Minnesota Pollution Control Agency

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March 5, 2007

Mr. Craig Cooper, Chair
Shingle Creek Water Management Commission
3235 Fernbrook Lane
Plymouth, MN 55447

Re: Shingle Creek Chloride Total Maximum Daily Load and associated Implementation Plan Approvals

Dear Mr. Cooper:

This letter is to inform you that the U.S. Environmental Protection Agency has approved the Shingle Creek Chloride TMDL and Minnesota Pollution Control Agency (MPCA) has reviewed and is approving the Implementation Plan for the Shingle Creek Chloride Total Maximum Daily Load (TMDL).

The Implementation Plan calls for ongoing activities by the Commission and the member cities. The Implementation Plan lays out five principles to be followed and further explains the best management practices which will be employed to protect Shingle Creek and to achieve the reductions in Chloride necessary to meet the TMDL.

The MPCA would like to thank the Commission for all your hard work in successfully completing these two important documents. The MPCA looks forward to working with the Commission and the member cities in restoring Shingle Creek to once again achieving water quality standards.

Sincerely,

Faye E. Sleeper

Faye Sleeper, Manager
Watershed Section
Regional Division

FES/TL:bao

cc: Doug Thomas, BWSR

Shingle Creek Chloride TMDL Implementation Plan

Shingle Creek WMC
Brooklyn Center
Brooklyn Park
Crystal
Maple Grove
Minneapolis
Minneapolis Parks
New Hope
Osseo
Plymouth
Robbinsdale
Mn/DOT
Hennepin County

Wenck File #1240

Prepared for:

SHINGLE CREEK
WATER MANAGEMENT COMMISSION

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February 2007

Wenck

Wq-iw8-02c

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1.0 Introduction

Shingle Creek, an 11-mile urban/suburban stream located in the northwestern portion of the Minneapolis metropolitan region, was designated an Impaired Water by the Minnesota Pollution Control Agency (MPCA) and US Environmental Protection Agency (EPA) for chloride concentrations that exceed the State established standards. The Shingle Creek Watershed Management Commission (SCWMC) has completed a Total Maximum Daily Load (TMDL) analysis to quantify the pollutant reductions needed to meet the water quality standards for chloride in Shingle Creek, in accordance with Section 303(d) of the Clean Water Act. The TMDL was prepared in cooperation with the nine cities with land located in the Shingle Creek watershed as well as Hennepin County and the Minnesota Department of Transportation (Mn/DOT).

The analysis determined that the majority of chloride in the Shingle Creek watershed is derived from nonpoint sources including road deicing, commercial and industrial deicing, and fertilizer application, with the primary source being road salt and salt substitutes applied to the dense network of local roads and county and state highways in the watershed. The TMDL concluded that an overall 71 percent reduction in chloride load must be achieved to meet State chloride concentration standards. This Implementation Plan details the specific activities the stakeholders in the watershed plan to undertake to attain that reduction.

2.0 Chloride TMDL Summary

A key aspect of a TMDL is the development of an analytical link between loading sources and receiving water quality. To establish that link, conductivity and chloride concentrations were measured at various locations in Shingle Creek and several key tributaries and storm sewers in the watershed. The cities in the watershed, Hennepin County, and Mn/DOT tracked and reported the road salt applied during all ice and snow control operations in 2002-2003. Load duration curves were prepared to better understand the relationship between flow in Shingle Creek and chloride concentration, to compare dry conditions to flood conditions. Load duration curves were also prepared seasonally to better understand seasonal variations.

Table 1. Summary of Exceedance Occurrences under Varied Flow Regimes.

Site	Winter			Spring			Summer		
	Low Flow	Medium Flow	High Flow	Low Flow	Medium Flow	High Flow	Low Flow	Medium Flow	High Flow
SC00	*Yes*	*Yes*	*Yes*	No	No	No	No	No	No
SCI94	*Yes*	*Yes*	*Yes*	No	No	No	No	No	No
SC03	*Yes*	*Yes*	*Yes*	No	No	*Yes*	No	No	No
SC04	*Yes*	*Yes*	*Yes*	No	No	*Yes*	No	No	No
SCSS1	--	*Yes*	No	No	*Yes*	No	No	No	No
SCPine	*Yes*	*Yes*	*Yes*	No	No	No	No	No	No

Source: ***Shingle Creek Chloride TMDL Report.***

Winter (December 1 through March 31) load violations occurred across all of the flow regimes. Spring (April and May) load violations occurred during the low flows. High flows offered enough dilution capacity or were late enough that the salt sources were depleted. Summer (June 1 through August 31) load violations did not occur. However, very dry periods had loads approaching the standard, suggesting that ground water is close to the standard concentration of 230 mg/L.

Critical conditions for the load and wasteload allocations were defined as all winter flow conditions. However, because chloride is entirely a nonpoint source issue in the Shingle Creek watershed, it is inappropriate to define the TMDL as a single number. The TMDL is entirely dependent upon the daily flow and concentration, which is highly dynamic. Therefore, the TMDL is represented by an allowable daily load across all flow regimes as is demonstrated in Figure 1. To determine acceptable loads under the critical flow regimes, chronic standard concentrations were multiplied by the flow at each interval.

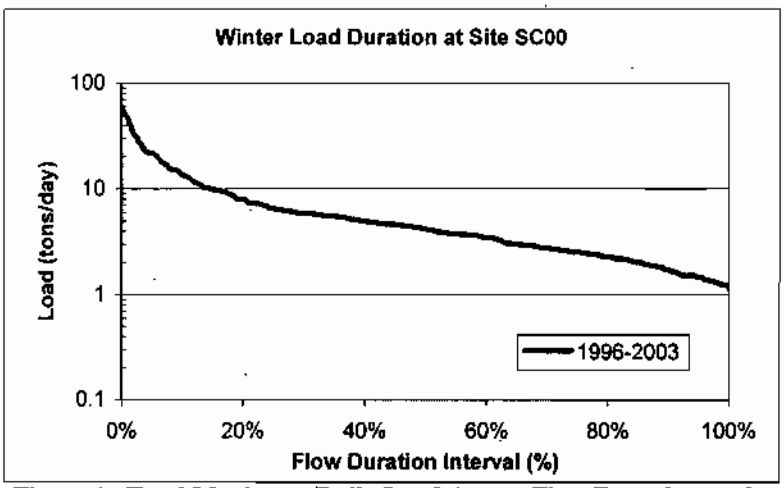

Figure 1. Total Maximum Daily Load Across Flow Exceedances for Shingle Creek. Data used to calculate the load duration curve was from December 1996 thorough March 2003.
Source: ***Shingle Creek Chloride TMDL Report.***

For purposes of implementation, the TMDL is represented as a percent reduction across the flow regimes needed to meet the standard (see Table 2). Reductions were calculated as the 90th percentile of all reductions needed to meet the standard during winter. In essence, the reduction represents what is needed so that 90% of the samples would be in compliance with the water quality standard.

Table 2. TMDL for Chlorides in Shingle Creek as Represented by a Percent Reduction.

Critical Condition[1]	Wasteload Allocation (percent reduction)	Load Allocation (percent reduction)	Margin of Safety (percent reduction)	TMDL (percent reduction)
Winter Low Flow (60 to 100%)	48%	3% [1]	12%	63%
Winter Runoff (60% to 0%)	61%	4% [1]	6%	71%

[1]Assumed groundwater reductions with reductions of surface application of chloride (37% and 52% respectively). Total load reduction was based on an assumed stream load share of 8%. For example, a 37% load reduction on 8% of the entire load results in a 3% reduction of the entire load.

3.0 Implementation Plan Development

The activities and BMPs identified in the implementation plan are the result of a series of stakeholder working-meetings led by the Shingle Creek Watershed Management Commission. Representatives from cities, Mn/DOT, Hennepin County and regulatory agencies met four times to discuss the TMDL requirements, BMPs and technologies available to address chloride, public safety, and the feasibility of implementing the activity. A summary implementation plan for the TMDL document was developed using this input, distributed to stakeholders for review and posted on the SCWMC website www.shinglecreek.org for public review and comment. This Implementation Plan expands upon that summary plan with more detail.

3.1 PLAN DEVELOPMENT PROCESS

The first task in developing the implementation plan was determining the allocation of load reductions to the users in the watershed. The stakeholders agreed to work collectively towards a 71% reduction in chloride use to understanding that each stakeholder was working under unique financial, public safety and perception, and feasibility limitations. This collective approach allows for greater reductions for some agencies and less for those with greater constraints.

As the second step in the process, member cities of the SCWMC, Mn/DOT, and Hennepin County agreed to identify and implement BMPs focused on reducing chloride use. Stakeholder meetings focused on current activities and identification of activities that can be considered to address the needed load reductions. The topics discussed included:

1. Product application equipment and decisions
2. Product stockpiles
3. Product type and quality
4. Operator training
5. Clean-up and snow stockpiling
6. Ongoing research into salt alternatives

During the stakeholder process, each stakeholder discussed their current policies and practices for winter road maintenance and identified those areas where load reduction improvements could be achieved in each of the six identified categories. These comments are detailed in the tables in Appendix A.

3.2 IMPLEMENTATION PLAN PRINCIPLES

Through the discussion of policies and practices, current activities, and ongoing research, the stakeholders developed five principles to guide development and implementation of the load reduction plan. These include:

1. Utilize appropriate snow plow techniques
2. Select, store, and apply materials appropriately to balance public safety and environmental risks
3. Encourage communication between applicators
4. Foster stewardship through improved applicator awareness
5. Communicate with the public

3.2.1 Utilize Appropriate Plow Techniques

Written snowplow policies should specify salt application policies and practices as well as other snow and ice control policies and practices. These policies should include expectations for operator training, materials use, application rates and procedures, and equipment maintenance and replacement. Each stakeholder should annually evaluate its policies and practices and make adjustments to the written policies as necessary.

3.2.2 Balance Public Safety and Environmental Risk

Each stakeholder agreed that chloride use must be reduced, but that it should be done so strategically to minimize risks to public safety, especially on high priority ice control locations such as bridge decks, intersections, ramps, and hills. Initial efforts should focus on implementing salt reduction practices where feasible and in environmentally sensitive areas, and continuing research into and conducting trial applications of new products and equipment.

3.2.3 Encourage Communication

The stakeholders agreed that the stakeholder meetings themselves had been a useful forum for discussion and sharing. Opportunities to share ideas and experiences to widen the knowledge base should be part of the implementation plan.

3.2.4 Foster Stewardship

Improved applicator training should focus on ways to reduce the use of salt while maintaining public safety. Applicators should understand the environmental risks from the overuse of salt to place the reduction plan into context and to gain a sense of stewardship.

3.2.5 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
- Public agency staff
- Private applicators
- Property managers

Education opportunities might include workshops, public meetings, brochures, newspaper articles, and signs.

3.3 IMPLEMENTATION PLAN PROCESS

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 applicators taking responsibility for BMP implementation. The cities, Hennepin County, and MnDOT would be expected to incorporate these BMPs into their Storm Water Pollution Prevention Plans (SWPPP) and NPDES Minimum Measures, and to annually assess progress toward advancing the implementation principles detailed above in Section 3.2. 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 2 below.

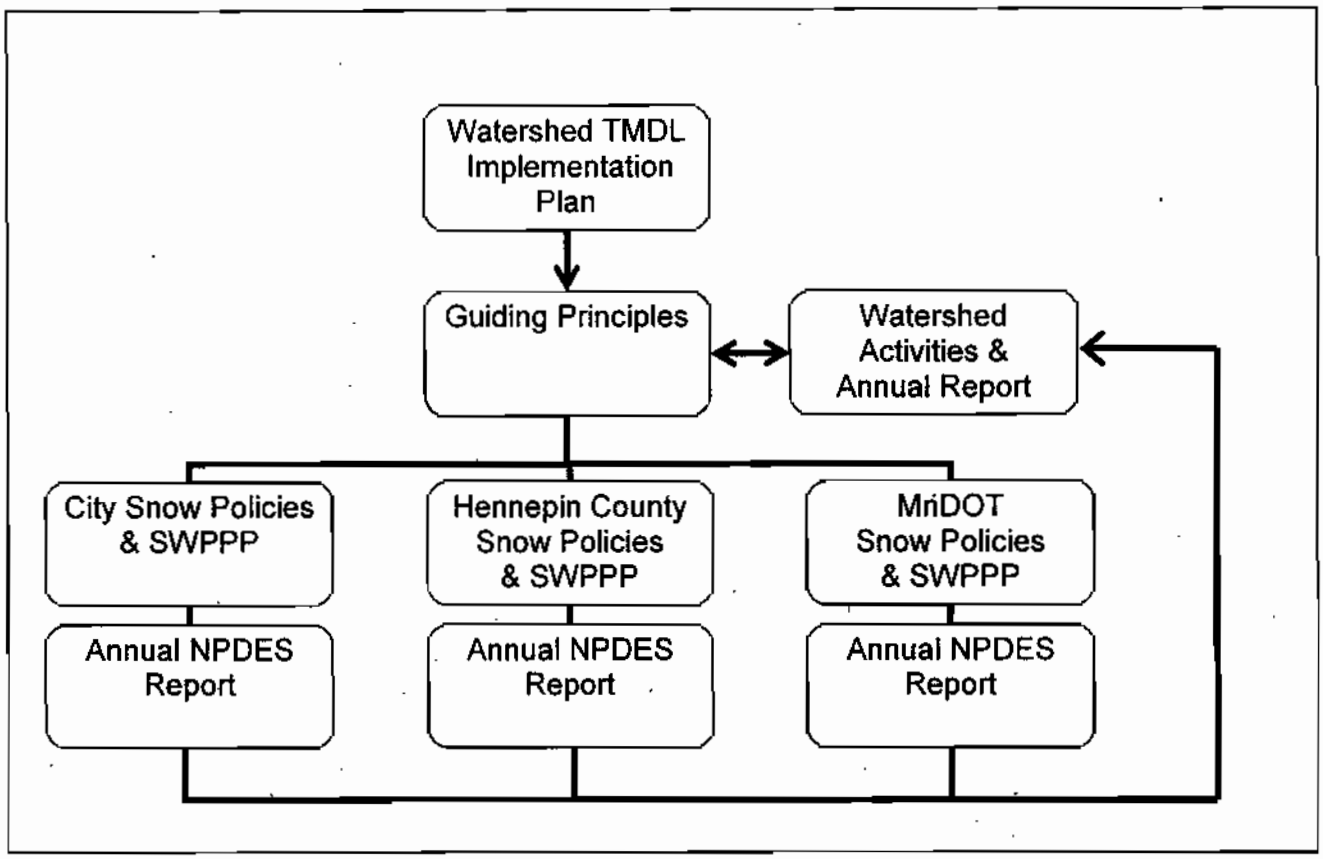

Figure 2. Implementation Framework.

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 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 Annual Report on Monitoring and Activities

An annual report on salt reduction activities is necessary under the adaptive management guidelines established in the TMDL. This report will provide the cities with necessary information for their annual NPDES reports. The report will track BMP implementation and monitoring data to evaluate activity effectiveness. The estimated annual cost of this activity is $5,000.

4.1.2 City Salt Management Plans

The implementation plan asks the Cities to develop and maintain a City Salt Management Plan. Many Cities already have these, but a template is needed to easily compare activities between Cities. A template will reduce the Cities' workload, promote consistency across the watershed, and provide an easily amendable plan for reducing salt use. The SCWMC will develop a template for the City Salt Management Plans at an estimated cost of $3,000.

4.1.3 Permit Requirements

The commission will incorporate private (commercial) snow management rules for reducing chloride use and include chloride reduction in the Commission project review program. One requirement may be the development of a salt management plan for individual commercial

properties. The commission will develop a template for the salt management plan. The estimated cost of this activity is $2,000.

4.2 EDUCATION

4.2.1 Private Applicator Education

Although chloride used by private (commercial) applicators is a small proportion of the overall load in the watershed, education can help reduce unnecessary chloride-based deicer use in the watershed. Some educational materials have been developed by Canadian agencies regarding private use of chloride-based deicers. Private applicator education will include development of brochures, newsletters, and workshops to educate private applicators on chloride issues in the watershed. The estimated cost of this activity is $1,500 annually.

4.2.2 Public Education and Outreach

One measure that may allow for reductions in usage of deicing chemicals is to increase public awareness of the environmental effects of road salt and ultimately to gain public acceptance for changing ice control practices. This acceptance may require encouraging behavioral changes such as reduced driving speeds during icy conditions or changing public expectations for snow removal and deicing. This task will educate the public to help manage expectations and identify the need for chloride reductions. Activities may include newsletter articles, brochures, and presentations. The estimated cost of this activity is $3,000 annually.

4.2.3 Conduct Official Education

There is a need for city, county, and state officials to understand the TMDL and the proposed implementation activities so that they can effectively balance public safety issues with environmental risks. The SCWMC will develop an education strategy and materials for this task. The estimated cost of this activity is $1,000 annually.

4.2.4 Coordinate an Annual Applicator Workshop

The purpose of the workshop is to annually bring together city, county, and state supervisory and street and highway maintenance staff to discuss salt use, application, and storage issues,

techniques, and technologies, thus facilitating information sharing and technology transfer. The estimated cost of this activity is $1,000 annually.

4.3 ONGOING MONITORING

4.3.1 Monitoring

The SCWMC has agreed to take the lead on monitoring and tracking the effectiveness of activities implemented to reduce chloride in Shingle Creek; chloride and conductivity monitoring at two locations is already incorporated into the Commission's annual monitoring activities. The Commission has routinely monitored stream flow and water quality in Shingle Creek since 1996. Two locations, one downstream of Humboldt Avenue in Minneapolis ("SC-0, ") and one upstream of Zane Avenue in Brooklyn Park ("SC-2") are monitored for water quantity and various water quality chemical parameters.

Upon the initiation of the TMDL study, the SCWMC increased monitoring at these two stations to include grab samples of chloride and collection of conductivity at 15-minute intervals. A third site at Queen Avenue in Minneapolis ("SC-1") is monitored for flow by the US Geological Survey (USGS) as a part of its ongoing National Assessment of Water Quality (NAWQA). Chemical parameters are no longer routinely measured at the USGS site, although conductivity is collected. The Queen Avenue data are available on-line real-time at http://waterdata.usgs.gov/mn/nwis/uv?05288705.

The Commission also on a continuing basis collects from the road authorities in the watershed a monthly report of road salt applied by snow plow route. This data is compiled into a database and is used to calculate the amount of chloride applied per lane mile. This can be summarized by road authority or subwatershed.

By combining in-stream data such as flow, conductivity and concentration with salt application data, the Commission can evaluate how BMPs implemented in the watershed impact chloride concentrations in the creek.

The Commission also sponsors annual volunteer macroinvertebrate monitoring in Shingle Creek at three locations. Student groups led by trained volunteers collect macroinvertebrates twice a year through Hennepin County Environmental Services' RiverWatch program. Hilsenhoff's Family Biotic Index is calculated from these results, and is used as a general indicator of stream biotic health.

The Commission has also periodically undertaken a more rigorous macroinvertebrate analysis using the MPCA collection protocol. The Macroinvertebrate Index of Biotic Integrity (M-IBI) is calculated from these results, and is used as a more precise indicator of stream health. The Commission expects that this level of analysis will be undertaken about every five years, with the next collection scheduled to be completed in 2007 as part of the Shingle Creek Biotic Integrity/Dissolved Oxygen TMDLs.

Limited fish community data is available. A fishery analysis was last performed in 1997; the next collection is scheduled to be completed in 2007 as part of the Shingle Creek Biotic Integrity/Dissolved Oxygen TMDLs. The fish and macroinvertebrate data will be used to evaluate the impacts of various stressors, including chloride, on biotic integrity. Future monitoring will be performed to determine how implementation of BMPs in the watershed and in the stream improve the biologic communities.

The Commission annually publishes a Water Quality Report that compiles and interprets this and other monitoring data from the lakes, streams, and wetlands in the watershed. The Annual Report on Monitoring and Activities described in Section 4.1.1 above will be included in this annual Water Quality Report. As the Commission moves into implementing BMPs in response to other TMDLs in the watershed (13 lake excess nutrient TMDLs, biotic integrity and dissolved oxygen in Shingle Creek, biotic integrity in Bass Creek), those Annual Reports will be incorporated into the annual Water Quality Report as well. The Water Quality Report will demonstrate the linkage between BMP implementation and water quality and biotic integrity, especially for waters with multiple impairments such as Shingle Creek.

5.0 Stakeholder Activities

Although the SCWMC will be the lead on the implementation of the Chloride TMDL, individual stakeholders will be ultimately responsible for implementing the identified BMPs. These activities will be included in the NPDES Phase II Permits that all of the stakeholders hold, and activities will be reported annually.

Each stakeholder is in a unique position to implement BMPs. For example, implementation of BMPs requiring new equipment or accessories is dependant upon the individual stakeholder's ongoing equipment replacement schedule. Other activities must be integrated into other street and highway maintenance responsibilities. The following are the general BMP implementation areas agreed to by the stakeholders. The tables in Appendix A provide more detail by stakeholder on current activities and proposed BMPs or activities.

5.1 BMP IMPLEMENTATION

5.1.1 Product Application Equipment and Decisions

In many cases, less road salt can be used without compromising public safety. To avoid over application, standards can be established for application rates that account for pavement temperature ranges and timing. Newer technologies such as pre-wetting and anti-icing can result in the same results while using significantly less product. Pre-wetting of salt refers to applying water, or some other liquid agent such as magnesium chloride, to the salt either prior to or during application of the material. Pre-wetting reduces the amount of scatter and loss of material, ultimately reducing the usage amounts. To this end, the stakeholders in the watershed have agreed to incorporate the following practices:

1. Calibrate spreaders annually.

2. Use the Road Weather Information Service (RWIS) and other sensors such as truck mounted or hand held sensors to improve application decisions such as the amount and timing of application
3. Evaluate new technologies such as prewetting and anti-icing as equipment needs to be replaced. These technologies will be adopted where feasible and practical.
4. Investigate and adopt new products (such as Clear Lane, a commercially available pretreated salt) where feasible and cost effective.

The estimated cost of implementing this activity will vary based on the technologies. Some examples include:

- Dry tailgate spreader: $3,000
- Prewetting: $6,000
- Spreader: $9,000
- Epoke spreaders: $60,000
- Brine storage system: $25,000
- Salt: $34/ton; Clear Lane: $39/ton + $5/ton delivery

5.1.2 Deicer Stockpiles

One source of chloride is runoff from salt storage facilities. The stakeholders agree to cover all product stockpiles and store them on impervious surfaces. Additionally, stakeholders will maintain general housekeeping policies associated with the handling of road salt to minimize the potential for wash-off of excess or spilled salt. There is no additional cost expected for this activity.

5.1.3 Operator Training

Operator training may result in significant reductions in road salt use. Training will focus on finding the best balance between environmental concerns and public safety. Supervisors and operators will be trained to determine the least amount of product necessary to maintain public safety. The stakeholders agree to conduct annual training that may include outside support such as LTAP (Local Technical Assistance Program) or vendor training on the appropriate use of technologies or products. The estimated cost of this activity is $1,000 for staff time annually per LGU.

5.1.4 Cleanup and Snow Stockpiling

Snow disposal can be a concern, especially in areas where snow cannot be pushed off the side of the road. Snow plowed directly streamside can leak high concentrations of chloride directly into the base flow resulting in increased chloride concentrations. Although little snow hauling occurs in the Shingle Creek watershed, the stakeholders agree to stockpile snow away from sensitive areas. All stakeholders also agree to sweep City streets as soon as possible in late winter to remove as much residual product as possible. There is no additional cost expected for this activity.

5.1.5 Ongoing Research into Salt Alternatives

Technologies associated with winter road maintenance are constantly changing based on the needs of the industry, resulting in a need to keep informed on new practices, technologies, and products that can ultimately protect public safety and the environment. All of the stakeholders will evaluate the technologies on an annual basis and implement the most appropriate technologies where feasible. Information will be shared at the annual applicator workshop. The estimated cost of this activity is $2,000 for staff time annually per LGU, plus the cost of any technologies implemented.

5.2 TRACKING AND REPORTING

Each stakeholder will integrate BMPs into the SWPPP six minimum measures required by their NPDES General Permits for stormwater discharges. Activities will be tracked and reported in their annual NPDES report. Each stakeholder will provide a copy of the annual report to the Commission, which will then incorporate that information into the Commission's annual Water Quality Report. There is no additional cost expected for this activity.

APPENDIX A STAKEHOLDER ACTIVITIES DETAIL TABLES

6.0 Adaptive Management

The load allocations in the TMDL represent aggressive goals for chloride reductions with the added challenge of addressing public safety and ice control expectations. Consequently, implementation will be conducted using adaptive management principles. Adaptive management is appropriate because it is difficult to predict the chloride reduction that will occur from implementing strategies with the paucity of information available to demonstrate expected reductions. Future technological advances or unacceptable impacts to public safety may alter the specific course of actions detailed here. Continued monitoring and "course corrections" responding to monitoring results are the most appropriate strategy for attaining the water quality goals established in this TMDL while maintaining required levels of public safety.

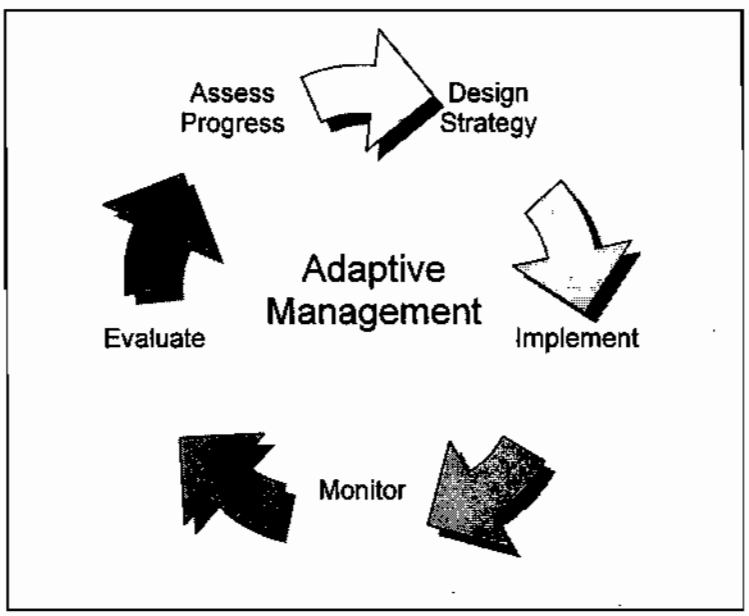

Figure 3. Adaptive management

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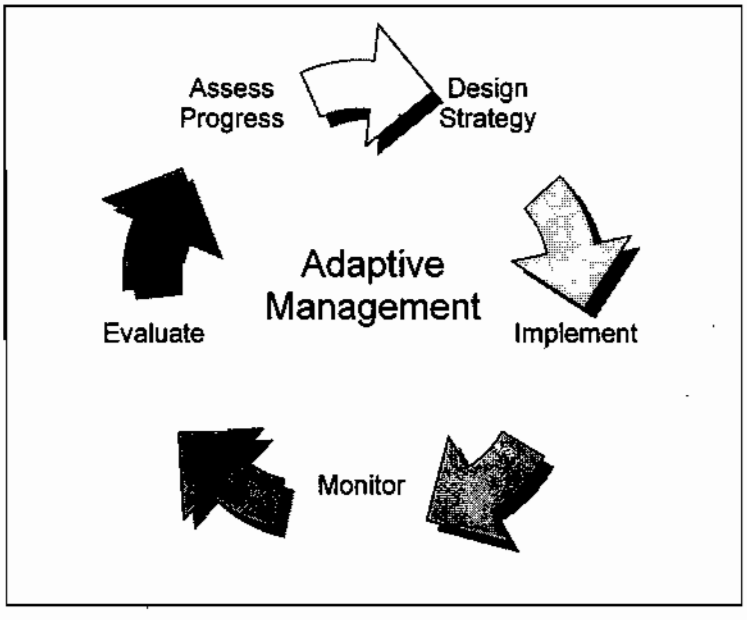

Figure 3. Adaptive management

TABLE A1. PRODUCT APPLICATION EQUIPMENT AND DECISIONS

CITY	CURRENT ACTIVITIES	PROPOSED BMPS/ACTIVITIES
Brooklyn Center	Dry Salt. Calibrate spreaders annually. Weather dependent decisions. Use MnDOT pavement sensors (RWIS) and hand held sensor. Turnover = 11 years.	Annual/on-going process. Investigate alternatives such as Clear Lane. Evaluate prewetting in sensitive areas. Implement if funds available.
Brooklyn Park	Dry salt. Calibrate spreaders annually Weather dependent application. Monitor Mn/DOT pavement sensors. Turnover = 15 years	Investigate alternatives such as prewetting. Improve driver training.
Crystal	3:1 dry sand/salt mixture. <0 degrees for Clear Lane. Turnover = 14 years.	
Maple Grove		
Minneapolis	3:1 dry salt/sand mixture on residential, curves, intersections, and hills. Anti-ice mix, Clear Lane, Salt. Turnover = 15 years.	Research into new products and appropriate BMPs.
Minneapolis Parks	Use straight sand on walking paths and parking lots. Rely on City of Minneapolis for salt when necessary.	Considering pilot project to test anti-icing materials.
New Hope	2:1 salt/sand. Computerized sanders. Truck temperature sensors - air and pavement. Turnover = 12 years.	Annual calibration of spreaders. Continued research.
Osseo	2:1 salt/sand. Use Clear Lane in mixture applied at all intersections, curves and slight inclines. Operators use judgment based on current and future weather conditions. Turnover when Council deems necessary.	Annual calibration of spreaders.
Plymouth	Prewetted on most trucks. $MgCl_2$ on bridges. One hand-held temp sensor. Follow MnDOT temp guidance. Turnover = 14 years.	All trucks prewetting in 10 years. Add a couple of brine units/year. Try treated salt (Clear Lane) Calibrate annually.
Robbinsdale	Dry salt/sand mixture. Turnover = 7 years. Not calibrated.	Interested in EPOKE. May recommend as part of capital budget. Calibrate spreaders annually. Review CIP for salt storage and application technologies.
Hennepin County	Snow and Ice Control Manual used to set policy for: 1. Use of straight salt, treated salt, or salt sand mix dependent upon ADT volumes, temperature, and weather conditions. 2. Rates of product and ratio of salt/sand mixture to be used for given ADT volumes, temperature and weather conditions. 3. Level of service based on end of storm. Equipment consists of tandem and single axle trucks equipped with tailgate or hopper sanders Foreman and Supervisors' trucks and select plowing equipment are equipped with ambient and pavement temperature sensors	Begin an anti-icing program for bridges and select roadway areas. Money budgeted for 2006, use to occur on third shift. Purchase of 2- 2,500 to 3,000 gallon tanker trucks for anti-icing application. Equip all application trucks with AVL and ability for automated data capture. Fleet turnover 10 years

TABLE A2. PRODUCT STOCKPILES

CITY	CURRENT ACTIVITIES	PROPOSED BMPS
Brooklyn Center	Enclosed bldg on impervious surface, small detention area that returns all water, minimal runoff.	At MEP.
Brooklyn Park	Enclosed bldg on impervious surface, minimal runoff - goes to pond, spillage pushed back into bldg.	At MEP.
Crystal	Enclosed bldg, half of runoff goes to drainage pond.	Future, improve runoff detention w/better pond facility. Working on it now.
Maple Grove	Covered on asphalt.	
Minneapolis		
Minneapolis Parks	Use City of Minneapolis' stockpiles.	
New Hope	Enclosed bldg on impervious surface, detention pond.	At MEP.
Osseo	No salt storage in watershed. Covered on asphalt. Spillage pushed back into shed.	Hennepin County is building a new facility in 2005 where the City will store the bulk of its material.
Plymouth	Facility is outside watershed	
Robbinsdale	Salt and sand piles on impervious surface, tarped.	Salt shed in 2005 budget.
Hennepin County	All storage areas are in enclosed buildings with impervious floors Runoff from loading area goes to storm sewer connections Loading area spills are pushed back into building	

MEP = Maximum Extent Practicable

TABLE A3. OPERATOR TRAINING

CITY	CURRENT ACTIVITIES	PROPOSED BMPS
Brooklyn Center	Annual driver training. Review application procedures with drivers after each event.	Consider outreach training (LTAP) if funds available.
Brooklyn Park	Attend annual snow plow/ice control meeting. Talk to drivers who use more salt.	Provide additional training.
Crystal		
Maple Grove		
Minneapolis	Vendors, Mn/DOT, LTAP, and internal trainers review, bring to and discuss practices and methods or material applications with the work force.	Additional training is always a need as equipment and material practices change.
Minneapolis Parks		Annual operator training. Establish in-house written procedures.
New Hope	Operators use their own judgment. Have sensors in truck. Need to retrain and calibrate every year	
Osseo	None.	Provide additional training.
Plymouth		Improve driver training. Need training by vendors. Remind drivers how much salt they're using.
Robbinsdale		
Hennepin County	Annual driver training with equipment vendors for proper calibration of equipment. Operators attend annual snow and ice control district meetings. Management reviews application data with operators that appear to be using the product incorrectly	Automate the gathering of data through the use of AVL Develop additional annual training with MnDot, and LTAP

TABLE A4. CLEAN-UP / SNOW STOCKPILING

CITY	CURRENT ACTIVITIES	PROPOSED BMPS
Brooklyn Center	Plow ASAP, No hauling unless problematic. Sweep ASAP in spring and fall.	Evaluate annually.
Brooklyn Park	Plow ASAP, no hauling. Sweep ASAP in spring	Evaluate annually.
Crystal	Plow ASAP. Haul from some cul-de-sacs - goes to old field at airport. Little/no salt content. Sweep 5-6 times annually, in spring ASAP.	Evaluate annually.
Maple Grove	Haul snow. Vacuum sweep 2x/year. Other sweeping thru-out year including winter.	Evaluate annually.
Minneapolis	Arterials plowed immediately, residential next day. Spring/fall comprehensive sweeping. Actually sweep 5-6 times/year. Parkways on 11 to15-day cycle. Watersheds on 30-day cycle. Critical watersheds regenerative sweeper. Tier system.	Evaluate annually.
Minneapolis Parks	No hauling and no stockpiling. Vacuum sweep all year long. Sweep along parkway if city can't.	Evaluate annually.
New Hope	Plow ASAP. Minimal hauling. Sweep spring & fall, early window in spring (contracted).	Evaluate annually.
Osseo	Plow ASAP. Haul snow off of Central and intersections along 81. Piled on field behind Elementary School. Sweep streets 5-6 times a year. Central done ASAP in Spring and then monthly..	Evaluate annually.
Plymouth	Plow ASAP. Plows active during storms. No hauling. Sweep ASAP, annually. Broom works all year long after storms. Vacuum-assisted sweeping.	May have to haul downtown. Evaluate annually.
Robbinsdale	Plow ASAP; have two areas for stockpiling. Sweep 4x/year.	Evaluate annually.
Hennepin County	Plow ASAP No hauling unless requested by city Will clear bridge decks of snow but dispose of on roadside area Annually sweep all needed roadway areas Clean silt traps in various catch basins	Evaluate annually

TABLE A5. ONGOING RESEARCH RE SALT ALTERNATIVES

CITY	CURRENT ACTIVITIES	PROPOSED BMPS
Brooklyn Center	Network w/other organizations re new products. Monitor new products/equipment - Clear Lane.	Continue monitoring of new products and equipment for effectiveness (Mn.DOT, MSSA, SUPPUNERS)
Brooklyn Park	Try new products/equipment - Clear Lane. Shed for prewetting.	
Crystal	Check out electronic controls on sanders.	
Maple Grove	Has tried several new products. Future: No change.	
Minneapolis	Mn/DOT does deep research, City actively researches. Has limited lab. Research Clear Lane – Current research= does the product do what it claims -- determine if better/worse than what we're currently doing/using. Determine where to do BMPs -- is it giving us bang for the buck? Looking to partner w/St. Paul. $MgCl_2$ truck.	Continue research department. Research Clear Lane.
Minneapolis Parks	Use City of Minneapolis' research.	Considering pilot project to test anti-icing materials.
New Hope	Investigate new products, equipment, and methods.	Will probably try Clear Lane next year.
Osseo	None.	Investigate and monitor new products, equipment, and methods.
Plymouth	Investigate new products, equipment, and methods.	Try new products as feasible.
Robbinsdale		Monitor new products/equipment.
Hennepin County	Attend conferences to stay current on technology and monitor technical publications and trade journals Investigate and try new products, equipment and methods Network with other agencies	