

Local Surface Water Management Plan

City of Lakeland Shores, Minnesota

SEH No. LAKSH 104829

April 2009



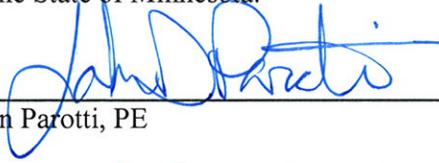
Multidisciplined. Single Source.
Trusted solutions for more than 75 years.

Local Surface Water Management Plan
City of Lakeland Shores, Minnesota

SEH No. LAKSH 104829

April 2009

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



John Parotti, PE

Date: April 2, 2009 Lic. No.: 24677

Reviewed by: David F. Simons 4/2/09
Date

Table of Contents

Certification Page
Table of Contents

	Page
1.0 Introduction.....	1
1.1 Purpose.....	1
1.2 Executive Summary	1
1.3 Inter-Agency Agreements	1
1.3.1 Middle St. Croix Watershed Management Organization (MSCWMO).....	1
2.0 City Review Process.....	1
3.0 Land Use.....	2
3.1 Location	2
3.2 Existing Land Use	2
3.3 Future Land Use	2
3.4 Additional Land Use Control	3
3.4.1 Shoreland.....	3
3.4.2 Floodplain.....	3
4.0 Hydrologic Setting.....	3
4.1 Regional Climate.....	3
4.2 Surface Water Resources.....	4
4.2.1 Wetlands	4
4.2.2 Swales and Detention Areas.....	4
4.3 General Drainage Patterns	4
4.4 Hydrologic Modeling	5
4.4.1 Design Storm	5
5.0 Geology and Hydrogeology.....	6
5.1 Soils	6
5.2 Surficial Hydrogeology	6
5.3 Bedrock Geology	7
5.4 Bedrock Hydrogeology.....	7
5.5 Recharge Zones	7
5.6 Recent Groundwater Studies.....	7
5.7 Pollutant Sources.....	8
5.7.1 Existing Pollutant Sources	8
5.7.2 Potential Future Pollutant Sources.....	8
5.7.3 Fish and Wildlife Habitat.....	9
5.8 Water Based Recreation.....	9
6.0 Goals and Policies.....	9
6.1 Goal No. 1 - Water Quantity.....	10
6.1.1 River Flooding	10

Table of Contents (Continued)

6.1.2	Storm Water Runoff.....	11
6.2	Goal No. 2 – Water Quality	12
6.2.1	Street Sweeping.....	13
6.2.2	Fertilizing Lawns.....	13
6.2.3	Structural Best Management Practices	13
6.3	Goal No. 3 - Erosion Control.....	14
6.4	Goal No. 4 - Public Participation, Information and Education	15
6.5	Goal No. 5 - Maintenance and Inspection.....	16
6.6	Goal No. 6 – Recreation, Fish and Wildlife	17
6.7	Goal No. 7 – Ground Water	18
6.8	Goal No. 8 - Finance.....	19
6.8.1	Ad Valorem Tax	20
6.8.2	Special Tax District.....	20
6.8.3	Special Assessments	20
6.8.4	Development Charges.....	20
6.8.5	User charges	20
6.8.6	Grants	20
6.9	Goal No. 9 - Drainage Pattern Mapping.....	22
7.0	Implementation	23
7.1	Implementation Priorities	23
7.2	Amendment Procedures	24
7.2.1	Request for Amendments.....	24
7.2.2	Staff Review	24
7.2.3	Council Consideration	24
7.2.4	City Council, MSCWMO and County Approval	24
7.2.5	Council Adoption	24
7.2.6	Annual Report to Council	25

Table of Contents (Continued)

List of Tables

Table I Average Annual Values for Weather Data	4
Table III.D.1. Rainfall Depths for 24-hr Event (USWB TP-40)	6
Table V Summary of Goals	10
Table V.A. Goal No. 1 Water Quantity Action Plan	11
Table V.B. Goal No. 2 – Water Quality Action Plan	14
Table V.C. Goal No. 3 -Erosion Control Action Plan.....	15
Table V.D. Goal No. 4 - Information and Education Action Plan.....	16
Table V.E. Goal No. 5 -Maintenance and Inspection Action Plan.....	17
Table V.F. Goal No. 6 Recreation, Fish and Wildlife Action Plan	18
Table V.G. Goal No. 7 - Groundwater Action Plan.....	19
Table V.H.1. Advantages and Disadvantages of Different Funding Alternatives	21
Table V.H.2. Goal No. 8 - Finance	22
Table V.I. Goal No. 9 Drainage Pattern Mapping.....	23
Table VI Lakeland Shores LSWMP Implementation Summary.....	23

List of Figures

- Figure 1 – Water Resources Inventory
- Figure 2 – SSURGO Soil Map

Local Surface Water Management Plan

Prepared for City of Lakeland Shores

1.0 Introduction

1.1 Purpose

The City of Lakeland Shores has developed this Local Surface Water Management Plan (LSWMP) to comply with Minnesota Statute and the requirements of the Middle St. Croix Watershed Management Organization (MSCWMO). This plan shall serve as a guide for development and redevelopment within the City of Lakeland Shores as well as for the implementation of future public improvements within the City.

The City of Lakeland Shores will continue to work with the watershed to implement policy and code revisions to protect valuable natural resources.

1.2 Executive Summary

The City of Lakeland Shores' Local Surface Water Management Plan summarizes the existing drainage patterns, and discusses the hydrologic and hydrogeology systems within the City. It further identifies known drainage issues and outlines goals, policies and implementation strategies for addressing surface water management efforts within the City.

1.3 Inter-Agency Agreements

1.3.1 Middle St. Croix Watershed Management Organization (MSCWMO)

The MSCWMO operates under a joint powers agreement executed by the City of Lakeland Shores on February 5, 2008. Lakeland Shores is one of ten member communities in the joint powers agreement and appoints one manager and one alternate to the WMO board each year. The Joint Powers Agreement requires that the City develop its own Local Water Management Plan to be approved by the WMO Board. This Plan is intended to meet the requirements of the MSCWMO 2006 Watershed Management Plan and State Statute which requires that the City adopt the MSCWMO Watershed Management Plan.

2.0 City Review Process

Given that that City of Lakeland Shores is a small community with limited growth opportunities, staff resources are limited. As a result, the process for obtaining project review and approval typically begins with the City Clerk who then directs the applicant to the appropriate City contact.

The City is part of a ten-member joint powers agreement (JPA) under which the Middle St. Croix Watershed Management Organization (MSCWMO) is operated. As a JPA, the MSCWMO has the authority to issue permits but chose instead to implement its watershed management plan through its member communities. Therefore, MSCWMO staff reviews project plans (when they qualify for review) and provides comments to the City which are then included as part of the City's overall review and approval process.

The following outlines the City review process:

Step 1. Initial City Contact. A potential applicant is to contact the City Clerk to initiate the project review process. The Clerk directs the applicant to the appropriate City staff, commission or consultant based on the understanding of the project as presented by the applicant.

Step 2. Staff/Consultant Review. When requested, staff will provide an initial review of a project to determine the appropriate City review and approval process. Staff will also advise the City and applicant if watershed review and/or permitting are required. Any project meeting the review qualifications (or triggers) listed in Section 6.2.1 of the MSCWMO 2006 Watershed Management Plan (latest version), shall be referred to the WMO for review.

Step 3. City Council Review. The City Council shall consider all projects requiring its review and shall consider input and recommendations from staff, commissions and consultants as well as input from the watershed when appropriate.

Step 4. City Approval. The City will not approve projects which require watershed permitting without the required permits. However, at the City Council's discretion, conditional approval may be given to projects which require watershed permitting provided the project not begin until the appropriate permit has been obtained and a copy provided to the City.

3.0 Land Use

3.1 Location

The City of Lakeland Shores lies along the eastern boarder of Washington County. The City is bounded by the City of Lakeland on the north, west and south sides. The St. Croix River is located along the City's east corporate limit.

3.2 Existing Land Use

The City of Lakeland Shores is currently divided into four zoning districts. Three of the zones are residential, and the fourth is commercial with residential allowed. See the existing land use section of the City's Comprehensive Plan for a detailed discussion of existing land use.

3.3 Future Land Use

At this time, there are no changes planned for land use, and it is anticipated that the existing land use plan will not change. See the existing land use section of the City's Comprehensive Plan for a detailed discussion of land use.

3.4 Additional Land Use Control

3.4.1 Shoreland

The City has adopted the Lower St. Croix River Bluffland and Shoreland Management Ordinance in compliance with the Minnesota Department of Natural Resources Standards and Criteria for the Lower St. Croix National Scenic Riverway (NR 2200-2202).

3.4.2 Floodplain

The City participates in the National Flood Insurance Program (NFIP). The City of Lakeland Shores Flood Plain Management Ordinance, which was adopted in accordance with Minnesota Statutes Chapter 103F and Chapter 462, is based on the effective Flood Insurance Study (FIS) for the City of Lakeland Shores (dated September 26, 1975). The St. Croix River (Lake St. Croix) is the primary flooding source within the City of Lakeland Shores.

4.0 Hydrologic Setting

4.1 Regional Climate

The climatology of Minnesota is described in the U.S. Geological Survey Water-Supply Paper 2375 as follows:

Minnesota is affected by a variety of air masses. In winter, the weather is dominated by cold, dry, and polar continental air masses from northwestern Canada. In summer, the weather is dominated by dry, tropical continental air masses from the desert Southwest or by warm, moist, tropical maritime air masses from the Gulf of Mexico. In spring and fall, the weather is transitional and is affected by alternating intrusions from these three air masses.

Almost 45 percent (about 12 inches) of Minnesota's annual precipitation is received from June through August, when moisture from the Gulf of Mexico is most available. Only 8 percent of the annual precipitation is received from December through February.

Cyclonic and convective storms are the two major types of storms that bring moisture into Minnesota. Cyclonic storms are large-scale, low-pressure systems associated with frontal systems that approach the State from the northwest or southwest. Cyclonic storms that approach from the northwest are common in winter and produce small quantities of precipitation. Cyclonic storms that approach from the southwest occur in the fall, winter, and spring and can bring substantial quantities of rain or snow by drawing moisture northward from the Gulf of Mexico. Cyclonic storms in combination with unstable conditions can produce severe weather and excessive precipitation.

In late spring and summer, thunderstorms are common. These small-scale convective storms typically form because of the presence of unstable, warm, tropical air near the surface and colder air above.

Floods in Minnesota are of two forms--large-scale floods in late winter and early spring and small-scale flash floods in late spring and summer. Large-scale floods generally result from a combination of deep, late winter snowpack, frozen soil that prevents infiltration, rapid snowmelt

due to an intrusion of tropical air, and widespread precipitation caused by cyclonic storms that approach the State from the southwest. Flash floods result from powerful, slow-moving thunderstorms.

Average annual values for various weather data components for the Lakeland Shores area are listed below in Table 1.

Table I
Average Annual Values for Weather Data

Weather Data	Value
Annual Normal Temperature	43°
Annual Normal Precipitation	29 inches
Annual Runoff Depth	4.7 inches
Storm Duration	6 hours
Storm Intensity	1.4 inches per hour
Time Between Storm Midpoints	89 hours

Additional description of the climate of the area is provided in the Middle St. Croix Watershed Management Organization (MSCWMO) Watershed Management Plan.

4.2 Surface Water Resources

4.2.1 Wetlands

The Water Resources Inventory Map shows the location and type of wetlands within the City of Lakeland Shores. The St. Croix River is listed on the National Wetlands Inventory as a shallow open water resource. There are no other known wetlands within the City.

4.2.2 Swales and Detention Areas

The City does not have a formal storm sewer system, although there are small sections of storm sewer in some areas, such as the crossing under Division Street Court. Instead, storm runoff typically flows in shallow swales along road edges and between homes. Some properties contain shallow depressions where water may stand for a short time after a heavy rain or during a snow melt event. Because of the high infiltration rates of the soils, water typically drains into the ground shortly after a rainfall event, except when the ground is frozen.

The former gravel pit areas located north of Division Street on both sides of Quinlan Avenue function as detention areas for storm water. Standing water is not normally observed in these areas due to the high infiltration rate of the soils. The exception is when the ground is frozen and a snow melt event occurs.

4.3 General Drainage Patterns

Drainage patterns within Lakeland Shores vary depending on the location within the City. In the southeast quadrant of the City (south of Division Street and east of Quinlan Avenue), storm water runoff generally drains to the St. Croix River. The exception is a strip of land adjacent to Quinlan

Avenue that drains north to the former gravel pit area located east of Quinlan Avenue.

In the southwest quadrant of the City (south of Division Street and west of Quinlan Avenue), drainage patterns are split with some of the land draining west to CSAH 18, and some draining north to the former gravel pit area.

In the northeast quadrant (north of Division Street and east of Quinlan Avenue), drainage patterns are again split. Much of the area west of Lakeland Shores Road drains to the former gravel pit located east of Quinlan Avenue. The area east of Lakeland Shores Road drains to the St. Croix River.

In the northwest quadrant (north of Division Street and west of Quinlan Avenue), most of the area drains to CSAH 18, except for the area immediately surrounding the former gravel pit, which drains to the former gravel pit.

In general, there are few concentrated discharge points to these downstream receiving areas. Instead, the surface waters generally sheet flow into swales or shallow ditches where run-off either infiltrates or discharges to the downstream receiving areas at numerous locations.

Storm water which drains to CSAH 18 is picked up in the County's storm drainage system. This drainage system consists of inlets, storm sewer piping, ditches and storm water basins. Storm water originating in Lakeland Shores and draining to CSAH 18 is taken to one of several detention areas located in Lakeland. The goal of these detention areas is to infiltrate the storm water to the greatest extent possible.

With no formal storm sewer system in place, periodic flooding has occurred in some areas along roadways. For example, there is a persistent localized flooding problem at the northwest corner of 3rd Street North and Quixote Avenue. This is a low point in the road that where the water has little opportunity to flow off of the road and infiltrate.

4.4 Hydrologic Modeling

When designing components of a drainage system, the City must designate the criteria to be used to evaluate proposed designs. The criteria selected will have a direct impact on system capacity and the risk of localized flooding. While there has not been a hydrologic model created for the City of Lakeland Shores, the following shall be used when designing and evaluating the level of risk associated with drainage improvements.

4.4.1 Design Storm

The 24-hour duration, Natural Resources Conservation Service (NRCS) Type II rainfall distribution with average soil moisture conditions (AMC-2) will be used for overall sub-watershed planning within the City of Lakeland Shores. The rainfall depths for storms associated with various return periods is shown below in Table III.D.1. This criterion is consistent with the MSCWMO standards.

**Table III.D.1.
Rainfall Depths for 24-hr Event
(USWB TP-40)**

Return Period	Rainfall Depth (inches)
1-yr	2.3"
2-yr	2.7"
5-yr	3.5"
10-yr	4.1"
50-yr	5.3"
100-yr	5.9"

The choice of a design storm is largely an economic rather than a technical decision. For instance, a culvert designed to convey flow from the 50-yr rainfall event is likely to be larger and more costly than one designed to convey flow from the 10-yr event. Accordingly, the City may choose to use design criteria that fits a given condition (i.e. use a larger event to design critical components with higher flood risks and lesser events to design low risk components). The City should deliberately consider the level of service desired on a case-by-case basis when it chooses the recurrence interval used in any construction project. The minimum design storm for local collection system evaluation and design will be a 10-year return period event. Local drainage systems will generally be designed using the Rational Formula.

Any new construction or development has the potential of increasing runoff rates and volumes. Development and redevelopment must include facilities to provide water quality treatment and control runoff at or below existing rates and volumes as required by the MSCWMO. Variances from plan standards may be considered if computations can be provided to the City Engineer's satisfaction that demonstrates no adverse upstream or downstream effects will result from the proposed system. Variance requests may also be subject to MSCWMO review.

5.0 Geology and Hydrogeology

5.1 Soils

Soils in Lakeland Shores are typified by gently sloping sandy loams and loamy sands formed on outwash plains and outwash terraces. Loams will typically be underlain by brown gravelly coarse sands. The soils are generally very well drained, brown or dark brown in color, and have a high rate of permeability. In many areas, natural fertility and organic matter content are low. Available water holding capacity and runoff are also low. In general, the soils are suitable for building sites and on-site septic systems, although mound systems may be required in some areas. The soils have a fair suitability to growing crops, but due to the low available water holding capacity, fertilizing and watering is typically necessary. A map of soil types is included in this plan.

5.2 Surficial Hydrogeology

The geology within the City of Lakeland Shores consists of layers of river terrace deposits overlying bedrock. In much of southern Washington County, the saturated portion of the glacial drift is primarily outwash sand

and gravel deposits. The water from the local groundwater table is most easily obtained from these outwash deposits with broad areas of till acting as confining layers. Groundwater flow in the unconsolidated glacial deposits is generally southeast toward the St. Croix River. Based on the Minnesota Geologic Survey Atlas, the water table in the City ranges from approximately elevation 675 to elevation 700 feet above mean sea level. Actual water table elevations are affected by fluctuations in St. Croix River elevations.

5.3 Bedrock Geology

According to the Minnesota Geological Survey, the bedrock surface in Lakeland Shores lies at an elevation that varies from approximately 550 feet to 600 feet above mean sea level. Ground surface elevations in Lakeland Shores vary from 675 feet to 740 feet above mean sea level. This means that the depth to bedrock in Lakeland Shores is generally on the order of 100 to 150 feet. The City of Lakeland Shores sits on the eastern side of the Twin Cities basin, a bowl-like structure in the bedrock. At this location, the bedrock strata dips gently toward the west. The youngest and stratigraphically highest bedrock underlying the City of Lakeland Shores is the Ironton and Galesville Sandstones. Beneath the Ironton and Galesville Sandstones is the Eau Claire Formation and the Mt. Simon Sandstone respectively.

5.4 Bedrock Hydrogeology

Major bedrock aquifers underlie the City of Lakeland Shores. They are the Franconia-Ironton-Galesville, and the Mount Simon-Hinckley. These aquifers are separated by lower permeability confining layers. The Eau Claire Confining Layer separates the Franconia-Ironton-Galesville Aquifer from the deepest aquifer, the Mt. Simon-Hinckley Aquifer. The flow direction in the bedrock aquifers is generally east toward the St. Croix River.

5.5 Recharge Zones

Recharge to the bedrock aquifers beneath the City of Lakeland Shores occurs both vertically and horizontally. Vertical recharge occurs through overlying glacial sediments and other bedrock aquifers. Horizontal recharge occurs as ground water moves laterally from outside the City, through the aquifer. The horizontal recharge to the bedrock aquifers within Lakeland Shores comes from the west. Recharge to the water table aquifer occurs primarily from precipitation and surface water groundwater interactions as well as laterally from west of the City. Lakes, wetlands, depressions, and landlocked basins are all characteristic of the western part of the watershed. Water drains to these vital areas and infiltrates into the groundwater system to later be discharged in the eastern portion of the watershed.

5.6 Recent Groundwater Studies

There are several recent groundwater studies that are available for review from Washington County. They include:

Intercommunity Groundwater Protection – Sustaining Growth and Natural Resources in the Woodbury/Afton Area, 2005. This project was completed in 2005 with the purpose of developing a predictive tool that can be used to evaluate the sustainability of groundwater withdrawals in the

Woodbury/Afton area. The study focuses on the potential effects of pumping of new Woodbury municipal wells on stream flows in nearby Valley Creek, a designated trout stream.

Integrating Groundwater & Surface Water Management – South Washington County, 2005. This study was completed in 2005 and was commissioned to develop a tool for planners and water resource managers to assist them in making decisions to balance land use needs with protection of groundwater and surface water resources.

Washington County Groundwater Plan, 2003. The overall goal of this plan was to protect the economic and environmental values groundwater provides through coordinated, intergovernmental efforts in research and assessment, policies, political influence, regulation, education, consultation and technical assistance.

Cottage Grove Nitrate Study, 2003. This project was completed in 2003 and was initiated to evaluate the increasing trend of nitrate-nitrogen concentrations in the Prairie du Chien and Jordan aquifers in southern Washington County.

5.7 Pollutant Sources

5.7.1 Existing Pollutant Sources

Pollution of water resources in and around Lakeland Shores comes from both non-point sources and point sources. Non-point pollution sources from agricultural and low density residential areas can generally be characterized as widespread and relatively dilute, but significant in its accumulation. Factors contributing to non-point pollution include soil erosion, chemical fertilizers and pesticides, construction site erosion, and gully and stream channel erosion.

In 1987, the Minnesota Department of Health (MDH) issued a Well Advisory for Lakeland and Lakeland Shores. Wells were identified with higher than average volatile organic compounds (VOCs). At least two sources of plumes were identified in the area, one with fluorocarbons and petroleum products (Ray’s Truck Stop Plume), and the other with solvents. As a result of VOC’s detected in nearly 200 wells, the communities of Lakeland, Lakeland Shores and Lake St. Croix Beach were connected to a municipal water system. According to a recent discussion with the project manager from the Minnesota Pollution Control Agency (MPCA), well sampling has been ongoing for years, and they are currently conducting another round of sampling to include sampling of some new wells.

The well monitoring data collected by the MPCA to date indicates that the plumes are fully contained, and the MPCA hopes to “close” the site in the next year or two. In order for the site to be closed, the MPCA must determine that it no longer poses a health risk.

5.7.2 Potential Future Pollutant Sources

Future pollutant sources could result from either point or non-point sources. One such possibility is that of an uncontrolled spill. Since Lakeland Shores has no commercial, retail, or industrial land uses, the likelihood of such a

spill is much lower than in communities where these uses do exist. For this reason, the City has not identified the need for separate spill containment and clean up plan. However, the potential for a spill still exists, and if a spill does occur, the City would follow the recommendations of the Minnesota Division of Homeland Security and Emergency Management which asks local authorities to first call 911 when there is a threat to life or property. The Minnesota Duty Officer [(651) 649-5151] will be notified if there is a public safety or environmental threat and/or if state agency notification is required. Once contacted, the City will follow direction given by the State Duty Officer.

5.7.3 Fish and Wildlife Habitat

Lakeland Shores is home to a variety of fish and wildlife. The St. Croix River and adjacent areas contains many species of fish and attracts many types of waterfowl. Geese, ducks, and other migratory birds are very common. Upland game animals such as deer can also be found in Lakeland Shores.

5.8 Water Based Recreation

The St. Croix River is one of Lakeland Shores' key assets. Water based recreation is plentiful on the St. Croix River. Activities include but are not limited to fishing, swimming, water skiing, jet skiing, sail boating, and pleasure boating in general. The City has no public beach or boat landing, but does have considerable river frontage under private ownership. Public beaches are located in Lakeland to the north and in Lake St. Croix Beach to the south.

6.0 Goals and Policies

This section of the plan identifies nine goals for water resources planning and management functions. The goals of this plan are consistent with the goals of the Middle St. Croix Watershed Management Organization which has jurisdiction in Lakeland Shores.

Each goal has several corresponding policies. A goal is defined as a desired end toward which management efforts are directed. A policy is defined as a governing principle that provides the means for achieving established goals. The goals are summarized in Table V.

**Table V
Summary of Goals**

Goal No.	General Goal Category	Goal Statement
1	Water Quantity	Minimize property damage, expenses and inconvenience associated with periodic flooding of the St. Croix River and from large storm water runoff events.
2	Water Quality	Minimize impact of future development activities and current land use practices on water quality of the St. Croix River.
3	Erosion Control	Minimize or control soil erosion through enforcement and education.
4	Public Participation, Information and Education	Increase public participation and knowledge in management of the water resources.
5	Maintenance and Inspection	Preserve the function of water resource facilities through routine inspection and regular maintenance activities.
6	Recreation, Fish and Wildlife	Manage water recreation activities and improve fish and wildlife habitat, enhancement, and protection.
7	Ground Water	Prevent contamination of the aquifers and promote groundwater recharge.
8	Finance	Establish funding sources to finance water resources management activities.
9	Drainage Pattern Mapping	Create a City-wide map of existing drainage patterns.

6.1 Goal No. 1 - Water Quantity

Minimize property damage, expenses and inconvenience associated with periodic flooding of the St. Croix River and from large storm water runoff events.

Water quantity concerns in Lakeland Shores include periodic flooding of properties along the St. Croix River due to high river elevations.

6.1.1 River Flooding

River flooding has occurred periodically in the community. Major flooding events on the St. Croix River have occurred in 1965, 1969, 1993, 1997, and 2001. It is anticipated that the St. Croix River will continue to flood on a periodic basis. Accordingly, the City encourages river front owners to stabilize the shoreline in front of their homes to minimize erosion and other property damage that may occur during future flooding events. In addition, for any structures that are located in the flood plain, the City encourages property owners to consider either elevating existing structures or to flood proof to an elevation above the 100 year flood level. At this time, the City is aware of only one structure that is located in the flood plain, and that structure has been flood proofed.

6.1.2 Storm Water Runoff

The volume, rate, and quality of storm water runoff are directly related to surface coverage. The type of surface coverage is related to the land use. Impervious surfaces have less detention storage, deliver water faster downstream, and have larger negative impacts on water quality than pervious surfaces. Controlling the impervious area reduces the impacts of urbanization. The City presently has a land use ordinance with maximum impervious surface requirements based upon the zoning district.

Collecting and managing the runoff prior to discharge to downstream conveyance systems and water resources mitigates the impact of urbanization. Examples include infiltration swales along property lines, rain gardens, detention areas, drainage structures, etc. This approach to water quantity management relates directly to water quality, erosion control, and land development strategies.

The City currently requires that all construction projects which include grading, take necessary measures to control runoff by allowing no increase in volume for the 2, 10 and 100-year rainfall events and, in some cases, mitigate existing localized flooding issues. Watershed requirements relating to storm water quantity controls will also be followed as required. By doing a better job at managing the quantity of runoff, the other goals of this plan can be met.

Table V.A. Goal No. 1 Water Quantity Action Plan

Subject:

- Management of surface water, both from flooding of the St. Croix River and from storm water runoff.

Purpose:

- To reduce flooding damage and control storm water runoff.

Goal:

- Minimize property damage, expenses and inconvenience associated with periodic flooding of the St. Croix River and from large storm water runoff events.

Water Quantity Policies:

Policy 1.1: For new construction or reconstruction/remodeling projects, best management practices shall be implemented to limit runoff in accordance with applicable watershed standards. Examples include infiltration swales, detention areas, rain gardens, etc.

Policy 1.2: The City will implement the Middle St. Croix Watershed Management Organization Policies and Performance Standards regarding water quantity for new construction and reconstruction when required to do so.

Policy 1.3: The City intends to fully implement its responsibilities under the NFIP and encourages property owners in the flood plain to consider stabilizing their shoreline to protect against future

**Table V.A. Goal No. 1
Water Quantity Action Plan**

damage and either elevating existing structures or flood proofing existing structures to an elevation above the 100 year flood level.

- Policy 1.4:** Properties must make use of drainage swales, detention areas, drainage structures or other techniques to keep drainage on the property and to avoid directing drainage onto other adjacent properties.
- Policy 1.5:** The minimum building elevation (lowest floor elevation) for all new structures must be a minimum of 2 feet above the established 1% Annual Chance Flood level. The 1% Annual Chance Flood elevation for the St. Croix River in Lakeland Shores is 692. The corresponding minimum building elevation is 694.
- Policy 1.6:** Increased volumes of runoff due to development should be minimized by limiting impervious cover and by requiring infiltration of storm water in accordance with applicable watershed standards.
- Policy 1.7:** The City encourages the use of alternative landscape techniques and materials to reduce rates and volumes of runoff (rain gardens, porous pavers, etc.) and will require their use when necessary to comply with WMO rules.
- Policy 1.8:** Property owners must maintain runoff control and infiltration practices in good working order, to function as intended at the time of approval.

6.2 Goal No. 2 – Water Quality

Minimize impact of future development activities and current land use practices on water quality of the St. Croix River.

Water quality of water bodies is generally evaluated by the public based upon the clarity of the water. The water clarity is a function of the algae present in the water, and the amount of algae is generally dependant upon the amount of available phosphorus. Hence, water quality is directly related to the available phosphorus. The St. Croix River has been listed by the Minnesota Pollution Control Agency as nutrient-impaired due to high phosphorous levels. The St. Croix Basin Water Resources Planning Team, comprised of state, federal and local representatives, recommends a 20-percent reduction in total phosphorous loading to the river.

Storm water runoff from urbanized areas contains phosphorus and also contains other contaminants such as heavy metals. Heavy metals can bioaccumulate causing problems for wildlife and fish.

These contaminants and nutrients are generally associated with sediment in the runoff. Controlling sediment (Total Suspended Solids [TSS]) that is discharged to water bodies controls the elements that impact water quality.

Since there are no storm sewer point source discharges to the St. Croix River within the City of Lakeland Shores, any contaminants or nutrients potentially entering these resources would do so via surface or groundwater flows. Measures that minimize the amount of pollutants available to enter the runoff are termed "source control." One source control measure commonly used is street sweeping. Others include a reduction of lawn fertilizer use, and various best management practices.

6.2.1 Street Sweeping

Street sweeping activities presently occur once a year throughout the City, and are performed by the City's maintenance contractor. The City also requires home owners to sweep streets in front of new home projects or remodel projects on an as needed basis. Recent advances in street sweeping technology have significantly increased the removal efficiencies. Sweepers with vacuum technology perform better than traditional broom sweepers. Unfortunately, even with the best sweepers, the fine soil particles are typically not removed from the street, and these are the particles that have the most negative affect on water quality. The City will continue the practice of street sweeping.

6.2.2 Fertilizing Lawns

Property owners generally apply more phosphorus on established lawns than needed. A number of measures including the use of nonphosphate fertilizer can be utilized as source control to minimize the amount of phosphorus applied to the landscape and available for transport to downstream water bodies.

It is difficult to measure the effectiveness of lawn practice alteration due to the human behavior component. Long-term pollutant reductions are possible with the implementation of modified lawn care practices. However, it is difficult if not impossible to regulate the amount of phosphorus placement on lawns. The City of Lakeland Shores will support the MSCWMO education efforts to minimize the amount of phosphorus applied for turf management. This must be an ongoing effort due to the inherent turnover of property owners.

6.2.3 Structural Best Management Practices

When considering applications for new homes or remodeling, the City will require that onsite treatment devices such as swales, rain gardens, and drainage structures be employed whenever possible or as required by the MSCWMO.

Table V.B.
Goal No. 2 – Water Quality Action Plan

Subject:

- Water quality that is discharged to the St. Croix River

Purpose:

- To protect and improve water quality.

Goal:

- Minimize impact of future development activities on water quality of the St. Croix River.

Water Quality Policies:

Policy 2.1: Proposed developments will be required to comply with WMO rules and standards to avoid water quality impacts on receiving waters and mitigate with appropriate best management practices (BMPs).

Policy 2.2: The City will implement the Middle St. Croix Watershed Management Organization Policies and Performance Standards regarding water quality for new construction and reconstruction when required to do so.

Policy 2.3: The City will support the WMO’s information/education efforts to reduce nutrient loadings to rivers.

Policy 2.4: The City will support the WMO’s effort to promote the reduction of hard surfaced areas through the implementation of City ordinances and standards.

Policy 2.5: The City encourages the use of alternative landscape techniques and materials to reduce water quality impacts and will require their use as necessary to comply with WMO rules.

Policy 2.6: The City will manage its properties in accordance with the appropriate best management practices.

6.3 Goal No. 3 - Erosion Control

Minimize soil erosion through enforcement and education.

High phosphorus concentrations generally correlate to poor water quality characteristics. A significant portion of the available phosphorus in storm water runoff bonds with soil particles. Hence, limiting the movement of soil particles (and the associated phosphorus) will benefit downstream water bodies. Soil erosion can also cause problems for drainage way conveyance systems and detention basins. Deposition of eroded material can reduce the effectiveness of these systems and require additional maintenance activities. Soil erosion also can create pond and detention basin performance and maintenance issues.

Drainage facilities are impacted by erosion and sediment from a variety of sources including construction sites and street sanding in the winter. The coarse sediment accumulates in ditches and swales where runoff velocities are low. Usually a sand delta appears at a storm water outfall which is a visible indication of the effectiveness of erosion and sediment control measures and road maintenance activities of the past winter. As the sediment builds up over time, it reduces the runoff carrying capacity of the drainage system and the pollutant removal capabilities of swales by reducing the storage volume. Extending the life and effectiveness of facilities involves source control and elimination of the material that causes the problem.

Table V.C.
Goal No. 3 -Erosion Control Action Plan

Subject:

- Erosion Control

Purpose:

- To prevent and control erosion and the movement of sediment.

Goal:

- Minimize soil erosion through enforcement and education.

Erosion Control Policies:

Policy 3.1: Erosion control plans shall be required for grading activities in accordance with applicable WMO standards.

Policy 3.2: The City will implement the Middle St. Croix Watershed Management Organization Policies and Performance Standards regarding erosion and sediment control for new construction and reconstruction when required to do so.

Policy 3.3: The City may, at its discretion, require an Erosion and Sediment Control Plan review and approval for land disturbing activities that do not require a review from the MSCWMO.

Policy 3.4: Erosion control measures as outlined in Minnesota Stormwater Manual shall be employed as applicable.

Policy 3.5: The City shall support MSCWMO erosion control education efforts. The MSCWMO plan recommends no construction on slopes greater than 12%.

6.4 Goal No. 4 - Public Participation, Information and Education
Increase public participation and knowledge in management of the water resources.

The purpose of public participation, information and education efforts are to:

- Disseminate information regarding the water resources component of the Comprehensive Plan, specifically its goals, standards, and policies; and
- Engender support for the implementation of the goals and policies.

Since the overall goals of the Lakeland Shores Comprehensive Plan and the MSCWMO are very similar, information disseminated by the WMO to meet the WMO's goals will also assist in achieving the goals of Lakeland Shores. The City of Lakeland Shores will support the activities of the WMO in their information and education efforts. Information from the WMO could be included in the City newsletter and will be made available to residents at City Hall. In cooperation with the MSCWMO, the City will distribute information relating to the use of phosphorous fertilizer on lawns and how it effects water quality.

Table V.D.

Goal No. 4 - Information and Education Action Plan

Subject:

- Enhancement of Public Participation, Information and Education

Purpose:

- Encourage active community involvement in water resources management.

Goal:

- To increase public participation and knowledge in management of the water resources of the community.

Public Involvement Policies:

- Policy 4.1:** The City shall support the MSCWMO and other water resource management organizations in their public information efforts.

6.5 Goal No. 5 - Maintenance and Inspection

Preserve the function of water resource facilities through routine inspection and regular maintenance activities.

“It is impossible to overstate the importance of maintenance in the overall storm water management effort. Without maintenance, drainage facilities may deteriorate, their design capacities reduced by accumulated weeds, sediment and debris. Not only will they fail to function as intended, they will become a blight on the urban landscape and in some cases become hazards.” (Engemoen, Michael Mercer and Roger E. Krempel, 1985).

Inspections help to spot potential problems before they become major problems. Routine maintenance reduces the long-term costs related to drainage system maintenance, while achieving water quantity and water quality goals. The application of development standards ensures consistency in the work produced and the documentation of the constructed systems. Appropriate land use controls can be used to maximize the preservation of the natural drainage systems and to control increases in runoff rate, volume and pollutant loading.

Maintenance of private drainage facilities constructed within the City are the responsibility of the property owner.

The City of Lakeland Shores presently sweeps the streets during the spring of each year and will continue to do so at a minimum. Additional street sweeping is performed throughout the summer by contractors as the need arises at various construction sites. This is the property owner's responsibility. The City does not own a street sweeper and street sweeping services are let out for bid.

Table V.E.
Goal No. 5 -Maintenance and Inspection Action Plan

Subject.

Maintenance and Inspection of the Drainage Systems

Purpose:

To maximize system performance.

Goal:

Preserve the function of water resource facilities through routine inspection and regular maintenance activities.

Maintenance and Inspection Policies:

- Policy 5.1:** The City will develop and implement an annual inspection and maintenance plan for water resource facilities.
- Policy 5.2:** The City shall require maintenance of privately-constructed water quality treatment ponds.
- Policy 5.3:** The City shall require adequate maintenance-related access for public and private water resources facilities (i.e., drainage structures, detention basins, etc.).
- Policy 5.4:** The City shall require all new City snow plowing contracts to follow the Minnesota Snow and Ice Control Field Handbook for Snowplow Operators as published by Mn/DOT.

6.6 Goal No. 6 – Recreation, Fish and Wildlife

Improve fish and wildlife habitat and water resource-based recreational opportunities where feasible.

Fish and wildlife habitat are impacted by development activities. These include direct impacts such as conversion of land use, and indirect impacts such as disturbing wildlife corridors or degradation of existing downstream water resources because of impacts to storm water runoff. The impacts can be due to temporary disturbance associated with construction activities or permanent disturbance such as land use conversion.

Wildlife generally need a variety of habitats during their individual life cycles. The ability to connect larger areas and types of habitat is more beneficial than having a number of isolated pockets. In other words, protecting the upland area adjacent to a wetland is generally more advantageous than having the same size upland and wetland areas completely separated. Methods of maximizing the benefit of natural areas by connecting

the habitat types include the maintenance of vegetative buffers and wildlife corridors.

The St. Croix River serves as a wildlife corridor. The preservation of these corridors and development of buffer areas shall be encouraged through the City's land use planning and administration activities. Removal of exotic invasive species such as buckthorn will also be encouraged.

Table V.F.
Goal No. 6 Recreation, Fish and Wildlife Action Plan

Subject:

Water Resource-Based Recreational Activities and Wildlife Interests.

Purpose:

To enhance water recreational opportunities, and fish and wildlife habitat.

Goal:

Improve fish and wildlife habitat and water resource-based recreational opportunities where feasible.

Recreation, Fish and Wildlife Policies:

- Policy 6.1:** Natural areas and wildlife habitat intended for preservation shall be protected during construction by appropriate BMPs.
- Policy 6.2:** Support the preservation and improvement of vegetative buffers around the St. Croix River and the wetlands areas to provide habitat for wildlife.
- Policy 6.3:** The City shall support programs for controlling exotic and invasive species of plants and animals.
- Policy 6.4:** The City will support new opportunities to integrate water based recreation activities and wildlife interests within wildlife corridors.

6.7 Goal No. 7 – Ground Water

Prevent contamination of the aquifers and promote groundwater recharge.

Chapter 5 discusses hydrogeology, recharge zones and pollutant sources. Significant ground water recharge areas are located west of Lakeland Shores, as are several known pollutant sources. Although these recharge areas and pollutant sources are located outside the City, there are some things that the City can control relative to ground water protection. The policies listed below describe some ways in which the City can protect the quality of the ground water.

Table V.G.
Goal No. 7 - Groundwater Action Plan

Subject:

Groundwater Protection

Purpose:

To protect ground water by understanding and accounting for groundwater/surface water interactions.

Goal:

Prevent contamination of the aquifers and promote groundwater recharge.

Groundwater Protection Policies:

Policy 7.1: The City shall promote proper well abandonment when old wells are taken out of service.

Policy 7.2: The City will consider alternatives to conventional storm water detention to enhance groundwater recharge through infiltration.

Policy 7.3: The City will encourage water conservation techniques, especially relative to lawn sprinkling.

Policy 7.4: The City shall encourage the use of alternative landscape techniques and materials to reduce dependency on groundwater supplies (i.e., rain gardens, cisterns, etc.).

Policy 7.5: The City shall support the protection of any recharge areas within or adjacent to the City.

Policy 7.6: The City supports the fundamental goal in the Washington County Groundwater Plan which states *“Protect the economic and environmental values groundwater provides through coordinated, intergovernmental efforts in research and assessment; policies; political influence; regulation; education; and consultation and technical assistance.”*

6.8 Goal No. 8 - Finance

Establish funding sources to finance water resources management activities.

Paying for water management projects has become more complex in recent years.

The major categories of funding sources are 1) Ad Valorem Taxes 2) Special Tax District 3) Special Assessments 4) Development Charges 5) User charges and 6) Grants.

Following is a brief description and financing principles used with each of these financing mechanisms.

6.8.1 Ad Valorem Tax

General taxation is the most common revenue source used to finance government services including minor maintenance measures for drainage and water quality facilities. Using property tax has the effect of spreading the cost over the entire tax base of a community.

6.8.2 Special Tax District

A special tax district can also be used to raise revenue. The special tax district is similar to the administrative structure under general taxation except that all or part of the community may be placed in the tax district. The principle is to better correlate improvement costs to benefited or contributing properties.

6.8.3 Special Assessments

Municipalities are familiar with the use of special assessments to finance special services from maintenance to construction of capital improvements. The assessments are levied against properties benefiting from the special services. The philosophy of this method is that the benefited properties pay in relation to benefits received. The benefit is the increase in the market value of the properties.

6.8.4 Development Charges

Fees charged to new development which generate runoff can be charged to finance infrastructure needed to serve the development. This is a useful tool in communities that are rapidly developing.

6.8.5 User charges

User charges, which support surface water utilities, are mechanisms by which a City can generate funds through billings similar to water and sewer billings. The principle is to charge for services rendered to properties generating runoff, as well as the service to properties being protected from the effects of runoff, without consideration to an increase in market value of the property.

6.8.6 Grants

State grants are available for surface water management and nonpoint source pollution. However, it is generally not a good financial practice to rely on for a service program. This source of revenue is not dependable and requires constant speculation as to its availability.

Grants are useful but should only be used to supplement a planned local revenue source.

Table V.I.1 illustrates the advantages and disadvantages of the different financing methods.

**Table V.H.1.
Advantages and Disadvantages of Different Funding Alternatives**

Funding Method	Advantages	Disadvantages
Ad Valorem Tax	<ol style="list-style-type: none"> 1. Administrative structure for collection in place. 2. Simple and accepted source of revenue. 3. Allows for a larger revenue base. 4. Through tax districts contributions pay. 	<ol style="list-style-type: none"> 1. No incentive to reduce runoff or pollution. 2. No relationship to level of benefits received. 3. Discontinuous source of revenue. 4. Limitations on amount of expenditures due to budget constraints. 5. Competition with other City services (i.e., police, fire).
Special Assessments	<ol style="list-style-type: none"> 1. Only benefited properties pay. 2. Revenues from assessment are applied to a specific project cost. No competition with general services. 3. Benefits directly related to cost for service. 4. Assessment can be deferred in hardship 	<ol style="list-style-type: none"> 1. Rigid procedural requirements. 2. Runoff contributions cannot be assessed. 3. Difficult to determine and prove benefit. 4. May place an unfair burden on some segments of the population.
Development Charges	<ol style="list-style-type: none"> 1. New development generating runoff pays and for runoff management. 2. Administrative structure for reviewing plans and collecting fees is in place. 3. Systems can be tailored to the specific needs through regulatory changes. 4. Revenues are applied to water. 	<ol style="list-style-type: none"> 1. Only address problems within the vicinity of the new development, not usually existing developments. 2. Only address prevention not correction of major problems. 3. Limited usefulness as a financing mechanism. 4. Limited new development pressure within existing City limits.
User Charges	<ol style="list-style-type: none"> 1. Properties causing or contributing to the need for runoff management pay relative to their contribution to the problem. 2. Self-financing system not in competition with general services funds. 3. Existing and new developments both pay. 4. Flexibility in the system. 5. Continuous source of revenues. 6. Specific dedicated fund. 7. Administrative structure for collection already in place. 	<ol style="list-style-type: none"> 1. Some initial costs in development of rate formula and philosophy. 2. May require an expanded administrative structure.
Grants	<ol style="list-style-type: none"> 1. Reduce cost burden to residents in the community. 	<ol style="list-style-type: none"> 1. Undependable source of revenue. 2. Increase administrative costs for securing and managing the funds. 3. Most often grants require cost sharing and thus additional funding source. This results in double administrative costs due to several funding sources. 4. Limited availability on an irregular schedule. 5. Requires considerable lead time from application to receiving funds.

Table V.H.2.
Goal No. 8 - Finance

Subject:

Paying for Water Resources Management

Purpose:

To adequately finance management activities in an equitable manner.

Goal:

Establish funding sources to finance water resources management activities

Finance Policies:

Policy 8.1: The City shall identify and implement possible funding sources for water resources management.

Policy 8.2: The City will pursue grants, where feasible, donations, and in-kind contributions to help fund water resources management.

Policy 8.3: The City shall support citizens and businesses in their efforts to improve water quality, decrease water quantity and/or upgrade wetlands.

6.9 Goal No. 9 - Drainage Pattern Mapping

Create a City-wide map of existing drainage patterns.

In order to better understand and communicate the issues around surface water management, the City will investigate resources available to create a City-wide drainage pattern map. Such a map will be used in evaluating, plans for future drainage system improvements as well as how construction of private property could impact larger drainage issues within the City. The City will investigate existing sources of topographic data as well as potential funding sources for this effort.

**Table V.I.
Goal No. 9 Drainage Pattern Mapping**

Subject:

Mapping of existing City-wide drainage patterns.

Purpose:

Develop a City-wide map of existing drainage patterns.

Goal:

To better understand and communicate drainage-related issues within the City.

Drainage Pattern Mapping Policies:

Policy 9.1: The City shall develop a City-wide drainage pattern map using existing data where available.

Policy 9.2: When available, the City’s drainage pattern map shall be used to provide a basis for reviewing and designing drainage improvements within the City.

7.0 Implementation

The Implementation Section is intended to provide guidance in carrying out the plan objectives. The implementation program summarizes the schedule for recommended actions. Procedures for amending the plan are also discussed. Table VI summarizes the Implementation Schedule of the Lakeland Shores LSWMP.

**Table VI
Lakeland Shores LSWMP Implementation Summary**

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Adopt MSCWMO Watershed Management Plan	X								
Adopt Lakeland Shores Local Surface Water Management Plan (LSWMP)		X							
Create a City-wide Map of Existing Drainage Patterns			X						
Update City Code in Response to Approved LSWMP		X	X						
Update 5-Year CIP	X		X		X		X		X
Information and Education	X	X	X	X	X	X	X	X	X

7.1 Implementation Priorities

The implementation plan includes identification and prioritization of capital improvements, administration, inspections, permitting, plan amendments, financing alternatives, public involvement and monitoring programs. Prioritization of improvements is based on a review of all recommended actions. The activities have been distributed throughout a 9-year implementation plan extending from 2008 through 2016. The Implementation Plan is not a hard and fast commitment to complete each and every activity

in the time frame suggested. Rather, it is a proposed course of action that will accomplish the major goal of this plan, to accommodate growth in the community while protecting the environment.

The City of Lakeland Shores is part of a ten-community joint powers agreement to operate the Middle St. Croix Watershed Management Organization (MSCWMO). It is the City's desire to cooperate with the MSCWMO in implementing the MSCWMP 2006 Watershed Management Plan.

The Implementation Plan should be reviewed on an annual basis. At that time, each proposed improvement is to be reconsidered, City budgets adjusted and additional improvements added to the program.

7.2 Amendment Procedures

The Lakeland Shores LSWMP is intended to extend through the year 2016. For the plan to remain dynamic, an avenue must be available to implement new information, ideas, methods, standards and management. Amendment proposals can be requested any time by any person or persons owning property within the City.

7.2.1 Request for Amendments

Written requests for plan amendment are to be submitted to the City staff. The request shall describe the need for the amendment and shall contain any additional materials that the City will need to consider before making its decision.

7.2.2 Staff Review

A decision is made as to the validity of the request. Three options exist; 1) reject the amendment 2) accept the amendment as a minor issue, with minor issues collectively added to the plan at a later date 3) accept the amendment as a major issue, with major issues requiring an immediate amendment. In acting on an amendment request, staff shall make recommendation to City Council for consideration.

7.2.3 Council Consideration

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

7.2.4 City Council, MSCWMO and County Approval

The City Council could approve of the draft amendments, and if necessary, refer the amendments to the Metropolitan Council, the Middle St. Croix Watershed Management Organization (MSCWMO) and Washington County for comment and approval.

7.2.5 Council Adoption

Final action on an amendment following approval by the MSCWMO is Council adoption.

7.2.6 Annual Report to Council

A brief annual Report should be made by City staff summarizing development changes, capital improvements and other water management-related issues that have occurred over the past year. The review should also include an update on available funding sources for water resource issues. Grant programs are especially important to review since they may change annually.

These changes do not necessarily require individual amendments. The reports can be filed and then be utilized at a later time when the plan is brought up to date. The report should be completed by July 1st to allow implementation items to be considered in the normal budget process. Copies of the report should be filed with the MSCWMO. The annual update can also serve as an important public information tool. A summary could be published in the City's newsletter.

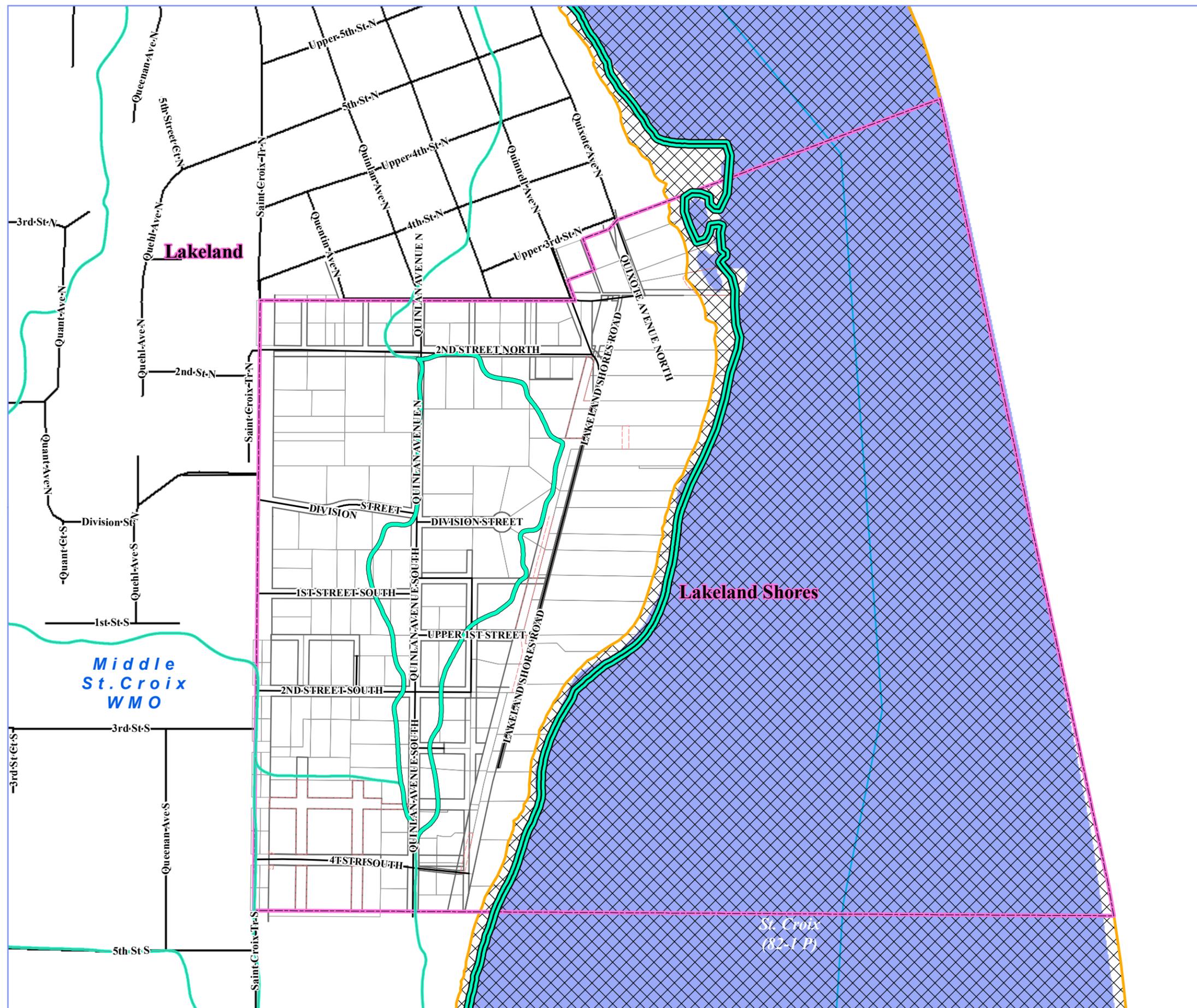
The plan will remain in effect through 2016. At that time, the plan should be reviewed for consistency with current water resources management methods, and revised as appropriate.

List of Figures

Figure 1 – Water Resources Inventory

Figure 2 – SSURGO Soil Map

Map Document: (\\sp3020-1\projects\KOL\laksh\common\GIS\SWMP_Update\FIGURE01_Water_Resources.mxd) 9/4/2008 -- 3:08:48 PM



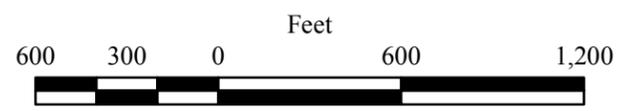
Water Resources Inventory

City of Lakeland Shores

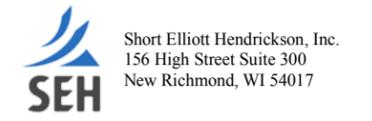
- Major Watershed Boundary
- Subwatershed (Landlocked)
- Subwatershed
- Flood Hazard Zones (Mn/DNR Preliminary DFIRM)**
 - AE - An area inundated by 1% annual chance flooding, for which BFEs have been determined.
 - X - An area that is determined to be outside the 1% and 0.2% annual chance floodplains.
- NWI - Shallow Open Water
- Streams
- Easements
- Right-of-Way
- Parcels
- Municipal Boundary
- Roads



Printing Date: September 4, 2008



Sources:
 Washington County (07/31/2008), Middle St. Croix WMO,
 Metropolitan Council, FEMA, and
 Minnesota Department of Natural Resources

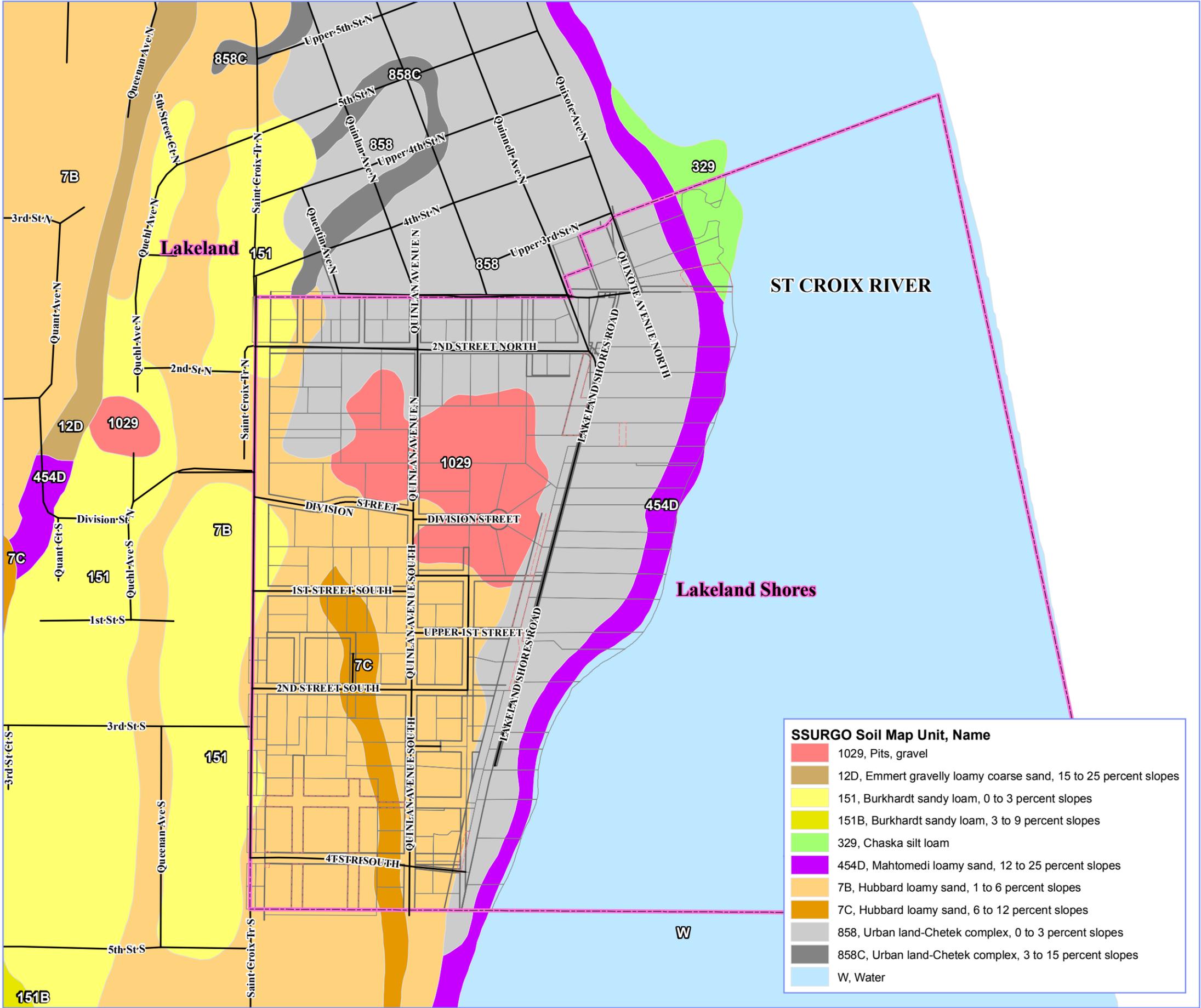


Note: For planning purposes only.

SSURGO Soils

City of Lakeland Shores

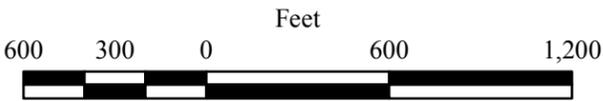
 Easements
 Right-of-Way
 Parcels
 Municipal Boundary
 Roads



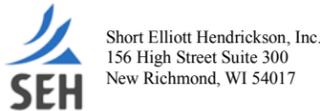
SSURGO Soil Map Unit, Name	
	1029, Pits, gravel
	12D, Emmert gravelly loamy coarse sand, 15 to 25 percent slopes
	151, Burkhardt sandy loam, 0 to 3 percent slopes
	151B, Burkhardt sandy loam, 3 to 9 percent slopes
	329, Chaska silt loam
	454D, Mahtomedi loamy sand, 12 to 25 percent slopes
	7B, Hubbard loamy sand, 1 to 6 percent slopes
	7C, Hubbard loamy sand, 6 to 12 percent slopes
	858, Urban land-Chetek complex, 0 to 3 percent slopes
	858C, Urban land-Chetek complex, 3 to 15 percent slopes
	W, Water



Printing Date: September 4, 2008



Sources:
Washington County (07/31/2008), Metropolitan Council, and USDA-NRCS.



Note: For planning purposes only.

Map Document: (\\sp3020-1\projects\KOL\laksh\common\GIS\SWMP_Update\FIGURE02_Soils.mxd) 9/4/2008 3:18:37 PM