Oaks

Charley (62-62 P)

Pleasant (62-46 P)

Black (62-19 P)

Gilfillan (62-27 P)

Ox (62-25 W)

City Limits

NWI

VLAWMO Wetlands

- Preserve
- Manage 1
- Manage 2
- Manage 3

N W E S

0 0.15 0.3 0.6 Miles

Source: VLAWMO

Sambatek

City of North Oaks Local Water Plan

MAP 13: Potential Pollution Sources

City Limits

Sites

- Air Quality
- Environmental Review
- Feedlots
- Hazardous Waste
- Investigation and Cleanup
- Multiple Programs
- SSTS
- Solid Waste
- Stormwater
- Tanks
- Water Quality

N
W E
S

0 0.15 0.3 0.6 Miles

Source: MPCA, What's In My Neighborhood Database

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City of North Oaks Local Water Plan

MAP 14: Storm Sewer Systems

- City Limits
- Storm Sewer Lines
- Storm Sewer Structures
- Storm Water Pond

N
W E
S

0 0.15 0.3 0.6 Miles

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City of North Oaks Local Water Plan

MAP 15: Areas Served by Municipal Sewer

- Met Council Meter Locations
- Sanitary Sewer Connection Points
- Centerville Trunk Line
- Private sewer line
- Regional Interceptor

Service Types

- Future Service Area
- Sewer Only
- Sewer and Water
- City Limits

N W E S

0 0.175 0.35 0.7 Miles

*Alignments as shown are approximate. Please refer to record drawings for actual utility locations.

Sambatek

City of North Oaks Local Water Plan

MAP 16: Existing Water Systems

Wilkinson Lake
Deep Lake
Charley Lake
Pleasant Lake
Black Lake
North Mallard Pond
South Mallard Pond
Teal Pond
Gilfillan Lake
Ash St
County Road 86 E
Highway 96 W
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

City Limits
Existing Water Main
Future Water Service Areas

N
W E
S

0 0.175 0.35 0.7 Miles

*Alignments as shown are approximate. Please refer to record drawings for actual utility locations.

Sambatek