Surface Water Management Plan

City of Apple Valley

September 2007

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September 20, 2007

Mr. Neal Heuer
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City of Apple Valley
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Re: Surface Water Management Plan
City of Apple Valley
Bonestroo File No.: 000068-04262-0

Dear Neal:

Transmitted herewith is the final draft of the City of Apple Valley's Surface Water Management Plan (Plan). The Plan is considered the City's local water management plan and addresses water quantity, water quality, and wetland management issues and priorities.

This Plan incorporates comments from City staff, the Metropolitan Council, and the watershed organizations having jurisdiction within the City. Consequently, the Plan represents a consensus among different levels of government on Apple Valley's approach to managing its local water resources as well as how Apple Valley's efforts fit with broader regional water resource management objectives. Equally important, the Plan meets the requirements listed under Minnesota Statute 103B, Minnesota Rules 8410, and applicable watershed organization rules.

Thank you for the opportunity to serve the City of Apple Valley. If you have any questions regarding the Surface Water Management Plan, please contact me at (651) 604-4783.

Sincerely,

BONESTROO

Rich Brasch
Project Manager

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

Colin G. Manson, P.E.

Date: September 20, 2007 Reg. No. 44194

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Executive Summary

INTRODUCTION

This report provides the City of Apple Valley with a comprehensive Surface Water Management Plan (SWMP) that will serve as a guide to managing the surface water system throughout the City. The report builds upon and updates the 1997 Apple Valley Surface Water Management Plan.

Several changes have occurred since the 1997 SWMP that necessitate this update. These include the following:

- In some areas, land use changed from that anticipated in the 1997 report. This has changed the runoff characteristics of these areas from that assumed in the 1997 plan.
- A number of ponds have been added to the system, and some have been re-configured. Some of these ponds provide significant rate control, flood storage benefits, and/or water quality benefits and need to be accounted for in the modeling of the system.
- Grading activities associated with new development within the City have changed the boundaries of some drainage districts.
- Public and government attitudes, perceptions, and awareness regarding surface water quality management have changed, with much more emphasis than in the past on protection, enhancement, and restoration efforts.
- New water quality management regulations that affect municipalities, such as the National Pollutant Discharge Elimination System (NPDES) MS-4 permitting system and the Total Maximum Daily Load (TMDL) program, have arisen.
- There have been advances in stormwater management practices, including an improvement in the number and type of "tools in the toolbox" and the effectiveness of those tools in improving stormwater and receiving water quality.

The overall purpose of this plan is to develop a framework for sustaining the long-term integrity of the community's surface waters and maintain ongoing compliance with surface water regulations. This plan identifies system improvements and other actions that will improve the integrity of Apple Valley's surface waters.

THE PROCESS

To help meet these challenges, the City Council in 2004 authorized commencement of a process to update the SWMP. As part of that process, an Interagency Committee was formed to provide input during the development of the SWMP update. The Interagency Committee was comprised of members from five agencies who were both knowledgeable in stormwater and wetlands management and familiar with the community. Agencies represented on the Committee were:

- Metropolitan Council;
- Vermillion River Watershed Joint Powers Organization;
- Black Dog Watershed Management Organization;
- Department of Natural Resources; and
- Dakota County Soil and Water Conservation District.

The Committee met three times during the project to provide input on important aspects of the plan, particularly regarding goals and policies, lake and wetland classification and management standards, establishment of management priorities, and the overall program for system improvements.

EXISTING SYSTEM

One of the major challenges of water resources protection and improvement in a nearly fully developed community like Apple Valley is dealing with the effects of the existing storm drainage infrastructure. Comprehensive storm drainage planning efforts in the mid-1980's helped Apple Valley to develop into among the largest Twin Cities Metro area communities. These efforts were made during a time when flood protection was the order of the day across the nation and when the impacts of stormwater runoff on water quality were barely recognized.

While the SWMP addresses flood management and protection as well as water quality and wetlands management, some of the most challenging issues have to do with protection of the City's lakes and management of stormwater quality. Past degradation is in many cases directly related to a largely irreversible system configuration that routes runoff from urbanized areas through these water features. This is the starting point of the water quality and wetland portion of this plan. The City must find ways of making the stormwater system as water quality friendly as possible, including decreasing the amount of stormwater entering the system where feasible. This requires attention to "state of the art" thinking, both in the development of this SWMP and the implementation of the program in the future.

OTHER PLAYERS

When it comes to stormwater management and wetland protection, there are other agencies with whom the City must interact and coordinate. Among the most significant are:

Metropolitan Council. This regional planning agency has long focused on stormwater quality improvement in municipalities of the seven county Metro area. Updated stormwater management plans for all communities in the Metro area will be needed to support the community comprehensive plan updates that are due in 2008.

Board of Water and Soil Resources (BWSR). This agency oversees administration of the state Wetlands Conservation Act (WCA) by local governments and must approve any local wetland management plan developed by a local government.

Department of Natural Resources (MDNR). This agency has major responsibilities in the management of designated public waters, including development of public access, fisheries management, and water level control.

Pollution Control Agency (MPCA). This agency has wide-ranging and high profile regulatory, research, and planning responsibilities for implementing the federal Total Maximum Daily Load (TMDL) and National Pollution Discharge Elimination System (NPDES) programs. These programs are major justifications behind this Plan revision.

The Vermillion River Watershed Joint Powers Organization (VRWJPO). This local water management organization was established in 2002, and covers almost 90% of the City of Apple Valley within its jurisdictional boundary. The VRWJPO adopted a watershed plan in November of 2005 and is in the process of developing standards and rules to implement that plan. The City's revised Plan must be in compliance with the WMO's Plan as amended in October 2006.

The Black Dog Watershed Management Organization (BDWMO). This local water management organization was formed in 1985. The BDWMO includes about 8% of the City of Apple Valley, including Lac Lavon and Keller Lake and those portions of the City draining to these two resources. The BDWMO adopted a revised plan in 2002, and the City Plan must be in compliance with the WMO's revised Plan.

These agencies rely on the cooperation of local governments like the City of Apple Valley to help meet their goals and mandates, although several have powerful regulatory authority as well. Many of these organizations also offer technical and/or financial assistance that is of value to the City. Representatives from the organizations above were included on the Interagency Committee which gave valuable guidance in its development.

GOALS AND POLICIES

Surface water management is a very strong component of the City's overall approach to protecting and preserving the community's natural resources. The City of Apple Valley recognizes both the value and impact that surface water can have on the quality of life in the community. In general, the goals and policies presented in the SWMP set expectations for management with regard to:

- The conditions to be achieved in the water resources of the City;
- The requirements and performance standards that need to be met for certain types of activities;
- How the City will interact with other management and regulatory organizations and their requirements and objectives; and
- How the City will allocate its own resources for water resources management.

The goals and some of the key supporting policies are highlighted below:

1. Provide adequate flood protection for residents and structures by adopting and implementing standards that meet or exceed regulatory requirements.

   Supporting policies include:

   - Requiring a freeboard of at least one foot between the established High Water Level (HWL) of a designated ponding area and the low floor elevation of an adjacent constructed building within the Vermillion River Watershed JPO boundaries.
   - Requiring a minimum three-foot freeboard between the lowest exposed entry of a building and the HWL of an adjacent ponding area.
   - Identifying where in the existing developed portions of the City freeboard requirements may not be met and pursuing a strategy to address the situation where reasonable and practical.
   - Complying with watershed organization flow rate limits.
   - Establishing storm sewer improvement taxing districts as necessary.

2. Manage surface water resources using scientifically-based, common sense approaches.

   Supporting policies include:

   - Managing lakes to achieve a clearwater condition with an abundant and diverse native rooted aquatic plant community.
   - Combining watershed control measures with in-lake management measures.
   - Managing high priority lakes according to individual lake management plans.

3. Control watershed loadings to help meet or exceed surface water quality requirements.

   Reaching this goal will include:

   - Promoting compliance with statewide no-phosphorus fertilizer regulations.
   - Continuing to implement a regular and targeted street sweeping program.
   - Increasing awareness of, and enforce, the City's prohibition on dumping into the storm drainage system.

4. Manage wetlands in compliance with all regulations and according to community's values and priorities.

   This will involve:

   - Assessing functions and values of jurisdictional wetlands.
   - Acting as the responsible government unit for protection of wetlands within the City's boundaries.
   - Looking for and pursuing opportunities to enhance wetlands, especially those in public areas.

5. Protect surface water resources from impacts of land development and redevelopment activities.

   This includes:

   - Requiring and enforcing construction site erosion and sediment control for land development activities.
   - Requiring new development and redevelopment activities to incorporate stormwater management features that meet strict performance standards for treating and infiltrating runoff from their site.

6. Foster citywide support for surface water management goals through an active education program. Supporting policies include:
   - Holding at least one community-wide forum per year to discuss water quality and wetland protection issues;
   - Educating City staff to set a good example in the community for water quality and wetland protection by the way they conduct their duties as employees; and
   - Continuing and improving the City's education and outreach program to engage citizens in water quality and wetland protection.

KEY IMPLEMENTATION ELEMENTS

The real measure of success of the updated SWMP will be its implementation. A community-wide comprehensive plan like this one plays a valuable role in setting standards for affected parties, identifying priorities, defining expectations, and providing guidance and direction on key issues. Following is a brief summary of the key implementation elements in this SWMP.

REQUIREMENTS FOR NEW AND REDEVELOPMENT ACTIVITIES

The increase in impervious cover, associated with new and redevelopment activities, is a primary factor behind increases in surface runoff and pollutant loading to the City's lakes and wetlands. Apple Valley's SWMP requires new and redevelopment activity creating more than 0.2 acres of new impervious surface to achieve, at a minimum, no-net-increase in annual runoff volume and the amount of two key pollutants – phosphorus and suspended solids – compared to the pre-development condition.

As part of meeting these requirements, the City will increase its efforts to pre-treat and infiltrate runoff where conditions allow, either in on-site features or in regional features. These measures will enhance groundwater recharge, decrease the burden on the storm drainage system, and minimize the pollutant loads reaching high priority downstream waterbodies.

The City will provide guidance to developers to meet these requirements, but developers will be responsible to incorporate into their site design such practices as are necessary to meet the above performance standards. A cash dedication in lieu of on-site treatment may be collected at the City's discretion where the City determines it is either not desirable or not feasible to achieve the applicable performance standards within the development or redevelopment site.

The SWMP also proposes revised freeboard standards to address flood protection and meet watershed organization requirements. These standards require that there be at least one foot of freeboard between the established High Water Level (HWL) of a designated ponding area and the minimum elevation of an adjacent building. Further, a minimum three-foot freeboard will continue to be required between the lowest exposed entry of a building and the HWL of an adjacent designated ponding area. The flood risk will be based on the more critical of these two conditions.

NPDES AND TMDL REQUIREMENTS

In 2003, as part of the Clean Water Act, the U.S. Environmental Protection Agency began requiring municipalities to obtain permits to discharge stormwater. In Minnesota, the MPCA administers these permits under the NPDES MS4 program. The five-year NPDES Permit obtained by the City in 2003 required

preparation of a Stormwater Pollution Prevention Plan (SWPPP) and submission of an Annual Report. Each annual report must summarize the following:

- Compliance with permit conditions, including an assessment of the appropriateness of identified management practices and progress towards achieving identified measurable goals for six minimum control measures.
- Planned stormwater management activities during the next reporting cycle.
- Changes in identified management practices or measurable goals for any of the control measures.

As part of the revised NPDES permit program in 2005, the MPCA selected 30 municipalities that were most likely to have had expanded stormwater discharges to surface waters since 1980. As one of the selected municipalities, Apple Valley is required to complete additional work by November 1, 2007 to help the MPCA determine if the City has met state rules for nondegradation of water quality. This additional work includes assessing the increases of pollutant and discharge loads, writing a recovery and protection plan, and modifying the City's SWPPP to include the assessment and plan.

Every two years, the U. S. Environmental Protections Agency under the authority of the federal Clean Water Act requires each state to publish an updated list of streams and lakes that are not meeting their designated uses because of excess pollutants or degraded biological conditions. The Impaired Waters List – also known as the 303(d) list – is based on violations of state water quality standards and is organized by river basin. For a surface water to be listed, historical monitoring and assessment must indicate it is impaired by one or more pollutants.

Once the MPCA assigns a surface water to the 303(d) list, it requires a detailed strategy be developed and implemented within a specific time frame to meet water quality standards. This strategy is commonly known as a Total Maximum Daily Load (TMDL) study or plan. A TMDL study identifies both point and nonpoint sources of each pollutant that is causing impairment of a surface water. Water quality monitoring and modeling techniques are used to determine how much each pollutant must be reduced to assure the water quality standard is met. Five Apple Valley lakes are on the 2006 Impaired Waters List, four of which (Long, Farquar, Alimagnet, and Keller) are listed because of excess nutrients.

The City will generally take the lead to complete and implement TMDLs for impaired waters due to excess nutrients where the watersheds are located wholly within City boundaries. For impaired waters in the City whose watersheds extend into adjacent communities, the City may request the appropriate watershed management authority either take the lead (with the City participating as needed) or co-facilitate the completion and implementation of the TMDL. The City of Burnsville has expressed interest in partnering with the City of Apple Valley and the appropriate Watershed Management Organization to initiate TMDL studies on Lake Alimagnet and Keller Lakes which are shared by both Cities. For TMDLs that have regional implications (e.g., the Lake Pepin excess nutrients and turbidity impairments, the Vermillion River Fecal coliform bacteria impairment, or mercury-related impairments), the City will cooperate with lead agencies as appropriate.

WETLAND MANAGEMENT AND PROTECTION

Wetlands provide a variety of services (called "functions") valued by the City and its residents. Wetlands are a critical part of the natural storm drainage system in the City of Apple Valley, and help to maintain water

quality, reduce flooding and erosion, provide habitat for wildlife, and provide open spaces and natural landscapes that City residents enjoy.

The goal of the wetland management section of the SWMP is to prioritize and guide management of Apple Valley's wetlands based on their functions and values to the community. Standards for protection and enhancement of wetland resources included in the SWMP are prioritized on this basis. Because the functions and values provided by different wetlands vary, the SWMP presents an assessment and classification system that will assist the City in establishing priorities and focusing available resources for wetland protection, enhancement and restoration. Fifty wetlands, including all within the Black Dog Watershed Management Organization and a number of others elsewhere in the City that are located in public areas, were selected by the City to apply the classification system. This same technical approach will be used to assess and classify the remaining wetlands. Because all wetlands provide some functional values, all are protected to some degree under provisions in the SWMP.

The SWMP provides the following benefits related to wetlands:

- Includes wetland inventory, assessment, and management guidelines.
- Allows appropriate use of wetlands to preserve water quality and prevent downstream flooding.
- Enhances wildlife values of wetlands.
- Identifies potential wetland enhancement/restoration projects, emphasizing those wetlands that are in public space.
- Guides management of wetlands by their sensitivity to stormwater.

Regulation of activities that may impact individual wetlands will be based on evaluations of proposed activities, site-specific wetland boundary delineations, and wetland management classifications.

PRIORITY LAKE DESIGNATION AND MANAGEMENT

Through this revised SWMP, five priority lakes were identified, taking into account such factors as size and public access to the waterbody. Protecting and managing water quality in these lakes is a primary objective of this SWMP. As part of this strategy, the City has developed a customized lake classification system with measurable water quality goals for each lake. When met, those goals will assure that a specific lake will also meet proposed state standards as well as watershed management organization requirements.

The City has a strong commitment to manage its lakes to achieve a clear-water condition with a diverse community of plants dominated by native emergent and submergent species. Lake scientists acknowledge this condition as natural for lakes in this region of Minnesota. A healthy assemblage of native plants minimizes the likelihood that non-native plants will become a problem. State water quality standards also support achieving this condition.

The City will employ an "adaptive management" approach for these important community resources (Dietz et al., 2003). Adaptive lake management recognizes lakes as complex systems whose responses to numerous natural and unnatural variables are difficult to predict. Furthermore, there are never enough data to eliminate uncertainty. Adaptive lake management emphasizes assessing the impacts of management actions to a reasonable extent and applying lessons learned to guide future actions, as progress is made

toward goals. Adaptive management also implies a willingness to change desired end points, as necessary and if assessments are contrary to expected outcomes.

The City's understanding of how lakes function as well as the development of tools to manage lakes has improved dramatically over the last 15 years. If anything, our knowledge of how these systems work and how to manage them will likely accelerate over the next 10-15 years. The City staff must keep abreast of these developments and pursue those of merit to achieve the goals in this SWMP.

PUBLIC EDUCATION

Education serves an important role in enabling Apple Valley to implement its stormwater, lake water quality, and wetland management programs successfully.

Five principles will guide the City's future efforts in water resources education, as summarized briefly below:

1. **The goal is to change the way people consider water resources.** First, change what people know, then the way they think, and finally the way they act.
2. **Allocate educational effort appropriately.** In general, a base level of effort will be applied everywhere in the community, but extra effort will be directed in known "hot spots," areas with high loading risks to priority water bodies.
3. **Good public education generates and sustains program support.** Water resources education raises awareness of problems and offers opportunities to show the City is solving those problems. These efforts also can foster productive working partnerships with groups of interested citizens, which can generate even more support and visibility for protection efforts.
4. **Promote use to raise awareness.** Efforts to increase the use and enjoyment of the community's water resources help to increase support for taking care of those resources.
5. **Although important, public education is only a small part of solving water quality problems.** Fundamental alterations in drainage patterns and land use in Apple Valley require technical solutions to be combined with public education to achieve positive and effective results.

Target audiences for the education program are:

- **City Staff.** It is essential for the success of the program that City staff set a good example to the community's residents, businesses, and customers in carrying out their duties in a way that protects the City's water resources consistent with the SWMP.
- **City Residents.** The goal is that city residents be well educated about, actively involved in, and regularly supportive of SWMP policies and programs.
- **The Development Community.** It is important that City developers are knowledgeable about, and willing partners with, the City on SWMP policies and programs.

SYSTEM IMPROVEMENT PROGRAM

The system improvement program in the SWMP provides a prioritized blueprint for actions or projects to carry out SWMP goals and policies. The Improvement Program presented in the WQMP is organized into four groups of projects:

- General/Administrative

- Water Quantity/Flood Control
- Water Quality
- Wetlands

Table 10.1 in the Plan summarizes high and medium priority water resources management actions and projects on which the City will focus.

General/Administrative. These actions relate to development, evaluation, and revision of ordinances and policies for land use that can have major impacts on water resources. These improvements also include citywide planning and study efforts that are required by other authorities, such as the nondegradation provisions of the NPDES MS4 permit.

Water Quantity/Flood Control. Some of the improvement elements in this section involve execution of improvements for which a technical assessment has been completed and a preferred option identified. A second category calls for conducting a feasibility assessment to evaluate options and select a preferred alternative to address known problems. Finally, a broader pro-active flood risk assessment and prioritization of problem areas is called for to determine whether there are other areas of the City where flood protection standards are not met. Those areas will then be prioritized depending on their degree of risk and a more detailed evaluation will be done as resources allow finding solutions.

Water Quality. The first element of this part of the implementation program is to execute improvements that have already been identified through completed planning efforts, such as those for Keller Lake, Lake Alimagnet, and Lac Lavon. Equally important, the City will pursue development of lake management plans and implementation programs on remaining designated high priority lakes, often as part of the development of TMDL's for those waters when they are listed. Lake management plans are feasibility studies for specific lakes that will evaluate the costs and benefits of management alternatives and then provide specific costs and design guidance for recommended capital improvements as well as non-structural management activities.

As part of implementing the overall lake management plans, the City will need to carry out the capital improvement elements of those plans. As the City completes successive plans, it will spend decreasing amounts of time and effort developing plans and increasing levels of time and effort implementing recommended measures in the plans. To reflect its future directions, the City should update the water quality improvement program each year.

Wetlands. These activities reflect the City's intention to systematically pursue wetland restoration and enhancement, especially for wetlands in public space.

1. Introduction

1.1 GENERAL

This report provides the City of Apple Valley with a comprehensive Surface Water Management Plan (SWMP) that will serve as a guide to managing the surface water system throughout the City. The report builds upon and updates the 1997 Apple Valley Surface Water Management Plan.

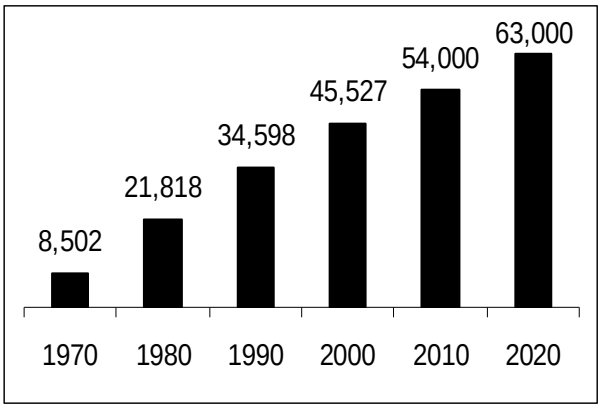
The City of Apple Valley is located in the southeastern portion of the Metropolitan Area in north-central Dakota County, as shown in Figure 1.2. Apple Valley is bounded on the north by the City of Eagan, on the north and west by Burnsville, on the east by Rosemount, and on the south by Lakeville.

The City lies within the boundaries of two separate watersheds, Black Dog and Vermillion River, managed respectively by the Black Dog Watershed Management Organization and the Vermillion River Watershed Joint Powers Organization. Each has its own distinctive approach towards protecting and managing the water resources of their watershed. The northwest and southwest corners of the City are part of the Black Dog Watershed, with most of the remainder being part of the Vermillion River Watershed. A small portion of the drainage area in the northern part of the Vermillion River Watershed in the City overflows into the Gun Club Lake Watershed; however, the Vermillion River Watershed maintains authority over that drainage area. These watersheds cross political boundaries; therefore, cooperation between communities within the watershed is necessary to effectively manage the resources within each watershed.

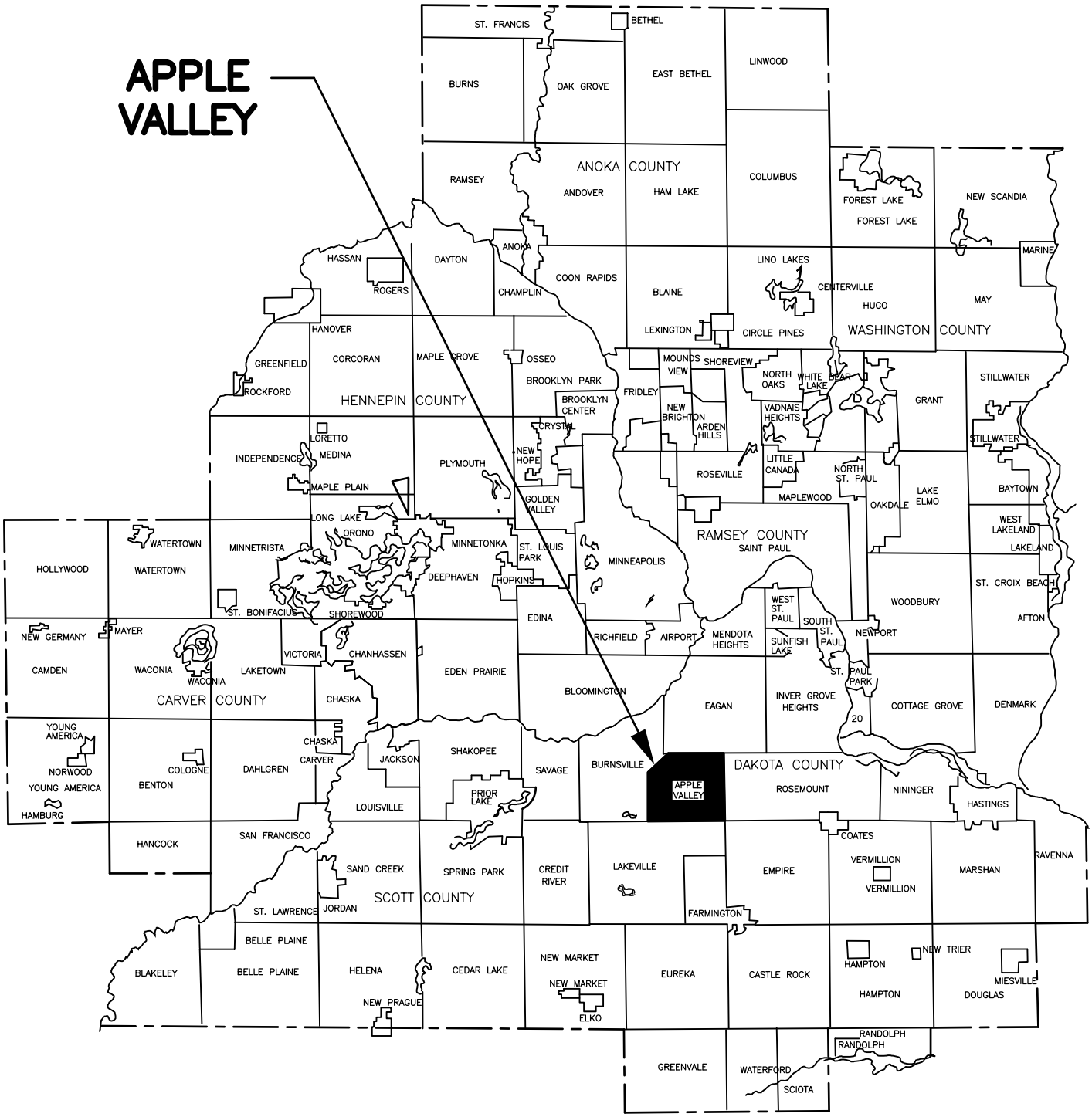
Apple Valley has continued its trend of steady population growth. The population has increased from 8,502 in 1970, to 21,818 in 1980, to 34,598 in 1990, to a 2000 population of 45,527. The City is expected to continue its steady growth, to a total population of 54,000 anticipated by the year 2010, and 63,000 in 2020. The City's population grew at an average annual rate of 1,093 people during the past 10 years but the rate is expected to slightly decrease to 847 people per year over the next 10 years.

Apple Valley encompasses approximately 17.5 square miles or about 11,200 acres. The City is about 89% developed, with an estimated 1,230 acres of vacant land. This area constitutes about 11% of the City area and is located mostly in its southeast and south-central areas.

Figure 1.1 – Apple Valley Population Summary[1]



[1] *Estimates based on Metropolitan Council population projections, 2003*



LOCATION MAP

SURFACE WATER MANAGEMENT PLAN FIGURE 1.2

APPLE VALLEY, MINNESOTA

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1.2 PURPOSE AND SCOPE

Several changes have occurred since the 1997 SWMP that necessitate this update. These include the following:

- In some areas, land use changed from that anticipated in the 1997 report. This has changed the runoff characteristics of these areas from that assumed in the 1997 plan.
- A number of ponds have been added to the system, and some have been re-configured. Some of these ponds provide significant rate control, flood storage benefits, and/or water quality benefits and need to be accounted for in the modeling of the system.
- Grading activities associated with new development within the City have changed the boundaries of some drainage districts.
- Public and government attitudes, perceptions, and awareness regarding surface water quality management have changed, with much more emphasis than in the past on protection, enhancement, and restoration efforts.
- New water quality management regulations that affect municipalities, such as the National Pollutant Discharge Elimination System (NPDES) MS-4 permitting system and the Total Maximum Daily Load (TMDL) program, have arisen.
- There have been advances in stormwater management practices, including an improvement in the number and type of "tools in the toolbox" and the effectiveness of those tools in improving stormwater and receiving water quality.

The scope of this SWMP is broad. This plan addresses numerous issues including runoff management for water quality purposes, flood control and mitigation, wetland management, development and redevelopment standards, public education, and regulatory programs.

The overall purpose of this plan is to develop a framework for sustaining the long-term integrity of the community's surface waters and maintain ongoing compliance with surface water regulations. This plan identifies capital improvements and other actions that will improve the integrity of Apple Valley's surface waters.

1.3 ORGANIZATION

This report is presented in a format that provides the appropriate context and setting for the issues and initiatives set forth while making key points clear and easy to find. The overall organization is as follows:

- Section 2 describes the physical environment including watersheds and drainage patterns, dominant land uses, and significant waterbodies within the City.
- Section 3 lists public agency requirements affecting surface water management in the City along with the City's goals and policies.
- Section 4 provides the technical background for the methods and tools used for surface water analyses and management (quantity and quality).
- Section 5 is an overview of the six major watersheds in the City and the major surface water management issues within each.
- Section 6 discusses classification and management of the City's wetlands.
- Section 7 describes classification and management of the City's priority lakes.

- Section 8 covers the NPDES Phase II MS4 stormwater permit.
- Section 9 provides a description of educational efforts that will be pursued by the City.
- Section 10 lists recommended high priority system capital improvements and actions to improve system management and provides financing information.
- Section 11 summarizes the amendment procedure for this plan and defines reporting requirements.
- Section 12 presents a general summary of key issues addressed through the plan.
- Section 13 lists the referenced material used in this plan.

2. Physical Environment

This section provides a general description of the natural features and historical processes which together create the physical environment of Apple Valley. This discussion is intended to broadly characterize the physical environment, with the purpose of establishing a context for surface water management.

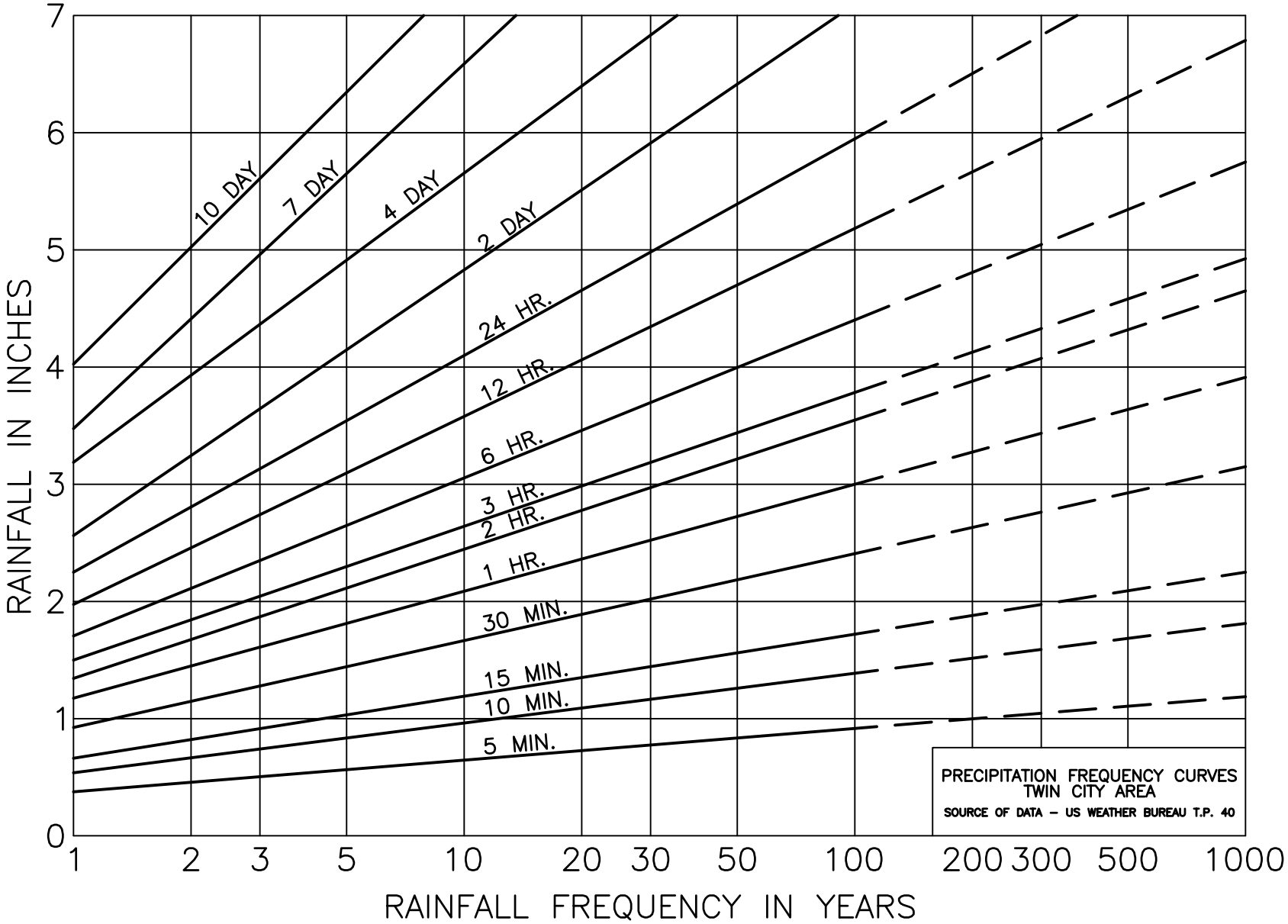
2.1 CLIMATE

Apple Valley has a continental climate because of its proximity to the middle of the North American continent. Annual normal precipitation (1971-2000), as measured at the Rosemount Agricultural Experiment Center, is approximately 34.6 inches, of which about two-thirds occurs during the summer months of May - September. The annual snowfall in Apple Valley averages approximately 50 inches, with the most severe runoff conditions usually occurring in March and early April. Mean annual lake evaporation is about 30.5 inches per year. The average date of the last below freezing temperature (32°F) in the spring is April 27 while the average date of the first below freezing temperature in the fall is October 2. Thus, the normal growing season is about 157 days.

2.2 PRECIPITATION

Precipitation Intensity-Duration-Frequency (IDF) curves typically used for hydrologic and hydraulic design for the Twin Cities metro area are shown in Figure 2.1 on the next page. Stormwater quantity management is generally concerned with runoff from relatively large but infrequent storm events. In general, municipal storm drainage systems are designed to convey runoff from the 10-20% probability (likely to occur every 5-10 years) 24-hour precipitation event (3.6 to 4.2 inches of precipitation in 24 hours, respectively). The High Water Levels of ponding areas are often based on a 1% probability ("100-year") precipitation event (such as 6 inches of precipitation in 24 hours). Water quality management, on the other hand, focuses on the small and moderate-sized storms, generally those that generate precipitation depths of 1.5 inches or less. These events occur frequently and the runoff generated is usually responsible for the bulk of pollutant loadings exported from urban areas during any given year.

Managing stormwater quantity focuses on large magnitude rain events which are infrequent. In contrast, managing stormwater quality focuses on small rain events (less than 1.5 inches) that occur many times annually.



PRECIPITATION FREQUENCY CURVE

SURFACE WATER MANAGEMENT PLAN

APPLE VALLEY, MINNESOTA

FIGURE 2.1

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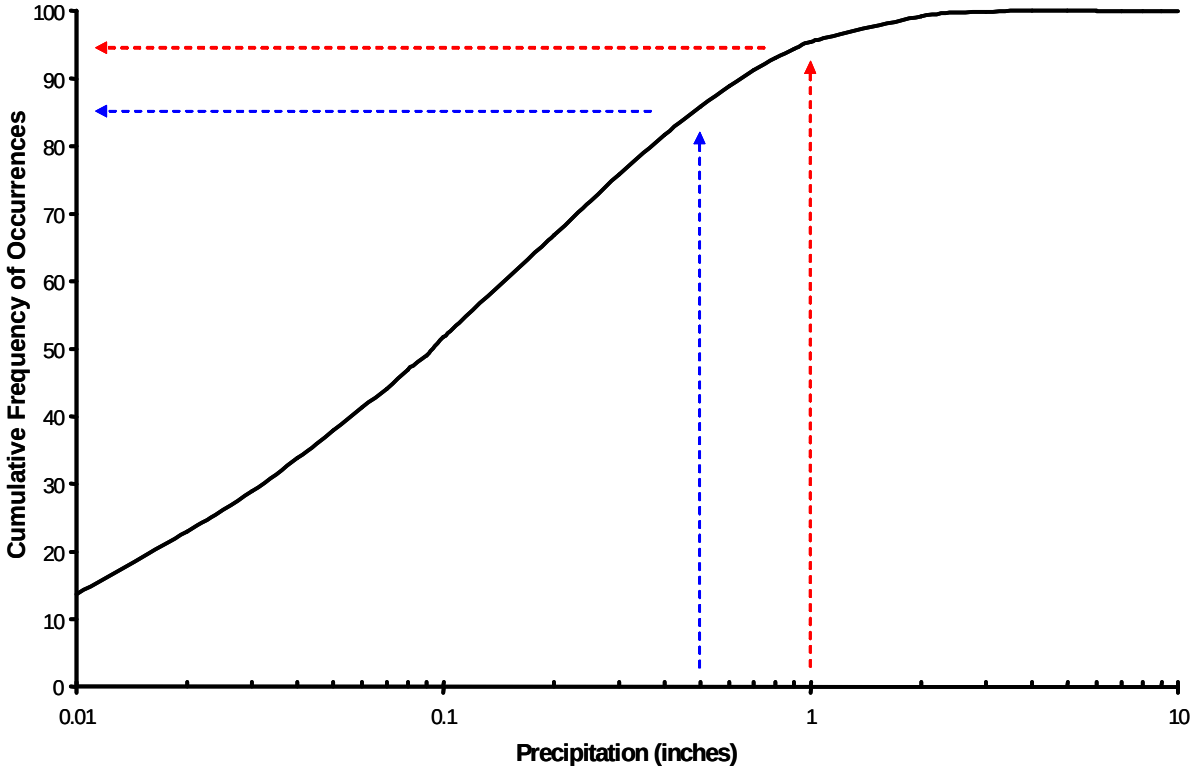
The distribution of storm precipitation depth probabilities for the Twin Cities metro area is illustrated below in Figure 2.2.

Figure 2.2 – Cumulative Precipitation Depth Frequency Curve for Twin Cities Metro Area

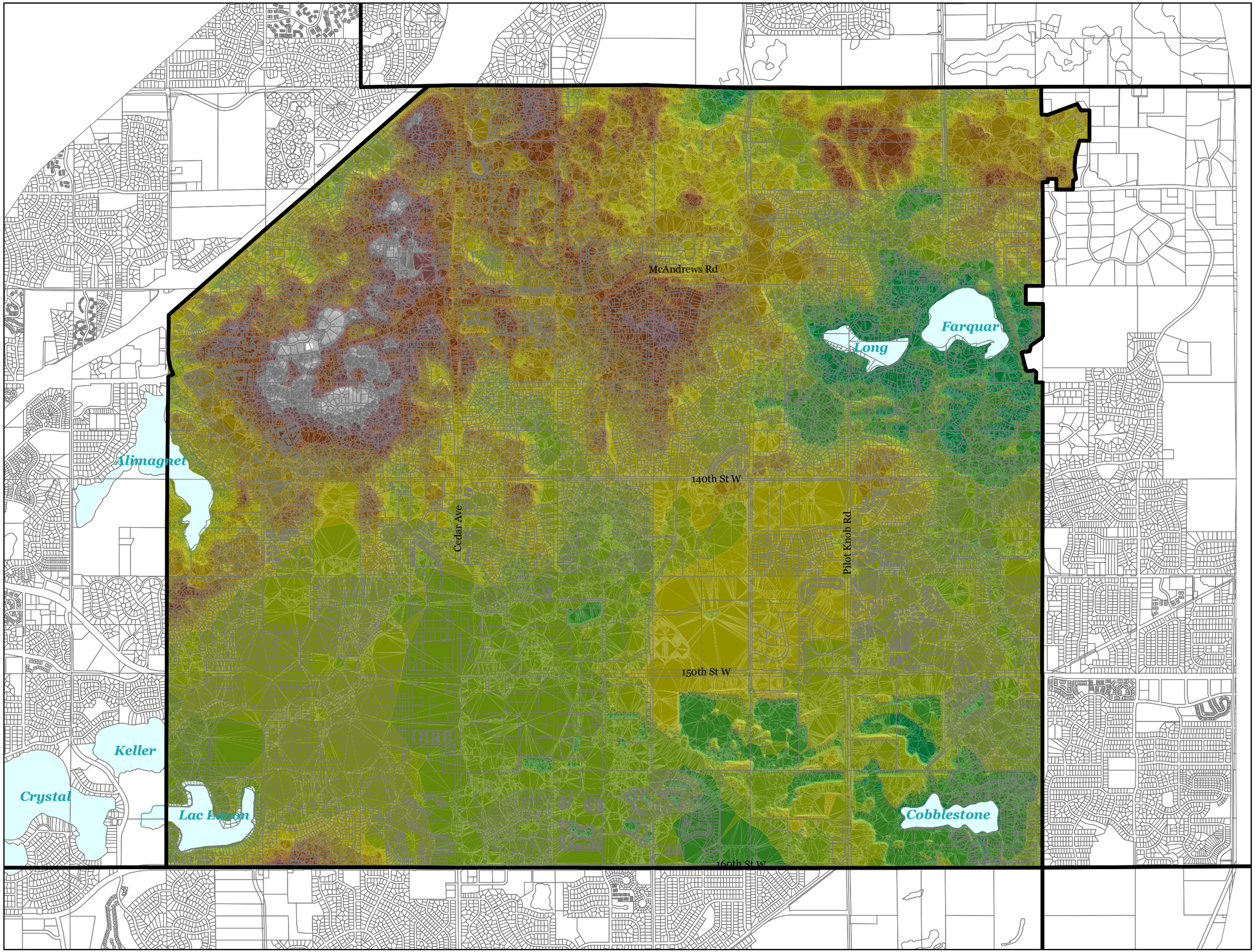


The graph shows that about 85% of all storm events in a typical year result in less than a ½ inch depth of precipitation. Almost all storms (95%) in a typical year are less than 1-inch in depth. This information greatly affects the approaches taken to manage stormwater runoff for water quality purposes versus flood control purposes.

In general, water quality management focuses on the treatment of runoff events generated by precipitation events that have near a 100% chance of being equaled or exceeded in almost any year. On the other hand, flood control is focused on large but infrequent events that have only a small probability (say, 1-10%) if occurring in any given year, but are capable of causing a lot of damage when they do occur. More background on this issue can be found in Chapter 4 of this report.

2.3 TOPOGRAPHY

Apple Valley has two distinct types of topography. Land surface elevations vary from a high of about 1,130 feet MSL in the northwest area of the City to a low of 900 feet MSL near Farquar Lake in the northeast (Figure 2.3). The rugged terrain in the north is characterized by steep slopes with many hills and depressions. These many depressions and natural ponds are ideal for long term storage of stormwater runoff. In contrast, the southern portion of the City is basically flat. It features gently sloping land draining into several draws that eventually reach the Vermillion River.



Apple Valley

City of Apple Valley

TOPOGRAPHY

Surface Water Management Plan

FIGURE 2.3

Legend

- City Boundary
- Lakes

Elevation Range

- 880 - 900
- 900 - 920
- 920 - 940
- 940 - 960
- 960 - 980
- 980 - 1000
- 1000 - 1020
- 1020 - 1040
- 1040 - 1060
- 1060 - 1080
- 1080 - 1100
- 1100 - 1120

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The major drainage divide separating the Minnesota River and the Mississippi River watersheds passes through Apple Valley. This divide generally runs from just north of Lake Alimagnet through the Palomino Hills area and then extends east to Rosemount. Apple Valley's topography is such that ultimately most of the City naturally drains into the Mississippi River. The landscape drains south through Lakeville and Farmington to the Vermillion River which discharges into the Mississippi River near Hastings. A small amount of drainage from Apple Valley passes to the north through Eagan and west through Burnsville to the Minnesota River.

2.4 SOILS

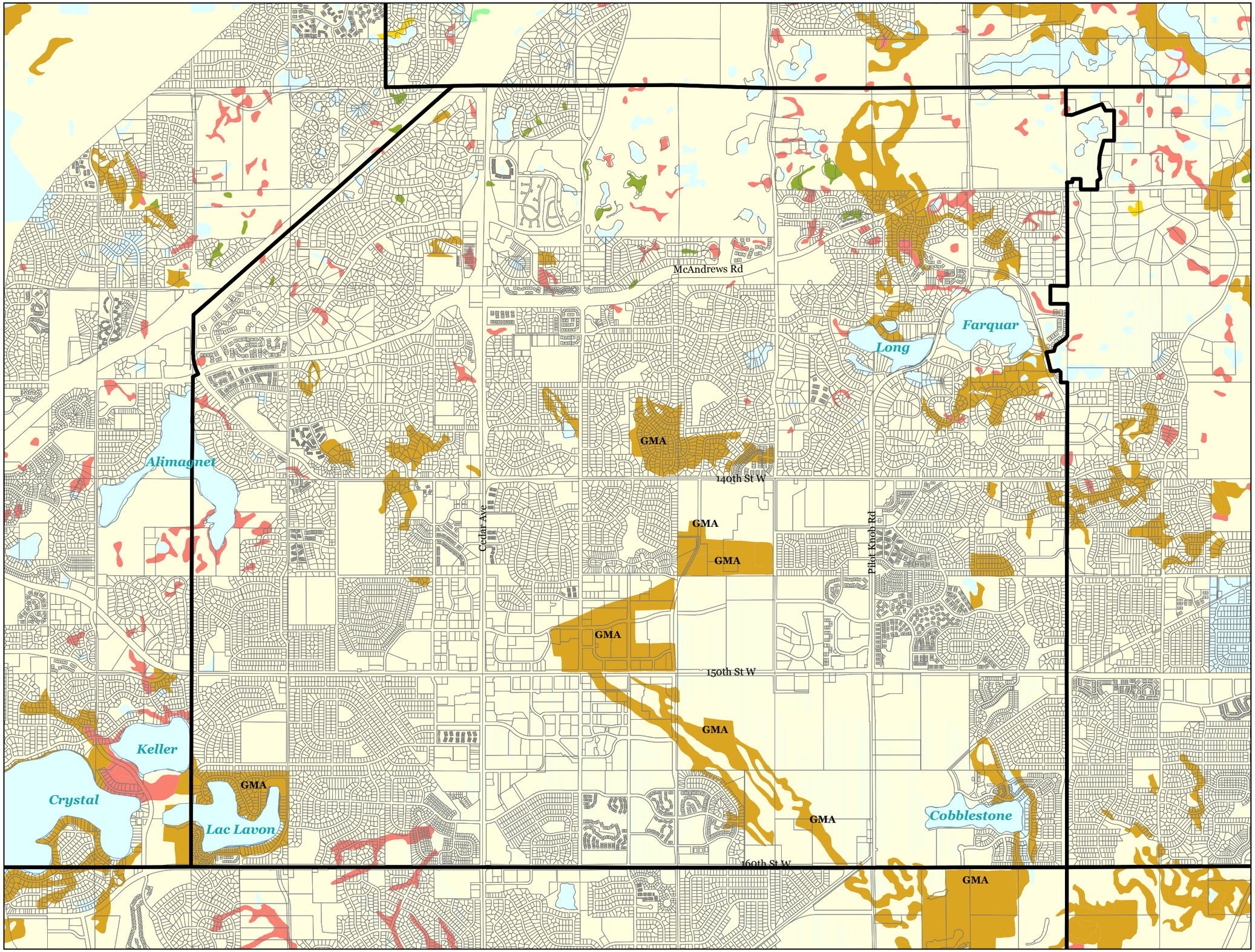
The soils in the northern and western part of Apple Valley are from the Kingsley-Mahtomedi association that are characterized as gently sloping to very steep, loamy and silty textured soils. These well drained to excessively well drained soils are extensively intermingled. The soils found around the drainage districts of Lac Lavon, Lake Alimagnet, Farquar Lake and Long Lake are from this association. The Waukegan-Wadena-Hawick association is common in the southern portion of Apple Valley. These soils are defined as level to very steep, silty, loamy and sandy textured soils.

Four soil hydrologic groups have been established by the Natural Resources Conservation Service (NRCS) for estimating runoff and infiltration potential. They are:

- Hydrologic Soil Group A – Low runoff potential – high infiltration rate;
- Hydrologic Soil Group B – Moderate infiltration rate;
- Hydrologic Soil Group C – Slow infiltration rate; and
- Hydrologic Soil Group D – High runoff potential – very slow infiltration rate.

The hydrologic soil groups found in the Apple Valley area are predominantly in Group B. This classification is combined with land use to estimate runoff that will occur over a given area for a particular rainfall amount. The identity and locations of various soil classifications is important to determine site-specific infiltration potentials and the possibility of using infiltration techniques in stormwater quality management. A map showing soil infiltration capacity based on hydrologic soil groups in Apple Valley is shown in Figure 2.4. In general, soils in Hydrologic Groups A and B are considered suitable for infiltrating stormwater as a runoff volume reduction technique.

Soil compaction and the addition of non-native soils to the soil profile often occurs with urban development and can be expected to decrease the infiltration capacity (i.e., increase the runoff from) of these soils. This underlines the importance of carrying out site specific investigations when managing the site to enhance infiltration.



Apple Valley

City of Apple Valley

SOILS

Surface Water Management Plan

FIGURE 2.4

Legend

Soils
- A
- A/D
- B
- B/D

No C, C/D or D type soils within the city limits

- Open Water
- City Boundary

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2.5 GEOLOGY

The bedrock geology which underlies Apple Valley was formed over 400 million years ago. At that time, a large shallow sea covered southeastern Minnesota and parts of adjacent states. The sediments that were deposited on the sea floor were converted over time into rock formations. Today, the formation underlying Apple Valley is chiefly comprised of the St. Peter Sandstone formation and is intermixed with the Platteville and Glenwood formation.

The surficial geology that is present near or at the land surface is a product of relatively recent geologic process. The advance and retreat of glacial lobes approximately 10,000 years ago deposited the rock material that characterizes Apple Valley. As a result, two major geomorphic regions are found within the City: moraine topography and valley outwash.

The Mississippi Valley Outwash Area is located near Alimagnet Lake and the southern portion of the City. This area was formed from the water associated with melting glaciers. The area appears as nearly level terraces and flood plains. On the higher terraces water tables are usually deep and in the low terraces water tables are shallow.

The central and northern portions of the City are within the Eastern St. Croix Moraine geomorphic area. The area consists of relatively steep hills, rolling topography and some deep depressions that are either filled with small lakes or peat. The area consists of a mixture of red and grey till and is composed of silt, clay, sand, pebbles, cobbles and boulders. Water tables may be at or near the surface in the depressions, but are 10 feet or deeper in the hills.

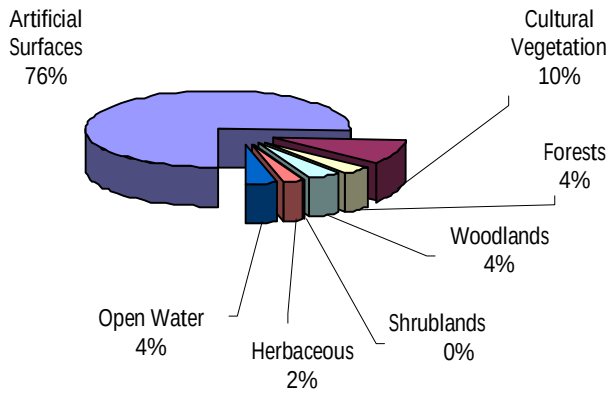
2.6 LAND COVER AND USE

Land cover classification is a characterization of the features covering the ground surface. These features can be both natural communities as well as human construction. In contrast, land use describes the activities that occur on a piece of land; land use is an expression of the function that the land serves. These are important distinctions in understanding which tool to use for management and planning purposes.

Identification and interpretation of land cover is standardized under the Minnesota Land Cover Classification System (MLCCS). The MLCCS "was developed as a result of unanswered questions regarding natural resource identification, protection and restoration efforts in the seven-county Metropolitan area" (MLCCS User Manual, version 5.4, 2004).

Dakota County SWCD maintains the MLCCS database for this region. MLCCS information is considered a snapshot in time, characterizing the land cover at the moment of inventory. Given that, the major land cover types found within Apple Valley are shown in Figure 2.5. This data is from Dakota County and is current as of 2004.

Figure 2.5 – Current Land Cover for Apple Valley



Classification of land use is performed at the local level. Municipal planning and zoning activities define the allowed land use activities within designated areas of a city. Different types of land use can have distinct impacts upon surface water quality. This is largely a function of the amount of impervious cover (e.g., rooftop, parking lot) associated with a type of land use. It is also a function of the intensity of activities that occur (e.g., industrial, commercial) and the quality of runoff historically observed with those land uses. The projected land use for Apple Valley under fully developed conditions is summarized in Figure 2.6.

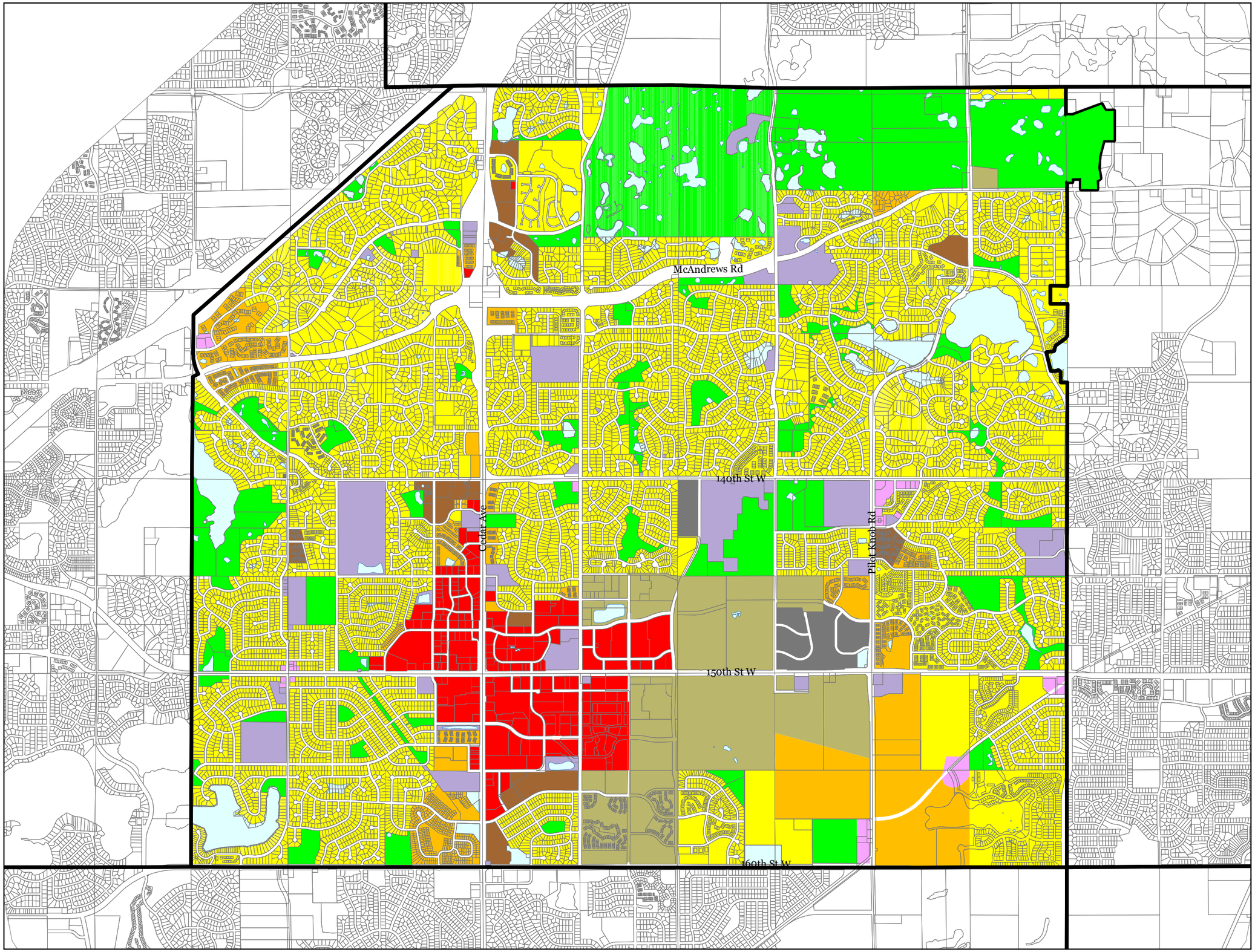
2.7 ENVIRONMENTAL CONCERNS

2.7.1 SIGNIFICANT NATURAL FEATURES

The Minnesota Department of Natural Resources (MnDNR) Natural Heritage and Non-Game Wildlife Program maintains a database of rare plant and animal species and significant natural features. The database indicates that there are several notable natural features found within the City of Apple Valley. These include plant species, plant communities as well as the Blandings and Wood Turtle, both of which are listed as threatened by the State of Minnesota. These are all located in older developments of the City and are not threatened by the City's expected future development.

2.7.2 POLLUTANT SOURCES

The Minnesota Pollution Control Agency (MPCA) maintains up-to-date information on potential sources of groundwater contamination, including sanitary landfills, hazardous waste sites, dumps, registered underground and above ground storage tanks, feedlots, abandoned wells, and permitted wastewater discharges. The information is available through the MPCA's Property Transfer File Evaluation Service. Currently, there are no permitted point source wastewater discharges within the City of Apple Valley.



Apple Valley

City of Apple Valley

LAND USE

Surface Water Management Plan

FIGURE 2.6

Legend

- City Boundary
- Lakes

Land Use

- LD - Low Density Residential (0-6 Units/Acre)
- MD - Medium Density Residential (6-12 Units/Acre)
- HD - High Density Residential (12+ Units/Acre)
- C - Commercial
- IND - Industrial
- NS - Neighborhood Service
- MIX - Mixed Use
- INST - Institutional
- P - Park
- W - Water/Wetland/Pond

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2.8 PRIORITY CITY LAKES

The management of lake resources within the City is a major focus of stormwater management in the SWMP. There are six lakes that lie wholly or partially within the City of Apple Valley that are priority resources: Lake Alimagnet, Long Lake, Farquar Lake, Cobblestone Lake, Keller Lake, and Lac Lavon Lake. While the vast majority of Keller Lake lies within Burnsville, a small portion of the east shoreline of Keller Lake is also within the City of Apple Valley.

Lac Lavon and Cobblestone lakes are both former sand and gravel mining areas that are now flooded. The remaining four lakes in Apple Valley are naturally occurring shallow lakes. All but Lac Lavon have large drainage areas. As a result, the characteristics of the lakes are greatly influenced by the make-up of the watershed. A discussion on the status of the priority lakes in Apple Valley, lake management and lake water quality can be found in Chapter 7.

3. Goals and Policies

3.1 PURPOSE

The primary purpose of this SWMP is to provide clear guidance on how the City of Apple Valley intends to manage its surface water. Over time, significant advancement has been made in our understanding of how natural and manmade systems function in the context of rainfall, infiltration and runoff. New regulations have been created that reflect increased protection for water bodies and emphasize treatment of stormwater to protect downstream resources and groundwater.

This section of the SWMP specifically outlines the City's goals and policies related to surface water management. The goals and policies are consistent with the requirements of Minnesota Rules 8410 and Minnesota Statute 103B.235 (Local Water Management Plans), and demonstrate a desire, willingness, and commitment by the City to reach and sustain a high quality of life for its residents.

3.2 CITY OF APPLE VALLEY

Surface water management is a very strong component of the City's overall approach to protecting and preserving the community's natural resources. The City of Apple Valley recognizes both the value and impact that surface water can have on the quality of life in the community.

3.2.1 OVERVIEW OF EXISTING CITY ORDINANCES AND CONTROLS

The City currently has the following water resource/stormwater-related ordinances in place:

Stormwater drainage connection and availability charge (Section 51.06 of the City Code) institutes the stormwater drainage utility.

Individual Sewage Treatment Systems Sections of the Code ensure ISTS's function in a manor which prevents pollution to surface and ground waters (Sections 51.55 – 51.63 of City Code).

Public nuisance regulations prohibit pollution and blockage of the City Storm Sewer System (Sections 94.15 and 94.17 of City Code).

Natural Resources Management Chapter of Code (152) establishes erosion and sediment control standards for land disturbance; wetland protection requirements for land disturbance; tree preservation and mitigation requirements; and requirements for conformance with watershed management plans and state wetland regulation.

Environment protection regulations (Section 153.60 of the City Code) establish further erosion and sediment control management regulations, and further requirements for waterbody alteration.

Reclamation standards for gravel and sand mining operations (Section 155.292) established. Shoreland Overlay District (Section 155.305 – 155.318) of the City Code) establishes land use standards within shoreland areas.

Drainage requirements (Section 155.350) lay out rate control and infiltration standards for development, redevelopment, and expanded development.

Floodplain Control (Chapter 156 of the City Code) promotes public health, safety, and general welfare by minimizing losses due to periodic flooding.

Dedication of Ponding Areas and Easements (Section 153.29 and 153.53 of the City Code) set aside land for stormwater treatment.

Subdivision Regulations (Chapter 153 of City Code)

Zoning Regulations (Chapter 155 of City Code)

The City requires different permits and/or approvals for land disturbing projects (including new developments and re-developments), depending on the type of project. The following is a list of water resource or stormwater-related City permits and/or approvals:

Preliminary Subdivision Approval
Final Subdivision Approval
Re-zoning Approval
Comprehensive Plan Amendment
Planned Development (PD) Approval
Conditional Use Permit
Building Permit
Natural Resources Management Permit
Right of Way Permit

Applications for preliminary and final subdivision approvals, planned development approvals, natural resources management permits, and building permits must include a grading and drainage plan, an erosion and sediment control plan, a tree preservation plan, and a wetland protection plan.

To meet the future needs of the City, a comprehensive stormwater management ordinance will need to be developed. The ordinance will be developed to provide adequate support to implement the policies and standards in this Plan.

3.2.2 Plan Goals and Policies

In general, the goals and policies presented below set expectations for management with regard to:

- The conditions to be achieved in the water resources of the City;
- The requirements and performance standards that need to be met for certain types of activities;
- How the City will interact with other management and regulatory organizations and their requirements and objectives; and
- How the City will allocate its own resources for water resources management.

GOAL 1: PROVIDE ADEQUATE FLOOD PROTECTION FOR RESIDENTS AND STRUCTURES BY ADOPTING AND IMPLEMENTING STANDARDS THAT MEET OR EXCEED REGULATORY REQUIREMENTS.

Policy 1.1 – High Water Levels (HWL) shall be established for designated ponding areas and freeboard requirements will be applied to buildings and other critical structures to minimize flooding risk.

High Water Levels shall be established based on modeling conducted for this Plan or as an area develops or when drainage facilities are constructed for an area. The City requires a three-foot freeboard between the lowest exposed entry of a building and the HWL of a designated ponding area. For new developments and new buildings constructed as part of re-development projects, the lowest floor elevation of buildings will be set at least 1 foot above the established HWL of the adjacent pond as required by the Black Dog Watershed Management Organization and the Vermillion River Watershed Joint Powers Organization.

Policy 1.2 – The High Water Level (HWL) for designated stormwater ponds used to set the lowest floor elevations for new buildings will be based on an appropriate 1% probability critical duration storm event. In the BDWMO, this requirement will only apply to new ponding areas.

This standard will comply with requirements in the plans for the BDWMO and the VRWJPO.

Policy 1.3 – The City will identify where in the existing developed portions of the City adopted freeboard requirements may not be met and develop and pursue a strategy to meet freeboard standards where reasonable and practical.

Certain existing properties may be vulnerable to flooding impacts. As part of the implementation phase for this Plan, the City will assess the status of freeboard elevations in developed areas of the City through hydrologic modeling conducted for this Plan update , topographic data, and detailed survey information on building elevations. Options for providing 100-year flood protection will be analyzed as part of these investigations, and feasible options pursued on a priority basis depending on risk. Areas where 100-year flood protection is not reasonable and practical will be identified and emergency response plans will be developed for those areas.

Policy 1.4 – Flow rate limits that meet watershed organization requirements shall be applied to new and redevelopment activities as well as public improvements.

The runoff rates for proposed activities and development shall not exceed existing runoff rates for the one-year, 10-year, and 100-year critical storm events. These flow rate limits are intended to protect the stability of downstream open channel features and avoid over-burdening the storm drainage systems of adjacent communities that receive stormwater from the City of Apple Valley. The City will expect adjacent communities and jurisdictions with stormwater management responsibility to abide by discharge limits for stormwater discharged to Apple Valley to avoid over-burdening the City's system.

Policy 1.5 – All new buildings must be constructed above the seasonal high groundwater elevation.

This policy is designed to minimize over-reliance on sump pumps for the buildings within the community and to protect groundwater resources.

Policy 1.6 – Redevelopment in land locked basins shall not increase runoff volume.

The City requires all redevelopment within land locked basins to preserve the previous water balance so that no net increase in runoff occurs from the site compared to the existing condition. The City has provided an outlet for all land locked basins that have had any record of potentially damaging HWLs. None of the remaining land locked basins within the City appear to pose an unacceptably high flood or safety risk to citizens or property.

Policy 1.7 – Parties who develop vacant land or redevelop existing developed parcels will be required to install such flood management and conveyance facilities as are necessary to meet the standards set out in this Plan.

Infrastructure that does not meet the design criteria of the Plan shall be brought into compliance as a condition of development/redevelopment approval.

Policy 1.8 – Establish storm sewer improvement taxing districts as necessary.

Special taxing districts may be established for specific areas of the city which are in need of and would benefit from certain storm sewer improvements and ongoing maintenance activities.

GOAL 2: MANAGE SURFACE WATER RESOURCES USING A SCIENTIFICALLY-BASED, COMMON SENSE APPROACH THAT MEET OR EXCEED REGULATORY REQUIREMENTS.

Policy 2.1 – Comply with watershed management plan requirements, Metropolitan Council directives, and state and federal requirements for surface water quality management and shoreland management.

The City will adhere to the adopted standards and requirements of the governing watershed organizations of the City, as well as those adopted by the Metropolitan Council and the State of Minnesota (including the TMDL program and NPDES Phase II requirements).

Policy 2.2 – Manage lakes to achieve clear water conditions with abundant and diverse emergent and submergent native-dominated plant communities.

Most of Apple Valley's lakes are classified as shallow (i.e., at least 80% of the lake is less than 15 feet in depth). Aquatic science recognizes the natural state of these types of systems as one of clear water with a rich community of native submergent and emergent aquatic plants. State water quality eutrophication standards also support achieving this type of condition.

Policy 2.3 – Emphasize adaptive management in managing priority aquatic ecosystems.

The state-of-the-art view is that lakes are complex adaptive systems that are hard to predict. A high priority will be placed on management measures that have a reasonable cost and a reasonable chance of a positive outcome for a specific lake, and then monitoring the system

thoroughly to determine the cost-effectiveness of that management measure in achieving the goals set for the particular resource. At a minimum, it is expected that priority lakes within the City will continue to be monitored under the Metropolitan Council Citizen-Assisted Monitoring Program (CAMP).

Policy 2.4 – Combine watershed control measures with aggressive in-lake management measures, where necessary.

A strong emphasis will be placed on implementing appropriate and reasonable Best Management Practices throughout a lake's watershed to minimize runoff-derived and runoff-delivered sources of nutrients and other pollutants to high priority recreational water bodies. However, watersheds of the City's lakes and ponds have been profoundly affected by the development of the storm drainage system and the land use changes associated with suburban development. Watershed management measures need to be combined with in-lake management to cost-effectively achieve water quality and public usage goals for many of the recreational water bodies within Apple Valley. The City will work with other jurisdictions to ensure the full range of these control methods can be employed in a safe and cost-effective manner on as frequent a basis as necessary to achieve the goals in this Plan.

Policy 2.5 – Prioritize use of City resources for pond/wetland management where public access and city-wide benefits exist.

Water quality or habitat improvement efforts for ponds and wetlands without a developed public access must be balanced against overall public benefits. The City will work with affected residents in an advisory capacity to improve the pond/wetland environment. Where a significant city-wide benefit and/or knowledge benefiting the City can be gained, there is adequate staff and financial resources available, and there is the likelihood of a successful effort, the City may elect to assist with or implement management measures on a specific pond/wetland.

Policy 2.6 – Manage high priority lakes according to individual lake management plans.

This plan sets general goals and guidelines for management of the City's high priority lakes. However, a more detailed, in-depth level of evaluation is needed to develop a customized management strategy for a specific lake that takes into account unique in-lake conditions, watershed factors, and management opportunities for that lake. The City will identify partnerships with various groups such as residents, lake associations, watershed management organizations or other governmental agencies, to increase the chance of success and reduce the overall cost for developing and executing lake management plans.

GOAL 3: CONTROL WATERSHED LOADINGS TO HELP MEET OR EXCEED SURFACE WATER QUALITY REQUIREMENTS.

Policy 3.1 – Promote compliance with zero-phosphorus content fertilizer legislation.

Effective January 1, 2005, Minnesota state law bans application of fertilizer containing phosphate to lawns with some exceptions, such as, where a recent soil test has shown the lawn soil is

deficient in phosphorus. State law also requires clean-up of any fertilizer spread or spilled on paved surfaces. The City will promote awareness of this law in public education efforts.

Policy 3.2 – Tailor ice and snow control strategies to balance public safety and impact on water resources.

The City has a Sensible Salt Program which determines the appropriate application of deicing chemicals or sand/salt for road application according to the temperature, forecast and road conditions. The City strives to reduce the use of sand to the greatest extent. The application of sand on impervious surfaces results in significant sedimentation of downstream ponds and basins. Snow removal staff will receive annual training on the "state of the practice" for de-icing procedures and hold meetings before each deployment to discuss application procedures appropriate to the weather conditions.

Policy 3.3 – Remove street debris through regular spring and fall sweeping, with more aggressive sweeping in watersheds of priority water bodies and in the downtown area where large blocks of high impervious area exist.

Apple Valley has developed a policy (independent of this plan) to guide the City's street sweeping efforts. This policy is summarized below. The City may periodically amend or update the street sweeping policy as warranted. The City undertakes two seasonal City-wide street sweeping efforts. Streets are swept twice in the spring, as soon as practical, and streets are swept once in the autumn, generally after most leaves have fallen, targeting mature tree areas. Additional sweeping operations are conducted as necessary throughout the year.

The City has prioritized street sweeping in the community based mainly on location in relation to priority downstream drainage features and impact on water quality. Therefore areas draining to lakes receive top priority. Other factors such as street function and traffic volume are also considered. Apple Valley will utilize a Sweeping Order Map to guide the order that streets are swept.

The City intends to keep informed of street sweeping technologies and evaluate replacing obsolete equipment, subject to available funding and according to capital improvement priorities. Recently the City procured a regenerative air sweeper that is utilized throughout the year, weather permitting, and in tandem with the mechanical sweepers during the seasonal efforts. The regenerative air sweeper follows behind the mechanical sweepers to pick up fine particles associated with high amounts of total phosphorus and effectively pick up wet leaf material.

Policy 3.4 – Inspect and maintain storm drainage system to preserve the effectiveness of stormwater treatment features.

At least 20% of stormwater treatment facilities will be inspected each year to assess the need for maintenance. The City will utilize the University of Minnesota "Assessment of Stormwater Best Management Practices" to determine its protocols for inspection, emphasizing the Level 1, visual inspection/rapid assessment procedure. Priorities for clean-out/rehabilitation will be established based in part on the results of these inspections. High priority maintenance actions will be implemented through the City's capital improvements program.

Policy 3.5 – Increase awareness that dumping into the storm drainage system is prohibited and enforce as necessary.

City code prohibits the discharge of foreign material into the stormwater system, including refuse, yard wastes, sewage, industrial waste or other substances. Examples of other substances include oil, gasoline, antifreeze, paint, solvent, herbicides/pesticides, pet waste and other ecologically-harmful chemicals.

Policy 3.6 – Maintain spill response capability.

The City supplies spill clean-up kits in selected municipal vehicles and in the Central Maintenance Facility. Staff is given MSDS training for hazardous waste. The City will review the current program, and if warranted, develop improvements.

Policy 3.7 – The City requires Individual Sewage Treatment System (ISTS) inspections.

As of January 2006 there were 59 ISTS within the City. The City reminds owners of septic systems by letter every three years of the requirement to provide inspection records, signed by a certified septic tank inspector. If at any time an ISTS fails inspection and becomes a threat to public health, it must be repaired or replaced. If City sanitary sewer service is available when a system fails, it shall be required to connect to the City sewer service.

GOAL 4: MANAGE WETLANDS IN COMPLIANCE WITH ALL REGULATIONS AND ACCORDING TO THE COMMUNITY'S VALUES AND PRIORITIES.

Policy 4.1 – Assess functions and values of jurisdictional wetlands.

The City will use the information developed through this process to guide action on wetland restoration efforts, protective standards for new and redevelopment activities, and modifications of wetlands to increase protection to downstream water bodies. Wetlands not inventoried and classified will be assessed before development or redevelopment activity occurs adjacent to them. For new and re-development activities, a field inventory and classification will be required in these situations as part of submittal requirements and the management standards (including buffer requirements) will be applied as presented in this SWMP. The order in which wetlands are to be inventoried and classified outside the development review process will consider which wetlands are located in public open space and could be enhanced through City action. It will also be driven by whether the wetland could be impacted by development/redevelopment activities.

In the absence of information from the field-based classification methodology presented in this Plan to determine appropriate wetland protective measures, the City will rely for guidance on credible off-site classification information (such as that provided by the Dakota County SWCD for that portion of the City within the Vermillion River Watershed) until a field classification is completed.

Policy 4.2 – The City will act as the responsible government unit for protection of wetlands within City boundaries. With the adoption of this plan, the City is adopting the water quality treatment, hydrologic, and buffer standards referred to in Chapter 6.

The City will act as the Local Government Unit (LGU) for administration of the Wetland Conservation Act of 1991 and all subsequent amendments in all portions of the City. The City will also apply appropriate wetland protection standards promulgated through the NPDES MS-4 permit and the watershed organizations covering the City, including:

- Wetland impact sequencing;
- Pre-treatment of stormwater prior to discharge to wetlands;
- Wetland buffer requirements for new development; and
- Wetland replacement.

The City will uphold the objective of no net loss in wetland functions and values within the City and look for opportunities to protect and enhance priority wetland resources within the City.

Policy 4.3 – Enhancement of wetlands will be pursued.

The City will look for and pursue opportunities to undertake projects to enhance the function, value, and ecological diversity of wetlands and adjacent uplands based on the classification system within this plan. These activities will be subject to available funding and labor. Where a city-wide benefit or city-wide knowledge can be gained, however, the City may elect to assist with or implement itself, restoration measures on a specific wetland.

GOAL 5: PROTECT SURFACE WATER RESOURCES FROM IMPACTS OF LAND DEVELOPMENT AND REDEVELOPMENT ACTIVITIES.

Policy 5.1 – The City shall require compliance with all post-construction water quality criteria for new and redevelopment activity adopted by the watershed organization within which the development activity lies.

The references for the appropriate mitigation criteria to apply in the Vermillion River Watershed Joint Powers Organization will be their Standards, and in the Black Dog Watershed Management Organization (BDWMO) the reference will be the most recently adopted BDWMO Watershed Plan.

Policy 5.2 – At a minimum, new and redevelopment activity creating over 0.2 acres of new impervious surface shall be required to achieve no-net-increase in average annual Total Suspended Solids (TSS) and Total Phosphorus (TP) loading compared to the pre-development condition of the site or meet the post-construction runoff treatment section of the MPCA NPDES General Construction Permit, whichever is more restrictive.

This policy is consistent with the nondegradation requirements of the NPDES MS4 permit. Compliance can be achieved through on-site measures such as the application of Low Impact Design principles and/or on-site mitigation features, regional treatment and/or infiltration facilities, or some combination thereof. Compliance must be achieved before the runoff from the site

reaches a designated public water or City jurisdictional boundary. The burden of proof to show compliance lies with the applicant.

Policy 5.3 – The City may require additional treatment measures as needed for any development activity in order to protect downstream receiving waters.

This includes mandating additional treatment measures to comply with completed or pending TMDLs or lake management plans for a downstream receiving water.

Policy 5.4 - New and re-development activity creating over 0.2 acres of new impervious surface shall be required to achieve no-net-increase in average annual runoff volume compared to the 1990 nondegradation baseline loading condition. Within the Vermillion River Watershed JPO boundaries, new development and re-development activities creating over one acre of new impervious area will be required to keep runoff volume for the 2-year 24-hour storm at or under the runoff volume for the pre-development condition, or meet the above criteria, whichever is more restrictive.

At its discretion, the City may modify or waive these requirements, based on consideration of any of the following;

1. soil borings indicate unsuitability for infiltration (e.g., hydrologic group soil types C or D);
2. Infiltration of the equivalent runoff volume is accomplished elsewhere in the City within the same City drainage district and prior to discharge to a City jurisdictional boundary or priority lake.
3. A significant potential for groundwater contamination exists based on Minnesota Department of Health's guidance document "Evaluating Proposed Storm Water Infiltration Projects in Vulnerable Wellhead Protection Areas".
4. Other circumstances that may affect feasible and prudent implementation of this policy.

Policy 5.5 - The City recognizes Cobblestone Lake as an important regional infiltration feature and will monitor and protect infiltration capacity in Cobblestone Lake and its drainage.

This portion of the City has unique soil and geologic characteristics that allow infiltration of large amounts of runoff. Preservation of this infiltration capacity is a City and watershed organization priority. Pre-treatment of stormwater runoff discharged to features that serve a regional infiltration role such as Cobblestone Lake will be practiced by the City in order to protect the operational life of these features.

Policy 5.6– Collect cash dedications in lieu of treatment for water quality/wetland protection capital improvements, at the City's discretion and as a last resort.

This policy recognizes that it may not always be desirable and/or feasible for development/redevelopment activity to comply with on-site mitigation requirements as outlined in Policies 5.1 and 5.2. This provision provides another alternative to achieve compliance with those policies by financing off-site improvements. The methodology for applying and calculating the cash dedication is in Chapter 10.

Policy 5.7 – The City will refer to the following technical documents to guide application and design of Best Management Practices (BMPs) and Low Impact Development (LID) to achieve the performance standards identified previously in this section:

- Protecting Water Quality in Urban Areas (MPCA, 2000)
- Minnesota Urban Small Sites Best Management Practices Manual (Metropolitan Council, 2001)
- The Minnesota Stormwater Manual (MPCA, 2005a)
- The Vermillion River Watershed Joint Powers Organization Standards

The City will review and, as appropriate, approve the application, performance estimate, and final design of any stormwater Best Management Practice proposed for use in the City.

There has been a rapid increase in the availability, quantity, and quality of information available on urban stormwater BMPs since the City's 1997 SWMP was adopted. The technical resources cited above provide valuable guidance on the proper application, design, and expected performance of numerous BMPs that can be considered for use in the City. As the information in these manuals is updated or other credible documents are developed, the application and design of the BMPs in the City will be required to reflect the new or revised guidance.

Policy 5.8 – Control erosion at construction sites.

The City will continue to be engaged in the strict implementation of its Natural Resource Management ordinance, which includes requirements for construction site erosion and sediment control. In addition, the City requires that applications for new or redevelopment activity include in their applications for City review, the Storm Water Pollution Prevention Plan (SWPPP), as required under the NPDES construction permit.

Construction sites are inspected to ensure compliance with the existing erosion and sediment control ordinance and with the construction site permit under NPDES Phase II rules administered by the MPCA. Inspections are performed weekly and/or after a significant rain event. A plan review process and performance security bonds are the primary instruments used to establish a basis for compliance.

Erosion and sediment control Best Management Practices as outlined in but not limited to "Protecting Water Quality in Urban Areas – Best Management Practices for Dealing with Stormwater Runoff from Urban, Suburban and Developing Areas of Minnesota" by the MPCA (2000), designed by an ESC Certified Professional (through either CPESC or the University of Minnesota/MnDOT programs or with appropriate experience) is required and must be shown on required submittals to the City for approval. Any street sweeping conducted by the City to remove erosional debris from streets will be charged to the owner of the property.

Policy 5.9 – Development pays for itself.

Storm drainage system financing shall be by trunk area assessments against benefiting properties and storm sewer facilities. All new developments shall be required to pay the prorated cost to

dedicate land and construct a water quality treatment facility meeting City requirements and acceptable to the City.

GOAL 6: FOSTER CITYWIDE SUPPORT FOR WATER QUALITY MANAGEMENT GOALS THROUGH AN AGGRESSIVE EDUCATION PROGRAM.

Policy 6.1 – Hold at least one annual public meeting each year to discuss water quality and wetland protection issues.

This is mandated by NPDES MS4 requirements and provides a regular opportunity for the community to present views on these issues.

Policy 6.2 – Educate all City staff to set a good example in the community for water quality and wetland protection.

The City will carry out its public improvement projects and operation and maintenance activities in a way that complies with applicable regulations and policies.

Policy 6.3 – Provide regular orientation to City Council, Advisory Parks Commission, and Advisory Planning Commission on City's stormwater management/water quality/wetland protection programs.

The advisory and governing bodies rely on City staff to interpret and guide application of the policies and requirements in this plan. In addition, these entities need to be kept appraised of the cost and effectiveness of City efforts to achieve the Plan's goals.

Policy 6.4 – Use the educational approaches outlined in Chapter 9 to get key messages to residents.

Central messages for the public education/information program should emphasize – but not be limited to – the following:

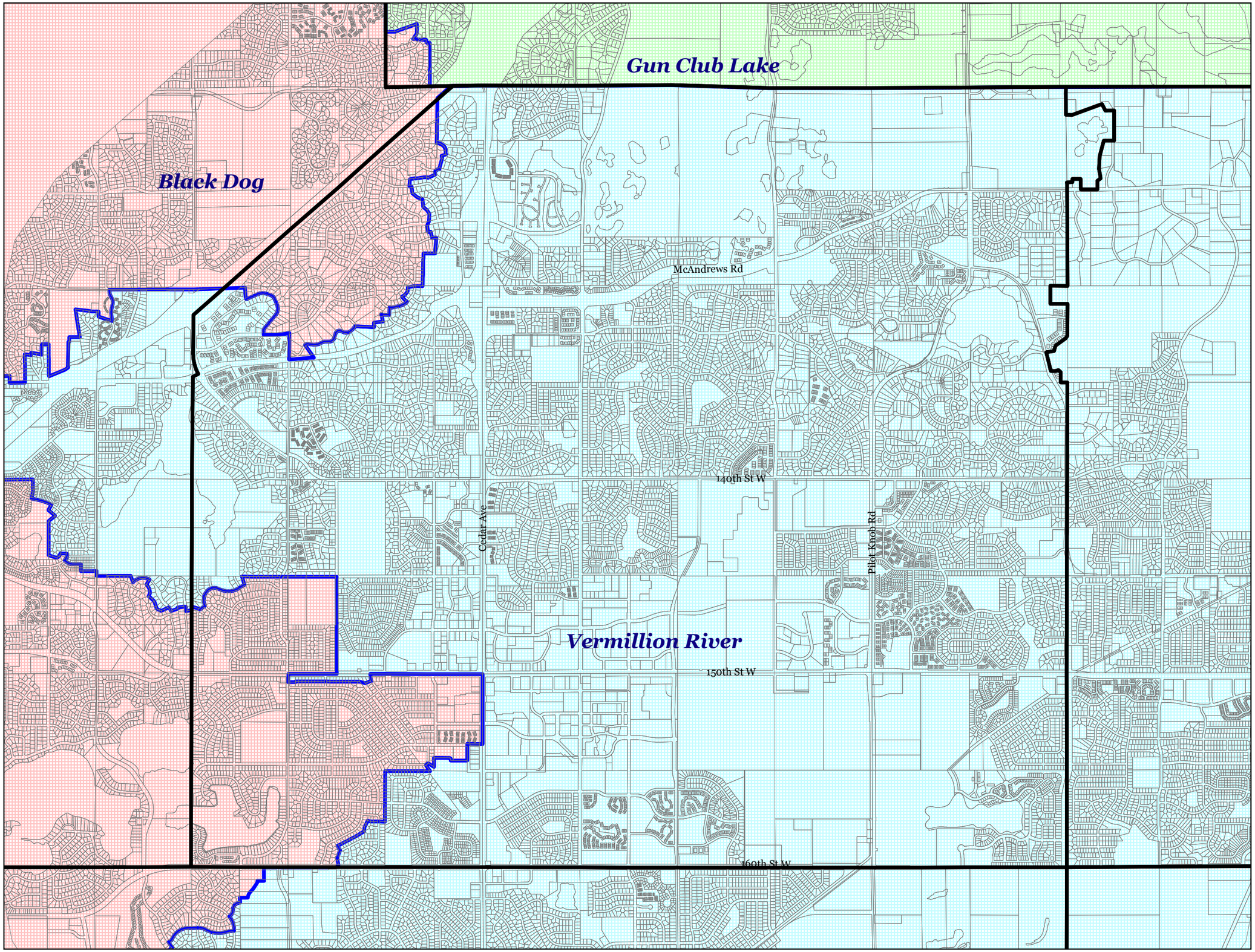
- The high degree of connection between the City's water bodies and developed areas because of the stormwater drainage system and the implications for this to mobilize and transport pollutants to community water bodies.
- The specific actions citizens, businesses, etc. can take on their property and as part of larger community volunteer efforts to reduce pollutant and runoff volume loadings to the storm drainage system.
- The requirements imposed on businesses and residents by local, state, and federal regulations.
- The financial investments and staff resources the City is putting toward water quality system improvements.
- The specific actions the City takes as part of its own day-to-day operations to set a good example in water resources protection.

3.3 WATERSHED MANAGEMENT ORGANIZATION REQUIREMENTS

The City of Apple Valley is within the jurisdiction of two watershed management organizations, the Black Dog Watershed Management Organization and the Vermillion River Watershed Joint Powers Organization.

(A small portion of the drainage area in the northern part of the Vermillion River watershed overflows into the Gun Club Lake watershed, however, the Vermillion River Watershed Joint Powers Organization maintains authority over that drainage area).

The geographical extent of each organization's jurisdiction within the City of Apple Valley is shown in Figure 3.1. Both of these entities have distinct approaches and requirements for surface water management which the City of Apple Valley is required to incorporate in this SWMP. A general overview of the requirements of each organization is presented below, but readers are encouraged to contact each organization directly to obtain the most up-to-date information on their goals, policies, and programs.



Apple Valley

City of Apple Valley

WATER MANAGEMENT ORGANIZATION BOUNDARIES

Surface Water Management Plan

FIGURE 3.1

Legend

Watershed Management Organizations
- Black Dog Lake
- Gun Club Lake
- Vermillion River
- City Boundary

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3.3.1 VERMILLION RIVER WATERSHED JOINT POWERS ORGANIZATION

The Vermillion River Watershed Joint Powers Organization (VRWJPO) covers an area of approximately 335 square miles in central Dakota County and a portion of southeast Scott County. Over 90% of the City is within the VRWJPO district, yet Apple Valley constitutes only 5% of the overall Vermillion River watershed. Significant City water resources in this area include Long Lake, Farquar Lake, Cobblestone Lake and Lake Alimagnet. (Lake Alimagnet and its drainage area are hydrologically outside of the Vermillion River watershed, but the lake levels are controlled by a lift station. The outflows from Lake Alimagnet are discharged via storm sewer into the VRWJPO watershed).

The original Vermillion River Watershed Management Organization was established in 1984 but was dissolved in 2000. Currently the VRWJPO is administered through a Joint Powers Agreement signed by Dakota and Scott Counties in September 2002 (the City of Apple Valley is not a party to the Agreement) and a watershed plan was adopted in November 2005. It is anticipated that the Watershed Plan will guide VRWJPO activities through at least 2015.

The Plan identifies eight broad issues of concern for the VRWJPO. In large part, the issues that pertain to this SWMP relate to pressures from development and urban growth. Increases in impervious surfaces have contributed to increased flow volumes in the Vermillion River. At the same time, groundwater resources have been negatively impacted due to impervious surfaces preventing infiltration and groundwater recharge. Land use activities and development have negatively affected lake water quality.

Highlights of the goals of the VRWJPO are to:

- Protect and enhance the surface water quality in the Vermillion River Watershed;
- Manage the rate and volume of runoff entering rivers, streams, lakes and wetlands within the Watershed;
- Protect groundwater quality and quantity to preserve it for sustainable and beneficial purposes; and
- Maintain and enhance, where possible, the functions and values of existing wetlands and habitats within the Watershed. Promote the restoration and/or creation of wetlands.

As of November 2006, the VRWJPO is engaged in the development of standards which provide detailed guidance on how it expects cities to implement the policies and goals of the organization. The standards cover floodplain alterations, wetland alterations, buffers, stormwater management (including construction erosion control, post-construction water quality management, temperature control, peak runoff rate control, and runoff volume control), drainage alteration, and agricultural standards. The development of the standards is called for in the November 2005 VRWJPO Watershed Plan. The VRWJPO intends to convert the standards into Rules in 2007. Additional standard and rule development is anticipated in the future. For example, the VRWJPO's intent is to revise its standards to include numerical standards for 100-year peak flow and storage at a subwatershed level after it completes the modeling to support those standards. In the interim, the standard will be implemented as follows; runoff rates for the proposed activities and development shall not exceed the existing rate for the 100-year critical duration event.

A detailed review of the standards will be necessary prior to revision of the City of Apple Valley's ordinances in order to assure compliance with these standards. Areas of the current City ordinances that will likely need to be revised include the following:

- Revision of the flood freeboard standard regarding the elevation at which the low floor of a building can be set.
- Revision of the infiltration standard to maintain runoff volume under post-development conditions at no more than the pre-development condition for up to the 2-year 24-hour rainfall.
- Establishment and protection of wetland buffers based on wetland type

3.3.2 Black Dog Watershed Management Organization

The Black Dog Watershed Management Organization (BDWMO) was formed in 1985 when the cities of Apple Valley, Burnsville, Eagan, Lakeville and Savage executed a joint powers agreement to establish the WMO. The BDWMO encompasses only about 8% of Apple Valley, including Lac Lavon Lake, and a small portion of the east shoreline of Keller Lake that lies within Apple Valley. Stormwater runoff from over 820 acres within Apple Valley discharges to this significant water resource.

Apple Valley's 1997 SWMP incorporated the policies of the BDWMO's original Watershed Management Plan adopted in 1989. The BDWMO has since adopted its second generation Watershed Management Plan in 2002.

The WMO recognizes member cities as being responsible for primary management of stormwater and water resources within their boundaries. It assigns responsibility to its member cities to administer regulatory programs for water management, including stormwater, wetlands, and shorelands.

Highlights of the BDWMO plan include:

- Designation of Lac Lavon and Keller Lake as strategic water resources and as such the BDWMO intends to partner with the cities of Apple Valley and Burnsville to manage these resources. (Strategic water resources are water resources of broad watershed significance that are important to a larger population than just the municipalities in which they are located);
- Requirements that existing discharge rates are maintained for the five-year (or 10-year) and 100-year frequency critical storm event;
- Requirements that erosion control and runoff control plans are developed for work that will disturb more than one acre of land;
- Requirements that member cities incorporate and adhere to the WMO's detention pond design standards;
- Requirements pretreatment of stormwater prior to its discharge to wetlands and other water resources (for new developments); and
- Requirements that member cities develop wetland protection ordinances by 2005, based on comprehensive wetland management plans and wetland functions and values assessments.

The BDWMO Watershed Management Plan sets forth implementation tasks which the member cities are expected to complete. Many of the implementation tasks reflect the requirements noted in the bulleted section above. The BDWMO will work with the member cities to set goals and a schedule for completion of implementation tasks.

A complete list of the implementation tasks affecting the City of Apple Valley is presented in Chapter 10.

A summary of the BDWMO requirements to be incorporated by the City of Apple Valley is presented in Table 3.1.

Table 3.1 – Summary of BDWMO Requirements for the City of Apple Valley

Easements	Cities to secure easements or fee title to the stormwater system as areas develop or redevelop.
Minimum Building Elevations	Adopt ordinances or policies that set minimum building elevations at least one foot above the critical 100-year flood elevation for structures adjacent to inundation areas. Cities should consider the effects of events larger than the 100-year flood when setting minimum building elevations. Higher minimum building elevations should be considered for structures adjacent to ponding areas with large tributary watersheds and for structures adjacent to landlocked basins.
Erosion/Sediment Control and Runoff Water Management	Ordinances are to include requirements for the preparation of erosion control plans and runoff water management plans, which require the use of Best Management Practices on construction sites, for all projects that will disturb one or more acres of land. Ordinances are to include the requirements and procedures for reviewing, approving and enforcing runoff control and erosion control plans. Adopt, administer, implement and enforce ordinances addressing erosion and sediment control, including the permitting and inspection of such controls.
Wetland Management	Develop wetland protection ordinances by 2005, based on comprehensive wetland management plan and wetland functions and values assessment.
Shoreland Regulation	Adopt DNR-approved shoreland ordinances, in accordance with the DNR's priority phasing list.
Individual Sewage Treatment Systems	Develop management programs and ordinances for Individual Sewage Treatment Systems (ISTS) that are consistent with MPCA Rules 7080 and Metropolitan Council policies.
General	If the interim period between approval of the BDWMO plan and a local (city) plan is anticipated to be longer than 2 years, the BDWMO expects that member city will implement the standards in Section 5.9 of the BDWMO plan within 2 years of approval of the BDWMO plan.

3.4 REGIONAL, STATE, AND FEDERAL JURISDICTIONS

This section is a synopsis of current agency requirements while acknowledging the existence of other requirements that may be applicable. These agency requirements are current as of fall of 2005, however, state and federal regulations are subject to change in the future and the City will be abreast of any new developments that may affect water quality initiatives. Many of these agency requirements are focused on wetland resources. However, recent programs at the state level involve non-point source pollution control.

The City is committed to the preservation and enhancement of its wetlands and water resources through compliance with local, state, and federal wetland and non-point source pollution regulations.

3.4.1 METROPOLITAN COUNCIL

The Metropolitan Council has broad authority for water management planning across the seven-county Twin Cities Metro area. It reviews local water plans, as part of the local comprehensive planning process, prior to their approval by the local watershed management organization(s) and adoption by the City. In the Council's *2030 Regional Development Framework* (Metropolitan Council, 2005), the Council adopted the following water management goal for the region: "The quality of water leaving the Metropolitan Area is as good as the water quality entering the Metropolitan area." To meet this goal, the Council has linked the control of pollution from point and non-point sources. The *2030 Water Resources Management Policy Plan* states that if a community does not have a local water management plan as part of its 2008 community comprehensive land use plan update, that comp plan may be found incomplete for review. If the community has a plan that does not meet Council requirements for local water management plans, the Council will likely find the plan to have an impact on the system and require a plan modification. Through Minnesota Rules Chapter 8410 and subsequent follow-up guidance, the Council requires what communities should do to ensure their local water plans are consistent with the *2030 Water Resources Management Policy Plan*.

3.4.2 MINNESOTA DEPARTMENT OF NATURAL RESOURCES (MNDNR)

The Department of Natural Resources has jurisdiction over water bodies appearing on the State's Public Waters Inventory. Information on the location of public waters in Apple Valley is presented in Figure 3.2. The water bodies shown in this figure are on the DNR inventory list and are subject to MNDNR regulation.

If a water body meets the jurisdictional criteria but is not on the state's inventory, it is not regulated by the DNR. If it does not meet the statutory criteria but is listed on the inventory, it still is subject to MNDNR regulation. There is no current process to add or delete public waters. The inventory was begun in the late 1970s and all state inventories were completed during the early 1980s.

The MNDNR rules specify that permits may not be issued for projects that compromise health, public safety, and welfare.

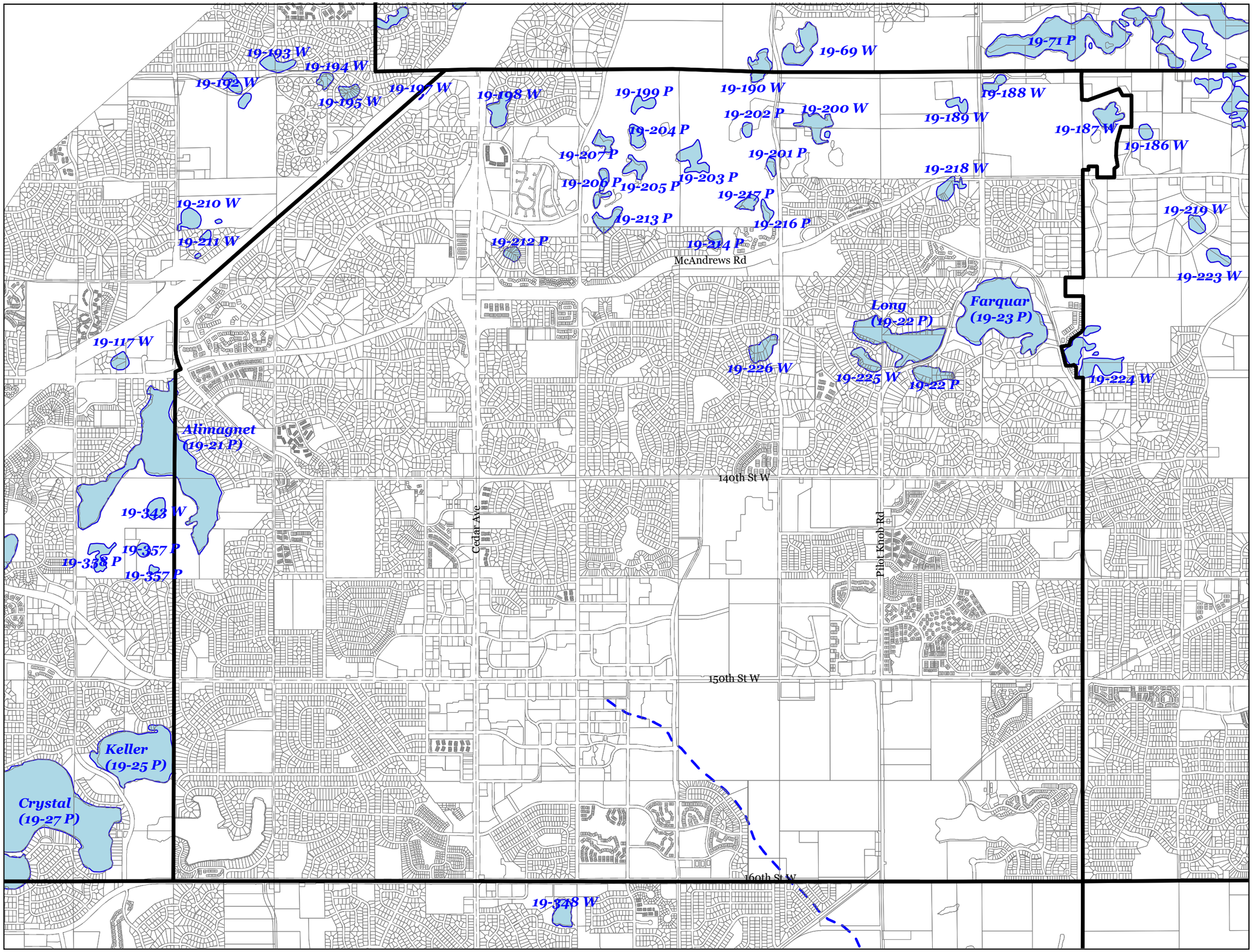
3.4.3 U.S. ARMY CORPS OF ENGINEERS (USACE)

Under Section 404 of the Clean Water Act, including subsequent modifications, the U.S. Environmental Protection Agency (USEPA) and the U.S. Army Corps of Engineers (USACE) regulate the placement of fill into all wetlands of the U.S. In 1993, there was a modification of the definition of "discharge of dredged material" to include incidental discharges associated with excavation. This modification of the "discharge of dredged material" definition meant that any excavation done within a wetland required the applicant to go through Section 404 permitting procedures.

3.4.4 Board of Water and Soil Resources (BWSR)

This agency oversees administration of the state Wetlands Conservation Act (WCA) by Local Government Units (LGU) and must approve any local wetland management plan developed by a local government. The WCA, passed in 1991, extends protection to all non-public-water wetlands unless they fall under one of the exemptions. The WCA was ordered to implement a "no net loss" policy for wetland functions and values. Provisions restrict draining or filling, wholly or partially, unless it is replaced by restoring or creating wetland of at least equal public value under an approved replacement plan. Replacement ratio is typically 2:1, 2 acres created for every 1 acre of impact.

A Local Government Unit (LGU) is responsible for making exemption and no-net-loss determinations and approving replacement plans. The City of Apple Valley is the LGU for WCA administration.



Apple Valley

City of Apple Valley

DNR Waters

Surface Water Management Plan

FIGURE 3.2

Legend

- City Boundary
- Public Waters
- Public Water Courses (Apple Valley Reach contained in Storm Sewer and not subject to VRWJPO Buffer requirements)

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3.4.5 State and Federal Jurisdictional Boundaries for Public Wetlands and Waters

Wetlands boundaries are delineated according to the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory, 1987). Wetlands must have a predominance of hydric soils, be inundated or saturated by water sufficiently to support a prevalence of hydrophytic (water tolerant) vegetation, and under normal circumstances, support a prevalence of hydrophytic vegetation.

For public-water wetlands, the boundary of MNDNR jurisdiction is determined by the Ordinary High Water Level (OHWL), which is established by the DNR.

3.4.6 Minnesota Pollution Control Agency (MPCA)

The Section 404 permit also requires a Section 401 water quality certification before it is valid. The EPA has given Section 401 certification authority to the MPCA.

The MPCA also administers two programs that regulate non-point source pollution, the National Pollutant Discharge Elimination System (NPDES) program and the Total Maximum Daily Load (TMDL) program. These programs affect stormwater management and address water quality impacts from watershed activities.

Generally, Phase II of the NPDES program regulates small communities (less than 100,000 people) that are within "urbanized" areas. NPDES Phase II addresses three areas of stormwater management:

- Municipal Separate Storm Sewer Systems (MS4)
- Construction site activity
- Industrial site activity

The primary goal of the MS4 program is to restore the integrity of waters of the state through management and treatment of urban stormwater runoff. This program was implemented by the MPCA in 2003. Regulated communities are required to apply for a permit to the MPCA every five years. MPCA requires MS4 communities to develop a Storm Water Pollution Prevention Program (SWPPP) that details the use of appropriate Best Management Practices. Apple Valley is one of over 100 Minnesota cities that are regulated under the MS4 program.

The TMDL program addressed surface waters (lakes, streams or rivers) that do not meet their designated uses; these waters are considered impaired. Every two years the MPCA publishes a list of impaired waters. As of preparation of this plan, three lakes within Apple Valley-Alimagnet, Farquar, and Long, are listed as impaired. Keller Lake, which is located in Burnsville but receives stormwater discharge from Apple Valley, is also listed as impaired.

The TMDL process identifies the sources and relative load contributions of all inputs to a water body for a given pollutant. Through this process, pollutant reduction strategies can be developed to allow a water body to meet its designated use. Specifically, a TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet its designated use, and an allocation of that amount to the pollutant's sources.

3.5 AGENCY STORMWATER PUBLICATIONS

Best Management Practices (BMPs) are techniques, methods, and measures that prevent or reduce water pollution from stormwater runoff. These practices may include regulations, structural features, and operation/maintenance procedures.

The MPCA, Metropolitan Council and others have produced many guidance documents and technical manuals to help guide the selection, design and use of BMPs.

The City of Apple Valley has adopted the MPCA's "Protecting Water Quality in Urban Areas – Best Management Practices for Minnesota" (2001) as a guiding document for erosion and sediment control measures.

The Metropolitan Council has published the "Minnesota Urban Small Sites BMP Manual Stormwater Best Management Practices for Cold Climate" (2001). This resource provides information on tools and techniques to assist Twin Cities municipalities and WMOs in guiding development and redevelopment. The manual includes detailed information on 40 BMPs that are aimed at managing stormwater pollution for small urban sites in a cold-climate setting. The goal of the manual is to support the principles of accommodating growth while preserving the environment.

Progress continues in the state for advancing BMPs and improving surface water conditions. In 2004, the MPCA gathered representatives from nearly 30 public and private organizations to form the Minnesota Stormwater Steering Committee. Among other tasks, this Committee is charged with guiding the development of state stormwater performance criteria and recommended Best Management Practices for Minnesota. This result was the publication of a Minnesota Stormwater Manual in November 2005.

The City of Apple Valley may choose to supplement the MPCA's BMP guidance document with alternative available publications and technical documents as appropriate in guiding (or requiring) the use of BMPs to manage surface water quality.

3.6 WATERSHED AGENCY CONTACTS

The primary contacts for local regulating agencies described above are presented below. These contacts are accurate as of June 2007.

Vermillion River Watershed Joint Powers Organization
14955 Galaxie Avenue
Apple Valley, MN 55124
Phone: (952) 891-7011 Fax: (952) 891-7031
http://www.co.dakota.mn.us/CountyGovernment/PublicEntities/VermillionJPO/default.htm

Black Dog Watershed Management Organization
100 Civic Center Parkway
Burnsville, MN 55337
Phone: (952) 895-4505 Fax: (952) 895-4531
http://www.dakotacountyswcd.org/watersheds/blackdogwmo/intro.htm

4. Technical Background

4.1 STORMWATER QUANTITY MANAGEMENT

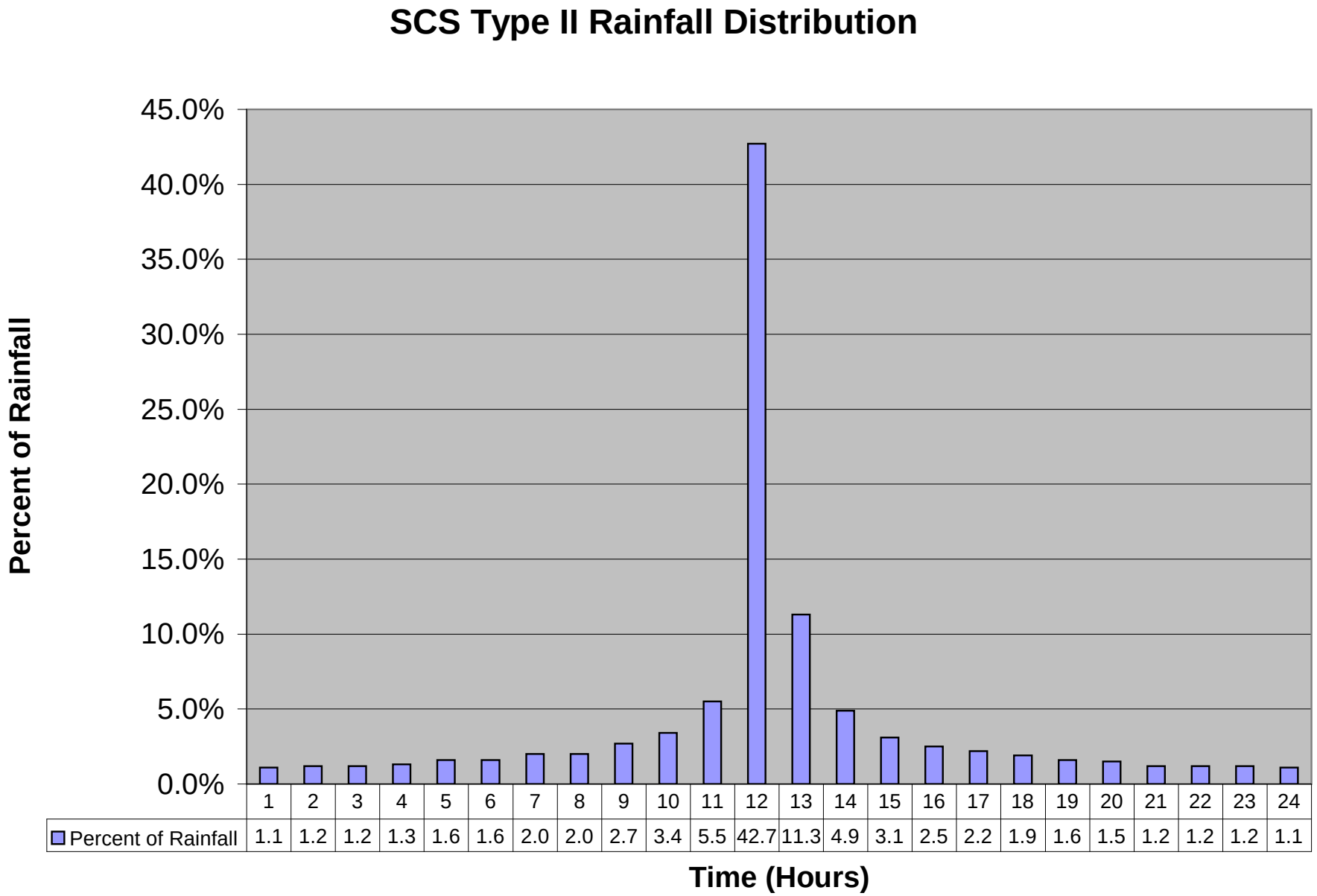
This section is intended to articulate criteria for design of some of the key aspects of the stormwater quantity management system. The first portion of this section presents information on precipitation analysis used to size and design the City's drainage system. The next sections explain the City's freeboard criteria and other technical criteria affecting water quantity management. Finally, the last sub-section provides information on the methods used to conduct the hydrologic modeling, results of which are presented in Chapter 5.

4.1.1 PRECIPITATION EVENTS

The City has adopted the 1% probability 24-hour rainfall event as its critical design event for setting High Water Levels (HWLs) in existing designated ponding areas. Commonly known as a 100-year rainfall, this event has a 1% chance of occurring during any year at any given point in a watershed. This hypothetical storm assumes that six inches of rainfall occurs over a 24-hour period. For the purposes of modeling, the rainfall is distributed over this time period using the SCS Type II distribution. Figure 4.1 shows the percent of the total rainfall depth of six inches that falls within each one-hour time increment over the 24-hour storm. Based on this distribution, about 60% of the rainfall (3.5 inches) falls within a three-hour period, near the middle of the event.

The 1% probability rainfall event is commonly used throughout the Twin Cities to design and guide management of urban stormwater management infrastructure. Complete protection against very large and infrequent precipitation events of less than 1% probabilities are typically justified only for flood control projects where loss of life and catastrophic property damage would likely occur if the capacity of the system to handle the runoff is exceeded.

For most developing areas like Apple Valley, the cost of constructing a system with a capacity to convey and store runoff from storms larger than the 1% event is much greater than the property damage that would result. Nevertheless, there is a small probability every year that a storm event will generate runoff that exceeds the capacity of the conveyance and storage system. Two such rainfall events that affected Apple Valley – one in July 1987 and one in July 2000 – were characterized by rainfall depths and intensities that exceeded significantly the design criteria for municipal storm drainage systems. In addition, other issues can arise that compromise the effective functioning of the system as well during a large storm, such as partial blockage of outlets. For these reasons, the City of Apple Valley – like other municipalities in the Twin Cities Metro area – applies a factor of safety known as a "freeboard" to calculated High Water Levels in designated ponding areas. The City's freeboard criteria are explained in more detail in the following sub-section.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Percent of Rainfall	1.1	1.2	1.2	1.3	1.6	1.6	2.0	2.0	2.7	3.4	5.5	42.7	11.3	4.9	3.1	2.5	2.2	1.9	1.6	1.5	1.2	1.2	1.2	1.1

RAINFALL DISTRIBUTION

SURFACE WATER MANAGEMENT PLAN

APPLE VALLEY, MINNESOTA

FIGURE 4.1

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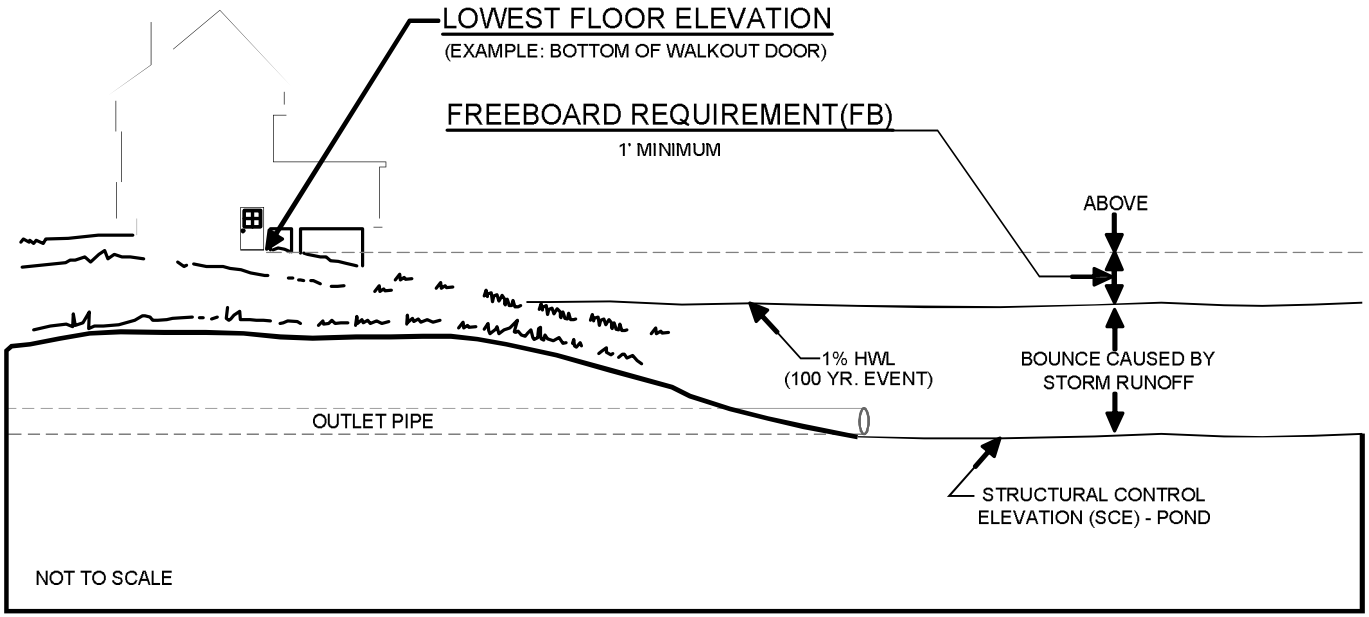
Bonestroo

4.1.2 FREEBOARD CRITERIA

Freeboard is a factor of safety against flooding represented by the vertical separation between the peak water elevation for a pond or conveyance route for the design precipitation event and the elevation at which unacceptable property damage occurs. In general, this elevation is based on the lowest elevation of a building.

The incorporation of a freeboard criterion is recognition of the possibility that larger precipitation/runoff events than the design precipitation event may occur and/or that optimum operation of the system may at times be compromised due to partial blockage of outlets with debris, etc. Figure 4.2 illustrates an example of a one-foot freeboard above a pond High Water Level (HWL) for a 1% probability critical duration precipitation rainfall. It is important to note that in the example shown in Figure 4.2, the City of Apple Valley would apply a three-foot freeboard requirement because of the presence of the door of the walk-out basement, which represents the lowest exposed opening for the building (see Policy 1.1 in Chapter 3).



"FREEBOARD" FOR DESIGNATED STORMWATER PONDING AREA

SURFACE WATER MANAGEMENT PLAN

APPLE VALLEY, MINNESOTA

FIGURE 4.2

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4.1.3 Other Technical Standards

This sub-section explains other technical criteria that guide the design of key aspects of the storm drainage system, such as the access to the system, conveyance facilities, and temporary flood storage outside of designated ponding areas. These standards shall be followed in the design and construction/re-construction of the system.

a. Manhole Access. Proper design of a storm sewer system requires that all sewer lines be provided with access through manholes for maintenance and repair operations. Spacing of manholes should be no greater than 400 feet for storm sewer lines 15 inches or less in diameter, and 500 feet for sewer lines 18 inches to 30 inches in diameter. Intervals on larger diameter lines can be increased since the pipes are sufficiently large enough for a person to enter. Regardless of sewer size, manholes should normally be provided at all junction points and at points of abrupt alignment or grade changes.

b. Surcharging of System. Although lateral systems are designed for 10-20% probability storm events, their performance must be analyzed for storms exceeding the design storm. It should be anticipated that surcharging of the system will occur when the design storm is exceeded. During surcharging, the system works as a closed conduit and the pipe network becomes pressurized with different pressure heads throughout the system. Low areas that are commonly provided with catch basins become small detention ponds often performing like pressure relievers (water "gushing out" in some locations). For this reason, it is extremely important to ensure that these low areas have an acceptable overland drainage route with proper transfer capacity and are not landlocked.

c. Temporary Ponding in Street Low Areas. Ponding on streets must meet the minimum requirements of the 100-year design criteria. For safety reasons, the maximum depth should not exceed three feet at the deepest point and the lowest exposed building elevation should be at least two feet above the High Water Level. The High Water Level for temporary street ponding is defined as the elevation to which water rises before overflowing through overland routes.

d. Efficient Hydraulic Design of Conveyance Pipes. All storm sewer facilities and especially those conveying large quantities of water at high velocities should be designed with efficient hydraulic characteristics. Special attention should be given during final design to those lines that have extreme slopes and create high hydraulic heads. These lines should be designed to provide adequate energy dissipation, which will reduce the risk of back pressure effects and reduce the risk of downstream erosion. Manholes and other structures at points of transition should be designed and constructed to provide gradual changes in alignment and grade. Pond outlet control structures should be designed to allow water movement in natural flow line patterns to minimize turbulence, provide good self-cleaning characteristics, and prevent damage from erosion.

e. Inlet Structures. Inlet structures should be liberally provided at all low points where stormwater collects and at points where overland flow is to be intercepted. Inlet structures are of special importance since it is a poor investment to have an extensive storm sewer line flowing partially full while property is being flooded due to inadequate inlet capacity.

Inlets should be placed in accordance with State Aid Standards for all collector streets to limit lane flooding to within half of the outside lane. Additionally inlets shall be located to eliminate overland flow in excess of 1,000 feet on streets or a combination of streets and swales and 600 feet on collector streets and arterials. Additionally, inlets shall be placed and located such that 3cfs is the maximum flow at the inlet for the five-year event. It is very important that consideration be given to each intake to ensure adequate inlet capacity. This is especially true in rolling areas where steep grades allow excessive carry over where conventional grates are used. The desired inlet structure is one which will provide the required inlet capacity and will not produce a hazard or hindrance to traffic. In some cases, specially designed intakes with increased inlet area and oriented more normal to the direction of the water flow may be necessary. All of these details should be considered during final design. Inlet grates and openings should be of self-cleaning design to minimize capacity reduction when clogged with twigs, leaves, and other debris.

f. Energy Dissipation at Outfalls. Effective energy dissipation devices or stilling basins to prevent stream bank or channel erosion at all stormwater outfalls shall be provided. The following recommendations should be kept in mind when designing an outlet:

Storm sewer inlet and outlet pipes of stormwater ponds shall be extended down to the control water level where possible.

Outfalls with velocities of less than 4 feet per second (fps) that project flows downstream into the channel in a direction at less than 30 degrees from the normal channel axis generally do not require energy dissipaters or stilling basins, but do require rip rap protection.

Where an energy dissipater is used, it should be sized to provide an average outlet velocity of less than 6 fps, unless rip rap is also used. In the latter case, the average outlet velocity should not exceed 8 fps.

Where outlet velocities exceed 8 fps, the design shall be based on the unique site conditions present. Submergence of the outlet and the installation of a stilling basin approved by the city are required.

Rip rap shall be provided on all outlets to an adequate depth below the channel grade and to a height above the outfall or channel bottom. It shall be placed over a suitably graded filter material and filter fabric to ensure that soil particles do not migrate through the rip rap and reduce its stability.

Rip rap should be placed to a thickness at least 2.5 times the mean rock diameter so as to ensure that it will not be undermined or rendered ineffective by displacement.

Overland drainage routes where velocities might exceed 8 fps shall be evaluated by the City on a case-by-case basis.

g. Open Channels for Conveyance. Open channels may be appropriate where flows and small grade differences prohibit the economical construction of an underground conduit and in areas where open channel type drainage will enhance the aesthetic qualities of a development. A minimum slope of 1.0% should be maintained in unlined, open channels and overland drainage routes whenever possible. Slopes of less than 2.0% are difficult to construct and maintain and can create problems with ponding of water. Side slopes shall be a maximum of 4:1 (horizontal to vertical) with flatter slopes being very desirable. Where space permits, slopes shall be cut back to the existing ground level. Rock rip rap shall be provided at all points of juncture between two open channels and where storm sewer pipes discharge into a channel. The design velocity of an open channel shall be sufficiently low to

prevent erosion of the bottom. Rip rap or concrete liners shall be provided in areas where high velocities cannot be avoided. Periodic cleaning of an open channel is required to insure that the design capacity is maintained. Therefore, all channels shall be designed to allow easy access for equipment.

h. Protection of Sanitary Lines. Both storm drainage facilities and sanitary sewer lines are designed to take advantage of natural draws and usually follow a ravine, creek, or gully.

   As more area develops in the city, the total runoff in natural drainageways will increase and peak water levels will rise. In certain areas, water could enter the sanitary sewer system causing capacity problems and added costs for treatment of stormwater. For this reason, sanitary sewer manholes that could be subject to temporary inundation should be equipped with water-tight castings and added precautions should be taken in construction of these manholes to prevent the entrance of stormwater. Sanitary manholes located near ponding areas should be raised above the 100-year High Water Level and the adjacent areas filled when access is required at all times. If access is not required, water-tight castings should be installed. Future storm drainage construction should include provisions for improving the water tightness of nearby sanitary sewer manholes.

   All newly constructed sanitary manholes in the vicinity of ponding areas and open channels described in this report should be waterproof.

i. New Stormwater Ponds. New stormwater ponds should be constructed to provide a large surface area with gradually sloping sides to provide substantial storage volume for stormwater and water quality purposes. The side slopes of any pond should not be steeper than three-foot horizontal to one-foot vertical (3:1). The first foot below the control water level should be designed to slope at a 10-foot horizontal to one-foot vertical (10:1) slope in order to provide an aquatic bench for safety and emergent vegetation. Where possible, a 10-foot wide maintenance bench shall be provided with a slope of 10-foot horizontal to one-foot vertical (10:1) and elevated one foot above the control water level. More detailed guidelines on pond design are provided in Appendix E.

4.1.4 Modeling Approach and Methods

Simulating the stormwater conveyance and storage system is important to determine the adequacy of the existing system and to provide guidance in designing and operating the system to handle surface runoff for ultimate development conditions.

A hydrologic model simulates the rainfall-runoff process so that runoff rates and volumes from specific design storms can be estimated for different stormwater configurations and land use conditions.

The rate and volume of stormwater runoff is heavily dependent on several factors, including:

- The intensity and duration of the precipitation event;
- The total amount of precipitation;
- Soil moisture conditions immediately preceding the event;
- The infiltration characteristics of the soil;
- The amount of vegetation cover;
- The amount of impervious coverage and the extent to which it is connected; and
- The size and slope of the contributing drainage area.

The computer modeling of stormwater runoff quantities to determine High Water Levels in ponds was carried out using the software package HydroCAD (Version 7.1). Stormwater runoff hydrographs were generated and routed through the system in accordance with TR-20 methodology from the former USDA Soil Conservation Service (now the Natural Resources Conservation Service or NRCS). This methodology is an industry standard for the analysis of flood hydrology for a community-wide stormwater management plan.

Key inputs for the model include:

- Watershed size;
- Watershed curve numbers;
- The time of concentration for each watershed;
- The pond area and water surface elevation at the control water level;
- The relationship between stage and storage above the control water level; and
- The pond outlet configuration, including the diameter of outlet, slope, roughness, and length and the nature of any controls on the outlet (orifices, weirs, etc.).

The runoff curve number determines the percentage of precipitation falling on an area that results in runoff. Curve numbers used to represent runoff conditions for various sub-districts were based on ultimate land uses identified in the City's 1999 Comprehensive Guide Plan.

The runoff curve number varies from 61 for parks to 99 for pond water surfaces and areas that are completely paved. The curve numbers were chosen to reflect normal soil moisture conditions before the storm (Antecedent Moisture Condition (AMC) II for the TR-20 method). Curve numbers under AMC II conditions for various land uses are shown in Table 4.1.

Table 4.1 – Curve Numbers for Land Uses in Apple Valley

Land Use	SCS Curve Number
Low Density Residential	72
Medium Density Residential	78
High Density Residential	84
Commercial	90
Industrial	90
Neighborhood Service	85
Mixed Use	85
Institutional	Varies
Local Park	62
Regional Park	58
Water	99

The time of concentration is the time required for runoff from a storm to become established and for flow from the most remote point (in time, not distance) of the watershed to reach a specified point. The time of concentration will vary with the type of surface the precipitation falls on, the slope of the surface, and the distance from the specified point. Once the storm duration equals the time of concentration, it is assumed that the entire watershed is contributing runoff to the specified point and consequently the maximum rate of runoff will occur at this time for a specific design frequency storm. A minimum time of concentration of 15 minutes was used for the HydroCAD analysis of the 1% chance rainfall event.

Information on watershed areas, stage/storage information for individual ponding areas, and outlet configurations was obtained from topographic maps and utility record and location plans obtained from the City.

4.2 STORMWATER QUALITY MANAGEMENT

This section is intended to explain key concepts of urban stormwater quality management and the City's approach to this issue. The first portion of this section presents information on basic concepts of pollutant generation and transport in an urban environment. The next section explains the approach used in developing the stormwater quality modeling tool for the City. Finally, an overview of Best Management Practices (BMP's) for stormwater quality improvement applicable to the City is provided.

4.2.1 POLLUTANT LOADING BASICS

The quality of urban runoff is strongly influenced by the impervious coverage within the area, such as roads, driveways, and rooftops. Higher impervious coverage generally increases the total amount of pollutants in runoff generated within a given area. These higher pollutant "loadings" are related to four changes that occur as land is changed to accommodate more intensive uses:

- Impervious coverage produces a higher volume of runoff. Impervious surfaces such as rooftops and pavement cover natural soil. When precipitation falls on these impervious surfaces, it cannot soak into the soil; instead it leaves the area as surface runoff.
- The rate of runoff increases, primarily because the runoff concentrates and travels over smooth surfaces such as pavement. This increase in the rate of runoff increases the ability of the runoff to pick up and carry pollutants.

- Urban and suburban activities can generate high amounts of pollutants that are released into the environment. Examples of these activities include lawn maintenance, operation of vehicles, construction, and domestic pet "activity". In addition, wash-off of wind-driven dust and other residue falling on pavement is a significant component in urban pollutant loads.
- The storm sewer systems installed to quickly carry away runoff to prevent flooding also act as an efficient system for transport of pollutants washed off impervious surfaces and maintained areas.

Field research has shown that most of the pollutant load carried in urban stormwater runoff over a given year is the result of wash-off of pollutants from small to moderate sized rainfall events. **One of the most important findings from this research is that runoff from rainfall events less than or equal to 1.5 inches in depth is responsible for carrying over 95% of the average annual runoff volume and pollutant mass discharges from residential areas (MPCA 2000).**

Annual pollutant loading is more closely associated with total annual runoff volume than with peak runoff rates from individual rainfall events.

Pollutant loading to receiving waters is expressed in terms of mass per unit time. In this Management Plan, loads are presented as pounds per year and referred to as annual load. Pollutant load is the product of pollutant concentration and total flow volume.

Pollutant concentrations in runoff can vary dramatically for any given land use as a result of time of the year, climatic conditions, human activities, or other variables such as soils, slope, and vegetative cover. For general watershed loading analyses, a single pollutant concentration (termed Event Mean Concentration) is often chosen from a range of published values to approximate local runoff quality for a specific type of land use for an annual analysis period. For phosphorus, these annual EMC values often range from 150-200 parts per billion (ppb) for runoff from relatively undisturbed land (forest, grassland, etc.) to as high as 400-800 ppb for modified landscapes supporting land uses such as residential, commercial, or agricultural row crop activities.

The runoff volume applied to the pollutant concentration to generate a load estimate is dependant on annual rainfall depth and land use characteristics of the watershed. A runoff coefficient (Rv) is used to represent the proportion of annual rainfall that results in runoff. (This differs from the use of a CN value which characterizes runoff from a single storm event.) Annual volumetric runoff coefficients reflect the percent of annual precipitation that runs off the landscape and is expressed as a decimal fraction. The coefficients can vary from between 0.05 and 0.1 for well vegetated, undisturbed land uses to upwards of 0.3 to 0.7 for high density residential and commercial/industrial development with high impervious coverage.

4.2.2 STORMWATER QUALITY MODELING

As with the stormwater quantity model, the PondNet water quality model developed as part of this Plan update was based on expected ultimate development conditions for the City. In those portions of the City that are already developed, the model reflects as closely as possible the actual land use, stormwater routing, and other features on the ground now. For areas that were not yet developed at the time of the model update, it was assumed that ultimate land uses, drainage sub-districts, and stormwater routing would be the same as that assumed for the water quantity modeling. Use of the PondNet model for specific applications, such as development of a lake management plan or completion of modeling to comply with NPDES nondegradation requirements (explained in Chapter 8), is appropriate. However, the effort should include an evaluation of key input data to make sure they reflect actual field conditions for the time period of interest and development of credible watershed-specific factors that can have a large impact on model output (such as actual wet volumes and infiltration losses associated with key ponds).

As discussed in Section 4.2.1, runoff pollutant loads are the product of flow volume and runoff pollutant concentration. To achieve pollutant load estimation, the key input parameters for the PondNet model include:

- A pollutant Event Mean Concentration (EMC) (variable by land use);
- An annual runoff coefficient (Rv) for each identified land use (variable by land use); and
- A representative annual average precipitation amount (34.6 inches for Apple Valley).

Together, the second and third bullets generate an annual flow volume.

For each of the major land use categories within the study area, a combination of EMC's and Rv values were selected which resulted in an annual unit load representative of that land use. These values are critical to the modeling results and are presented in Table 4.2.

Table 4.2 – PondNet Input Values Used for Apple Valley Modeling

Land Use	Phosphorus Runoff Concentration[1] (ppb)	Hydrologic Runoff Coefficient (Rv)	Phosphorus Unit Export Load[2] (lbs/ac/yr)
Low Density Residential	450	0.22	0.76
Medium Density Residential	450	0.31	1.08
High Density Residential	350	0.43	1.17
Commercial & Neighborhood Service	350	0.43	1.17
Industrial	350	0.52	1.42
Mixed Use	400	0.43	1.34
Institutional	350	0.34	0.92
Local Park	250	0.12	0.23
Regional Park	200	0.05	0.08
Golf Course	550	0.12	0.52
Zoo	550	0.16	0.69

[1] *This is also referred to as an Event Mean Concentration.*

[2] *Phosphorus unit export loads are based on a total annual precipitation of 34.6 inches, which is the 30-year normal precipitation recorded at the Rosemount Agricultural Experiment Station (station 217107).*

The PondNet model is capable of estimating phosphorus load reductions associated with stormwater detention ponds. Pond surface area and wet volume are the key variables associated with modeling pond nutrient load reduction. Some field data was collected in Apple Valley to characterize pond mean depths, enabling wet volumes to be estimated for ponds with unknown wet volume. For natural wetlands incorporated into the City's storm drainage system (approximately 20% of the ponds accounted for in the PondNet model), the following mean depths were used to calculate wet volumes:

Table 4.3 – PondNet Mean Depth Assumptions for Natural Basins Based On Field Data

Pond Surface Area (acres)	Mean Depth (feet)
Less than 1.0	0.75
Between 1.0 and 2.5	1.5
Greater than 2.5	2.0

For constructed basins, mean depths were assumed to be three feet. Updating mean volumes for constructed ponds based on approved grading plans should be considered before all or portions of the City-wide model are used for lake management plans or other detailed studies to improve the accuracy and credibility of the results.

As part of creating a credible set of results for this Plan, a modification was made in the computational component of the PondNet model that can be used to prevent any pond outflows from being lower than 150 ppb if appropriate. Information published by the Center for Watershed Protection (1996) suggests that under most conditions, 150-200 ppb is the lowest outflow concentration of total phosphorus from a multi-celled pond that could be achieved. This is consistent with MPCA reports showing typical annual phosphorus concentrations for minimally impacted streams in the region ranging from 60-150 ppb.
This new component of PondNet can be used or not, depending on how the system being modeled actually functions. For example, the irreducible component may not be appropriate where heavy aquatic vegetation growths enhance phosphorus attenuation through vegetative uptake, adsorption, and other mechanisms.

It is known that ponds, especially those in the southern sections of the City, experience high water losses due to seepage of water into the sand and gravel substrates that underlie this area of the City. This can have a dramatic effect on the volume of water reaching downstream water bodies and consequently on downstream flow regimes and pollutant loads. Thus, another modification made to the PondNet model for Apple Valley was incorporation of a factor that can be used to account for loss of water through infiltration. The factor simply allows the user to reduce the annual runoff volume (and consequently the pollutant loading) by a percentage (1-100%) based on observation or field data collection. The best way to arrive at a credible value for water and phosphorus load reduction due to seepage losses is by measurement. Specific recommendations for developing factors for ponds in critical locations in the City are provided in Chapter 5, but for purposes of the model developed as part of this SWMP update, the factor is assumed to be zero (no losses) pending development of field data to credibly assign a value.

A limitation of the PondNet model is that it is not intended be used to predict phosphorus concentrations in large water bodies. In general, water bodies larger than 20 acres or with maximum depths exceeding 10 feet should be assessed with in-lake models. Empirical models such as the Wisconsin Lake Modeling Suite (WiLMS) predict in-lake water quality conditions as a function of phosphorus loading, lake morphometry and hydraulic residence time. For detailed lake management assessments, a model such as WiLMS should be used as it generally provides a more robust characterization of a lake's response to watershed loading

and phosphorus assimilation. This type of modeling would be done as part of a more detailed watershed analysis associated with a specific project (such as the Alimagnet Lake Management Plan).

It should be noted there is significantly more variability in stormwater quality modeling than in water quantity modeling. This is due to several factors, including the following:

- Water quality is affected by the variability in both stormwater runoff volume and pollutant concentration. Together, the composite variability of both is greater than the variability of each separately.
- Important input parameters must often be estimated. For example, pond wet storage volume greatly effects pond pollutant removal efficiency, and this data is often lacking for natural low areas that comprise a large percentage of the City's ponding areas.
- Water losses from ponds can vary widely depending on the soils in which they are constructed and whether they have or develop a layer of tighter material to prevent those losses. This often reduces the runoff volume from small storms more than the runoff volume from a large storm.

These points underline the importance of adapting the general model developed for this SWMP update to site-specific and watershed-specific conditions when evaluating a particular water body or load delivery point.

4.3 OVERVIEW OF STORMWATER BMPS

The City of Apple Valley strives to maintain the highest water quality that is practical in the stormwater system. The only completely effective way to maintain high water quality in ponds and lakes is to prevent undesirable sediments, nutrients and other materials from entering the storm drainage system. Complete removal of pollutants from runoff prior to discharge into the drainage system is neither practical nor economically feasible. Thus, efforts to maintain acceptable water quality need to focus on preventing to the degree practical target pollutants from reaching the resources to be protected.

Sections 4.4 and 4.5 provide a brief overview of selected BMPs that focuses on treatment and prevention of stormwater pollution.

4.4 STRUCTURAL WATERSHED PRACTICES

Structural BMPs are often referred to as "end-of-pipe" treatments. Common examples of these types of BMPs include:

- Stormwater Quality Ponds;
- Infiltration/filtration systems; and
- Hydrodynamic separators.

A brief overview of these structural BMP's for stormwater management is provided below along with guidelines for their application in the City of Apple Valley. For more detailed information on the application of these and other BMP's, refer to The State of Minnesota Stormwater Manual (MPCA 2005), Protecting Water Quality in Urban Areas (MPCA 2000), and Minnesota Urban Small Site Best Management Practice Manual (Metropolitan Council 2001). These manuals all contain detailed guidance regarding the application and design of many urban stormwater management BMP's and can be used as technical guidance in evaluating and implementing those practices in Apple Valley as appropriate.

4.4.1 Stormwater Quality Ponds

Properly designed wet detention basins are among the most effective means for removing sediment and other pollutants, such as trace metals and nutrients. In addition, the ponds provide rate control for both small and large runoff events. It is important to note that it is the volume of the pond above the elevation of the pond outlet that provides the floodwater storage and rate control function, while the volume of the pond below the control water elevation of the pond (i.e., standing water or dead storage volume) provides most of the water quality treatment benefit for removal and storage of pollutants.

The pollutant removal efficiency of ponds is based on the detention time that runoff is held in the basin, with particulate pollutants more effectively removed than dissolved pollutants. Settling column studies have shown that the majority of urban sediment that can be removed settle out within the first six to eight hours of detention. However, the period between runoff events provides the longer detention times needed to allow settling of fine sediments and uptake of soluble pollutants like nutrients (phosphorus and nitrogen) through vegetative uptake.

In some cases, ponds can also promote reduction in runoff volume through infiltration losses along the sides or through the bottom of the pond if soils are suitable or through evaporation from the pond surface. Restriction of outflow rates from the ponds (such as through the use of V-notch weirs or orifices) can hold water levels in the pond up longer, thereby increasing the potential for infiltration losses through side slopes of the pond. Quantification of infiltration losses should usually be based on site-specific considerations. In some cases where infiltration losses are suspected of being large, a short-term field monitoring effort will provide the most credible basis for quantifying these losses.

There are several key considerations in the design of an effective ponding system. These include the following:

1. The wet volume (i.e., the standing water volume below the control water level) of the pond should be equal to the runoff from a 2.5-inch, 24-hour precipitation event.
2. The minimum mean depth of the pond should be three to four feet to minimize the potential for re-suspending accumulated sediments in the pond and to minimize the need for frequent sediment removal maintenance operations.
3. The inlets and outlet of the pond should be as far apart as possible, preferably at opposite ends of the pond, to minimize the potential for short-circuiting of incoming runoff.

Multiple cell ponds are also preferable when possible. The idea with multi-celled ponds is that all raw stormwater runoff is directed first to a smaller, upstream cell for pre-treatment before it overflows to the remaining cell(s). Because most of the sediment load that is likely to accumulate in the pond is relatively large sediment that settles quickly, the first cell is designed to contain most of this mass where it is more easily accessible for removal through maintenance operations. A general guideline is that the upper cell of a multi-cell pond system should contain no less than 1/3 of the design wet volume of the entire detention pond. It is important to note that in multi-cell pond systems, the second and/or third cells of the system provide opportunities to provide enhanced treatment of stormwater runoff.

Examples include management of these later stages of the ponding system to promote infiltration or as a wetland system to remove more dissolved nutrients and fine sediments. In these cases, it is important that

the pre-treatment (first) cell of the system be lined with clay or compacted topsoil to minimize leakage of raw stormwater from the cell and that consideration be given to sizing the pre-treatment cell as large as practical to provide as much sediment storage volume and treatment as practical before discharge of the runoff to later cells. In addition, careful design of the secondary cells is necessary to create conditions suitable for desirable vegetation to grow. Accomplishing this objective almost always requires a site-specific approach by experienced personnel.

4.4.2 INFILTRATION/FILTRATION

Generally, infiltration as a BMP consists of engineering a system whereby stormwater runoff is allowed to filter through soil and recharge the local groundwater, whereas a filtration BMP is designed to allow runoff to filter through an engineered soil matrix then the filtered water is collected with an under drain and discharged to the stormwater system or surface water feature. In the infiltration approach, pollutants are removed and the overall downstream water load is reduced, whereas in filtration only the pollutant load is reduced. Due to the conditions in Apple Valley, the following will concentrate on infiltration as it is the more likely of the two BMPs to be promoted in the City because suitable soils exist in many areas and it is a good technique for runoff volume reduction.

Infiltration BMPs must be employed with caution. Infiltration serves to recharge groundwater features. It is therefore important to consider the nature of pollutants in the stormwater and the relative sensitivity of the groundwater resources in the area. For instance, it is not advisable to infiltrate stormwater from industrial areas since the runoff can potentially have high amounts of organochlorines that can contaminate groundwater supplies. In general, infiltration appears to be best-suited to treat runoff from watersheds that are largely residential, since these areas have a relatively low risk of generating contaminants that can compromise groundwater quality.

Another consideration is that the soils in the area must be amenable to infiltration BMPs. Poorly drained, clay soils impede infiltration. Many of the soils in the Apple Valley area are classified as well drained and excessively drained. The sandy nature of these soils is well-suited to using infiltration approaches for stormwater management. However, surface soils in the urban and suburban environment can differ markedly from those in the soil survey due to grading activity, waste soil disposal, etc. Use of infiltration BMPs should be preceded by site-specific soil evaluation as part of the planning and design process. Infiltration BMPs are often incorporated underground yet can require a relatively large amount of space, depending on the impervious coverage in the drainage area.

When incorporating infiltration features for stormwater management, it is important to provide some form of pre-treatment for stormwater prior to infiltration. The importance of pre-treatment increases as the impervious coverage of the watershed to the infiltration feature increases. Pre-treatment can be provided through several mechanisms such as a structural hydrodynamic separators or a grassed swale for relatively small areas (i.e., under 10 acres). For larger areas, construction of a well designed detention basin should be considered, and that portion of the pond system receiving raw stormwater should be lined with clay or compacted topsoil to minimize leakage to groundwater. Without pre-treatment, the grit in stormwater can prematurely clog an infiltration system. It is important to reduce the amount of grit that enters an infiltration system in order to enhance the longevity and functionality of the system.

Table 4.4 provides guidance on how much of the average annual runoff volume and phosphorus load can be reduced by infiltration in a medium density residential neighborhood based on study findings from Pitt

(1998) for the Milwaukee, WI metropolitan area. For example, if the infiltration feature is designed to catch and infiltrate all runoff from a rainfall of one inch, a reduction in average annual runoff volume and total phosphorus load of 60% can be achieved. These values should be considered conservative estimates (more likely to under-estimate than over-estimate reductions) for the design rainfall depths shown. The key message from this information is that designing infiltration features to handle even relatively small events can result in a large reduction in runoff volume and pollutant loading, since the runoff and associated loads infiltrated are completely removed from the surface drainage system.

Table 4.4 – Estimated Average Annual Runoff Volume
Total Phosphorus Load Reduction for Infiltration Feature in SFR Watershed

Rainfall Design Depth for Feature	Estimated Reduction in Annual Runoff Volume and Phosphorus Load
0.5”	25%
1”	60%
1.5”	75%
2”	80%
2.5”	82%

Parts of the southern and southeastern areas of the City have unique soil and geologic characteristics that allow infiltration of large amounts of runoff, even from very large storms. For example, Cobblestone Lake – located in the southeastern corner of the City – has a surface drainage area of over 3,000 acres, yet the lift station (installed in 2001) that serves as the discharge for the lake has never operated because of the large amounts of infiltration that occur both in the watershed above it as well as in Cobblestone Lake itself. These areas are also the headwaters of the Vermillion River, portions of which are a designated Metro area trout stream. It is widely recognized that infiltration is especially important in this area to protect the River downstream. Preservation of this infiltration capacity is a priority, and pre-treatment of stormwater runoff discharges to regional infiltration features will be practiced in order to protect the surficial aquifers as well as preserve the operational life of those features.

4.4.3 Hydrodynamic Separators

The final category of structural BMP’s discussed in this section is comprised of manufactured, proprietary units that are designed to be installed underground. As opposed to detention ponds or other above ground BMP’s , these devices take up little space and can be favored in areas where there is little or no room for above ground BMP’s. Most of these systems are designed to remove sediment and in some cases trap oil, grease and floating debris. However, some other non-point pollutants are likely to be removed as well, such as those that adhere to sediment. Some technologies also include different filter media through which water is filtered before it exits the unit.

Following are some considerations to guide application of these BMP’s in the City of Apple Valley:

- These types of units are most appropriate to use in treating raw runoff from relatively small (less than 20 acre) urban drainages.
- The units should be installed “off-line” (i.e., off the main stormwater line) and flow into the unit should be tightly controlled to minimize the potential for re-suspension and flushing of sediment trapped in the unit caused by larger runoff events.
- The flow diverted from the main storm sewer line to the unit for treatment should not be more than the runoff generated by a 1.5-inch rainfall event.

- Sediment and debris trapped in the units need to be removed frequently in order for the units to work properly. The units should be cleaned at least twice per year – once in the fall after leaf fall and once in the spring after snowmelt – unless field experience dictates differently.
- The units can be considered to serve a pre-treatment function for downstream devices designed to infiltrate stormwater or remove fine particulates or dissolved nutrients.

A few studies have been conducted to independently assess the removal effectiveness of various propriety devices for common urban runoff pollutants, including a comparative study from the Connecticut Department of Environmental Protection (2002). Removal efficiencies vary between units and applications. However, total suspended solids and total phosphorus removal efficiencies in the 50-70% and 15-25% range, respectively, can be assumed as a rough estimate if the above guidelines are followed. Assessment studies forthcoming from the University of Wisconsin and University of Minnesota will provide more data on the removal efficiencies of various units.

4.5 NON-STRUCTURAL BMPS

Non-structural BMPs are often referred to as good housekeeping practices and can include municipal activities, outreach programs, or regulatory measures. The City has a Stormwater Pollution Prevention Program (SWPPP) to meet NPDES Phase II requirements through 2011. This document is the most comprehensive summary of the City's current and intended future efforts in stormwater management and contains information that describes the practice, the responsible person/party for implementing the practice, an explanation of how the practice benefits stormwater management, and how the implementation of the practice will be measured. While there are some structural elements addressed in this Program, the majority of the elements are non-structural. The following is a brief overview of the non-structural practices covered in the SWPPP:

Public Education and Outreach

- Quarterly City newsletters
- Stormwater Outreach Education/Presentations
- Public Notice for Annual Stormwater Meeting
- Stormwater Information on City Website
- Stormwater Brochures
- Pet Waste Signage in Parks
- "Apple Valley Today" Television Broadcast
- Evaluation of Additional Educational Material

Public Involvement and Participation

- Storm Drain Stenciling Program
- Lake Association Weed Control
- Annual Stormwater Public Meeting
- Stormwater Informational Booth
- Citizen-Assisted Monitoring Program (CAMP)

- Wetland Health Evaluation Program (WHEP)
- Household Clean-up Day

Illicit Discharge, Detection, and Elimination

- Spill Reduction and Response Program
- Septic System Maintenance Program
- Nuisance Ordinance/Illegal Dumping
- Illicit Discharge and Illicit Connection Ordinance and Enforcement
- Storm Sewer Map
- Illicit Discharge Inspection Program

Construction Site Runoff Control

- Grading Pre-Construction meetings
- ESC Construction Site Signage
- ESC Plan Requirements and Review Process
- Minimum ESC BMPs
- ESC Inspection and Enforcement
- ESC Ordinance
- Pond Maintenance Procedures for Developments
- Construction Site Waste Control Requirements

Post-construction Runoff Control

- MPCA Stormwater Manual Standard
- Zoning Ordinance
- Plan Review Procedures and Requirements
- Wetland Buffer Zone Requirements
- Natural Resource Management Ordinance
- Stormwater Management Plan
- Sanitary Sewer Comprehensive Plan Updates
- Long-Term Operation and Maintenance of the Storm Sewer System

Pollution Prevention/Good Housekeeping

- Pond and Outfall Inspection and Cleaning Procedure Program
- Structural Pollution Control Device Inspection and Cleaning
- Street De-Icing Program
- Fertilizer Application Program
- Pesticide and Herbicide Control Program
- Fleet and Building Maintenance Program

- Hazardous Material Storage and Recycling Program
- Municipal Street Sweeping Program
- Sanitary Sewer Maintenance Program
- Municipal Turf Maintenance Program
- Inspection Analysis and Frequency
- Stockpile, Storage, and Material Handling Program

A current copy of the SWPPP, with detailed accounts of BMPs within each program category, is available for reference purposes from the City of Apple Valley. The SWPPP can also be accessed on the City website at http://www.ci.apple-valley.mn.us/natural_resources/water_resources/main_page.html.

5. Stormwater System Analysis

5.1 DISTRICT SUMMARIES

The following sections include water information on individual major drainage districts within the City. The first sub-section for each district contains information on water quantity management and is organized as follows:

- Location, land use, and major drainage features of the district.
- Major differences between the current analysis and 1997.
- Any significant changes in High Water Levels compared to the 1997 plan and the reason why those changes occurred.
- Major modeling findings and stormwater behavior.
- Identification of operational issues, including which ponds exhibit High Water Levels for extended periods of time.

Map 1 – Storm Drainage Area Map at the back of this report includes the following information:

- Location and names of designated stormwater ponds and lakes.
- Names and boundary locations of major and minor watersheds.
- Stormwater trunk lines connecting the ponding areas.
- Locations where stormwater in the City's storm drainage system is discharged to an adjacent community.

Map 2 – Storm Drainage System Map at the back of this report includes the following information:

- Major watershed boundaries.
- Location and names of designated stormwater ponds and lakes with Control Water Level (CWL) and High Water Level (HWL) annotations.
- Stormwater trunk lines connecting ponds with flow direction and pipe sizes.
- Lift station lines with flow direction and pipe sizes.
- Structure locations.
- Locations where stormwater in the City's storm drainage system is discharged to an adjacent community.

Detailed information for the stormwater flood storage and conveyance system, as modeled in HydroCAD, is included in Appendices A through C. Appendix B generally provides the information for all ponds that are part of the City's storm drainage system, including the following:

- Pond designation.
- Whether the pond is a State Public Water.
- Direct, indirect, and total drainage areas to the pond.
- Pond area at the Control Water Level or CWL.
- Pond area at the calculated High Water Level (HWL).
- Storage volume between CWL and the HWL.
- Control water level elevation.
- Existing outlet type and size.
- Peak High Water Level (HWL) for the 1% probability rainfall as well as the peak outflow rates from each pond for that event.

The HWL for existing ponds listed at the back of this report is based on the 1% probability six-inch, 24-hour rainfall event. This design event has embedded within it several 1% probability rainfall events of shorter durations, whose impact on peak water elevations is reflected in the modeling results used to establish the High Water Levels for each pond. The City's history with large rainfall events (notably those in July 1987 and July 2000, both of which exceeded the 1% probability design event) has influenced its decision to apply a relatively conservative supplemental freeboard standard of 3 feet to new developments (see Policy 1.1 in Section 3.2). However, for new developments in the Black Dog watershed, the City will also analyze the 1% probability 10-day snowmelt and set the HWL for new ponds based on the higher of the two elevations to comply with BDWMO requirements.

It is important to note that the district water quantity summaries identify a number of areas where flood risk to adjacent structures may be unacceptably high. These higher risk areas are virtually all in older developed areas of the City. These areas will be studied in more detail as part of the implementation phase of this Plan (see Table 10.1 in Section 10.1) to determine actual risk based on the degree to which the areas meet the freeboard requirements presented in this Plan. Improvements will be evaluated and pursued as necessary and will take into account downstream impacts.

The second sub-section for each district summarizes information on significant water quality issues. These sub-sections focus on two types of issues. These issues are 1.) the nature of estimated average annual flows and phosphorus loads crossing inter-community jurisdictional boundaries and 2.) the condition of high priority recreational water bodies in that drainage, such as lakes. Where recent detailed studies have already been completed, the sub-sections reference those studies. Summaries of those detailed studies are included in Appendix G. Important implementation recommendations are included in Chapter 10 – System Improvement and Financing Program. Where studies have not yet been completed, the need for those investigations is explained and guidance provided on how they should be carried out. Also, a planning-level cost estimate is included in Chapter 10 for these efforts.

Appendix G contains the following water quality information:

- Executive summaries from recently completed lake management plans for Lac Lavon (Blue Water Science 2002), Alimagnet Lake (Bluewater Science, et. al. 2005) and the Crystal and Keller Lake Use Attainability Analysis (Barr, 2003).
- Summary information regarding protection of Keller Lake from the impact of discharges from the City of Apple Valley.
- Graphical representations of historical June-September total phosphorus, chlorophyll-a, and water clarity values for Long Lake, Farquar Lake, Lake Alimagnet, and Lac Lavon.
- Output from the PondNet water quality model for the City showing drainage areas, land use composition, and pond linkages for each system modeled.

5.2 EAST VERMILLION RIVER DISTRICT

Drainage Area: 3,628 acres (3,623 acres in Apple Valley)
Number of Ponds: 73 (including lakes)
Major Lakes: 3 – Long, Farquar, and Cobblestone Lakes
Lift Stations: 2

5.2.1 WATER QUANTITY

5.2.1.1 GENERAL OVERVIEW

The East Vermillion River District is located in the eastern third of the City of Apple Valley (Map 1). The district is generally bounded by Lebanon Hills Regional Park, the Minnesota Zoo, and Valleywood Golf Course on the northern edge, the Apple Valley-Rosemount border on the eastern edge, 160th Street (County Road 46) on the south. The western edge of the district generally follows Pilot Knob north to County Road 42, along Johnny Cake Ridge Road North of 42 to 140th Street, and bisects the Greenleaf Neighborhood area to McAndrews Road.

Topography in the northern part of the district is characterized by deep natural depressions, a number of which have been incorporated into the City's storm drainage system. Further south, the sub-surface geology transitions from moraine deposits to valley outwash and the topography moderates and flattens out. Here, manmade ponds are heavily relied upon to control stormwater.

The system can be conceptually divided into three major portions. The first portion of the system is the area tributary to Farquar Lake (EVR-P35). Nearly 2,200 acres (60% of the total district) is tributary to Farquar Lake. Much of the district is routed through a long series of ponds prior to discharge to the lake. The discharge from Farquar Lake is through a lift station that causes some management issues for this lake. This watershed includes nearly all of the area north of 144th Street.

The second portion of the district is the area tributary to Cobblestone Lake (WVR-P44). Cobblestone Lake is a manmade lake located in an area formerly used for gravel extraction. Cobblestone Lake receives most of the runoff from the remaining 40% of the district not draining to Farquar Lake first. In addition, Farquar Lake pumps through the series of ponds in this district to Cobblestone Lake, giving Cobblestone Lake a very large drainage area.

The third major portion of the district consists of a series of ponds located in the northeastern portion of the district, adjacent to the City of Rosemount. These ponds drain to Berger Pond, located in the City of Rosemount. Water discharged from this area is pumped from Berger Pond into the City of Rosemount's stormwater system. This area includes ponds EVR-P45, EVR-P46, EVR-P47, and EVR-P56.

5.2.1.2 Differences from 1997 Stormwater Management Plan

Major differences between the current analysis and the one conducted for the 1997 plan include the following:

- Most of the ponds formerly located in the Gun Club District in the 1997 plan have been relabeled as ponds in the EVR district. The changes in pond identification numbers are shown in Table A-1 at the beginning of Appendix A. Only the new pond designations are used in the system maps.
- 21 ponds that were not previously identified have been added to the plan. This includes ponds that have been constructed as the result of development and other ponds that reflect a finer level of detailed modeling than was performed for the 1997 plan.
- Drainage boundaries were fully updated to reflect the current configuration of the storm drainage system.

The following table shows ponds for which the updated modeling indicates that the peak water level elevations for the 1% chance rainfall event exceed by 1 foot or more the designated High Water Level (HWL) in the 1997 plan.

Table 5.1 – Significant Differences In Modeled Vs. 1997 Plan HWL

Pond	1997 HWL (ft.)	Modeled Peak Water Elevation	Difference (ft.)	Comments
EVR-P1	993.6	999.3	+5.7	Revised CWL
EVR-P5	958.8	960.3	+1.5	Updated Drainage Area
EVR-P8	920.4	924.4	+4.0	Updated Drainage Area
EVR-P10	919.8	921.4	+1.6	Updated Modeling Technique
EVR-P14	904.1	905.9	+1.8	Revised CWL
EVR-P18	965.7	967.4	+1.7	Updated Drainage Area
EVR-P20	944.8	946.6	+1.8	Updated Drainage Area
EVR-P26	937.8	940.3	+2.5	Updated Drainage Area
EVR-P27	938.1	939.4	+1.3	Updated Modeling Technique
EVR-P30	907.7	908.8	+1.1	Updated Drainage Area
EVR-P34	891.9	901.6	+9.7	Updated Modeling
EVR-P37	965.4	967.7	+2.3	Updated Drainage Area
EVR-P38	966.1	967.6	+1.5	Revised CWL
EVR-P39	952.8	956.0	+3.2	Updated Drainage Area
EVR-P40	949.1	950.2	+1.1	Updated Drainage Area
EVR-P41	936.8	938.1	+1.3	Updated Storage Volume
EVR-P43	923.5	925.0	+1.5	Updated Modeling Technique
EVR-P47	903.6	906.9	+3.3	Updated Modeling Technique
EVR-P51	974.5	979.3	+4.8	Tailwater Condition
EVR-P54	1031.1	1032.2	+1.1	Updated Modeling Technique
EVR-P55	977.6	978.9	+1.3	Updated Modeling Technique

The structural control elevation of **Pond EVR-P1** was changed from the 1997 plan. The rim elevation of the catch basin that drains the pond has been used as the starting water surface elevation for this plan, causing the observed rise in control water levels.

The High Water Level in **Pond EVR-P10** is higher than reported as the result of improvements put in place after the preparation of the 1997 plan. The assumed outlet details from the 1997 plan have been replaced by the outlet that was constructed with the improvements to Pilot Knob Road.

Pond EVR-P14 has a revised starting water surface elevation. The pond outlet was constructed since the completion of the 1997 stormwater management plan. The updated HWL reflects the new outlet.

Pond EVR-P18 has a High Water Level higher than listed in the 1997 plan as the result of changes made to the drainage boundaries in the district. In particular, the boundaries around Shepherd of the Valley Lutheran Church were modified.

The High Water Level of **Pond EVR-P20** was raised from the level reported in the 1997 plan as the result of modifications made to the drainage boundaries of this pond. Additional drainage area was added as a result of the modifications.

The High Water Level on **Pond EVR-P26** was raised from the elevation reported in the 1997 plan. The additional outlet proposed in the 1997 plan has not been constructed, resulting in the increase in the high water elevation.

The modeling for **Pond EVR-P27** has been modified to more accurately represent the interaction of this pond with the associated storm sewer. The modifications result in higher water levels than assumed in the 1997 plan.

The drainage area for **Pond EVR-P30** was modified from what was used in the 1997 plan. The increase in drainage area results in the changes to the High Water Level projected for this pond.

The High Water Level in **Pond EVR-P34** has been raised substantially from the 1997 plan. This is the result of acknowledging the interconnection of this pond and Farquar Lake at high water elevations. This raises the High Water Level to match the High Water Levels in Farquar Lake.

Changes to the drainage area of **Pond EVR-P37** results in an increase in the High Water Level of this pond.

The starting water surface elevation of **Pond EVR-P38** was raised from the assumed level in the 1997 plan. The increase in the outlet elevation results in the increase in the High Water Level of the pond.

Pond EVR-P39 has a High Water Level higher than assumed in the 1997 plan. Increases in the size of the direct drainage area results in the increased water level in this pond.

The drainage area for **Pond EVR-P40** has been increased from what was used in the 1997 plan, which results in the changes to the High Water Level projected for this pond.

The High Water Level of **Pond EVR-P41** was raised from the level reported in the 1997 plan. This is a result of a smaller storage volume in this pond than reported in the 1997 plan. The High Water Level of **Pond EVR-P43** was raised from the elevation reported in the 1997 plan. The outlet was modified to reflect the actual outlet configuration in place on this pond. The decrease in outlet capacity as a result causes the higher water level predicted for this pond.

The outlet from **Pond EVR-P47** was modified from the 1997 plan to reflect the actual outlet pipe elevation. The increase in outlet elevation results in the increase in the High Water Level of the pond.

Pond EVR-P5 has a High Water Level higher than reported in the 1997 management plan as the result of changes to the drainage area to this pond. In addition, the interaction of the outlet from this pond and EVR-P4 also contribute to the higher water levels.

Pond EVR-P51 has a High Water Level that is several feet higher than reported in the 1997 plan. The tailwater interaction with the downstream Pond WVR-P55 has been included in this plan, resulting in the higher water level.

Pond EVR-P54 and **Pond EVR-P55** have higher water levels than reported in the 1997 plan as a result of updated modeling techniques that take into account the limitations in the downstream storm sewer system.

The High Water Level of **Pond EVR-P8** is higher than indicated in the previous plan as a result of modifications to the drainage area.

5.2.1.3 Operational Issues

There are several operational issues in the EVR District. Most of the issues revolve around ponds that may have High Water Levels in the 100-year storm event that exceed the elevation of adjacent structures.

Pond EVR-P12 has a High Water Level that appears to be above the adjacent structures and is noted for additional more detailed investigation. This High Water Level could be reduced by increasing the size of the outlet from EVR-P12 from the existing 30-inch to a 36-inch RCP outlet.

The 1997 plan suggested adding an 18-inch culvert outlet from **Pond EVR-P26**. However, the updated modeling shows the downstream pond to be at capacity. As an alternative, the storage volume for **Pond EVR-P26** should be expanded to the north into the adjacent park to lower High Water Levels.

Pond EVR-P8 may need to have the outlet size increased from a 36 inch to a 42 inch to prevent flooding of adjacent structures. This may also require an increase in the outlet size from **Pond EVR-11** to ensure freeboard is maintained on that pond.

There are nine basins in this district that are currently landlocked with no plans to provide outlets to them in the future. In all cases, the water levels in the ponds should be monitored to ensure that seepage is being maintained at sufficient rates.

Additionally, the Lebanon Hills Stormwater Management Plan (Barr 2005) proposed a 1 CFS lift station to be installed in Lebanon Hills Regional Park to discharge high water from Wheaton Pond ultimately to Farquar Lake during very wet periods. The City requires that the proposed pumping will only occur after the water in Farquar Lake returns to its normal water level. The City has currently proposed for the lift station to discharge into a swale at the top of sub-district EVR-190.

5.2.2 WATER QUALITY

There are three recreational-classified water bodies in this drainage district. They are Long, Farquar, and Cobblestone Lakes. Key lake and watershed summary statistics for each lake are presented in Chapter 7. All three of the lakes are affected by nutrient enrichment and two – Long and Farquar – are on the impaired waters list for the State of Minnesota (Chapter 8) and currently the subject of a cooperative effort between the City and the Vermillion River Watershed JPO to prepare a TMDL.

Development of a detailed lake management plan was initiated by the City in 2005 for both Long and Farquar Lakes. The plan is expected to be completed by the spring of 2007. A detailed lake management plan for Cobblestone Lake is also underway and is expected to be completed by the fall of 2007. Both efforts will look at watershed improvements to decrease loads to the lakes as well as in-lake measures to control internal loading (if any) to achieve the in-lake TP goals listed in Chapter 7, Table 7.5.

As noted in Section 5.1.1, there are two locations where stormwater discharges into other municipalities from the East Vermillion District: Pond EVR-P44 (Cobblestone Lake) discharges into Lakeville and EVR-P47 discharges into Rosemount (See Map 1). Table 5.2 summarizes the size of the watershed and discharge characteristics of water passed to Lakeville from Pond EVR-P44 (Cobblestone Lake).

Table 5.2 – East Vermillion River District Water Quality Summary Statistics for Discharge to Lakeville

	Total Watershed*	Direct Watershed	Indirect Watershed
Drainage Area (acres)	3,417	0	3,248
Ave. Ann. Phosphorus Load (lbs/yr)[1]	Unknown[2]	0	Unknown[2]
Ave. Ann. Runoff (AF/yr)[1]	Unknown[2]	0	Unknown[2]

** Watershed area associated with landlocked sub-districts is not included*

[1] See following text for explanation of estimated runoff and phosphorus load figures

[2] Currently no water is discharged from Cobblestone Lake.

Any discharges from EVR-P44 are of particular concern because water crossing the jurisdictional boundary at this point could eventually reach the Vermillion River, a designated trout stream. In addition, reaches of the Vermillion River are designated as impaired. Figure 5.1 illustrates the discharges from Apple Valley and their drainage course to the Vermillion River and shows the reaches of the upper Vermillion River system that are designated trout stream as well as identified as impaired. The top of the designated trout stream reach begins approximately 5 miles south of the Apple Valley border. It is very important to limit or eliminate surface discharges as much as reasonably possible at this location to avoid adversely impacting the downstream resource and possibly being drawn into a TMDL for the Vermillion River.

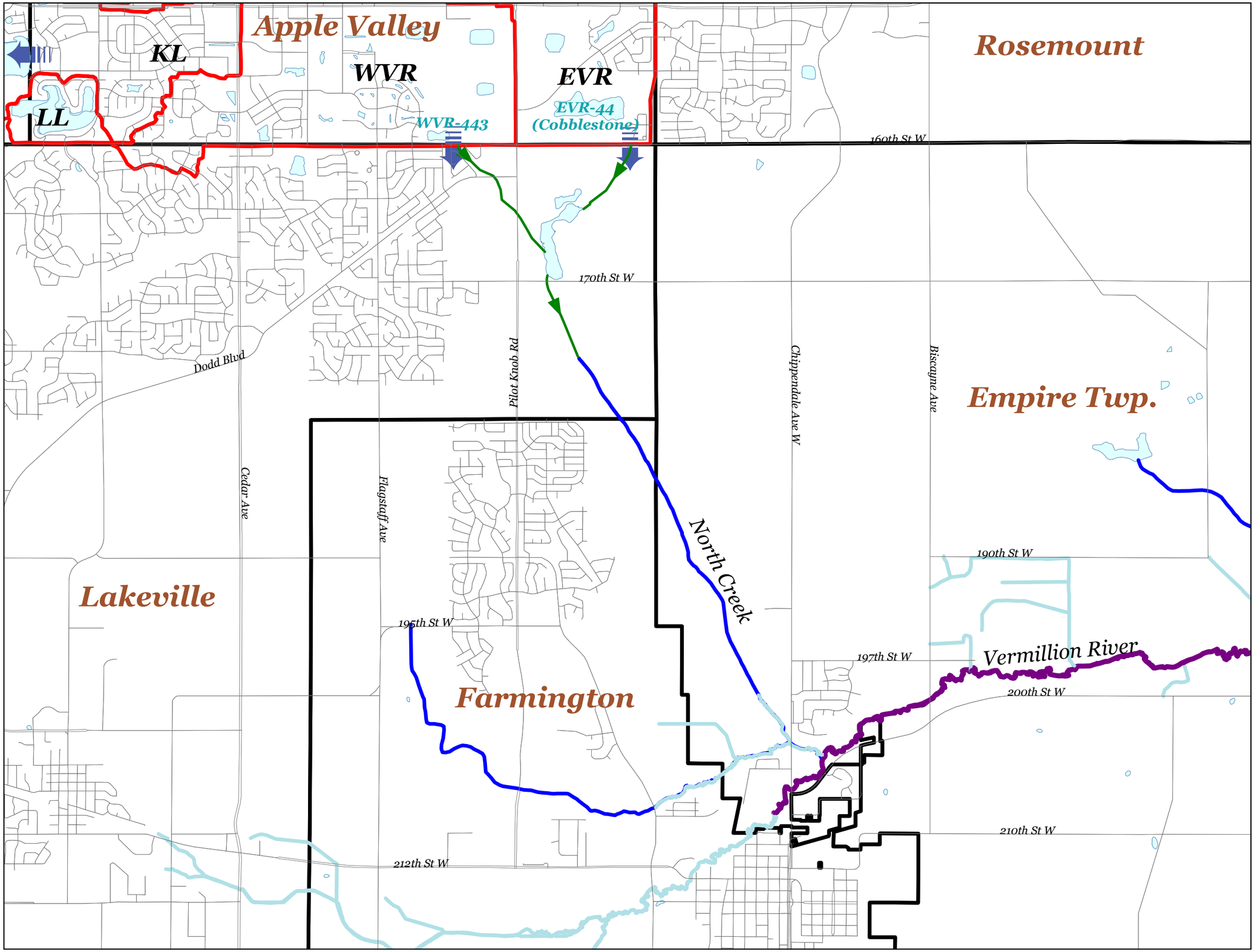
As pointed out in the previous subsection, the outlet for Cobblestone Lake (EVR-P44) is a lift station (26 CFS pump capacity), thus making tracking of outflows from this location fairly easy.

Since the lift station was installed in 2001, there have been no recorded discharges of water from Cobblestone Lake, even for large runoff events affecting the sub-district like that of October 4, 2005 (this event was approximately a 100-year/1% probability rainfall). The only discharges that have occurred from this location have been during short periods to test the operational capability of the lift station itself. This data is evidence that there is a large amount of water infiltrated by Cobblestone Lake and several ponds upstream, all of which are constructed in the sand and gravel that characterizes this part of Apple Valley. About 89% of the watershed is in ultimate development conditions as of the date of this report. Additional development should not increase either average annual runoff volumes or runoff volumes from up to the two-year, 24-hour storm to Cobblestone Lake, based on implementation of the standards in this plan for new and redevelopment. Prolonged wet periods or moderate to extreme runoff events could cause discharges from the lift station, but these occurrences are expected to be infrequent, based on the current behavior of the system. The City is committed to monitoring and protecting the infiltration capacity of Cobblestone Lake as well as other key watershed ponds.

The watershed and estimated average annual cross-boundary phosphorus and water loads discharging to Rosemount from Pond EVR-P47 is summarized in Table 5.3. Since infiltration losses in the system are probably relatively small due to less permeable soils underlying the many natural ponding areas in this part of the City and because the watershed is almost fully developed, these are reasonable estimates of the ultimate phosphorus and runoff loads. Because of extensive treatment upstream in Apple Valley, the estimated phosphorus loads are relatively low.

Table 5.3 – East Vermillion River District Water Quality
Summary Statistics for Discharge to Rosemount

	Total Watershed	Direct Watershed	Indirect Watershed
Drainage Area (acres)	115	0	115
Ave. Ann. Phosphorus Load (lbs/yr)	26	0	26
Ave. Ann. Runoff (AF/yr)	64	0	64



Apple Valley

City of Apple Valley

DRAINAGE COURSE TO THE VERMILLION RIVER

Surface Water Management Plan

FIGURE 5.1

Legend

- Regular Water
- Trout Stream Only
- Trout Stream and Impaired Water
- Discharge from Apple Valley
- Street Centerlines
- Water Features
- City Boundaries
- Major Boundaries
- District Cross Flow Locations

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5.3 WEST VERMILLION RIVER (WVR) DISTRICT

Drainage Area: 4,880 Acres (4,814 Acres in Apple Valley, remainder in Lakeville)
Number of Ponds: 97
Major Lakes: None
Lift Stations: 5

5.3.1 WATER QUANTITY

5.3.1.1 GENERAL OVERVIEW

The West Vermillion River District is the largest District in the City of Apple Valley. The district extends from as far north as the city limits with the City of Eagan around the Cedar Avenue Corridor to the southern border with the City of Lakeville. On the southern end of the City, the drainage borders extend from Pilot Knob Road on the East to near the Long Ridge Water tower on the west (Map 1). There are no major lakes located within the district.

Nearly all of the drainage area in the district is from the City of Apple Valley. There are several areas on the southern border of the city totaling less than 100 acres that drain from Lakeville into the City of Apple Valley. The district does receive the runoff from the Lake Alimagnet lift station. Additionally the Minnesota Zoo has an agreement with the City to discharge water from land locked ponds during wet periods to WVR-P17. The Zoo must first get written permission from the City and show the water quality of the discharge is at or below the water quality of downstream waterbodies.

In general, runoff in the district flows from north to south, with nearly all of it discharging to the City of Lakeville through Pond WVR-P443, adjacent to the Regatta Development and 160th Street.

The topography of the district varies greatly from north to south. In general, the northern portion of the district is composed of rugged, potholed, glacial terrain. The existing natural depressions were used as basins to receive stormwater runoff. Many of the basins remain landlocked, with no gravity outlet or lift station proposed at this time. As one proceeds south, the topography of the district flattens out considerably. As a result of this, the ponds used for stormwater purposes consist of manmade ponds created specifically for stormwater. Often, the creation of the basins coincides with a need to extract the gravel material for use in other land development operations.

Gravel mining operations continue to occupy the southeastern corner of the district.

5.3.1.2 DIFFERENCES FROM 1997 STORMWATER MANAGEMENT PLAN

Major differences between the current analysis and the one conducted for the 1997 plan include the following:

- Pond WVR-P43 in the 1997 plan was removed from the district and added to the Keller Lake District as KL-P4 to better reflect the dominant discharge direction of high flows.
- Pond EVR-P9 in the 1997 plan was removed from the district and added as WVR-P560.
- Pond WVR-P590 was added after a detailed study of Pond WVR-P59 (Pond 213P) in 2000.
- Drainage boundaries throughout the district were revised to bring them up-to-date with the current layout of the stormwater system.

- 28 new ponds were added to the system to reflect the addition of new ponds in the southern portion of the district and to better reflect the existing conditions in other portions of the district.

The following table shows ponds for which the updated modeling indicates that the peak water level elevations for the 1% chance rainfall event exceed by 1 foot or more the designated High Water Level (HWL) in the 1997 plan.

Table 5.4 – Significant Differences in Modeled Vs.1997 Plan HWL

Pond	1997 SWMP HWL	Modeled Peak Water Elevation	Difference (ft.)	Comments
WVR-P17	981.8	984.2	+2.4	Updated Drainage Area and Revised CWL
WVR-P21	1045.7	1050.6	+4.9	Updated Drainage Area
WVR-P23	964.5	968.7	+4.2	Reflects Current Land Use
WVR-P24	960.5	962.0	+1.5	Updated Modeling Technique
WVR-P26	953.7	955.8	+2.1	Reflects Changes at WVR-P23, Revised CWL
WVR-P28	940.2	942.0	+1.8	Reflects Upstream Changes, Updated Storage
WVR-P29	1006.8	1009.6	+2.8	Updated Storage Volume
WVR-P30	1027.6	1028.9	+1.3	Update Drainage Area
WVR-P33	957.9	960.4	+2.5	Reflects Changes at WVR-P29
WVR-P35	949.3	953.2	+3.9	Updated Modeling Technique
WVR-P40	967.8	969.3	+1.5	Updated Modeling Technique
WVR-P41	955.9	961.4	+5.5	Reflects Upstream Changes in Drainage Area
WVR-P441	933.6	938.9	+5.3	Newly Constructed
WVR-P442	934.8	938.7	+3.9	Newly Constructed
WVR-P49	972.6	974.5	+1.9	Updated Drainage Boundaries
WVR-P50	942.8	945.6	+2.8	Updated Drainage Boundaries and Outlet Structure
WVR-P190	1045.2	1046.8	+1.6	Updated Drainage Boundaries
WVR-P19	1017.8	1025.6	+7.8	Updated Drainage Boundaries, Storage Information, Revised CWL

Pond WVR-P17 has a High Water Level 2.4 feet higher than listed in the 1997 plan. The higher water level is a reflection of changed drainage boundaries that resulted in a much larger direct drainage area to the pond, although the total drainage area did not increase significantly. The CWL was also revised to reflect the current pump on elevation.

The drainage area to **Pond WVR-P21** was modified to better reflect the actual drainage boundaries in the field. The increase in direct drainage area results in an increase in the HWL from the level shown in the 1997 plan.

The High Water Level of **Pond WVR-P23** reflects changes in land use made since the preparation of the 1997 plan. In particular, an additional pond was called for upstream of WVR-P23 and WVR-P23 was to be excavated out to create additional storage volume. Neither of these projects was constructed, and the area proposed for the upstream pond has since been developed with no accommodations for the pond. As a result, the High Water Level in this pond was raised. It should be noted that despite the High Water Levels projected in the modeling, no problems have been reported at this pond to date.

The High Water Level in **Pond WVR-P24** was revised higher as the result of more advanced modeling techniques. The current model better reflects the interaction of the pond and the storm sewer trunk line draining the pond.

Pond WVR-P26 has a water level that is higher than shown in the 1997 plan. This is the result of the changes that were not implemented at **WVR-P23** since the preparation of the 1997 plan. The CWL was also revised to reflect the current pump on elevation.

Pond WVR-P28 has a higher water level than listed in the 1997 plan as the result of changes made to the outlet configuration (to a gravity outlet from a lift station in the 1997 plan), changes made to the storage volume with the development of the surrounding area, and changes made at upstream ponds. This includes the impact of increasing the outlet size from **Pond WVR-P36** to the north.

Pond WVR-P29 has a higher water level than indicated in the 1997 plan as the result of not implementing the recommendations of the 1997 plan. In particular, the storage volume of the pond was not expanded. As a result, water levels are higher than previously indicated.

Pond WVR-P30 had its drainage area updated and the increased drainage area, in combination with improved modeling, resulted in a higher water level than previously shown.

Pond WVR-P33 has water levels higher than projected in the 1997 plan as the result of not increasing the storage volume of WVR-P29 upstream.

Pond WVR-P35 has a higher water level than indicated in the 1997 plan as the result of better modeling techniques that account for the tailwater conditions caused by the downstream **Pond WVR-P36**.

The High Water Levels in **Ponds WVR-P40 and WVR-P41** have been raised as a result of increased drainage area contributing to the ponds and improved modeling of the interaction of the trunk storm sewer draining each pond and the interconnections between the two ponds.

Ponds WVR-P441 and WVR-P442 were both constructed since the preparation of the 1997 plan.
The changes in High Water Levels reflect ponds as they were actually constructed.

Pond WVR-P49 has a High Water Level that is higher as the result of including drainage from the City of Lakeville that was not included in the 1997 plan.

Pond WVR-P50 has a higher water level as the result of improved modeling of the outlet configuration of the pond.

Pond WVR-P190 has a higher water level as the result of updating the drainage boundaries to the pond. The increased drainage area resulted in a rise in water levels.

Pond WVR-P19 has a water level that is significantly higher than the 1997 plan. This is the result of a combination of factors, including updated storage information and revisions made to the drainage area to reflect the actual drainage boundaries in the tributary watershed. The CWL was also revised to reflect the current pump on elevation. The changes resulted in a substantial increase in the direct drainage area to the pond.

5.3.1.3 Operational Issues

The major issue in this district is flooding at several locations in the system. The areas of concern and solutions to the problems are outlined below.

The major flooding issue is **Pond WVR-P19**. One home has a low entry elevation over 8 feet below the projected High Water Level of this pond. In addition, three other homes are at risk of damage at the projected High Water Level.

Construction of gates or valves to restrict the runoff from **Ponds WVR-P37 and WVR-P191** are recommended to lower water levels below the three other homes at risk. The valves should remain in the closed position to prevent water from discharging from these ponds until after the flood peak has passed downstream. In both cases, the adjacent structures are located well above the pond, allowing the valves to remain closed without causing damages.

In addition, the opportunity to increase the discharge from the lift station should be explored. It appears a slight increase in discharge capacity is possible without impacting downstream ponds or structures. However, these are still not enough to protect the lowest adjacent structure. Modifying the structure should be considered to prevent flood damages.

Flooding of three homes around **Ponds WVR-P35 and WVR-P36** can be corrected by increasing the discharge from **Pond WVR-P36**. The existing 18-inch RCP should be replaced by a 21-inch RCP. Impacts to the downstream system are restricted to an increase in the elevation of **WVR-P28** of 0.3 feet.

Ponds WVR-P23 and WVR-P231 should be monitored in the future. Modeling indicated several adjacent structures could be damaged during a 1% probability 24-hour rainfall event. However, no damages have been reported after several large rainfall events in the preceding years. **WVR-P23** should be cleaned out, as it is currently full of sediment.

Pond WVR-P25 is not a pond in a true sense of the word. Instead, this low point serviced by storm sewer attenuates flow to the downstream system slightly. Modeling indicates water levels may impact adjacent structures, but no damages have been reported.

Flooding at **Pond WVR-P33** is indicated in the modeling of the system, but no flood damages have been reported at this location. If flooding is occurring at this location, it can be eliminated by reducing the outlet size from **Pond WVR-P29** to a 6-inch orifice, and increasing the storage capacity to 19.6 acre feet.

Another issue in this district is urban street flooding. The "downtown" area of the City, located near County Road 42 and Cedar Avenue, is heavily dependent on the storm sewer in the area. There are no ponds that water can easily overflow to and it all needs to get out of the area through the storm sewer system. More advanced computer modeling of the area could be conducted in the future to address this potential issue.

Finally, discharge from Pond WVR-P443 is an issue that will be addressed cooperatively by the cities of Apple Valley and Lakeville. The City of Apple Valley will assess the capacity of the existing 60"-diameter outlet pipe from Pond WVR-P443 to Lakeville to determine the maximum allowable discharge without causing surcharge through the manholes and catch basins connected to it. Lakeville will review the assessment and work with the City of Apple Valley to reach a new agreement on maximum allowable flow rate in the pipe. The City of Apple Valley will consider and analyze various alternatives to achieve the agreed upon flow rate (including diversion from this pond to the East Vermillion River drainage) and maintain an acceptable high water elevation in Pond WVR-P443 for the 1% probability precipitation event.

5.3.2 Water Quality

There are no recreational-classified water bodies/lakes in this district. As noted in Section 5.3.1.1, discharges from this district cross the jurisdictional boundary between Apple Valley and Lakeville after they leave Pond WVR-P443 in the southeast portion of Apple Valley. The discharge from Pond WVR-P443 is carried in a 60-inch RCP for over 5,000 feet before discharging to a large pond northeast of the intersection of 170th Street and Pilot Knob Road in Lakeville. This discharge point in turn is 4 miles from the beginning of the upper reach of the Vermillion River and above the upper-most point of the designated trout stream portion of the Vermillion River. (See Figure 5.1)

Table 5.5 presents a summary of the modeled average annual water and phosphorus load discharged across the inter-city jurisdictional boundary below **Pond WVR-P443**. These loads represent estimated loads at ultimate development of the watershed and account for the impact of BMPs that will be required to achieve the performance criteria of 60% removal of total phosphorus for future development (about 18% of the total watershed at that point). **They do not, however, account for infiltration and pond seepage losses upstream**. These losses appear to be substantial and are likely to significantly reduce the actual water and phosphorus load crossing the jurisdictional boundary if they are accounted for.

Table 5.5 – West Vermillion River District Water Quality Summary Statistics for Discharge to Lakeville

	Total Watershed*	Direct Watershed	Indirect Watershed
Drainage Area (acres)	4,521	0	4,521
Ave. Ann. Phosphorus Load (lbs/yr)	1,960	0	1,960
Ave. Ann. Runoff (AF/yr)	4,100	0	4,100

** Watershed area and phosphorus loads associated with landlocked sub-districts are not included.*

Monitoring to quantify these losses is a high priority. The data will provide a credible basis to more accurately quantify trans-boundary flow volumes and phosphorus loads. Cost for this monitoring effort is presented in Chapter 10.

5.4 ALIMAGNET LAKE DISTRICT

Drainage Area: 1,258 Acres (489 Acres in Apple Valley)
Number of Ponds: 16
Major Lakes: 1 – Alimagnet Lake (shared with Burnsville)
Lift Stations: 1

5.4.1 WATER QUANTITY

5.4.1.1 GENERAL OVERVIEW

The Alimagnet Lake District is located in the northwestern portion of the City of Apple Valley. The portion of the district in Apple Valley generally extends from the city limits with Burnsville on the west, I-35E on the North, Gardenview Drive on the east, and Walnut Lane on the South. Just over one third of the total drainage area to Alimagnet Lake lies within the City of Apple Valley. The remainder lies in the City of Burnsville.

Runoff from the district in Apple Valley collects in 16 ponds upstream of Alimagnet Lake. In general, runoff runs from east to west, with most of Apple Valley's portion of the watershed entering Alimagnet Lake near the intersection of McAndrews and 140th Street.

5.4.1.2 DIFFERENCES FROM 1997 STORMWATER MANAGEMENT PLAN

Major differences between the current analysis and the one conducted for the 1997 plan include the following:

- The drainage boundary for Pond AL-P5 was adjusted significantly to account for drainage areas located northeast of 140th Street and Gardenview Drive.
- Ponds identified as WVR-P39 and WVR-P390 were relabeled as Ponds AL-P11 and AL-P13, respectively.
- Six additional ponds were added to account for additional storage present in the system.

The following table shows ponds for which the updated modeling indicates that the peak water level elevations for the 1% chance rainfall event exceed by 1 foot or more the designated High Water Level (HWL) in the 1997 plan:

Table 5.6 – Significant Differences In Modeled Vs. 1997 Plan HWL

Pond	1997 HWL (ft.)	Modeled Peak Water Elevation	Difference (ft.)	Comments
AL-P3	1001.9	1005.0	+3.1	Updated Drainage Area
AL-P4	994.6	995.7	+1.1	Updated Drainage Area
AL-P5	989.1	993.9	+4.8	Updated Drainage Area and Revised Modeling Technique
AL-P6	992.5	993.5	+1.0	Updated Outlet Structure
AL-P8	964.8	966.4	+1.6	Updated Drainage Area

The total drainage area assumed to drain to **Pond AL-P3** increased nearly 100% to 12 acres. The revised drainage boundary correctly identifies the additional street drainage directed to this pond. As a result, the identified HWL increased 3.1 feet from the previously identified HWL.

Pond AL-P4 also had an increase in drainage area that resulted in an increase in the HWL of 1.1 feet from the 1997 plan HWL.

Pond AL-P5 has a High Water Level that is 4.8 feet higher than identified in the 1997 HWL. Several factors combine to result in the increase in High Water Levels for this pond. First, the drainage area was significantly revised to include areas located to the north and east of 140th Street and Gardenview Drive. This area was not included in the 1997 plan, but drains to AL-P5 through the storm sewer system. Second, the control water level of the pond was incorrectly identified as 985.8 in the 1997 plan. The downstream pond, AL-P6, has an outlet control elevation of 988.7, nearly three feet above the invert elevation of the outlet pipe from Pond AL-P5. The outlet pipe from AL-P5 is submerged under normal operation of the pond.

5.4.1.3 Operational Issues

Three issues require attention in this district in various locations. Issues regarding landlocked basins, flooding during the 100-year design rainfall event around certain ponds, and extended duration High Water Levels may need to be addressed in the future.

Two ponds in this district are landlocked. **Pond AL-P12** is located on the Apple Valley nine-hole golf course. **Pond AL-P14** is located at the southeast corner of the intersection of 140th Street and Gardenview Drive. Neither pond is currently connected or proposed to be connected to the drainage system at the present time. Neither receives concentrated flows from public streets or developed areas and seepage through the pond bottom has been sufficient to maintain acceptable water levels. If seepage does not maintain acceptable water levels in the future, temporary pumping or construction of permanent drainage outlets may be needed and should be studied in detail at that time.

Flooding of adjacent structures around **Ponds AL-P4, AL-P5, and AL-P6** has been an ongoing issue over many years. Improvements are suggested to the outlets of Ponds AL-P4 and AL-P6 to reduce water levels in each of these ponds to below the low entry elevations in the 100-year design event. The outlet from Pond AL-P4 is suggested to be built as an 18-inch parallel line adjacent to the existing trunk storm sewer alignment. Surcharging from the trunk storm sewer currently contributes to the High Water Levels experienced in Pond AL-P4. The outlet of Pond AL-P6 is suggested to be upgraded to a 42-inch RCP outlet from the existing 30-inch RCP outlet. The increase in the outlet diameter will lower water levels in ponds AL-P5 and AL-P6. The High Water Level in Pond AL-P7 will increase as a result of these improvements, and the acquisition of additional storage easements around AL-P7 may be necessary.

Extended periods of High Water Levels are expected to occur on **Alimagnet Lake (Pond AL-P9)**. This occurs as the lake is the low point of the entire drainage district and is serviced by a relatively small lift station. As a result, nearly all of the upstream ponds will have emptied completely well before the water can be pumped out of the Lake. Modeling shows that it would take over 40 days for the lake to return to an elevation within a ½ foot of the estimated control water level. During this interval, it is very likely that there will be additional rainfall events that occur that may result in it taking even longer to return to its structural control elevation. If extended High Water Levels become an issue in the future, opportunities to increase the capacity of the lift station may need to be explored.

5.4.2 Water Quality

The only recreational classified water body in this drainage is Alimagnet Lake, a shallow, 109-acre hypereutrohpic lake shared by the cities of Apple Valley and Burnsville. All runoff from the Alimagnet sub-district of Apple Valley discharges to Alimagnet Lake. An overview of the lake and its watershed is presented in Chapter 7. About 460 acres (37%) of the watershed lie within Apple Valley with the remaining 790 acres (63%) lying within the City of Burnsville. Because of excess nutrients, Alimagnet Lake has also been designated an impaired water (Chapter 8).

All discharge from the Lake is accomplished by a 6.9 CFS capacity lift station in the southeast corner of the Lake that pumps the water back into Pond WVR-P40 in the West Vermillion District of Apple Valley. Ultimately, these flows cross the border of Apple Valley at its southern border with Lakeville (Pond WVR-P443).

In March 2005 a lake management plan was completed for Lake Alimagnet (Bluewater Science and Bonestroo, Rosene, and Anderlik, Inc. 2005). The primary goal of the lake management plan is to reduce summer mean phosphorus concentrations in the lake from current levels (113 ppb in 2003) to about 54 ppb, which would be low enough to provide the basis to remove the lake from the impaired waters list. The Executive Summary of this Plan is included in Appendix G at the back of this report. It contains a list of recommended projects, estimated costs for those projects, and a time schedule for initiation and completion of those projects.

The City adopted the Plan in 2005 and is currently implementing the recommendations of that plan. These improvements and their estimated costs are referenced and summarized in Chapter 10.

5.5 BLACK DOG DISTRICT

Drainage Area: 440 Acres
Number of Ponds: 27
Major Lakes: None
Lift Stations: 2

5.5.1 WATER QUANTITY

5.5.1.1 GENERAL OVERVIEW

The Black Dog District is located in the northwestern portion of the City of Apple Valley. The district generally extends from I-35E on the northwest, west of Pennock Avenue on the east, north of McAndrews Drive (County Road 38) on the south and Gardenview Drive on the west.

Runoff from this district is routed through 27 ponds, and all runoff from the City's system is eventually discharged to the City of Burnsville. The district was connected to the City of Burnsville with the construction of I-35E and its associated storm sewer system. Runoff ultimately discharges to the Minnesota River through the City of Burnsville's storm sewer system.

5.5.1.2 DIFFERENCES FROM 1997 STORMWATER MANAGEMENT PLAN

Major differences between the current analysis and the one conducted for the 1997 plan include the following:

- 11 new ponds were identified for this plan that were not identified in the previous plan. These ponds reflect a finer, more detailed level of modeling of several ponds that were either ignored as landlocked areas or broken into individual ponds instead of one combined pond.
- Drainage boundaries were modified from the 1997 boundaries to better reflect the storm sewer systems and to accommodate the changes made as the result of improvement projects, such as the Palomino Road changes.

The following table shows ponds for which the updated modeling indicates that the peak water level elevations for the 1% chance rainfall event exceed by 1 foot or more the designated High Water Level (HWL) in the 1997 plan:

Table 5.7 – Significant Differences In Modeled Vs. 1997 Plan HWL

Pond	1997 HWL (ft.)	Modeled Peak Water Elevation	Difference (ft.)	Comments
BD-P2	1019.6	1022.0	+2.4	Updated Drainage Area
BD-P5	1001.8	1006.7	+4.9	Revised CWL
BD-P6	970.8	974.1	+3.3	Updated Drainage Area, Tailwater Condition
BD-P7	998.7	1003.8	+5.1	Updated Drainage Area
BD-P9	950.1	957.9	+7.8	Updated Drainage Area
BD-P10	977.1	978.1	+1.0	Updated Drainage Area and Outlet Structure
BD-P14	953.8	955.2	+1.4	Updated Drainage Area

The total drainage area assumed to drain to **Pond BD-P2** increased nearly 100% to 21 acres. The revised drainage boundary correctly identifies the additional street drainage directed to this pond. The additional drainage area to this pond is generally a result of improvements made to Palomino Drive.

Pond BD-P5 has a High Water Level that is nearly 4 feet higher than identified in the 1997 plan. The increase in high water elevation is entirely due to a change in the assumed starting water level. The previous plan identified the starting water surface elevation several feet below the structural outlet from the basin, based on the historical observation that **Pond BD-P5** historically maintains its water level several feet below the structural outlet elevation because of losses through evaporation and seepage. This plan makes the conservative assumption that the starting water surface elevation is equal to the structural outlet elevation, thus raising the HWL 4.9 feet.

Pond BD-P6 has a change in High Water Level as the result of modifications to the drainage characteristics in the basin from what was assumed in the 1997 plan. The higher water level is also a result of the tailwater interaction with the downstream **Pond BD-P11**.

Pond BD-P7 has a High Water Level 5.1 feet higher than identified in the 1997 plan as the result of a major change in drainage boundaries from the 1997 plan. These changes are generally the result of changes made to Palomino Drive. In addition, the assumption of **Pond BD-P5** being at the structural outlet control elevation contributes to the change.

Pond BD-P9 has a change in HWL of 7.8 feet from the 1997 plan as the result of a changed drainage boundary from what was assumed in the 1997 plan. The increase in total drainage area to 18 acres represents an increase in drainage area of approximately 450%.

Pond BD-P10 has a change in HWL of 1 foot from the 1997 plan. The 1997 plan showed that BD-P10 had a temporary lift station. This lift station is actually permanent, and is the only outlet for the pond. The 1997 plan also did not show BD-P102 routed through BD-P10, so the drainage area to BD-P10 has increased by 20 acres.

Pond BD-P14 has a change in HWL of 1.4 feet from the 1997 plan as the result of changes in upstream drainage boundaries in the system.

5.5.1.3 Operational Issues

There are several operational issues to consider in this district. First, there are two ponds that appear to have the potential to impact the adjacent residences during a 100-year rainfall event. These are **Ponds BD-P2 and BD-P7**. Each of these ponds should be monitored in the future or have the low entry elevations to the adjacent homes surveyed to ensure flood damage does not occur at these ponds. **Pond BD-P7** may not have any issues depending on the degree to which water in **Pond BD-P5** infiltrates so that the starting water surface elevation is below the structural outlet control elevation. This will need to be evaluated as part of a follow-up investigation.

Pond BD-P15 will overflow to **Pond BD-P14** using the street during a 100-year rainfall event. Chapparal Drive will have water flowing over it during a 100-year rainfall event.

Eight ponds are designated as landlocked in this district, and there are no plans to connect them to the system unless seepage is not sufficient to drain them in the long term. These ponds include BD-P2, BD-P13, BD-P101, BD-P103, BD-P104, BD-P110, BD-P120, BD-P150. Each of these basins has adequate storage to prevent flooding in a 100-year rainfall event.

5.5.2 Water Quality

There are no recreational water bodies within this sub-district. As noted in Section 5.4.1, there are two locations (BD-P11 and BD-P14) where stormwater discharges into Burnsville from the Black Dog District. At both locations, all stormwater runoff from Apple Valley is treated by water quality ponds prior to discharge into Burnsville. A summary of the Black Dog District drainage area and estimated average annual phosphorus and water loading discharging to Burnsville is shown in Table 5.8. The watershed is fully developed under existing conditions. Infiltration and associated runoff volume and phosphorus losses are expected to be low in this district due to relatively low permeability soils, thus the PondNet modeling results presented below are reasonable planning-level estimates.

Table 5.8 – Black Dog District Water Quality Summary Statistics

	Total Watershed*	Direct Watershed	Indirect Watershed
Drainage Area (acres)	390	0	390
Ave. Ann. Phosphorus Load (lbs/yr)	152	0	152
Ave. Ann. Runoff (AF/yr)	236	0	236

** Watershed area and phosphorus loads associated with landlocked sub-districts are not included.*

The modeled average annual phosphorus unit loading levels are less than 1/3-pound per acre per year. Predicted phosphorus concentrations leaving the Black Dog district are 182 ppb and 177 ppb for the BD-P11 and BD-P14 sub-districts, respectively. This indicates that phosphorus concentration reductions by water quality treatment ponds in this District are effectively approaching irreducible levels (see Section 4.3.2 for further discussion).

5.6 LAC LAVON DISTRICT

Drainage Area: 187 Acres (157 Acres in Apple Valley)
Number of Ponds: None other than Lac Lavon
Major Lakes: 1 – Lac Lavon
Lift Stations: None

5.6.1 WATER QUANTITY

5.6.1.1 GENERAL OVERVIEW

The Lac Lavon District is located in the southwestern corner of the City of Apple Valley. The district extends roughly from Whitney Drive on the north side, Gardenview Drive on the east side, 160th Street (County Road 46) on the south side, and a portion of Lac Lavon Park located in Burnsville. Over 80% of the total drainage area to Lac Lavon is located in the City of Apple Valley.

Lac Lavon is a manmade waterbody. The lake was formed in an abandoned gravel pit and has side slopes and a bottom composed of primarily granular material. Water levels in the lake are primarily a function of the local groundwater table, and are generally not a reflection of the runoff from the local drainage area. As a result, water levels may vary based on longer term rainfall patterns in addition to any low frequency, large rainfall events. There are no additional ponds located within the Lac Lavon District.

5.6.1.2 DIFFERENCES FROM 1997 STORMWATER MANAGEMENT PLAN

No major changes in High Water Levels are projected in this district. The total drainage area to Lac Lavon is less than indicated in the 1997 plan. This is the result of improved mapping of the watershed since the preparation of the last plan in 1997.

5.6.1.3 OPERATIONAL ISSUES

An emergency outlet exists from Lac Lavon that drains from the northwestern lobe of the lake to Keller Lake. The outlet consists of a 12-inch reinforced concrete pipe controlled by a valve in a manhole located at the corner of Whitney Drive and Hyacinth Path. In the event water levels in Lac Lavon rise to unacceptable levels, the outlet can be opened to lower water levels.

5.6.2 WATER QUALITY

Lac Lavon is the only recreational-classified water body in this drainage district. Key lake and watershed summary statistics for Lac Lavon are presented in Chapter 7. The watershed for the lake is fully developed under current conditions. Historically, Lac Lavon has been one of the best quality lakes in the Metro area, based on water quality data collected through the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). However, like many lakes in Minnesota, it is listed as being impaired for mercury (see Section 8.4).

Currently, stormwater runoff from the Lac Lavon District is conveyed directly to Lac Lavon without treatment. There are a total of eight separate outfalls serving the 119 acres of land draining to the lake. As noted in Section 5.5.1, Lac Lavon is a landlocked basin. Nutrient inputs to the lake do not travel downstream from Lac Lavon and will continue to accumulate in the bottom sediments. This will increase the risk of significant internal recycling of nutrients within the lake over time, especially if the deeper areas of the lake show oxygen depletion.

In 2002 a lake management plan was completed for Lac Lavon (Bluewater Science 2002) by the City of Apple Valley and the City of Burnsville in cooperation with the lake homeowners, stimulated in part by a concern that water quality in the lake may be declining and by concerns about control of the exotic macrophyte Eurasian milfoil. The primary goal of the lake management plan is to implement landscaping projects, extensive aquatic plant management for three exotic species, and continued monitoring to sustain the lake's current excellent water quality. The Executive Summary of this Plan is included in Appendix G at the back of this report. The Executive Summary contains a list of recommended projects, and estimated costs for those projects. The City adopted the Plan in 2002 and is currently implementing the recommendations of that plan associated with the City of Apple Valley. These improvements and their estimated costs are referenced and summarized in Chapter 10.

5.7 KELLER LAKE DISTRICT

Drainage Area: 1,479 Acres (824 Acres in Apple Valley)
Number of Ponds: 3
Major Lakes: 1 – Keller Lake (shared with Burnsville)
Lift Stations: None

5.7.1 WATER QUANTITY

5.7.1.1 GENERAL OVERVIEW

The Keller Lake District is located in the southwestern portion of the City of Apple Valley. The district extends from Cedar Avenue on the east side to the border with the City of Burnsville on the west side. Just over half of the total drainage area to Keller Lake lies within the City of Apple Valley.

Runoff from the district collects in three widely scattered regional ponds. Each of the ponds drains through trunk storm sewer to Keller Lake. Keller Lake ultimately discharges to Crystal Lake in the City of Burnsville. Ultimately, this system reaches the Minnesota River through the outlet from Crystal Lake.

5.7.1.2 DIFFERENCES FROM 1997 STORMWATER MANAGEMENT PLAN

Major differences between the current analysis and the one conducted for the 1997 plan include the following:

- Pond KL-P1 (Redwood Park Pond) was reconfigured to account for the revised outlet configuration.
- Pond KL-P4 (previously identified as WVR-P43) was added to the district on the basis that the majority of flood flows are directed to Keller Lake.

The following table shows ponds for which the updated modeling indicates that the peak water level elevations for the 1% chance rainfall event exceed by 1 foot or more the designated High Water Level (HWL) in the 1997 plan:

Table 5.9 – Significant Differences In Modeled Vs. 1997 Plan HWL

Pond	1997 HWL (ft.)	Modeled Peak Water Elevation	Difference (ft.)	Comments
KL-P1	958.4	959.8	+1.4	Updated outlet
KL-P3	955.2	958.8	+3.6	Updated drainage area

Pond KL-P1, also known as the Redwood Park Pond, was recently reconfigured to improve the water quality leaving the pond. While the improvements did not dramatically change the flood storage available for the pond, changes to the pond outlet did result in a change to the 100-year High Water Level of this pond. For the purposes of the flood control routing, it was assumed the existing gate remains closed and the pond returns to a control water level at the overflow grate elevation.

Pond KL-P3 also has a revised High Water Level that is significantly higher than shown in the 1997 plan. This is the result of a large increase in the direct drainage area to the pond relative to the 1997 plan. The revised drainage area takes into account the current configuration of the storm drainage system.

5.7.1.3 Operational Issues

Two issues of note appear in this district. First, the outlet configuration at Pond KL-P1 assumes the control water level is at the overflow outlet elevation, assuming the existing slide gate remains closed as observed during a field inspection. If the slide gate were to be opened, the pond control water level would drop several feet and there would be a large increase in flood storage at this pond. Under this condition, the High Water Level would be significantly lower.

The second issue is Pond KL-P4. This pond, previously identified as WVR-P43, has two outlets that flow into different drainage districts. While all or most of the runoff from small runoff events such as the one-year rainfall event is directed to Pond WVR-P46, the majority of 1% probability flood flows pass to Keller Lake. For this reason, this Plan calls for the sub-district to be listed as part of the major sub-district draining to Keller Lake. This sub-district is shown as KL-4 on Map 1.

Overall, no improvements are required in this system to provide flood control for the 100-year storm event.

5.7.2 Water Quality

Keller Lake is the only recreational-classified water body in this district. The BDWMO sets Keller Lake as a Category III, based on pre-ferric chloride system (See BDWMO Watershed Management Plan (2002)). Although Keller Lake lies almost entirely in the City of Burnsville, a small portion of the east shoreline of the Lake does lie within Apple Valley, and is therefore considered as lying within both communities. More importantly, a significant portion of the watershed to Keller Lake lies within Apple Valley. Keller Lake is listed as being impaired for excess nutrients (see Section 8.4).

In Apple Valley, there are five sub-districts identified in the Keller Lake District. Ponds currently treat stormwater runoff from half of the watershed area (sub-districts KL-1, KL-3, and KL-4) draining to Keller Lake from Apple Valley. The KL-4 sub-district generates negligible nutrient inputs to Keller Lake on an average annual basis. This is due to invert elevation differences for the primary and secondary outlet structures of Pond KL-P4. This outlet control configuration causes all of the runoff volume for a one-inch, 24-hour rainfall and approximately 93% of the total runoff volume for the two-inch, 24-hour rainfall event to be routed to Pond WVR-P46.

Runoff from sub-districts KL-2 and KL-300 drains directly to Keller Lake without treatment. These direct drainage sub-districts comprise 50% of the 825 acres draining to Keller Lake from Apple Valley, yet contribute a disproportionately high amount (about 70%) of the average annual phosphorus load.

Keller Lake is designated by the BDWMO as a strategic water resource, indicating the lake is of broad watershed significance. This means Keller Lake is important to a larger population than just the municipality in which it is located. Also, because Keller Lake drains to Crystal Lake in Burnsville, watershed activities in Apple Valley's Keller Lake District can impact water quality both in Keller Lake as well as Crystal Lake. This has important management implications for the City of Apple Valley because Crystal Lake is also a BDWMO strategic water resource.

In 2003, the BDWMO completed an extensive Use Attainability Analysis (UAA) for these two water bodies (Barr Engineering Company 2003). A key finding of this analysis was that Keller Lake outflow comprises about 30% of the total Crystal Lake phosphorus budget. This analysis reported that 3,370 acres of land area drains to Crystal Lake, of which over 40% (1,387 acres) first passes through Keller Lake. The Keller Lake watershed area is nearly equally split between Apple Valley (56%) and Burnsville (44%).

Keller and Crystal lakes are impacted by poor quality stormwater runoff. Keller Lake is listed by the MPCA as impaired for swimming. Recreational use activities in Crystal Lake are typically impaired by late-summer algae blooms. The UAA evaluated water quality issues and potential restorative measures for Keller and Crystal lakes. As an outcome of the UAA, several stormwater quality improvements (BMPs) were recommended for the Keller Lake District within Apple Valley.

Apple Valley's direct drainage to Keller Lake is fully developed. Consequently there is little available space to incorporate new stormwater treatment ponds as a retrofit improvement. The UAA identified the following items as recommended improvements to benefit the Keller and Crystal Lake strategic water resources:

- Upgrade Pond KL-P1 in Redwood Park into an infiltration basin, including excavating to meet NURP criteria.
- Construct a regional infiltration basin north of Valley Middle School in sub-district KL-2.
- Upgrade dead storage volume of KL-P4 (formerly WVR-P43) to meet NURP criteria.
- Construct a wet pond near the intersection of Whitney Drive and Hyacinth to treat stormwater runoff from Apple Valley sub-districts KL-2 and KL-300 prior to discharge to Keller Lake.

Improvements to KL-P1 were implemented by Apple Valley in early 2005. The City will pursue implementation of the other recommended BMPs in the report. Those projects and their estimated costs are listed in Chapter 10.

5.8 NORTHERN NON-CONTRIBUTING AREAS

Drainage: 885 ac. (Including the Minnesota Zoological Gardens, Lebanon Hills Regional Park, Valleywood Municipal Golf Course, and the Beckman Addition)
Number of Ponds draining to the City of Apple Valley: 2 (1 in Lebanon Hills Regional Park proposed to drain to Apple Valley, and 1 located in the MN Zoo that is occasionally pumped to the City)
Major Lakes: None
Lift Stations: 1 temporary and 1 proposed

5.8.1 DRAINAGE OVERVIEW

This portion of the City is made up of areas north and east of the West Vermillion River District and north of the East Vermillion River District. The areas include most of the Minnesota Zoo, Lebanon Hills Regional Park, Valleywood Municipal Golf Course, and the City's Beckman addition.

In general the drainage pattern of this area is to the north and east, to the City of Eagan and Lebanon Hills Regional Park lakes, including Gerhardt Pond and Jensen Lake. However, the topography of this area is such that many basins are land locked, often with 8-10 feet or more of vertical separation from NWL, and no structural outlets. Also, much of the area is largely undeveloped and many small basins exist in the area creating many small ponds that never outlet. However, the area has a recent record of high water problems during wet periods. There are now plans to discharge high water through lift stations to the City of Apple Valley during wet periods from select critical basins.

The Minnesota Zoo handles its most highly polluted surface water by discharging drainage from animal enclosures to the City of Eagan's sanitary sewer system. Drainage that accumulates in the Zoo's main surface water pond can be pumped to the City of Apple Valley by way of a storm sewer discharging to WVR-P17 during wet periods when the ponds get too high. However, the Zoo must first request permission from the City in writing to discharge to its system and prove that the water quality being discharged is the same or better than the water quality of the receiving water bodies.

The Dakota County Parks Department manages the Lebanon Hills Regional Park, including its stormwater storage and conveyance features. The County recently produced a Stormwater Management Plan for the Park (Barr 2005). The report proposes to install a 1-CFS lift station at Wheaton Pond, within the park, to discharge water from this drainage when needed because of High Water Levels in the Pond. The City of Apple Valley and Dakota County have worked together to develop a proposed plan to outlet the force main to a swale in EVR-190 that will route runoff to Farquar Lake. The City will require that the pump be used only when water levels in Farquar Lake are at normal elevation.

The golf course and the Beckman Addition are under City jurisdiction. The Beckman Addition was a private development north of the golf course that the City acquired. Both areas north of the East Vermillion River District discharge north to the Regional Park. The outlet of a pond within the Beckman addition is currently not up to the City standards and is proposed to be reconstructed to meet current standards.

6. Wetlands

6.1 BACKGROUND

Wetlands fill a number of roles in the landscape, including improving water quality, and providing floodwater retention. They are also a critical habitat component for many species of wildlife and often contribute significantly to the aesthetics of an area.

There are approximately 300 wetlands within the City of Apple Valley listed on the National Wetland Inventory (NWI). Thirty (30) of these wetlands are located in the Black Dog Watershed Management Organization (BDWMO) jurisdiction with the remaining approximately 270 wetlands located in the Vermillion River Watershed Joint Powers Organization (VRWJPO) jurisdiction. This wetland inventory was conducted to fully meet the requirements of the BDWMO Watershed Management Plan and partially meet the VRWJPO Watershed Management Plan as they relate to wetland management.

All of City's mapped NWI wetlands (30) within the BDWMO were evaluated and 27 NWI wetlands in the VRWJPO were evaluated as part of this project. The goal of this wetland assessment was to determine the appropriate function and value for the selected wetlands by utilizing an on-site evaluation methodology (see Section 6.2). Functions and values can include water quality treatment enhancement potential, but also recreation potential and the potential for aesthetic and wildlife enhancements to the wetlands and buffer areas. For this reason, wetlands located in parks or open space were primarily selected for evaluation.

The Dakota County SWCD completed an inventory (Summer 2006) of the wetlands within VRWJPO's portion of the City, utilizing an off-site methodology including aerial photography, National Wetlands Inventory data, county soils data, DNR Public Waters maps and data on rare or endangered communities and species. The primary focus of the Dakota County SWCD inventory was on water quality protection. Its inventory and assessment will be used to evaluate watershed and community based policy that will provide the most benefit to water quality in the future.

Because the primary goal and methodology of the SWCD assessment is slightly different than the City assessment, the same wetland may be ranked differently in each. However, most wetlands were found to be ranked similarly in each inventory. The main discrepancy appears to be due to slightly different evaluation criteria and the use of on-site data in the City's assessment. For this reason, the Apple Valley assessment should be used for wetland management when available. However, if the wetland has not been assessed using the City inventory, the Dakota County SWCD inventory data and classification system should be used to provide wetland management recommendations until the wetland is assessed using the City's field-based method.

With the inventory by the Dakota County SWCD and this inventory, it is expected that all of the wetlands in the City will be inventoried and classified. However, there is always the potential that some wetlands may be missed during the assessment. If wetlands are encountered that were not classified or inventoried, they will need to be assessed and classified at the time of proposed development. Regulation of activities potentially impacting individual wetlands will be based on a site-specific delineation of the wetland boundary and classification as part of the proposed project.

6.2 WETLAND INVENTORY AND ASSESSMENT APPROACH

A total of 57 wetlands in the City were initially chosen for evaluation as part of this assessment. Seven wetlands listed on the NWI were found to be non-wetland during the site visit and were not further classified because it is anticipated they will not be managed or regulated as wetlands. There were 24 wetlands evaluated and classified in the BDWMO and 26 in the VRWJPO that were chosen by City staff. These wetlands were located in high priority watersheds that drained to major recreational resources within the City, as well as, park locations where there may be opportunities for enhancement and restoration for aesthetics and enjoyment within the parks.

The objectives of the inventory and assessment include the following:

- Determine the attainable use for the wetlands.
- Identify water quality treatment or enhancement potential of wetlands.
- Identify potential aesthetic and wildlife habitat improvements to wetlands and adjacent buffers.
- Determine wetland protection criteria.
- Determine wetland stormwater susceptibility.
- Determine wetland management classification.
- Produce detailed management criteria for priority wetlands.

6.2.1 INVENTORY METHODOLOGY (SEE APPENDIX F)

The wetland Inventory and Assessment process involved the following steps:

- Preliminary mapping and identification of wetlands within the project area to be assessed, including numbering of wetlands to be assessed.
- Field evaluation/site assessment and determination of potential restoration sites.
- Qualitative ranking of each wetland, based on community type and quality.

Prior to beginning any field assessments, preliminary wetland determinations were made using National Wetland Inventory (NWI) data. Other information that was also reviewed included the Natural Heritage and T/E species databases and existing stormwater maps. Thirty wetlands located within the BDWMO were selected for assessment. The City then selected 27 other wetlands located in the VRWJPO to be included in the study. For this inventory, only wetlands that were identified in the NWI were evaluated. Seven of the NWI wetlands that were selected for assessment were found to be non-wetland during the field review. These sites were then excluded from further investigation/assessment. Therefore, a total of 50 wetlands were assessed. Twenty-four of these were in the BDWMO and 26 were in the VRWJPO.

Wetland identification numbers used in the wetland inventory are based on the township, range and section in which the wetlands exist. Each wetland is identified by the following numbers: County Code (CC), Township (T), Range (R), Section (S) and then an individual number for the wetland within the section. The following is an example of the wetland ID.

19	115	20	16	023
CC	T	R	S	Wetland No.

The wetland designations can be found on Map 3 – Apple Valley Wetland Inventory Wetland Management Classification located in the back of the report. Note: only the last 5 digits of the ID number (bolded) are used to identify wetlands on the included maps.

Each of the 50 wetlands inventoried was assessed in the field. During the field visit, the following parameters were evaluated for each wetland:

- Wetland Type (Cowardin and Circular 39 type).
- Natural community type and quality.
- Floral Diversity.
- Restoration potential for hydrology and vegetation.
- Direct Stormwater Inputs.
- Adjacent land uses.
- Aesthetic Value.
- Alterations to the site and its immediate watershed.

Inventoried wetlands were evaluated according to a hybrid methodology adapted to Apple Valley's urban setting by using a method that combined the MnRAM, Version 3.0 – Vegetative Diversity and Integrity Section, the New Hampshire Method – Urban Section and a customized Restoration Potential Evaluation section. A brief explanation of the MnRAM, New Hampshire and Restoration section methods are provided below (See Appendix F).

MnRAM, V. 3.0 – Vegetative Diversity and Integrity Section

This evaluation method/section is included to understand the diversity and integrity of the plant community(ies) within each wetland basin inventoried. Diversity refers to species richness, i.e., number of plant species. Integrity refers to the condition of the plant community in comparison to a reference standard for that community.

Generally, the more floristically diverse a community is, the higher its ranking in this section. The highest ranking is given to those communities that represent the characteristic condition of that particular community. The degree (e.g., minor versus substantial) and type of disturbances typically play an important role in the diversity/integrity of plant communities. Typically, the more human-related disturbances that are evident, the more negatively impacted the plant communities tend to be.

New Hampshire Method

Wetlands have the potential to enhance the quality of human life in an urban environment. Historically, many wetlands in urbanized areas were left undeveloped because of severe site limitations. Because of the impacts of intense human activity, urban wetlands may not perform certain functions as well as wetlands in undeveloped areas. However, this should not be interpreted to mean that urban wetlands have no value for Ecological Integrity, Wetland Wildlife Habitat, and Visual/Aesthetic Quality. Wetlands in urbanized settings may have considerable value when considered in the context of the surrounding urban land. In a sense, the importance of an urban wetland is increased by its surroundings. For example, the wetland itself may provide only marginal wildlife habitat, but because it is surrounded by urban land, which may have little or no habitat for wildlife, the wetland takes on a significance that it would not otherwise have.

As a result, those wetlands remaining in urban areas may be among the last refuges for wildlife as well as some of the few remaining "natural" viewscapes. The section of the New Hampshire method used in Apple Valley evaluated wetlands with an understanding of their importance in an urbanized setting.

Wetland Restoration/Enhancement Section

The Restoration/Enhancement Section of the evaluation gathered specific information about a particular wetland basin regarding its hydrologic and/or vegetation restoration potential. Because all of the wetlands that were evaluated are in an urban area, none of the more common hydrologic alterations common in more rural areas (ditches, tiles etc.) were observed. The wetland restoration/enhancement section focused more on vegetation restoration/ enhancement in the wetland and buffer areas. Restoration/enhancement factors considered in this evaluation include:

- Ease of restoration/enhancement as it relates to cost, time, complexity and level of nonnative species infestation/control that is required;
- Number of landowners;
- Surrounding buffer size and vegetative quality (especially level of invasive species);
- Opportunity to restore ecological connectivity to other areas; and
- Site-specific activities to undertake in a particular wetland basin such as vegetation restoration activities/cost, wildlife habitat management opportunities, and aesthetics.

Using the data collected during the field visit, personnel were able to rate each of the above functions (floral diversity, urban quality of life, restoration potential) on a scale from Low to Exceptional. These function ratings were then used to develop a wetland management classification system and stormwater susceptibility ranking, described below.

A summary table for the 50 wetlands inventoried as part of this effort is located in Appendix F (the seven non-wetlands are not included).

6.2.2 Management Classification Methodology

Wetland management classifications were determined using a flow chart that ranked the wetland based on the functional values determined in the field using the criteria of vegetation diversity/integrity, presence of direct stormwater inputs, restoration potential and location in public space (Figure 6.1). The Urban Quality parameter ended up not being very useful.

All of the wetlands ranked either high or medium, and did not correlate with any of the other parameters. Therefore, it was not considered in the classification system. First, a vegetation diversity/integrity determination was made for each plant community within a wetland, using criteria established by MnRAM. While these criteria vary for different plant communities, the levels of native plant diversity, exotic/invasive species infestations, adjacent land use, and other disturbance indicators form the basis for this determination.

Wetlands were also observed for the presence of direct stormwater inputs (observed or indicated on the City stormwater maps) because of the affect that untreated stormwater inputs can have on a wetland's quality and diversity. Restoration potential was determined by comparing several factors in and around the wetland. Wetlands having higher floral diversity ranked higher in enhancement potential than those with lower diversity did. This is because wetlands with higher floral diversity will require less time and effort to maintain species diversity, whereas those with lower diversity will require more work (seeding, planting etc.) and effort.

In addition, wetlands that had wide buffers, low levels of exotic/invasive species and one land owner ranked higher in restoration potential than those without these characteristics. Those wetlands that were completely within public space ranked highest in that portion of the restoration potential section.
The Minnesota Natural Heritage database and MnDNR information on rare/endangered species was also reviewed for the surveyed wetlands.

A brief description of the wetland classification type requirements is listed below:

Protect
Wetland is listed as a Natural Heritage Site or has rare, threatened or endangered wetland plant and animal species present within ¼ mile. When wetland species are taken into account, 38 wetlands in the City are within ¼ mile of Blanding's turtle and/or Wood turtle record, which are federally threatened species. However, for this study, only 5 of the wetlands inventoried fell within the ¼ mile radius of a record.
The Blanding's turtle preferred habitat is shallow water, rich, aquatic vegetation and sandy uplands for nesting. Wood turtles are semi-terrestrial; it prefers small, fast-moving streams and the grassy meadows along side the streams. These habitats when associated with a documented record of these species will be afforded the highest protection.

Wetlands that have either exceptional or high floral diversity/integrity and thus have undisturbed and diverse plant communities are afforded the Protect classification to maintain their existing ecological integrity. Also, wetlands that are mapped on the DNR's Map of Rare Features were automatically considered to have exceptional quality and were given the Protect classification.

Manage 1
Wetlands that have medium floral diversity/integrity, relatively undisturbed and diverse plant community, and no direct stormwater input were placed under the Manage 1 classification to maintain their existing ecological integrity.

Manage 1, Restore
Wetlands in this classification have medium floral diversity/integrity, but also have direct stormwater input. The wetland must have high or exceptional restoration potential and be located in public or open space in order to meet the restoration classification. Despite direct stormwater input, the wetlands have medium floral diversity and their locations within public or open space offer restoration and protective management opportunities for the wetland.

Manage 2
Wetlands in this classification have medium floral diversity and direct stormwater inputs. They are characterized by high or exceptional restoration potential but are not located in public or open space.

Manage 2, Restore

Wetlands are assigned to this category if they have medium floral diversity/integrity, direct stormwater inputs, and medium restoration potential. The wetland must be located in public or open space. Wetlands are also assigned to this classification if they have low floral diversity/integrity, exceptional restoration potential and are located in public or open space. Restoration and more intensive management of these wetlands will enable them to obtain a Manage 2 classification.

Manage 3

Wetlands assigned to this category have medium floral diversity/integrity, direct stormwater input, medium restoration potential and are not located in public or open space. Wetlands are also assigned to this category if they have low floral diversity/integrity and restoration potential is not exceptional.

6.2.3 Stormwater Susceptibility Determination

Site visits to wetlands included a verification of the Wetland Community Type and documentation of the plant communities. The technical paper Guidance for Evaluating Urban Stormwater and Snowmelt Runoff Impacts to Wetlands completed by the State of Minnesota Stormwater Advisory Group was used as a guide in the determination of wetland sensitivity to stormwater. This document divides wetlands in categories that include: highly susceptible, moderately susceptible, slightly susceptible, and least susceptible. The following are the guidelines used in this document to assess wetland susceptibility to stormwater impacts.

Highly Susceptible Wetlands Determination: A wetland is considered highly susceptible if 40% or more of the wetland complex has one or more of the following highly susceptible wetland communities and has medium to exceptional floral diversity/integrity within the susceptible wetland community or communities. Highly susceptible wetland communities include:

- Sedge Meadow,
- Bogs,
- Coniferous Bogs,
- Open Bogs,
- Calcareous Fens,
- Low Prairies,
- Coniferous Swamps,
- Hardwood Swamps, and
- Seasonally Flooded Basins.

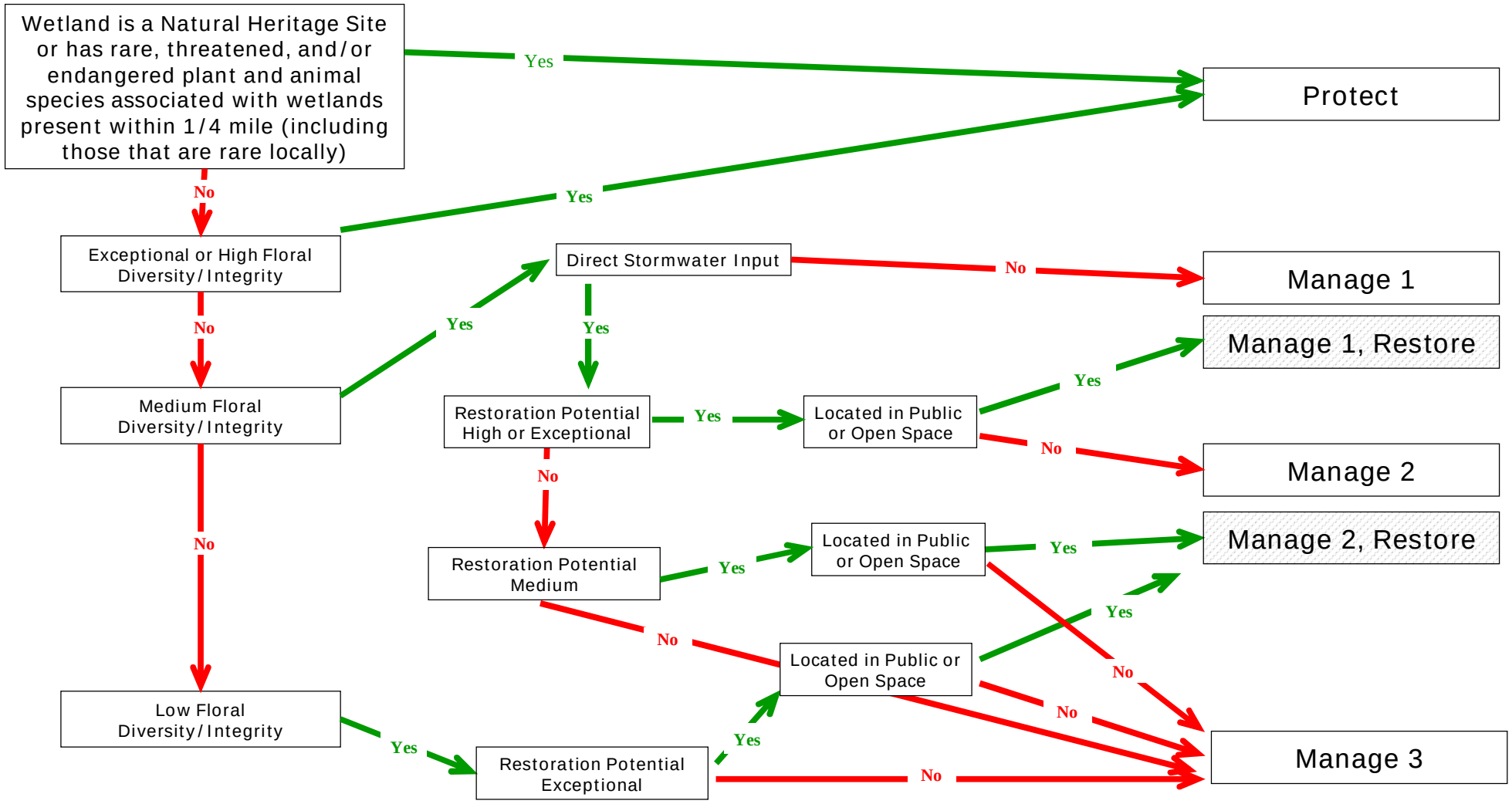
Moderately Susceptible Wetlands: A wetland is considered moderately susceptible if 40% or more of the wetland complex has one or more of the following moderately susceptible wetland communities and the wetland has medium to exceptional floral diversity/integrity within the susceptible community or communities.

Moderately susceptible wetland communities include:

- Shrub-Carrs,
- Alder Thickets,
- Fresh (wet) Meadows,
- Shallow Marsh,
- Deep Marsh, and
- Shallow Open Water.

Slightly and Least Susceptible Wetlands: Wetlands with low floral diversity as determined by MNRAM were considered to be least susceptible wetlands. Wetlands that do not fall under the high or moderate categories are considered slightly susceptible.

These classifications are important because they provide guidance on which wetlands should be protected from additional stormwater inputs and which wetlands could be modified to improve stormwater treatment as well as enhance wildlife habitat. For example, if a slightly or least susceptible wetland is located upstream of a highly susceptible or moderately susceptible wetland or lake basin, it may be appropriate to modify the upstream wetland basin to decrease pollutant loading to the downstream basin. In order to insure that these modifications benefit both water quality and wildlife habitat functions, design guidelines have been developed that involve creating a meandered wetland edge, preserving aquatic benches for shallow water habitat and emergent growth, and planting of native emergent vegetation to increase habitat diversity.



Wetland Management Classification Flow Chart

City of Apple Valley
Surface Water Plan Update
I: \68-04-262

Figure 6.1

Bonestroo

6.3 WETLAND STANDARDS AND RECOMMENDATIONS

All of the inventoried wetlands within the study area were classified for protection. These recommendations include water quality standards with additional recommendations for buffer strip width.

The following sections provide details about the protection strategies developed for wetlands within the City.

6.3.1 WATER QUALITY PROTECTION

Water quality plays a significant role in the overall quality of a wetland. When the quality of the incoming water decreases, the wetland plant community often becomes less diverse and retains only those species that are tolerant of high nutrient and sediment loads. Once a wetland's plant community changes, the wetland's character and overall ecosystem often shifts to a less valuable system in terms of biodiversity, wildlife habitat value, and aesthetic quality. In order to preserve wetland quality in the face of stormwater impacts, a series of pretreatment standards have been developed. These reflect the quality standards which runoff must meet before discharging into a wetland of a given management classification, and can be achieved through treatment ponds or other BMP's (Best Management Practices). Water quality standards for input are listed in Table 6.1.

Table 6.1 – Apple Valley Water Quality Protection Standards

Wetland Management Category	Stormwater Pretreatment Requirement
Protect	Meet NPDES Permit Standards[1] and Maintain the existing conditions[2] in the wetland for: Storm bounce (10-year) Inundation period for 1, 2 & 10 year precipitation event and greater
Manage 1, 2, 3	Meet NPDES Permit Standards[1]

[1] *See General Permit Authorization to Discharge Stormwater Associated with Construction Activity Under the NPDES/SDS Permit Program (2003), pages 10-13 and 21-22.*

[2] *"Existing" in this table means the existing hydrologic conditions.*
If there have been recent significant changes in conditions, it means the conditions that established the current wetland.

6.3.2 BUFFERS

Buffer strips help mitigate the impacts of development adjacent to wetlands. Catch basins and storm sewers typically collect street and front yard drainage and direct the drainage to an appropriately sized pond for pre-treatment prior to discharge to a wetland or waterbody. Backyard drainage typically reaches wetlands or waterbodies without any pre-treatment, thereby allowing lawn and garden chemicals, sediments, pet wastes, fertilizer and other types of contaminants to directly impact the receiving waterbody.

Buffer strips can provide needed treatment of stormwater drainage to protect wetlands from human impacts as areas develop. A secondary benefit is valuable habitat protection, especially near aquatic areas. Habitats adjacent to aquatic areas generally have a higher diversity of bird species than other habitats (Johnson, 1992). The reasons for this include: the proximity of habitat requirements (i.e., food, cover, and water), the increased number of niches (because of the wider diversity of plant species and structure), and the high edge-to-area ratio that results from the linear shape of most riparian zones (MPCA, 1997).
As the buffer width increases, the effectiveness of removing sediments, nutrients, and other pollutants from surface water increases. In addition, as buffer width increases, direct human impacts, such as dumped debris (i.e., garbage, lawn and garden cuttings, or fill) and trampled vegetation will decrease. A field study of wetland buffers in Seattle showed that 95% of buffers less than 50 feet wide suffered a direct human impact within the buffer, while only 35% of buffers wider then 50 feet suffered direct human impact (Castelle, et. al. 1992). An overview of scientific literature on wetland buffers suggests the following minimum buffer widths for protection of these buffer functions (MPCA, 1997):

Water Quality Protection:	25 feet or more
(Depends on vegetation, slope, density and type of adjacent land use and quality of receiving water)	
Protection from human encroachment:	50-150 feet or more
Bird habitat preservation:	50 feet or more
Protection of threatened, rare or endangered species:	100 feet or more

Setbacks of 10 feet between structures and the edge of the buffer are recommended by the Minnesota Pollution Control Agency (MPCA, 1997) and have been incorporated as part of this plan to insure there is usable space between structures and buffers and to prevent encroachment of lawns into buffer areas.

Vermillion River Watershed Joint Powers Organization (VRWJPO): The Vermillion River Watershed Joint Powers Organization (VRWJPO) standards recommend that wetland buffers be placed around wetlands at the time of development, according to the basin's qualitative ranking. The City wetland buffer standard incorporates the VRWJPO Buffer Strip Standards with the Apple Valley Classifications, as shown in Table 6.2, for the entire city including areas in VRWJPO and BDWMO.

Table 6.2 – Wetland Buffer Standards

Development Type	Wetland Ranking	Permanent Buffer Zone Average Width (feet)	Minimum Permanent Buffer Zone Width (feet)	Minimum Building Setback from Outer Edge of Buffer (feet)
New Development and Subdivisions	Protect (P)	50	30	10
	Manage 1 (M1)	40	30	10
	Manage 2 (M2)	30	25	10
	Manage 3 (M3)	25	16.5	10
Redevelopment	All Rankings (P, M1-M3)	16.5	16.5	10

Source: Vermillion River Watershed Joint Powers Organization Standards

* *Buffer area vegetation shall be considered adequate when the buffer has a continuous, dense layer of perennial grasses, flowers, trees and/or shrubs that has been uncultivated or unbroken for at least 5 consecutive years.*
Vegetation shall be considered unacceptable if:
1. Topography or sparse vegetation tends to channelize the flow of surface water; or
2. For some other reason the vegetation is unlikely to retain nutrients and sediment.

6.3.3 Wetland Restoration and Enhancement

Wetlands assigned to Manage 1-Restore or Manage 2-Restore were further evaluated to determine wetland restoration/enhancement priorities. Wetland restoration priorities were developed based on perceived ease of hydrologic restoration, quality/size of existing buffer, public/private ownership and existing vegetation quality. These sites include basins that are owned completely by one owner or in public ownership, and were determined to have a medium or high vegetation restoration potential and high buffer quality during the field assessment. These criteria were developed by wetland scientists and ecologists at Bonestroo and Associates, for use in this project. The restoration priorities are based on the data collected from the wetlands that were inventoried in both the BDWMO and VRMJPO.

The following summarizes the wetland restoration/enhancement potential categories used in this report and defines the evaluation criteria used to assign wetlands to each category.

<u>Exceptional</u>
Minimal effort would be required to correct hydrologic alterations or no alterations currently exist. Wetland currently has a good to excellent quality plant community with minimal or no effort required to maintain. Wetland has an un-mowed herbaceous buffer at least 25 feet wide and wetland is completely within public ownership.

<u>High</u>
Minimal effort would be required to correct hydrologic alterations. Examples include blocking a small ditch, breaking one or a few tile lines, taking minor corrective actions within the watershed to restore the historic quantity and/or quality of waters reaching the wetland. Upland buffer is 12-24 feet wide. Basin is owned by one landowner. Site has good quality plant communities, minimal effort required to restore composition, structure, and function for community type. Efforts needed include minor species reintroduction, limited management via cutting, spot herbicide treatment, prescribed fire, and/or other practices within the wetland. Limited exotic/invasive species infestations.

Medium

Some physical and financial efforts would be required to restore these communities. Upland buffer is 3-11 feet wide. Basin owned by two landowners. Moderate quality site, some physical and financial efforts are required to restore vegetation. For example, reseeding portions of the wetland and multi-year efforts that include a variety of management tools. Includes crop fields that can be seeded, hydrologically restored, and has potential to achieve moderate quality within 5-25 years, and existing wetland communities with low to moderate exotic/invasive species infestations.

Low

These communities have often experienced significant hydrologic alteration through human activity. Improvement of these communities in the short term often requires substantial efforts. Upland buffer is 0-3 feet wide. Basin owned by 3 or more landowners. Low quality sites are often dominated by nonnative species, or are in a cultivated field known to have problem species (on-site or in seedbank). Restoration/improvement requires substantial efforts over 10-30 or more years. Examples include reseeding of significant portions of wetland, multi-decade restoration efforts requiring a variety of management tools, both within the wetland and in the immediately surrounding upland buffer.

Wetland restoration/enhancement sites were identified during the field inventory. Typically, these are sites that have experienced minor alterations in hydrology or have high floral diversity and large buffer areas. Most of these areas are located in public or open space and thus give the City the opportunity to implement restoration or enhancement opportunities that will provide benefits to the public. These wetlands are classified as Manage 1-Restore or a Manage 2-Restore. Details of each of these wetland basins follow and their locations are shown on Map 3 at the back of this report.

MANAGE 1-RESTORE

19-115-20-14-002 **Approximate Size: 2.5 Acres**

General Description

The wetland is located on zoo property. This wetland is made up of two wetland communities: an emergent marsh dominated by cattail and reed canary grass with an area of open water and a wet meadow fringe dominated by reed canary grass and heath aster present. The wetland appears to receive stormwater inputs. The wetland appears to be in moderate condition with a good buffer.

Attainable Use/Restoration Goal

The wetland has good aesthetic, education and wildlife values due to its setting on the Minnesota Zoo property. The wetland does not appear to have hydrologic impacts. Restoration/enhancement opportunities include control of reed canary grass and improving the upland buffer quality. The buffer is currently a good size. However, controlling the invasive buckthorn and thistles will improve the buffer and wetland habitat and make the area more aesthetically pleasing.

19-115-20-14-003 **Approximate Size: 2.9 Acres**

General Description

This site is a shallow, open water community with an abrupt boundary. The wetland is located on the west side of Zoo Boulevard, south of the Minnesota Zoo. There are some small areas of narrow-leaved cattail. The wetland appears to receive stormwater inputs. There is a moderate buffer with some oaks and other native tree species.

Attainable Use/Restoration Goal

Attainable uses for the wetland include aesthetic and wildlife opportunities. The wetland is mostly buffered with some minor exceptions. Good buffer of oaks and black willow that could be improved with removal of buckthorn. Controlling the invasive species in the buffer will improve the upland and wetland habitat and make the area more aesthetically pleasing.

19-115-20-16-017 **Approximate Size: 1.6 Acres**

General Description

This is a shallow, open water wetland with the open water dominated by lesser duckweed and some white water lily. The wetland is located in Chaparral Park. The abrupt boundary limits the wetland to the open water area. No emergent vegetation was observed. The fringe is dominated by shrubs and trees including dogwoods and willows. The wetland itself is in good shape, relatively undisturbed and isolated, and should be preserved.

Attainable Use/Restoration Goal

The wetland has high wildlife values and is good habitat for wood ducks due to dense woody vegetation along open water. Wood ducks were viewed utilizing shallow open water. The trail in the park ends at the wetland, overlooking the basin. However, scrubby trees such as box elder and buckthorn limit view. The percentage of buckthorn is high in the surrounding woods. Removal of buckthorn in the upland buffer would offer an excellent opportunity for restoration of the upland which when combined with the wetland, the overall habitat and aesthetics of the area would be improved. The flat shelf would allow planting of vegetation, and could improve the wetland diversity. The wetland appears to have good wildlife habitat values already.

19-115-20-16-023 **Approximate Size: 1.0 Acres**

General Description of Basin

This site is a shallow open water community with an abrupt boundary. The wetland is located in Chaparral Park. The open water is dominated by lesser duckweed and white water lily. There is a narrow fringe of shallow marsh that contains a good variety of wetland plant species including blue flag iris, river bulrush, woolgrass, reed canary grass and sandbar willow. The wetland is mostly buffered with some minor exceptions (less than 20 feet of the wetland perimeter). Good buffer of oaks and black willow that could be improved with removal of buckthorn.

Attainable Use/Restoration Goal

Attainable uses include aesthetic, recreation, education, and wildlife habitat due to the park setting.
Its location in a park offers excellent education and aesthetic values and provides excellent viewing from the park trails. This wetland does not have hydrologic impacts. It offers opportunities for enhancement due to a natural, flat (less then 1 foot deep) aquatic shelf area around the open water that could be planted with emergent vegetation. In addition, this may be a good area to demonstrate buffer restoration by removing buckthorn and wetland restoration by planting emergent vegetation.

19-115-20-16-030 **Approximate Size: 1.5 acres**

General Description

This is a Type 5, shallow open water wetland that is located in Belmont Park. The majority of the wetland is open water with lesser duck weed visible. A narrow fringe of emergent vegetation is present that includes reed canary grass, narrow-leaved cattail, woolgrass, jewel weed and stinging nettle. The wetland appears to receive stormwater inputs. The adjacent upland is woodland, backyards and mowed park fields/playground.

Attainable Use/Restoration Goal

Attainable uses for the wetland include recreation and wildlife opportunities. The wetland is located in Belmont Park and is connected to corridor of wetlands in the park area. There is an existing trail and bridge over the wetland that offers excellent views of the wetland and potential wildlife. Restoration/ enhancement opportunities include buffer management. There is a narrow buffer (5-10 feet) around wetland near playground and lawn areas but also some area of large buffer (>75 feet) toward the eastern and southern side of wetland. Increasing the buffer width around the narrow areas and controlling the invasive buckthorn will improve the wetland habitat and make the area more aesthetically pleasing.

MANAGE 2-RESTORE

19-115-20-14-001 **Approximate Size: 1.9 Acres**

General Description

This site is a shallow, open water community with an abrupt boundary. The wetland is located on the Minnesota Zoo property. There is a narrow fringe of shallow marsh dominated by narrow-leaved cattail and reed canary grass. The wetland appears to receive stormwater inputs. There is a moderate buffer with some oaks and other native tree species.

Attainable Use/Restoration Goal

The wetland has good aesthetic, education and wildlife values due to its setting on the Minnesota Zoo property. The wetland is near a picnic area for the zoo and offers a good opportunity to plant more native vegetation, control invasive species (buckthorn, thistles etc.) and perhaps include some educational signage for the public.

19-115-20-16-022 **Approximate Size: 0.30 acres**

General Description

This wetland is an emergent marsh, less than one-foot deep that is dominated by narrow-leaved cattail. A very small portion of the wetland near the stream inlet to the wetland is open water with lesser duckweed. The wetland is located in Chaparral Park. The wetland is good habitat for amphibians and frogs were noted during site visit.

Attainable Use/Restoration Goal

The site has potential for wildlife habitat and is currently good habitat for amphibians. However, there are limited aesthetics due to dominance of cattail. Because the wetland is dominated by narrow-leaved cattail, vegetative restoration potential is minimal. Narrow-leaved cattail covers greater then 90% of the wetland making restoration very difficult.

19-115-20-16-034 **Approximate Size: 0.33 acres**

General Description

This is a shallow, open water wetland that is currently being used for stormwater management. Lesser duckweed dominated most of the site; however, stinging nettle, water smartweed and some other native wetland species are also present on site. A wide buffer is present around the wetland.

Attainable Use/Restoration Goal

The site is currently used as stormwater management. However, some additional attainable uses for this wetland are wildlife habitat and aesthetic value. The wetland and adjacent upland offer a good spatial buffer to the surrounding development. Controlling invasive buckthorn and honeysuckle in the buffer will improve the upland and wetland habitat and make the area more aesthetically pleasing.

7. Priority Apple Valley Lakes

Based on recent guidance from the State of Minnesota (Minnesota Pollution Control Agency 2005), a lake is considered to be a standing water body with a surface area of 10 acres or more. By that definition, there are six lakes that lie wholly or partially within the City of Apple Valley: Lac Lavon, Lake Alimagnet, Long Lake, Farquar Lake, Cobblestone Lake and Keller Lake. (Keller Lake, a BDWMO strategic water resource, is located almost entirely within Burnsville but is still a priority lake for classification and management in this Plan.) Protecting and managing water quality in these six lakes is a primary objective of this plan.

The first section (7.1) of this chapter provides a basic primer on lake ecology and characterization. Section 7.2 presents a summary of key information on the six lakes and their watersheds as well as brief narrative descriptions of each lake system. Finally, Section 7.3 lays out lake classification criteria to guide management of the lakes.

7.1 LAKE MANAGEMENT PRIMER

7.1.1 TYPES OF LAKES

There are two types of lakes that are distinguished for lake management purposes: shallow lakes and deep lakes. This distinction is made on the basis of certain physical characteristics of a lake. Differences in the physical characteristics of lakes effect how lakes respond to seasonal changes and watershed inputs. Therefore management strategies must be based on whether a lake is considered shallow or deep.

7.1.1.1 DEEP LAKES

By definition, a deep lake is a water body with at least 20% of the lake having a depth of 15 feet or greater (Minnesota Pollution Control Agency 2005). Lac Lavon and Cobblestone Lake are classified as deep lakes. Because of their depth, deep lakes exhibit a seasonal phenomenon known as "thermal stratification." Stratification occurs in the summer and winter seasons due to meteorological influences.

During stratification a deep lake becomes separated into three zones. The epilimnion is the top portion of a stratified lake and is enriched with oxygen while the hypolimnion is the bottom portion and is devoid of oxygen (anoxic). A thermocline is an area in the middle portion (metalimnion) of a stratified lake marked by rapid temperature change separating the upper and lower layers. Wind and changing temperatures during the spring and fall cause the stratified deep lakes to "turn-over" whereby the entire lake mixes completely. Thus, deep lakes are often referred to as dimictic, meaning they mix twice a year (spring and fall).

Another important characteristic of deep lakes is that a significant portion of the bottom of the lake is too deep for adequate light to reach it to support rooted aquatic vegetation growth. Figure 7.1 shows how light limitation and depth characteristics can affect rooted plant growth in deep and shallow lakes.

7.1.1.2 Shallow Lakes

Shallow lakes are defined as having a maximum depth of 15 feet or less, or with 80% or more of the lake area shallow enough to support rooted aquatic plants (MPCA 2005). Lake Alimagnet, Long Lake, Farquar Lake and Keller Lake are shallow lakes. Shallow lakes are generally not wetlands, which are defined by specific language and criteria.

Shallow lakes can be strongly affected by wind and wave action. It is not uncommon to see a shallow lake that is intermittently weakly stratified, then mixed periodically during the open water season. Because they can mix many times throughout the open water period, they are referred to as "polymictic". The constant mixing during open water conditions facilitates a high degree of interaction between the water and underlying sediment. This dynamic makes shallow lakes more prone to nutrient enrichment compared to deep lakes of similar surface area and watershed size. During winter, the limited volume of shallow lakes can result in low oxygen condition which can result in fish kills. These low oxygen conditions often have a greater negative impact on gamefish species like bass, northern, and walleye than on roughfish like carp and bullhead because the former require higher levels of oxygen in the water to survive.

In a natural, pristine state, shallow lakes typically have clear water and a rich aquatic vegetation community almost everywhere in the lake that is dominated by rooted aquatic plants (Scheffer 1998). Figure 7.2 shows a picture of a turbid lake in Apple Valley compared with a minimally impacted shallow lake in northeastern Minnesota. Note the abundance of emergent and submergent vegetation even in the relatively pristine system.

Shallow lakes with a low nutrient content usually have vegetation dominated by relatively small rooted aquatic plants. Shallow lakes that receive large stormwater inputs from urban areas (like Long, Farquar, Keller, and Alimagnet) often have significantly higher concentrations of plant nutrients like phosphorus than pristine lakes. In these lakes, the total mass of aquatic plants increases as more nutrients are available to support plant growth. Plants that fill the entire water column or concentrate much of their growth near the lake surface dominate the vegetative community in these lakes. If something is done to eradicate the rooted aquatic plants, algal blooms often result which can lead to a highly turbid conditions in the lake. Ultimately, shading by the algal blooms leads to a collapse of the rooted aquatic vegetation due to light limitation. Invertebrates associated with the vegetation disappear and with these also disappear, the birds and fish that feed on them or on the plants. Once a lake has turned to a turbid condition without rooted aquatic plants, it is difficult to restore it to a clear water vegetated state (Scheffer 1998).

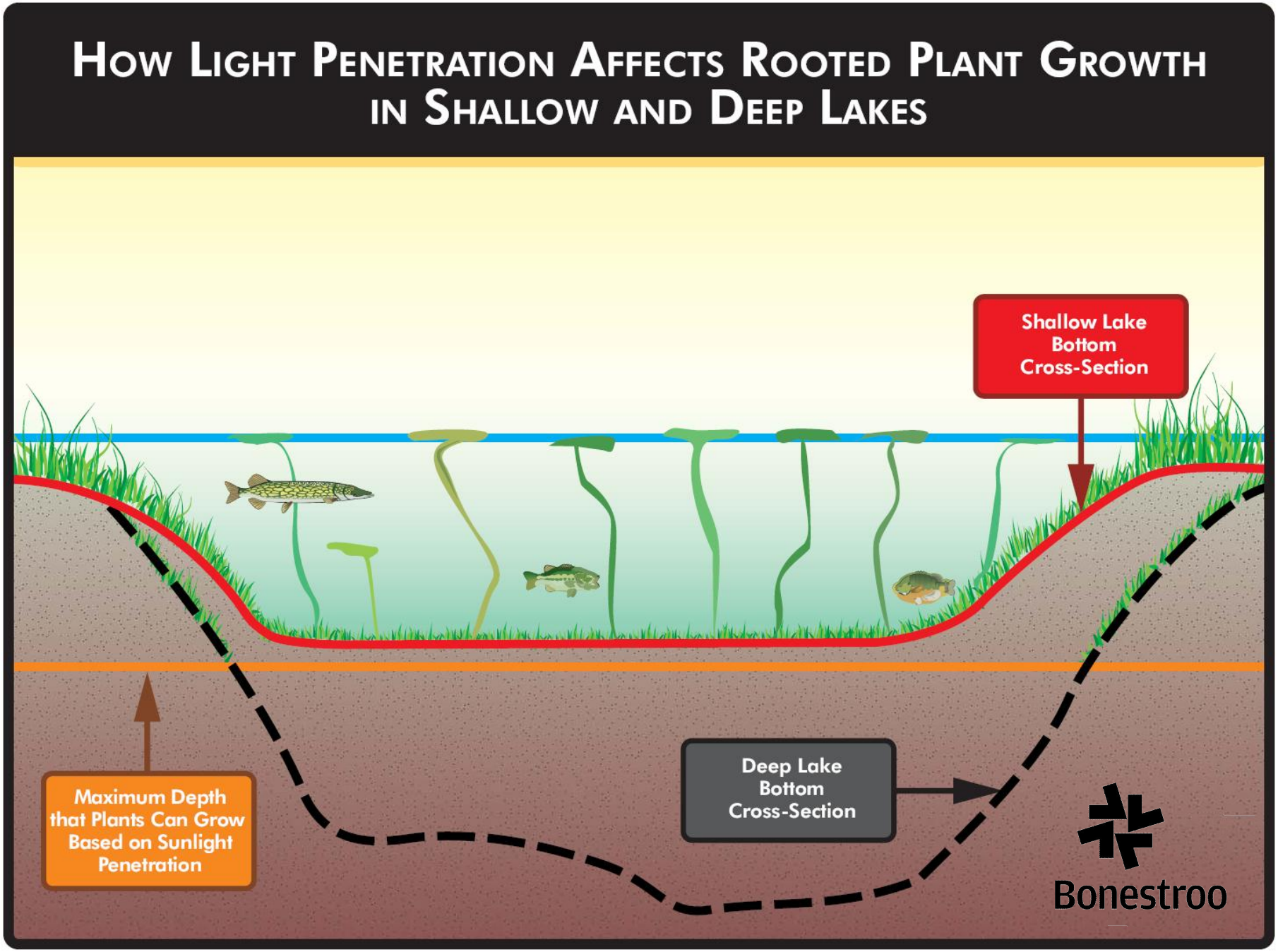


Figure 7.1

City of Apple Valley

Light Limited Compensation Depth in Lakes

SURFACE WATER MANAGEMENT PLAN

minimally impacted shallow lake

turbid shallow lake

COMPARISON OF TURBID SHALLOW LAKE WITH MINIMALLY IMPACTED SHALLOW LAKE

SURFACE WATER MANAGEMENT PLAN FIGURE 7.2

APPLE VALLEY, MINNESOTA

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Bonestroo

In short, there is no such thing as a shallow lake without abundant vegetation (whether algae or rooted aquatic plants or some combination thereof); it is more a question of what types of plants will dominate in the system. A native rooted aquatic plant–dominated system with clear water is generally considered the most desirable condition of shallow lakes because of the diversity and perceived value of the plants and animals it supports. Further, state water quality standards also support achieving this type of condition. Thus, the City intends to restore its shallow lakes to a clear water condition with a diverse emergent and submergent native-dominated plant community.

7.1.2 WATER QUALITY VARIABLES

Water quality data has been collected for numerous years for Lac Lavon, Alimagnet, Keller, Long, and Farquar lakes. The information collected includes data on total phosphorus, dissolved oxygen concentrations, chlorophyll-a, and secchi disk transparency.

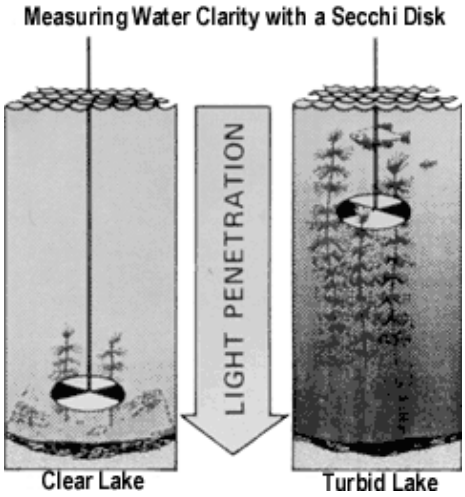
Total Phosphorus (TP) is a measure of all of the different forms of phosphorus in water. TP includes phosphorus dissolved in water, suspended or incorporated in algae or other organisms.

Dissolved Oxygen (DO) is the uncombined molecular oxygen that is in solution in water. Aquatic plants and algae produce DO as a result of photosynthesis while fish, zooplankton, and bacteria consume DO. Generally, DO concentrations provide insight on:

- Habitat suitability for fish and other vertebrate populations;
- Stratification of a lake system; and
- Potential for internal nutrient cycling.

A secchi disk provides a visual estimate of water clarity and the depth of light penetration in a lake. Water clarity is a key physical parameter affecting user perceptions of the suitability of a lake for recreation. As water clarity decreases, human perceptions of the suitability of a lake for recreational use also drop. A secchi disk is a circular disk with alternating white and black quadrants. It is lowered through the water column and the depth at which it disappears from view is recorded as the water clarity.

Figure 7.3



The chlorophyll-a concentration is a measure of algae (phytoplankton) in the water. The amount of algal growth strongly influences the clarity of the water. In general, higher phosphorus concentrations cause more algal growth which decrease water clarity. High chlorophyll-a concentrations indicate a nutrient-rich environment with large amounts of algae in the lake water.

7.1.3 Role of Phosphorus in Lake Quality

Phosphorus is an essential nutrient for plant growth. It is the nutrient most commonly limiting plant and algae growth in lakes in the upper Midwest. This is because, compared with other plant nutrients such as nitrogen, the supply of phosphorus in a lake is generally lowest relative to demand by algae.

If phosphorus concentrations are low, algal growth will be low.
Conversely, high phosphorus concentrations often foster high algal productivity.

Algae obtain almost all of their nutrients from the water column in a dissolved form. A balanced population of algae is an important part of the biological system within a lake. However, too great an abundance of algae adversely affects both the ecology of the lake as well as the suitability of the lake for use by people. Under nutrient enriched conditions (i.e., high phosphorus concentrations in the water column), populations of certain types of algae can explode during the summer growing season, causing what is commonly referred to as a "bloom".

Phosphorus concentration is the most critical factor in the quality of any lake. Controlling and reducing the amount of phosphorus that reaches a lake is essential in managing lake quality. Phosphorus can be delivered to a lake from a watershed in many ways.

Elevated phosphorus loadings from developed areas are in part a consequence of more runoff volume as a result of increased impervious surfaces such as roads, rooftops, and driveways. They are also a consequence of higher concentrations of pollutants in runoff from urbanized areas.

For example, major sources of phosphorus in urban runoff include improperly applied fertilizers containing phosphorus, vegetative material left on hard surfaces, soil and dust particles, and animal waste. Municipal storm drainage systems installed to prevent flooding provide an efficient vehicle for delivery of these pollutants from their places of origin to the receiving water.

7.1.4 Internal Nutrient Cycling

Elevated nutrient loading (phosphorus) to lake systems can greatly affect lake management strategies. As a result of long-term elevated phosphorus loads, a lake can accumulate a large reserve of phosphorus in its sediments. Phosphorus accumulation promotes a perpetual condition of internal nutrient cycling within a lake system.

Internal nutrient cycling can exist in both shallow and deep lakes. The cycling process is triggered by periods of low Dissolved Oxygen (DO) at the sediment/water interface as a result of thermal stratification. Low DO causes the nutrient enriched bottom sediments to release the accumulated phosphorus content into the overlying water. The phosphorus released from the sediments is made available to algae at the lake surface during periods of mixing.

In deep lakes, the mixing can be expected during spring and fall "turn-over" events and occasionally in the summer during strong storms. In shallow lakes, intermittent calm summer conditions promote a temporary lake stratification which is frequently broken by the mixing effect of wind and wave actions.

The mixing transfers sediment-released phosphorus from lower to upper layers of the lake. The re-introduction of phosphorus to the water column from bottom sediments is known as "internal loading." The loading contributes to algae blooms that negatively affect the ecology of the lake as well as the suitability of the lake to support desirable uses such as swimming, fishing, or boating. Eventually the algae die, sink to the bottom of the lake and decompose, ultimately returning the organic material (including phosphorus) back to the sediment and completing the internal nutrient cycle.

Most rooted aquatic plants obtain their nutrients from lake sediments. Nutrient enriched sediments can foster an overabundance of aquatic plants causing nuisance conditions. The proliferation of the aquatic plant curly leaf pondweed can also contribute to internal nutrient loads. This plant grows during early spring before water temperatures are favorable for other aquatic plants. Curly leaf pondweed completes its growing cycle and begins to die off by mid-summer. As with algal blooms, curly leaf pondweed sinks to the lake bottom and decomposes, further contributing to TP reserves and internal release of phosphorus by oxygen depletion during decomposition.

Effective lake management strategies must account for internal nutrient cycling dynamics. In-lake conditions favoring internal phosphorus recycling can sustain poor water quality conditions, even while watershed sources of phosphorus are being mitigated. Even if watershed inputs are brought to near-zero conditions, water quality can remain impacted until the reserves of phosphorus in the sediment are exhausted, a process which could possibly take decades.

7.2 LAKE DESCRIPTIONS

Key information characterizing Apple Valley's six priority lakes and their watersheds is shown below in Table 7.1.

Table 7.1 – Key Information for Priority Apple Valley Lakes

	Lac Lavon	Alimagnet	Long	Farquar	Cobblestone	Keller
DNR ID	19-0446	19-0021	19-0022	19-0023	19-0456	19-0025
Surface Area (Ac)	60[7]	109[1]	34[2]	67[2]	37[2]	55[6]
Volume (Ac-Ft)	880[4]	545[1]	77[3]	290[1]	440[3]	203[6]
Max. Depth (Ft)	32[5]	11[5]	5[3]	10[1]	21[3]	7[5]
Mean Depth (Ft)	13	5	2.3	4.5	12.6	3.7
Watershed^ Area (Ac)	119	985*	963	1,889	3,208	1387[6]
Direct Drainage (Ac)	119	263	50	68	286	551[6]
Indirect Drainage (Ac)	0	722	913	1,821	2,922	836[6]
Watershed: Lake Ratio	2:1	9:1	28:1	28:1	92:1	25:1

^ Watershed area does not include landlocked sub-districts or surface area of water body in the column heading.

** Reflects drainage from Burnsville and Apple Valley as determined in the 2005 Lake Management Plan for Alimagnet Lake, prepared by Blue Water Science and Bonestroo & Associates.*

Data Sources:

1. Metropolitan Council CAMP report
2. Obtained from aerial photo using GIS
3. City of Apple Valley: field collected or grading plan review
4. DNR bathymetric map
5. DNR lake finder
6. UAA, 2003. Barr Engineering Co.
7. Black Dog Watershed Management Organization

A more detailed description of each of these lakes and their watersheds is presented in the following sections.

7.2.1 LAC LAVON

Lac Lavon is a manmade deep lake with a surface area of 67 acres and a maximum depth of 32 feet. Lac Lavon was formed by gravel quarry work that extended into a groundwater source. This lake is within the Lac Lavon District and is situated on the boundary between Apple Valley and Burnsville.

The lake has no active outlet and is therefore considered landlocked. A 12-inch diameter emergency overflow pipe exists; however, it is normally closed by a valve which is not actively used. (Keller Lake would receive any emergency discharges from Lac Lavon in the event of flooding).

Lac Lavon currently has a "carry in" access and a fishing pier, owned by Apple Valley, and located in the northeast portion of the lake. The lake is used for a variety of recreational purposes including swimming and fishing. This is the only assessed lake within the City of Apple Valley that is classified by the MPCA as fully supporting direct contact recreation. Water quality of Lac Lavon is exceptional and consistently ranks among the top lakes in the Metro area for water quality. Lac Lavon is considered a strategic water resource by the Black Dog Watershed Management Organization. Although Lac Lavon carries a DNR water body identification number, it is not considered a DNR Public water. Being groundwater-fed has created conditions of high oxygen and low temperatures within the lake. The areas of high oxygen (over 5.0 ppm) and low temperatures (under 70 degrees Fahrenheit) within Lac Lavon makes it suitable for trout. The lake has been stocked with rainbow trout by the DNR in the past.

Eurasian watermilfoil is present in areas of the lake and may hinder some of the recreation within the lake. One objective of managing the lake has been to control the Eurasian watermilfoil without harming the important native aquatic plant community.

A lake management plan for Lac Lavon was prepared in 2002 (Bluewater Science 2002). A summary of this report is located in Appendix G at the back of this report.

7.2.2 ALIMAGNET LAKE

Alimagnet is a shallow lake with a maximum depth of 11 feet and a surface area of 109 acres. This lake is located on the border between Burnsville and Apple Valley in the northeast part of Dakota County. The entire shoreline is developed as single-family homes with the exception of Alimagnet Park located in the southern end of lake in Apple Valley and Burnsville which is nearly half of the shoreline of the lake. There is a City owned fishing pier located on the south end as well.

Water quality of this lake is poor, with severe algae blooms. The lake has had a history of winterkill events. However, these events no longer occur since the installation of an aerator in 1999/2000 winter season. Alimagnet Lake is identified as an impaired water body due to excess nutrients by the MPCA. The lake has a low diversity of native aquatic plants. Fishing use of this lake is generally low. The most recent fish community survey (MnDNR, 2000) indicated that black bullhead were the dominant species.

Dissolved Oxygen (DO) concentrations were monitored for an entire year in 1990 as part of an intensive study on the lake and its watershed. The collected data showed that Alimagnet Lake will weakly stratify during the summer, exacerbating poor water quality conditions. In the past, winter DO levels were depleted in some years producing a winterkill condition. A winter aeration system was installed in the east arm of Alimagnet Lake in November 1999.

A lake management plan for Alimagnet Lake was completed in 2005 for the Cities of Apple Valley and Burnsville (Bluewater Science, et. al. 2005). A summary of this report is located in Appendix G at the back of this report.

7.2.3 Long Lake

Long Lake is a shallow lake with a maximum depth of five feet, an estimated mean depth less than three feet, and a surface area of 34 acres. (No formal bathymetric survey has been performed for the lake. However, lake depth data was field collected by City staff at 19 points on the lake, thereby allowing an estimate of lake bathymetry). No developed water access exists for the lake but there is a public park located on the west end of the lake.

Water quality conditions for Long Lake are extremely degraded. In fact, the average water clarity for Long Lake in 2004 was one foot, the lowest out of 140 lakes evaluated by the Metropolitan Council. Long Lake is identified as an impaired water body due to excess nutrients by the MPCA.

Not much is known about the characteristics of the lake. The entire lake is a littoral region, dominated by aquatic plants. The exotic invasive curly leaf pondweed appears to be a nuisance to local landowners abutting the lake. The City of Apple Valley initiated the development of a detailed Lake Management Plan for both Long Lake and Farquar Lake in August 2005. Farquar Lake is included in this effort because Long Lake discharges to Farquar Lake, and the watershed of Long Lake comprises over 50% of the watershed to Farquar Lake. Further, it appears that the poor quality of Long Lake is an important factor in the condition of Farquar Lake.

A major factor in the water quality management for Long Lake is the large ratio of watershed area to lake surface area (28:1). The large ratio indicates that Long Lake is vulnerable to stress from watershed inputs. Even with low TP unit loads, the magnitude of the drainage area delivers nutrients at levels beyond the assimilative capacity of the lake. Based on the incoming average annual volume of stormwater runoff, the lake will be flushed, on average, seven times per year. As such, the lake quality will be strongly influenced by the quality of the incoming stormwater as well as in-lake biological processes.

A TMDL is expected to be completed in 2007 for both Long and Farquar Lake (to which Long Lake discharges) as part of a joint effort between the City and the Vermillion River Watershed Joint Powers Organization. As part of this effort, more detailed watershed and lake response modeling will be carried out as will efforts to quantify the lakes' internal load, which appears to be high.

7.2.4 FARQUAR LAKE

Farquar Lake is a shallow 67-acre lake with a maximum depth of 10 feet. There is a City park (Farquar Park) in the southwest corner of the Lake. A fishing pier is present at the park but no public boat access.

Water quality conditions for Farquar Lake have declined substantially since the mid-1990s. An MPCA trend analysis revealed a statistically significant decrease in water clarity over the last ten years. Currently, water quality in the lake is very poor. Farquar Lake is identified as an impaired water body due to excess nutrients by the MPCA.

As with Alimagnet Lake, black bullhead are the dominant fish species. The lake is limited to rough fish due to low dissolved oxygen conditions. This lake has a history of fish kills. The first recorded fish kill was in 1960. MnDNR records indicate that excessive algae may have caused a dissolved oxygen deficit and resulted in the fish kill. In recent years there has been an increasing number of large mouth bass.

Farquar Lake has a total watershed of almost 1,900 acres, about 1,000 acres of which discharge first through Long Lake. Upstream water quality conditions in Long Lake can significantly contribute to Farquar's overall annual TP load. As with the Long Lake watershed, the consistent use of stormwater quality treatment ponds in the Farquar watershed reduces unit phosphorus loads compared to direct (untreated) drainage areas.

The role of Long Lake in affecting water quality in Farquar Lake has critical implications for water quality management. Any actions to improve the Farquar Lake system, whether watershed or in-lake, will not prove successful unless upstream improvements are made in tandem. Thus, development of a lake management plan for Farquar Lake will be carried out simultaneously with that for Long Lake. As mentioned in Section 7.2.3, a TMDL is expected to be completed in 2007 for both Long Lake and Farquar Lake as part of a joint effort between the City and the Vermillion River Watershed Joint Powers Organization.

7.2.5 COBBLESTONE LAKE

Cobblestone Lake is a manmade lake with a surface area of 37 acres and a maximum depth of 21 feet. The lake is a redevelopment of a former mining pit area. Cobblestone Lake is located in East Vermillion River District and is situated at the southeastern portion of the City. While a proposed grading plan developed in 2000 is available for the lake, it appears that the actual grading of the lake deviated somewhat from the grading plan. A bathymetric survey was conducted in 2006 to determine its current depth characteristics, which in turn will help guide management expectations for the lake.

Water levels in Cobblestone Lake are controlled by a lift station which pumps outflow into Lakeville's storm sewer system. However, the pump has never been operated (except for standard maintenance) due to seepage losses to groundwater.

Water quality conditions in Cobblestone Lake were consistently monitored for the first time in 2005 by City staff through the Metropolitan Council's Citizen Assisted Monitoring Program. The results of that monitoring program will be used with subsequent data to assess the nutrient levels in the lake and compare them to nutrient standards for the purpose of setting goals and assessing use classification. A fish survey was conducted by the DNR for Cobblestone Lake in 2005 and noted that bluegill, sunfish, and bullhead

were present. The DNR stocked the lake with adult bluegill and small walleye. A fishing pier owned by the City is located on the lake.

A preliminary watershed assessment done as part of this plan update indicates that almost 25% of the total phosphorus load to Cobblestone Lake could come from the direct drainage area. Because the runoff from the direct drainage area is untreated, high priority should be placed here on implementing treatment to protect Cobblestone. Another technical issue of importance to managing the lake is the volume of stormwater actually reaching the lake. Infiltration of stormwater in the contributing watershed of the Lake will help decrease the pollutant load reaching the lake and could be an important component for achieving and maintaining acceptable in-lake water quality.

Outflow from Farquar Lake comprises over half of the overall volume of surface water runoff flowing into Cobblestone Lake. However, outflow from Farquar is routed through several stormwater treatment ponds before discharging into Cobblestone. The resulting hydraulic loading will reduce efficiencies in these ponds for treating runoff within the Cobblestone drainage area. Development of a Lake Management Plan for the Lake began in 2005 and is expected to be completed in 2007. The Plan will help guide future development near the lake to protect in-lake water quality.

7.2.6 KELLER LAKE

Keller is a shallow lake with a surface area of 55 acres and a maximum depth of 7 feet. This lake is located in the southwestern portion of the city on the border between Burnsville and Apple Valley. Only a small portion of the eastern shoreline resides within Apple Valley, and just over 820 acres or about half of the total drainage area to Keller Lake lies within the City of Apple Valley. The lake also receives emergency discharge from Lac Lavon through a 12-inch diameter pipe. The primary use of the lake is for fishing, canoeing, and wildlife viewing by local residents. The direct drainage is largely residential with park areas on the south side of the lake. The lake has no public beach or developed boat access.

Water quality conditions for Keller Lake have improved slightly since Metropolitan Council's Citizen Assisted Monitoring Program began monitoring the lake in 1996, but conditions remain poor overall within the lake. The MPCA lists Keller Lake as impaired due to excess nutrients. The major reason for this is that the watershed was developed during a time when the cities were allowed to use Keller Lake for stormwater detention and water quality treatment. As a result, runoff from roughly 644 acres drains directly to the lake without first passing through any form of wet detention for water quality treatment. Nearly the entire sub-watershed is developed, over half of which is low density residential.

The lake is entirely classified as littoral and rooted vegetation covers most if not the entire lake bed most years. The lake has a low diversity of native aquatic plants as invasive curlyleaf pondweed dominates this system as well as stringy pondweed, coontail and elodea. Summertime die back of dense plant growth contributes to high internal loading rates as found in the Use Attainability Analysis (UAA) study published by Barr Engineering Company in 2003. See Section 5.7.2 for a summary of suggested strategies to improve Keller Lake's water quality identified in the UAA report.

7.3 LAKE CLASSIFICATION

The following section provides the basis for classification of lakes in Apple Valley to guide water quality management actions. The primary purpose of a water body classification system is to establish a framework

for appropriately categorizing, managing, protecting and utilizing surface water resources. The framework should address and illustrate the intended use of a water body. The desired water quality for a particular water body has much to do with its intended use. This section is focused primarily on the six recreational lakes covered earlier in this chapter.

7.3.1 Ecoregion Reference

When evaluating water quality for lake management, it is valuable to have a reference as to what constitutes typical conditions. Typical conditions for lake (and stream) systems can be characterized based on minimally-impacted reference resources within the ecoregion in which they are located.

Ecoregions, mapped by the U.S. Environmental Protection Agency, are areas of relative uniformity characterized by distinctive regional ecological factors, including land use, soils, topography and potential natural vegetation (MPCA 1997). An ecoregion approach is valuable because it addresses the wide variability in environmental conditions across the state.

There are seven ecoregions defined for Minnesota, however, four of the seven ecoregions contain 98% of Minnesota's lakes. Through extensive monitoring and analysis of lake systems, the MPCA has established typical TP ranges for reference lakes within each ecoregion. Reference lakes are considered "minimally impacted" by human activities. Reference lakes are not the most pristine lakes in a particular ecoregion. Instead they are representative of lakes in the region. In general, as one moves from north to south in the state, phosphorus and chlorophyll-a concentrations rise and water clarity falls for minimally impacted reference lakes.

The boundary between the North Central Hardwood Forest (NCHF) ecoregion and the Western Cornbelt (WCB) ecoregion runs north to south through the center of Apple Valley. Of the six lakes in Apple Valley, Long, Farquar, and Cobblestone Lakes lie in the Western Corn Belt ecoregion, with the remaining lakes lying in the NCHF ecoregion. The table below presents typical summer lake water quality ranges for the NCHF and WCB ecoregions, as developed by the MPCA.

Table 7.2 – Typical Summer Lake Water Quality Ranges

Water Quality Parameter	NCHF Ecoregion Range	WCB Ecoregion Range
Total Phosphorus (µg/L)	23-50	65-150
Chlorophyll-a (µg/L)	5-22	30-80
Secchi Disk Transparency (meters)	1.5-3.2	0.5-1.0

In this manner, water bodies can be classified and managed based on the ecoregion they are within and the typical reference ranges developed for those areas.

In addition to providing typical ranges for lake water quality conditions, the MPCA has proposed eutrophication standards for shallow and deep lakes based on the ecoregion approach. The standards* are intended to illustrate thresholds which indicate a polluted condition. Exceedance of the total phosphorus and either the chlorophyll-a or Secchi disk standard is normally required to indicate a polluted condition. The table below illustrates these proposed standards.

Table 7.3 – Proposed Eutrophication Standards* for NCHF and WCB Ecoregions (June - September Mean Values)

Water Quality Parameter	NCHF		WCB	
	Shallow Lake	Deep Lake	Shallow Lake	Deep Lake
Total Phosphorus (µg/L)	< 60	< 40	< 90	< 65
Chlorophyll-a (µg/L)	< 20	< 14	< 30	< 22
Secchi Disk Transparency (meters)	> 1.0	> 1.4	> 0.7	> 0.9

** Currently these standards are still in draft form but are expected to be finalized in State ruling in 2008.*

7.3.2 Apple Valley Lake Classification System

This section outlines the standards that the City of Apple Valley intends to use to guide management of water quality in its six lakes. An additional classification category is added to encompass all constructed stormwater management basins that are not historical wetlands, such as detention ponds in upland areas. **The remaining water bodies in the City are wetlands which may or may not be incorporated into the City's storm drainage system at the present time. Management guidance for those water bodies is presented in Chapter 6 of this report and includes management standards based on the classification of the individual wetland basin.**

In developing its lake classification system, the City has taken into account the following factors:

- Coordination with existing classification systems. The City of Burnsville as well as the BDWMO both have existing classification systems, addressing Lake Alimagnet, Lac Lavon and Keller Lake. The City of Apple Valley intends to be consistent with these existing classification systems.
- Incorporation of regulatory agency eutrophication standards. The MPCA has proposed guidelines for shallow and deep lakes in the NCHF and WCBP ecoregions which address whether a water body can fully or partially support direct contact recreation.
- Attainable water quality conditions for the specific lake. Improving water quality in severely degraded lake systems is often a very costly proposition. Measurable results in water quality conditions can lag many years behind the implementation of improvements. As such, the intended use of an impaired water body must be realistic and attainable in the foreseeable future. The attainability issue will be addressed during the development of detailed studies and management plans for each lake.
- Depth characteristics of the lake. The USCOE and other regulatory agencies use a maximum depth of 6.6 feet (2 meters) to distinguish open water wetlands from deepwater habitat characteristic of lakes and reservoirs (USCOE 1987). Thus, the maximum depth of a natural water body will be taken into account when determining the uses for which it will be managed.

The Apple Valley classification system contains four categories as defined below:

- Class I – These water bodies are intended to fully or partially support direct (full-body) contact recreation activities including swimming and snorkeling. Their current or historical quality indicates that they can sustain water quality over the long-term suitable for supporting intended uses with a reasonable level of management effort. Where in-lake quality is better than the numerical classification standards, water bodies in this classification will be managed for nondegradation of water quality, with allowance for natural variability.
- Class II – These water bodies are intended to support indirect contact recreation activities that involve incidental contact with lake water. Examples include fishing, canoeing, and perhaps limited use of motor-driven water-craft. They also have depth characteristics (maximum depth > 6.6 feet and mean depth > 3 feet) that allow these uses for the vast majority of the summertime recreation season in almost all years.
- Class III – These water bodies are intended for passive recreation, primarily aesthetic wildlife activities. The water bodies will have the potential for diverse wildlife habitat and/or wetland vegetation communities. They are accessible to the public for educational, interpretive or scenic benefits. They generally will have depth characteristics (maximum depth < 6.6 feet and mean < 3 feet) that severely limit opportunities for sustained high quality warm-water fishing, use of motor-driven water craft, etc.
- Class IV – These water bodies are constructed in upland areas specifically to manage stormwater. Their most important use is the management of stormwater to reduce pollutant loading and runoff volumes to downstream areas as well as to provide flood protection. Secondary benefits may include aesthetic enjoyment.

Numerical in-lake water quality standards associated with each category are outlined in Table 7.4 for lakes in the City. Values in parenthesis in Table 7.4 pertain to the three eastern lakes located in the Western Cornbelt Plains ecoregion. The classification assigned to specific water bodies in the City under this classification system are shown in Table 7.5. These standards are intended to meet or exceed those set by the watershed organizations as stated in their respective watershed plans.

Table 7.4 – Numerical In-Lake Standards by Use Classification[1]

Intended Use	Class	Average June-September Values		
		Total P (ug/l)	Chlorophyll-a (ug/l)	Clarity (m)
Direct Contact Recreation	I	< 40 (65)	< 14 (22)	> 1.4 (0.9)
Indirect Contact Recreation	II	< 60 (90)	< 20 (30)	> 1 (0.7)
Aesthetic/Wildlife	III	< 60 (90)	< 20 (30)	> 1 (0.7)
Stormwater Basin	IV	No standard	No standard	No standard

[1] *Numbers in parenthesis could be applied to the Western Corn Belt Plains ecoregion (WCBP)*

Table 7.5 – Classification of Priority Apple Valley Lakes

Priority Water Body	Class	Type of System	Comments
Lac Lavon^	I	Deep	BDWMO strategic water resource; 2.8-3.6 meter water clarity goal as stated in the 2002 Lake Management Plan.
Lake Alimagnet^	II	Shallow	City is executing recommendations of 2005 Lake Management Plan to achieve a 1.2 meters clarity goal.
Long Lake*	III	Shallow	City is developing a TMDL for this water body and may re-evaluate the classification based on recommendations and outcomes of the TMDL.
Farquar Lake*	II	Shallow	Same comment as above.
Cobblestone Lake*	II	Shallow	A Lake Management Plan, started in 2006, may recommend a re-classification of this water body based on findings from the lake management planning effort.
Keller Lake^	II	Shallow	Tributary to BDWMO strategic resource (Crystal Lake). In cooperation with the BDWMO, additional efforts to achieve water quality better than the City's Class II standards may be necessary to meet agreed upon in-lake water quality goals for Crystal Lake. 1.8 meters clarity goal for Keller Lake (BDWMO Crystal and Keller Lakes Use Attainability Analysis 2003).

** Lakes located in the Western Corn Belt Plains ecoregion (WCBP)*
^ Lake Management Plans have been developed that set clarity goals higher then the MPCA regulated eutrophication standards

8. National Pollutant Discharge Elimination System (NPDES) and Total Maximum Daily Loads (TMDLs)

The foundation for many of the water quality-related goals and policies in this SWMP is grounded in federal and state laws and regulations. In the past few years, several programs have been established that are changing the ways in which local governments are required to manage surface water resources. The programs are based on the federal Clean Water Act, the requirements of which the U.S. Environmental Protection Agency (USEPA) is responsible to implement. The USEPA delegates much of this responsibility to the MPCA, however, which then applies the regulations to Local Government Units. The City of Apple Valley intends to meet or exceed the requirements of these programs.

Following is an overview of the Federal and State regulatory programs that are important drivers behind the City's stormwater management effort.

8.1 NPDES PROGRAM

In 2003, The Minnesota Pollution Control Agency (MPCA) required Apple Valley to submit a National Pollutant Discharge Elimination System (NPDES) Permit to authorize stormwater discharge from a Municipal Separate Storm Sewer System (MS4). The Permit required the City to submit a standard Permit Application and develop a Storm Water Pollution Prevention Program (SWPPP).

The SWPPP identifies appropriate Best Management Practices (BMPs) and corresponding measurable goals and timelines to comply with the NPDES Maximum Extent Practical (MEP) standard.

8.1.1 NPDES PERMIT SUBMITTAL PROCESS

Stormwater Pollution Prevention Program Development

The City followed a detailed eight-step process developed by the League of Minnesota Cities (LMC) to meet the MEP standard. The process identified the appropriate BMPs, measurable goals, and timelines needed to meet the NPDES standard of maximum extent practical.

- Step 1: Self-Assessment
- Step 2: Develop a list of existing BMPs
- Step 3: Review existing ordinances
- Step 4: Select appropriate BMPs
- Step 5: Assemble the SWPPP
- Step 6: Determine appropriate Measurable Goals
- Step 7: Fill in the gaps
- Step 8: Finalize the Permit Application & SWPPP

8.1.2 NPDES Annual Reports

The NPDES Permit requires the City to provide a summary of the BMPs identified in the SWPPP and submit an Annual Report for the life of the five-year permit term. The MPCA publishes a standard annual report form and requires subsequent information to meet these standards. Each annual report must summarize:

- The status of compliance with permit conditions, including an assessment of the appropriateness of the identified BMPs and progress towards achieving the identified measurable goals for each minimum control measure. The assessment must be based on the results of information collected and analyzed, including monitoring (if any), inspection findings, and public input received during the reporting period;
- The stormwater activities planned during the next reporting cycle;
- A change in any identified BMPs or measurable goals for any of the minimum control measures; and
- Notice that the City is relying on another entity to satisfy some of the permit obligations (if applicable).

The goals and policies are listed in Chapter 3.

8.2 NPDES PHASE II MS4 PROGRAM

The SWPPP identifies BMPs associated with six minimum control measure categories. These categories are summarized below and specific goals and policies discussed in Chapter 3 are listed in their corresponding minimum control measure. These policies will help guide implementation of the BMPs listed in the City's SWPPP.

8.2.1 Public Education and Outreach

An informed and knowledgeable community is crucial to the success of any stormwater management program. In general, stormwater education programs tend to:

- Gain public support for program initiatives which may require funding or regulatory actions by increasing awareness and understanding of the importance of stormwater runoff control and the impacts of nonpoint source runoff into local receiving waters;
- Increase awareness of the different types of BMPs or individual actions to minimize the impact of runoff from their property to the storm sewer system; and
- Greater compliance with existing or future policies and/or ordinances. Specific goals and policies listed in the SWMP which relate to the general goals listed above include the following:
    - Policy 2.2 – Comply with watershed organization, Metropolitan Council, and state and federal requirements for stormwater management.
    - Policy 3.1 – Promote compliance with zero-phosphorus content fertilizer legislation.
    - Policy 3.5 – Increase awareness that dumping of wastes into the storm drainage system is prohibited.
    - Policy 3.7 – Inform ISTS owners of system inspection requirements.
    - Policy 6.4 – Carry out public education.

8.2.2 Public Participation and Involvement

An active and involved community is crucial to the success of a stormwater management program because it allows for:

- Broader public support since citizens who participate in the development and decision-making process are partially responsible for the program. Therefore, they are less likely to raise legal challenges to the program and more likely to take an active role in its implementation;
- Shorter implementation schedules due to fewer obstacles in the form of public and legal challenges and increased sources in the form of citizen volunteers;
- A broader base of expertise and economic benefits since the community can be a valuable and free intellectual resource; and
- Conduits to other programs as citizens involved in the stormwater program development process provide important cross-connections and relationships with other community and government programs.

Specific goals and policies listed in the SWMP which relate to the general goals listed above include the following:

- Policy 2.2 – Comply with watershed organization, Metropolitan Council, and state and federal requirements for stormwater management.
- Policy 3.3 – Manage priority lakes according to individual lake management plans.
- Policy 6.1 – Hold at least one public meeting each year to discuss water quality and wetlands issues.
- Policy 6.2 – Provide regular orientation to the City Council and advisory commissions on stormwater management and wetland protection.
- Policy 6.4 – Carry out public education.

8.2.3 Illicit Discharge Detection and Elimination

Federal regulations define an illicit discharge as:

> *"...any discharge to a MS4 that is not composed entirely of stormwater..."*

This definition applies with some exceptions. These exceptions include discharges from NPDES/SDS-permitted industrial sources and firefighting activities. Illicit discharges are considered "illicit" because storm sewer systems are not designed to accept, process, or discharge such non-stormwater wastes. It is important to note that illicit does not mean illegal, although sometimes they are illegal.

Illicit discharges enter the system through either direct connections (i.e., wastewater piping either mistakenly or deliberately connected to the storm drains) or indirect connections (i.e., infiltration into the MS4 from cracked sanitary systems, spills collected by drain outlets, or paint or used oil dumped directly into a drain).

The result is untreated discharges that contribute high levels of pollutants including heavy metals, toxics, oil and grease, solvents, nutrients, viruses, and bacteria to receiving water bodies. Pollutant levels from these illicit discharges have been shown in USEPA studies to be high enough to significantly degrade receiving water quality and threaten aquatic, wildlife and human health.

Specific goals and policies listed in the SWMP which relate to the general goals listed above include the following:

- Policy 2.2 – Comply with watershed organization, Metropolitan Council, and state and federal requirements for stormwater management.
- Policy 2.7 – Increase awareness that dumping of wastes into the storm drainage system is illegal.
- Policy 3.1 – Promote compliance with zero-phosphorus content fertilizer legislation.
- Policy 3.2 – Tailor ice/snow control to balance public safety and impact on water resources.
- Policy 3.3 – Remove street sweeping through regular sweeping.
- Policy 3.6 – Maintain a spill response capability.
- Policy 3.7 – Require inspections every three years.
- Policy 6.4 – Carry out public education.

8.2.4 Construction Site Runoff Control

Polluted stormwater runoff from construction sites often flows to the City's storm sewer system and ultimately is discharged into local rivers and streams. Sediment is usually the main pollutant of concern. According to USEPA, sediment runoff rates from construction sites are typically 1 to 10 times greater than those of agricultural lands, and 1,000 to 2,000 times greater than those of forest lands.

During a short period, construction sites can contribute more sediment to streams than can be deposited naturally over several decades. The resulting siltation and the contribution of other pollutants from construction sites can cause physical, chemical, and biological harm to our nation's waters. For example, excess sediment can quickly fill rivers and lakes, requiring dredging, destroying aquatic habitats.

Specific goals and policies listed in the SWMP which relate to the general goals listed above include the following:

- Policy 2.2 – Comply with watershed organization, Metropolitan Council, and state and federal requirements for stormwater management.
- Policy 5.6 – Control erosion at construction sites.
- Policy 6.2 – Educate all City staff to set a good example in the community for water quality and wetland protection.
- Policy 6.4 – Carry out public education.

8.2.5 Post Construction Runoff Control

Post-construction stormwater management in areas undergoing new development or redevelopment is necessary because runoff from these areas has been shown to significantly affect receiving water bodies. According to EPA, many studies indicate that prior planning and design for the minimization of pollutants in post-construction stormwater discharges is the most cost-effective approach to stormwater quality management.

There are generally two forms of substantial impacts of post-construction runoff. The first is caused by an increase in the type and quantity of pollutants in stormwater runoff. As runoff flows over areas altered by development, it picks up harmful sediment and chemicals such as oil and grease, pesticides, heavy metals, and nutrients (i.e., nitrogen and phosphorus). These pollutants often become suspended in runoff and are carried to receiving waters such as lakes, ponds and streams. Once deposited, these pollutants can enter the food chain through small aquatic life, eventually entering the tissues of fish and humans.

The second kind of post-construction runoff impact occurs by increasing the quantity of water delivered to the water body during storms. Increased impervious surfaces interrupt the natural cycle of gradual percolation of water through vegetation and soil. Instead, water is collected from surfaces such as asphalt and concrete, and routed to drainage systems where large volumes of runoff quickly flow to the nearest receiving water. The effects of this process include stream bank scouring and downstream flooding. This often leads to a loss of aquatic life and damage to property. Specific goals and policies listed in the SWMP which relate to the general goals listed above include the following:

- Policy 1.1 – Establish High Water Levels and freeboard requirements governing building elevations adjacent to ponding areas and floodplains.
- Policy 1.2 – Identify where in the existing developed portions of the City adopted freeboard requirements may not be met.
- Policy 1.3 – Apply peak discharge control requirements as per watershed standards.
- Policy 2.2 – Comply with watershed organization, Metropolitan Council, and state and federal requirements for stormwater management.
- Policy 3.1 – Promote compliance with zero-phosphorus content fertilizer legislation.
- Policy 3.3 – Remove street debris through regular sweeping.
- Policy 3.4 – Inspect and maintain the stormwater drainage to preserve the effectiveness of treatment features.
- Policy 4.2 – The City will act as the local government unit for protection of wetlands.
- Policy 5.1 – Require compliance with all post-development stormwater quality criteria for new and redevelopment activity adopted by the watershed organizations.
- Policy 5.2 – At a minimum, require no net increase in average annual TSS, TP, and runoff volume compared to the existing condition for new and redevelopment activities creating more than 0.2 acres of new impervious.
- Policy 5.3 – Require additional treatment as necessary to protect downstream water bodies.
- Policy 5.4 – Use accepted technical documents to guide the application and design of BMPs to meet standards.

8.2.6 Pollution Prevention/Good Housekeeping

This measure requires the MS4 to examine and subsequently alter their own actions to help ensure a reduction in the amount and type of pollution that (1) collects on streets, parking lots, open spaces, and storage and vehicle maintenance areas and is discharged to local waterways; and (2) results from actions such as environmentally damaging land development and flood management practices or poor maintenance of storm sewer systems.

While the goal of this measure is to improve and/or protect the quality of receiving waters by altering the performance of MS4 operations, it can also result in cost savings for the MS4 since proper and timely maintenance of storm sewer systems can help avoid repair costs from damage caused by age and neglect.

Specific goals and policies listed in the SWMP which relate to the general goals listed above include the following:

- Policy 2.2 – Comply with watershed organization, Metropolitan Council, and state and federal requirements for stormwater management.
- Policy 2.4 – Reduce the use of sand in street de-icing procedures.
- Policy 2.5 – Street sweeping to protect water quality will, at a minimum, be carried out in the spring and fall.
- Policy 2.6 – Implement a storm system maintenance program based on objective standards.
- Policy 2.8 – The City will have spill response capability.
- Policy 3.1 – Promote compliance with zero-phosphorus content fertilizer legislation.
- Policy 3.3 – Remove street debris through regular sweeping.
- Policy 3.3 – Comply with the NPDES Phase II program administered by the MPCA.
- Policy 3.5 – Increase awareness that dumping of wastes into the storm drainage system is prohibited.
- Policy 3.6 – Maintain a spill response capability.
- Policy 3.7 – Require inspections of ISTSs every three years.

8.3 NONDEGRADATION

Minnesota nondegradation rules (MN Rules Ch. 7050.0185) specify conditions for discharges to surface waters that have occurred since 1988. They support state policy to protect Minnesota waters from significant degradation and to maintain uses, habitats, and water quality in these waters.

As part of the revised NPDES permit program in 2005, the MPCA required the City of Apple Valley and 29 other MS4s (municipalities) to complete additional work that will enable the state agency to determine if nondegradation rules were being met. The additional work includes conducting a loading assessment, writing a nondegradation plan, and modifying the City's SWPPP to include both the assessment and the plan. Apple Valley must complete all of this work by November 1, 2007. MPCA selected 30 MS4s most likely to have expanded stormwater discharges to surface waters and based its selections on population changes since 1990, current population, and projected population growth to 2020.

The loading assessment will focus on significant discharges of total phosphorus, total suspended solids, and runoff volume. To meet requirements, the City will compare three time periods: 1) baseline (1988) conditions, 2) 2005 conditions, and 3) ultimate development or projected 2020 conditions, whichever comes first. The City will use best available data that best match these milestone years. The PondNet watershed model can be the primary tool to estimate significant discharges for each of the three time periods. PondNet can estimate significant discharges of total phosphorus and runoff volume, but not total suspended solids. With modifications, PondNet could estimate significant discharges of total suspended solids, however, in most cases, if nondegradation criteria were met for total phosphorus, they would also be met for total suspended solids as well.

In the nondegradation plan, the City will provide calculated values that illustrate the degree to which current strategies and practices have and future applications will achieve nondegradation conditions. It may be necessary, following the adoption of the nondegradation plan, for the City to update this Plan prior to 2017.

8.4 TOTAL MAXIMUM DAILY LOADS (TMDLS) AND IMPAIRED WATERS

Several waters within the City as well as the Vermillion River, whose watershed includes about 75% of the City, are listed on the state impaired waters list. Known as the 303(d) list from the applicable section of the federal Clean Water Act, these waters are ones that do not currently meet their designated use due to the impact of a particular pollutant or stressor. If monitoring and assessment indicate that a waterbody is impaired by one or more pollutants, it is placed on the list. Development and implementation of a strategy is then required to attain the applicable water quality standard. The process of developing this strategy is commonly known as the Total Maximum Daily Load (TMDL) process and involves the following phases:

- Assessment and listing.
- TMDL study.
- Implementation plan development and implementation.
- Monitoring of the effectiveness of implementation efforts.

Responsibility for implementing the requirements of the federal Clean Water Act falls to the U.S. Environmental Protection Agency. In Minnesota, the EPA delegates much of the program responsibility to the MPCA. Information on the MPCA program can be obtained at the following web address: http://www.pca.state.mn.us/water/tmdl/index.html.

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

> *The Clean Water Act requires states to publish, every two years, an updated list of streams and lakes that are not meeting their designated uses because of excess pollutants. The list, known as the 303(d) list, is based on violations of water quality standards and is organized by river basin. Environmental organizations and citizen groups have sued the EPA because states have not made adequate progress to meet Section 303(d) requirements. The EPA has been sued for various reasons. Over the past 10 years, lawsuits have been filed in 42 states and the District of Columbia. Of those, 22 have been successful. There is currently no such lawsuit in Minnesota. However, beyond the federal requirements, there are many reasons for us to move forward with the development of TMDLs. Foremost is the need to clean up our rivers, streams and lakes to maximize their contributions to the state's economy and quality of life and to protect them as a resource for future generations.*
>
> *For each pollutant that causes a water body to fail to meet state water quality standards, the federal Clean Water Act requires the MPCA to conduct a TMDL study. A TMDL study identifies both point and nonpoint sources of each pollutant that fails to meet water quality standards. Water quality sampling and computer modeling determine how much each pollutant source must reduce its contribution to assure the water quality standard is met. Rivers and streams may have several TMDLs, each one determining the limit for a different pollutant.*

Table 8.1 lists the 303(d) impaired waters within the City of Apple Valley as well as impaired waters in other communities that could affect the City. Figure 8.1 shows the location of impaired waters in the City and provides information on the nature of their impairments.

Table 8.1 – 303(d) List of Impaired Waters within the City of Apple Valley

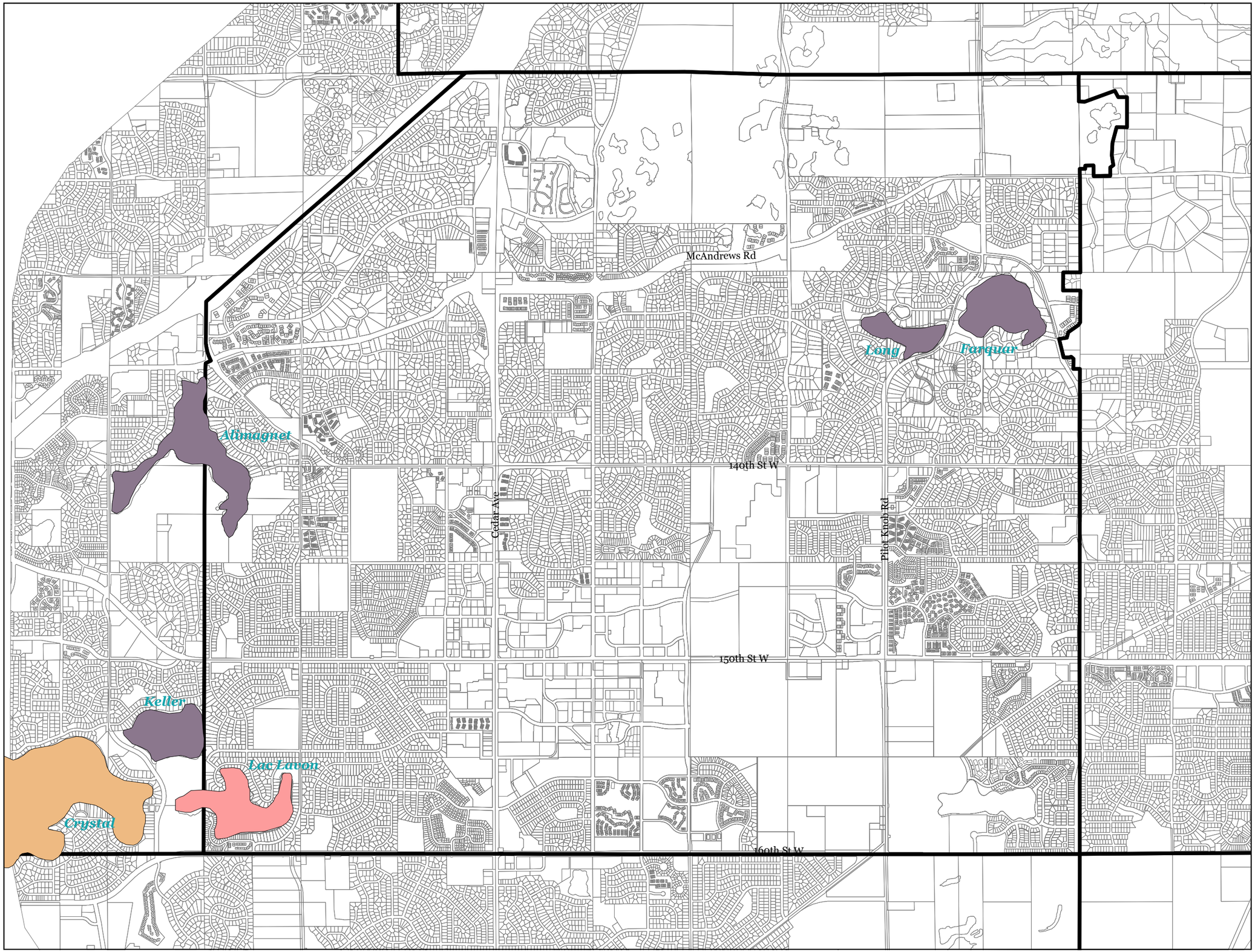
Water Body	City Ponding Designation	Year First Listed	Assessment Unit ID #	Affected Use	Pollutant or Stressor	TMDL start/ TMDL complete
Alimagnet	AL	02	19-0021-00	Aquatic Recreation	Excess Nutrients	2005/2009
Lac Lavon	LL	98	19-0446-00	Aquatic Consumption	Mercury, FCA	1999/2011
Long	EVR	02	19-0022-00	Aquatic Recreation	Excess Nutrients	2007/2011
Farquar	EVR	02	19-0023-00	Aquatic Recreation	Excess Nutrients	2007/2011
Keller	KL	02	19-0025-00	Aquatic Recreation	Excess Nutrients	2004/2008
Crystal[1]	KL	02	19-0027-00	Aquatic Recreation	Excess Nutrients	2006/2011
Crystal[1]	KL	98	19-0027-00	Aquatic Consumption	Mercury, FCA	1999/2011
Vermillion River[2]	WVR & EVR	98	07040001-504	Aquatic Consumption	Mercury, FCA	1999/2011
Vermillion River[2]	WVR & EVR	02	07040001-504	Aquatic Consumption	PCB, FCA	2002/2015
Vermillion River[2]	WVR & EVR	94	07040001-504	Aquatic Life	Turbidity	2003/2007

[1] Crystal Lake, located in Burnsville, receives discharge from Keller Lake.
[2] This reach of the Vermillion River begins about 5 miles south of the Apple Valley/Lakeville border in Farmington.
Notes: FCA stands for Fish Consumption Advisory and is thus not an independent pollutant or stressor.
Source: MPCA

The absence of a waterbody from the 303(d) list does not necessarily mean the waterbody is meeting its designated uses. It may be that it has either not been sampled or there is not enough data to make an impairment determination. Additionally, where mercury is identified as a stressor, the TMDL approach will be regional in nature as mercury is most commonly an air-borne pollutant.

Generally, the City will take the lead to complete and implement TMDLs for impaired waters due to excess nutrients where the watersheds are located wholly within the City boundaries. For impaired waters in the City whose watersheds extend into adjacent communities, the City may request the appropriate watershed management authority either to take the lead (with the City participating as needed) or to co-facilitate the completion and implementation of the TMDL. For TMDLs that have regional implications (e.g., the Vermillion River or mercury-related impairments), the City will cooperate with lead agencies. The City of Burnsville has expressed interest in partnering with Apple Valley and associated WMOs on efforts to initiate TMDL studies for Lake Alimagnet and Keller Lake. The City of Apple Valley strongly supports this collaborative approach and will cooperate in initiating these projects.

As a result of any approved TMDL plans, it may be necessary for the City to make updates to this Plan prior to 2017.



Apple Valley

City of Apple Valley

IMPAIRED WATERS[1]

Surface Water Management Plan

FIGURE 8.1

Legend

Impairment

- Excess Nutrients
- Excess Nutrients & Mercury
- Mercury
- City Boundary

[1] From Draft 2006 Impaired Waters List - MnPCA

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9. Education

9.1 GENERAL

Education will serve an important role in enabling Apple Valley to successfully implement the water quality and wetland management programs outlined in this plan. The City of Apple Valley has been engaging in various stormwater education efforts for many years. These efforts are specifically detailed in the City's NPDES Phase II MS4 SWPPP.

In contrast to the SWPPP document, this section is intended to give a broader overview of education, providing guidance on approaches and illustrating the impact of education on stormwater management and municipal operations. The City must resubmit an MS4 permit every five years whereas the lifespan of this plan is roughly ten years. This distinction is important because education programs (as written into a SWPPP) evolve over time. Issues can change and new opportunities and resources may become available.

Target audiences are the individuals or groups to whom education is being directed.
The content and delivery of educational messages must be tailored to each audience.

For developing any educational program, it is critical to begin by defining the target audience. Target audiences are the individuals or groups to whom education is being directed. The target audience is those who either can take positive action, or support positive action being taken. The content and delivery of educational messages must be tailored to each audience. In general, the target audience for the material presented in this section includes City staff, City residents, and the development community.

An effective educational program must also incorporate goals. Achieving educational goals that result in behavioral change is the ultimate measure of a program's success. The goals of a stormwater educational program should focus on increasing people's awareness and understanding of stormwater. Awareness means knowing that an issue or concern exists. Understanding means having sufficient comprehension of a subject, issue, or concern to be able to explain it to others.

The following sections identify the target audiences for this plan and describe why educating these groups is important. Educational methods for each group are identified. The identified methods are either currently used by Apple Valley or are methods the City is considering.

9.2 CITY STAFF

This SWMP incorporates a diverse range of issues. As such, the implementation of this plan will impact numerous departments and personnel with the City. Municipal staff involved with the implementation of the SWMP will have a wide range of tasks and responsibilities, including:

- Implementing street sweeping and spill response programs;
- Maintaining detention basin/stormwater management pond performance and system operability;
- Planning for and management of projects to enhance pollutant removal performance, wetland quality, etc.;
- Administration of regulatory programs such as the Wetland Conservation Act as well as the wetland buffer program;
- Application of Best Management Practice policies and regulations to new and redevelopment projects;
- Planning and delivering education programs;
- Working out cooperative arrangements with regulatory and non-regulatory jurisdictions outside the City to achieve plan objectives; and
- Assisting the City Council in the application of the plan policies to issues in review by the Council.

These responsibilities will involve many different levels of City staff. Staff members should acquire a basic understanding of the SWMP to effectively carry out their tasks and fulfill their responsibilities. Information that should be a part of any such overview includes:

- A description of the priority water resources and why they are significant;
- The objectives of the plan and the general approach outlined in the plan for resource protection;
- The responsibilities of the different work units (departments) in implementing the plan;
- How staff can access the information provided in the plan; and
- Identification of the in-house key contacts and experts.

Methods to educate this target audience (City staff) include presentations at staff meetings, coverage in internal newsletters, and/or issuance of internal memos.

9.3 CITY RESIDENTS

City residents are a vital group to reach for the successful implementation of this SWMP. In large part, the residents are the group most affected by the resources managed under this plan. It will be essential to educate, and involve, City residents in order to obtain the necessary political and economic support for effective SWMP implementation. In particular this support relates to the adoption of capital improvements as well as sustaining ongoing or new operations and maintenance activities.

Initial education efforts should focus on increasing awareness and understanding of stormwater impacts and the City's approach to managing surface water. Residents of Apple Valley should be aware of the SWMP policies in order to understand the City's intentions for surface water management. Educational materials should explain the causes of water quality degradation and ways the SWMP addresses these problems.

Public expectations and perceptions for water body use and quality may differ from the classification system and management criteria in the SWMP due to the limited understanding of water body dynamics by the general public.

Initial education efforts should emphasize the water body and wetland classification system and management criteria developed in this plan. Public expectations and perceptions for water body use and quality may differ from the classification system and management criteria in the SWMP. This conflict is often due to the public's limited understanding of water body dynamics. Therefore managing resident's expectations for the quality of a given water body will be important in maintaining public support for the plan.

This initial information can be presented to the public during the public meeting process, the City newsletter, and press releases to local papers. The City's website is also a valuable tool to provide public access to educational material.

Periodic updates on water quality trends in the City, the progress of plan implementation, and information on specific improvement projects should also be provided to the public. Again, the City newsletter and press releases to local papers are good methods by which this information may be disseminated. In addition, municipal staff is encouraged to take advantage of invitations to speak at gatherings of local service clubs and church groups. These clubs and groups also often seek public service opportunities and City staff will enlist the services of service group volunteers to carry out education activities.

Finally, special efforts will be made to coordinate education and environmental awareness programs with the school district. These programs will focus on K–12 science curricula as well as adult community education. These groups are constantly in need of speakers and would probably welcome requests from the City to provide information on water quality and wetlands in Apple Valley.

Specific education programs that Apple Valley currently implements are detailed in the City's MS4 SWPPP. These include:

- Distribution of a quarterly newsletter;
- Catch basin stenciling and door hanger distribution;
- Distribution of stormwater brochures in bill invoices or at City Hall;
- "Apple Valley Today" television broadcast;
- Use of a stormwater informational booth at public events;
- Participation in volunteer monitoring programs including the Metropolitan Council's CAMP and Dakota County's WHEP; and
- Phosphorus animation on City website.

Other educational programs have been used successfully in the metro area to support surface water management initiatives. Relevant examples of such programs that may be employed in the City of Apple Valley include the following:

Lawn Soil Testing

This activity involves the collection and analysis of soil samples from residential lawns and public spaces throughout the City to determine whether additional phosphorus in fertilizer is needed for good turf growth. The results would be helpful in characterizing the benefit of no-phosphorus fertilizer use that is promoted in the City.

Promote awareness of no-phosphorus fertilizer sales

If soil test results generated elsewhere in the Twin Cities are any indication, it is likely that a significant percentage of lawn soils tested in Apple Valley will indicate that no additional phosphorus is necessary to achieve good turf growth.

Studies in Wisconsin and the Twin Cities have been implemented to evaluate the impact of fertilizer use. These studies have quantified the benefit to surface water quality by not using phosphorus-based fertilizers. Phosphorus loads in areas where fertilizer use is controlled appear to be almost 50% below the areas where there is no control.

The City may wish to work with lawn and garden retailers and/or volunteer groups to promote awareness of regulations concerning zero-phosphorus fertilizers. This kind of project has been a good fund raising activity for volunteer groups elsewhere in the Metro area. The City's quarterly newsletter and website can be effective vehicles for implementing a campaign to promote awareness. The University of Minnesota Extension Service, the Minnesota Office of Environmental Assistance and other agencies have educational materials that can easily be incorporated by the City of Apple Valley.

Performance of water quality plays in local grade schools

An original 35-minute play for grade school children (K-2) entitled "Toadilly Turtle" is performed for a fee by the CLIMB Theater based in Inver Grove Heights. The topic of the play is protecting/preserving lakes and wetlands. It has been performed hundreds of times throughout the state and has been well received. The play teaches the importance of having healthy lakes and wetlands, and explains how lakes and wetlands become contaminated. One of the play's main premises is that children can be very influential in prompting their parents to set up practices that won't degrade lakes and wetlands and to begin more environmentally sound practices.

Lake Information Kiosks

Those who enjoy and use a resource are likely to be highly receptive to information on the condition of the resource and what is needed to protect it. Through the construction of lake information kiosks in strategic places, important water quality and other information would be presented at the "point of use/enjoyment." The size and extent of the watersheds within Apple Valley that drain to the particular resource, what residents can do to reduce their contributions to the pollution load, could be combined with information about the lake itself as well as about fishing, boating, and other recreational opportunities on the lake.

Facilitating/Promoting Workshops

Workshops can be an effective way to reach a broad group of people in a hands-on (i.e., verbal/visual) manner. Workshops can involve a fee and Apple Valley may choose to partner with the WMO's to help defray the cost. An example of a relevant workshop is the Minnesota DNR's Project WET (Water Education for Teachers). Workshops hosted by Project WET give educators materials such as activity guides and supplemental teaching resources as well as direct training. Other workshops such as environmentally friendly yard care may be available from other institutions as resources allow.

9.4 DEVELOPMENT COMMUNITY

The development community is a target audience for stormwater education. Although Apple Valley is nearly fully developed and new construction is not a major influence across the community, this target audience still needs to be reached. Even relatively small localized construction and reconstruction activities can have a substantial impact on runoff quality and downstream water bodies. Making developers and their consulting engineers aware of the Plan requirements for new construction and reconstruction activities will be an important component of the education program.

In addition to a basic understanding of the overall plan policies, the development community will need a good understanding of the reasons behind those policies. Specifically, developers and consultants must understand the impact of development on water quality and value of appropriate Best Management Practices, both during construction and post-construction. It is also necessary to ensure that developers and consultants understand the economic and social value of maintaining high water quality.

Much of the necessary information can be disseminated to the developers in an information packet during the preliminary plat stage. The information packet could contain, among other things, the pertinent policies and mitigation requirements impacting development, basic information on the Erosion Control and Best Management Practices required by the City, and stormwater control-related requirements for new and redevelopment projects and guidance for meeting those requirements.

10. System Improvement and Financing Program

This chapter summarizes the high priority improvements identified previously in this plan and presents a preliminary estimate of project costs based on the best available information. It is important to note that where the costs presented are not based on a previous detailed report (such as a feasibility study or detailed scope of services), they are preliminary only and are designed for long-term budget planning purposes. Feasibility-level technical assessments and cost estimates will be completed for those improvements involving system infrastructure modifications to provide a sound basis for design and construction.

10.1 PRIORITY SYSTEM IMPROVEMENTS/ACTIVITIES AND ESTIMATED COSTS

One of the objectives of this plan is to update the total cost of the system and revise the trunk assessment rates. Cost estimates presented in this report are based on December 2005 construction costs and can be related to the ENR Construction Cost index value of 7646. Further changes in this index are expected and will result in future cost changes in the proposed facilities.

The cost of trunk storm sewers and development costs are included in the cost estimates. Some ponds may have to be acquired prior to development. Lateral systems are not included. All lateral sewers will be installed as development occurs and will be totally assessed to the developing property. All pipes which serve as connections between ponds or as outfall sewers from ponding areas are considered trunk storm sewer facilities.

Priority to complete construction projects to finish the stormwater system as outlined in the plan may be given to those areas that are under development or facing imminent development pressure.

In addition to projects to complete construction of planned system infrastructure, this plan is also intended to identify opportunities to improve system operation and restore high priority lake and wetland resources. Table 10.1 presents a summary of recommended high and medium priority stormwater management and water resource management projects. The budget amounts provided are planning-level cost ranges unless more detailed information is available.

For capital improvement projects, the City will continue to rely on its very detailed 5-year Capital Improvement Planning process to schedule and plan for funding these projects. This CIP is updated annually by City staff and reviewed and approved annually by the City Council.

Table 10.1 – High and Medium Priority System Improvement Projects and Activities

Project	Description	Estimated Cost	Priority	Comments
General/Administrative				
NPDES MS4 Nondegradation Plan	Complete Loading Assessment and Nondeg Plan	$50,000 - $70,000	High	City's plan due to MPCA by November 1, 2007.
Evaluate Watershed Standards and Rules, update City ordinances to comply with new standards	Evaluate new watershed standards, rules, and plans as necessary to provide comment on drafts, determine City strategy for compliance	City staff time plus up to $10,000 - $20,000 for City Attorney/Consulting assistance	High	VRWJPO standards on floodplain alterations, wetland alterations, buffer, stormwater management, and drainage alterations scheduled for conversion to rules. Other standards and rules likely in future. Ordinance update needs to be completed within six months of date of approval of City SWMP by VRWJPO (estimated to be September 2007)
Construction Site Runoff Control Ordinance	Establish an ordinance to effectively handle regulating construction site runoff	City staff time plus up to $10,000 - $20,000 for City Attorney/Consulting assistance	High	Update ordinances as necessary to address this issue by December 30, 2007.
Wetland Management Ordinance	Establish an ordinance to effectively manage wetlands in the City	City staff time plus up to $10,000 - $20,000 for City Attorney/Consulting assistance	High	Update ordinances as necessary to address this issue by April 2008.
Redevelopment Ordinance	The VRWJPO will adopt a new redevelopment standard in December 2006 which the City will adopt	City staff time plus up to $10,000 - $20,000 for City Attorney/Consulting assistance	High	Update ordinances as necessary to address this issue by April, 2008.
Discharge Agreement with the Zoo	Develop/update agreement with the zoo to regulate discharge quality from Zoo grounds to City system (Pond WVR-P17)	City staff time plus up to $5,000 - $10,000 for City Attorney/Consulting assistance	High	The City plans to draft an updated agreement with the Zoological Board regarding the release of surface water from the Zoo's main lake during wet periods by December 2007.
Illicit Discharge Detection and Elimination Ordinance	Establish an ordinance to effectively prohibit non-stormwater discharges	City staff time plus up to $10,000 - $20,000 for City Attorney/Consulting assistance	Medium	Update ordinances as necessary to address this issue by March 2008.

Project	Description	Estimated Cost	Priority	Comments
Structural BMP Long-Term Maintenance Ordinance	Establish an ordinance to effectively address maintenance requirements	City staff time plus up to $5,000 - $10,000 for City Attorney/Consulting assistance	Medium	Update ordinances as necessary to address this issue by March 2008.
Education program for municipal officials	Develop and implement an education program about the connection between land use decisions and water quality impacts	City staff time	Medium	By December 2008
Floodplain Management Ordinance	Establish an ordinance to effectively address floodplain management	City staff time plus up to $5,000 - $10,000 for City Attorney/Consulting assistance	Medium	Update ordinances as necessary to address this issue by March 2008
Shoreland Management Ordinance	Evaluate, and update if necessary, City's shoreland management ordinance	City staff time plus up to $10,000 - $20,000 for City Attorney/Consulting assistance	Medium	MnDNR indicates City is not under any mandated timeline, though current ordinance is not consistent with current state-wide standards. This task to be done at discretion of City.
Water Quantity/Flood Control				
Flood risk assessment and prioritization of problem areas	Follow-up effort Plan to identify where freeboard standards are not met, prioritize areas for detailed analysis to find cost-effective solutions	$15,000 - $30,000 (study cost only)	High	Modeling results of this Plan will be used to identify which areas to assess.
WVR-P19 Improvements	Based on completed technical assessment, restrict upstream pond outlets to modify adjacent yard	$20,000 - $40,000	High	Provided additional protection to structure that flooded during October 2005 rainfall event.
WVR-P36 Outlet	Based on completed technical assessment, increase size of WVR-P36 pond outlet to alleviate flooding	$7,000 - $14,000	High	Provided additional protection to three structures that flooded during October 2005 rainfall event.

Project	Description	Estimated Cost	Priority	Comments
WVR-P443 Pond Reconfiguration	With development in the area, Johnny Cake Ridge Road will be constructed and require the reconfiguration of WVR-P443. A partial diversion of discharge from Pond WVR-P443 will also be evaluated and, if appropriate, pursued	$15,000 - $40,000 (feasibility study costs only)	High	Improvements will be planned/implemented based on agreement with Lakeville regarding the maximum allowable discharge from Pond WVR-P443. Partial diversion/infiltration of discharge from Pond WVR-P443 to the East Vermillion River drainage may be pursued to help meet the allowable discharge criteria and/or to help meet nondegradation baseline conditions for average annual runoff volumes discharged to Lakeville from the WVR drainage district. Complete evaluation by August 2008.
Upgrade Stormwater Infrastructure in Beckman Addition	Bring the current stormwater system in the development up to City standards	$10,000 - $20,000 (feasibility study and preliminary design only)	High	Conduct feasibility study by December 30, 2007.
AL-P4 and AL-P6 Outlets	Based on completed technical assessment, increase pond outlet sizes to alleviate flooding	$116,000 - $150,000	Medium	Will alleviate long standing structure flooding issue.
Water Quality				
Long Lake/Farquar Lake Management Plan/TMDL	Complete Lake Management Plan and TMDL as a joint effort with VRWJPO	$65,000 - $75,000	High	Project under contract, TMDL scheduled submission to MPCA for approval in early 2008 after proposed eutrophication standards are adopted by MPCA.
Long Lake/Farquar Lake TMDL Implementation	Implement recommendations from TMDL process	Unknown	High	Project recommendations will be developed as part of TMDL effort, and will start in 2007/2008.
Lac Lavon Management Plan	Implement recommendations in management plan	$2,000 - $10,000 per year	High	Management plan completed and approved by City in December 2005. Implementation is underway. Management priorities focus on voluntary shoreline management projects, control of exotic aquatic plants, and continued monitoring. See Appendix G for summary of recommended improvements.

Project	Description	Estimated Cost	Priority	Comments
Lake Alimagnet Management Plan	Implement recommendations in plan	$660,000 (Five year cost for both Apple Valley and Burnsville)	High	Management plan completed and approved by City in March 2005. Implementation underway. See Appendix G for summary of recommended improvements.
Keller Lake Watershed Improvements	Implement watershed capital improvements in Apple Valley as called for in Crystal Lake UAA	$570,000 (2003 cost estimate from UAA)	High	Includes construction of infiltration basin, excavation/enlargement of Pond WVR-P43a (KL-P4), and construction of regional water quality treatment pond at SE corner of Keller Lake. See Appendix G (page iii of Executive Summary for Crystal Lake/Keller Lake UAA).
Cobblestone Lake Management Plan	Develop lake management plan	$50,000 - $70,000	High	Plan development expected to begin in summer of 2006, completed by November 2007. Monitoring of water quality conditions essential. Improvement projects and development restrictions will be identified.
Characterize inter-community flow-Vermillion River Watershed	Install, operate, and analyze data from water level recorder in Pond WVR-P443 to quantify flows to Lakeville	$3,000 - $4,500 for first year	High	This project will provide important information on cross boundary flows in a sensitive watershed and help quantify infiltration losses in the WVR system.
Wetlands				
Wetland Restoration and Enhancement	Remove invasive buckthorn in wetland buffers and install live plants for Wetlands 16-017, 16-022, and 16-023	$34,000 - $38,000	High	All three wetlands are adjacent to each other in Chaparral Park. (See Map 3 at back of report) Cost is for buckthorn removal over 4.4 acres and purchase and installation of 2,300 live native plants to create high quality buffer.
Wetland Restoration and Enhancement	Remove invasive buckthorn in wetland buffer and install live plants for Wetland 16-030	$12,000 - $14,000	Medium	Wetland located in Belmont Park. (See Map 3 at back of report). Cost is for buckthorn removal over 2.5 acres, installation of native vegetation.
Wetland Restoration and Enhancement	Remove invasive buckthorn in wetland buffer and install live plants for Wetland 16-034	$6,500 - $7,500	Medium	Wetland located on City property. (See Map 3 at back of report). Cost is for buckthorn and honeysuckle removal over 1.9 acres.

Note there are several projects to better utilize available storage in existing ponding facilities and to address duration effects are also identified in Appendix B at the back of this report. The projects are not crucial to the operation of the system under design conditions. The proposed modifications may provide benefits for storms exceeding the cities current design standards. However, the water quantity/flood control projects addressed in Table 10.1 are those the City will pursue as a higher priority to address recurring flooding situations in the City.

The cost estimates contained in Appendix D also identify additional projects or analysis that the City may wish to pursue in the future. Costs are calculated in December 2005 dollars and will need to be adjusted in future years. For stormwater infrastructure improvement projects, the costs include the following:

- Construction of the recommended facilities along with any associated appurtenances.
- Engineering, capitalized interest and administration costs.
- 10% contingency.

The costs do not include any necessary street re-construction, as it is assumed that improvements will be made at the time of street improvement projects in the area or as part of other utility improvements.

10.2 FINANCING

Several methods of financing the proposed projects and programs in this SWMP are available. These are discussed in more detail in the following sub-sections:

10.2.1 AREA AND CONNECTION CHARGES

These are fees charged to developments on an area (cost per acre) and/or connection (cost per unit) basis. These charges are frequently used in developing communities to ensure that new development pays for facilities required to serve it. Charges may be levied against redevelopment in a similar manner. An area charge calculation based on a cost per acre is included in Table 10.2 below. The area charges for the land use types more dense than single-family residential are higher because these land uses have a higher percentage of impervious surface and thus generate more runoff. The ratio used is the runoff coefficient for the 10-year storm event as compared to single-family residential land uses.

For this SWMP, area charges were developed to pay for the completion of the City's surface water system. These area charges are presented in Table 10.2.

Table 10.2 – Area Charges

Land Use	Developable Acreage (acres)	C(10 year)	Land Use Multiplier	Equivalent Acreage	Area Charge[1] ($/acre)	Area Charge[1] ($/sq ft)
Low Density Residential	317.1	0.4	1.0	317.1	4,133	0.09
Medium Density Residential	312.3	0.5	1.25	396.4	5,166	0.12
Mixed Use	481.3	0.6	1.5	722.0	6,200	0.14
Commercial/ Industrial	60.9	0.6	1.5	91.4	6,200	0.14
Total	1171.6			1526.9		
Total Cost = $6,310,300						
Cost per Equivalent Acre = $4133/equivalent acre						
[1]Area charges do not include land costs.						

10.2.2 Special Assessments

Assessments against benefiting or responsible properties can be used to finance surface water improvements. The assessment policy of the City is to finance storm drainage facilities through special assessment against benefiting properties. All land within a drainage area is considered to be benefiting since all land contributes runoff to the stormwater system.

Assessment rates for commercial, industrial, and high density residential areas are higher than for low density residential areas. The higher rate is justified because these areas typically have a larger percentage of roofed and paved areas which increase the amount of runoff. The velocity of runoff on impervious surfaces is also greater, which results in lower times of concentration, higher peak runoff rates, and larger required storm sewer pipe. The number of acres of these higher density land uses have been scaled up to the number of equivalent single family residential acres by the ratio of their 10-year runoff coefficient values as presented in Table 10.2. The cost per acre for the higher density land uses is determined by scaling up the total cost per acre of equivalent single family residential based on this same runoff coefficient ratio.

10.2.3 Stormwater Utility Fee

This is a fee charged to existing properties based on an estimate of runoff generated and discharged to the City's system. The revenues collected are dedicated to the surface water system. They are frequently used to pay for operation and maintenance of the system. The City initiated its Stormwater Utility Fee (SUF) collection program in 1988. The SUF provides funding to improve lake water quality through management plans and implementation of improvements. The funds are also used to improve and/or repair the storm sewer system, and for maintenance of water quality ponds. Recent projects include the Redwood pond upgrade (2004 - 2005) and the Scout pond improvements (2006).

10.2.4 Grants

Though subject to budgetary constraints, a number of state and other grant programs are available for surface water management. Grant programs the City may pursue for lake and wetland management include Section 319 of the Clean Water Act administered by the MPCA through the Clean Water Partnership Program for watershed improvements and lake improvements. The Minnesota Department of Natural Resources also offers funding. Most DNR funding is focused on a broader perspective, but watershed improvement projects could be proposed in a way that could fit various programs. At this time these grants are the only stable funding, but other opportunities develop frequently. Another project funding opportunity for development and implementation of TMDLs is the newly passed Clean Water Legacy program. For more information on these and other granting opportunities, contact the MPCA at http://www.pca.state.mn.us/water/cwp-319.html. For DNR grants see http://www.dnr.state.mn.us/grants/index.html. Grant programs can change frequently in their objectives, the amount of funding available and what the funding can be used for. Thus, it is important to keep up-to-date on the funding programs available.

A good prospect for outside financial support for water resources management-related projects may be the Dakota County SWCD and watershed organizations of which the City is a part. The SWCD, the Black Dog WMO, and the Vermillion River Watershed JPO have the capability of cost-sharing projects within the City that are of interest to the organization. Examples of projects that might be attractive to the watershed organizations to support financially include the following:

- Capital improvements that benefit a high priority resource (e.g., Lac Lavon) of watershed-wide or regional importance or whose benefits extend across jurisdictional boundaries.
- Some aspects of projects that need to be brought through the TMDL process.
- Monitoring to determine inter-jurisdictional flows and loadings.
- Monitoring to determine the fate of infiltrated water and its impact on local groundwater systems.
- Implementation of TMDL BMP projects.
- Development utilizing Low Impact Development techniques.

10.2.5 Water Quality Cash Dedication

Greater impervious coverage associated with new development or redevelopment activity places additional burdens on the storm drainage system by increasing the rate and volume of runoff. This in turn increases the amounts of pollutants exported from a development site. Existing or expanded storm drainage systems needed to serve the developed area provide an efficient means of delivering these higher pollutant loads to downstream receiving waters. Unless these pollutant loads are reduced, downstream receiving waters will be degraded over time as a result of development.

The City of Apple Valley recognizes its responsibility to protect priority water resources from adverse impacts due to increases in land use intensity caused by development and redevelopment activities. To minimize the impacts of development on Apple Valley's priority water bodies, development and redevelopment activity shall be subject to water quality mitigation requirements as outlined in Chapter 3, Policy 5.1-5.5.

Regional as well as on-site mitigation measures to reduce pollutant export can both be used to treat stormwater. This plan also includes provisions for collecting water quality cash dedications under certain situations and dedication of the revenue from such collections to help finance stormwater quality and wetland-related system improvements.

The following is intended to better define under what conditions the City can collect a cash dedication and how it will be calculated:

1. The City has the discretion of requiring water quality cash dedication for all or a portion of the pollutant removal targets for total phosphorus and total suspended solids. In exercising its discretion, the City will consider such factors as:
   - topographic suitability of the site for water quality treatment features;
   - the size of the site;
   - the location of the site relative to sensitive resources or system components that require protection;
   - whether public improvements have been or will be made off-site for the expressed purpose of mitigating the water quality impacts of the development; and
   - the extent to which the development has paid for mitigation already for the site.
2. The amount of the cash dedication will be based on the size of a hypothetical treatment pond with a wet volume sufficient to contain the runoff from a 2.5-inch rainfall event from the project. The design of the hypothetical pond shall meet the pond design standards in Appendix E.
3. For redevelopment projects, when the impervious area on the site is increased by more than 0.2 acres, the cash dedication will be determined as if the original condition of the site was undeveloped. The purpose of this standard is to discourage increases in impervious coverage for redevelopment projects.
4. The City Council each year shall adopt a unit land area price for each general type of land use, a unit pond volume price, and an appurtenance price that will be applied to the area and wet volume of the pond at control water level. The sum of all three components will be the total cash dedication for the project.
5. For the year 2006, the recommended rates are as follows:

   Cost per acre of calculated wet pond surface area for specific land use types:

Single Family Residential	($150,000/ac.)
Multi-Family Residential	($175,000/ac.)
Industrial	($100,000/ac.)
Commercial	($260,000/ac.)
Unit pond volume cost	$4/yd^3

   Appurtenance cost (outlet, skimmer, etc.) 20% of the sum of the land pond volume cost or $4,000, whichever is less.
6. The proceeds from the cash dedication will be ear-marked exclusively to finance water quality and wetland management improvements in the City.

Example cash dedication amounts based on this procedure are as follows:

- Five acre new single-family residential development (30% impervious) – $32,035
- Five acre new commercial development (75% impervious) – $89,520
- Two acre commercial redevelopment project (impervious increase from 50% to 80%) – $38,052
- Two acre commercial redevelopment project, no impervious increase – $0

Detailed guidance on how cash dedication amounts are to be calculated, using the above examples as a basis, is included in Appendix H.

11. Amendment Procedures and Reporting

11.1 AMENDMENT PROCEDURES

The SWMP is intended to extend through the year 2017. For the plan to remain credible and relevant, an avenue must be available to implement new information, ideas, methods, standards, management practices and any other changes that may affect the intent and/or results of the SWMP. This includes updates that may be necessary following the adoption of the Nondegradation and any approved TMDL plans.
The amendment procedure for the SWMP is presented below.

Request for Amendment
Written request for plan amendment is submitted to City staff. The request shall outline the need for the amendment as well as additional materials that the City will need to consider before making its decision.

Staff Review of Amendment
A decision is made as to the validity of the request. Three options exist: 1) reject the amendment, 2) accept the amendment as a minor issue, with minor issues collectively added to the plan at a later date, or 3) accept the amendment as a major issue, with major issues requiring an immediate amendment. In acting on an amendment request, City staff shall recommend to City Council whether or not a public hearing is warranted.

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

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

Watershed Organization Approval
All proposed amendments must be reviewed and approved by the watershed organizations prior to final adoption of the amendments.

Council Adoption
Final action on an amendment, following approval by the watershed organizations, is City Council adoption. However, prior to the adoption, an additional public hearing could be held to review the plan changes and notify the appropriate stakeholders.

11.2 ANNUAL REPORT TO COUNCIL

An annual report will be submitted by City staff summarizing development changes, capital improvements, and other surface water management-related issues that have occurred over the past year. The review will also include an update on available funding sources for water resource issues. Grant programs will be reviewed since they may change annually. These changes do not necessarily require individual amendments. The report can, however, be considered when the plan is brought up to date. The annual report shall be completed by March 1st to allow implementation items to be considered in the normal budget process.

The City's SWMP will remain in effect through 2016. The City will then review the SWMP for consistency with current water resource management methods. At that time, all annual reports and past amendments will be added to the document. Depending on the significance of changes, a new printing of the SWMP may be appropriate.

12. Summary and Recommendations

12.1 SUMMARY

The Apple Valley Surface Water Management Plan addresses the current needs of the City regarding stormwater management. It serves as a guide to managing the surface water system and protecting the quality of key water resources within the City.

The following issues have been incorporated into this SWMP:

1. Description of the physical environment and context for surface water management in Apple Valley.
2. Up-to-date goals and policies of the City as well as agency requirements affecting surface water management.
3. General layout and a description of the system.
4. Regulatory responsibilities.
5. Guidelines for surface water management as redevelopment occurs.
6. Public education.
7. Operation and maintenance of the surface water system.
8. Capital improvement program.

12.2 RECOMMENDATIONS

The following actions are recommended to implement this SWMP:

1. The City will proceed with implementing the capital improvement program.
2. The City will continue operating and maintaining the City's surface water system in accordance with this SWMP.
3. The City will continue a public education program to inform citizens about water resource management and protection.
4. The City will establish standard review procedures to ensure that all new development/redevelopment is in compliance with the City's goals and policies as well as agency requirements.
5. The City will continue cooperating with the watershed organizations in the City to regulate, manage, and protect water resources.
6. The City will adopt and implement amendments to the SWMP as warranted by future standards or regulations.

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APPENDIX A – Drainage Areas

Appendix A - Drainage Areas

Alimagnet Lake

Area Designation	Area (acres)	Runoff Volume (acre-feet)
AL-1	3.8	1.1
AL-100	11.1	3.3
AL-11	21.0	4.6
AL-12	9.5	2.0
AL-13	7.9	1.6
AL-14	7.4	1.8
AL-2	57.8	17.8
AL-200	1.9	1.0
AL-201	4.2	1.3
AL-202	10.2	3.0
AL-3	11.6	3.5
AL-4	13.0	3.3
AL-5	40.9	10.5
AL-6	22.4	5.8
AL-7	2.6	0.8
AL-8	42.6	11.0
AL-9	194.0	51.5
AL-9B	796.7	251.0
Total	**1258.3**	**374.8**

Appendix A - Drainage Areas

Black Dog District

Area Designation	Area (acres)	Runoff Volume (acre-feet)
BD-1	30.6	7.6
BD-10	26.6	6.6
BD-100	3.0	0.8
BD-101	1.6	0.4
BD-102	32.1	8.0
BD-103	2.7	0.7
BD-104	1.6	0.4
BD-11	32.1	8.0
BD-110	4.6	1.2
BD-12	3.1	0.9
BD-120	2.0	0.5
BD-13	9.4	2.6
BD-14	43.8	10.9
BD-140	18.8	4.8
BD-15	47.5	11.8
BD-150	6.8	1.7
BD-2	21.3	5.5
BD-3	5.6	1.4
BD-4	6.1	1.5
BD-5	25.2	6.3
BD-6	4.6	1.2
BD-61	12.2	3.1
BD-7	63.1	16.3
BD-70	6.2	1.3
BD-71	3.4	0.8
BD-8	8.5	2.2
BD-9	8.1	2.2
BD-90	9.5	2.8
Total	**440.1**	**111.7**

Appendix A - Drainage Areas

East Vermillion River District

Area Designation	Area (acres)	Runoff Volume (acre-feet)
EVR-1	19.1	5.9
EVR-10	74.1	18.5
EVR-11	15.8	3.9
EVR-12	61.0	16.2
EVR-13	84.3	23.1
EVR-14	25.8	7.3
EVR-15	12.1	3.0
EVR-150	7.8	2.2
EVR-151	23.5	5.9
EVR-16	7.1	1.8
EVR-160	6.8	1.8
EVR-17	83.4	27.7
EVR-170	95.7	25.9
EVR-18	68.9	17.7
EVR-180	13.1	4.6
EVR-19	168.6	36.8
EVR-190	46.6	7.1
EVR-2	84.2	23.0
EVR-20	29.3	7.8
EVR-21	63.9	17.5
EVR-210	57.8	14.9
EVR-211	6.0	1.9
EVR-22	40.7	10.8
EVR-220	3.6	1.0
EVR-221	7.0	1.2
EVR-24	11.9	3.0
EVR-25	14.3	4.6
EVR-26	79.7	22.4
EVR-27	90.7	21.9
EVR-28	5.7	1.4
EVR-280	6.2	1.6
EVR-29	113.0	28.2
EVR-290	9.5	2.5
EVR-3	15.8	3.2
EVR-30	37.8	9.7
EVR-31	6.1	1.5
EVR-32	2.8	0.8
EVR-33	7.1	2.1
EVR-34	14.2	4.0
EVR-35	142.2	49.7
EVR-350	42.4	9.9
EVR-351	21.5	5.4
EVR-352	6.8	2.1
EVR-36	79.8	21.8
EVR-37	25.4	7.2

Appendix A - Drainage Areas

East Vermillion River District

Area Designation	Area (acres)	Runoff Volume (acre-feet)
EVR-38	14.3	4.4
EVR-39	221.3	56.9
EVR-4	84.2	21.7
EVR-40	118.2	29.5
EVR-400	8.9	1.9
EVR-41	69.0	18.9
EVR-42	169.3	46.3
EVR-43	90.0	21.7
EVR-430	13.2	3.3
EVR-44	325.7	97.1
EVR-440	19.9	6.4
EVR-45	46.4	12.0
EVR-46	27.3	7.2
EVR-47	8.5	2.5
EVR-48	160.2	58.9
EVR-49	21.9	5.0
EVR-5	79.3	19.8
EVR-50	39.9	10.3
EVR-51	22.8	5.7
EVR-52	6.6	1.8
EVR-53	14.5	4.1
EVR-54	17.0	3.9
EVR-55	39.7	10.2
EVR-550	2.4	0.6
EVR-551	3.1	0.6
EVR-552	2.0	0.5
EVR-553	4.8	1.2
EVR-56	33.2	8.5
EVR-6	16.6	3.4
EVR-7	79.9	19.9
EVR-8	28.7	6.9
Total	**3628.0**	**981.6**

Appendix A - Drainage Areas

Keller Lake District

Area Designation	Area (acres)	Runoff Volume (acre-feet)
KL-1	206.5	51.5
KL-2	330.1	85.0
KL-2B	654.6	163.3
KL-3	113.4	28.3
KL-300	82.0	21.1
KL-4	92.1	31.4
Total	**1478.7**	**380.5**

Appendix A - Drainage Areas

Lac Lavon District

Area Designation	Area (acres)	Runoff Volume (acre-feet)
LL-1	186.9	53.2
Total	**186.9**	**53.2**

Appendix A - Drainage Areas

West Vermillion River District

Area Designation	Area (acres)	Runoff Volume (acre-feet)
WVR-1	6.6	1.8
WVR-10	9.5	2.5
WVR-11	8.5	2.2
WVR-111	12.2	3.1
WVR-112	11.3	2.8
WVR-113	12.4	3.1
WVR-12	2.4	0.8
WVR-13	91.3	24.2
WVR-130	15.4	4.1
WVR-14	11.9	2.8
WVR-15	8.3	2.1
WVR-16	7.0	1.6
WVR-17	206.2	56.4
WVR-170	2.0	0.5
WVR-171	2.5	0.7
WVR-172	3.7	0.9
WVR-18	20.7	5.3
WVR-19	57.0	12.0
WVR-190	13.7	3.4
WVR-191	19.8	4.9
WVR-2	4.2	1.2
WVR-20	9.4	2.4
WVR-201	13.7	3.4
WVR-202	3.7	0.9
WVR-21	25.0	6.2
WVR-22	70.6	17.6
WVR-23	148.3	39.4
WVR-230	10.8	2.7
WVR-231	16.4	4.4
WVR-24	24.7	6.2
WVR-25	11.1	3.5
WVR-26	170.6	46.7
WVR-27	56.2	17.7
WVR-28	547.0	172.4
WVR-280	161.0	42.7
WVR-281	21.1	5.3
WVR-29	52.9	14.9
WVR-290	8.4	2.1
WVR-291	4.7	1.2
WVR-292	4.1	1.1
WVR-3	3.2	0.8
WVR-30	16.9	4.4
WVR-31	23.7	7.5
WVR-32	4.6	1.2
WVR-320	5.1	1.4
WVR-321	64.6	16.1
WVR-322	3.7	1.0
WVR-33	63.7	16.9
WVR-34	2.6	0.9
WVR-340	2.6	0.7
WVR-35	17.4	4.3
WVR-36	186.5	45.6
WVR-37	12.3	2.6
WVR-370	3.2	0.8
WVR-38	28.6	6.0
WVR-4	14.8	3.7
WVR-40	277.5	82.8

Appendix A - Drainage Areas

West Vermillion River District

Area Designation	Area (acres)	Runoff Volume (acre-feet)
WVR-41	70.1	17.5
WVR-42	68.4	18.7
WVR-4333	12.7	3.2
WVR-4334	9.0	2.2
WVR-4335	8.4	2.2
WVR-4336	6.1	1.6
WVR-4337	20.5	5.5
WVR-4338	22.9	8.0
WVR-44	92.4	15.5
WVR-440	14.6	5.2
WVR-441	24.8	8.7
WVR-4410	5.4	2.0
WVR-4411	20.2	7.3
WVR-442	50.1	17.5
WVR-4420	17.1	6.0
WVR-4421	52.6	18.4
WVR-4422	11.5	4.1
WVR-4423	16.0	5.6
WVR-443	173.9	44.8
WVR-4430	26.7	6.9
WVR-4431	3.4	0.9
WVR-4432	1.3	0.4
WVR-45	211.2	73.8
WVR-46	38.4	12.8
WVR-47	97.4	26.6
WVR-48	14.1	4.3
WVR-49	30.2	7.5
WVR-490	62.8	15.7
WVR-5	52.7	15.7
WVR-50	125.4	35.3
WVR-52	136.0	47.6
WVR-53	141.5	48.2
WVR-54	106.3	31.7
WVR-55	130.3	45.6
WVR-56	171.6	51.2
WVR-560	80.3	18.8
WVR-57	19.8	6.8
WVR-58	4.4	1.6
WVR-59	15.2	5.3
WVR-6	8.4	2.3
WVR-60	3.4	0.9
WVR-7	12.2	3.0
WVR-710	8.4	2.0
WVR-711	9.2	3.1
WVR-8	15.4	3.9
WVR-9	39.2	10.1
Total	**4879.6**	**1399.4**

Appendix A - Drainage Areas

Apple Valley Pond Change ID

Old Pond ID	New Pond ID
WVR-P39	AL-P11
WVR-P390	AL-P13
WVR-P43	KL-P4
EVR-P9	WVR-P560
GCL-P1	WVR-P60
GCL-P50	EVR-50
GCL-P51	EVR-51
GCL-P52	EVR-52
GCL-P53	EVR-53
GCL-P54	EVR-54
GCL-P55	EVR-55

APPENDIX B – Pond Data

Appendix B
Water Quantity Modeling
Alimagnet Lake District

		Tributary Area (acres)			Pond Area @ CWL	Pond Area @ HWL	Storage Volume	CWL	Existing Outlet	1% Rainfall HWL	1% Rainfall Peak Pond Outflow	Comments
Pond #	DNR#	Direct	Ponded	Total	(acres)	acres	(acre-feet)	(feet)		(feet)	(cfs)	
AL-P1		4	11	15	0.5	0.6	1.7	975.3	12" RCP	978.2	3.5	
AL-P2		58	32	90	0.9	2.2	13.4	962.4	18" RCP	970.9	13.6	
AL-P3		12	0	12	0.3	0.4	1.7	999.7	12" RCP	1005.0	5.2	
AL-P4		13	0	13	0.3	0.6	1.3	992.8	18" RCP	996.5	11.1	HWL by XP-SWMM
AL-P5		41	42	82	1.7	0.7	1.3	985.8	48" RCP	993.9	44.8	Operating CWL Set by AL-P6 988.7
AL-P6		22	82	105	0.4	0.8	2.9	988.7	30" RCP	993.5	44.3	
AL-P7		3	105	107	0.5	0.8	2.1	986.1	36" RCP	989.2	42.8	
AL-P8		43	209	252	0.6	3.1	15.9	958.0	21" RCP	966.4	59.4	
AL-P9	19-21P	991	252	1242	113.3	116.9	357.7	954.8	L.S.	957.9	4.0	Includes Drainage from City of Burnsville
AL-P11		21	0	21	0.5	1.3	2.0	999.6	18" RCP	1001.8	10.2	
AL-P12		9	0	9	0.4	0.9	2.0	1000.0	Landlocked	1003.2	0.0	
AL-P13		8	21	29	0.3	0.7	1.0	996.9	21" RCP	998.7	10.8	
AL-P14		7	0	7	0.1	1.0	1.8	995.0	Landlocked	998.4	0.0	
AL-P100		11	0	11	0.4	0.8	1.7	979.9	12" RCP	982.5	5.5	
AL-P200		3	0	3	0.1	0.2	0.4	985.0	12" RCP	987.3	5.0	
AL-P201		4	0	4	0.1	0.2	0.4	983.8	15" RCP	986.2	7.8	
AL-P202		10	0	10	0.5	0.8	1.9	980.0	12" RCP	981.6	2.0	

Appendix B
Water Quantity Modeling
Black Dog District

Pond #	DNR#	Tributary Area (acres) Direct	Ponded	Total	Pond Area @ CWL (acres)	Pond Area @ HWL acres	Storage Volume (acre-feet)	CWL (feet)	Existing Outlet	1% Rainfall HWL (feet)	1% Rainfall Peak Pond Outflow (cfs)	Comments
BD-P1		31	0	31	0.5	1.5	3.9	1009.7	18" RCP	1013.4	6.1	
BD-P2		21	0	21	0.7	1.3	5.5	1016.0	Landlocked	1022.0	0.0	
BD-P3		6	0	6	0.0	0.2	0.4	1007.7	18" RCP	1010.5	12.0	
BD-P4		6	0	6	0.0	0.3	0.6	1005.5	12" RCP	1009.3	4.2	
BD-P5		25	6	31	1.0	1.3	4.5	1002.8	12" RCP	1006.7	5.3	
BD-P6		5	12	17	0.1	0.5	2.1	968.1	12" RCP	974.1	3.3	
BD-P7		63	37	101	1.0	1.6	9.4	996.5	18" RCP	1003.8	21.7	
BD-P8		9	0	9	0.5	0.8	1.2	984.0	12" RCP	985.7	2.7	
BD-P9		8	10	18	0.1	0.6	3.1	946.7	L.S.	957.9	0.8	
BD-P10		32	170	202	1.3	5.6	30.5	968.1	L.S.	978.1	4.0	
BD-P11		32	248	280	0.9	2.5	12.9	965.9	12" RCP	973.8	5.5	Overflow to Burnsville
BD-P12		3	0	3	0.4	0.5	0.5	974.0	12" RCP	975.2	0.7	
BD-P13		9	0	9	0.9	1.1	2.6	1032.0	Landlocked	1034.6	0.0	
BD-P14		44	66	110	1.4	3.2	17.4	947.2	12" RCP	955.2	6.5	Overflow to Burnsville
BD-P15		47	0	47	0.4	0.8	3.6	949.5	18" RCP	955.5	122.3	Overflows via Street
BD-P61		12	0	12	0.2	0.9	1.6	987.0	12" RCP	990.0	3.9	
BD-P70		6	0	6	0.0	0.3	0.3	1017.4	24" RCP	1019.0	11.1	
BD-P71		3	0	3	0.0	0.3	0.3	1009.0	Overflow Weir	1010.9	11.1	Overflows Backyard
BD-P90		10	0	10	0.8	1.0	1.6	956.9	12" RCP	958.6	2.7	
BD-P101		2	0	2	0.0	0.2	0.4	1006.0	Landlocked	1010.3	0.0	
BD-P102		30	0	30	0.7	2.0	12.0	969.0	Overflow Weir	978.2	64.0	
BD-P103		3	0	3	0.2	0.3	0.7	967.0	Landlocked	969.8	0.0	
BD-P104		2	0	2	0.0	0.2	0.4	964.0	Landlocked	968.3	0.0	
BD-P110		5	0	5	0.3	0.5	1.2	974.0	Landlocked	976.7	0.0	
BD-P120		2	0	2	0.0	0.2	0.5	977.6	Landlocked	977.6	0.0	
BD-P140		19	0	19	0.9	1.2	1.1	955.5	Overflow Weir	956.1	56.6	
BD-P150		7	0	7	0.1	0.4	1.7	946.0	Landlocked	952.2	0.0	

Appendix B
Water Quantity Modeling
East Vermillion River District

Pond #	DNR#	Tributary Area (acres) Direct	Ponded	Total	Pond Area @ CWL (acres)	Pond Area @ HWL acres	Storage Volume (acre-feet)	CWL (feet)	Existing Outlet	1% Rainfall HWL (feet)	1% Rainfall Peak Pond Outflow (cfs)	Comments
EVR-P1		10	0	10	0.9	1.3	2.5	997.2	Beehive	999.3	12.4	
EVR-P10		74	80	154	0.6	1.1	4.0	916.3	36" RCP	921.4	115.1	Split Outflow
EVR-P11		16	450	466	0.3	0.8	2.7	912.6	48" RCP	918.2	99.1	
EVR-P12	19-225W	61	466	527	5.7	6.9	30.0	903.9	30" RCP	908.7	75.1	Split Outflow
EVR-P13		84	151	235	0.3	0.6	1.5	911.9	36" RCP	915.6	178.3	
EVR-P14		26	0	26	3.6	3.8	4.8	904.6	12" RCP	905.9	3.4	
EVR-P15		12	8	20	0.0	1.0	3.0	904.0	Landlocked	909.4	0.0	
EVR-P150		8	0	8	0.5	1.3	2.2	920.0	Landlocked	922.3	0.0	
EVR-P151		23	0	23	0.1	0.5	1.8	943.1	21" RCP	948.9	25.9	
EVR-P16		7	0	7	0.2	0.8	1.8	906.0	Landlocked	910.3	0.0	
EVR-P160		7	0	7	0.1	0.7	1.8	916.0	Landlocked	920.3	0.0	
EVR-P17	19-22P	83	984	1067	32.5	38.2	169.2	900.8	12" RCP	905.7	5.6	
EVR-P170	19-22P	96	101	196	7.3	9.9	32.9	901.8	36" RCP	905.7	30.5	
EVR-P18		69	13	82	2.3	3.5	16.0	962.0	12" RCP	967.4	6.6	
EVR-P180		13	0	13	0.6	1.3	2.3	982.4	Beehive	984.7	5.8	
EVR-P19	19-218W	169	47	215	5.7	11.1	40.8	927.7	12" RCP	932.4	3.2	
EVR-P190		47	0	47	0.2	0.5	2.1	960.3	27" RCP	966.8	44.2	
EVR-P2	19-226W	84	0	84	7.2	7.6	18.3	970.6	12" RCP	973.1	4.8	
EVR-P20		29	0	29	1.6	1.9	5.2	943.6	12" RCP	946.6	3.2	
EVR-P21		64	390	454	1.4	5.1	17.5	897.2	30" RCP	902.8	44.9	
EVR-P210		58	117	175	0.8	1.2	5.0	904.8	42" RCP	910.0	85.5	
EVR-P211		6	0	6	0.2	0.3	0.7	958.8	15" RCP	961.7	8.8	
EVR-P22		41	26	66	2.9	4.5	11.7	976.0	15" RCP	979.1	6.8	
EVR-P220		4	0	4	0.4	0.4	1.1	985.6	12" RCP	988.4	2.8	
EVR-P221		7	0	7	0.0	0.6	1.2	996.0	Landlocked	1002.6	0.0	
EVR-P24		12	0	12	0.1	1.1	1.3	939.3	Beehive	942.0	3.8	
EVR-P25		14	0	14	0.2	0.6	1.4	939.5	24" RCP	943.4	23.3	
EVR-P26		80	26	106	2.0	5.5	27.3	931.5	12" RCP	940.3	5.1	
EVR-P27		91	0	91	0.5	2.9	14.2	928.9	42" RCP	939.4	151.1	
EVR-P28		6	0	6	0.1	0.6	1.4	910.0	Landlocked	914.9	0.0	
EVR-P280		6	0	6	0.5	1.1	1.6	922.0	Landlocked	924.1	0.0	
EVR-P29		113	197	310	2.5	4.9	21.8	900.4	21" RCP	906.0	19.0	
EVR-P290		9	0	9	0.0	0.7	1.0	904.2	Beehive	906.5	5.4	
EVR-P3		16	0	16	0.4	0.7	3.2	972.0	Landlocked	977.9	0.0	

Appendix B
Water Quantity Modeling
East Vermillion River District

Pond #	DNR#	Tributary Area (acres) Direct	Ponded	Total	Pond Area @ CWL (acres)	Pond Area @ HWL acres	Storage Volume (acre-feet)	CWL (feet)	Existing Outlet	1% Rainfall HWL (feet)	1% Rainfall Peak Pond Outflow (cfs)	Comments
EVR-P30		38	0	38	0.9	1.8	6.3	904.2	12" RCP	908.8	4.7	
EVR-P31		6	0	6	0.7	0.9	1.3	901.0	12" RCP	902.6	1.8	
EVR-P32		3	0	3	0.3	0.5	0.4	910.0	12" RCP	910.9	1.3	
EVR-P33		7	0	7	1.8	1.9	2.1	892.0	Landlocked	893.1	0.0	
EVR-P34		14	0	14	2.2	2.5	4.0	892.0	Landlocked	893.7	0.0	
EVR-P35	19-23P	164	2003	2167	66.2	69.3	225.5	898.1	36" RCP	901.4	6.8	CWL and outflow driven by EVR-P352 LS
EVR-P350		42	66	109	0.4	1.4	3.7	925.0	30" RCP	929.8	44.4	
EVR-P352		7	366	373	2.2	3.3	9.0	898.1	LS	901.4	6.9	
EVR-P36		80	0	80	0.5	2.9	12.1	968.7	18" RCP	978.3	17.3	
EVR-P37		25	80	105	0.1	0.7	3.2	959.4	24" RCP	967.7	27.9	
EVR-P38		14	0	14	0.8	1.1	2.3	965.1	15" RCP	967.6	6.4	
EVR-P39		221	2286	2507	3.5	11.4	71.2	946.0	27" RCP	956.0	22.7	
EVR-P4		84	0	84	0.8	1.5	7.5	961.7	36" RCP	968.4	69.2	
EVR-P40		118	2516	2634	2.9	8.8	33.6	944.2	24" RCP	950.2	18.7	
EVR-P400		9	0	9	0.0	3.2	5.8	948.3	Beehive	952.2	4.5	
EVR-P41		69	0	69	3.3	4.2	14.8	934.2	12" RCP	938.1	5.1	
EVR-P42		169	0	169	8.0	9.2	42.7	932.0	12" RCP	936.9	3.5	
EVR-P43		103	2634	2738	0.8	3.2	13.3	918.2	2' x 3' CB	925.0	33.1	
EVR-P44		346	3136	3482	36.5	42.9	181.4	912.5	LS	917.1	26.7	To Lakeville from Cobblestone LS
EVR-P45		46	33	80	0.8	1.2	2.5	913.6	Overflow Channel	916.1	84.0	
EVR-P46		27	80	107	1.7	2.8	12.7	908.0	12" RCP	913.7	7.4	
EVR-P47		9	107	115	2.7	3.1	7.7	904.1	12" RCP	906.9	4.7	To Berger Pond (Rosemount)
EVR-P48		160	0	160	2.1	4.1	34.0	957.3	24" RCP	968.0	47.1	
EVR-P49		22	0	22	0.0	1.2	1.3	983.6	Beehive	986.0	23.5	
EVR-P5		79	0	79	0.5	1.1	5.4	953.4	42" RCP	960.3	83.2	
EVR-P50		40	0	40	2.1	2.9	7.3	898.9	12" RCP	992.8	3.4	
EVR-P51		23	40	63	0.4	1.4	5.3	974.0	Overflow Weir	979.3	50.0	
EVR-P52		7	0	7	1.0	1.2	1.0	980.6	18" RCP	981.5	2.4	
EVR-P53		15	7	21	2.0	2.5	2.9	980.0	12" RCP	981.2	3.2	
EVR-P54		17	0	17	0.3	0.9	2.1	1028.5	12" RCP	1032.2	3.5	
EVR-P55	19-214P	40	101	141	3.2	4.5	24.3	972.7	12" RCP	978.9	3.6	
EVR-P550		2	0	2	0.4	0.5	0.6	1020.0	Landlocked	1021.3	0.0	
EVR-P551		3	0	3	0.1	0.2	0.6	988.0	Landlocked	992.7	0.0	

Appendix B
Water Quantity Modeling
East Vermillion River District

		Tributary Area (acres)			Pond Area @ CWL	Pond Area @ HWL	Storage Volume	CWL	Existing Outlet	1% Rainfall HWL	1% Rainfall Peak Pond Outflow	Comments
Pond #	DNR#	Direct	Ponded	Total	(acres)	acres	(acre-feet)	(feet)		(feet)	(cfs)	
EVR-P552		2	0	2	0.1	0.3	0.5	1004.0	Landlocked	1006.3	0.0	
EVR-P553		5	0	5	0.4	0.6	1.2	1002.0	Landlocked	1004.3	0.0	
EVR-P56		33	0	33	0.9	3.9	8.5	998.0	Landlocked	1001.7	0.0	
EVR-P6		17	0	17	0.6	1.6	1.8	964.9	12" RCP	966.4	3.3	
EVR-P7		80	264	344	0.9	3.5	22.3	927.3	27" RCP	938.3	144.9	Includes Overflow
EVR-P8		29	344	373	0.2	2.5	11.0	914.0	36" RCP	924.4	88.2	

Appendix B
Water Quanity Modeling
Keller Lake District

		Tributary Area (acres)			Pond Area @ CWL	Pond Area @ HWL	Storage Volume	CWL	Existing Outlet	1% Rainfall HWL	1% Rainfall Peak Pond Outflow	Comments
Pond #	DNR#	Direct	Ponded	Total	(acres)	acres	(acre-feet)	(feet)		(feet)	(cfs)	
KL-P1		207	0	207	1.6	5.4	20.9	952.5	OCS / 30" RCP	959.7	67.0	
KL-P2	19-25P	1067	412	1479	55.0	97.7	188.0	934.3	Oveflow Weir	937.4	228.6	Keller Lake
KL-P3		113	0	113	2.4	4.7	21.9	952.5	12" RCP	958.8	6.3	
KL-P4		92	0	92	1.5	3.3	16.7	945.8	15" RCP / 24" RCP	953.3	39.0	24" RCP to KL, 15" to WVR

Appendix B
Water Quantity Modeling
Lac Lavon District

		Tributary Area (acres)			Pond Area @ CWL	Pond Area @ HWL	Storage Volume	CWL	Existing Outlet	1% Rainfall HWL	1% Rainfall Peak Pond Outflow	Comments
Pond #	DNR#	Direct	Ponded	Total	(acres)	acres	(acre-feet)	(feet)		(feet)	(cfs)	
LL-P1		187	0	187	67.7	68.6	53.2	932.0	Landlocked	932.8	0.0	

Appendix B
Water Quantity Modeling
West Vermillion River District

Pond #	DNR#	Tributary Area (acres) Direct	Ponded	Total	Pond Area @ CWL (acres)	Pond Area @ HWL acres	Storage Volume (acre-feet)	CWL (feet)	Existing Outlet	1% Rainfall HWL (feet)	1% Rainfall Peak Pond Outflow (cfs)	Low Entry Minimum Elevation (feet)	Comments
WVR-P1		7	3	10	0.4	0.5	0.7	1016.9	27" RCP	1018.5		1023	
WVR-P10		9	0	9	0.4	0.7	2.5	1000.0	Landlocked	1004.7	0.0	1021	
WVR-P11		9	24	32	0.5	0.9	4.0	998.0	15" RCP	1002.3	11.4	1026	
WVR-P111		12	8	21	0.2	0.4	1.7	1013.3	12" RCP	1019.1	6.8	1022	
WVR-P112		24	0	24	0.0	0.6	1.2	999.8	36" RCP	1004.0	54.9	1012	
WVR-P12		2	0	2	0.2	0.3	0.4	1012.0	Proposed 12" RCP	1013.3	3.3	1022	
WVR-P13		91	0	91	0.0	0.4	0.4	997.5	42" RCP	999.5	62.9	NA	Shallow Road Flooding of Cedar Avenue
WVR-P130		15	0	15	0.2	0.6	2.0	1016.0	12" RCP	1021.3	5.6	1022	
WVR-P14		11	0	11	0.9	1.1	2.8	1000.0	Landlocked	1002.8	0.0	1018	
WVR-P15		8	0	8	0.3	0.6	2.1	998.0	Landlocked	1002.9	0.0	1018	
WVR-P16		7	0	7	0.1	0.4	1.6	996.0	Landlocked	1001.9	0.0	1018	
WVR-P17		206	205	412	3.6	8.3	115.2	965.4	LS	984.1	4.0	990	
WVR-P170		2	0	2	0.1	0.2	0.5	1007.0	Landlocked	1010.4	0.0	1020	
WVR-P171		2	4	6	0.3	0.4	0.8	1027.4	12" RCP	1029.5	3.3	NA	
WVR-P172		4	0	4	0.0	0.1	0.1	1032.9	18" RCP	1035.6	11.9	1038	
WVR-P18		21	0	21	0.2	1.0	1.7	999.0	Beehive	1001.8	15.3	1004	
WVR-P19		57	61	118	0.3	2.2	14.0	1009.8	LS	1025.6	7.0	1017.7	4" Orifice US lowers HWL to 1024.83
WVR-P190		14	0	14	0.2	0.9	3.4	1040.0	Landlocked	1046.8	0.0	1060.0	
WVR-P191		20	0	20	0.1	0.6	1.3	1025.2	21" RCP	1030.3	23.9	1058.0	4" Orifice Suggested for DS Ponds, Raises HWL to 1033.5
WVR-P2		4	10	14	0.4	1.1	0.9	1002.6	30" RCP	1004.4	12.0	1016	
WVR-P20		9	0	9	0.0	0.4	0.7	990.0	18" RCP	993.6	10.2	1002	
WVR-P201		14	0	14	0.2	1.0	3.4	1050.0	Landlocked	1055.4	0.0	1070	
WVR-P202		4	0	4	0.1	0.3	0.9	1058.0	Landlocked	1064.5	0.0	1072	
WVR-P21		25	118	143	0.7	1.5	9.0	1040.2	12" RCP	1050.6	6.4	1062	
WVR-P22		71	152	223	2.5	4.2	25.2	980.0	12" RCP	988.0	5.3	1000	
WVR-P23		159	223	382	0.1	1.0	4.8	953.7	Twin 48" RCP	968.7	328.0	966	
WVR-P231		16	382	398	1.2	5.3	37.2	955.0	15" RCP	968.8	10.1	966	
WVR-P24		25	0	25	0.0	0.7	1.9	956.4	Beehive	962.0	21.7	963	
WVR-P25		11	0	11	0.6	1.1	1.3	959.1	Beehive	960.5	10.8	957	
WVR-P26		171	434	605	1.6	6.1	28.4	944.7	LS	955.8	97.8	956	Includes Overflow Outflow
WVR-P27		56	416	472	1.6	3.8	24.7	947.7	18" RCP	957.7	19.6	958	
WVR-P28		547	2504	3051	6.8	17.1	166.1	925.6	36" RCP	943.6	84.9	945	
WVR-P280		182	480	662	6.8	13.4	57.1	939.1	15" RCP	945.2	5.3	947	
WVR-P29		53	425	478	0.4	3.0	17.6	999.5	12" RCP	1009.6	4.6	1021	
WVR-P290		8	0	8	0.0	0.8	0.9	1041.0	12" RCP	1043.4	4.3	1051	
WVR-P291		5	0	5	0.0	0.2	0.4	1038.0	12" RCP	1041.3	5.9	1064	
WVR-P292		4	0	4	0.1	0.5	1.1	1034.0	Landlocked	1037.7	0.0	1051	
WVR-P3		3	0	3	0.2	0.2	0.7	1015.0	12" Orifice	1016.2	4.2	1018	
WVR-P30		17	0	17	1.0	1.3	2.4	1027.0	12" RCP	1028.9	4.5	1031	
WVR-P31		24	0	24	0.4	1.6	6.3	988.0	Proposed 4" Orifice	994.9	1.1	NA	
WVR-P32		5	0	5	0.2	0.4	0.5	1009.8	15" RCP	1011.1	4.6	1011	
WVR-P320		5	0	5	0.5	1.2	0.8	987.1	12" RCP	988.0	1.5	988	
WVR-P321		65	10	74	2.5	4.9	14.8	983.3	12" RCP	987.1	3.4	986	
WVR-P322		4	0	4	0.4	0.5	0.5	985.3	12" RCP	986.3	1.7	990	

Appendix B
Water Quantity Modeling
West Vermillion River District

Pond #	DNR#	Tributary Area (acres) Direct	Ponded	Total	Pond Area @ CWL (acres)	Pond Area @ HWL acres	Storage Volume (acre-feet)	CWL (feet)	Existing Outlet	1% Rainfall HWL (feet)	1% Rainfall Peak Pond Outflow (cfs)	Low Entry Minimum Elevation (feet)	Comments
WVR-P33		64	501	565	1.0	2.4	15.1	950.3	15" RCP	960.4	7.9	954	
WVR-P34		4	0	4	0.3	0.4	0.9	948.0	Landlocked	950.7	0.0	952	
WVR-P340		3	0	3	0.0	0.4	0.7	948.0	Landlocked	954.1	0.0	956	
WVR-P35		17	0	17	0.1	1.1	4.4	946.1	36" RCP	953.2	26.0	953.23	
WVR-P36		183	582	765	3.6	7.1	34.6	946.1	18" RCP	953.2	19.1	953	
WVR-P37		12	0	12	0.6	0.9	1.5	1056.2	12" RCP	1058.2	4.7	1071.0	6" orifice to protect Downstream Pond, HWL to 1058.6
WVR-P370		3	0	3	0.1	0.3	0.8	1068.0	Landlocked	1071.8	0.0	1079.0	
WVR-P38		29	12	41	0.2	1.5	5.6	1035.8	12" RCP	1043.7	5.2	1043.0	US 6" Orifice will Lower HWL to 1042.8
WVR-P4		15	0	15	0.3	1.0	1.8	1017.0	12" RCP	1019.9	5.3	1040	
WVR-P40		277	0	277	3.3	12.3	64.3	959.0	18" RCP	969.3	29.4	974	
WVR-P41		70	277	348	0.8	4.0	26.0	950.2	21" RCP	961.4	19.2	962	
WVR-P42		68	0	68	1.1	2.6	14.9	951.9	15" RCP	959.6	4.0	963	
WVR-4333		13	44	57	1.0	1.7	4.6	926.5	12" RCP	929.8	4.2	936	
WVR-4334		9	0	9	0.7	0.9	1.6	927.5	12" RCP	929.8	3.0	939	
WVR-4335		8	27	35	0.4	0.9	2.7	927.5	12" RCP	931.4	2.5	939	
WVR-4336		6	0	6	0.6	0.9	0.9	930.2	12" RCP	931.4	1.8	934	
WVR-4337		21	0	21	0.6	1.0	3.5	928.1	12" RCP	933.0	2.7	934	
WVR-44		44	15	59	1.1	2.0	11.0	934.5	12" RCP	940.3	7.1	Unknown	
WVR-440		15	0	15	1.1	1.7	5.2	934.0	42" RCP	937.8	2.8	NA	Estimated Outlet and Routing
WVR-441		25	26	50	0.7	1.5	5.7	933.5	15" RCP	938.9	6.4	NA	Esitmated Outlet and Routing
WVR-4410		5	0	5	0.4	0.7	1.9	933.8	12" RCP	937.6	1.0	NA	
WVR-4411		20	0	20	1.6	1.8	5.6	936.9	12" RCP	940.2	2.3	948	
WVR-442		50	97	148	0.9	2.4	21.0	926.4	18" RCP	938.7	5.3	942	
WVR-4420		17	0	17	0.1	0.6	3.0	929.9	24" RCP	938.7	19.9	943	
WVR-4421		53	0	53	1.7	2.7	16.1	932.0	12" RCP	939.4	3.7	945	
WVR-4422		12	16	28	0.1	0.6	3.4	930.2	12" RCP	938.9	4.0	944	
WVR-4423		16	0	16	0.2	0.8	4.3	930.6	10" PVC	939.3	1.4	944	
WVR-P443		224	3965	4188	8.0	10.0	51.5	922.0	60" RCP	927.8	125.9	934	TO LAKEVILLE
WVR-4431		3	0	3	0.4	0.6	0.5	931.9	12" RCP	932.9	1.1	935	
WVR-4432		1	0	1	0.2	0.3	0.2	933.2	12" RCP	934.0	1.3	938	
WVR-P45		211	0	211	3.5	7.2	68.5	933.1	15" RCP	944.7	5.4	948	15" RCP is DS Control, 18" FES.
WVR-P46		38	0	38	2.9	4.7	29.9	939.8	48" RCP	947.5	104.5	952	DS System Control is 12"
WVR-P47		97	93	190	1.4	2.5	14.5	939.8	48" RCP	947.4	105.1	950	DS System Control is 12"
WVR-P48		14	0	14	0.9	1.6	7.3	942.0	24" RCP	947.5	29.5	950	DS System Control is 12"
WVR-P49		93	0	93	0.2	0.9	4.7	966.1	15" RCP	974.5	10.2	976	
WVR-P5		53	32	85	9.1	9.6	22.7	997.8	LS	1000.2	0.7	1008	
WVR-P50		125	243	368	4.1	6.7	47.0	936.9	12" RCP	945.6	4.4	948	
WVR-P52		136	0	136	8.5	10.0	44.9	944.0	Proposed 12" RCP	948.8	2.4	NA	
WVR-P53		141	136	277	13.0	14.4	50.6	936.0	Proposed 12" RCP	939.7	2.3	NA	
WVR-P54		106	277	384	6.5	7.6	32.0	930.0	Proposed 12" RCP	934.5	2.3	NA	
WVR-P55		130	0	130	10.0	12.3	40.9	951.1	Proposed 12" RCP	955.5	4.7	NA	
WVR-P56		191	211	402	12.0	14.2	66.4	942.0	Proposed 12" RCP	949.7	3.0	NA	
WVR-P560		80	0	80	0.2	4.3	10.5	969.4	15" RCP	976.9	12.9	991	
WVR-P58		4	0	4	0.1	2.6	1.2	1009.5	12" RCP	1010.2	0.6	NA	

Appendix B
Water Quantity Modeling
West Vermillion River District

		Tributary Area (acres)			Pond Area @ CWL	Pond Area @ HWL	Storage Volume	CWL	Existing Outlet	1% Rainfall HWL	1% Rainfall Peak Pond Outflow	Low Entry Minimum Elevation	Comments
Pond #	DNR#	Direct	Ponded	Total	(acres)	acres	(acre-feet)	(feet)		(feet)	(cfs)	(feet)	
WVR-P59		15	0	15	5.4	5.7	4.4	1008.8	12" RCP	1009.6	1.0	1028	
WVR-P590		22	0	22	4.0	5.2	4.4	1009.0	12" CMP	1010.0	1.2	NA	Assumed CMP for culvert
WVR-P6		8	0	8	0.9	1.1	1.1	1035.5	21" RCP	1036.6	5.1	1038.0	
WVR-P60		3	0	3	0.4	0.4	0.4	1047.1	18" RCP	1048.1	3.8	1052.0	
WVR-P7		12	8	21	0.1	0.3	1.0	1017.8	18" RCP	1024.1	15.5	1034.0	
WVR-P710		8	0	8	0.0	0.5	0.7	1032.4	12" RCP	1038.1	4.8	1052.0	
WVR-P711		9	21	30	0.9	1.7	8.7	1006.0	Landlocked	1012.5	0.0	NA	
WVR-P8		15	0	15	0.4	0.7	2.2	1004.0	12" RCP	1008.2	3.1	1010.0	
WVR-P9		39	15	55	1.5	2.3	8.5	1001.1	LS	1005.9	3.6	1006.0	

APPENDIX C – Lift Stations

Appendix C - Lift Station Data

LIFT STATION	PUMPED FROM	PUMPED TO	PUMP SIZE (GPM)	PUMP SIZE (CFS)
Alimagnet Lake	AL-P9	WVR-P40	3100	6.9
Belmont Pond	BD-P10	BD-P11	1800	4.0
Briar Oaks	WVR-P5	WVR-P17	310	0.7
Cedar Knolls	WVR-P9	WVR-P17	1800	4.0
Cobblestone Lake	EVR-P44	Lakeville	11,700	26.1
Farquar Lake	EVR-P35	EVR-P39	3150	7.0
Hannover	WVR-P19	WVR-P21	3150	7.0
Hidden Ponds	WVR-P17	WVR-P29	1800	4.0
Hunters Wood	BD-P9	BD-P11	350	0.8

APPENDIX D – Costs

APPENDIX D - COSTS

	Flow From	Flow To	Size (in)	Length (ft)	Pipe Cost/Lf (1)	Pipe Cost	Pond Exc. (Ac-ft)	Pond Cost (2)	Indirect Cost (3)	Total Cost (4)
evr	194	195	33	680	89	60,520			21,182	81,700
evr	195	EVR-P42	42	440	131	57,640			20,174	77,800
evr	196	195	27	680	70	47,600			16,660	64,300
evr	206	207	27	500	70	35,000			12,250	47,300
evr	207	208	36	580	103	59,740			20,909	80,600
evr	208	EVR-P42	48	330	155	51,150			17,903	69,100
evr	209	210	27	320	70	22,400			7,840	30,200
evr	210	208	30	720	77	55,440			19,404	74,800
evr	212	214	30	480	77	36,960			12,936	49,900
evr	213	214	24	520	56	29,120			10,192	39,300
evr	214	216	36	520	103	53,560			18,746	72,300
evr	215	216	27	610	70	42,700			14,945	57,600
evr	216	EVR-P42	48	140	155	21,700			7,595	29,300
evr	225	226	30	570	77	43,890			15,362	59,300
evr	226	227	36	580	103	59,740			20,909	80,600
evr	227	228	42	850	131	111,350			38,973	150,300
evr	228	EVR-P44	48	300	155	46,500			16,275	62,800
evr	229	230	27	680	70	47,600			16,660	64,300
evr	230	232	33	550	89	48,950			17,133	66,100
evr	231	232	27	660	70	46,200			16,170	62,400
evr	232	234	42	610	131	79,910			27,969	107,900
evr	233	234	27	660	70	46,200			16,170	62,400
evr	234	236	48	450	155	69,750			24,413	94,200
evr	235	234	27	480	70	33,600			11,760	45,400
evr	236	EVR-P44	48	230	155	35,650			12,478	48,100
evr	237	238	27	770	70	53,900			18,865	72,800
evr	238	EVR-P44	30	500	77	38,500			13,475	52,000
evr	239	240	36	520	103	53,560			18,746	72,300
evr	240	EVR-P44	42	410	131	53,710			18,799	72,500
wvr	281	282	27	870	70	60,900			21,315	82,200
wvr	282	284	33	400	89	35,600			12,460	48,100
wvr	283	284	21	1040	52	54,080			18,928	73,000
wvr	284	WVR-P55	42	80	131	10,480			3,668	14,100
wvr	292	293	27	300	70	21,000			7,350	28,400
wvr	293	294	36	370	103	38,110			13,339	51,400
wvr	294	WVR-P56	48	740	155	114,700			40,145	154,800
wvr	295	296	30	600	77	46,200			16,170	62,400
wvr	296	294	42	340	131	44,540			15,589	60,100
wvr	297	298	24	470	56	26,320			9,212	35,500
wvr	422	423	30	610	77	46,970			16,440	63,400
wvr	423	424	36	400	103	41,200			14,420	55,600
wvr	434	435	36	460	103	47,380			16,583	64,000
wvr	435	WVR-P52	42	420	131	55,020			19,257	74,300
wvr	436	437	30	340	77	26,180			9,163	35,300
wvr	437	WVR-P52	42	180	131	23,580			8,253	31,800
wvr	438	439	27	630	70	44,100			15,435	59,500
wvr	439	440	36	320	103	32,960			11,536	44,500
wvr	440	WVR-P52	48	200	155	31,000			10,850	41,900
wvr	441	442	33	500	89	44,500			15,575	60,100
wvr	442	WVR-P52	48	250	155	38,750			13,563	52,300
wvr	443	444	33	590	89	52,510			18,379	70,900
wvr	444	447	42	280	131	36,680			12,838	49,500
wvr	445	446	33	540	89	48,060			16,821	64,900
wvr	446	447	42	310	131	40,610			14,214	54,800
wvr	447	WVR-P53	54	240	190	45,600			15,960	61,600
wvr	448	449	36	520	103	53,560			18,746	72,300
wvr	449	450	42	380	131	49,780			17,423	67,200
wvr	450	WVR-P53	48	110	155	17,050			5,968	23,000
wvr	451	452	30	510	77	39,270			13,745	53,000
wvr	452	453	33	350	89	31,150			10,903	42,100
wvr	453	WVR-P53	36	80	103	8,240			2,884	11,100
wvr	454	455	27	650	70	45,500			15,925	61,400

APPENDIX D - COSTS

	Flow From	Flow To	Size (in)	Length (ft)	Pipe Cost/Lf (1)	Pipe Cost	Pond Exc. (Ac-ft)	Pond Cost (2)	Indirect Cost (3)	Total Cost (4)
wvr	455	WVR-P54	60	230	220	50,600			17,710	68,300
wvr	456	457	24	860	56	48,160			16,856	65,000
wvr	457	455	42	770	131	100,870			35,305	136,200
wvr	458	459	27	340	70	23,800			8,330	32,100
wvr	459	WVR-P54	33	260	89	23,140			8,099	31,200
wvr	460	461	21	740	52	38,480			13,468	51,900
wvr	461	WVR-P54	24	190	56	10,640			3,724	14,400
wvr	462	463	24	790	56	44,240			15,484	59,700
wvr	463	WVR-P443	36	420	103	43,260			15,141	58,400
wvr	464	465	24	870	56	48,720			17,052	65,800
wvr	465	466	27	930	70	65,100			22,785	87,900
wvr	466	WVR-P443	27	940	70	65,800			23,030	88,800
al	AL-P4	AL-P5	18	700	48	33,600			11,760	45,400
al	AL-P6	AL-P7	42	400	131	52,400			18,340	70,700
bd	BD-P12	BD-P11	12	500	42	21,000			7,350	28,400
bd	BD-P61	BD-P6	12	290	42	12,180			4,263	16,400
evr	EVR-P40	EVR-P41	18	1900	48	91,200			31,920	123,100
evr	EVR-P8	EVR-P11	42	400	131	52,400			18,340	70,700
evr	EVR-P180	15	18	700	48	33,600			11,760	45,400
evr	EVR-P12	EVR-P17	36	400	103	41,200			14,420	55,600
evr	EVR-P42	200	12	1020	42	42,840			14,994	57,800
wvr	WVR-P31	WVR-P33	12	570	42	23,940			8,379	32,300
wvr	WVR-P36	226	21	100	52	5,200			1,820	7,000
wvr	WVR-P52	447	12	1520	42	63,840			22,344	86,200
wvr	WVR-P53	455	12	1250	42	52,500			18,375	70,900
wvr	WVR-P54	462	12	880	42	36,960			12,936	49,900
wvr	WVR-P55	294	12	490	42	20,580	30.0	491,500	179,228	691,300
wvr	WVR-P56	301	12	1430	42	60,060			21,021	81,100
wvr	WVR-P23						5.2	91,393	31,988	123,400
wvr	WVR-P29						5.5	96,233	33,682	129,900
					Total	**$4,000,430**		**$679,127**	**$1,637,845**	**$6,310,300**

Pipe Cost Estimates

Dia.	Cost/Lf
12	$42
15	45
18	48
21	52
24	56
27	70
30	77
33	89
36	103
42	131
48	155
54	190
60	220
66	255
72	297
78	338
84	408
90	523
96	587
102	613
108	664
120	807

Notes:

1: Includes manholes, compaction, and restoration costs
2: Includes $7,500 for outlet structures, and $10.00/Cy for pond excavation
3: Includes engineering, administration, and 10% contingencies
4: Rounded to the nearest hundred
5: Based on ENR Construction Cost index December 2005 = 7646

APPENDIX E – Standards for Detention Basin Design

Appendix E

STANDARDS FOR DETENTION BASIN DESIGN
WATER QUALITY MANAGEMENT PROGRAM
CITY OF APPLE VALLEY

The following standards apply to all detention basin designs, as stated in the City of Apple Valley Surface Water Management Plan:

(1) Permanent pool volume shall be greater than or equal to the volume of runoff from a 2.5-inch rainstorm under full projected watershed development. This value has been derived from design criteria developed under NURP, with a 25% increase in volume to allow for roughly 25 years of sediment accumulation. In the summer, St. Paul climate, this sizing rule provides a mean hydraulic residence time of about 15 days.

(2) To promote settling and provide space for sediment accumulation, the mean depth of the permanent pool (volume/surface area) shall be greater than or equal to 4 feet. This constraint may be infeasible for small ponds (< approx. 2 acre-feet in volume), where mean depths of 3-4 feet may be used.

(3) To promote plug flow behavior, the ratio of length to maximum width shall be greater than or equal to 3. This constraint may be infeasible for some site plans or for small ponds. In such situations, baffles may be installed to isolate the inflow area from the remainder of the pond. A desirable alternative (for all pond sizes) is to construct two separate ponds in series with a total volume equal to that specified above (1). A staged design would consist of a smaller inflow pond for removal of coarse particulates followed by a larger, deeper outflow pond. Any length/width ratio can be used in staged designs.

(4) For safety purposes and to provide suitable habitat for rooted aquatic plants, an aquatic bench at least 10 feet in width and with a slope not steeper than 10 feet horizontal to 1 foot vertical shall extend into the pond from the shoreline at normal water level.

(5) To provide stability, the side slopes shall not be steeper than 3 feet horizontal to 1 foot vertical. Shallower slopes may be appropriate, depending upon soil engineering properties. Shallower slopes are more feasible for larger ponds.

(6) To prevent development of thermal stratification, loss of oxygen, and nutrient recycling from bottom sediments, the maximum depth of the permanent pool shall be less than or equal to 8 feet.

Other design features include provision of a shoreline buffer zone and access for maintenance.

APPENDIX F – Wetland Data Sheets and Classification Methodology

Appendix F
Wetland Assessment Summary Table
City of Apple Valley

Wetland ID	WD	Type	Floral Diversity/ Integrity	Wetland Restoration Potential	Overall Urban Quality	Direct Stormwater Input	Located in Public or Open Space	Within ¼ mile T/E species	Classification	Stormwater Susceptibility
19-115-20-**13-001**	VR	3	Low	Low	Medium	**x**			M3	Least
19-115-20-**13-002**	VR	3	Low	Medium	High	**x**	**x**		M3	Least
19-115-20-**13-003**	VR	2	Low	Low	High		**x**		M3	Least
19-115-20-**13-004**	VR	5	Medium	Medium	High	**x**	**x**		M3	Moderately
19-115-20-**13-005**	VR	5	Medium	Medium	High	**x**	**x**		M3	Moderately
19-115-20-**14-001**	VR	5	Low	Exceptional	High	**x**	**x**		M2R	Least
19-115-20-**14-002**	VR	4	Medium	High	High	**x**	**x**		M1R	Moderately
19-115-20-**14-003**	VR	5	Medium	High	High	**x**	**x**		M1R	Moderately
19-115-20-**14-004**	VR	2	Medium	High	Medium		**x**		M1	Moderately
19-115-20-**14-005**	VR	2	Low	High	Medium		**x**		M3	Least
19-115-20-**14-006**	VR	2	Medium	Medium	High		**x**		M1	Moderately
19-115-20-**14-007**	VR	3/5	Medium	Low	High				M1	Moderately
19-115-20-**16-005**	BD	2	Low	Low	Medium	**x**			M3	Least
19-115-20-**16-008**	BD	5	Low	Medium	Medium	**x**	**x**		M3	Least
19-115-20-**16-017**	BD	5	Medium	Exceptional	High	**x**	**x**		M1R	Moderately
19-115-20-**16-022**	BD	3	Low	Exceptional	Medium		**x**		M2R	Least
19-115-20-**16-023**	BD	5	Medium	Exceptional	High	**x**	**x**		M1R	Moderately
19-115-20-**16-026**	BD	2	Low	High	High	**x**	**x**		M3	Least
19-115-20-**16-027**	BD	2/3	Medium	Medium	Medium				M1	Moderately
19-115-20-**16-030**	BD	5	Medium	High	Medium	**x**	**x**		M1R	Moderately
19-115-20-**16-031**	BD	5	Low	Low	Medium				M3	Least
19-115-20-**16-032**	BD	5	Medium	High	High	**x**			M2	Moderately
19-115-20-**16-033**	BD	3	Medium	High	Medium	**x**			M2	Moderately
19-115-20-**16-034**	BD	5	Medium	Medium	Medium	**x**	**x**		M2R	Moderately
19-115-20-**16-035**	BD	5	Low	Low	High	**x**			M3	Least
19-115-20-**16-036**	BD	3	High	Exceptional	High				P	Moderately
19-115-20-**17-021**	BD	5	Medium	Medium	Medium				M1	Moderately

Appendix F
Wetland Assessment Summary Table
City of Apple Valley

Wetland ID		Type	Floral Diversity/ Integrity	Wetland Restoration Potential	Overall Urban Quality	Direct Stormwater Input	Located in Public or Open Space	Within ¼ mile rare or T/E species	Classification	Stormwater Susceptibility
19-115-20-**17-022**	BD	3	Medium	Low	Medium	**X**			M3	Moderately
19-115-20-**17-024**	BD	5	Low	Low	High	**x**			M3	Least
19-115-20-**20-003**	VR	3/6	High	Medium	High	**x**		**x**	P	Moderately
19-115-20-**20-018**	BD	5	Medium	High	High	**x**		**x**	P	Moderately
19-115-20-**21-004**	BD	5	Low	Low	Medium				M3	Least
19-115-20-**21-005**	BD	1/7	Low	Low	Medium	**x**			M3	Slightly
19-115-20-**21-006**	BD	2	Low	Medium	Medium				M3	Least
19-115-20-**23-001**	VR	5	Low	Low	High	**x**			M3	Least
19-115-20-**23-002**	VR	1/7	Medium	Medium	High		**x**		M1	Highly
19-115-20-**23-003**	VR	4	Low	Low	Medium	**x**	**x**	**x**	P	Least
19-115-20-**23-004**	VR	5	Low	Low	Medium	**x**	**x**	**x**	P	Least
19-115-20-**23-006**	VR	5	Low	Low	Medium	**x**	**x**		M3	Least
19-115-20-**23-008**	VR	2/3/6	Low	High	High		**x**		M3	Least
19-115-20-**24-001**	VR	5	Medium	Medium	High	**x**			M3	Moderately
19-115-20-**24-002**	VR	2/3/5 /6	Low	Low	High	**x**			M3	Least
19-115-20-**24-003**	VR	5	Low	Low	High	**x**			M3	Least
19-115-20-**24-004**	VR	5	Low	Low	High	**x**			M3	Least
19-115-20-**25-001**	VR	2/3/6	Low	Medium	High	**x**	**x**		M3	Least
19-115-20-**25-002**	VR	5	Low	Medium	High	**x**	**x**		M3	Least
19-115-20-**25-003**	VR	5	Low	Medium	High	**x**	**x**	**x**	P	Least
19-115-20-**29-001**	VR	5	Low	High	Medium	**x**			M3	Least
19-115-20-**33-001**	VR	5	Low	Medium	Medium	**x**			M3	Least
19-115-20-**33-002**	VR	5	Medium	Low	Medium	**x**			M3	Moderately

Totals

Protect (P) = 6; Manage 1 (M1, M1R) = 11; Manage 2 (M2, M2R) = 5; Manage 3 (M3) = 28

Appendix F

Apple Valley Wetland Assessment Methodology

1. Review NWI data, create preliminary maps, and review Natural Heritage and T/E species databases.

2. Determine wetlands to be assessed.

3. Assign Wetland ID.

4. Field evaluation using database (see summary of field assessment below).
    a. MnRAM V3.0 – Vegetative Diversity and Integrity Section
    b. New Hampshire Method – Urban Section
    c. Restoration\Enhancement Potential Evaluation
    d. Record any additional field observations including presence of direct stormwater inputs.

5. Rate stormwater susceptibility based on wetland community and vegetative diversity/integrity.

6. Rate functions for each wetland based on field evaluation and classify wetland according to wetland classification system (Figure 6.1).

Summary of Apple Valley Wetland Field Assessment

General Information

Evaluator, Date, County, City, Section, TWP, Range, Picture #, Subdistrict, OHW, DNR Wetland ID, Circular 39 Type

Access denied. Yes/No

Total size (acres).

No wetland? Entire wetland filled? Wetland part of another (via excavation)? Potential Restoration?

Describe temporal factors of this assessment due to seasonal considerations and/or existing hydrologic and climatologic conditions (e.g. after heavy rains, snow or ice cover, frozen soil, during drought period, during spring flood, bird migration).

List all inlets and outlets.

Appendix F

Vegetation Section

List community type and percent cover of wetland by each community.

Community ID, Percent Cover, NWI/Cowardin

MnRAM Community Type.

MnRAM Quality.

List dominant species (>10%).

List other species.

List invasive species.

Community Hydrology.

Beaver Pond, Ditched, Tiled, Farmed, Diked/Impounded, Art. Substrate, Spoil, Excavated, Stm. Mgmt, Wildlife Mgmt, Reservoir, Livestock watering hole, Stream present, Ditch present, Grnd discharge/Springs present, Fill added, Mowed, Grazed, Docks added.

Restoration Section

1. Indicate the number of landowners that would be affected by the wetland restoration project.

- Exceptional : Completely within public ownership
- High: 1
- Moderate: 2
- Low: 3 or more

2. What percent of the wetland is surrounded by public land?

- Exceptional: 75-100%
- High: 50-74%
- Moderate: 25-49%
- Low: < 25%

3. Does the wetland have potential for hydrologic restoration without flooding: roads, houses, septic systems, golf courses or other permanent infrastructure (active agricultural fields are acceptable uses within potential restoration areas) within the restoration area?

If yes: 4. Indicate the type of hydrologic alteration.

Appendix F

5. Enter the existing wetland area and estimated size of the total wetland if effectively drained or filled areas were restored (not including any buffer areas).

- § Size of existing wetland.
- § Total wetland including restorable and existing wetland.
- § Calculated potential new wetland area.

6. Rate the opportunity to restore the ecological connectivity of this wetland to other areas.

- Exceptional: Currently connected to other natural/semi-natural areas that may include wetland and/or upland areas.
- High : Basin has good opportunity to restore connectivity to extensive natural communities that appear to be in good condition, and thus both wildlife and aesthetic value of the area could be improved by enhancing wetland quality.
- Moderate: Basin is near or adjacent to smaller areas of woods, prairie, or old field, or is at one end of a corridor.
- Low : Basin is isolated within an intensely used landscape, such as agricultural field, urban, or development setting.

7. Rate the potential ease of wetland restoration.

- Exceptional
- High
- Moderate
- Low

8. Indicate the potential restoration wetland classification according to the Circular 39 (USFWS, 1956): Types 1-8.

9. Comments

10. Enter the average width of naturalized upland buffer that could potentially be established around the restored wetland.

11. Current Buffer Width.

12. Dominant Vegetation Type.

13. Rate the Condition of the existing buffer.

- Exceptional – Unmowed herbaceous buffer at least 25’ wide.
- Good – Unmowed buffer, 12-24’ wide
- Moderate – Unmowed buffer, 3-11’ wide
- Low – Buffer less than 3’, mowed to edge or bordered by impervious

14. List and estimate the aerial cover of ALL exotic/invasive species present within the buffer.

15. Rate the ease in restoration/planting aquatic vegetation.

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- NA: Wetland type does not support aquatic vegetation.
- Exceptional: Adequate aquatic vegetation present, little to no effort required.
- Good: Minor bounce, geese/muskrats, substrate, low sedimentation, and other conditions appear conducive to planting. Aquatic shelf 1' or less, and >=8' wide.
- Moderate: Several feet of vertical bounce evident, substrate as well as evidence of herbivores and moderate sedimentation would likely make restoration of aquatic plants more problematic. Aquatic shelf 1' or less deep and 5-7' wide.
- Low: More than 3 feet of vertical bounce evident, substrate not conducive to planting, clear signs of heavy sedimentation and herbivores such as geese/muskrat. Aquatic shelf <= 1' deep, less than 5' wide.

16. Comments

17. Rate the wetland vegetation restoration potential.
    - Exceptional – Wetland currently has a good to excellent quality plant community, minimal or no effort required to maintain.
    - High – site has good quality plant communities, minimal effort required to restore composition, structure, and function for community type. Efforts needed include minor species reintroduction, limited management via cutting, spot herbicide treatment, prescribed fire, and/or other practices within the wetland. Limited exotic/invasive species infestations
    - Moderate – Moderate quality site, some physical and financial efforts required to restore vegetation. E.g., reseeding portions of the wetland, and multi-year efforts that include a variety of management tools.

      Wetland: includes crop field that can be seeded, hydrologically restored, and has potential to achieve moderate quality within 5 – 25 years, and existing wetland communities with low to moderate exotic/invasive species infestations.
      Watershed: moderate efforts required to restore historic quantity/quality of waters reaching wetland.

    - Low – Low quality sites, often dominated by nonnative species, or be in a cultivated field known to have problem species (onsite or in seedbank). Restoration/improvement requires substantial efforts over 10 – 30 or more years. Examples include reseeding of significant portions of wetland, multi-decade restoration efforts requiring a variety of management tools, both within the wetland and in the immediately surrounding upland buffer.

      Wetland: crop field that can be seeded and hydrologically restored, but would require significant long-term maintenance in order to achieve at least moderate quality in 20 – 100+ years, or severe levels of exotic species (note potential seedbank both onsite and through tributary systems).

      Watershed: significant efforts to restore vegetation are necessary, or development is complete (or nearly so) and there are few opportunities for corrective action.

Appendix F

New Hampshire Method Section

1. Dominant land use within 0.5 miles of the wetland
   - High: C/I/HDR/Trans
   - Moderate: Rural/Res
   - Low: Ag/Open Space

2. Rate of development within 0.5 miles of the wetland
   - High: Rapidly Developing/Developed
   - Moderate: Moderate Development
   - Low: Little/No Development

3. Area of shallow permanent open water (including streams)
   - High: >= 0.5 acre
   - Low: < 0.5 acre

4. Wetland Diversity
   - High: Two or more communities
   - Low: One community

5. Stream corridor vegetation
   - High: >75% of stream corridor is covered in mixed veg for 1000' up/down stream
   - Mod: 25% - 75% of stream corridor is covered in mixed veg for 1000' up/down stream
   - Low: <25% of stream corridor is covered in mixed veg for 1000' up/down stream

6. Number of wetland classes visible from primary viewing location
   - High: Two or more classes
   - Low: One class

7. Approximate extent of open water visible from primary viewing location(s)
   - High: >= 0.5 Ac. or 200' of stream
   - Low: < 0.5 acre or 200” of stream

8. Area of wetland dominated by flowering trees or shrubs, OR shrubs which turn vibrant colors in the fall.
   - High: >= 1.0 acre
   - Low: <1.0 acre

9. General appearance of wetland visible from primary viewing location(s).
   - High: No major detractors
   - Moderate: Some detractors not easily removed
   - Low: Major detractors not easily removed

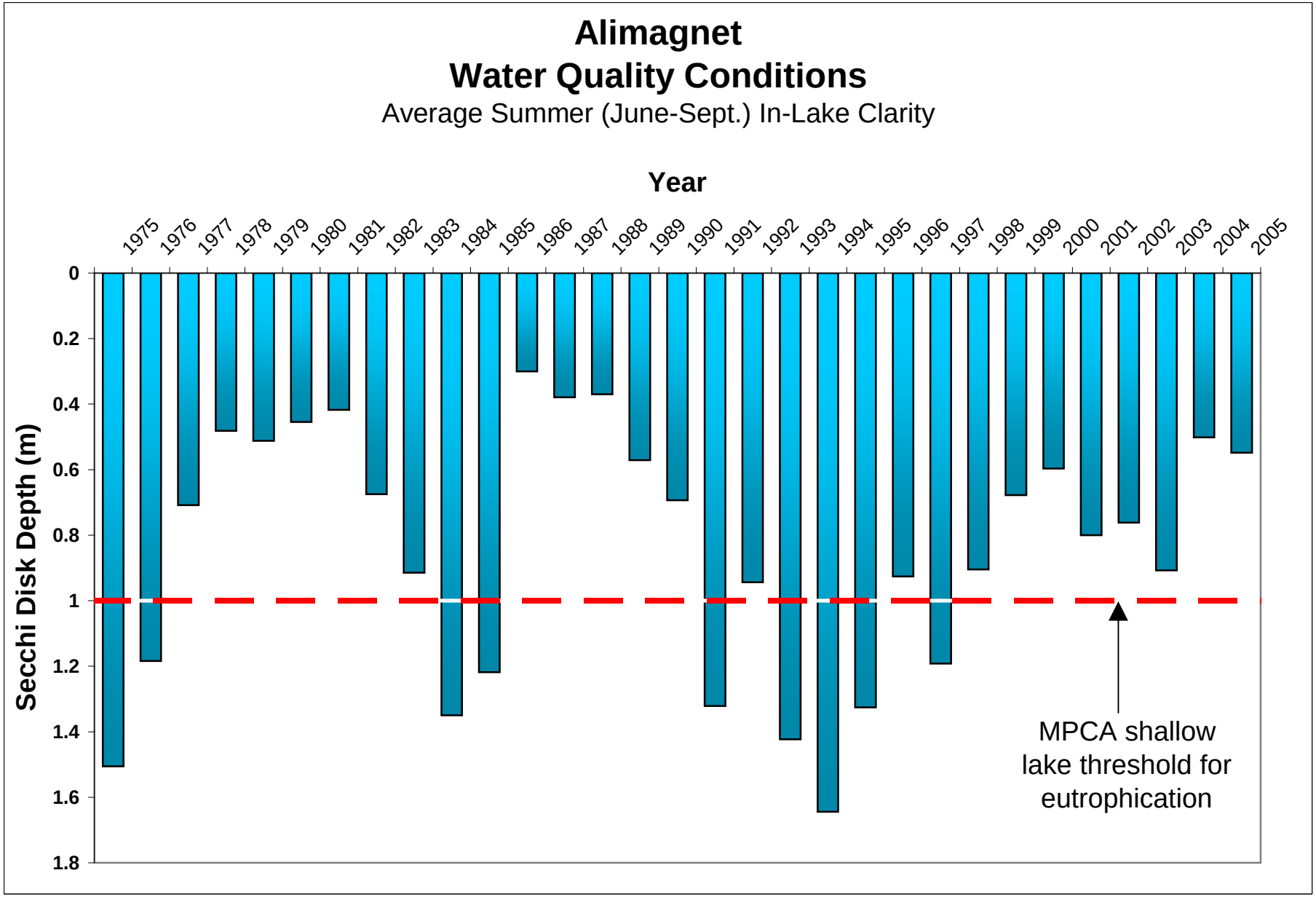
Appendix F

10. Water quality of watercourse, pond, or lake associated with the wetland
    - High: Minimal pollution
    - Medium: Moderate pollution
    - Low: STINKY WATER!

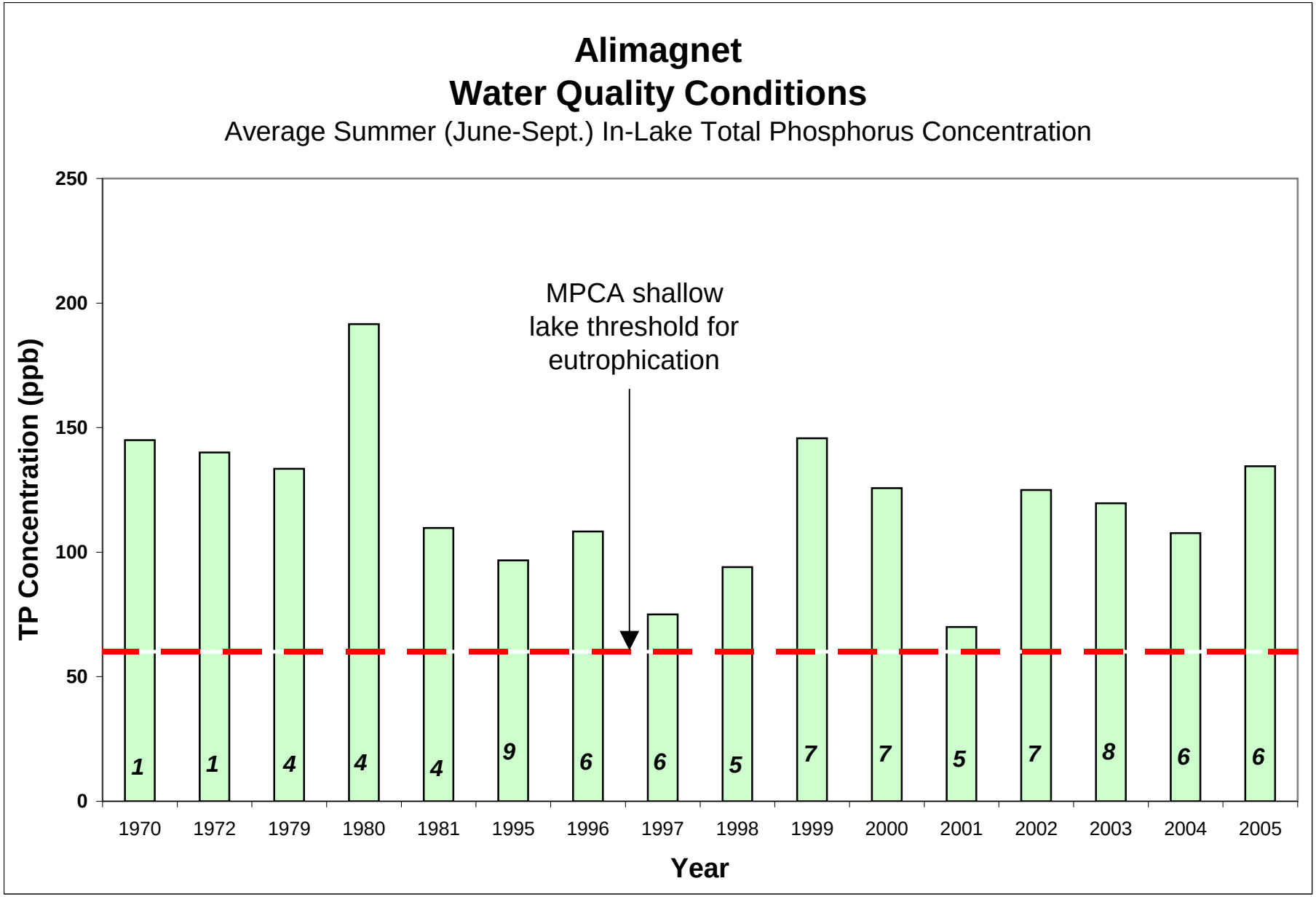
11. Hazard(s) which may limit public use
    - High: No major hazards and/or correctable hazards
    - Moderate: Existing hazards moderately difficult to correct
    - Low: Major hazards difficult and/or $$ to correct

APPENDIX G – Water Quality Information

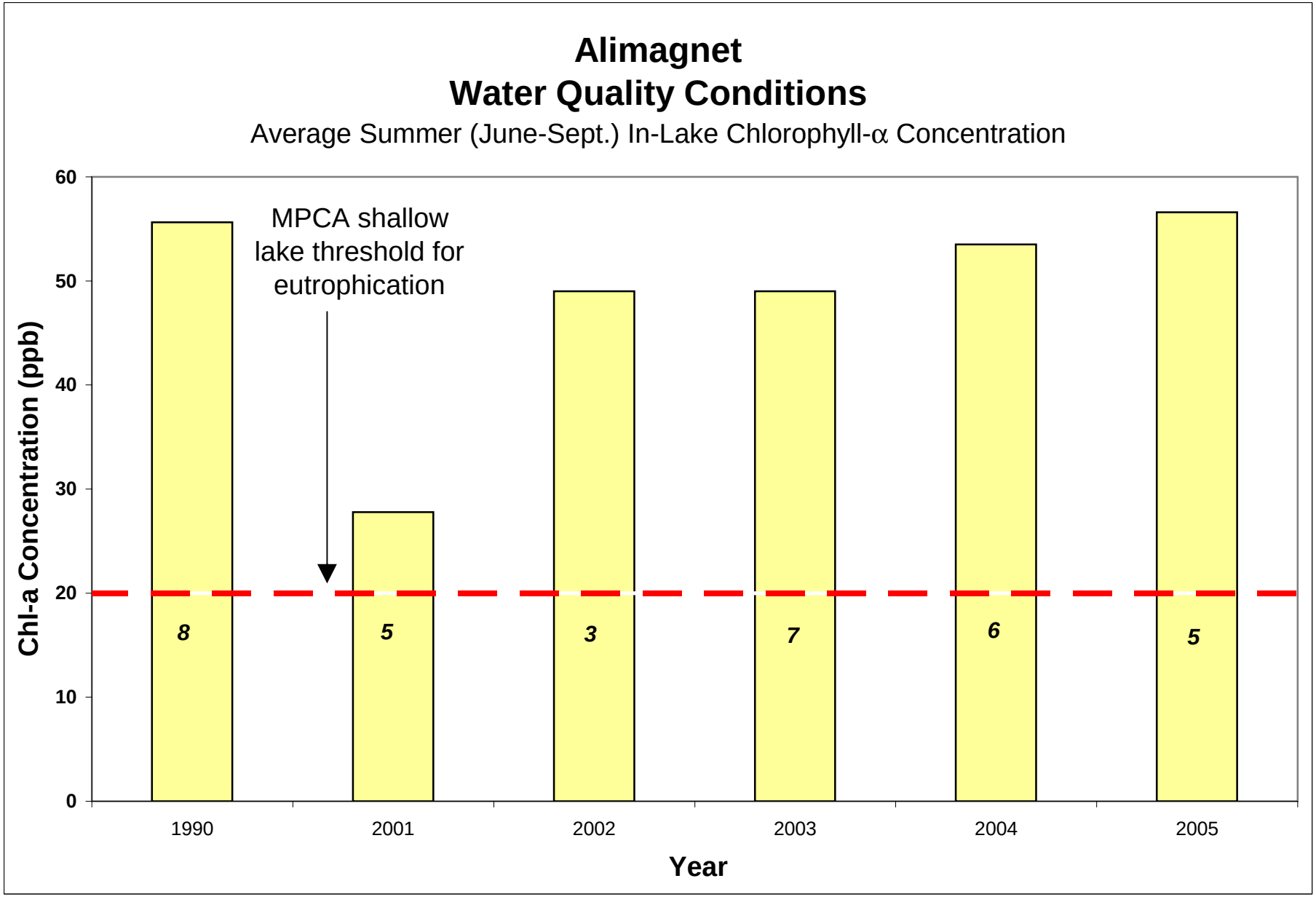
Appendix G


Alimagnet
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Clarity
Year
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Secchi Disk Depth (m)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
MPCA shallow lake threshold for eutrophication

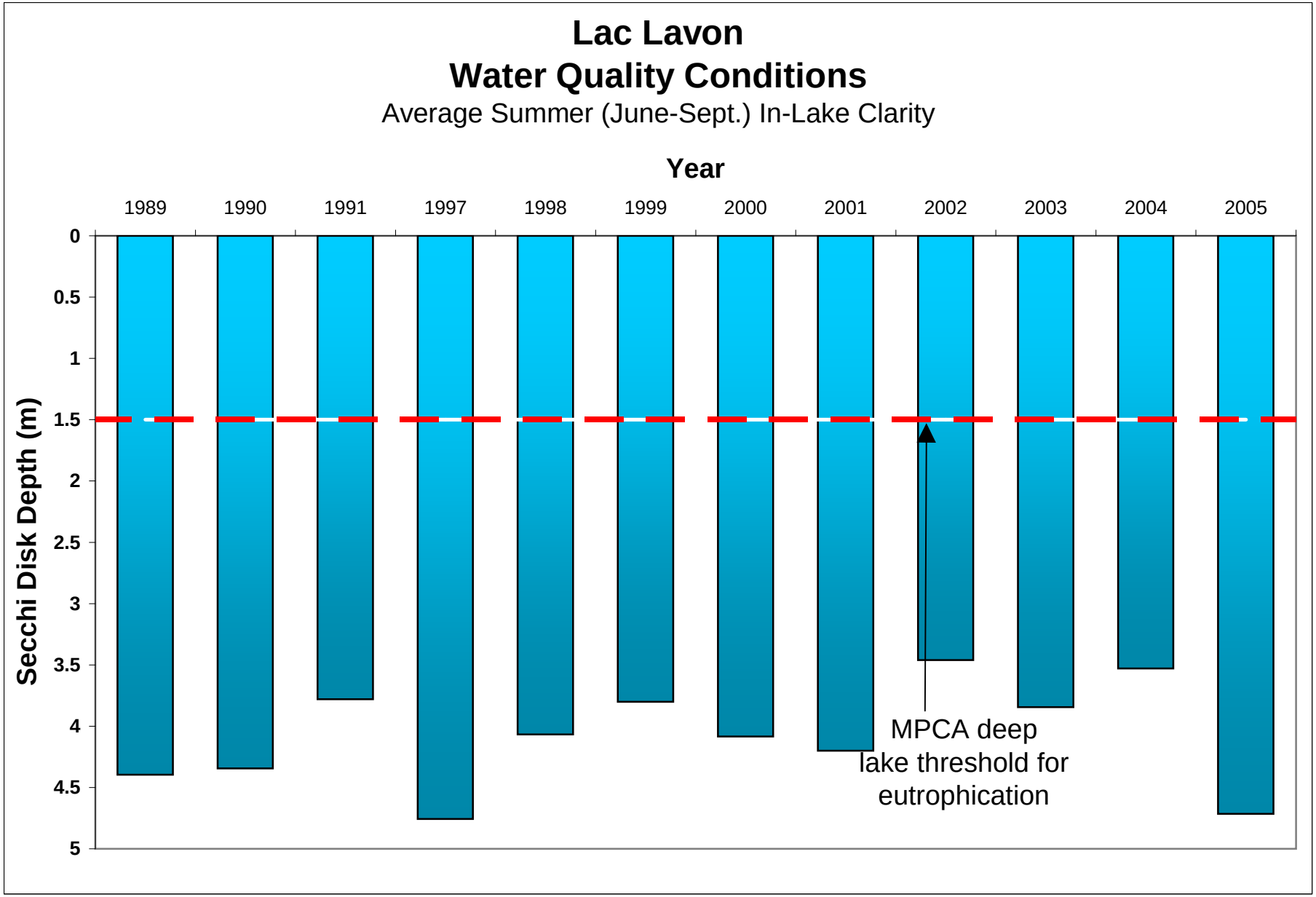
Appendix G


Alimagnet
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Total Phosphorus Concentration
MPCA shallow lake threshold for eutrophication
TP Concentration (ppb)
250
200
150
100
50
0
1
1
4
4
4
9
6
6
5
7
7
5
7
8
6
6
1970
1972
1979
1980
1981
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year

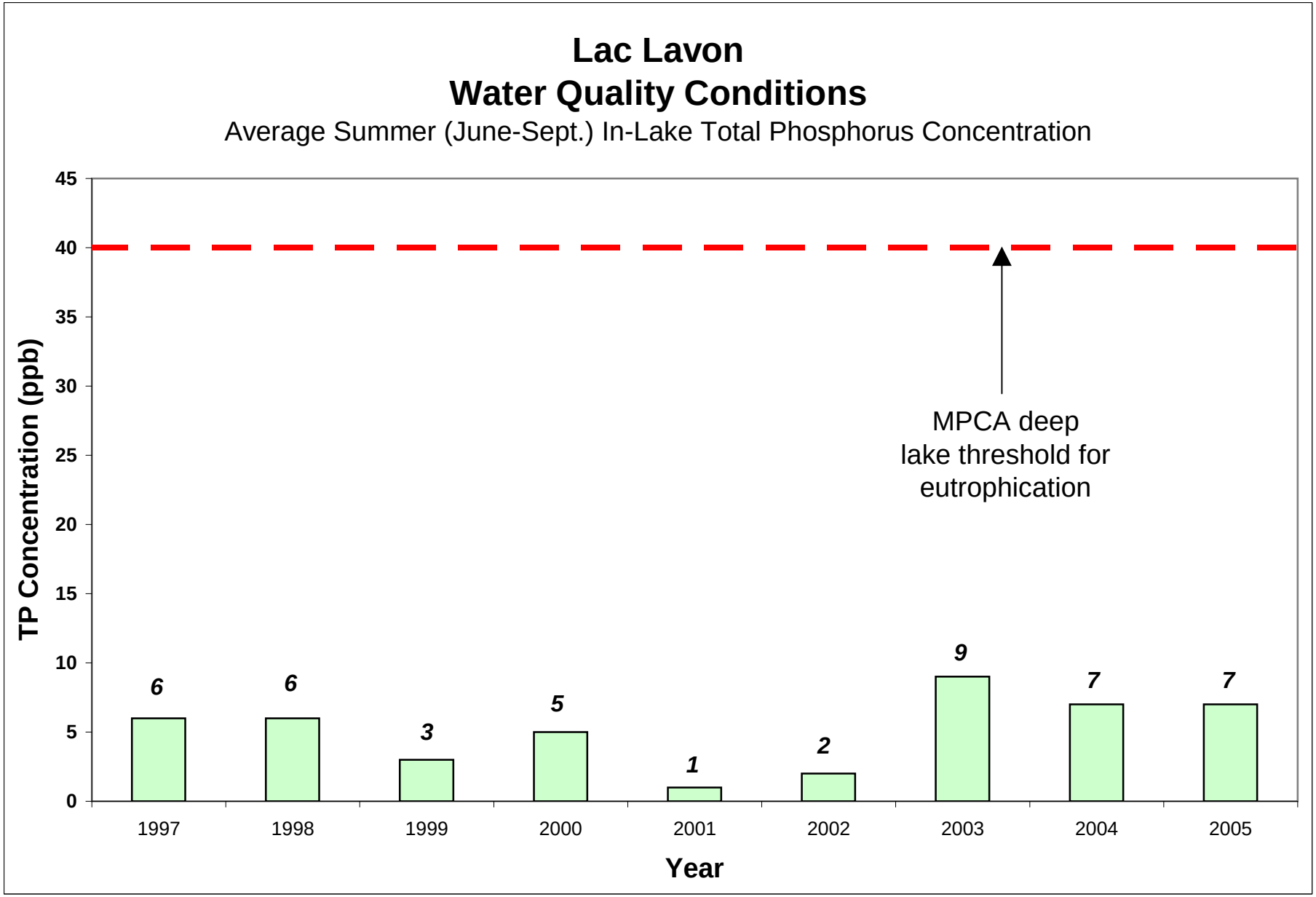
Appendix G


Alimagnet
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Chlorophyll-α Concentration
MPCA shallow lake threshold for eutrophication
Chl-a Concentration (ppb)
60
50
40
30
20
10
0
8
5
3
7
6
5
1990
2001
2002
2003
2004
2005
Year

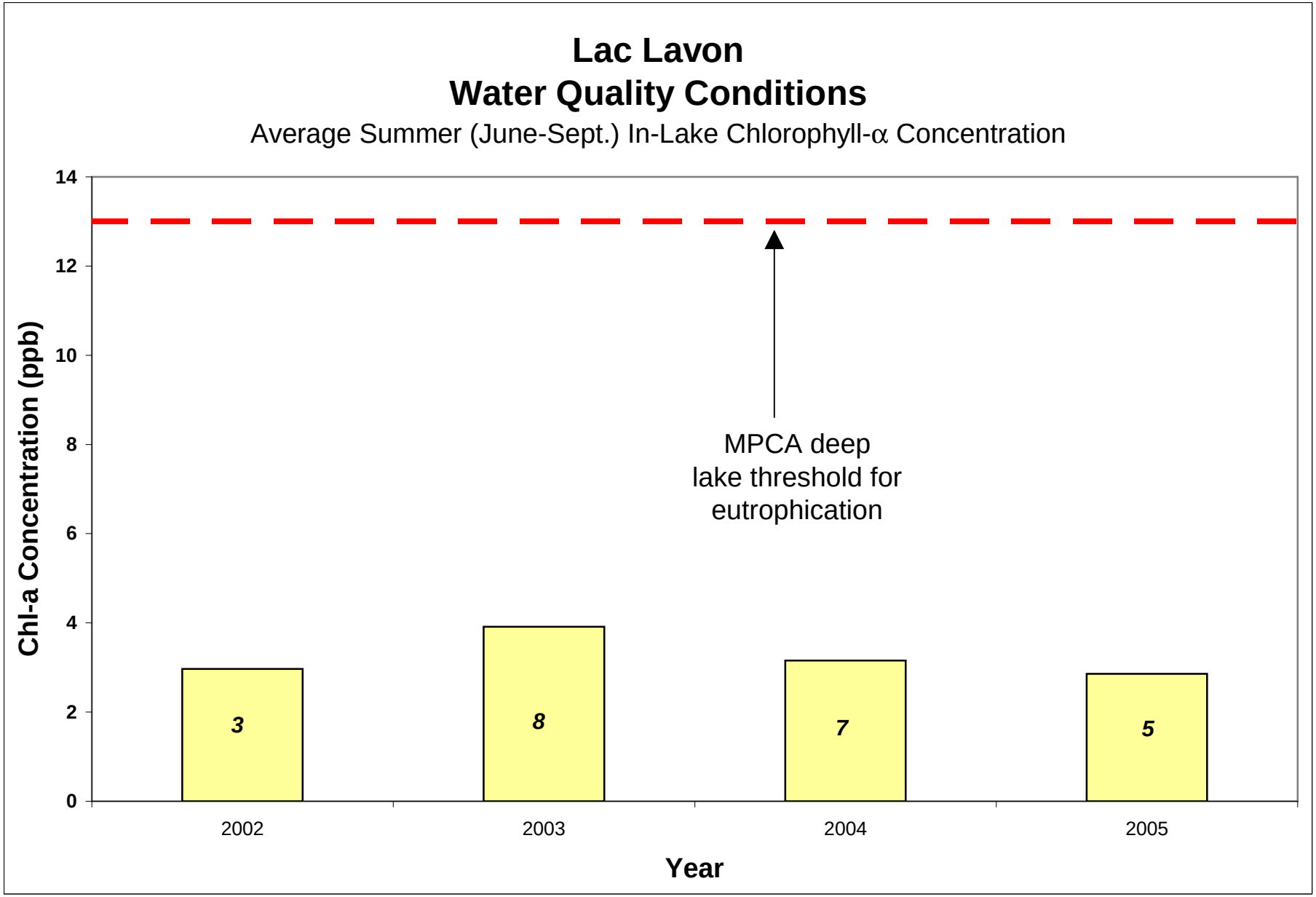
Appendix G


Lac Lavon
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Clarity
Year
1989
1990
1991
1997
1998
1999
2000
2001
2002
2003
2004
2005
Secchi Disk Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
MPCA deep lake threshold for eutrophication

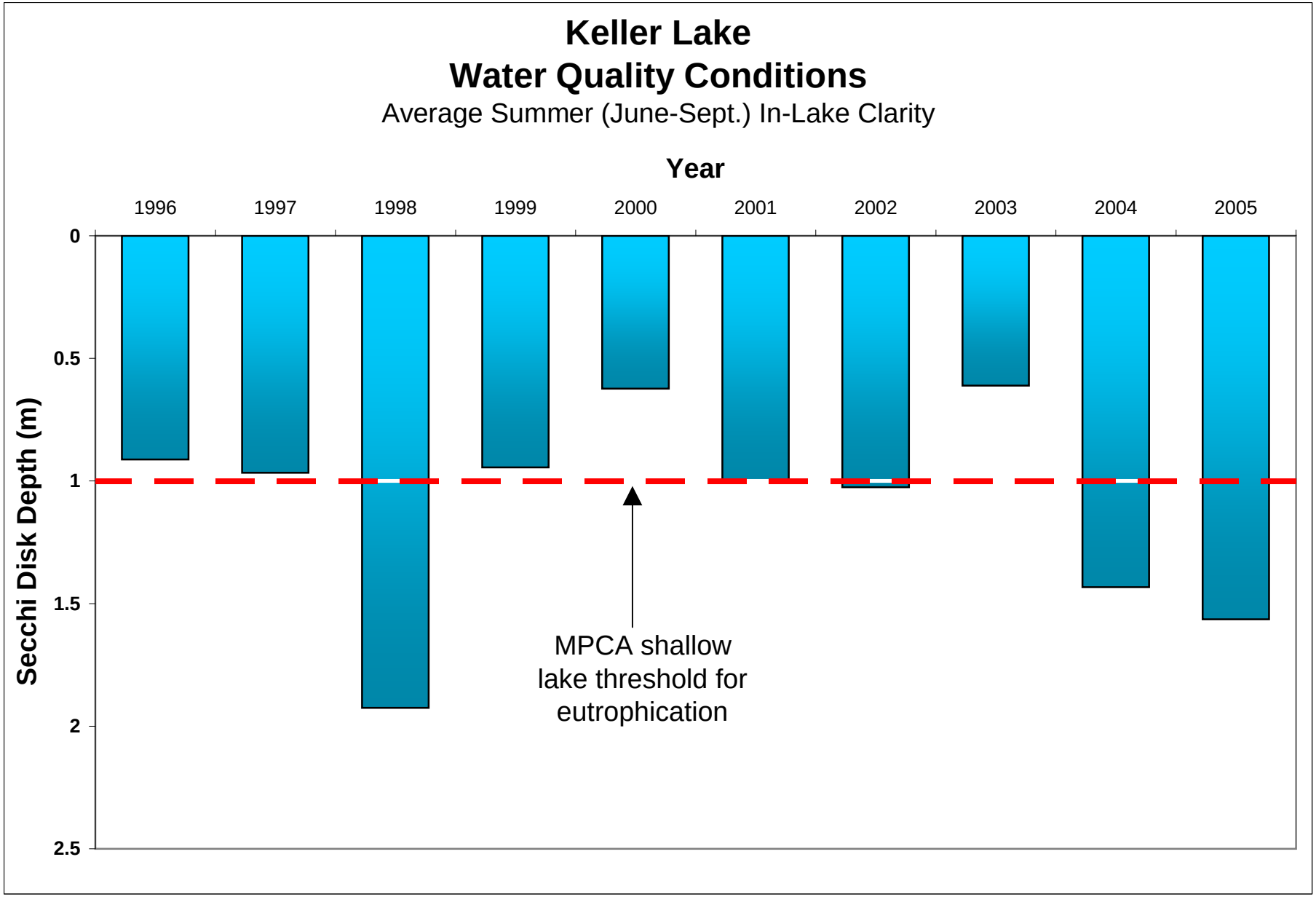
Appendix G


Lac Lavon
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Total Phosphorus Concentration
TP Concentration (ppb)
45
40
35
30
25
20
15
10
5
0
MPCA deep lake threshold for eutrophication
6
6
3
5
1
2
9
7
7
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year

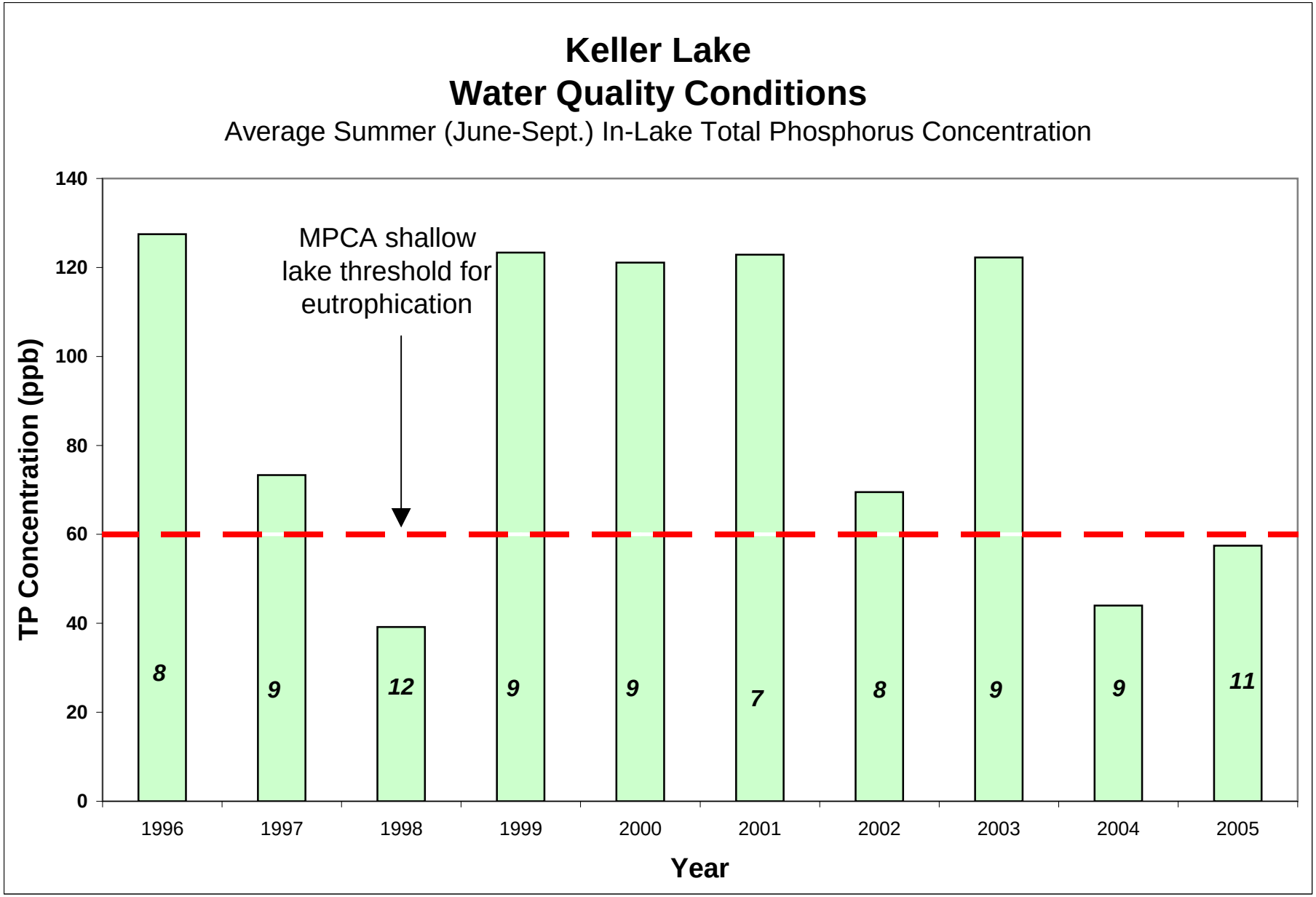
Appendix G


Lac Lavon
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Chlorophyll-α Concentration
Chl-a Concentration (ppb)
14
12
10
8
6
4
2
0
MPCA deep lake threshold for eutrophication
3
8
7
5
2002
2003
2004
2005
Year

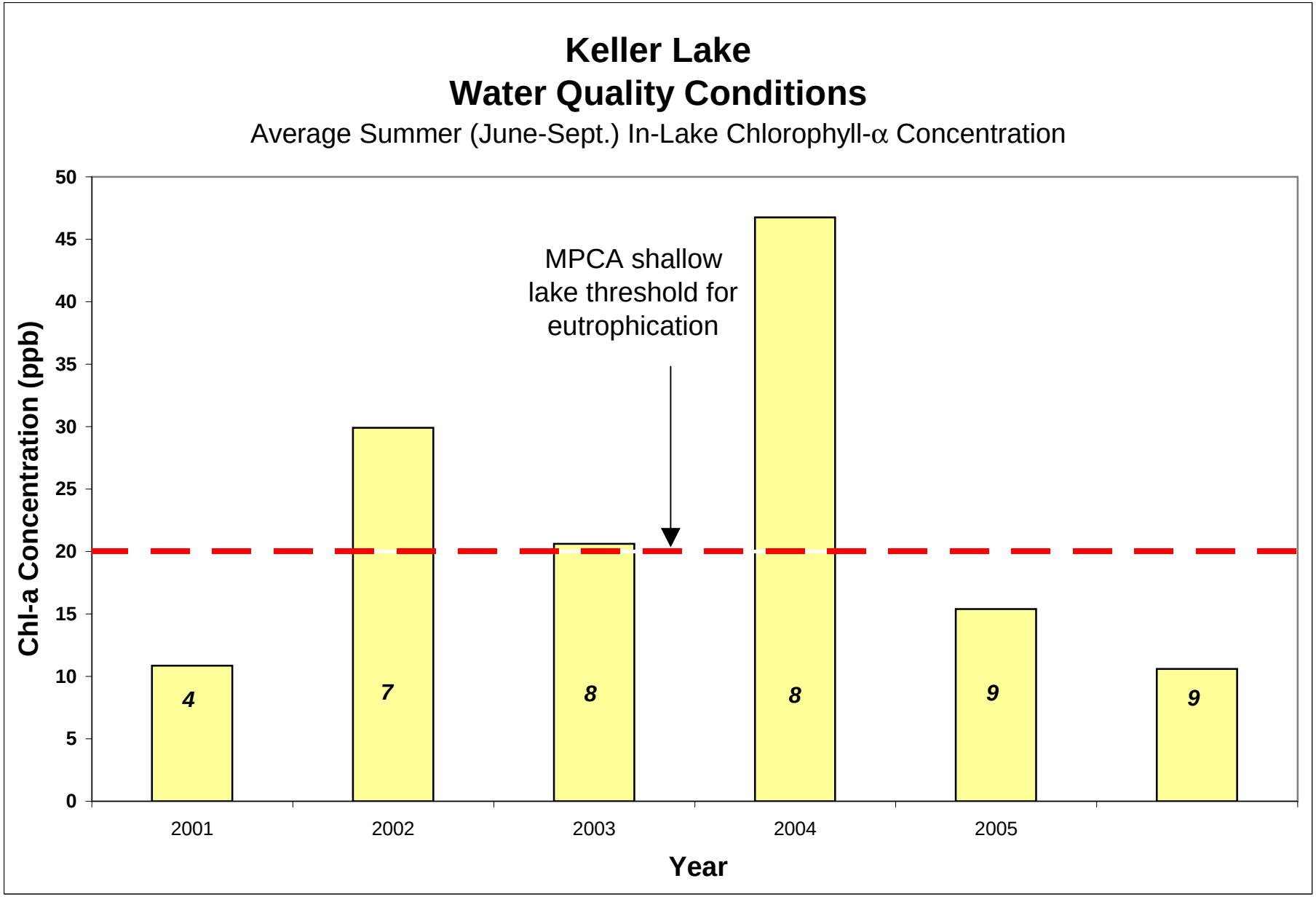
Appendix G


Keller Lake
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Clarity
Year
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Secchi Disk Depth (m)
0
0.5
1
1.5
2
2.5
MPCA shallow lake threshold for eutrophication

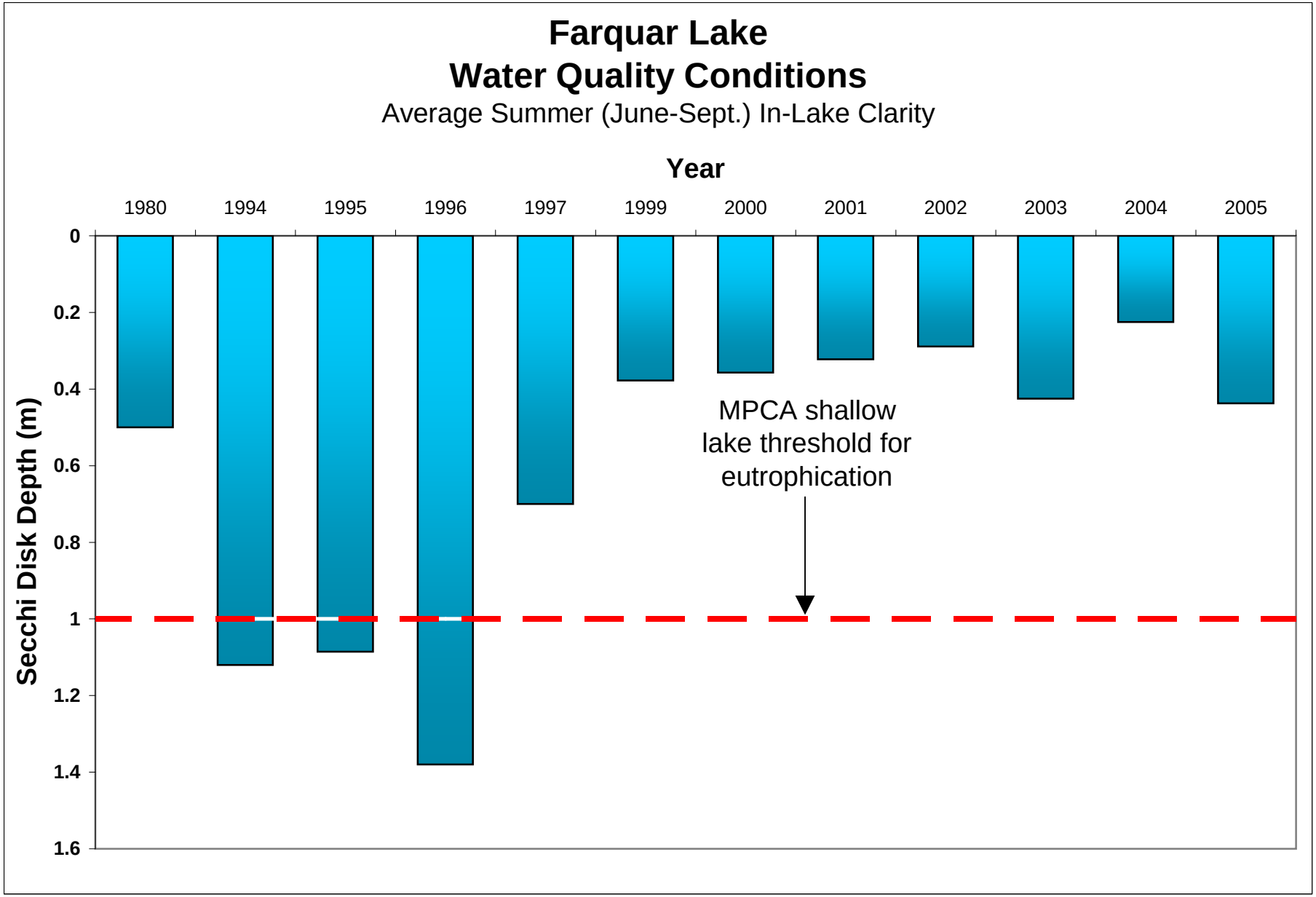
Appendix G


Keller Lake
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Total Phosphorus Concentration
MPCA shallow lake threshold for eutrophication
TP Concentration (ppb)
140
120
100
80
60
40
20
0
8
9
12
9
9
7
8
9
9
11
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year

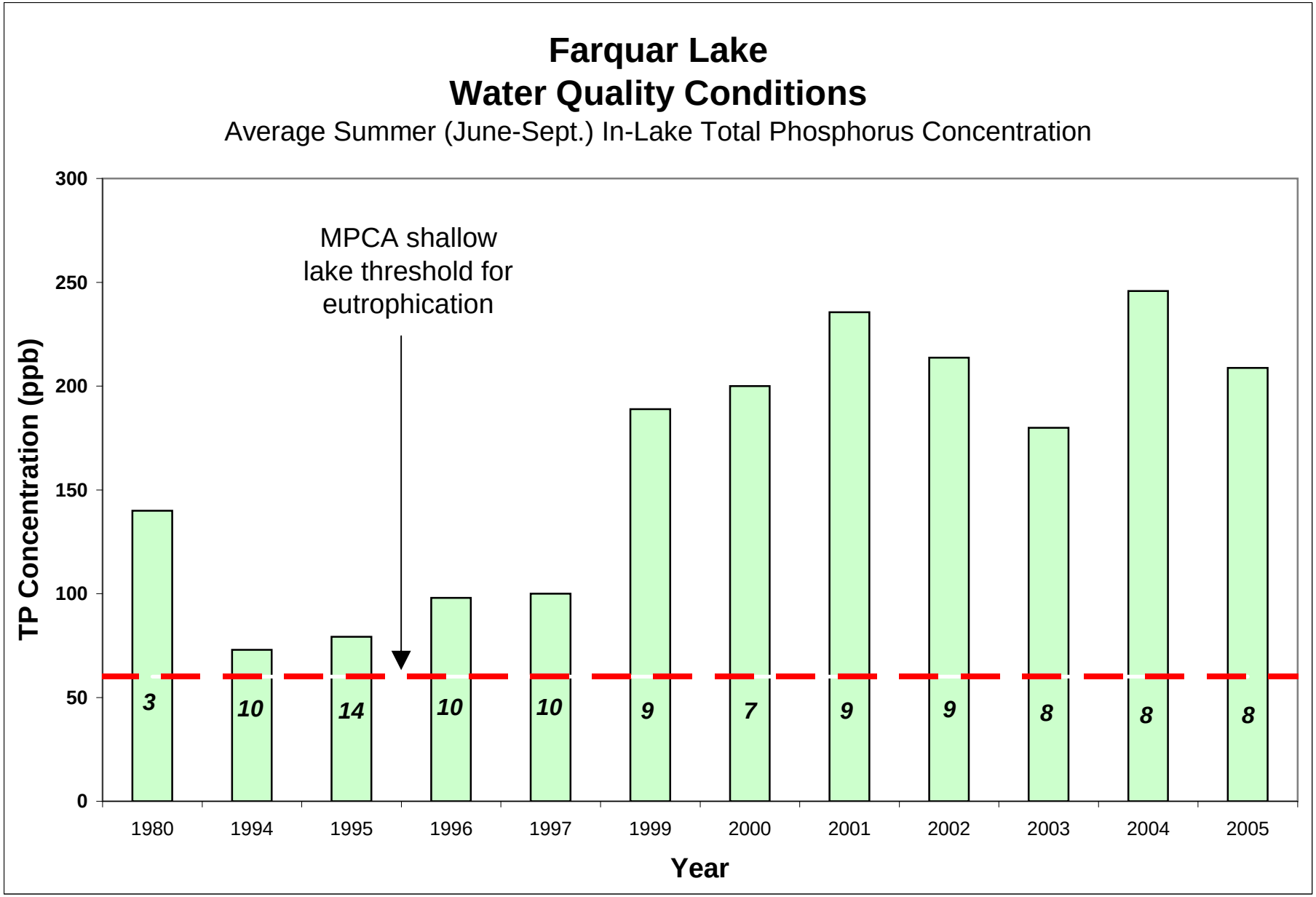
Appendix G


Keller Lake
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Chlorophyll-α Concentration
Chl-a Concentration (ppb)
50
45
40
35
30
25
20
15
10
5
0
MPCA shallow lake threshold for eutrophication
4
7
8
8
9
9
2001
2002
2003
2004
2005
Year

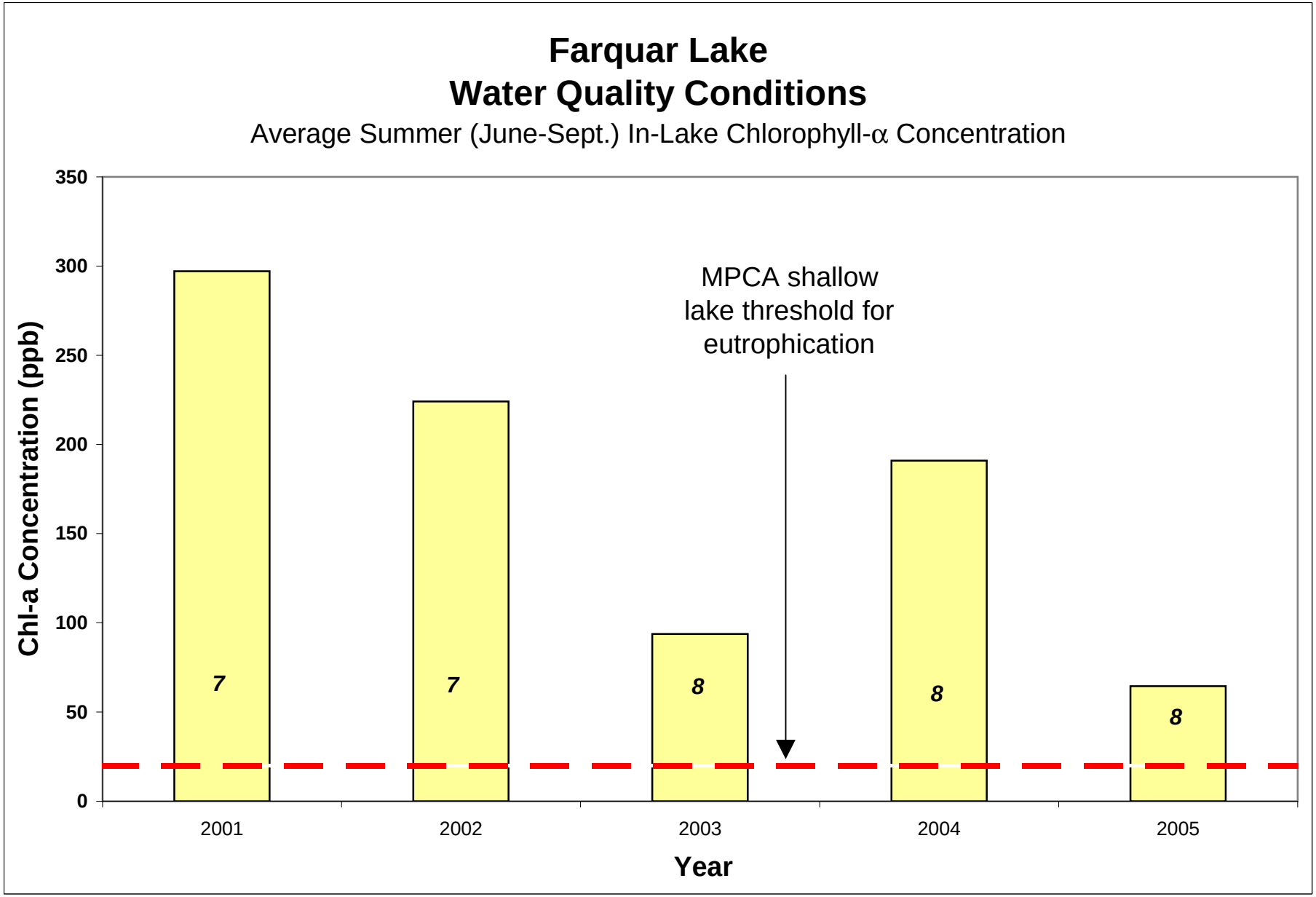
Appendix G


Farquar Lake
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Clarity
Year
1980
1994
1995
1996
1997
1999
2000
2001
2002
2003
2004
2005
Secchi Disk Depth (m)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
MPCA shallow lake threshold for eutrophication

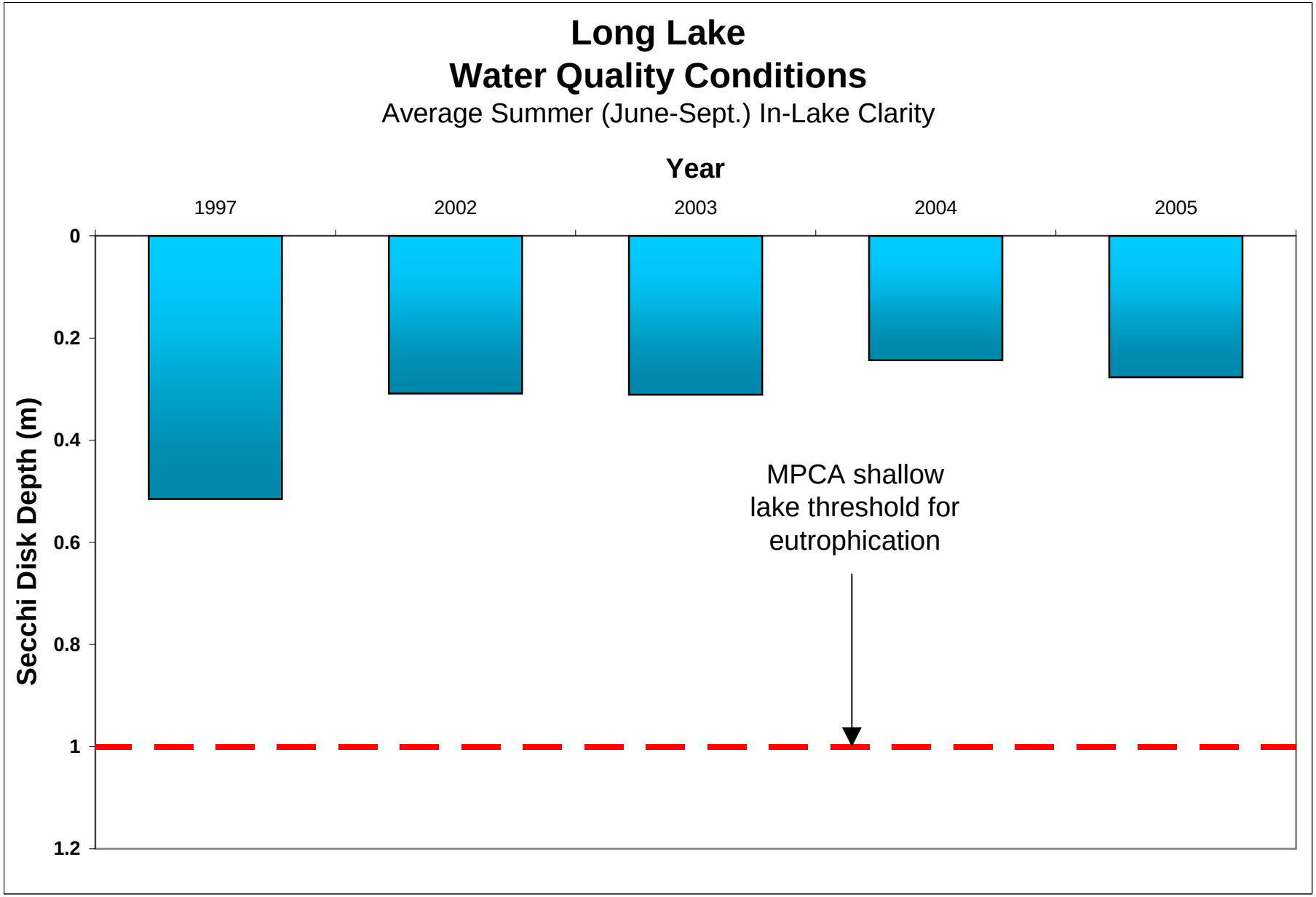
Appendix G


Farquar Lake
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Total Phosphorus Concentration
MPCA shallow lake threshold for eutrophication
TP Concentration (ppb)
300
250
200
150
100
50
0
3
10
14
10
10
9
7
9
9
8
8
8
1980
1994
1995
1996
1997
1999
2000
2001
2002
2003
2004
2005
Year

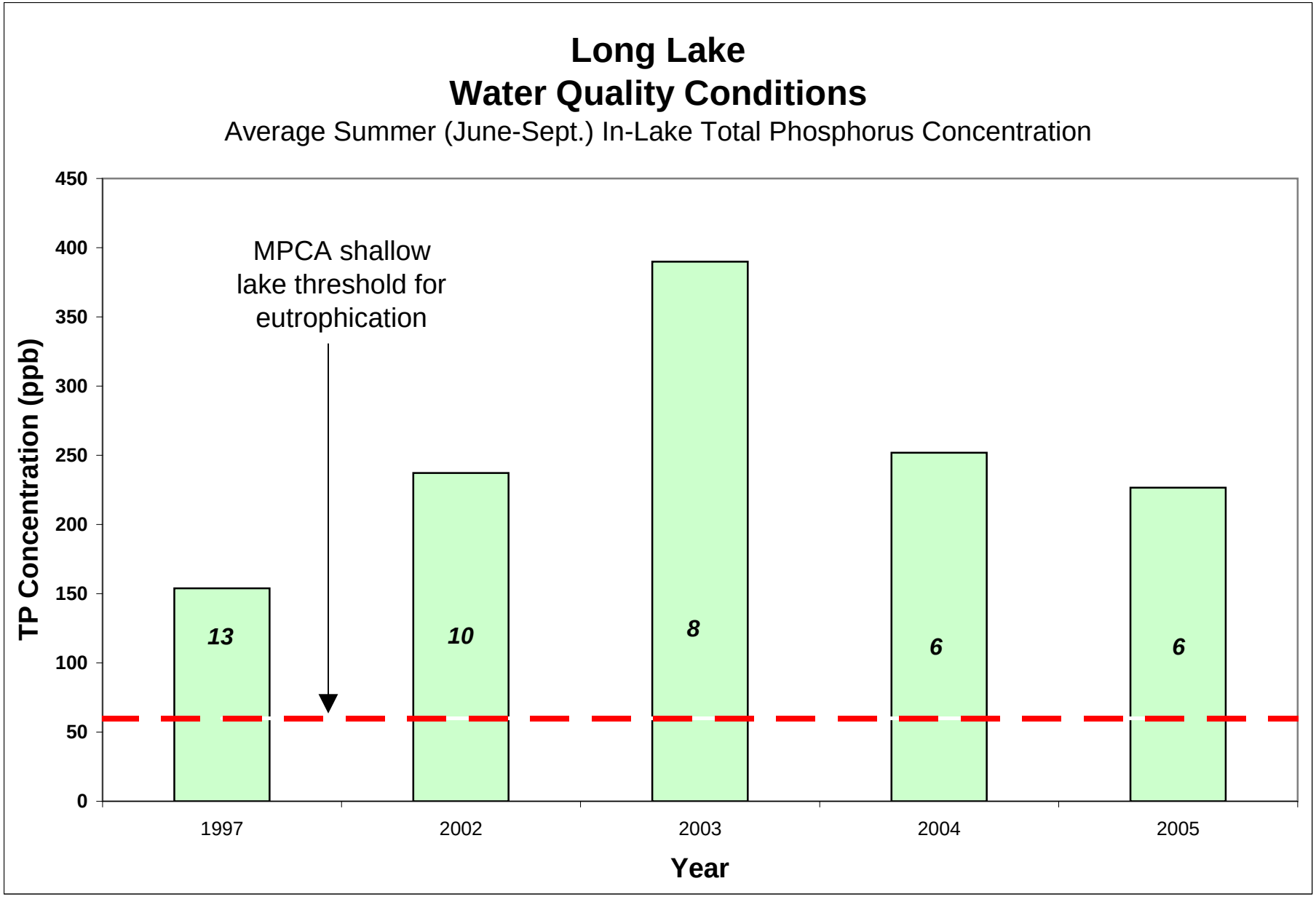
Appendix G


Farquar Lake
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Chlorophyll-α Concentration
Chl-a Concentration (ppb)
350
300
250
200
150
100
50
0
MPCA shallow lake threshold for eutrophication
7
7
8
8
8
2001
2002
2003
2004
2005
Year

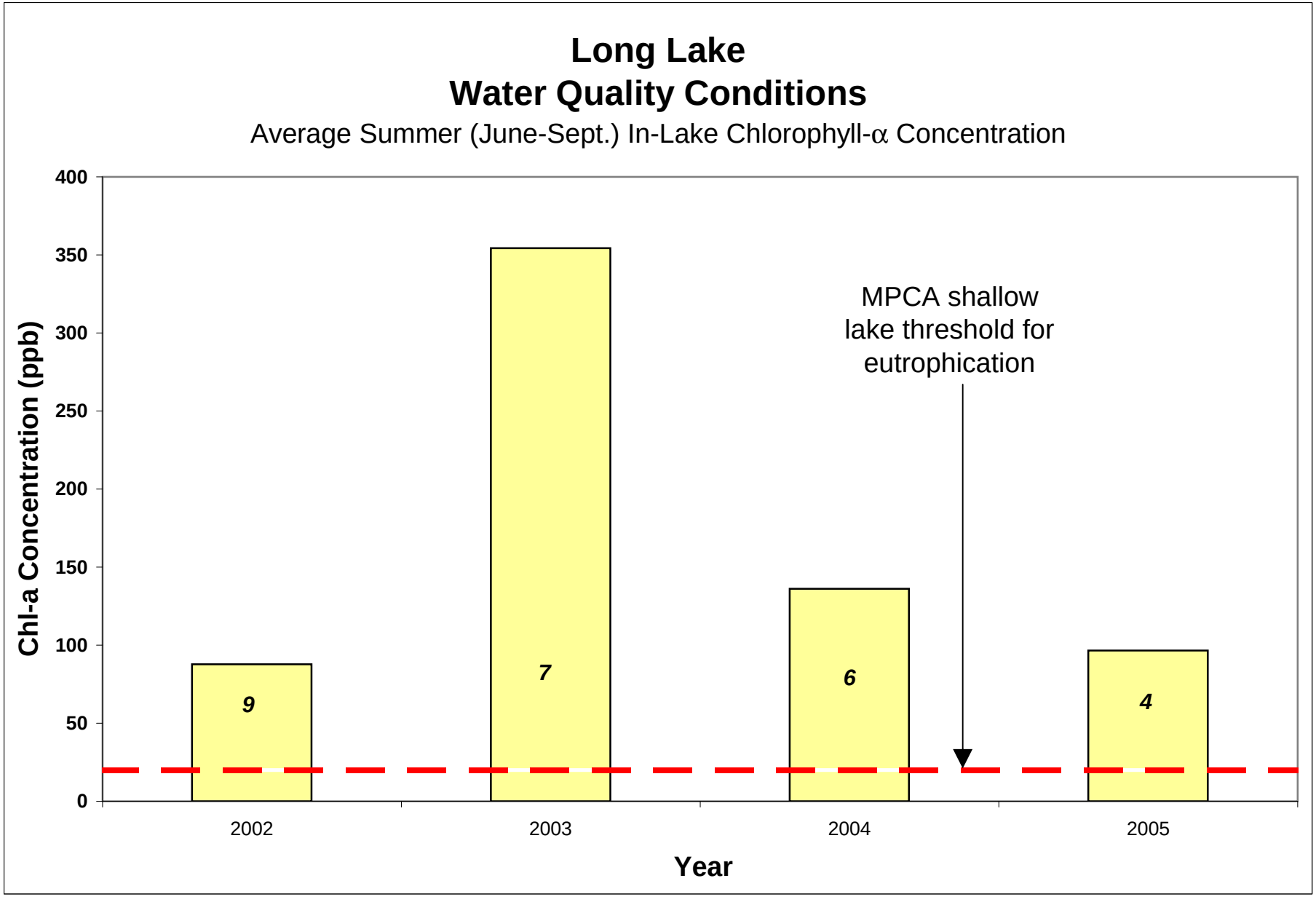
Appendix G

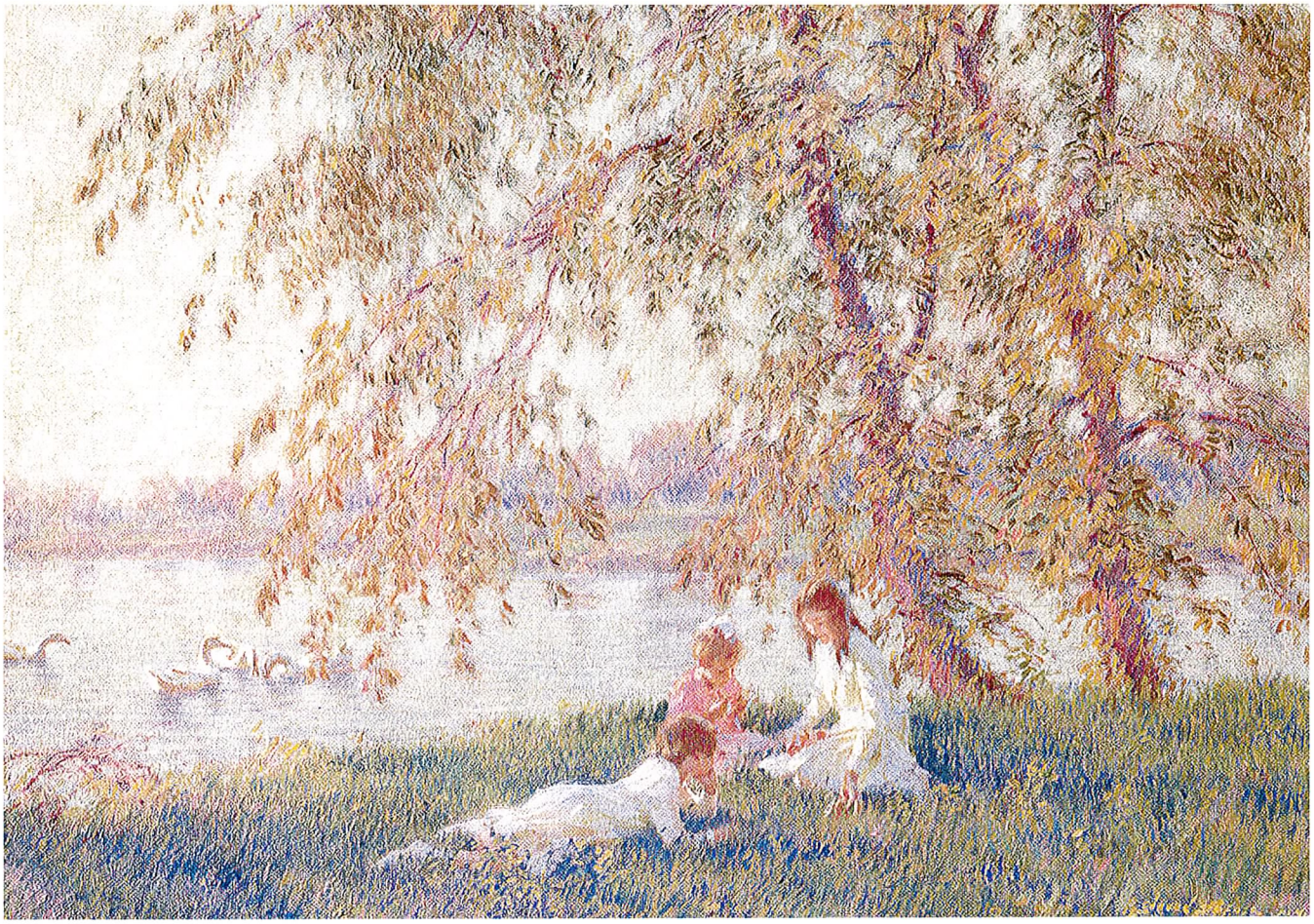

Long Lake
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Clarity
Year
1997
2002
2003
2004
2005
Secchi Disk Depth (m)
0
0.2
0.4
0.6
0.8
1
1.2
MPCA shallow lake threshold for eutrophication

Appendix G


Long Lake
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Total Phosphorus Concentration
MPCA shallow lake threshold for eutrophication
TP Concentration (ppb)
450
400
350
300
250
200
150
100
50
0
13
10
8
6
6
1997
2002
2003
2004
2005
Year

Appendix G


Long Lake
Water Quality Conditions
Average Summer (June-Sept.) In-Lake Chlorophyll-α Concentration
Chl-a Concentration (ppb)
400
350
300
250
200
150
100
50
0
9
7
6
4
MPCA shallow lake threshold for eutrophication
2002
2003
2004
2005
Year



Edward Dufner: *Joyous Days*, **early-mid 1920s**

Lake Management Plan for Alimagnet Lake, Dakota County, Minnesota

March 2005

Prepared by Blue Water Science and Bonestroo, Rosene, Anderlik and Associates

with contributions from City of Apple Valley, City of Burnsville, and the Alimagnet Lake Association

Funded by the City of Apple Valley and the City of Burnsville

Lake Management Plan for Alimagnet Lake, Dakota County, Minnesota

SUMMARY

Project Goals

The goals of this lake management report were:

- to examine existing lake conditions.
- to develop a lake management plan that protects, maintains, and enhances Alimagnet Lake water quality.
- meet the basic MPCA/EPA criteria for a TMDL

Watershed Characteristics

Alimagnet Lake's watershed is approximately 1,094 acres (includes the lake). Land use is primarily residential. Three subwatersheds (1, 6, and 7) contribute most of the watershed phosphorus to Alimagnet Lake (Table 1 and Figure 1).

Table 1. Phosphorus load by outfall based on P-8 model.

Storm Sewer Outfall	Total Drainage Area (acres)	Total Phosphorus Load (lbs/yr)	Unit Phosphorus Load (lbs/acre/yr)
1	**288.6**	**158.8**	**0.55**
2	6.6	3.8	0.58
3	7.2	3.9	0.54
4	29.0	14.5	0.50
5	3.4	1.7	0.50
6	**187.4**	**130.6**	**0.70**
7	**256.6**	**93.9**	**0.37**
8	16.0	9.2	0.58
9	30.2	10.5	0.35
10	47.7	17.4	0.36
Developed Shoreline	32.1	9.3	0.29
Undeveloped Shoreline	80.3	7.9	0.10

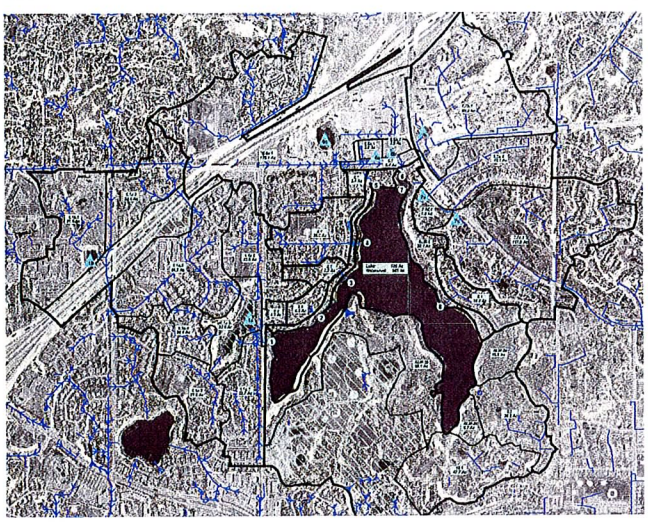


Figure 1. The Alimagnet Lake watershed and subwatersheds are outlined in black.

Shoreland Characteristics

The shoreland area is the transition area between the watershed and lake and encompass three components: the upland fringe, the shoreline, and the shallow nearshore area. Results of a shoreland inventory show over half of the parcels have existing natural conditions (Table 2). This is about average for urban lakes in the metro area.

Table 2. Summary of shoreline buffer and upland conditions in the shoreland area of Alimagnet Lake. Approximately 108 parcels were examined.

Alimagnet Lake	Natural Shoreline Condition		Natural Upland Condition		Undevel. Photo Parcels	Shoreline Structure Present	
	>50%	>75%	>50%	>75%		riprap	wall
TOTALS (no. of parcels = 108)	69% (75)	61% (66)	54% (58)	47% (51)	37% (40)	15% (16)	3% (3)

Lake Statistics

Alimagnet Lake is a 109 acre lake located in Dakota County, Minnesota with an average depth of 5 feet and a maximum depth of 11 feet.

Lake Dissolved Oxygen and Temperature

Alimagnet Lake does not strongly thermally stratify during the summer. This means that wind action can mix the entire lake during the summer. Dissolved oxygen concentrations are found throughout the water column most of the time, although there are days during the summer when dissolved oxygen is depleted on the bottom of the lake (Figure 2).

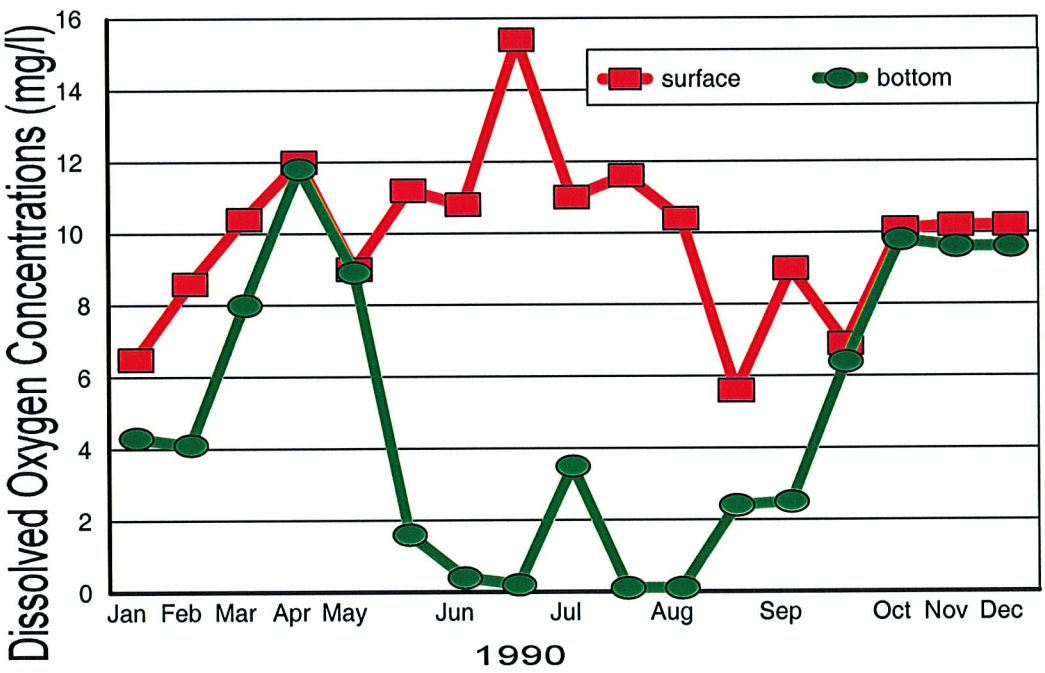


Figure 2. Monthly dissolved oxygen readings for top and bottom conditions for Alimagnet Lake in 1990 (source: JM Montgomery Engineers).

Lake Transparency and Nutrient Status

Phosphorus concentrations in Alimagnet are higher compared to other lakes in the North Central Hardwood Forest ecoregion. The 2003 growing season phosphorus average was 113 ppb. A predicted phosphorus concentration based on ecoregion values and ecoregion modeling is predicted to be 54 ppb. This indicates Alimagnet Lake has the potential to have better water quality than it presently has. Reducing lake nutrient levels is a primary goal for Alimagnet Lake.

Summer average Secchi disc readings have fluctuated over the years (Figure 3). Some of the variability may be influenced by winterkill events that have occurred in the past.

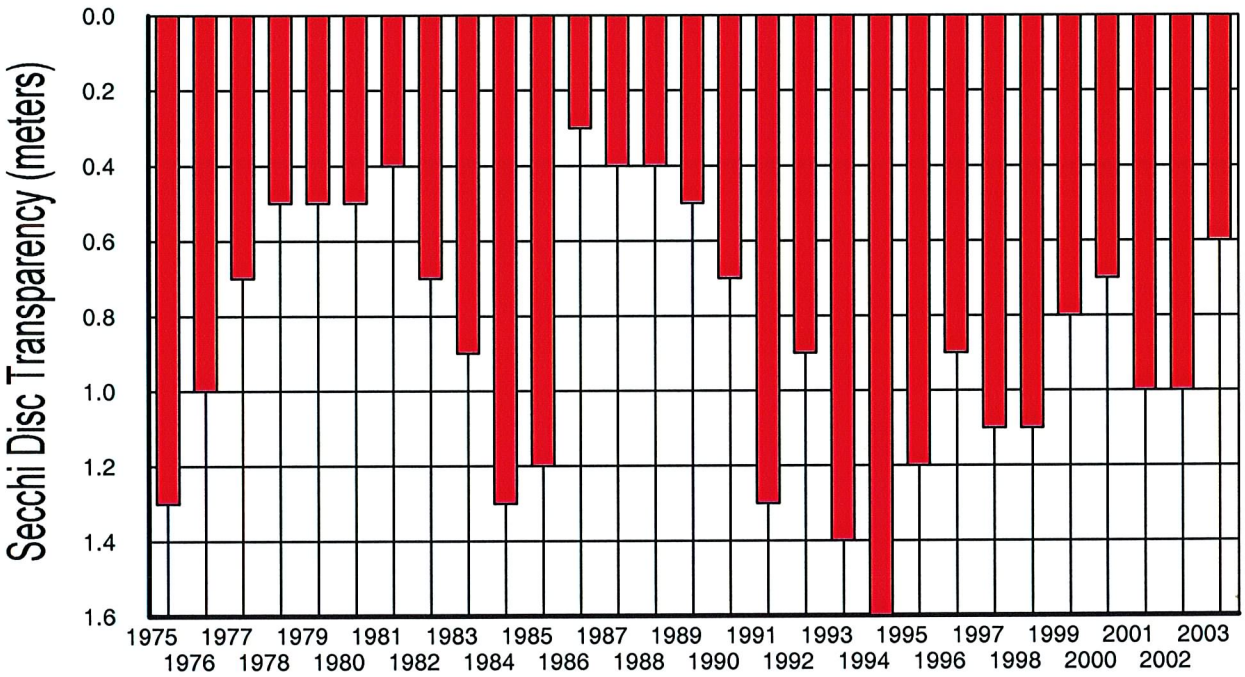


Figure 3. Summer average for Secchi disc readings from 1975-2003.

Lake Algae

Alimagnet Lake has algae species that are common to eutrophic lakes in this part of the state. By mid-summer, blue-green algae concentrations increase dramatically and water clarity decreases. Elevated phosphorus levels produce the excessive algal growth.

Lake Aquatic Plants

Alimagnet Lake has a low diversity of native aquatic plants. Elodea is common but the only other rooted native plant observed has been sago pondweed and it is rare in the lake. Curlyleaf pondweed, an exotic plant, is present in Alimagnet and grows to moderate nuisance conditions throughout the shallow waters of the lake. Lake sediment analysis predicts sediment characteristics would produce moderate nuisance conditions around most of the lake (Table 3 and Figure 4).

Table 3. Alimagnet Lake sediment data and ratings for potential nuisance curlyleaf pondweed growth.

Sample ID	Bulk density (g/cm^3)	Organic Matter (%)	pH (su)	Fe:Mn Ratio	Potential for Nuisance Curlyleaf Pondweed Growth
non-nuisance	1.04	5	6.8 (6.7-6.9)	4.5 (2-5)	Low
light nuisance	0.94	11	6.2	5.9	Med
heavy nuisance	<0.51	>20	>7.7	<1.6	High
1	1.18	2.7	6.6	9.3	Medium
2	0.71	15.8	5.9	8.0	Medium
3	1.13	2.9	6.2	5.5	Medium
4	1.2	2.3	6.3	6.5	Medium
5	1.16	2.0	6.6	5.5	Medium
6	0.88	4.6	6.2	4.7	Medium
7	0.94	4.7	6.7	9.7	Medium
8	1.01	2.7	6.9	10.9	Low
9	0.85	7.1	6.1	4.5	Medium
10	1.09	4.1	6.6	11.9	Medium
11	0.89	6.6	6.6	7.5	Medium
12	0.94	3.3	6.7	7.4	Medium
13	1.02	3.8	6.8	11.5	Low
14	1.01	3.7	6.2	8.3	Medium
15	1.29	1.3	6.2	11.0	Medium
16	0.75	22.0	6.3	9.0	Medium
17	1.44	0.5	6.6	13.5	Medium
18	0.66	10.4	6.0	9.8	Medium
19	0.70	34.1	6.4	7.9	Medium
20	0.78	12.2	6.0	10.1	Medium
21	0.38	34.2	6.0	5.6	High

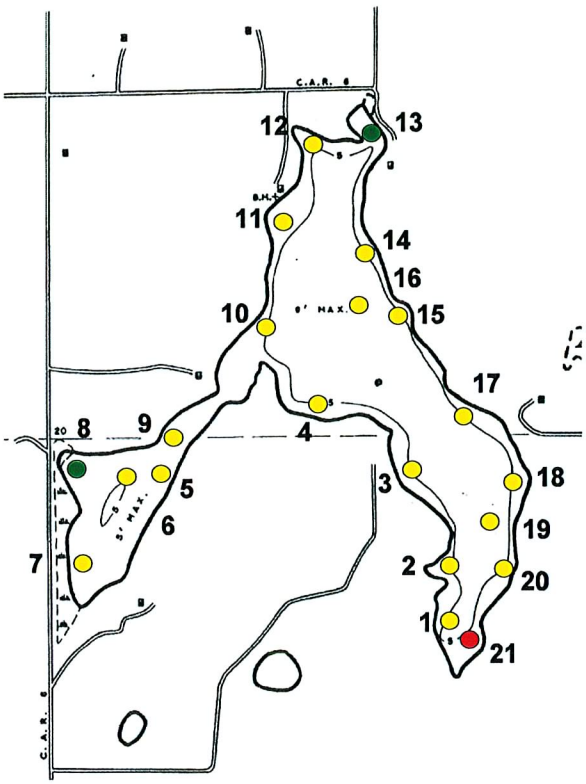


Figure 4. Areas that are predicted to support various types of curlyleaf pondweed growth are shown by colored dots. Green = non-nuisance, yellow = medium nuisance, and red = heavy nuisance.

Figure 5. The Alimagnet Lake Association has developed a curlyleaf control technique, where a cable strung between two boats, is pulled through the curlyleaf beds.

Fish

The fish community of Alimagnet Lake was last surveyed by the MnDNR in 2000. Black bullhead (at 84 fish/trapnet) were the dominant species. The black bullhead density may be even higher in 2004 and could be producing adverse impacts on lake water quality. The number of northern pike and black crappie were also above average. Largemouth bass and bluegill sunfish were also present at typical densities for a shallow lake like Alimagnet.

Lake Assessment

- Lake water quality results are below-average compared to Ecoregion values, meaning there is room for improvement.
- Phosphorus concentrations in watershed runoff are estimated at 336 ppb based on the P-8 model. This is above Ecoregion values which are around 150 ppb-P.
- The water clarity data base shows fluctuating seasonal averages over the years. However, Alimagnet Lake has the potential to get better.

Table 4. Summer average water quality characteristics for lakes in the Western Corn Belt Plains and the North Central Hardwood Forest Ecoregions compared to water quality for Alimagnet Lake.

Parameter	North Central Hardwood Forest	Alimagnet (2003)
Total phosphorus (ug/l) - top	23-50	113
Algae [as Chlorophyll (ug/l)]	5-22	45
Chlorophyll - max (ug/l)	7-37	130
Secchi disc (ft)	4.9-10.5	2.0

These comparisons indicate that the water quality of Alimagnet Lake are out of range compared to the North Central Hardwood Forest ecoregion water quality values. The challenge will be to bring water quality values within ecoregion ranges. The estimated nutrient load to Alimagnet Lake is shown in Figure 6.

Total estimated load: 600 pounds of phosphorus per year (272 kg-P/yr)

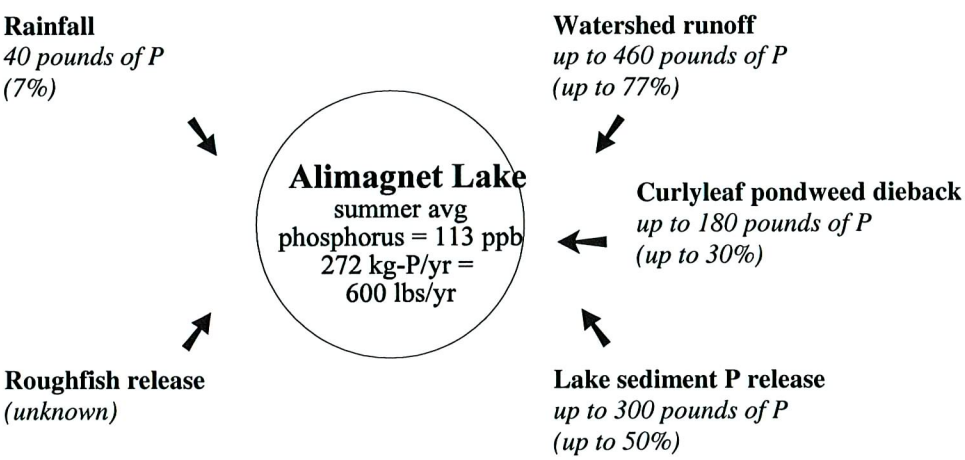


Figure 6. Estimated annual phosphorus loads to Alimagnet Lake.

Setting Water Quality Goals for Alimagnet Lake

Water quality in Alimagnet Lake has the potential to be better. Lake models were run to help determine feasible water quality goals for Alimagnet Lake. A lake model is a mathematical equation that uses phosphorus inputs along with lake and watershed characteristics to predict what a lake phosphorus concentration should be. Once a lake phosphorus concentration is determined, then seasonal water clarity and algae concentrations can be calculated as well.

Several lake models were run based on nutrient inputs using the Canfield-Bachmann natural lake model. Lake model runs were conducted for existing watershed runoff conditions (using a flow weighted mean concentrations of 336 ppb-P), predicted watershed runoff after watershed practices are implemented (FWMC 161 ppb-P), and for an ecoregion FWMC runoff P-concentration of 150 ppb. The existing observed conditions for lake phosphorus chlorophyll a, and Secchi depth are shown with red bar (Figures 7 and 8). Existing conditions are assumed to be dictated by an estimated phosphorus loading of 600 lbs/yr. The estimated phosphorus load for existing conditions was back-calculated for Alimagnet Lake based on a lake concentration of 113 ppb. The 113 ppb-P lake concentration was the summer average for 2003.

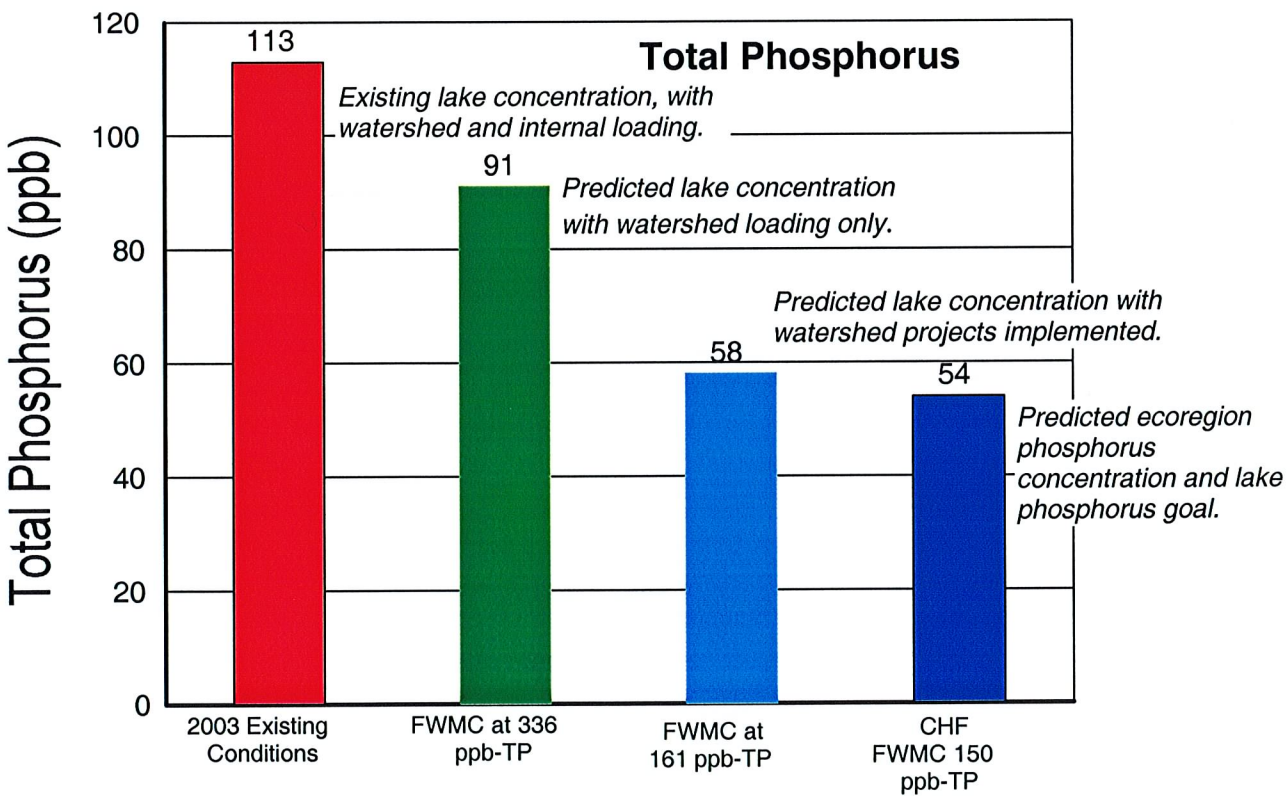


Figure 7. Comparison of total phosphorus concentration for Alimagnet Lake in 2003 to lake phosphorus concentrations based on estimated concentrations for a watershed runoff flow weighted mean concentration (FWMC) of 336 ppb-phosphorus (current watershed runoff conditions), for a watershed runoff FWMC of 161 ppb-P (predicted after watershed practices are implemented) and for a lake with a watershed the size of Alimagnet Lake situated in the Central Hardwood Forest (CHF) with a phosphorus runoff concentration of 150 ppb.

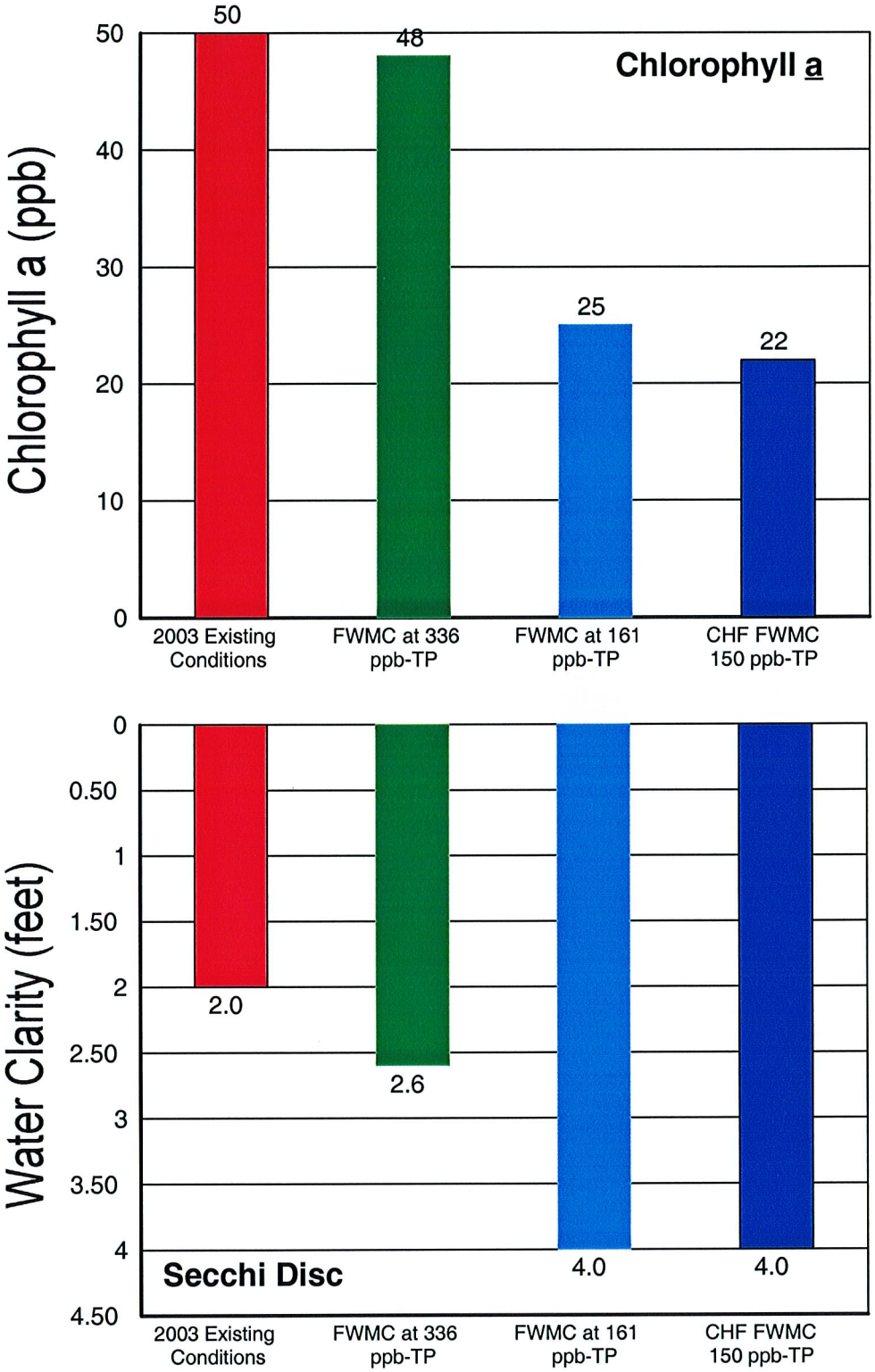


Figure 8. Comparison of chlorophyll a concentration (top) and water clarity (bottom) for Alimagnet Lake in 2003 to predicted lake chlorophyll concentrations and clarity for a watershed runoff flow weighted mean concentration (FWMC) of 336 ppb-phosphorus (current watershed runoff conditions), for a watershed runoff FWMC of 161 ppb-P (predicted after watershed practices are implemented) and for a lake with a watershed the size of Alimagnet Lake situated in the Central Hardwood Forest (CHF) with a phosphorus runoff concentration of 150 ppb.

Water Quality Improvement Strategy

There appears to be a need to reduce a significant amount of annual phosphorus loading to Alimagnet Lake in order to meet lake water quality goals.

An important finding of the watershed and in-lake modeling was that Alimagnet Lake will need both watershed and lake projects to meet the water quality goal of 54 ppb. This should produce a summer average Secchi disc reading of 1.2 m (4.0 ft). The water quality of a shallow lake system, like Alimagnet Lake, is greatly affected by in-lake processes such as internal recycling of nutrients that have accumulated in bottom sediment and relationships between fish, rooted aquatic plants, and algae. This underlines the importance of sound in-lake management programs while reducing watershed phosphorus inputs. Therefore, it will be difficult for watershed-based BMPs alone to meet lake water quality goals. The water quality improvement strategy will be to reduce watershed pollutant inputs to the maximum extent practical while implementing in-lake water quality improvement projects.

Algae blooms are an annual occurrence in Alimagnet Lake. The water quality improvement strategy will not eliminate algae blooms, but should reduce the number of days they occur as well as their intensity.

Recommended Lake Management Programs and Projects

Lake management programs are recommended to improve watershed nutrient inputs (Table 5) as well as in-lake conditions (Table 6).

Table 5. Phosphorus load reductions associated with watershed projects.

Priority Watershed Projects	Description	TP Load Reduction
1a	Barley straw treatment in Ponds 1A, 6C, and 7A.	123 lbs/yr
1b	Expand wet volume of Pond 7A (located in Apple Valley) through excavation.	16 lbs/yr
1c and 1d	Expand wet volume of north cell of Pond 1A (located in Burnsville) through excavation and develop pre-treatment basin prior to north cell of Pond 1A.	56 lbs/yr
2	Improve fertilizer management in the watershed, particularly emphasizing the urbanized direct drainage area.	13 lbs/yr

Table 6. Lake improvement benefits associated with lake projects.

Priority Lake Projects	Description	TP Load Reduction (lbs-P/yr)	Other Benefits
1	Shoreland projects	4	Wildlife enhancement, aesthetics
2a	Continue to control curlyleaf pondweed	90	Improved recreational use
2b	Harvesting nuisance aquatic plant growth	15	Improved recreational use
3a	Black bullhead removal	0 - 60	Improves fishing
3b	Stock catfish and bass	0	Improves fishing, controls roughfish
4	Organic carbon amendment	150*	No herbicides used, improved fishing

* 150 pounds of phosphorus per year is made unavailable to algae with this organic carbon amendment. This type of phosphorus redirection has been documented in lakes that used barley straw, where significant water column phosphorus concentrations have decreased.

Project Costs

Estimated project costs for the Alimagnet Lake improvement program are summarized in Table 7.

Table 7. Summary of recommended projects and costs.

	Estimated Phosphorus Reduction (pounds/year)	Capital Cost	Average Annual O & M (5 yr)	5 Year Cost
Watershed Projects				
1. Stormwater pond improvements.				
1a. Barley straw for three ponds.	123	0	4,000	20,000
1b. Excavation of pond 7A.	16	65,000	0	65,000
1c. Excavation of pond 1A.	37	150,000	0	150,000
1d. Construction of pre-treatment pond for 1A.	19	240,000	0	240,000
2. Fertilizer management and control.	13	0	2,000	10,000
Subtotal	***208***	***455,000***	***6,000***	***485,000***
Lake Projects				
1. Shoreland buffers.	4	0	3,000	15,000
2. Aquatic plant projects.				
2a. Continue curlyleaf control program	90	5,000	1,000	10,000
2b. Harvest nuisance plant growth.	--	0	3,000	15,000
3. Fish management				
3a. Black bullhead removal.	30	0	4,200	21,000
3b. Predator stocking.	--	0	800	4,000
4. Organic carbon amendment.	150	0	16,000	80,000
Subtotal	***274***	***5,000***	***28,000***	***145,000***
Watershed and Lake Programs				
1. Information and education	10	0	3,000	15,000
2. Watershed and lake monitoring	--	0	2,500	12,500
Subtotal	***10***	***0***	***5,500***	***27,500***
TOTAL	***492***	***460,000***	***39,500***	***657,500***
Reserve Projects				
Street sweeping	9	0	4,500	22,500
Infiltration and rain gardens	22	300,000	0	300,000
Lake sediment iron treatment for curlyleaf pondweed	150	30,000	0	30,000
Install winter aeration in two additional locations	100	30,000	3,000	45,000
Lake sediment alum project	150	100,000	0	150,000

Project Sequence

A five-year project sequence is summarized in Table 8. Several projects will occur annually for the next five years. After five years, lake conditions will be evaluated. It is anticipated that lake goals will be met by the end of year 5 and that several projects with high annual costs (for example the organic carbon amendment) can be curtailed or eliminated.

Table 8. Alimagnet Lake improvement project sequence, annual costs, and total project cost for a 5-year program.

	Year 1	Year 2	Year 3	Year 4	Year 5	5 Year Cost
Watershed Projects						
1. Stormwater pond improvements.						
1a. Barley straw for 3 ponds.	4,000	4,000	4,000	4,000	4,000	20,000
1b. Excavation of pond 7A.	--	65,000	--	--	--	65,000
1c. Excavation of pond 1A.	--	60,000	90,000	--	--	150,000
1d. Construction of pre-treatment pond for 1A.	--	40,000	120,000	80,000	--	240,000
2. Fertilizer management and control.	2,000	2,000	2,000	2,000	2,000	10,000
Subtotal	***6,000***	***171,000***	***216,000***	***86,000***	***6,000***	***485,000***
Lake Projects						
1. Shoreland buffers.	3,000	3,000	3,000	3,000	3,000	15,000
2. Aquatic plant projects.						
2a. Continue curlyleaf control program	6,000	1,000	1,000	1,000	1,000	10,000
2b. Harvest nuisance plant growth.	--	--	5,000	5,000	5,000	15,000
3. Fish management						
3a. Black bullhead removal.	7,000	7,000	7,000	--	--	21,000
3b. Predator stocking.	1,500	900	800	800	--	4,000
4. Organic carbon amendment.	16,000	16,000	16,000	16,000	16,000	80,000
Subtotal	***33,500***	***27,900***	***32,800***	***25,800***	***25,000***	***145,000***
Watershed and Lake Programs						
1. Information and education	3,000	3,000	3,000	3,000	3,000	15,000
2. Watershed and lake monitoring	2,500	2,500	2,500	2,500	2,500	12,500
Subtotal	***5,500***	***5,500***	***5,500***	***5,500***	***5,500***	***27,500***
TOTAL	***45,000***	***204,400***	***254,300***	***117,700***	***36,500***	***657,500***

Crystal Lake/Keller Lake Use Attainability Analysis

Project Synopsis

A Use Attainability Analysis (UAA) is a scientific assessment of a water body's physical, chemical, and biological conditions. It uses an outcome-based evaluation and planning process in order to obtain or maintain optimal water quality conditions and achieve beneficial uses, such as swimming, fishing, or wildlife habitat.

During 2001–2003, the Black Dog Watershed Management Organization (BDWMO) conducted a UAA for Crystal Lake/Keller Lake to address current water quality issues. The UAA includes a water quality analysis and prescription of protective measures for Crystal Lake/Keller Lake and the watershed, based on historical water quality data, the results of intensive lake water quality monitoring, and computer simulations of land use impacts on water quality.

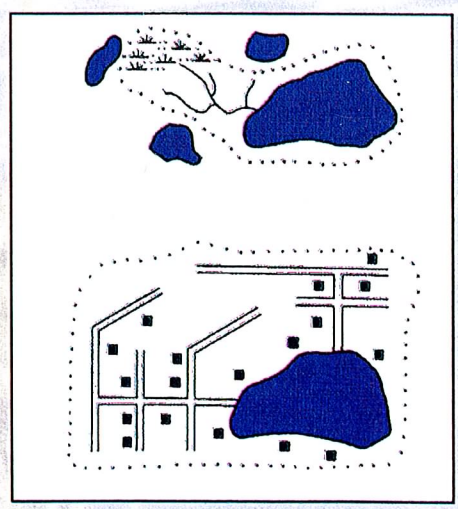
Typical Urban Lake Water Quality Problems

The primary problem in urban lakes is "cultural eutrophication," which is defined as the accelerated increase in concentrations of nutrients, primarily phosphorus and nitrogen, in a lake as a result of human activities in the watershed. Eutrophication is often indicated by increased algal growth, decreased water clarity, and loss of dissolved oxygen in the bottom waters of the lake, which leads to a shift in fish species from desirable game fish to non-game species such as carp and bullhead.

Nuisance algae in lakes results from the excess phosphorus that reaches lakes due to increased stormwater runoff.

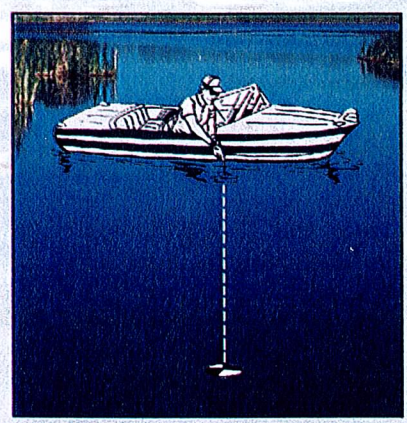
The Usual Suspects

These problems typically occur because of watershed urbanization and nonpoint source pollution. Increased urbanization in a watershed leads to more streets, driveways, and rooftops (impervious surfaces). This increased imperviousness results in more stormwater runoff traveling quickly through storm sewers, diminishing the runoff pollutant retention capacity of watershed ponds and wetlands. The increased stormwater runoff carries excess nutrients into lakes and streams as nonpoint source pollution. Increased concentrations of phosphorus in lake waters is the leading cause of algal blooms and decreased water clarity.



Source: Monson (1992)

Before development (top image), stormwater travels slowly through a watershed. After development (bottom image), impervious surfaces are increased, resulting in more stormwater runoff and less filtration of nutrients.



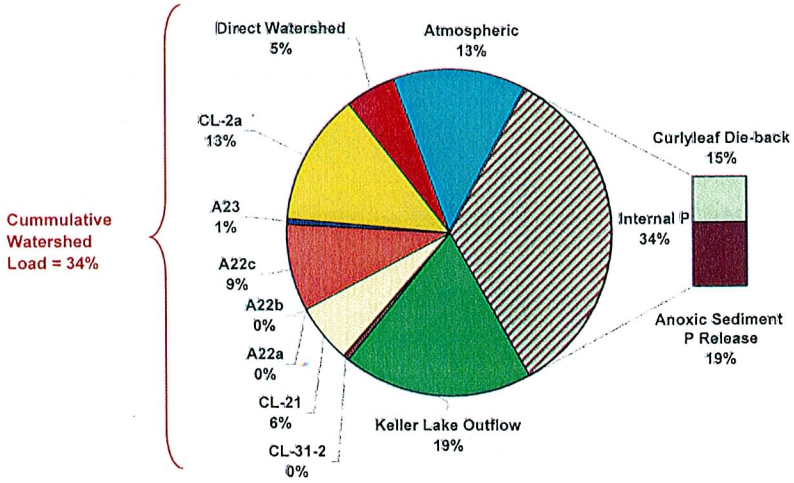
A lake's clarity (transparency) is measured by submerging a black and white patterned disc (a Secchi disc) into the lake. The depth at which the Secchi disc disappears determines the lake's transparency.

Crystal/Keller Lake Water Quality Problems and Causes

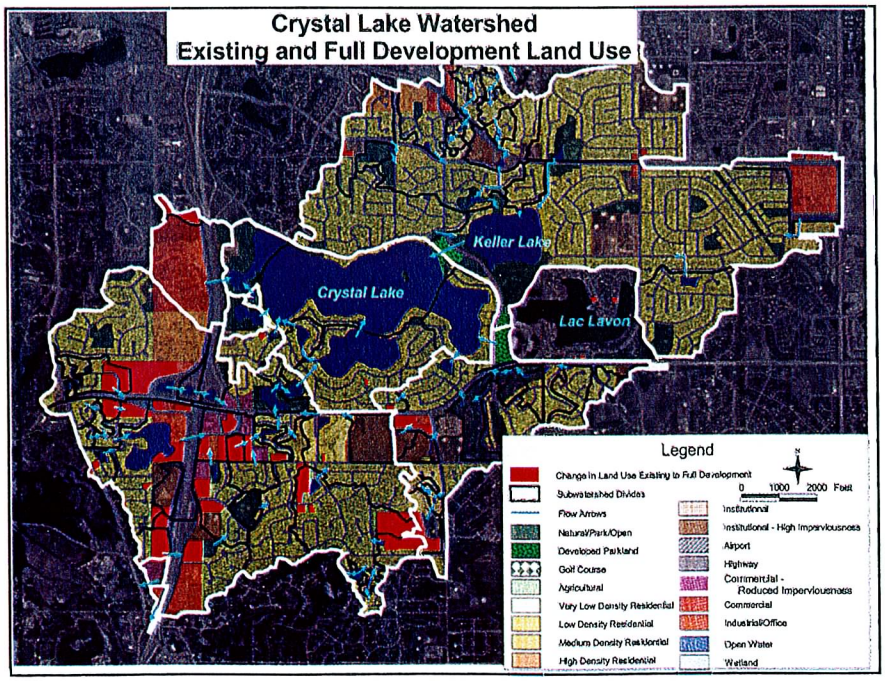
The water quality assessment portion of the UAA determined that Crystal and Keller Lakes suffer from two primary water quality problems: summer algal blooms and excess lake weeds. The algal blooms are caused by high phosphorus levels, due to poor quality urban stormwater runoff entering the lake. The problematic lake weeds are an exotic lake weed species called curlyleaf pondweed, which dies back in mid-summer each year, further increasing the lakes' phosphorus concentration and algal abundance. Nutrient-rich lake sediments also recycle phosphorus back into the lake water during summer months. The following page explains the recommended water management strategy for handling these problems.

Curlyleaf pondweed is a major problem that affects recreational use of both Crystal and Keller Lakes.

Crystal Lake Annual Phosphorus Budget (1082 lbs)
Model Calibration Year (2002) Using Existing Land Use



The UAA includes data such as this pie chart, which shows the breakdown of sources of the annual phosphorus load to Crystal Lake. See the map on page 4 to cross-reference the source/location codes. A similar pie chart for Keller Lake is included in the UAA.



Investigative Techniques Used in UAA Process

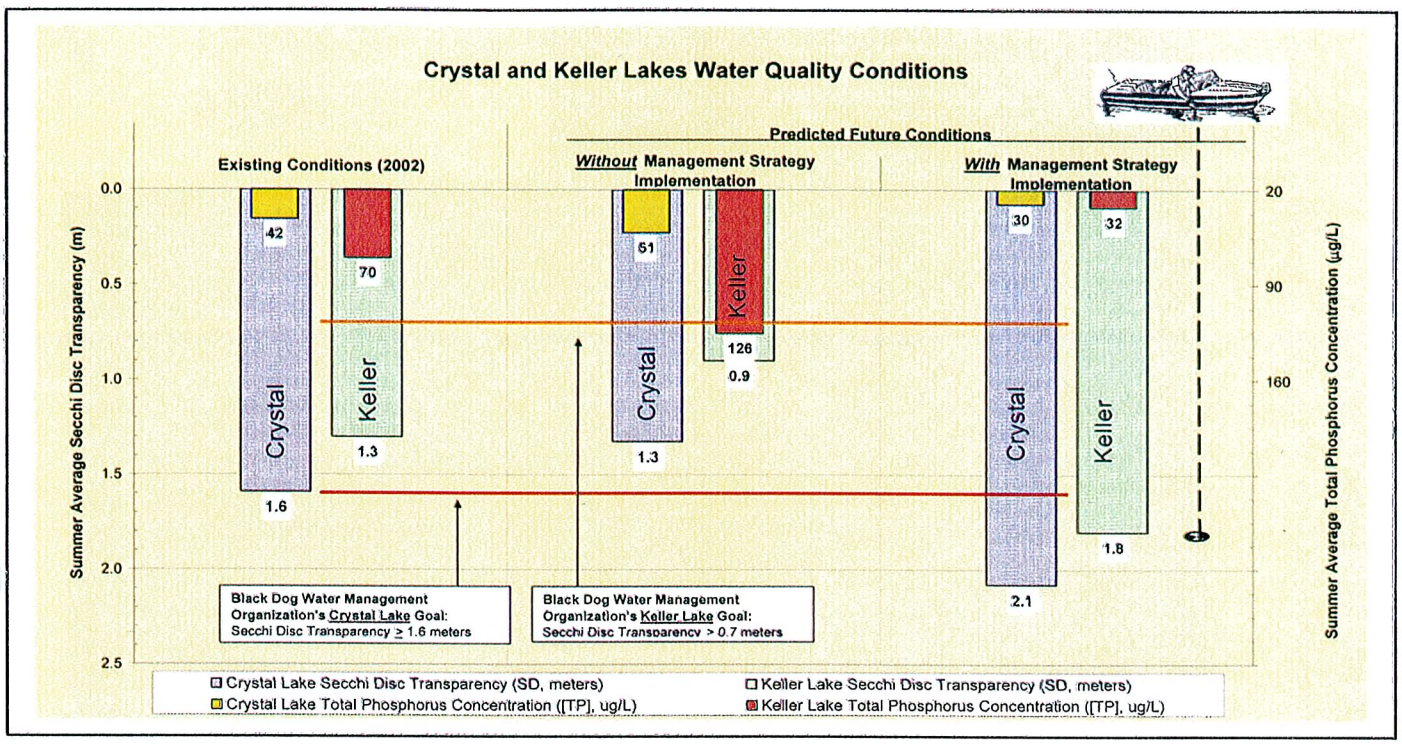
The UAA process included an intensive lakewater quality study, P8 computer simulation modeling of runoff water quality, lake hydrologic and phosphorus budget analyses, and an analysis of the likely water quality improvement benefits of several lake water management strategies. Secchi disc readings were conducted biweekly throughout the open water season as a general indicator of water quality.

The UAA found that watershed land use directly influences the lakes' annual water and phosphorus inputs.

Recommended Management Strategy for Crystal Lake and Keller Lake

The following figure and table summarize the recommended management strategy for Crystal Lake and Keller Lake. Several strategies (39 different combinations) were evaluated based on effectiveness, cost, and feasibility. Input was gathered from the BDWMO Board of Commissioners, city staff, and neighborhood residents as part of the evaluation process. The figure shows current and predicted water quality conditions, both with and without implementation of recommended water quality improvement projects. The table lists elements of the recommended strategy and its cost.

Water Quality Management Strategy



Recommended Water Quality Management Strategy and Estimated Implementation Costs

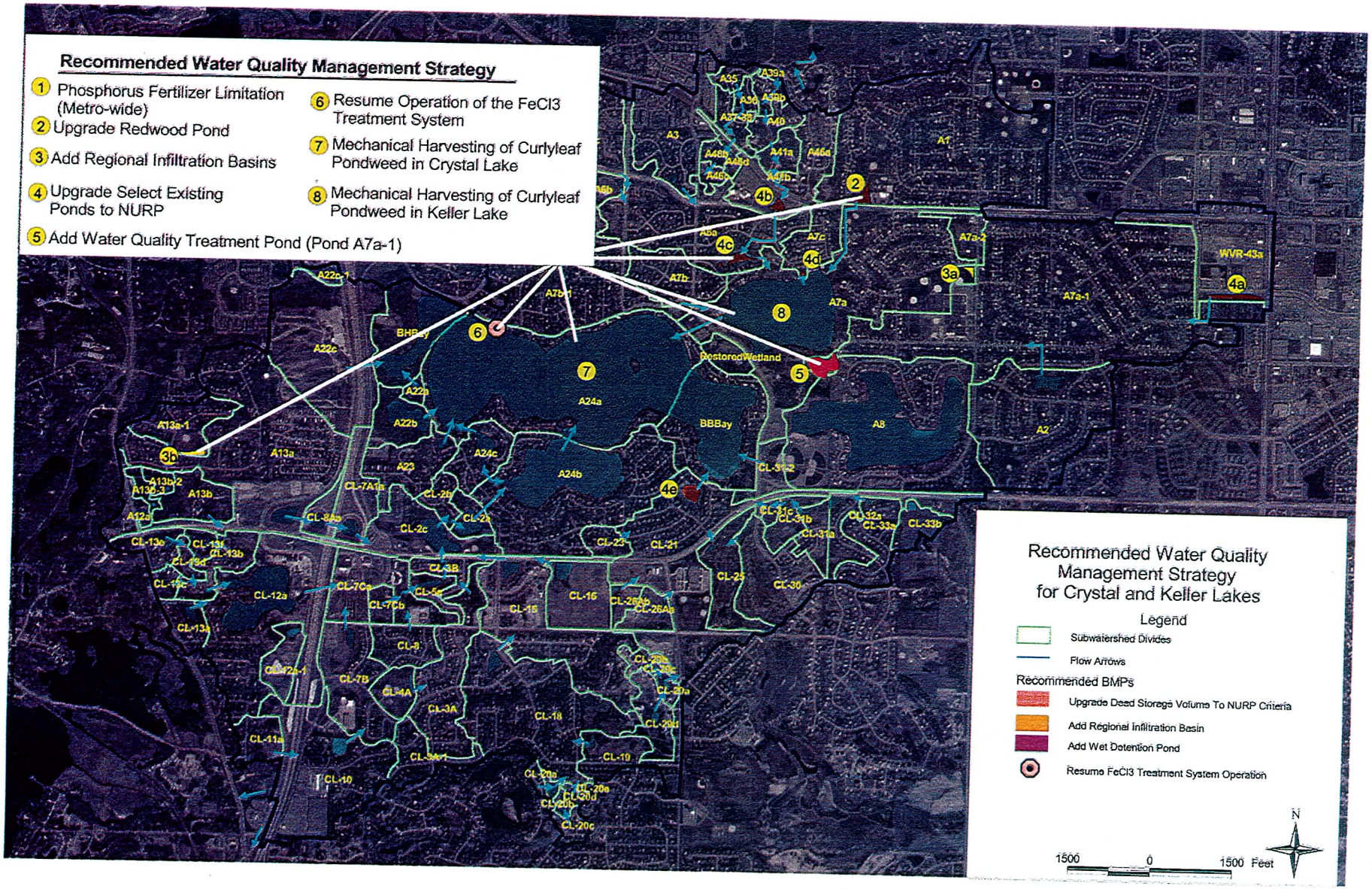
Water Quality Management Strategy Elements†	Capital Cost	Annual Operation & Maintenance Cost	Proposed Funding Source	Responsible Party for Implementation
Source Reduction Efforts				
1 Phosphorus Fertilizer Limitation	$0	$0	n/a	Homeowners
Infiltration of Runoff				
2 Upgrade Redwood Pond (Excavate & Enhance Infiltration)	$105,316	$843	City of Apple Valley	City of Apple Valley
3 Add Two (2) Regional Infiltration Basins	$107,825	$915		
3a Regional Infiltration Basin Located North of Valley Middle School	($48,899)	($416)	City of Apple Valley	City of Apple Valley
3b Regional Infiltration Basin Located in West Buckhill Park	($58,927)	($498)	City of Burnsville	City of Burnsville
Runoff Detention Ponding				
4 Upgrade Select Existing Ponds to NURP Design Criteria	$171,938	$1,376		
4a WVR-43a - 153rd St. Pond (Just South of Old Kmart) - Enlarge and Excavate	($52,728)	($422)	City of Apple Valley	City of Apple Valley
4b A46a - North of the Intersection of Southcross Drive and Keller Lake Drive - Excavate	($13,755)	($110)	City of Burnsville	City of Burnsville
4c A8a - Keller Lake Park Pond - Excavate	($45,850)	($367)	City of Burnsville	City of Burnsville
4d A7c - Northeast Edge of Keller Lake - Excavate	($18,340)	($147)	City of Burnsville	City of Burnsville
4e CL-21 - Bluebill Pond - Excavate	($41,265)	($330)	City of Lakeville	City of Lakeville
5 Add a Regional Water Quality Treatment Pond at the Southeast Corner of Keller Lake (Pond A7a-1)	$462,000	$3,696	City of Apple Valley	City of Apple Valley
In-Lake Chemical Treatments				
6 Resume Operation of Ferric Chloride ($FeCl_3$) Treatment System in Near-Surface Withdrawal Mode	$13,125	$36,520	Black Dog Water Management Organization	Black Dog Water Management Organization
In-Lake Mechanical Treatments				
7 Mechanical Harvesting of Curlyleaf Pondweed in Crystal Lake	$0	$54,600	Lakeshore Homeowners‡ & City of Burnsville	City of Burnsville
8 Mechanical Harvesting of Curlyleaf Pondweed in Keller Lake	$0	$14,359	Lakeshore Homeowners‡, City of Apple Valley, & City of Burnsville	City of Burnsville
Total	$860,203	$112,360		

† The attached map illustrates the approximate locations of the various water quality management strategies.

‡ Voluntary participation in the lake weed harvesting program, for harvesting of areas within 150 feet of the shoreline, will result in a *pro rata* charge (area harvested basis) to each participating lakeshore property owner. Harvesting of areas beyond 150 feet from shore, up to an aggregate area less than or equal to 50 percent of the littoral zone, will be paid for by the city (cities).

Location of Recommended Management Strategy Elements

This map shows the location of the eight elements of the recommended lake water management strategy for improving the water quality of Crystal and Keller Lakes.



Lake Management Plan for Lac Lavon, Dakota County, Minnesota

SUMMARY

Background

Lac Lavon is a 60 acre lake located in Dakota County, Minnesota with an average depth of 13 feet and a maximum depth of 32 feet. A lake management plan was prepared with the objectives to develop a plan that protects and sustains Lac Lavon water quality as well as address aquatic plant management options.

Watershed Characteristics

The lake's watershed is small, approximately 184 acres (including the lake). Land use is primarily residential (46%), with park land contributing as well.

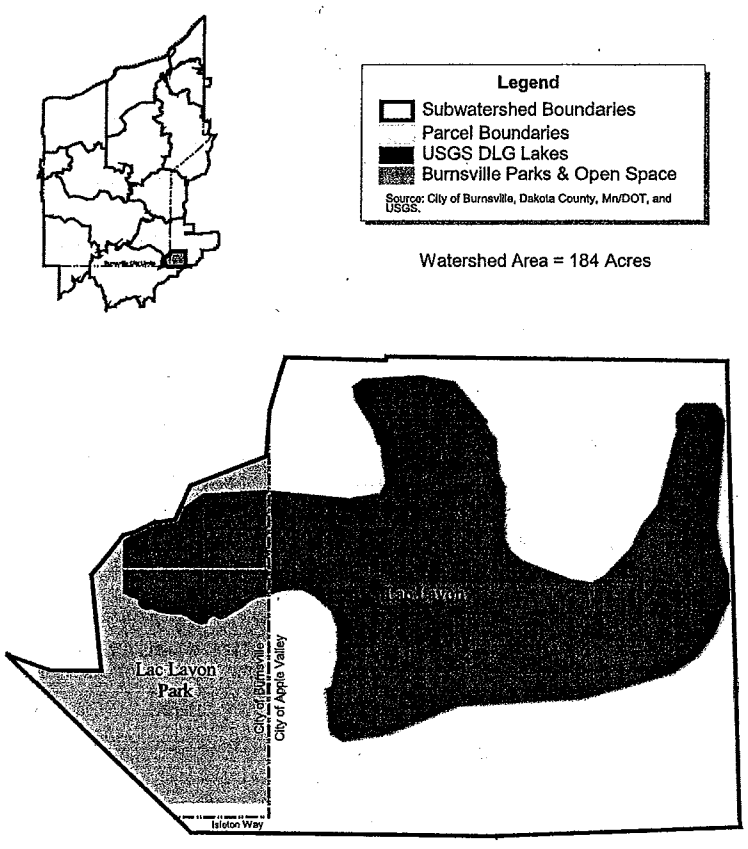


Figure 1. Lac Lavon watershed and City boundaries. The watershed areas was described to be 184 acres and that includes the lake area (source: City of Burnsville Water Resources Management Plan).

Nutrient Inputs to Lac Lavon

The nutrient input into Lac Lavon is estimated at approximately 37 pounds of phosphorus per year. This is a low amount and is one of the reasons why water clarity is good in Lac Lavon.

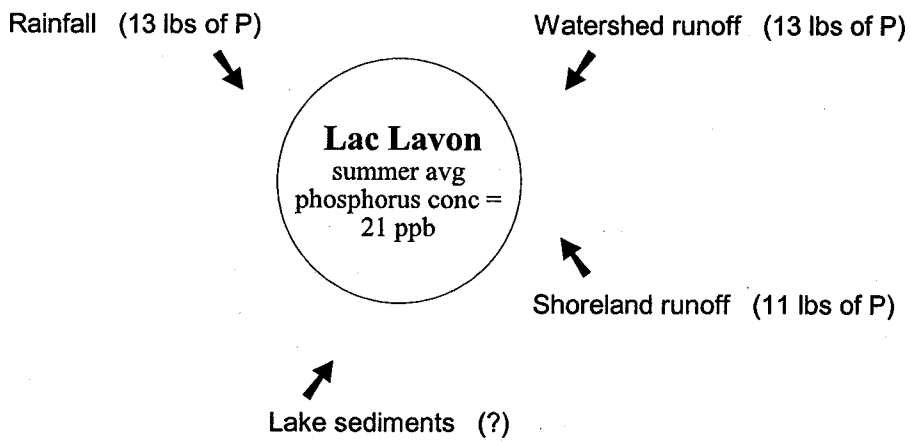


Figure 2. Sources of phosphorus (P) that feed into Lac Lavon are shown above. It is estimated that approximately 37 pounds of phosphorus enter Lac Lavon on an annual basis.

Shoreland Inventory

A summary of the inventory results is shown in Table 1. Based on our subjective criteria about 42% of the parcels in Lac Lavon shoreland area meet the natural ranking criteria for shorelines and upland areas. This is below average compared to other lakes found in the metropolitan area. In the next five to ten years proactive volunteer native landscaping could improve the natural aspects of a number of parcels.

Table 1. Summary of shoreline buffer and upland conditions in the shoreland area of Lac Lavon. Approximately 110 parcels were examined.

	Natural Shoreline Condition		Natural Upland Condition		Undevel. Photo Parcels	Shoreline Structure Present	
	>50%	>75%	>50%	>75%		riprap	wall
LAC LAVON TOTALS (no. of parcels = 110)	42% (48)	30% (33)	54% (59)	44% (48)	10% (11)	1% (1)	7% (8)

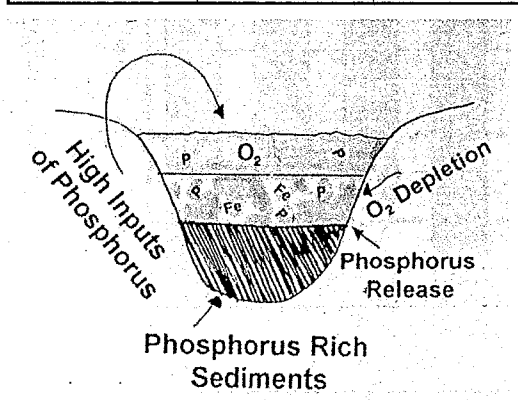
Deep Water Sediments

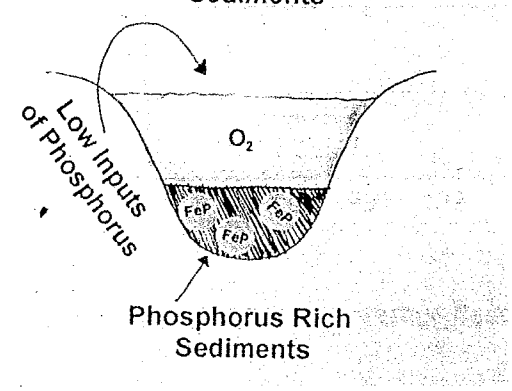
A special analysis was conducted on a Lac Lavon deep water sediment sample in 2004. The objective was to characterize the "available" or "mobile" phosphorus content of the deep sediments. Several types of tests were run and were different from the littoral zone sediment tests.

Sediment results, shown in Table 2, indicate Lac Lavon sediments have an extremely high mobile phosphorus content. For comparison, results from the two other eutrophic lakes are shown (Lake Volney and Alimagnet Lake). The high Lac Lavon mobile phosphorus content indicates that if oxygen becomes depleted in the bottom of the lake, there is the potential for a large amount of phosphorus to be released from the sediments. This could produce algae blooms in Lac Lavon. Currently, this phosphorus release does not appear to be occurring.

Table 2. Deep water sediment results for mobile phosphorus for Lac Lavon, Lake Volney, and Alimagnet Lake.

Core		Mobile - P ($\mu g\ cm^3$)	Al - P ($\mu g\ cm^3$)	Ca - P ($\mu g\ cm^3$)	Organic - P ($\mu g\ cm^3$)	Total P ($\mu g\ cm^3$)
Lac Lavon	0 - 10 cm	182.0	47.4	84.0	44.8	358.2
Volney - 40 ft	0 - 10 cm	31.2	3.6	53.4	38.1	126.3
Volney - 40 ft	0 - 10 cm	25.8	4.0	62.0	41.2	132.9
Volney - 50 ft	0 - 10 cm	33.0	5.3	63.1	46.9	148.4
Volney - 50 ft	0 - 10 cm	24.2	6.3	70.7	52.0	153.2
Alimagnet A	0 - 10 cm	78.0	54.9	54.4	73.7	261.0
Alimagnet B	0 - 10 cm	25.0	7.5	24.8	49.3	106.6
Alimagnet C	0 - 10 cm	15.1	4.7	13.9	30.4	64.1





Lac Lavon has a high mobile phosphorus content in the bottom sediments. What is "mobile" phosphorus? It is the phosphorus associated with solid iron compounds. This attached phosphorus can be released into the water column when oxygen is depleted in the lake bottom because the solid iron dissolves and releases phosphorus.

Lake Dissolved Oxygen and Temperature

Lac Lavon probably thermally stratifies during the summer. This means that warm water sits on top of the denser cold water during the summer. It is expected that dissolved oxygen concentrations are found throughout the water column most of the time, although there may be periods of time when oxygen is depleted on the bottom of the lake.

Lake Nutrients and Lake Water Clarity

Phosphorus concentrations in Lac Lavon water column are lower compared to other lakes in the North Central Hardwood Forest ecoregion. A three-year growing season phosphorus average is 15 ppb. A predicted lake phosphorus concentration based on ecoregion values is 25 ppb. Water clarity, as measured by Secchi disc readings, is excellent (Figure 3). As long as phosphorus remains low, clarity should remain high because of low algae growth.

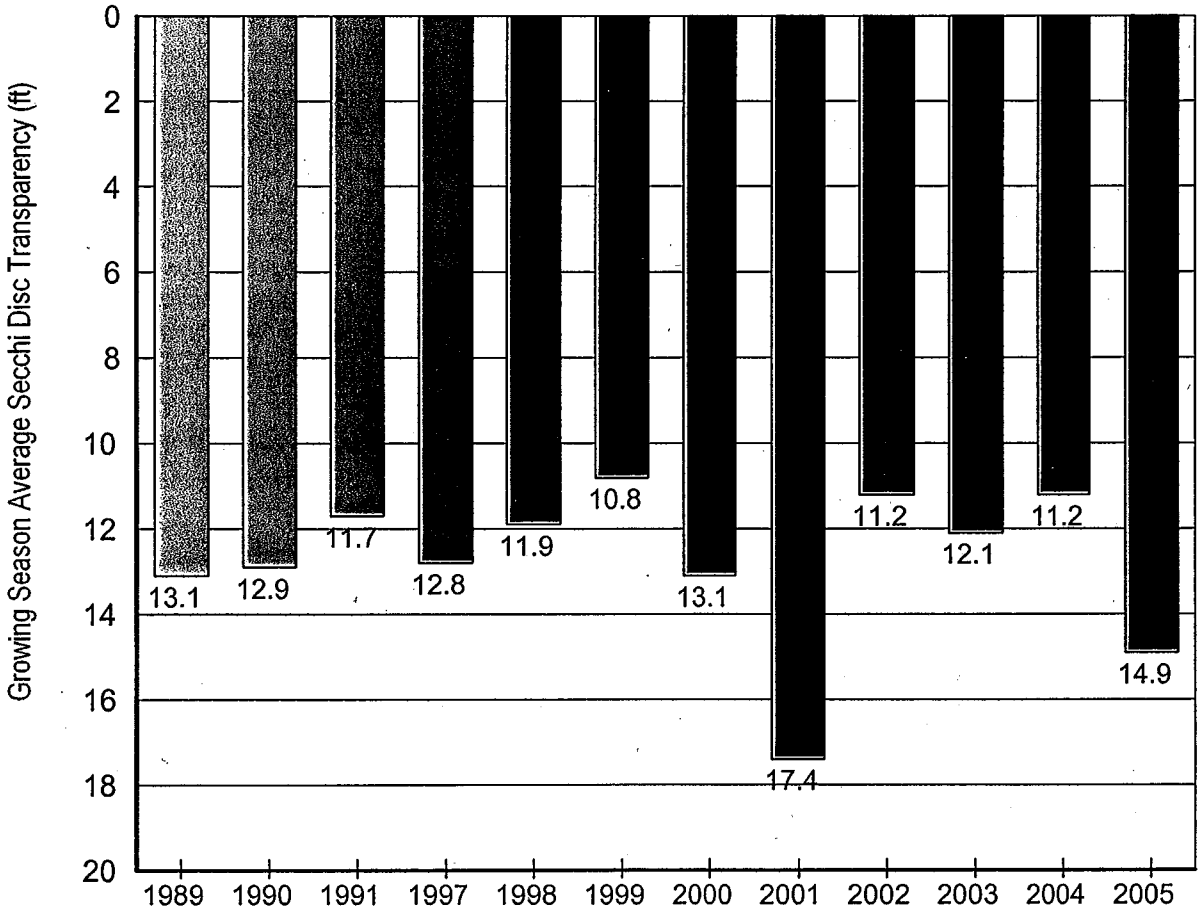


Figure 3. Growing season average Secchi disc readings from 1989-2005.

Lake Algae

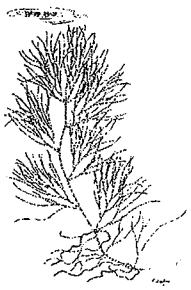
Lac Lavon has algae species that are common to lakes in this part of the state. By mid-summer algae concentrations increase slightly and water clarity decreases. Lake phosphorus levels will produce the increase in algal growth. Overall, algae has a low population density in Lac Lavon.

Lake Aquatic Plants

There are only a few stands of emergent vegetation in shallow water near the shoreline. However, when present, they are beneficial as a filter for nutrients and as fish and wildlife habitat. Aquatic plant diversity is good with 11 different submerged species identified. Three non-native submerged aquatic plants are present in Lac Lavon.

Common Native Plants in Lac Lavon

Sago Pondweed



Sago pondweed (*Stuckenia pectinata*) is found in water depths out to 11 feet deep. It can grow to the surface in water depths out to 10 feet along shoreline areas in the bay with the swimming beach and on the southwest side of the lake as well.

Illinois pondweed

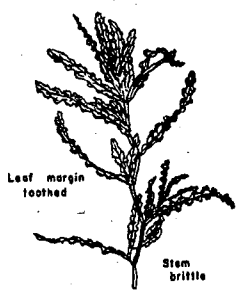
Illinois pondweed (*Potamogeton illinoensis*) is found in water depths to 10 feet. It can grow to the surface in some areas, especially by the swimming beach.

Coontail

Coontail (*Ceratophyllum demersum*) is found in several locations. Typically is not a nuisance in Lac Lavon.

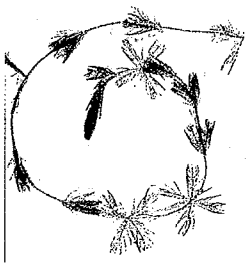
Non-Native Plants in Lac Lavon

Curlyleaf pondweed



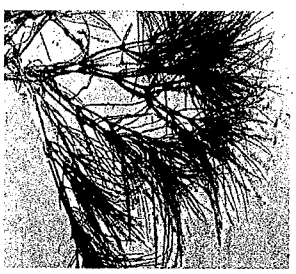
Curlyleaf pondweed (*Potamogeton crispus*) is an non-native invasive plant found in Lac Lavon. It does not produce nuisance matted conditions at this time.

Eurasian watermilfoil



Eurasian watermilfoil (*Myriophyllum spicatum*) first discovered in Lac Lavon in 1988 (source: MnDNR). It has produced nuisance conditions in some areas in some years.

Brittle naiad



Brittle naiad (*Najas minor All*) was discovered in 2002 and verified in 2004 and is a non-native plant species. It does not present nuisance growth as of 2004. Courtesy of USDA NRCS Wetland Science Institute (USDA, NRCS. 2004).

Predicting Areas of Nuisance Eurasian Watermilfoil Growth in Lac Lavon: Based on results from other studies conducted by Blue Water Science, there has been a correlation of sediment exchangeable ammonia concentrations over 10 pm with nuisance growth of Eurasian watermilfoil. Using the 10 ppm threshold as a basis for prediction, we have constructed a map showing the areas in Lac Lavon that have the potential to support nuisance milfoil growth (Figure 4). Eight out of eleven sample locations have exchangeable ammonia concentrations over 10 $\mu g/cm^3$-dry coupled with low organic matter. This combination is correlated with nuisance growth of EWM. We estimate that 11 acres of lake bottom could support matting EWM growth. Exchangeable ammonia can come from a variety of sources including runoff from fertilized yards. In other cases, lake sediments can be naturally high in nitrogen. The nitrogen source was not determined for Lac Lavon.

Table 3. Lac Lavon sediment data and ratings for potential nuisance Eurasian watermilfoil growth.

Sample Number	Water Depth at Sample Location (ft)	Lake Sediment Bulk Density (dry) grams/cm³	NH_4 Based on Corrected Weight-Volume (µg/cm³)	Organic Matter (%)	Potential for Nuisance EWM Growth
1	6	0.97	19.1	3.0	High
2	10	0.88	5.9	3.1/3.0	Med
3	6	1.37	6	0.5	Med
4	6	1.09	16.7	1.6	High
5	5	0.94	60.3	3.5	High
6	6	1.04	25.7	1.4	High
7	5	0.99	24.4	1.6	High
8	5	1.32	5	0.9	Low
9	6.5	0.92	15.4	2	High
10	8	0.91	25.2	2.6	High
11	8	0.92	15.2	2	High

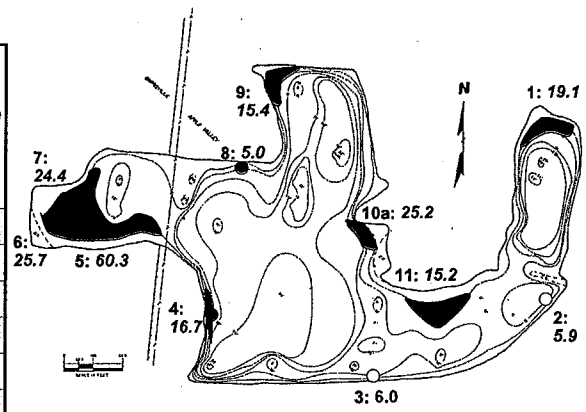


Figure 4. Areas that have the potential to support nuisance growth of Eurasian watermilfoil are shown in red shading.

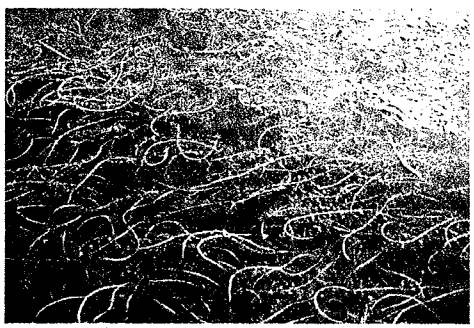


Figure 5. Matting, nuisance Eurasian watermilfoil is shown above. This is a density of a "5" and this is the kind of nuisance growth predicted by high sediment nitrogen values and a sediment organic matter content less than 20%.

Main Findings of this Study

1. Lake data reinforce that lake water quality is excellent.
2. MnDNR reported another new exotic plant found in the lake, a brittle naiad.
3. Shoreland conditions and the occurrence of native shoreland vegetation are below average.
4. Shallow lake sediment fertility indicated that persistent nuisance growth of milfoil would be expected in about 11 acres. However, conditions are not as suitable to support widespread nuisance curlyleaf pondweed.
5. Use of the herbicide, Sonar, controls Eurasian watermilfoil for up to three years. However Illinois pondweed and sago pondweed can grow to the water surface in the year after the Sonar treatment.
6. Lake sediment testing revealed that there is a huge phosphorus pool in the deep sediments. This has the potential to cause algae blooms if the phosphorus is released. At the present time, the phosphorus does not appear to release during the summer.
7. Aquatic plant management options should protect water quality. Management practices have achieved main objectives as of 2004. Recommend harvesting as a plant management option.

Recommended Lake Management Projects

1. Landscaping projects: Lac Lavon has stretches of natural shoreline conditions but is lacking along some of the developed parcels. The challenge is to protect the existing natural conditions and to enhance shorelands that lack native vegetative buffers. A volunteer lakescaping program should be implemented.

2. Aquatic plant projects: Aquatic plants are important in Lac Lavon for fish habitat and for helping sustain good water quality. Although there is good aquatic plant diversity with 11 species identified, three exotic aquatic plant species were found in Lac Lavon. Three management options were considered for addressing nuisance aquatic plant growth (Table 4). Options for implementation will be reviewed each year.

Table 4. Three options for aquatic plant management.

	Area to Be Treated	Annual Cost	3-Year Cost
1. Harvesting	15 ac x $500	$7,500	$22,500
2. Spot treatment with 2, 4D	15 ac x $425	$6,375	$19,125
3. Sonar every 3 to 4 years	whole lake	$6,000	$18,000

3. Watershed and lake monitoring program: Ongoing testing should include: Secchi disk, total phosphorus, or chlorophyll a levels in the lake. In addition, dissolved oxygen profiles should be taken through the summer months. The level of effort depends on the availability of volunteers and funding levels.

APPENDIX H – Water Quality Cash Dedication Methodology

Appendix H

Calculation of Cash Dedication – Supplemental Information
City of Apple Valley SWMP Update

Introduction

The following is a more detailed explanation of the calculation of cash dedications for new and re-development projects as proposed in the City of Apple Valley's Surface Water Management Plan. Guidance for calculation of the cash dedication amounts is presented on pages 150 through 152. This method is similar to the methods used in several other Twin City Metro area suburbs, including Wayzata and Eagan.

Background

The method of cash dedication calculation proposed in the plan relies on the use of a water quality pond design program called PONDSIZE to determine the size of a hypothetical pond recommended to treat runoff from the development in question. This model requires input on the area of the proposed development, how much of the site will be covered by impervious surfaces (such as rooftops, driveways, and streets), and the capability of non-impervious areas to absorb precipitation. The output of the PONDSIZE model provides information on the surface area of the pond at normal water level, the volume of the standing water pool in the pond (i.e. between the control water level and the bottom of the pond), and the mean depth of the standing water pool. Depending on the land use proposed for the development, the area of the hypothetical pond (acres) in the model output is then multiplied by the appropriate unit land cost under 5.) on page 152 and the volume (in cubic yards) is multiplied by the unit pond volume cost on the same page. The two figures are summed. A cost for appurtenances is then added which is 20% of the sum of the land and pond volume cost or $4,000, whichever is less. The total of the pond area cost, the pond volume cost, and the appurtenance cost is the total cash dedication for the development.

The same general method is used when figuring a cash dedication for a re-development project where impervious coverage would be expanded by more than a ½ acre as a result of the re-development activity. The purpose of this proposed provision is to provide an incentive to avoid expansion of impervious coverage associated with re-development projects. Impervious coverage is directly tied to the pollutant export characteristics of urban land; the higher the impervious coverage, the greater the pollution mass generated by that unit of land.

Appendix H

Explanation of Cash Dedication Calculations

The following is an explanation for calculation of cash dedication amounts for each of the four examples shown on page 152 of the Surface Water Management Plan.

1. **Example:** Five-acre new single family residential development (30% impervious coverage)

   Explanation:

   Based on a single family residential development area of 5 acres at 30% impervious coverage and a simple pro-rata adjustment to account for the small size of the development, the PONDSIZE model generates a hypothetical pond 0.170 acres in area with a wet volume of 0.401 acre-feet (X 1613 yds^3/acre-foot = 647 yds^3). Since the development is single-family residential, the pond area of 0.170 acres is multiplied by $150,000/acre (from the Unit Land Cost table on page 152) to give $25,447. The pond volume of 647 yd^3 is multiplied by the unit pond volume cost of $4/$yd^3$ (also on page 152) to give $2,588. The sum of these amounts is $28,035. The appurtenance cost is $4,000 (the lesser of 20% of this amount or 4,000). Thus, the total cash dedication is approximately $32,035.

2. **Example:** Five-acre new commercial development (75% impervious coverage)

   Explanation:

   Using the same model inputs as above but adjusting the impervious coverage to 75%, the PONDSIZE model generates a hypothetical pond, 0.309 acres in area with a wet volume of 0.819 acre-feet (1321 yd^3). The development is commercial, so the pond area of 0.309 acres is multiplied by $260,000/acre to give $80,236. The pond volume of 1321 yd^3 is multiplied by $4/$yd^3$ to give $5,283. The sum of these amounts is $85,520. The appurtenance cost is the lesser of 20% of this figure ($17,104) or $4,000. Thus the total cash dedication amount is $80,236 + $5,283 + $4,000 = $89,520.

3. **Example**: Two-acre commercial re-development project with increase in impervious coverage from 50% to 80%

   Explanation:

   Because the re-development project involves a 0.6 acre <u>increase</u> in impervious coverage of the site that exceeds ½ acre, the cash dedication for the parcel is calculated as it would be for a new development of the same size and ultimate land use characteristics. Using the same method as that in Example 2. above, the PONDSIZE model generates a hypothetical pond, 0.122 acres in area with a wet volume of 0.342 acre-feet (551 yd^3). The cash dedication is $38,052.

Maps 1, 2, 3