Crystal Lake Nutrient TMDL Implementation Plan

FINAL

Wenck File #1240-76

Prepared for:

SHINGLE CREEK WATERSHED MANAGEMENT COMMISSION

MINNESOTA POLLUTION CONTROL AGENCY

May 2009

Prepared by:

WENCK ASSOCIATES, INC.
1800 Pioneer Creek Center
P.O. Box 249
Maple Plain, Minnesota 55359-0249
(763) 479-4200

Table of Contents

1.0 INTRODUCTION 1-1

2.0 CRYSTAL LAKE TMDL SUMMARY 2-1

2.1 Current Water Quality 2-1
2.2 Meeting State Standards 2-3
2.3 Required Phosphorus Load Reductions 2-3
2.3.1 Allocations 2-3
2.3.2 Implementation Focus 2-4

3.0 IMPLEMENTATION PLAN 3-1

3.1 TMDL and Implementation Plan Process 3-1
3.2 Implementation Plan Principles 3-1
3.3 Implementation Plan 3-2
3.3.1 Implementation Approach 3-3
3.3.2 Implementation Strategies 3-4
3.3.3 Sequencing 3-5
3.3.4 Stakeholder Responsibilities 3-5
3.4 Adaptive Management 3-1

4.0 WATERSHED COMMISSION ACTIVITIES 4-1

4.1 General Coordination 4-1
4.1.1 Coordination 4-1
4.1.2 Annual Report on Monitoring and Activities 4-1
4.1.3 Rules and Standards 4-2
4.1.4 Establish Performance Standards 4-2
4.2 Education 4-3
4.2.1 Public Education and Outreach 4-3
4.2.2 Encourage Public Official and Staff Education 4-3
4.2.3 Presentations at Meetings 4-3
4.2.4 Demonstration Projects 4-4
4.3 Ongoing Monitoring 4-4
4.3.1 Water Quality Monitoring 4-4
4.3.2 Other Monitoring 4-5

5.0 STAKEHOLDER ACTIVITIES 5-1

5.1 Reduce External Load 5-1
5.1.1 Crystal Lake Improvement Project 5-1

5.1.2 Retrofit BMPs to Add Stormwater Treatment in the Watershed 5-2
5.1.3 Increase Infiltration in Watershed 5-3
5.1.4 Shoreline Management and Restoration 5-3
5.1.5 Street Sweeping 5-4
5.2 Reduce Internal Load 5-4
5.2.1 Internal Load Management 5-4
5.3 Biologic Integrity Management 5-5
5.3.1 Aquatic Plant Management 5-5
5.3.2 Fish Population Management 5-5
5.4 Tracking and Reporting 5-5

Tables

Table 1. Wasteload allocation by NPDES permitted facility 2-7
Table 2. TMDL total phosphorus allocations expressed as daily and annual loads 2-8
Table 3. TMDL total phosphorus loads partitioned among the major sources. 2-8
Table 4. Implementation activity by stakeholder. 3-7

Figures

Figure 1. Crystal Lake location 1-2
Figure 2. Summer mean total phosphorus concentrations for Crystal Lake 2-5
Figure 3. Summer mean chlorophyll-a concentrations for Crystal Lake 2-6
Figure 4. Summer mean Secchi depth for Crystal Lake 2-6
Figure 5. Implementation framework 3-2
Figure 6. Adaptive management. 3-6

1.0 Introduction

The Crystal Lake Nutrient Total Maximum Daily Load (TMDL) Implementation Plan addresses nutrient impairments in Crystal Lake, which is located in the City of Robbinsdale, Hennepin County, Minnesota, in the Shingle Creek watershed.

The Shingle Creek Watershed Management Commission (SCWMC) has completed a Total Maximum Daily Load (TMDL) analysis for the Minnesota Pollution Control Agency (MPCA) to quantify the phosphorus reductions needed to meet State water quality standards for nutrients in Crystal Lake (27-0034) (see Figure 1) in accordance with Section 303(d) of the Clean Water Act. The TMDL and Implementation Plan were prepared in cooperation with the two cities (Robbinsdale and Minneapolis) with land located in the Crystal Lake subwatershed and with review by Hennepin County.

The final step in the TMDL process is the development of an Implementation Plan that sets forth the activities that will be undertaken to reduce phosphorus loading to the lake. This Implementation Plan provides a brief overview of the TMDL findings; describes the principles guiding this Implementation Plan; discusses sequencing, timing, lead agencies and organizations, and other implementation general strategies; and describes the proposed implementation activities.

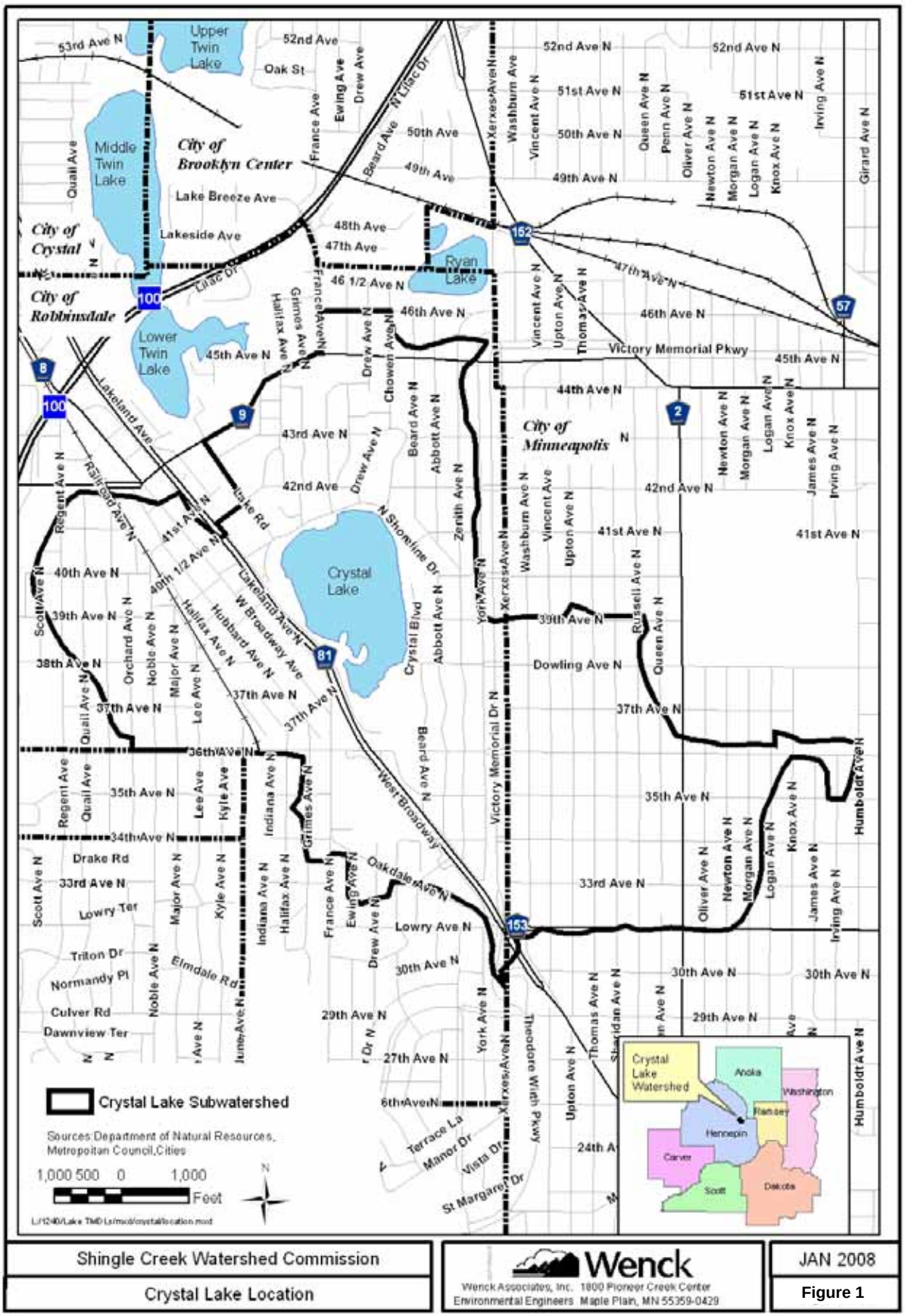

Figure 1. Crystal Lake location.

2.0 Crystal Lake TMDL Summary

A key aspect of a TMDL is the development of an analytical link between loading sources and receiving water quality. To establish the link between phosphorus loading to the quality of water in the lakes, monitoring data extending back to 1990 was reviewed to better understand conditions and trends. Other data examined include fish community data compiled by the Minnesota Department of Natural Resources (DNR), some limited aquatic vegetation data, and data collected for the 2003 *Water Quality Management Plan for Crystal Lake*.

2.1 CURRENT WATER QUALITY

Historic water quality is presented in Figures 2, 3, and 4. Crystal Lake does not meet state standards for total phosphorus concentration, nor for chlorophyll-a or clarity as measured by Secchi depth. The highest phosphorus concentration was observed in 1988 when the artificial aeration system was used to prevent fish kills in the lake due to anaerobic conditions. The result of aeration is the disruption of the thermocline and the delivery of phosphorus from the lower lake levels (hypolimnion) to the surface level (epilimnion) throughout the growing season. In recent years the total phosphorus concentration is approximately 100 µg/L, compared to the state standard of 40 µg/L total phosphorus.

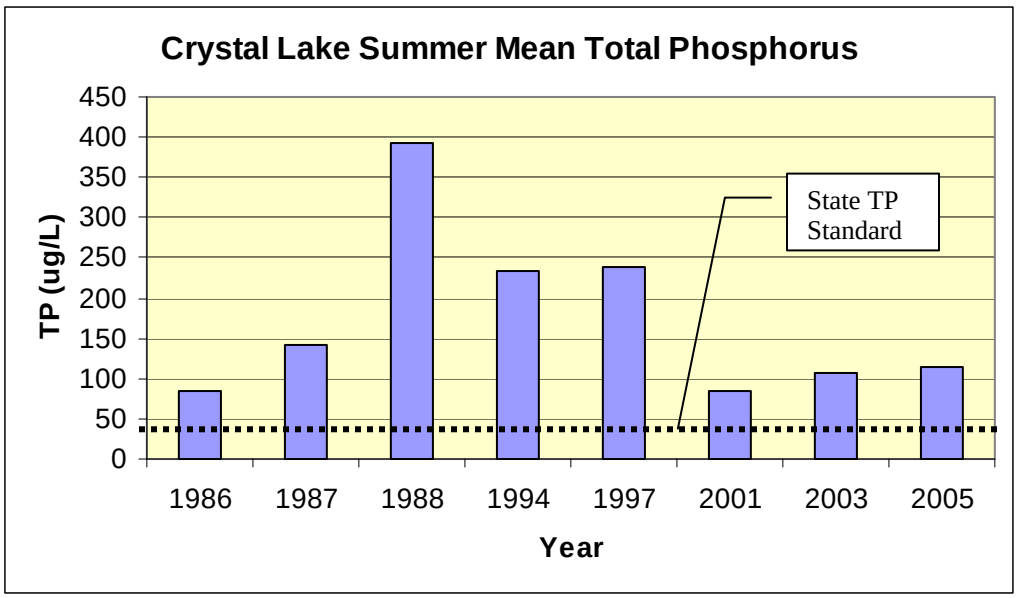

Figure 2. Summer (June 1 –September 30) mean total phosphorus concentrations for Crystal Lake.

Similar trends are observed in the chlorophyll-a concentrations as was seen in the total phosphorus concentrations. The highest concentration of chlorophyll-a was observed in 1988 when the aeration system delivered nutrient rich hypolimnetic water to the epilimnion, resulting in significant algal blooms. In recent years, the chlorophyll-a concentration is approximately 30 to 40 µg/L, compared to the state standard of 14 µg/L for chlorophyll-a.

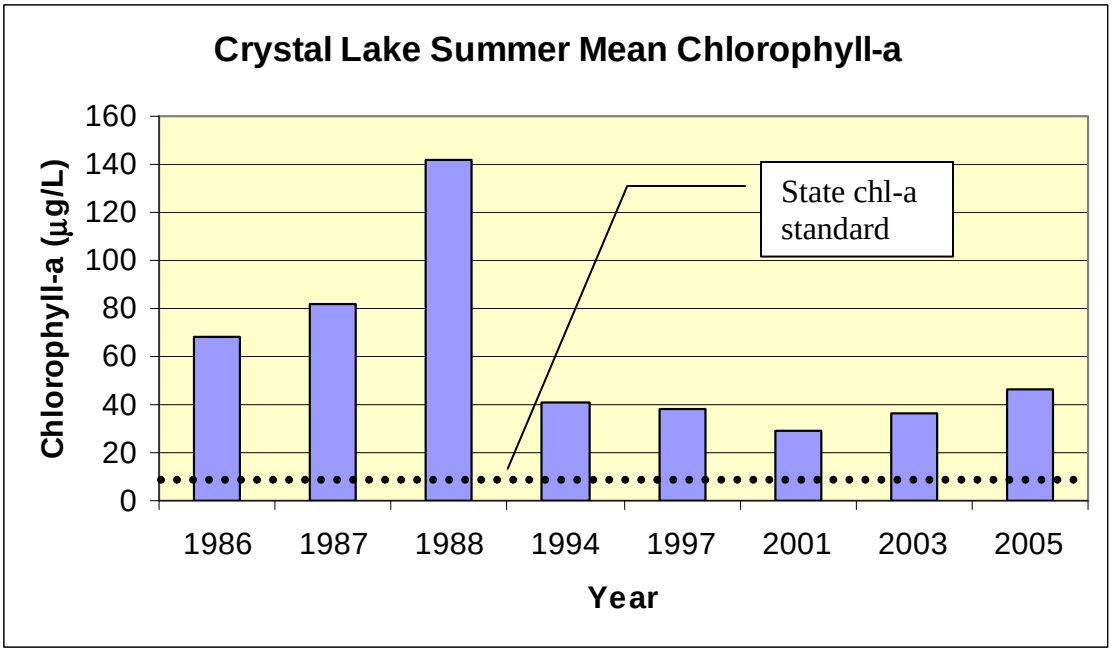

Figure 3. Summer (June 1 –September 30) mean chlorophyll-a concentrations for Crystal Lake.

Water clarity, as measured by Secchi depth measurements, was observed to follow similar trends as total phosphorus and chlorophyll-a concentration. Secchi depth ranged from approximately 0.3 meters to approximately 1.8 meters. The poorest clarity was observed in 1988 which coincides with the severe algal blooms observed in that year. Water clarity in recent years is approximately 1 meter. The numeric standard for Crystal Lake is 1.4 meters for clarity measured by Secchi depth.

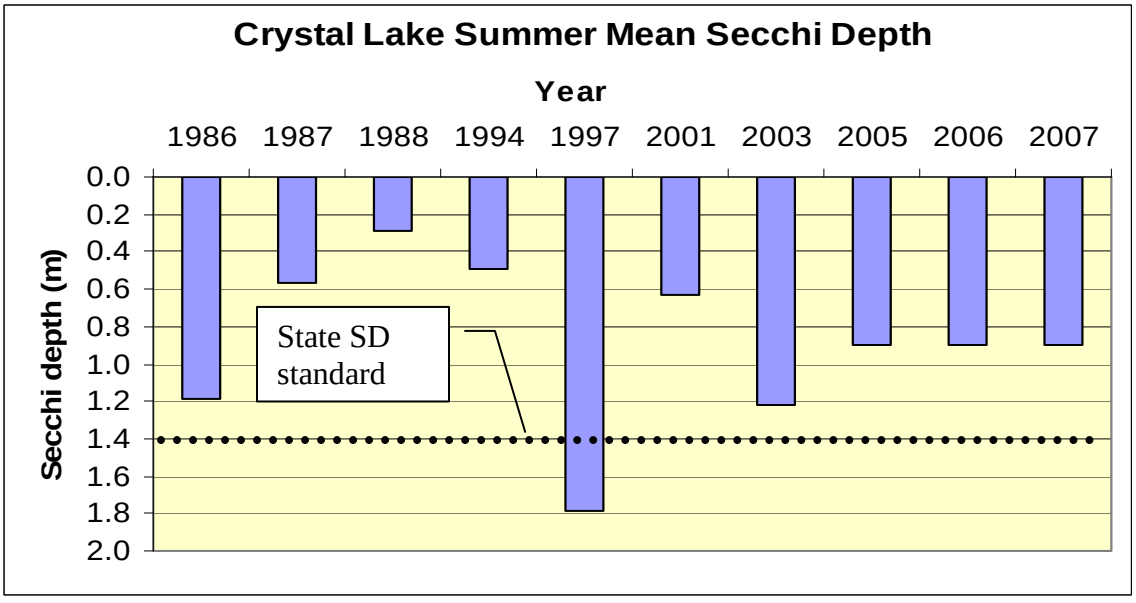

Figure 4. Summer (June 1 –September 30) mean Secchi depth (meters) for Crystal Lake.

2.2 MEETING STATE STANDARDS

Crystal Lake was listed as an Impaired Water because it consistently exhibits excess levels of nutrients that could lead to severe nuisance blooms of algae. Nutrient loads in this TMDL and Implementation Plan are set for phosphorus, since this is typically the limiting nutrient for nuisance aquatic plants. However, it is a goal of this TMDL and Implementation Plan to achieve state standards for chlorophyll-a and Secchi depth as well.

2.3 REQUIRED PHOSPHORUS LOAD REDUCTIONS

Wasteload and load allocations to meet State standards indicate a phosphorus load reduction of about 72 percent would be required to consistently achieve a total phosphorus concentration of 40 µg/L, which would meet the state standard. This Implementation Plan details the specific activities the stakeholders in the lake's watershed plan to undertake to attain that reduction.

2.3.1 Allocations

Stormwater discharges are regulated under the State of Minnesota's National Pollutant Discharge Elimination System (NPDES) General Permit, and are considered wasteloads. Entities with permits to discharge stormwater in the Crystal Lake watershed are shown in Table 1 below. Because there is not enough information available to assign loads to individual permit holders, the Wasteload Allocations are combined in the TMDL as Categorical Wasteload Allocations (WLA) (see Tables 1 and 2) assigned to all permitted dischargers in the contributing lakeshed. There are no known industrial dischargers in the watershed. The pollutant load from construction stormwater is considered to be less than 1 percent of the TMDL and difficult to quantify. Consequently, the WLA also includes pollutant loading from construction stormwater sources. The Load Allocation includes atmospheric deposition and internal loading and is allocated in the same manner as the WLA.

Table 1. Wasteload allocation by NPDES permitted facility.

NPDES Permit Number	Allocation
MN0061018-City of Minneapolis	Categorical WLA
MS400046-City of Robbinsdale	Categorical WLA
MS400138-Hennepin County	Categorical WLA

Each permittee has committed to implement Best Management Practices (BMPs) to reduce nutrient loading to Crystal Lake. The cities and Hennepin County cooperated in developing the TMDL and Implementation Plan and will continue to work together through the ongoing Shingle Creek Watershed Management Commission Technical Advisory Committee (TAC) to identify, implement, and evaluate BMPs either individually or in collaboration. This collective approach allows for greater reductions for some permit holders with greater opportunity and less for those with greater constraints. Construction stormwater activities are considered in compliance with provisions of the TMDL if they obtain a Construction General Permit under the NPDES program and properly select, install, and maintain all BMPs required under the permit, or meet local construction stormwater requirements if they are more restrictive than requirements of the State General Permit.

2.3.2 Implementation Focus

The focus in implementation will be on reducing the annual phosphorus loads to Crystal Lake through structural and nonstructural BMPs. The load and wasteload allocations are shown in Table 2.

Table 2. Crystal Lake TMDL total phosphorus allocations expressed as daily and annual loads. (Average of model years 2001 and 2003).

Wasteload TP Allocation[1]		Load TP Allocation		Margin of Safety	Total Phosphorus TMDL	
(kg/day)	(kg/yr)	(kg/day)	(kg/yr)		(kg/day)	(kg/yr)
0.22	79	0.06	23	Implicit	0.28	102

[1]The wasteload allocation is allocated to NPDES-permitted facilities in accordance with Table 1.

Load allocations by source are provided in Table 3. No reduction in atmospheric loading is targeted because this source is impossible to control on a local basis.

Table 3. Crystal Lake TMDL total phosphorus daily and annual loads partitioned among the major sources.

	Source	Total Maximum Daily TP Load (kg/day)	Total Maximum Daily TP Load (kg/yr)	Current Load (1999-2003 Average) (kg/yr)	percent of Total
Wasteload	Watershed Load	0.22	79	223.2	62 percent
Load	Atmospheric Load	0.03	10	10.0	3 percent
	Internal Load	0.03	13	128.8	35 percent
	TOTAL LOAD	**0.28**	**102**	362.0	
72 percent Load Reduction					

3.0 Implementation Plan

3.1 TMDL AND IMPLEMENTATION PLAN PROCESS

The activities and BMPs identified in this Implementation Plan are the result of a series of Technical Advisory Committee (TAC) and stakeholder meetings led by the Shingle Creek Watershed Management Commission. The TAC included stakeholder representatives from local cities, Minnesota DNR, the Metropolitan Council, the United States Geological Survey (USGS) and the Minnesota Pollution Control Agency. All meetings were open to interested individuals and organizations. Technical Advisory Committee meetings to review this and other lake TMDLs in the watershed were held on December 8, 2005, February 10, 2006, March 9, 2006, and June 27, 2007.

A task force of citizens, city staff, and agency representatives had previously provided guidance to the city of Robbinsdale in the development of the Crystal Lake Management Plan (2003), and the findings and recommendations of that Plan were incorporated into the TMDL where appropriate. The general TMDL approach and general results of TMDLs were presented to the Robbinsdale City Council on May 2, 2006, and to six other City Councils in May and July 2006. Finally, a public meeting was held August 14, 2008 to review the findings of the TMDL and to take public input in the development of this Implementation Plan. Lakeshore residents, members of the task force, and the general public in both Robbinsdale and Minneapolis were invited to attend.

This Implementation Plan was distributed to stakeholders for review and posted on the SCWMC website www.shinglecreek.org for public review and comment. On November 13, 2008 the Shingle Creek Watershed Management Commission reviewed the draft Implementation Plan and all comments received and approved this Plan.

3.2 IMPLEMENTATION PLAN PRINCIPLES

Through the discussion of policies and practices, current activities, and ongoing research, the stakeholders developed principles to guide development and implementation of the load reduction plan. These principles, in no order, include:

1. Restore Biological Integrity

The Commission, cities, and residents recognize the importance of a healthy biological community in the lake to provide internal controls on water clarity. To that end, the stakeholders agreed to work cooperatively to restore the biological community in this lake, including fish, plants, and zooplankton.

2. Control Internal Load

A significant portion of the phosphorus load in Crystal Lake is a result of internal loading and the internal load must be addressed to successfully improve water quality. Consequently, the cities and county agreed to work cooperatively to reduce internal phosphorus loading in the lake.

3. Retrofit BMPs in the Watershed As Opportunities Arise

Since the watershed to Crystal Lake is fully developed, options to retrofit BMPs to reduce nutrient loading are limited. Each MS4 will include in their SWPPP the statement that "Water quality BMPs will be incorporated into public improvement projects unless it can be demonstrated why it is technically infeasible or not cost-effective to do so within the context of the current practice." Each MS4 further agrees to take advantage of opportunities such as redevelopment to add or upsize BMPs.

4. Foster Stewardship

City staff, especially maintenance staff, will be provided opportunities for education and training to better understand how their areas of responsibility relate to the protection and improvement of water quality in the lake.

5. Communicate with the Public

Public education should take a variety of forms, and should include both general and specialized information, targeted but not limited to:

- General public
- Elected and appointed officials
- Lakeshore residents
- Lake users
- Property owners and managers

3.3 IMPLEMENTATION PLAN

The stakeholders agreed that implementation should be a joint effort, with the SCWMC taking responsibility for ongoing coordination, general education and monitoring activities and the NPDES permittees taking responsibility for BMP implementation. The two cities and Hennepin County will incorporate these BMPs into their Storm Water Pollution Prevention Programs (SWPPP) and NPDES Minimum Control Measures, and will periodically assess progress toward advancing the implementation principles detailed above. The stakeholders will annually report to the SCWMC their annual activities, and the Commission will summarize those activities into its own Water Quality Annual Report. This framework is illustrated in Figure 5 below.

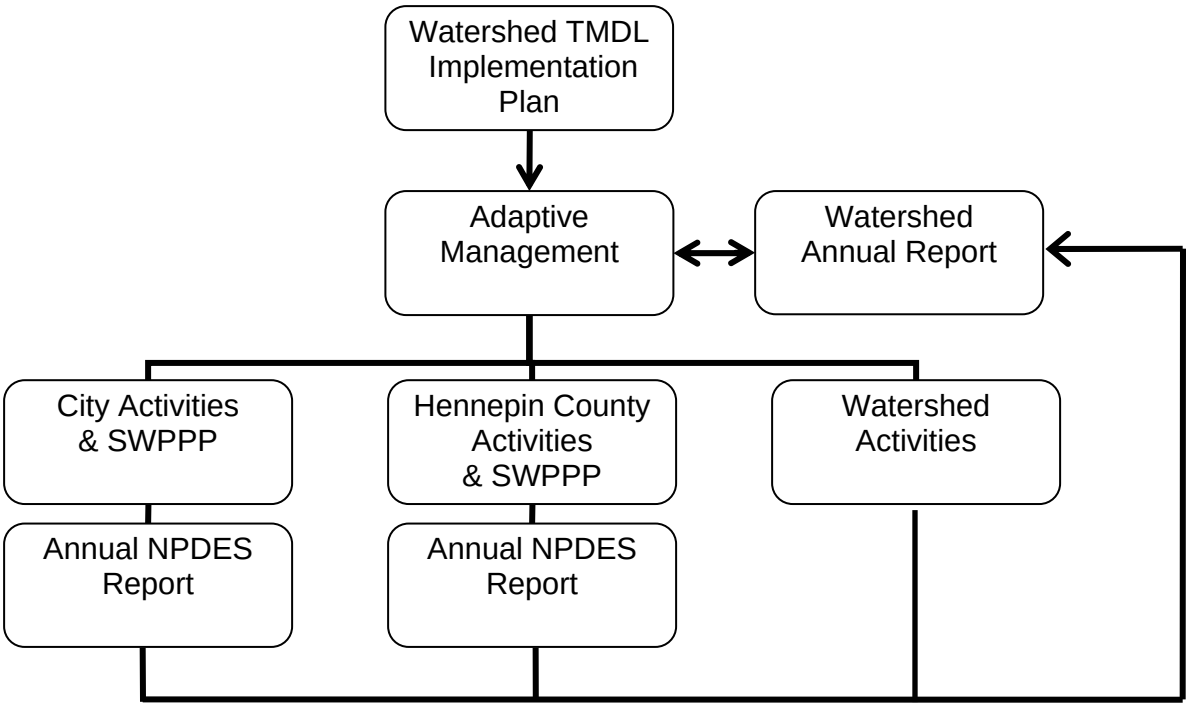

Figure 5. Implementation framework.

3.3.1 Implementation Approach

The impairment to Crystal Lake developed over time as the watershed draining to the lake urbanized. As the watershed developed, the native prairie and savanna was cleared and wetlands were ditched and filled to support farming. Over the past century the farms and remaining undeveloped land were converted to urban and suburban uses, increasing the volume of runoff and the amount of pollutants conveyed to the lakes. As a result of this land use and land cover change, the lake slowly degraded. Just as this degradation took many years, improvement will take many years through ongoing retrofit of the watershed with BMPs as well as eventual redevelopment of existing land uses with lower-impact development and stormwater treatment.

The TMDL study and this Implementation Plan identified specific improvements to reduce external and internal phosphorus loading. These are "short-term" projects that could be accomplished in the next 10-20 years. However, these projects alone will not be sufficient to achieve water quality goals for this lake. An essential "long-term" component of this Implementation Plan is to routinely retrofit BMPs in this fully developed watershed as redevelopment or construction activities provide opportunities.

As the road authorities cycle through their street and highway reconstruction programs, it is now routine to include treatment BMPs such as stormwater detention ponds and underground treatment devices where possible. The City of Robbinsdale has installed a number of small in-line treatment devices on several of the storm sewer trunk lines discharging to the lake, and is incorporating BMPs into a neighborhood street reconstruction project on the northeast corner of the lake, including a rain garden and bottomless manholes to increase infiltration and reduce small-event runoff. In 2009 the Commission received a research grant to install porous asphalt

streets at two locations, including one location in Robbinsdale in the Crystal Lake watershed. The research project will monitor the porous pavement to evaluate ice and snow buildup and to measure stormwater infiltration and other water quantity and quality improvements. Hennepin County incorporated new and enlarged existing ponds as part of its County State Aid Highway (CSAH) 81 (Bottineau Boulevard) reconstruction project, as well as several swirl separators to treat both runoff from the highway and treatment for neighborhood runoff draining through the highway system. These incremental reductions will over time add up to a significant external load reduction.

Another long-term type of external load reduction is redevelopment. Much of the watershed draining to the lake developed prior to the development of Shingle Creek Watershed rules and standards and subsequently there is currently little or no treatment of stormwater. However, some redevelopment has occurred and provided the opportunity to retrofit treatment BMPs and increase infiltration. As this area redevelops over time, the redevelopment will be required to abstract some stormwater and treat the balance of the runoff before discharging it to the lake. Depending on the nature of the development or redevelopment, it may be possible to provide even more load reduction by "upsizing" treatment above and beyond the minimum required by the rules or to create new regional treatment opportunities.

3.3.2 Implementation Strategies

The emphasis of implementation will be on controlling external loading. Because internal load is an important factor in this lake some internal load management activities could be initiated early in the Implementation Program. An important part of the internal load strategy is restoring and maintaining biological integrity and associated impacts to water quality through management of the aquatic plant community, fishery, and macroinvertebrate and zooplankton assemblages. However, biological manipulation cannot provide all the internal load reduction that would be required. Preliminary feasibility work has been completed to evaluate whether chemical treatment with alum, hypolimnetic withdrawal, or other means of reducing internal loading are feasible.

The following sections discuss the general BMP strategies that were identified in the TMDL process to reduce phosphorus load, restore ecological integrity, and meet state water quality goals for these lakes; the general sequence of implementation activities; and the stakeholders who would take the lead in implementing each activity. BMP strategies are listed below and described in more detail in Sections 4 and 5 of this Plan.

<u>External Load Best Management Practice (BMP) Strategies</u>

- Add BMPs as opportunities arise to decrease runoff from the watershed and increase stormwater treatment
- Increase infiltration and abstraction in the watershed
- Increase frequency of street sweeping in sensitive areas
- Encourage shoreline restoration to improve runoff filtration

<u>Internal Load Best Management Practice (BMP) Strategies</u>

- Conduct aquatic plant, fish, zooplankton, and phytoplankton surveys

- Prepare and implement an aquatic vegetation management plan
- Restore a balanced fishery
- Implement one or more internal load management projects, such as alum treatment or hypolimnetic withdrawal

3.3.3 Sequencing

Some of the above activities may be undertaken immediately, while others would be implemented as opportunities arise. In general implementation will proceed according to the following sequence of activities:

First Five Years

- Continue monitoring the lake
- Continuously update the watershed SWMM and P8 models
- Evaluate ways to refine street sweeping practices to maximize pollutant removal
- Evaluate a possible ordinance amendment to require street sweeping in parking lots
- Conduct aquatic vegetation, fish, phytoplankton, and zooplankton surveys
- Develop and implement an aquatic vegetation management plan
- Install gross pollutant traps upstream of stormsewer outfalls into the lake
- Complete the shoreline restoration project in Hollingsworth Park
- Encourage lakeshore property owners to plant native buffers on their shoreline
- Implement an internal load reduction project
- Implement BMP retrofits as opportunities such as street and utility reconstruction arise
- Implement BMP and restoration demonstration projects as opportunities arise

Second Five Years and Subsequent Permit Cycles

- Continue monitoring the lake
- Evaluate progress towards goals including what BMPs and activities were implemented and subsequent water quality improvement.
- Amend the Implementation Plan as necessary based on progress
- Implement BMP retrofits as opportunities arise to continue to reduce external loading
- Work with the DNR to restore a balanced fishery

3.3.4 Stakeholder Responsibilities

The primary stakeholders in this Plan are the Shingle Creek Watershed Management Commission (SCWMC), the cities of Robbinsdale and Minneapolis, and Hennepin County. In addition, property owners in the watershed have a role to play in implementing BMPs on their private properties. The SCWMC Education program will provide both residential and non-residential property owners and managers with information on BMPs that would have the most impact on improving water quality.

Table 4 shows which stakeholders will take the lead in implementing the various activities identified in this Plan.

Table 4. Implementation activity by stakeholder.

Actor	Stormwater	Internal Load	Aquatic Vegetation	Aquatic Life	Monitoring/ Reporting
SCWMC	• Evaluate watershed rules and standards • Evaluate volume management standards • Provide focused education and outreach • Solicit and fund Demonstration Projects • Prepare grant applications • Evaluate ways to refine street sweeping practices	• Measure internal loads • Prepare feasibility reports and make recommendations on internal load strategies in partnership with the City of Robbinsdale.	• Evaluate and make recommendations for curly-leaf pondweed management • Identify potential shoreline restoration projects	• Work in partnership with the DNR to manage the fishery to maintain a beneficial community	• Continue CAMP citizen water quality monitoring • Conduct periodic in-depth lake monitoring • Monitor aquatic vegetation, zooplankton, and phytoplankton every five years • Collect implementation data from stakeholders annually • Prepare annual report on monitoring and activities
Cities	• Provide focused education and outreach • Implement BMPs to reduce loads as opportunities arise • Conduct routine pond inspections for maintenance • Perform pond maintenance as necessary per inspection results • Sweep streets at least twice annually	• Consider internal load reduction strategies	• Consider curly-leaf pondweed management • Consider shoreline restoration projects	• Work in partnership with the DNR to manage the fishery to maintain a beneficial community	• Report implementation activities to SCWMC annually
Hennepin County	• Sweep streets at least twice annually • Implement BMPs to reduce loads as opportunities arise				• Report implementation activities to SCWMC annually
Property Owners	• Implement BMPs to reduce loads as opportunities arise		• Implement curly-leaf pond weed management • Implement shoreline restoration projects		

3.4 ADAPTIVE MANAGEMENT

The load allocations in the TMDL represent aggressive goals for nutrient reduction. Consequently, implementation will be conducted using adaptive management principles. Adaptive management is an iterative approach of implementation, evaluation, and course correction (see Figure 6). It is appropriate here because it is difficult to predict the lake response to load reductions. Future conditions and technological advances may alter the specific course of actions detailed in this Plan. Continued lake water quality monitoring and course corrections responding to monitoring results offer the best opportunity for meeting the water quality goals established in this TMDL and Implementation Plan.

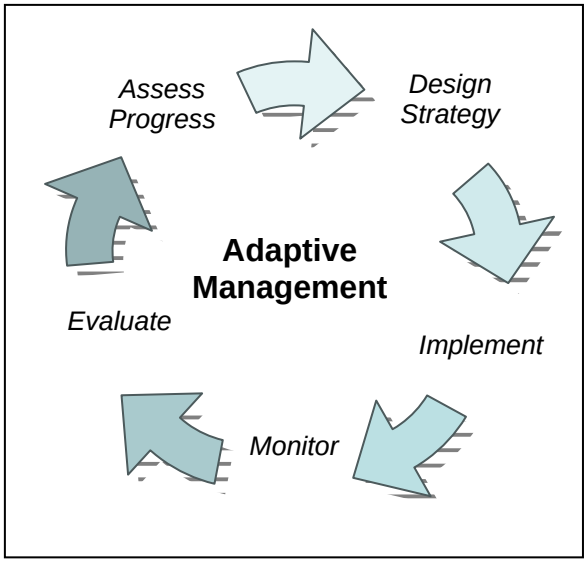

Figure 6. Adaptive management.

4.0 Watershed Commission Activities

The SCWMC has agreed to take the lead on general coordination, education, and ongoing monitoring. The Commission will also collect annual NPDES reports and other information from the stakeholders and compile BMP activities undertaken by all parties. This information will be incorporated into the Commission's annual Water Quality Report. The following activities will be conducted by the SCWMC.

4.1 GENERAL COORDINATION

4.1.1 Coordination

One of the primary Commission roles in managing the watershed is serving as a coordinator of water resource policies and activities. The Commission will continue in that role in the implementation of this TMDL. General activities now undertaken by the Commission will be continued or expanded as the Commission moves from management planning to implementation coordination. These are activities that are included as part of the Commission's general administrative budget and no additional cost is expected from their implementation:

- Provide advice and assistance to member cities on their implementation activities;
- Research and disseminate information on changing BMP technology and practices;
- Collect annual implementation activity data;
- Recommend activities such as vegetation or fishery management, partnering with the DNR;
- Periodically update the Commission's Capital Improvement Program (CIP);
- Maintain the watershed SWMM and P8 models;
- Conduct public hearings on proposed projects; and
- Share the cost of qualifying improvement projects.

Estimated Cost: Ongoing activity
Funding Source: General operating budget, county levy for project share

4.1.2 Annual Report on Monitoring and Activities

An annual report on phosphorus load reduction activities is necessary under the adaptive management approach established in the TMDL. Each year the Commission will collect from the permittees in the watershed a listing of the activities undertaken in the previous year. This report will summarize those activities and provide the permittees assigned a categorical wasteload allocation the necessary information for their annual NPDES reports. The report will detail BMP implementation, associated load and volume reductions, and current monitoring data to evaluate activity effectiveness. At the end of each five year period this report will include as assessment of progress and identification of any revisions to the implementation plan. This report will be a part of the Commission's annual Water Quality Report. The format and content of the Water Quality Report is being revised to include reporting on the three stream TMDLs and 13 lake TMDLs in the watershed.

Estimated Cost: $10,000-12,000
Funding Source: General operating budget (currently budgeted at about $5,000)

4.1.3 Rules and Standards

In early 2008 the Commission directed its Technical Advisory Committee (TAC) to review and if necessary recommend revisions to the current rules to address the effectiveness of the regulatory program in meeting the TMDL requirements. The TAC reviewed the current pollutant removal performance standard and current infiltration requirement to determine if a more stringent rule was necessary. The TAC concluded that the current pollutant removal standards of 85 percent total suspended solids (TSS) and 60 percent phosphorus removal combined with the infiltration standard were sufficiently stringent without being overly burdensome. The TAC did recommend revising the infiltration standard into a more broad volume management rule to provide flexibility in implementation. The revised rules and standards were adopted October 9, 2008 and are effective January 1, 2009.

Estimated Cost: $2,000
Funding Source: General operating budget for Management Plan activities (current budget is $3,000)

4.1.4 Establish Performance Standards

As a part of this and other TMDL Implementation Plans each city, the county, and MnDOT (for other TMDLs) will be implementing various BMPs to reduce phosphorus load and stormwater volume. Stakeholders will report load reductions made by each BMP to the Commission, which will track progress toward meeting load reductions throughout the watershed. BMPs implemented since the TMDL baseline "current phosphorus budget" year (2003) will be tracked.

Stakeholders will have varying levels of information and data about these BMPs. In some cases estimating the load reduction will be part of the BMP design process. For example, load reductions for a new or enhanced pond can be calculated using standard modeling techniques. However, many other types of BMPs such as rain gardens, reforestation, reductions in impervious pavement, etc. have an impact that is more difficult and time-consuming to calculate. The Commission has directed its TAC to review literature and other data and establish standardized performance values for various BMPs. For example, a typical residential rain garden might be credited with reducing phosphorus by X kilograms per unit area annually. Or, an underground treatment device of Brand X would be assigned specific removal efficiencies. The MPCA is exploring establishing such standards, as are other watershed management organizations.

Estimated Cost: $3,000
Funding Source: General operating budget for Engineering Administration activities (current budget is $41,000)

4.2 EDUCATION

4.2.1 Public Education and Outreach

The Commission operates an ongoing education and outreach program that is managed by the standing Education and Public Outreach Committee (EPOC). The EPOC is a group comprised of city staff, Commissioners, and watershed resident volunteers that develops and implements educational materials and programming.

The Commission in fall 2007 undertook a professional opinion survey to better understand what people know and how public education and outreach can most effectively communicate how individual property owners can impact water quality through the implementation of individual Best Management Practices in the watershed. The EPOC is preparing recommendations for the Commission for implementation in 2009 and beyond.

The Minnesota and Wisconsin Departments of Natural Resources, the University of Minnesota Extension Service, and University of Wisconsin Extension have prepared numerous fliers and brochures on various topics relating to lake management that can be made available to target audiences at city meetings, block club and National Night Out gatherings, and other opportunities, and links posted on the Commission's and cities' web sites. The EPOC has also developed specialty brochures focused on groups such as apartment and small commercial building managers.

Estimated Cost: Ongoing activity
Funding Source: General operating budget for Education activities (current budget is $28,700)

4.2.2 Encourage Public Official and Staff Education

There is a need for city, county and state officials and staff to understand the TMDL process and the proposed implementation activities so that they can effectively make regulatory, budget and programming decisions and conduct daily business. Resources such as self-study lake management background information from Water on the Web ("Understanding Lake Ecology"), Project NEMO (Nonpoint Education for Municipal Officials), UW Extension ("Understanding Lake Data") and other sources would provide basic information about lake ecology to help staff, Councils and Commissions make informed decisions about lake management.

Estimated Cost: $500
Funding Source: General operating budget for Education activities (current budget is $28,700)

4.2.3 Presentations at Meetings

Awareness of lake management can be raised through periodic presentations at meetings of lake associations, homeownership associations, block clubs, garden clubs, service organizations, senior associations, advisory commissions, City Councils, or other groups as well as displays at events such as remodeling fairs and yard and garden events. "Discussion kits" including more detailed information about topics and questions and points for topic discussion could be made available to interested parties. The Commission's annual education budget assumes staff attendance at three presentations or events per year such as staffing booths at events.

Estimated Cost: $1,000
Funding Source: General operating budget for Education activities (current budget is $28,700)

4.2.4 Demonstration Projects

Property owners may be reluctant to adopt good lake management practices without examples they can evaluate and emulate. A few demonstration projects have been completed in the watershed through outside grants or from the Commission's Education and Implementation Grant program, including a shoreline restoration project in a park on Middle Twin Lake in Brooklyn Center and a shoreline restoration and a rain garden in a park on Ryan Lake in Minneapolis. The Commission will encourage demonstration projects so property owners can see how a project or practice is implemented and how it looks. Examples might include planting native plants; planting a rain garden; restoring a shoreline; managing turf using low-impact practices such as phosphorus-free fertilizer, reduced herbicides and pesticides, and proper mowing and watering techniques; and improving drainage practices with redirected downspouts and rain barrels. The estimated cost of this activity is highly variable. The Commission annually budgets $20,000 for grant matching and small projects. The Commission will evaluate appropriate activities and develop guidelines for funding demonstration projects from this budget.

Estimated Cost: Varies based on the type of activity
Funding Source: General operating budget for grant match/demonstration projects (current budget is $20,000)

4.3 ONGOING MONITORING

4.3.1 Water Quality Monitoring

The SCWMC will lead monitoring and tracking of the effectiveness of activities implemented to reduce nutrient loading in the watershed. The Commission will continue to participate in the Metropolitan Council's Citizen Assisted Lake Monitoring Program (CAMP). Through this program, citizen volunteers monitor surface water quality and aesthetic conditions biweekly. Each year four to six lakes in the Shingle Creek watershed are monitored in this manner. This program is also a useful outreach tool for increasing awareness of water quality issues. The estimated cost of this monitoring is $6,500 annually, and is included in the Commission's existing Monitoring budget.

Estimated Cost: $6,500 annually
Funding Source: Monitoring budget for CAMP monitoring (current budget is $6,500)

The Commission will also periodically (every 4-5 years) conduct a more detailed analysis of water quality, collecting biweekly data on lake surface, water column, and bottom conditions. This data will provide a more detailed picture of lake response to BMP activities and will help determine necessary "course corrections" as part of the Adaptive Management philosophy guiding this Implementation Plan.

As described above, the Commission annually publishes a Water Quality Report that compiles and interprets monitoring data from the lakes, streams, and wetlands in the watershed. The monitoring data collected by the Commission and other agencies will be analyzed to determine the linkage between BMP implementation and water quality and biotic integrity in Crystal Lake, and to assess progress toward meeting the Total Maximum Daily Load and in-lake phosphorus concentration goals. This detailed monitoring is not part of the Commission's existing Monitoring budget. As the Commission completes its current cycle of management planning in 2010 with the Wetland Management Plan, that annual budget ($15,000) will be reallocated to more extensive lake monitoring.

Estimated Cost: $7,000 – 10,000 per lake
Funding Source: Reallocated operating budget for management plans (current budget is $15,000)

4.3.2 Other Monitoring

A baseline aquatic vegetation survey should be completed and then updated every 4-5 years as part of the more detailed water quality assessment described above. Zooplankton sampling has not been conducted and should be periodically completed to assess overall biologic conditions. The estimated cost of this monitoring is $2,000-3,000 per lake. Neither type of monitoring is routinely part of the Commission's existing Monitoring budget. As the Commission completes its current cycle of management planning in 2010 with the Wetland Management Plan, that annual budget ($15,000) will be reallocated to more extensive lake monitoring.

Estimated Cost: $2,000-3,000 per lake
Funding Source: Reallocated operating budget for management plans (current budget is $15,000)

The Commission will work together with the DNR to determine the optimum strategy for monitoring the fish community.

Estimated Cost: To be determined
Funding Source: To be determined

The Commission will explore funding opportunities to research or pilot monitoring of BMP effectiveness.

Estimated Cost: To be determined
Funding Source: To be determined

5.0 Stakeholder Activities

While the SCWMC will coordinate implementation of the Crystal Lake TMDL, individual MS4s ultimately will implement the identified BMPs. Table 4 in Section 3 of this report shows the lead agencies for each of the stakeholder activities. Not all stakeholders will undertake all these activities. Those activities for which the stakeholders will take the lead will be incorporated into their individual NPDES Stormwater Pollution Prevention Programs (SWPPPs), and implementation actions will be reported annually.

Each stakeholder is in a unique position to implement BMPs. For example, street and highway reconstruction can provide opportunities to retrofit or enhance treatment, but some streets and highways may not require reconstruction for years or even decades. BMPs requiring new equipment or accessories are dependent upon the individual stakeholder's ongoing equipment replacement schedule. Other activities must be integrated into ongoing maintenance responsibilities as the budget allows.

The following are the general BMP implementation activities that will be most effective in restoring water quality in the lakes to state standards and an estimate of their cost. Refer to Section 3 of this report for information regarding sequencing and lead agencies.

5.1 REDUCE EXTERNAL LOAD

5.1.1 Crystal Lake Improvement Project

In 2008-09 the City of Robbinsdale completed a feasibility study to consider improvements to Crystal Lake. The study evaluated both internal load reduction and options to incorporate external load reduction into a comprehensive project. The proposed Crystal Lake Improvement Project includes three primary components: treatment of stormwater from a trunk storm sewer that drains about 350 acres with little to no treatment; an alum treatment to reduce internal load and improve water clarity; and the infrastructure to implement a future hypolimnetic withdrawal project.

The project would divert discharge from the 38th Avenue trunk storm sewer into a treatment system to be constructed in Lakeview Terrace Park. The stormwater would be treated with alum, and then routed through a new pond and wetland system before being discharged into Crystal Lake. As a part of this project, facilities in the park would be relocated and upgraded, and currently untreated runoff routed into the pond and wetland system or into a pair of rain gardens to be constructed in the redesigned parking lot. It is estimated that if the alum injection system can achieve 90 percent phosphorus reduction efficiency, then the annual external load reduction from this component of the project could be about 70 kg/year Total Phosphorus (TP). The external load reduction required in the TMDL is about 144 kg/year TP.

The project also proposes to address internal load in two ways. First, an alum treatment would be applied to the lake to reduce sediment load release and improve water clarity. It is estimated that

the alum treatment could achieve a 90 percent internal load reduction, or about 116 kg/year TP. The project also includes installation of the infrastructure necessary to install hypolimnetic withdrawal and treatment in the future if lake conditions warrant. The hypolimnetic withdrawal system would pump phosphorus-rich water from the hypolimnion, or bottom layer, of the lake to the pumphouse being constructed to house the storm sewer alum injection system. The hypolimnetic water would be treated with alum and the discharge would be routed through the new pond and wetland system where it would eventually be discharged back into the lake. The necessary infrastructure would be incorporated in as part of the proposed Crystal Lake Improvement Project, however the hypolimnetic withdrawal system would not be implemented until the Technical Advisory Committee determines that it is necessary as part of the Adaptive Management process.

Estimated Cost: $1 million to construct (excluding park improvements), $7,000 annually to operate
Funding Source: Cities, Hennepin County, SCWMC through county levy, grant funds; operating costs funded by Robbinsdale's Stormwater Utility Fund

5.1.2 Retrofit BMPs to Add Stormwater Treatment in the Watershed

Much of the Crystal Lake watershed developed prior to the implementation of watershed rules and standards requiring treatment of stormwater runoff. Some treatment has been added as redevelopment or street and highway projects provide opportunities. Additional treatment Best Management Practices (BMPs) will be sought across the watershed as those opportunities continue to arise. Treatment options include but are not limited to:

- New or enhanced stormwater ponding;
- Infiltration basins and devices and other types of abstraction such as native vegetation or reforestation;
- In-line or off-line treatment manufactured devices; and
- Rain gardens and biofiltration.

Specific projects already completed in the past few years include:

- New and expanded ponds and underground treatment devices installed as part of the CSAH 81 (Bottineau Boulevard) improvements;
- In-line gross pollutant traps installed on an ongoing basis on Robbinsdale stormsewers discharging to the lake; and
- A rain garden and bottomless sump manholes installed as part of the Victory View neighborhood street reconstruction.

Other projects would be implemented as opportunities arise, such as through street reconstruction projects and redevelopment. The City of Minneapolis is in the preliminary planning stages of flood control projects in the vicinity of 36th Avenue North and Victory Memorial Drive and 36th Avenue to Dowling south of Crystal Lake Cemetery. As part of these projects the City is exploring options to reduce runoff and increase infiltration, potentially reducing pollutant loading downstream to Crystal Lake.

Examples of potential BMPs include detention ponds, native plantings, sump manholes, swirl separators, and trash collectors. These small practices are effective in removing debris, leaf litter, and other potential pollutants. Depending on the type of BMP, location, easement requirements, and other factors, costs can range from $5,000 for a sump manhole to $250,000 or more for a detention pond. The number of BMPs necessary to achieve the required phosphorus load reduction is unknown and is dependent on the types of opportunities that arise.

Estimated Cost: Varies by specific project
Funding Source: Cities, SCWMC through county levy, grant funds

5.1.3 Increase Infiltration in Watershed

Cities will incorporate infiltration and other abstraction strategies into city improvement projects where possible as opportunities arise, and will work with developers to incorporate Low Impact Development principles into redevelopment as appropriate.

The SCWMC received a 2008 research grant to evaluate the utility of pervious pavement on residential streets in reducing snow and ice buildup and thus the need to apply road salt, and the water quantity and quality impacts of pervious pavement. As part of this grant, the Commission will work with two cities to construct paired residential intersections to compare pervious pavement performance with traditional pavement performance. One of these locations is in Robbinsdale in the Crystal Lake watershed. One of the research goals of this project is to determine if pervious pavement can cost-effectively reduce runoff and increase infiltration.

The cost of this strategy varies depending on the BMP, and may range from a single property owner installing an individual rain garden to retrofitting parks and open space with native vegetation rather than mowed turf to installing pervious pavement. The Commission's Education and Outreach Committee regularly provides education and outreach information to member cities on these topics for publication in city newsletters, neighborhood and block club fliers, and the city's website.

Estimated Cost: Varies by specific project
Funding Source: Cities, Commission's education program

5.1.4 Shoreline Management and Restoration

Restore shoreline areas with native vegetation and lakescaping where opportunities present themselves. Shoreline restoration can cost $30-50 per linear foot, depending on the width of the buffer installed. Crystal Lake contains about 8,400 linear feet of shoreline. Residential property shoreline totals about 3,000 linear feet and parks about 2,800 feet, with the balance of the shoreline undeveloped in a more natural state. Ideally about 75 percent of the residential and park shoreline would be native vegetation, with about 25 percent available for lake access. Accomplishing this goal would require restoration of about 4,350 feet of shoreline. The City of Robbinsdale and the DNR have collaborated to begin the restoration of some shoreline in Hollingsworth Park, and have completed about 700 linear feet. Education materials targeted to shoreline owners (for example, **www.bluethumb.org)** will be promoted to encourage voluntary shoreline restoration.
Estimated Cost: $130,500 – $217,500

Funding Source: Private property owners, cities, grant funds

5.1.5 Street Sweeping

Newer street sweeping technologies are available that use high pressure to remove a greater percent of the small particles that can carry phosphorus to the lakes. Using these newer technologies can help improve water quality. Studies conducted in the Lakes Nokomis and Hiawatha lakesheds in Minneapolis (Wenck Associates 1998) suggest that improved street sweeping technologies and increased street sweeping frequency could reduce phosphorus loads by 7 percent. The cities will consider how to increase the efficiency and effectiveness of street sweeping within the context of their overall sweeping program.

Estimated Cost: $100,000 to 200,000 per new sweeper
Funding Source: Cities

Increased and targeted street sweeping may be most effective where there is minimal treatment opportunity in the catchment area. Cities' existing sweeping policies and practices should be reviewed to determine how existing practices could be refined to improve efficiency and effectiveness as well as to identify where additional sweeping would provide the most water quality benefit.

Estimated Cost: $65-85 per mile of additional sweeping
Funding Source: Cities

5.2 REDUCE INTERNAL LOAD

5.2.1 Internal Load Management

Several options have been considered to manage internal sources of nutrients. The City of Robbinsdale recently completed a Feasibility Study of the following options:

Hypolimnetic withdrawal. This option would require pumping nutrient-rich water from the hypolimnion to an external location where it could be chemically treated, and discharged through a constructed wetland treatment system outletting to the lake.
Hypolimnetic aeration. This option uses a specialized pump to circulate water from the hypolimnion to keep it aerated and reduce the potential for anoxic conditions that lead to sediment phosphorus release.
Chemical treatment. Chemically treating the lake with alum would remove phosphorus from the water column as well as bind it in sediments.

As described in Section 5.1.1, the City proposes to go forward with an alum treatment in conjunction with a project to significantly reduce external phosphorus load. This project would include the necessary infrastructure to later add hypolimnetic withdrawal should it be found to be warranted.

Estimated Cost: $150,000 - $1 million one-time construction, $25-50,000 annually
Funding Source: City of Robbinsdale, SCWMC through county levy, grant funds

5.3 BIOLOGIC INTEGRITY MANAGEMENT

5.3.1 Aquatic Plant Management

Aquatic plant management is a key aspect in maintaining a healthy shallow lake. To establish and maintain a healthy lake system, an aquatic plant management plan should be developed, including an action plan for treatment and management of invasive aquatic vegetation, most notably curly-leaf pondweed.

Estimated Cost: $10,000 for an aquatic plant survey and management plan and $5,000-10,000 per year for treatment
Funding Source: SCWMC, City of Robbinsdale, lakeshore owners

5.3.2 Fish Population Management

Partner with the DNR to monitor and manage the fish population to maintain a beneficial community and to maintain the integrity of the alum treatment.

Estimated Cost: varies depending on the necessary strategy(ies)
Funding Source: City of Robbinsdale, grant funds, DNR

5.4 TRACKING AND REPORTING

Each stakeholder will integrate BMPs into their SWPPPs required by their NPDES General Permits for stormwater discharges. Activities will be tracked and reported in their annual NPDES report. Each stakeholder will make a copy of the annual report available to the Commission, which will then incorporate that information into the Commission's annual Water Quality Report. Additional city and county staff time will be necessary to track and report on activities specific to this TMDL and Implementation Plan, however, it is difficult to estimate the magnitude of the additional level of effort.

Estimated Cost: City staff level of effort to be determined
Funding Source: Cities

Literature Cited

Wenck Associates Inc. 1998. Lakes Nokomis and Hiawatha Diagnostic Feasibility Study – Internal Phosphorus Load Estimates. Internal Technical Memorandum.

Wenck Associates Inc. 2008. Crystal Lake Nutrient TMDL. Wenck Project 1240-22.

WSB & Associates, Inc. 2003. Water Quality Management Plan for Crystal Lake. WSB Project No. 1359-02, prepared for the City of Robbinsdale.