Lake Magda Nutrient TMDL Implementation Plan FINAL

Wenck File #1240-76

Prepared for:

SHINGLE CREEK WATERSHED MANAGEMENT COMMISSION

MINNESOTA POLLUTION CONTROL AGENCY

October 2010

Prepared by:

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

Table of Contents

Tables

Figures

1.0 Introduction

The Lake Magda Nutrient Total Maximum Daily Load (TMDL) Implementation Plan addresses nutrient impairments in Lake Magda (27-0065), which is located in the City of Brooklyn Park, Hennepin County, Minnesota, in the Shingle Creek watershed (see Figure 1), which is part of the Upper Mississippi River basin. The lake was placed on the State of Minnesota's 303(d) list of impaired waters in 2002 for impairment of aquatic recreation. Lake Magda is a small, shallow urban lake with a surface area of about 10.2 acres and a fully developed watershed of about 68 acres. The lake is impaired by high concentrations of total phosphorus resulting in severe algal blooms, with the summer average total phosphorus concentration ranging from approximately 100 µg/L to over 180 µg/L in the years in which measurements were taken. For comparison, the numeric standard for Lake Magda is 60 µg/L or lower.

The Shingle Creek Watershed Management Commission (SCWMC or Commission) has completed a TMDL analysis for the Minnesota Pollution Control Agency (MPCA) to quantify the phosphorus reductions needed to meet State water quality standards for nutrients in Lake Magda in accordance with Section 303(d) of the Clean Water Act. The TMDL and Implementation Plan were prepared in cooperation with the City of Brooklyn Park and with review by the Minnesota Department of Transportation (Mn/DOT).

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; describes the proposed implementation activities; and discusses sequencing, timing, and lead agencies and organizations for the activities.

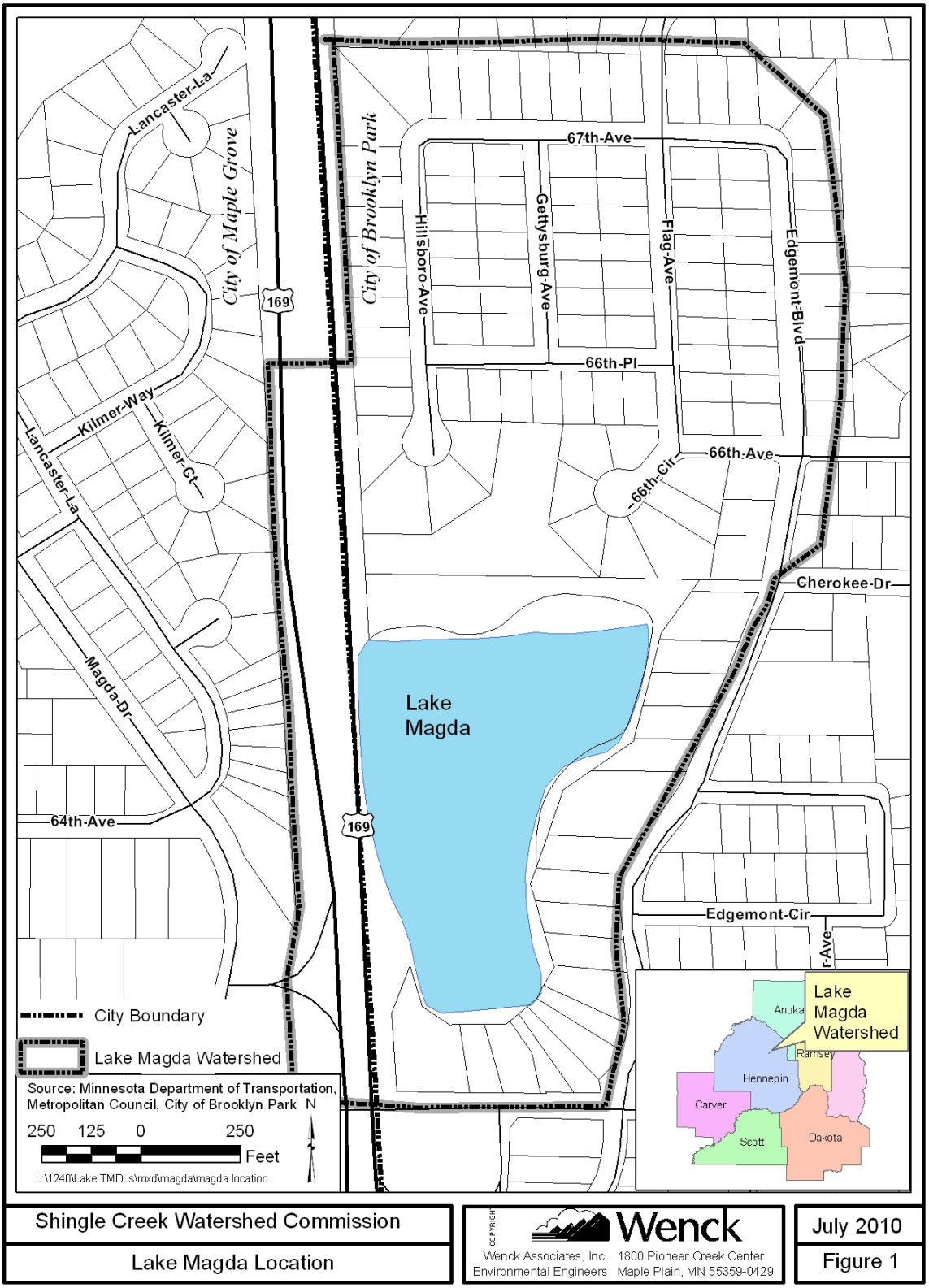

Figure 1. Lake Magda location.

2.0 Lake Magda TMDL Summary

The lake and its drainage area are located within the City of Brooklyn Park (see Figure 1). Lake Magda is a small lake in a fully developed suburban residential watershed, with state trunk highway TH 169 abutting the lake on the west. A small wetland area abuts the lake to the north. Lake Magda outlets into the wetland on the west side of TH 169, then through storm sewer to Eagle Creek. Eagle Creek joins with Bass Creek to form Shingle Creek, which ultimately discharges to the Mississippi River. Lake Magda's 68 acre watershed is fully developed. The lake is about 10.2 acres in size, with an estimated average depth of 2 feet and an estimated maximum depth of 6.5 feet. The lake is entirely littoral (shallow enough to support emergent and submerged rooted aquatic plants).

2.1 CURRENT WATER QUALITY

Historic water quality is presented in Figures 2, 3, and 4. Lake Magda does not meet state standards for total phosphorus concentration, chlorophyll-a, or clarity as measured by Secchi depth. There is limited data available. The summer average total phosphorus concentration in Lake Magda ranged from 100 µg/L to over 180 µg/L in the years for which data is available (Figure 2). For comparison, the numeric standard for Lake Magda is 60 µg/L or lower.

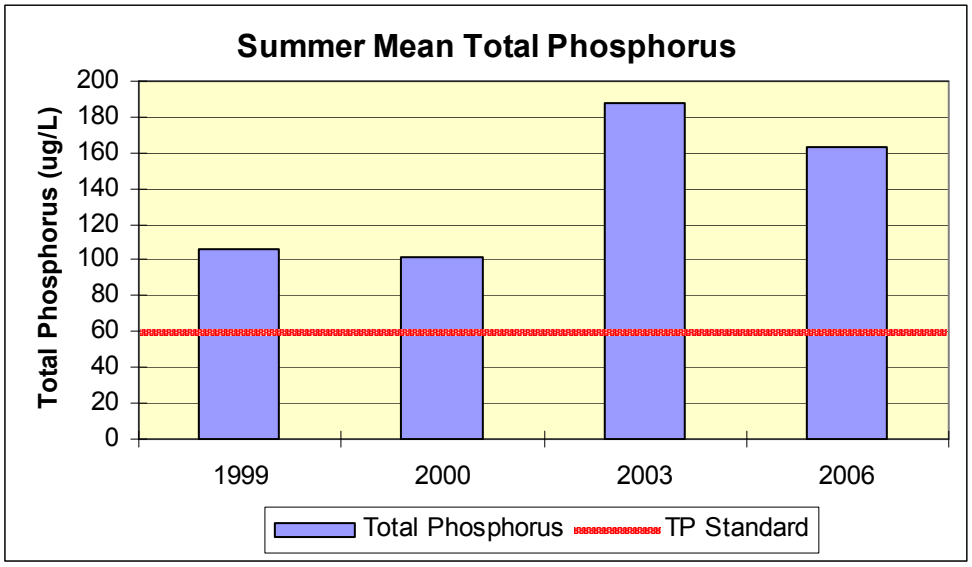

Figure 2. Summer (June 1 –September 30) mean total phosphorus concentrations for Lake Magda.

A similar trend is observed in chlorophyll-a concentration although the highest concentration is observed in 2006 at over 120 µg/L (Figure 3). The numeric standard for Lake Magda is 20 µg/L or lower for chlorophyll-a.

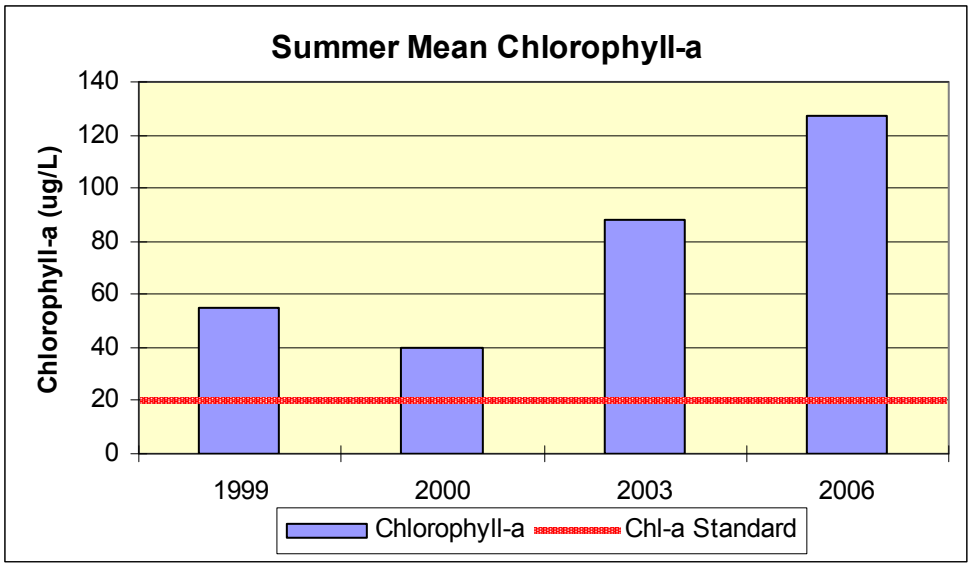

Figure 3. Summer (June 1 –September 30) mean chlorophyll-a concentrations for Lake Magda.

Water clarity, as measured by Secchi depth, ranges from approximately 0.3 meters to more than 0.6 meters (Figure 4). The best water clarity was observed in 2000 and the worst in 2006, coinciding with the high chlorophyll-a concentration observed in that year. The numeric standard for Lake Magda is 1.0 meter of clarity or more as measured by Secchi depth.

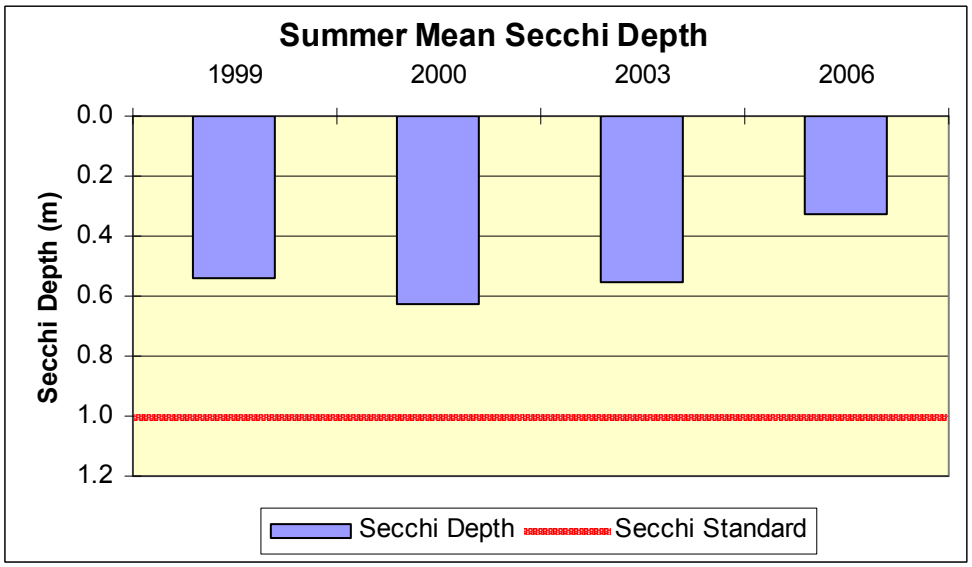

Figure 4. Summer (June 1 –September 30) mean Secchi depth (meters) for Lake Magda.

2.2 PHOSPHORUS LOAD SOURCES

Modeling data was used to develop a phosphorus budget for Lake Magda. The budget suggests that both internal and external phosphorus loads are significant factors in determining water quality in the lake. The primary sources of external phosphorus are sediment and nutrients from stormwater runoff from the watershed conveyed through storm sewers, channels, or direct runoff

into the lake. Internal loading can be a result of sediment anoxia where poorly bound phosphorus is released in a form readily available for phytoplankton. Aquatic vegetation die off can also be a source of phosphorus.

2.3 REQUIRED PHOSPHORUS LOAD REDUCTIONS

Wasteload and load allocations to meet State standards indicate a phosphorus load reduction of 69% would be required to consistently achieve a total phosphorus concentration of 60 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

All TMDLs have a Wasteload Allocation (WLA) that includes permitted discharges such as industrial point and regulated stormwater discharges. The Load Allocation (LA) in TMDLs includes phosphorus loading from non-permitted sources, such as internal loading or atmospheric deposition. Stormwater discharges are regulated under the State of Minnesota's National Pollutant Discharge Elimination System (NPDES) Program, and are considered wasteloads that must be divided among permit holders. Entities with coverage under the Municipal Separate Storm Sewer System (MS4) General Permit, with authorization to discharge stormwater in the Lake Magda 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.

The pollutant load from construction stormwater is considered to be less than 1 percent of the TMDL and difficult to quantify. Consequently, the WLA includes pollutant loading from construction stormwater sources. 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.

Each permittee has committed to implementing Best Management Practices (BMPs) to reduce nutrient loading in Lake Magda. Brooklyn Park and Mn/DOT cooperated in developing the TMDL and Implementation Plan and will continue to work together through the ongoing Commission Technical Advisory Committee (TAC) to identify and implement BMPs. This collective approach allows for greater reductions for some permit holders with greater opportunity and less for those with greater constraints.

The pollutant load from construction stormwater is considered to be less than 1 percent of the TMDL and difficult to quantify. Consequently, the WLA includes pollutant loading from construction stormwater sources. 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. There are no known municipal or industrial wastewater dischargers in the watershed.

Table 1. Wasteload allocation by NPDES permitted facility.

NPDES Permit Number	Allocation
MS400007-City of Brooklyn Park	Categorical WLA
MS400170-Mn/DOT Metro	Categorical WLA

2.3.2 Implementation Focus

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

Table 2. Lake Magda TMDL total phosphorus allocations expressed as daily and annual loads.

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)
0.029	10.7	0.016	6.0	Implicit	0.045	16.7

[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. Lake Magda 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)	Load Reduction (kg/year)
Wasteload	Watershed Load	0.029	10.7	37.5	26.8
Load	Atmospheric Load	0.003	1.1	1.1	-
	Internal Load	0.013	4.9	14.6	9.7
	TOTAL LOAD	0.045	16.7	53.2	36.5
69% Load Reduction					

3.0 Implementation Plan

3.1 TMDL AND IMPLEMENTATION PLAN PROCESS

The activities and Best Management Practices (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 (SCWMC). The TAC included stakeholder representatives from local cities, Minnesota Department of Natural Resources (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.

The general TMDL approach and general results of TMDLs were presented to seven City Councils in May and July 2006. A public meeting was held March 9, 2009 to review the findings of the TMDL with lakeshore property owners and to receive public input on the development of this Implementation Plan.

This Implementation Plan was distributed to Brooklyn Park and Mn/DOT for review and posted on the SCWMC website www.shinglecreek.org for public review and comment. This Implementation Plan was reviewed by the TAC at its April 30, 2009 meeting. On May 14, 2009 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, City of Brooklyn Park, 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

It is recognized that a significant portion of the phosphorus load in Lake Magda is a result of internal loading and that the internal load must be addressed to successfully improve water quality. Consequently, the stakeholders agreed to work cooperatively to reduce internal phosphorus loading in the lake.

3. Retrofit BMPs in the Watershed As Opportunities Arise

Brooklyn Park and Mn/DOT as the regulated MS4s in the watershed discharging to Lake Magda have agreed that nutrient loading must be reduced, but that options for retrofitting BMPs are limited. Each stakeholder agreed to evaluate and include nutrient-reduction BMPs in street and highway projects, and to consider 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

Implementation will 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. Brooklyn Park and Mn/DOT will incorporate these BMPs into their Storm Water Pollution Prevention Programs (SWPPP) and NPDES Minimum Measures, and will work with the SCWMC to periodically assess progress toward advancing the implementation principles detailed above. These agencies will report to the SCWMC or include in their NPDES Annual Reports their annual activities, and the Commission will summarize those activities into its own Water Quality Monitoring Annual Report. This framework is illustrated in Figure 5 below.

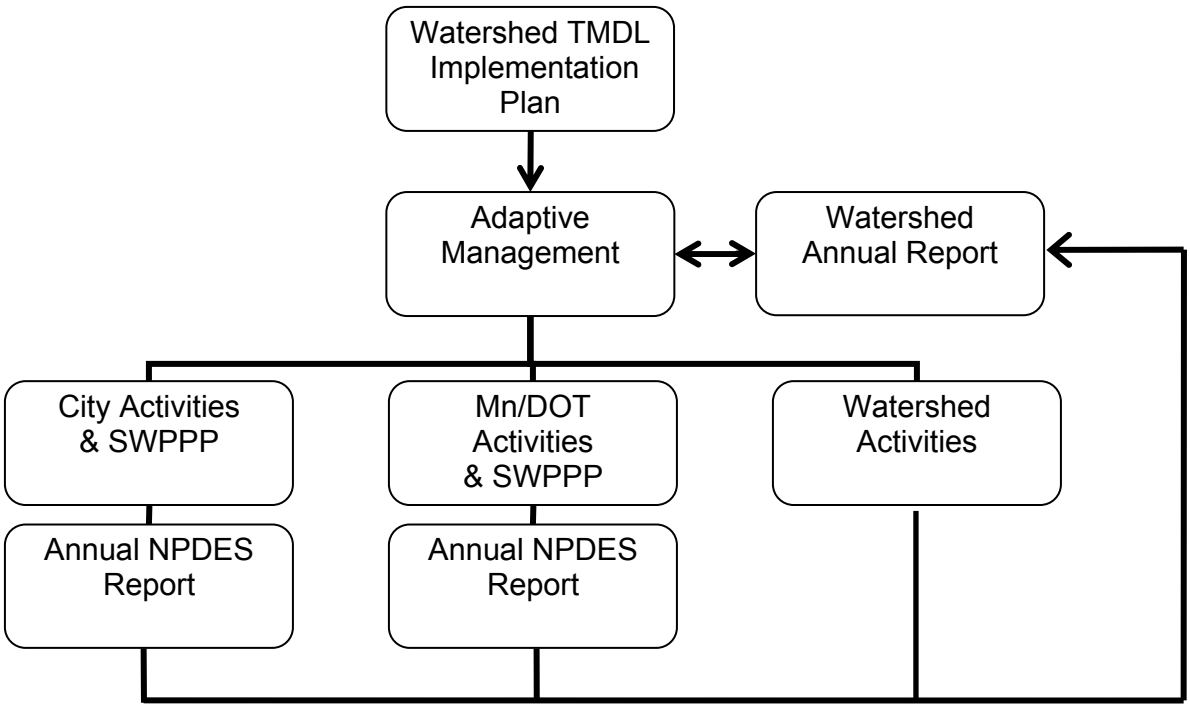

Figure 5. Implementation framework.

3.3.1 Implementation Approach

The impairment to Lake Magda developed over time as the watershed draining to the lake urbanized. As the watershed developed, the native prairie and savanna was cleared to support farming. Over the past century the farms and remaining undeveloped land were converted to residential use, increasing the volume of stormwater runoff and the amount of pollutants conveyed to the lake, slowly degrading water quality. 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. However, it is likely that it will take several decades to see any significant redevelopment in this subwatershed.

The TMDL study and this Implementation Plan identify general improvements to reduce external and internal phosphorus loading. Some of these actions are nonstructural and could be undertaken at any time, such as increased street sweeping or shoreline restoration, and some are structural actions that would be completed as part of a construction or redevelopment project. 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 City and Mn/DOT cycle through their street and highway reconstruction programs, it is now routine to include treatment BMPs such as stormwater detention ponds, infiltration basins and underground treatment devices where possible. These incremental reductions will over time add up to a significant external load reduction.

Another long-term type of external load reduction is redevelopment. The watershed draining to the lake developed prior to the enactment of Shingle Creek watershed stormwater management rules and standards and subsequently there is currently little or no treatment of stormwater. 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 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

Implementation in the early stages will focus on gathering additional monitoring data and on controlling both external and internal loading. 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, biomanipulation may not provide all the internal load reduction that would be required. Additional feasibility work must be completed to evaluate whether 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 loading, restore ecological integrity, and meet state water quality standards for the lake; 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 the frequency of street sweeping
- 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
- Evaluate other potential internal load management projects

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 hydrologic, hydraulic, and pollutant loading models.
- Evaluate ways to refine street sweeping practices to maximize pollutant removal and implement these practices.
- Conduct aquatic vegetation, fish, phytoplankton, and zooplankton surveys.
- Obtain more precise lake morphometry and lake sediment release rates.
- Develop and implement an aquatic vegetation management plan.
- Encourage lakeshore property owners who have not yet done so to plant native buffers on their shoreline.
- Increase education and outreach in the residential area to the north of the lake to encourage interest in implementing stormwater BMPs on their property.
- Implement BMP and restoration demonstration projects as opportunities arise.

Second Five Years

- Continue monitoring the lake.
- Evaluate progress toward goals including identifying BMPs and activities that were implemented and subsequent water quality improvement.
- Amend the Implementation Plan as necessary based on progress.
- Implement BMP retrofits with street reconstruction in the neighborhood to the north of the lake, which is expected by 2020.
- Work with the DNR to restore a balanced fishery.

After Ten Years

- Continue monitoring the lake.
- Evaluate progress toward goals including identifying BMPs and activities that were implemented and subsequent water quality improvement.
- Amend the Implementation Plan as necessary based on progress.
- Incorporate BMPs into TH 169 improvements as feasible.

3.3.4 Stakeholder Responsibilities

The primary stakeholders in this Plan are the Shingle Creek Watershed Management Commission (SCWMC), the City of Brooklyn Park, and Mn/DOT. In addition, property owners in the watershed have a role to play in implementing BMPs on their private properties. The SCWMC Education and Outreach program will provide 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	• 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 Brooklyn Park.	• Evaluate and make recommendations for aquatic vegetation 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 or as necessary • Collect implementation data from city and Mn/DOT annually • Prepare annual report on monitoring and activities
City of Brooklyn Park	• Provide focused education and outreach • Implement BMPs to reduce total phosphorus loads with street reconstruction or other opportunities • Sweep streets at least twice annually, and evaluate efficacy of more frequent sweeping	• Consider and implement internal load reduction strategies	• Consider aquatic vegetation 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
Mn/DOT	• Sweep highways at least once annually • Implement BMPs to reduce loads as opportunities arise				• Report implementation activities in annual NPDES report
Property Owners	• Implement volume and nutrient load reduction practices		• Implement aquatic vegetation management • Implement shoreline restoration projects		• Participate in volunteer monitoring

3.4 ADAPTIVE MANAGEMENT

The wasteload and load allocations in the TMDL are aggressive goals for nutrient reduction. 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.

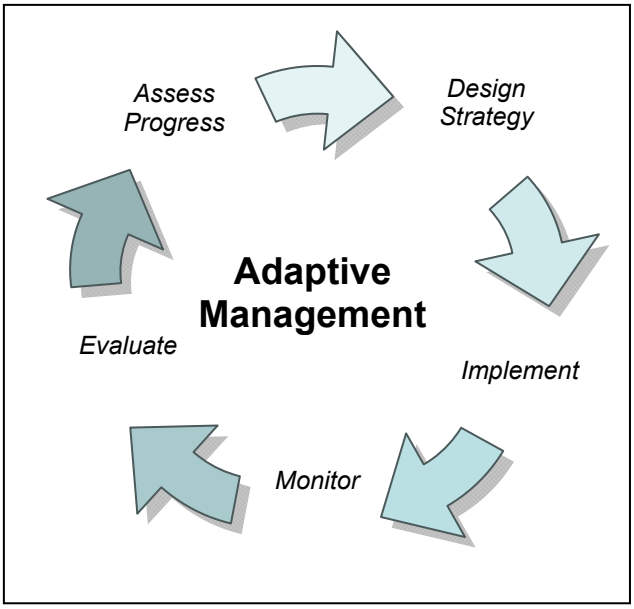

Figure 6. Adaptive management.

3.4.1 Interim Milestones

Lakes may take years to respond to phosphorus load reduction activities in the watershed and make progress toward the in-lake water quality standards. Interim measures to assess the progress of this TMDL include the following:

- Number and types of new Best Management Practices retrofit into the watershed
- Frequency and extent of additional priority street sweeping undertaken each year
- Number of redevelopment projects in the watershed that incorporate new or oversized load reduction and volume management
- Completion of aquatic vegetation, fish, and zooplankton surveys
- Completion of sediment core release rate studies
- Acquisition of more precise lake morphometry
- Number of informational pieces made available to property owners in the watershed on small BMP practices, lakeshore restoration, and other nutrient load reduction and habitat improvement practices

These milestones will provide information about documenting the progress towards achieving the TMDL likely even before we are able to show improvement in the water quality of Lake Magda. Monitoring of lake water quality is discussed in Section 4.3.

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 MS4 annual NPDES reports and other information from the city and Mn/DOT 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 Monitoring Report. The format and content of the Water Quality Monitoring 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 $10,000)

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% for total suspended solids (TSS) and 60% for phosphorus combined with the infiltration standard were sufficiently stringent without being overly burdensome. The Commission will keep abreast of regulatory trends and consider future rule revisions if necessary.

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 the City of Brooklyn Park and MnDOT will be implementing various BMPs to reduce phosphorus load and stormwater volume. These agencies will report load reductions made by each BMP to the Commission, which will track progress toward meeting load reductions throughout the watershed.

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 Technical Advisory Committee (TAC) to review literature, the State Stormwater Manual, and other guidance from Minnesota and other states to help provide guidance to the cities for estimating 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 undertook a professional opinion survey in fall 2007 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 results of this survey guide the Commission's annual education and outreach plan, which selects two or three topics each year for special focus. Past topics have included proper use of fertilizers and the phosphorus fertilizer ban; Ten Things You Can Do to Improve Water Quality; and proper use of ice-control salt. The EPOC has also developed specialty brochures for residential associations and small commercial building managers.

The Minnesota and Wisconsin Departments of Natural Resources and the Universities of Minnesota and Wisconsin Extension Service 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. Links to this information are posted on the Commission's and cities' web sites.

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

4.2.2 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. This monitoring will continue to be detailed in the Commission's Annual Water Quality Monitoring Report. 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. Lake Magda is schedule to be monitored through the CAMP program every three years.

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 Monitoring 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 Lake Magda, 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
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
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 Lake Magda TMDL, individual stakeholders 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 MS4s 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 to Lake Magda 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 Retrofit BMPs to Add Stormwater Treatment in the Watershed

The Lake Magda watershed developed prior to the implementation of watershed rules and standards requiring treatment of stormwater runoff. Treatment Best Management Practices (BMPs) will be sought across the watershed as those opportunities arise. Treatment options may include but are not limited to:

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

Brooklyn Park is considering reconstructing the streets in this area by 2020, although the specific year has not been established. The project will include load and volume reduction BMPs as feasible, given the limited space available. Mn/DOT does not have improvements programmed for TH 169 in the next 20 years, but future work may incorporate BMPs as feasible. Depending on the type of BMP, location, easement or right of way requirements, and other factors, costs can range from $5,000 for an outfall trash collector 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 project design and the types of opportunities that arise.

Estimated Cost: Varies by specific project
Funding Source: City, Mn/DOT, SCWMC through county levy, grant funds

5.1.2 Increase Infiltration in Watershed

The Lake Magda watershed is fully developed, with limited opportunities for redevelopment. The City will work with future developers to incorporate Low Impact Development principles into redevelopment as appropriate. MS4s will incorporate infiltration and other abstraction strategies into improvement projects where possible as opportunities arise. 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. 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. Load removals might range from a fraction of a pound for a small infiltration practice such as a rain garden to a few pounds per year for a regional infiltration basin.

Estimated Cost: Varies by specific project
Funding Source: City, Mn/DOT, Commission's education program

5.1.3 Shoreline Management and Restoration

While shoreline restoration provides minimal phosphorus load reductions, it provides habitat, aesthetic, and shoreline stabilization benefits. Many of the property owners on Lake Magda maintain at least a partially unmowed buffer on the lake. A full shoreline restoration with native plantings can cost $30-50 per linear foot, depending on the width of the buffer installed. Lake Magda 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. For many residences the shoreline is steep and difficult to maintain so it is left unmowed. 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 planting buffers or enhancing existing unmowed areas of about 4,350 feet of shoreline. 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, city, grant funds

5.1.4 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. There is a limited and varying amount of information and research from which to estimate load reductions from street sweeping. Studies in the Twin Cities Metro Area have ranged from 0.25 pounds per mile per year to 2-3 pounds per mile per year. The most systematic and scientific testing was performed by Selbig and Bannerman (2007) in Madison, WI for the USGS. Their findings suggest that high frequency, high efficiency sweeping could result in an annual phosphorus removal rate of 0.75 – 1 pound per mile per year. There are approximately 1.3 miles of street in the Lake Magda subwatershed, so if the City undertook high frequency sweeping it could achieve 1-2 pounds of phosphorus removal per year. The City will consider how to increase the efficiency and effectiveness of street sweeping within the context of its overall sweeping program.

Estimated Cost: $100,000 to 200,000 per new sweeper, $65-85 per mile of additional sweeping
Funding Source: City

5.2 BIOLOGIC INTEGRITY MANAGEMENT

5.2.1 Aquatic Plant Management

The SCWMC recognizes the importance of a healthy biological community in meeting water clarity goals, especially in shallow lakes. Aquatic plant management is a key aspect in maintaining a healthy shallow lake. Studies of water quality following whole-lake aquatic vegetation management have shown mixed but promising results, although it is difficult to establish a numerical link or a specific load reduction. To establish and maintain a healthy lake system, an aquatic plant management plan should be developed, including a DNR-approved action plan for treatment and management of invasive aquatic vegetation. Curly-leaf pondweed is present in Lake Magda, currently at non-nuisance levels. Should the pondweed become more established it may require treatment to control its spread.

Estimated Cost: $5,000 for an aquatic plant survey and management plan and $3,000-5,000 per year for treatment if necessary
Funding Source: City, lakeshore residents

5.2.2 Fish Population Management

Limited data on the fish community is available, but data that has been collected suggests that the lake does not currently support a balanced shallow lake fish assemblage. A healthy, clear-water shallow lake requires a fish community of predators and panfish, zooplankton, and aquatic vegetation, which all act to keep each other in balance. Unless there is an existing population of rough fish to control, fish population management is not a load-reduction activity but is necessary if the lake is to achieve a clear-water state. This activity is a partnership with the DNR and other potential entities to monitor and manage the fish and zooplankton population to restore and maintain a beneficial community.

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

5.3 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 be incorporated into the Commission's annual Water Quality Report. Additional city and Mn/DOT 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: Staff level of effort to be determined
Funding Source: City and Mn/DOT

6.0 Literature Cited

Selbig, W. and R, Bannerman, 2007. Evaluation of Street Sweeping as a Stormwater- Quality-Management Tool in Three Residential Basins in Madison, Wisconsin. US Department of the Interior, United States Geological Survey. Scientific Investigations Report 2007–5156.

Wenck Associates Inc. 2009. Lake Magda Nutrient TMDL. Wenck Project 1240-22.