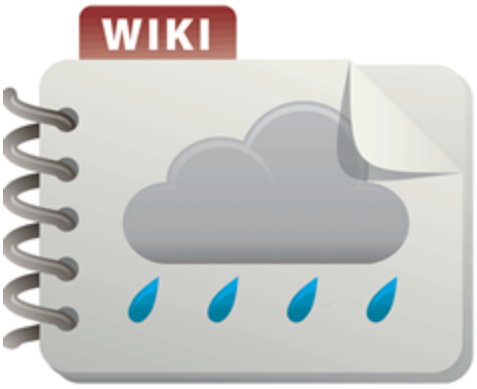


Page Content

Guidance for developing TMDL implementation plans for MS4 stormwater

Municipal Separate Storm Sewer System (MS4) permits must be consistent with Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs). Minnesota's Phase 1 (Minneapolis and St. Paul) permit and Phase 2 MS4 General Permit require regulated MS4s to demonstrate that they meet the WLA. TMDL implementation plans offer information on strategies to reduce point (WLA) and nonpoint (LA) source pollution and can be a valuable resource for regulated entities that must achieve a reduction in loading from their MS4.

An implementation plan that has a regulated MS4 component should contain information on four broad topics.

- Derivation of WLAs. This includes a discussion of how each MS4 can determine its target load; how the WLA was calculated, including modeling assumptions; and the geographic boundaries of the study area.
- A recommended stormwater management strategy. This includes a discussion of a stormwater management strategy that lays out an adaptive management approach to meeting the WLA, an overview of the adaptive management approach, general information on BMPs (e.g. removal efficiency, cost, maintenance requirements, resource requirements, and applicability), a summary of existing stormwater management strategies in the watershed, a summary of funding needs and mechanisms, and trading guidelines if applicable.
- Tracking and verification monitoring. TMDL implementation plans may provide information about tracking. This should be consistent with permit requirements. The implementation plan may include a discussion of on-going monitoring in the TMDL study area.
- A final date for achieving the TMDL. In some cases, a phased implementation approach and general timelines may be included in the implementation plan.

Contents

How to use this guidance

This guidance provides a recommended list of elements that enhance the linkage between implementation plans and MS4 permits. The level of detail in each implementation plan will vary.

The first three chapters provide an overview of the TMDL, TMDL implementation plan, and MS4 Stormwater General Permit. Chapter 4 discusses the elements of a TMDL implementation plan that may be appropriate for MS4 stormwater.

Each of the four sections in Chapter 4 has introductory text that describes the potential elements for an implementation plan. The elements are summarized in a text box within each section of Chapter 4. Each of the elements is then discussed in greater detail in the body of the guidance. Some examples are included as insets.

Several terms in the guidance are highlighted with blue font. These terms are defined at the end of the main body of the guidance and prior to the Appendices. Recommended websites are also highlighted in blue. In an electronic version of this guidance, these terms and websites are hyperlinked.

Appendices A, B, and C provide case studies, example calculations and more detailed discussion of BMP strategies for specific pollutants. These appendices may be useful for MS4s seeking clarity to the discussion in this document.

This document provides guidance for developing TMDL implementation plans that have a regulated MS4 component. It is not policy. TMDL projects vary significantly. This document outlines a preferred approach to developing an implementation plan. It is in the stakeholders interest to participate in development of an implementation plan because the plan can serve as a road map for meeting permit requirements.

The reader may wish to familiarize themselves with other policy and guidance for MS4 stormwater. These can be found at [1] (https://www.pca.state.mn.us/water/stormwater-programs-and-impaired-waters).

This guidance will be updated as needed, particularly Appendix C, which focuses on pollutant-specific stormwater management strategies and BMPs.

Introduction

This guidance document provides a discussion of components that could comprise a Total Maximum Daily Load (TMDL) implementation plan for Municipal Separate Storm Sewer System (MS4) stormwater. The document is primarily written for people who are involved in development of an implementation plan. It is intended for just the MS4 Stormwater portion of the implementation plan. This includes both regulated and non-regulated MS4 stormwater, although the focus of this document is on regulated stormwater.

TMDL and permit process overview

A TMDL is the quantity of pollutant than can be discharged to a lake or stream and still have the lake or stream meet its designated use, typically determined by compliance with water quality standards. TMDLs are developed for lakes or streams that currently exceed the water quality standard for one or more pollutants. The TMDL is comprised of pollutant loads from nonpoint sources (the Load Allocation), loads from point sources, which includes sources that require or will require a National Pollution Discharge Elimination System (NPDES) permit (the Wasteload Allocation), and a Margin of Safety.

- Note: It is the Minnesota Pollution Control Agency's policy to not include a separate load for Reserve Capacity in the TMDL. Reserve Capacity may be built into the LA or the WLA.

Pollutant loads from NPDES-permitted (regulated) MS4 stormwater must be included in the Wasteload Allocation (WLA). Federal law requires NPDES permits to be consistent with any TMDL WLA. When an MS4's current load exceeds its WLA, the MS4 must implement practices to reduce that load. For more information on the relationship between TMDLs and NPDES-permitted stormwater, see the EPA memo "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs" (November 22, 2002)([2] (http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf)),a second revision to this memo (November 12, 2010) ([3] (http://www.nctcog.org/envir/seeclean/wq/tmdl/EPAestablishingtmdlwla_revision.pdf)), and the most recent revision to this memo (November 26, 2014)([4] (http://water.epa.gov/polwaste/npdes/stormwater/upload/EPA_SW_TMDL_Memo.pdf)).

The TMDL implementation plan is completed concurrent with or shortly after completion of the TMDL. Following a period of implementing pollution control practices, an MS4 will meet the WLA. At this point, the lake or stream may reach water quality standards. For many impaired waters, there may be a considerable period of time between an MS4 meeting the WLA and the water meeting water quality standards. Even though a WLA has been met, an MS4 will need to maintain the BMPs that were used to meet the WLA.

- Note that there may be instances when the WLA cannot be met. Examples of these cases do not currently exist. Inability to meet a WLA may result in modification of the designated use for a receiving water or an MS4 meeting the criteria of Maximum Extent Practicable. The criteria for MEP have not been established.

Even if water quality goals in a receiving water are met, an MS4 must still meet the WLA as described in the TMDL. A new WLA can be established only if a TMDL is re-opened. Similarly, a change in the designated use of a receiving water would require a public notice process and a re-opening of the TMDL. More information on designated uses for lakes can be found in MPCA's Lakes Protocol ([5] (http://www.pca.state.mn.us/publications/

wq-iw1-10.pdf)).

Implementation plan overview

An implementation plan is developed concurrent with or shortly after completion of the TMDL. Implementation plans provide a discussion of management activities intended to achieve the WLA. Implementation plans include information on monitoring and compliance schedules and are completed within one year of United States Environmental Protection Agency (EPA) approval of a TMDL. The EPA does not approve implementation plans.

The level of detail in implementation plans varies with extent of local involvement, scope of the TMDL, and information available during development of the TMDL.

- Local involvement. Implementation plans developed with extensive local involvement typically contain information about specific Best Management Practices (BMPs) that will help restore an impaired water and can be implemented by an MS4 to meet a WLA. Costs and expected pollutant load reductions may be included. A compliance schedule may also be included. Extensive local involvement often occurs for smaller watersheds where there is a strong local sponsor.
- Scope of the TMDL. Implementation plans developed for small watershed studies are more likely to contain detailed information on BMP selection, monitoring, and compliance schedule than plans developed for large watersheds. MS4s in a small watershed often have similar land use and patterns of development, which facilitates BMP selection. Models are easier to fit to local conditions, versus large watersheds where MS4s may be geographically disconnected. The models may therefore be used to predict effectiveness of different BMPs and aid in BMP selection. Implementation plans for large watersheds are more likely to contain general information on BMP selection and monitoring. MPCA has developed guidance for large watershed TMDLs.
- Available information. When extensive monitoring data exist, it may be possible to gain a detailed understanding of pollutant sources, such as specific sub-basins, geographic locations, or land uses. These sources can be targeted in the implementation plan. When data are insufficient to identify specific sources, only general BMPs can be identified.

MS4 general permit overview

EPA regulations, 40 CFR 122.44(d)(1)(vii)(B), state *Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, [must be] consistent with the assumptions and requirements of any available wasteload allocation for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7*. Minnesota's Municipal Separate Storm Sewer System (MS4) General Permit requires an MS4permittee to address all WLAs in TMDLs approved prior to the effective date of the permit. In doing so, they must determine if they are currently meeting their WLA(s). If the WLA is not being achieved at the time of application, a compliance schedule is required that includes interim milestones, expressed as best management practices, that will be implemented over the current five-year permit to reduce loading of the pollutant of concern in the TMDL. Additionally, a long-term implementation strategy and target date for fully meeting the WLA must be included.

The EPA, in a November 22, 2002 memo written by Robert H. Wayland and James Hanlon, indicates Best Management Practices (BMPs) are an appropriate form of effluent limit for MS4 stormwater: *"in light of 33 U.S.C. §1342(p)(3)(B)(iii), EPA recommends that for NPDES-regulated municipal and small construction storm water discharges effluent limits should be expressed as best management practices (BMPs) or other similar requirements, rather than as numeric effluent limits."* MPCA advocates a BMP approach to meeting the WLA.

With this approach an MS4 will implement BMPs and estimate load reductions based on the performance of the BMP. When the reductions meet the reduction required in the TMDL, the MS4 meets the TMDL requirement in the permit.

An MS4, through its SWPPP (Storm Water Pollution Prevention Program), demonstrates how it will meet a WLA. A SWPPP is essentially a compilation or summary of BMPs designed to minimize water quality impacts from MS4 stormwater runoff. The implementation plan may contain specific information about implementation activities that can be incorporated into an MS4 SWPPP.

The MPCA prefers TMDL implementation plans be as prescriptive as data allows for MS4 stormwater provided MS4s have input into development of the implementation plan. A well written implementation plan provides a guide for MS4s to follow in meeting permit requirements. Appendix A provides a summary of some TMDL implementation plans that have an urban stormwater component. Even though these case studies illustrate examples of reasonably good implementation plans, none link well with the MS4 permit. This illustrates the need for implementation plan guidance.

Content of the implementation plan

A good TMDL implementation plan for MS4 stormwater contains information on four general topics.

- Derivation of wasteload allocations
- Selecting implementation strategies and activities
- Tracking and verification monitoring
- General compliance schedule

Each of these is discussed below.

Derivation of wasteload allocations

Implementation Plan contains

- **Individual target loads for each MS4**
- **Summary of model, model inputs, and model assumptions**
- **Description of method for delineating watershed**

A WLA represents a quantity of allowable pollutant that can be discharged to a receiving water. WLAs may be expressed in several ways. The most common expression is as a mass or quantity, such as pounds per day (e,g, for phosphorus) or number of organisms per day (e,g, for bacteria). This form of the WLA is necessary since TMDLs are expressed as a daily load. However, a WLA expressed in this form is problematic for most TMDLs and most MS4s. First, most TMDLs are determined using monitoring data for the receiving water. The TMDL thus represents the allowable pollutant entering a receiving water. This number may differ dramatically from the allowable pollutant load being discharged from a MS4 upstream of the receiving water because the pollutant delivery rate is almost never 100 percent. In an extreme example, a pollutant load determined at Lake Pepin does not represent the amount of pollutant discharged from Bemidji's stormwater system that is necessary to meet the load requirement at Lake Pepin. Second, few MS4s monitor and model discharges from their stormwater system. Complying with a WLA expressed as a mass would require MS4s to invest in monitoring and modeling. This would come at the expense of implementing BMPs. Third, even when complex models are used to estimate loads from a MS4, the model may not consider all BMPs that can be counted toward the WLA. The model may also fail to account for illicit discharges.

The TMDL should provide clear reduction targets. It is preferable if the TMDL expresses the reduction as a

percent from a well-defined baseline. If a baseline is not clearly identified in a TMDL, it can be determined if the allocation table(s) in the TMDL contain the current load. Baselines are discussed in section 4ii.

The implementation plan should contain the following three elements:

- each MS4 must have a target load;
- each MS4 should understand how the WLA was calculated, including modeling assumptions; and
- each MS4 should know the geographic area, e.g. the delineated watershed, included in the TMDL.

Each of these is discussed below.

Target loads for each MS4

MPCA's stormwater program prefers that WLAs be expressed individually for each MS4. This allows for easier translation into the permit. However, a TMDL may provide a categorical wasteload allocation rather than an individual WLA. Individual WLAs should be given to each permitted MS4 unless one of the following three conditions applies:

- Data are not adequate for assigning individual WLAs;
- There are reasonable assurances that a categorical WLA will be met collectively by the MS4s (One example of a reasonable assurance is the presence of a watershed organization that has regulatory authorities and water quality goals consistent with MPCA's water quality goals.);
- If the BMPs **required** to meet the WLA are defined either in the TMDL or in the permit.

Categorical WLAs allow flexibility in achieving the WLA since BMPs may be targeted to locations where they achieve the greatest reductions. Categorical WLAs make it difficult to determine what a MS4's responsibility is in the permit, since they do not have their own individual WLA. It would be cumbersome to track several MS4s that are working together to achieve a categorical WLA. It is therefore desirable to translate categorical WLAs into meaningful target loads for an MS4. A target load is the load which an MS4 attempts to achieve through implementation of BMPs. Although somewhat analogous to an individual WLA, a target load is not enforceable through the permit.

The target load should be expressed as a percent reduction from a baseline. If it is expressed as a mass load, the current load should be provided so that a percent reduction can be determined. The baseline year must be included (see Section 4.ii). If the percent reduction is the same for all MS4s, this should be stated clearly in the TMDL or implementation plan.

If the TMDL or implementation plan do not express the WLA or target load as a reduction, MPCA's stormwater program will determine a target load for each MS4. If progress is not being made toward this reduction, the stormwater program may ask that the TMDL be re-opened and individual WLAs assigned to the MS4s.

Target loads can be calculated using one of several approaches. Example approaches include the following.

- **Area approach.** The target load can be divided based on the relative area of each MS4. Only the areas within the study watershed should be considered. For example, if two MS4s have a WLA of 100 lbs/day, MS4 A covers 75 percent of the study area and MS4 B covers 25 percent of the study area, the target loads would be 75 lb/day for MS4 A and 25 lb/day for MS4 B. This is a desirable approach if the pollutant loading per unit area is considered to be similar across all MS4s.
- **Population approach.** The target load can be divided based on the relative population of each MS4. Only the population living within the study watershed should be considered. This approach is similar to the area approach but may be more desirable if the data are easier to access than the area information and if

population densities are considered homogenous across all MS4 areas.

- **Land use approach.** Loads can be apportioned based on land use if loading from the MS4s differs significantly because of the land use. For example, assume two MS4s have a categorical WLA of 100 lbs/day. MS4 A has an area of 60 acres that includes 40 acres of parkland and 20 acres of commercial. MS4 B has an area of 40 acres that consists of residential land use. Assume parkland has a loading factor of 1, commercial 2, and residential 3. Multiplying the loading factors by acres gives a value of 80 for MS4 A and 120 for MS4 B. MS4 B therefore accounts for 60 percent of the loading and has a target load of 60 lbs/day, compared to 40 lbs/day for MS4 A. This method requires derivation of land use loading factors. These are relatively easy to develop for phosphorus, suspended sediment and possibly fecal coliform.
- **Model approach.** An MS4 can replicate the model used for the TMDL to calculate its current pollutant load. This can be compared to the estimate of current load for all MS4s. The fraction contribution from the MS4 to overall loading is multiplied by the overall MS4 WLA to derive the individual target loads for the MS4.
- Percent impervious can be used to estimate target loads.

Although a target load can be determined using one of the above approaches, the target load for individual MS4s can be modified as new data become available, provided the overall WLA does not change. Appendix B provides examples of how to calculate individual target loads for different TMDLs. MS4s should find these examples useful as they determine their target loads in implementation plans.

Understanding modeling assumptions

The implementation plan should include information about how the WLA was calculated, or it can refer to this information if it exists in another document. The following may be useful for an MS4, particularly if the MS4 intends on utilizing the same model to track progress toward achieving the WLA.

- Model used (e.g. P8, SWAT, HSPF, Simple Method, SLAMM, etc.).
- Model inputs. Include model inputs for precipitation, land use, loading factors (e.g. event mean concentration), imperviousness, curve numbers, soils, etc.
- BMPs included in the model, including the type of BMP, their location, assumed pollutant removal efficiency including the source of this information, and volume of stormwater treated.

Since the stormwater program advocates an accounting process for achieving the WLA, with a percent reduction in loading being the target, it is important to define the baseline condition from which calculations will be made. The baseline must include a year but may include additional information, such as a summary of BMPs considered in deriving the WLA. Those BMPs cannot be applied toward the WLA.

For TMDLs developed with short-term monitoring data, such as two or three years, the baseline year will be one of those years. When long-term monitoring data is used it is difficult to determine the appropriate baseline year. TMDL authors, TMDL project managers, Stormwater Program staff, and stakeholders should work together to determine an appropriate baseline year. When a baseline is not clearly defined in the TMDL or implementation plan, Stormwater Program staff will determine the baseline.

Examples of baselines from TMDLs developed in Minnesota are provided below. In general, more recently-approved TMDLs provide clearer target loads and baselines.

- Hardwood Creek – this TMDL does not clearly define the target load from a baseline condition. The TMDL provides categorical WLAs for TSS and BOD across five flow regimes. The TMDL defines 2002 as the baseline year and provides a watershed TSS load for that year. Subtracting the WLA from the 2002 load and dividing by the 2002 load gives a reduction of 15.7 percent.

- Minnesota River Dissolved Oxygen TMDL – this TMDL provides a categorical WLA on a lb/day basis. The TMDL report states the reduction goal is 30 percent. The report also states that no BMPs were considered in the modeling. The model scenario chosen for setting the allocations was based on 1988 data. The target load is therefore assumed to be 30 percent from a no-BMP situation in 1988.
- Long-Farquar Lakes – Individual WLAs are provided for each MS4 on a lbs/day basis. Current watershed loads are given. Thus, a percent reduction can be calculated as well as an overall mass reduction. The TMDL does not define a specific year. The TMDL was based on data for three years – 2001, 2003, and 2005. The target load for the MS4s is thus either their WLA on a lb/day basis, or a percent or mass reduction from 2003, which represents an intermediate year.
- Kohlmann Lake TMDL – Individual WLAs are given to each MS4s. The WLA is expressed as lbs/day and as a percent reduction. The TMDL states that 2001 provides a reasonable starting point for tracking reductions.

Understanding geographic extent of the study area

All TMDL reports illustrate the study area in the final report. However, it is not always clear how the boundaries of the study area were determined. The implementation plan should describe the method used to delineate the watershed. For example, the DNR minor watershed GIS coverage is often used to delineate watersheds, including lakesheds. This approach may not accurately reflect a lakeshed, creating the potential for implementation of BMPs outside the actual lakeshed. In addition, many MS4s have modified drainages because of their stormwater sewer system. These modified drainages may not be reflected in the TMDL.

Selecting implementation strategies and activities

A WLA for MS4s will be met through implementation of BMPs. The implementation plan should include a stormwater management strategy that lays out an adaptive management approach to meeting the WLA, an overview of the adaptive management approach, and an overview of the general implementation strategy. The implementation plan may also contain general information on BMPs (e.g. removal efficiency, cost, maintenance requirements, resource requirements, and applicability), a summary of existing stormwater management strategies in the watershed, a summary of funding needs and mechanisms, and trading guidelines if applicable. These are discussed below.

Implementation Plan contains
- **Overview of Stormwater Management Strategy**
- **Overview of adaptive management approach**
- **Information on BMPs**
- **Summary of existing stormwater management strategies in the watershed (e.g. watershed plans, county plans)**
- **Summary of funding needs and mechanisms**
- **If applicable, trading guidelines**

Stormwater management strategies

MS4s should develop a stormwater management strategy, which is a general approach used to meet the WLA . The strategy consists of five general approaches to meeting a specific pollutant load. MS4s will typically employ more than one of these, but the priority for each will vary for different MS4s.

Example Language for a Stormwater Management Strategy

The Watershed is fully built out. Consequently, the stormwater management strategy consists of installing BMPs in areas of re-development (retrofits), source control practices, and non-structural BMPs. Trading will be considered if re-development opportunities are not sufficient to meet the WLA.

- **Stormwater retrofits.** In fully or largely built out MS4s, load reductions will primarily have to be addressed through stormwater retrofits.
- **New development.** In MS4s that are or will undergo significant new development, load reductions can be achieved by implementing a variety of BMPs, including use of Low Impact Development.
- **Source control BMPs.** For some pollutants source control may be an important method for decreasing

pollutant loads.

- **Non-structural treatment BMPs.** Most MS4s use these types of BMPs, such as street sweeping, although they are not likely to achieve the WLA by themselves.
- **Trading.** In some scenarios, it may be necessary or more cost effective for MS4s to trade for pollutant reductions.

The implementation plan should describe the general strategy that will be employed to meet the TMDL. An example is shown in the inset below.

Adaptive management approach

Example Language on Adaptive Management

Source control and non-structural BMPs will be identified and implemented to the extent practical during the first permit cycle. Stormwater retrofits will be tied to re-development plans and will focus on opportunities to get the greatest reduction in pollutant loading per unit cost of implementing the BMPs. Selection of BMPs and the BMP strategy may be modified as BMP research results become available.

Implementation of BMPs is expensive and environmental impacts of BMP implementation are uncertain. MS4s should employ an adaptive management approach to implementing BMPs. Using this approach, BMPs are selected, implemented, and evaluated. This may occur across multiple permit or funding cycles. Monitoring may occur concurrent with implementation. The TMDL implementation plan should provide a framework for the adaptive management approach. For example, an MS4 may choose to address the TMDL WLA by implementing Low Impact Development in newly developing areas. This may occur over a period of several permit cycles. The implementation plan could provide a framework for linking development with progress toward the WLA, including linking long-term development plans to likely load reductions. The inset below continues with the example from the previous section.

Information on BMPs

Example BMP Information for Implementation Plan

Construct urban BMPs within the watershed and on the shoreline of Lake Independence to reduce phosphorus inflows by 146 pounds or more. (Estimated total cost=$800,000.00) Between 2007 and 2015 install shoreline protection and stabilization on 1000 feet of shoreline. At the same time work with residents and cities within the watershed to create 50 rain gardens, filtration basins, and other urban best management practices to reduce phosphorus inputs to Lake Independence by 146 pounds or more.
1. Responsible Parties LICA, Landowners, TRPD, HCES, PSCWMC, Cities
2. Timeline 2008-2015
3. Estimated Costs $800,000
Shoreline Stabilization $150,000
Bank Stabilization $300,000
Channel Erosion $150,000
Urban BMP (nutrient management, shoreline restoration, rain gardens)$200,000
4. Estimated Phosphorus Reductions
a. Shoreline Stabilization (1,000 feet) 1 acre area @ 20 tons/ac @ 2#/phosphorus/ton=40# direct reduction of phosphorus
b. Bank Stabilization (1,000 feet) 1 acre area @ 50 t/ac@2#/ton=100# direct reduction of phosphorus.
c. Channel Erosion (3000 feet) (gully sediment 2 tons soil loss/1000 feet of channel = 2x3x2=12# direct phosphorus reduction
d. Urban BMP (50 rain gardens/pond basin) Average 1# direct phosphorus reduction per rain garden/pond/basin=50#

BMP selection and implementation is the tool by which an MS4 will achieve its WLA. There is considerable information in the literature on BMP pollutant removal efficiency, design, cost, and maintenance requirements. This information is scattered through the literature and represents a wide variety of environmental conditions that may not necessarily apply to Minnesota. Currently we lack standardized numbers that reflect pollutant removal efficiencies for specific BMPs. The MPCA, in conjunction with others, is developing standardized numbers for a wide range of BMPs. MPCA anticipates that as these numbers become available, they will be incorporated into the permit, either directly or by reference.

The implementation plan offers an opportunity to guide MS4s in selecting BMPs. For example, an implementation plan may indicate that infiltration BMPs, such as rain gardens, should be implemented to achieve a WLA. But because we lack standardized numbers for pollutant removal, the implementation plan should not provide specific information about those BMPs, such as where they should be located. An exception may occur when a very detailed model was used to determine current loading. To date, such modeling has not occurred. The Silver Lake and Medicine Lake TMDLs are examples where detailed modeling information could be used to identify BMP categories or target general areas where BMPs would be most effective. Appendix C provides guidance for BMP selection for bacteria, phosphorus, TSS, and chloride.

The following inset contains an example from the Lake Independence Nutrient TMDL. Note the task includes a description, cost, timeline, responsible party, expected phosphorus reductions, and specific BMPs. Additional information that could be included is maintenance requirements, resource requirements, and if possible, likely implementation scenarios, such as utilizing specific BMPs in certain types of land use.

Existing stormwater management strategies

Local water management organizations often lead the development of TMDLs. This is particularly true in the Twin Cities Metro area. These organizations typically have water management plans that lay out strategies for managing stormwater. Examples include watershed plans, county plans, city plans, and any other local water plans. Generally these plans are more detailed than TMDL implementation plans and because they are developed locally, they often serve as better tools for managing stormwater. In some cases, stormwater management plans, if fully implemented, will meet TMDL WLAs.

TMDL implementation plans should therefore include information from local water management plans. The implementation plan should include strategies and BMPs from these local plans. The implementation plan should quantify, to the extent possible, how local management strategies and BMPs will make progress toward the WLA. **NOTE: The MPCA does not approve BMP load reductions provided in implementation plans. These estimates of load reduction, however, may be viewed as reasonable estimates that a MS4 can use in developing a stormwater management strategy to address a WLA.**

Local stormwater management strategies may address goals other than impaired waters (e.g. flood control, nondegradation, specific watershed or receiving water goals, etc.). Ideally, the implementation plan would provide a discussion of how these strategies interrelate, and incorporate these strategies into the Stormwater Management Strategy. The discussion could include suggestions for interagency coordination. The process of identifying existing strategies and authorities can be used to determine the party responsible for implementing the different components of the stormwater management strategy.

The implementation plan may contain additional information on local requirements that may be related to stormwater. Examples include development plans, zoning rules, plan review, model ordinances, and so on. This information may be linked to implementation activities identified in the implementation plan. For example, development plans and zoning rules can be used to identify areas where Low Impact Development might be most effective in reducing pollutant loads.

Funding

The implementation plan should include a discussion of current funding and future funding needs, as well as explain the strategies to meet those needs. A discussion could include: 1) currently funded projects that will help meet the TMDL; and 2) proposed BMP projects, cost estimates for those projects, and strategies to secure those funds. Local water management plans often contain this information.

Example of Initial Funding Plan

1. Shoreline Stabilization: HCES will coordinate a grant application to solicit funds to assist homeowners with lakeshore stabilization projects.
2. Rain gardens: HCES will assist LICA with rain garden design and will apply for grant monies to design and construct demonstration sites for homeowners to view.
3. Street Sweeping: Street sweeping in areas immediately adjacent to Lake Independence will be completed by Medina and Independence

In addition to local government funding sources, several state and federal loan and grant programs may be available to pursue. This includes the Clean Water Legacy Act funds, Clean Water Revolving Fund, TMDL Grants, and Phosphorous Reduction Grants. In addition, although EPA 319 funds cannot currently be used to help an MS4 meet its permit requirements, 319 funds may be available for education and innovative BMPs. Further information on implementation funding can be found at [6] (http://www.pca.state.mn.us/water/tmdl/tmdl-financial.html#funds).

The inset below provides a summary of some language from the Lake Independence Nutrient TMDL. Specific costs were discussed in the inset example in Section 4.B.iii. The discussion in the inset could be expanded in the implementation plan to include information on existing stormwater utilities for the cities in the watershed and funding mechanisms for the watershed organization.

Trading

MPCA is currently writing a rule for water quality trading. Trading by MS4s will be a viable option to meet WLAs, but conditions under which trading is allowed have not been defined. If trading is an option for meeting the WLA, the implementation plan should summarize the conditions necessary for trading.

One possible important application of trading is when internal loading is an important component of the TMDL. Internal loading is part of the LA. Therefore an MS4 will not receive credit toward its WLA if it implements BMPs to reduce internal loading, such as alum treatments. This could disincentivize MS4s from implementing BMPs that improve water quality. To date, no TMDLs have addressed this issue, but trading appears to be a viable option for promoting BMPs that would typically not be used by an MS4 to meet its WLA.

Information on tracking and verification monitoring

A MS4 will have to track progress toward achieving the WLA. Tracking progress by MS4s will occur through the permit (i.e. the SWPPP and Annual Reports). The implementation plan may reference the permit, but methods for tracking should be consistent with permit requirements. Water quality monitoring may be conducted by MS4s or other entities to track progress and evaluate effectiveness of BMPs. Currently water quality monitoring is conducted primarily by the two Phase 1 cities and by watershed management organizations. The MPCA does not envision monitoring requirements for the 2013 Phase 2 permit. The implementation plan may, however, provide a summary of water quality monitoring currently being conducted within the study area.

Implementation Plan contains

- **Description of how MS4s will track progress toward meeting the TMDL. Must be consistent with permit**
- **Discussion of on-going monitoring**

General compliance schedule

The implementation plan should contain a target date for achieving the TMDL. The implementation plan may also contain a general compliance schedule, including rough timelines for implementing BMPs.

Implementation Plan contains

- **General compliance schedule based on consideration of pollutant, recommended BMPs, permit cycles, and funding cycles.**

Some TMDLs have very large reduction requirements and include multiple sectors (e.g. wastewater, agriculture). Examples include the Minnesota River turbidity TMDL and the Lower Cannon River turbidity TMDL. It is unreasonable to expect one sector to achieve reductions exceeding 50 percent of current loading while other sectors make no progress toward achieving their reduction goals. MPCA advocates a phased implementation approach for these situations.

With a phased approach, target reductions are set at specified timelines. All sectors are responsible for meeting their requirements within the timeline. If one sector does not meet its requirement while others do, those sectors meeting their requirements will not be required to make further reductions until all sectors have achieved the goal for a particular phase.

If the implementation plan provides a phased approach and compliance schedule, four factors should be considered.

- The pollutant, which affects the time over which we can expect to see changes in the receiving water as a result of BMPs. For example, chloride is primarily associated with road salt application and is a conservative chemical. We expect to see rapid changes in water quality in response to BMP implementation. Consequently, BMPs can be sequenced more closely. The same is not true for phosphorus loading to a lake that has a large internal loading component.
- BMP selection. Some BMPs are easily implemented and combined with the Minimum Control Measures in the SWPPP. Examples include pollutant-specific education efforts, such as education on pet waste. These are readily combined with prevention efforts, such as adoption of pet waste ordinances and supplying pet waste disposal bags in public parks. Other BMPs may require considerable time to implement. Examples include employing Low Impact Development (LID) practices in newly developing areas and retrofitting urban core areas with stormwater BMPs.
- The MS4 general permit, which is re-issued on a five year cycle. Permittees submit a SWPPP every five years and they are required to implement BMPs included in the SWPPP. Permittees can add BMPs during a permit cycle, but there is no requirement to do so. Because an adaptive management approach will be employed for TMDLs that take multiple permit cycles to achieve, it is important to find the correct balance between getting BMPs in place during specific permits cycles and allowing flexibility to evaluate existing and future BMPs in future permit cycles.
- Many MS4s have funding cycles and it is important to coordinate these cycles with the MS4 permit cycle and BMP selection. These funds are typically dependable (e.g. stormwater utility fee) and can be used to fund the highest priority BMPs. There are external sources of funding, such as Clean Water Legacy money. These are not reliable sources of funding and should not be relied on in developing a compliance schedule.

Case studies of implementation plans

This appendix contains information on implementation from completed TMDLs and TMDL implementation plans.

Ballona Creek and Estuaries Metals TMDL

The Ballona Creek and Estuaries TMDL encompasses a relatively small watershed in an urban area. Two other TMDLs have been completed or are underway for the study area. The Implementation section of the metals TMDL was reviewed for this TMDL. The WLA is expressed as a concentration for dry and wet weather conditions. Consequently, monitoring is necessary to evaluate progress toward the TMDL. Following are notes from the review of this TMDL.

- The TMDL process was stakeholder driven. The implementation effort was intended to link with regional planning efforts. In some areas where regional planning exists, the regional plan is sufficient to identify implementation actions. In other areas, regional plans are considered to be inadequate to meet the TMDL.
- The implementation strategy includes three separate strategies that are employed in a phased approach. The first phase consists of implementation of non-structural BMPs. The initial focus is on purchase of vacuum-assisted street sweepers and then implementation of a monitoring plan to evaluate effectiveness. Sweeping schedules will be adjusted based on monitoring results. Included in the non-structural phase are increased inspection and enforcement and a focus on identification and removal of illicit discharge connections.
- The second phase focuses on structural BMPs. Modeling was used to identify areas where certain types of structural BMPs will work best. Focus was on infiltration, combined in some cases with pre-treatment.

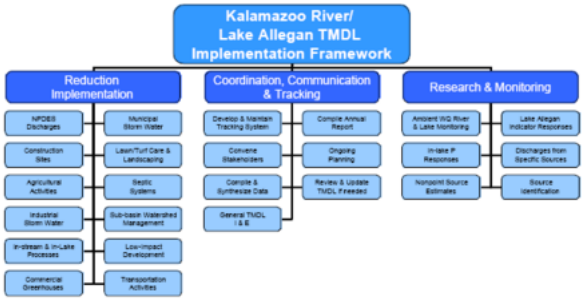
- The third phase focuses on ultimate reuse of stormwater. Stormwater is collected, treated, stored, and eventually used. During wet flows, excess water is diverted to a treatment train.
- The report discusses the projected success of the different phases in different parts of the study area.
- The report includes cost estimates and BMP removal efficiencies.
- The report was linked to the Ballona fecal coliform TMDL.
- The report discusses other needs, such as GIS and aerial photography, which are used to identify BMPs in different land uses.
- An implementation schedule is included. The schedule reflects a phased approach over a 15 year period. A dry weather compliance schedule is the early focus because it is anticipated that it can readily be achieved.
- Using an integrated approach, the implementation plan focuses on three different strategies for three different areas within the watershed. In one area, the regional plan will work. In another area, non-structural BMPs should achieve the necessary load reductions. In the third area, structural BMPs will be needed.

The Implementation section of the Ballona Creek TMDL report demonstrates the following concepts that can be incorporated into a TMDL implementation plan.

- Identification of local plans having implementation efforts that can help meet the TMDL
- A phased stormwater management strategy
- Cost estimates for BMPs
- Pollutant removal efficiencies for BMPs
- Discussion of resource needs needed to implement the stormwater management strategy
- A general compliance schedule

Kalamoazoo River/Lake Allegan Phosphorus TMDL

- The Implementation framework was divided into three general areas. These were Reduction Implementation (e.g. sector sub-groups); Coordination, Communication, and Tracking; and Research and Monitoring. The general framework is shown in the figure below.
- Identified existing programs and reductions that are likely to be occurring through these programs.
- Target subwatersheds where loading is greatest. Securing funding is part of this targeting.
- Trading is discussed as one implementation option.
- A mechanism was established for water quality data entry, data analysis, trading, reporting, tracking, and web maintenance.



Lake Independence Nutrient TMDL

This TMDL provides individual WLAs for three permitted MS4s. Two additional MS4s were given de minimus WLAs. The following information is from the TMDL implementation plan.

- WLAs and LAs were based on sources rather than geographic or political boundaries.
- The TMDL identified specific problems, such as shoreline erosion. This allowed targeting and sequencing of BMPs. An important target was lakeshore development. The Plan presented BMPs appropriate for this type of development, such as shoreline stabilization.

- The Plan identified organizations that could lead implementation of the BMP. Specific outreach strategies were presented.
- BMP cost estimates were included, as were potential funding mechanisms.
- Specific BMPs included rain gardens, shoreline stabilization, improved street sweeping, litter removal adjacent to the lake, education, and installation of shoreline buffers.
- Timelines are provided.
- Implementation activities are divided into tasks, which are basically BMPs.

Phosphorus Source	Phosphorus Reduction Strategies	NPDES Phase II Minimum Control Measures
Agricultural Cropland	Vegetated buffer strips	Public Education Public Participation Good Housekeeping
Animal Waste	Improved manure storage Improved land application practices Improved pasture management Removal of manure	Public Education Public Participation Good Housekeeping
Urban Development	Rain garden installations Shoreline stabilization Increased street sweeping Removal of leaf litter Shoreline buffer installations	Public Education Public Participation Construction Site Measures Good Housekeeping
Failing Individual Sewage Treatment Systems (ISTSs)	Increased inspection of ISTSs Increased enforcement of violations More frequent pump-out	Public Education Public Participation Illicit Discharge Measures Good Housekeeping
Geese	Reduce resident goose flock Promote shoreline buffers	Public Education Public Participation
Loretto Sewage Treatment Facility	Eliminate all discharge of effluent	Illicit Discharge Measures Good Housekeeping

Lake Independence implementation strategies

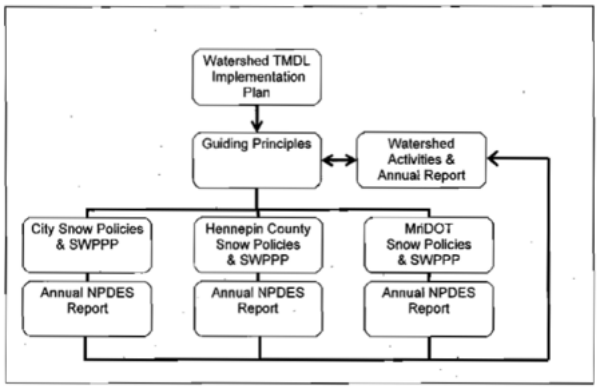
- Estimates of P reductions are given as a single gross number, but gains from individual BMPs are not presented.
- The Watershed Commission will modify it's plan as necessary to accommodate the TMDL
- The following table demonstrates reduction strategies for the different sectors. The entire watershed is permitted MS4. Consequently, the table indicates linkage between the permit and the strategy.
- Additional monitoring stations are being established to monitor inflow into the lake. This data can be used to assess BMP performance and progress toward meeting the TMDL. Future funding is linked to monitoring, assuming that the monitoring results will demonstrate additional needs.

The Implementation section of the Lake Independence TMDL report demonstrates the following concepts that can be incorporated into a TMDL implementation plan.

- Identification of specific tasks (BMPs).
- Timelines, estimated costs, and responsible party for each task.
- Proposal to modify local water plan to meet TMDL requirements.
- Linkage between tasks and NPDES permit.

Shingle Creek Chloride TMDL

This TMDL provides the WLA as a percent reduction in loading for a group of MS4s. All MS4s are given the same reduction. The implementation plan provides a suite of BMPs that, if implemented, are expected to achieve the WLA. All MS4s are expected to implement the same BMPs. The following information is from the TMDL implementation plan.



- The stakeholder group focused on identifying a suite of prevention BMPs that lead to reduced use of road salt. The general BMP categories included training, managing stockpiles, use of alternative deicers, application, and cleanup.
- After evaluating the above broad categories and current practices, the stakeholders developed a load reduction plan that included five activity areas. Improved plow techniques is an example of one of the activity areas.
- The figure below illustrates the implementation framework. The framework illustrates the link with NPDES permits and indicates that the watershed organization is responsible for ensuring that the activities of individual MS4s are consistent with the guiding principles.

- The watershed organization will conduct monitoring, track BMP implementation, coordinate activities, and provide education.
- Each city must develop a salt management plan.
- Each city must submit an annual report to the watershed organization.
- Education is an important component of the strategy. Education includes the public (e.g. implications of less road salt, such as reduced speeds) and applicators (e.g. training workshops).
- The watershed organization will conduct monitoring and collect salt use information in an attempt to track BMP effectiveness. Volunteer monitoring is incorporated into the monitoring scheme.
- Plan is to require annual reports for the other impairments in the watershed and thus link stormwater management activities.
- Many of the BMPs are management activities, such as calibrating spreaders and investing in new technologies.
- Costs are included for many BMPs and for new equipment associated with BMP implementation.
- An appendix in the implementation plan summarizes current activities and includes additional activities. This table can be easily used in development of SWPPPs.

Determining an individual target load

Below are several examples of how to determine a target load from a TMDL.

Example 1 - Lake Independence TMDL

This TMDL provides individual WLAs, expressed in lbs/year, for MS4s. The WLA is therefore the target load. The figure below illustrates WLAs for three MS4s in the Lake Independence watershed. The WLAs are 356 lbs-P/year for Independence, 16 lbs/year for Loretto, and 231 lbs/year for Medina. Existing (current) loads are included in the allocation table, as are load reductions. These can be translated into percent reductions if needed. This is the preferred form of the WLA since the WLA for each MS4 is clearly defined.

Phosphorus Loading - Wasteload Allocation (WLA)

Assigned Source	Existing Phosphorus Loading		Waste Load Phosphorus Allocation		Load Reduction
	(lbs/year)	(lbs/day)	(lbs/year)	(lbs/day)	(lbs)
Independence	891	2.44	356	0.95	535
Loretto	69	0.19	16	0.07	53
Medina	515	1.41	231	0.63	284
Total *(external only)*	1475	4.04	603	1.65	872

Example 2 - Lower Minnesota River Dissolved Oxygen TMDL

This TMDL provides a categorical WLA, in lbs-P/day, for MS4s. The implementation plan indicates the overall WLA for permitted MS4s is 147 lbs/per day during the summer low flow period. This load is the total cumulative acceptable load for the ten permitted MS4s in the study area.

MS4	Population	Fraction of population	WLA
Fairmont	10889	0.08	12.4
Mankato	32427	0.25	37.0
Marshall	12735	0.10	14.5
Montevideo	5346	0.04	6.1
New Ulm	13594	0.11	15.5
North Mankato	11798	0.09	13.5
Redwood Falls	5459	0.04	6.2
Saint Peter	9747	0.08	11.1
Waseca	8493	0.07	9.7
Willmar	18351	0.14	20.9

The Hydrologic Simulation Program Fortran (HSPF) model was used to calculate urban stormwater loads. All MS4s were treated equally. Consequently, the WLA can be divided among the ten MS4s based on either area or population contribution of each MS4. Since the model lumped all urban pervious area together, including nonpermitted MS4s, it would be difficult to determine the area contribution of each MS4. Using 2000 U.S. Census Bureau populations, the individual MS4 target loads can be determined by multiplying the categorical WLA (147 pounds) by the fraction of permitted MS4

population for each MS4. The results are illustrated in the table below. Thus, individual target loads during the summer low flow period are 12.4 lbs-P/day for Fairmont, 37.0 for Mankato, and so on.

This TMDL also provides the WLA as a uniform 30 percent reduction for all MS4s. Since no BMPs were assumed in the model, the baseline condition would include no BMPs. The TMDL report does not clearly define a baseline year. However, the Scenario used to set the allocations was based on 1988. The target load for MS4s could therefore be a 30 percent reduction from a no-BMP condition in 1988.

Example 3 - Shingle Creek Chloride TMDL

This TMDL concluded that a 71 percent reduction in chloride load was needed across the watershed to achieve the water quality standard in Shingle Creek. The assumption was that each permitted MS4 would implement the same suite of BMPs and these would result in a 71 percent reduction in chloride loading. However, the implementation plan provides a summary of BMPs but does not indicate which BMPs need to be implemented to reach the 71 percent reduction goal.

MS4	TMDL WLA					
	Percent of total lane miles	Duration interval = 5 %	Duration interval = 25 %	Duration interval = 50 %	Duration interval = 75 %	Duration interval = 95 %
Hennepin County	19	4.41	1.37	0.55	0.34	0.057
Brooklyn Park	18	4.18	1.30	0.52	0.32	0.054
Mn DOT	11	2.55	0.79	0.32	0.20	0.033
Brooklyn Center	10	2.32	0.72	0.29	0.18	0.030
Crystal	8	1.86	0.58	0.23	0.14	0.024
Minneapolis	8	1.86	0.58	0.23	0.14	0.024
Plymouth	7	1.62	0.50	0.20	0.13	0.021
Robbinsdale	6	1.39	0.43	0.17	0.11	0.018
Maple Grove	6	1.39	0.43	0.17	0.11	0.018
New Hope	5	1.16	0.36	0.15	0.09	0.015
Osseo	1	0.23	0.07	0.03	0.02	0.003

The preferred method for establishing a target load would be to have a reduction target, such as 71 percent, for each MS4, along with a summary of any progress the MS4s have made to date. The TMDL assigns a categorical WLA, however, with no indication of progress to date for the different MS4s.

The TMDL also expressed the WLA as a quantity at each of five different flow duration intervals. The primary source of chloride is application of salt to roads. Consequently, one way to calculate a target load is to partition the categorical WLA among each MS4 based on their proportion of road miles. The result of this calculation is shown below for the five different flow duration intervals.

The Shingle Creek TMDL does not clearly identify a target load for the MS4s. The default would be to assign a load reduction of 71 percent to each MS4 from the monitoring year, which was 2002. This approach is not equitable to MS4s that have implemented more BMPs than others.

Pollutant specific components recommended for inclusion in implementation Plans

Fecal coliform TMDLs

To date, most fecal coliform TMDLs have used Flow Duration Curves to derive WLAs. Loads are assigned to the Margin of Safety and wastewater. The remaining load is divided among the remaining sectors based on an area distribution. For example, if permitted MS4s make up 10 percent of the watershed, they receive 10 percent of the load that remains after the Margin of Safety and wastewater loads are assigned. Loads are typically given as a categorical load, in number of organisms per day across five flow regimes.

Concentrations of fecal coliform in urban stormwater exceed the water quality standard (200 colonies or MPN/100 ml) for all urban land uses. The tables below illustrate concentrations from urban areas. Even runoff from urban roofs exceeds the water quality standard.

Calculating and tracking loads of fecal coliform from an MS4 would be difficult. There is little information in the literature useful for calculating load reductions for specific BMPs. Furthermore, BMPs other than infiltration or disinfection are not likely to achieve the water quality standard. Consequently, the following should be considered in the TMDL implementation plan.

Comparison of Bacterial Densities in Different Waste Streams (MPN/100ml); (Pitt, 1998; Lim and Oliveri, 1982;Smith et al.,1982; Horsely and Witten, Inc. 1995)

Source	Total Coliform	Fecal Coliform	Fecal Streptococci
Raw Sewage	2.3 X 10^7	6.4 X 10^6	1.2 X 10^6
Combined Sewer Overflow	10^4-10^7	10^4-10^6	10^5
Failed Septic sytems	10^4-10^7	10^4-10^6	10^5
Urban Stormwater Runoff	10^4-10^5	2.0 X 10^4	10^4-10^5
Forest Runoff	10^2-10^3	10^1-10^2	10^2-10^3

Concentrations (geometric mean colonies per 100 ml) of fecal coliforms from Urban Source Areas (Steuer et al.,1997; Bannerman et al., 1993)

Geographic Location	Madison WI
Commercial parking lots	1,758.00
High traffic street	9,627.00
Medium traffic street	56,554.00
Low traffic street	92,061.00
Commercial rooftop	1,117.00
Residential rooftop	294.00
Residential driveway	34,294.00
Residential lawns	42,093.00

- Stormwater Management Strategy and Compliance Schedule
  - First permit cycle
    - Identify illicit discharges and develop a plan to eliminate them
    - Identify discharges to MS4 conveyance system from permitted industrial and commercial storm water
    - Identify Combined Sewer Overflows and wastewater bypasses
    - Identify cross-connections between the sanitary and storm sewer systems (e.g., inspect foundation drains to locate and disconnect clear water sources to sanitary sewers to avoid overflow)
    - Implement an inflow/infiltration assessment and correction program (e.g., slip line old inflow and infiltration prone sections of sanitary sewers)
    - Develop and implement a response plan for reports of sanitary sewer overflows
    - Provide dump stations for RV waste
    - Develop mitigation plans for all illicit discharges
    - Identify wildlife population centers and evaluate source control BMPs (e.g., wildlife feeding bans, permits to oil and shake eggs, goose harassment programs, special hunts, etc,) or treatment BMPs (e.g., riparian buffers) in these areas
    - Identify effective structural BMPs (e.g., wet detention basins, infiltration/filtration basins, constructed wetlands, bioretention systems, sand filters, riparian buffers, etc.) and develop a strategy for implementing them (MPCA can provide additional guidance on structural BMPs that are effective for fecal coliform bacteria)
    - Consider the development of a modeling program or monitoring plan to evaluate fecal coliform bacteria load reductions (monitoring could include BMP effectiveness monitoring, source identification, and BMP maintenance monitoring)
    - Evaluate existing ordinances or develop ordinances regarding the management of pet waste
    - Develop and distribute educational materials specifically about pet waste management
    - Install pet waste bag dispensers at key locations for public use.
    - Street sweeping
    - Evaluate the potential for implementing Low Impact Design BMPs and evaluate existing or draft new ordinances related to implementation of LID BMPs in newly developed areas
  - Second and later permit cycles
    - Extend municipal sewer service to areas with failing septic systems
    - Implement mitigation plan for illicit discharges
    - Develop an urban forestry program
    - Implement structural BMPs
    - Implement ordinances, conduct inspections, and conduct enforcement for BMPs implemented during the first permit cycle
    - Inspect and maintain BMPs

- Tracking and Monitoring. Tracking loads for fecal coliform is impractical with current information on BMP effectiveness. Therefore, the following activities should be tracked.
  - Implementation of BMPs
  - Inspection and enforcement
  - Effectiveness of education programs
- Estimated Costs of various activities

Phosphorus (Excess nutrient) TMDLs

WLAs for lake phosphorus TMDLs are generally expressed in pounds per day. These TMDLs are generally for small watersheds. WLAs may be derived using a variety of models. These can roughly be divided into watershed delivery models and in-lake models. The two types of models can be used in conjunction. Some TMDLs may consider different precipitation regimes.

Phosphorus WLAs for streams and rivers may be expressed as an allowable load in pounds per day or as a required load reduction. These TMDLs are generally for large watersheds and phosphorus may be a surrogate for the actual impairment (e.g. dissolved oxygen). Models used for these TMDLs are generally sophisticated and consider both watershed loading for a variety of land uses and in-stream processes.

Because of differences in scale and modeling approaches, TMDL implementation plans will differ for lake and stream phosphorus TMDLs. The following discussion focuses on lake TMDLs. Many of the principles discussed for turbidity TMDLs (below) are applicable for stream and river phosphorus TMDLs and the reader is referred to that section for these TMDLs.

Phosphorus WLAs will often be difficult to achieve, particularly in urban areas that are fully developed. BMPs can be expensive and many are marginally successful in reducing pollutant loads. BMP treatment train approaches may need to be implemented along with aggressive education and prevention strategies. Internal loading in lakes may contribute significantly to the lake impairment and we therefore may not see immediate water quality improvements as BMPs are implemented.

Many BMPs exist for reducing phosphorus loads. Because required phosphorus reductions are typically large, BMP options are varied, and structural BMPs are expensive, a phased approach is recommended. An example might be the following:

- Stormwater Management Strategy and Compliance Schedule
  - First permit cycle
    - Strengthen stormwater program structure, such as ensuring ordinances are in place, maps are developed, funding sources are identified, etc.
    - Implement prevention BMPs, such as leaf and compost collection programs, pet waste and wildlife management programs, leaf management ordinances, etc.
    - Implement education programs as appropriate
    - Determine how to incorporate Low Impact development into new development and re-development
    - Implement structural BMPs as opportunities arise
    - Evaluate street sweeping program
  - Second permit cycle and beyond
    - Continue with structural BMPs
    - Maintain structural BMPs

Total Suspended Solids (TSS)

TSS is a pollutant of concern in rivers and streams. Watersheds are typically larger than the watersheds for lake TMDLs. An important source of TSS in impaired streams is often in-stream erosion, which is typically related to altered hydrology.

Much of the discussion for phosphorus applies to TSS. These TMDLs will be addressed over multiple permit cycles and will involve implementation of expensive BMPs. The BMPs are similar to those for phosphorus with the exception of the prevention BMPs. In addition, BMPs that address hydrologic processes should be considered.

Chloride

The primary source of excess chloride in urban areas is road salt applied during the winter months. Chloride is a conservative chemical and readily moves with water. The primary cause of impairments appears to be short-term thaw events that occur in the winter. Because flow in urban streams is typically very low in the winter, these melt events represent a significant load to the streams.

Groundwater can also be an important source of chloride to urban streams. Highest elevations of chloride in groundwater are in areas where road salt is applied. Concentrations may be more than three times the water quality standard in these areas. In urban areas less impacted by road salt, concentrations are well below the water quality standard.

Currently there are only a small number of urban streams listed as impaired. However, the belief is that most urban streams will eventually be listed. TMDLs for these impairments are completed at the small watershed scale, such as a Shingle Creek or Nine Mile Creek.

Prevention BMPs will be most effective for chloride. BMPs that improve local hydrology, such as use of rain gardens and infiltration devices, will be effective if the BMPs are properly placed. Because chloride is a conservative chemical in water, implementation of BMPs may have relatively impacts low or high on the impaired water. The following BMPs are available for addressing chloride impairments.

- Infiltration requirement
- Water quality monitoring
- Research
- Thermal pavement
- Advanced road systems
- Aggressive salt substitute practices
- Aggressive application practices
- Aggressive plowing practices
- Vegetation management
- Targeted salt substitute practices
- Improved spreader equipment
- Targeted application practices
- Targeted plowing practices
- Targeted education program
- Certification
- Improved street sweeping
- Completion of management plan
- Improved snow stockpile management
- Stockpile management
- Salt inventories

The MPCA will attempt to address chloride impairments through specific permit requirements rather than through an accounting and tracking approach. Consequently implementation plans can list all these BMPs. It would be useful if the implementation plan provided an inventory of which BMPs are currently being implemented and which are being considered.