BACTERIA TMDL PROTOCOLS AND SUBMITTAL REQUIREMENTS

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I. Introduction

A. Purpose

The purpose of this document is to provide guidance on the submission requirements for Total Maximum Daily Load (TMDL) studies by the Minnesota Pollution Control Agency (MPCA) and the U.S. Environmental Protection Agency (EPA). The intended audience is the MPCA staff and management, as well as technical staff of local organizations and consulting firms responsible for developing TMDLs.

While several technical references are provided, the guidance is based on the assumption that the reader has knowledge of watershed science, including monitoring and assessment techniques, modeling tools, and restoration practices. This guidance is designed to bridge the gap between general watershed programs, such as Minnesota’s Clean Water Partnership and Section 319 programs, and the unique requirements of TMDLs.

While this guidance is intended to build a common understanding of TMDLs, it will not meet every project need. Each TMDL project tends to have its own unique set of issues and challenges. The MPCA will provide the assistance and oversight needed to address these issues on a case-by-case basis.

At the time of this revision, the MPCA is working to transition to a “One Water” framework based on full integration of the Agency’s many water-related activities at the major watershed scale (Minnesota has approximately 80 major watersheds). This framework also includes a comprehensive approach to the multiple pollutants or stressors that may exist in any watershed. Thus, this protocol document serves as a guide for completing one component of a comprehensive major watershed study.

B. TMDL Overview

The TMDL process offers an excellent opportunity to identify sources of pollution to streams, rivers, and lakes, and to define the scope and nature of the pollutant reductions needed to restore water quality. The process can also enhance the involvement of watershed residents and stakeholders in water quality issues. In more detail, the potential benefits of the TMDL process include:

- Develops a consistent framework for conducting water quality studies;
- Defines existing impairments and pollution sources, quantifies source reductions, and sets comprehensive restoration strategies to meet water quality standards;
- Provides a framework for assessing future impacts to water quality;
- Accelerates the schedule at which impaired waters are addressed through more effective coordination of resources among local entities, state, and federal environmental agencies;
- Provides a basis for revising local regulations (e.g., zoning and sub-division) and developing performance-based standards for future development; and
• Facilitates the incorporation of TMDL schedules and implementation activities into local government water plans.


What is a TMDL?

A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant’s sources. Section 303(d) of the Clean Water Act (CWA) and its implementing regulations (40 C.F.R. § 130.7) require states to identify waters that do not or will not meet applicable water quality standards and to establish TMDLs for pollutants that are causing non-attainment of water quality standards.

Water quality standards are set by states, territories and tribes. They identify the uses for each water body, such as drinking water supply, contact recreation (swimming), and aquatic life support (fishing), as well as the scientific criteria to support those uses.

As described in detail in Part III of this guidance, Bacteria TMDL Submittal Requirements, a TMDL needs to account for seasonal variation and must include a margin of safety (MOS). The MOS is a safety factor that accounts for uncertainty that may occur in different areas of TMDL analysis. Also, a TMDL must specify pollutant load allocations among sources. The total of all allocations, as outlined at right, cannot exceed the maximum allowable pollutant load.

Finally, a TMDL study includes the identification of pollutant sources as specifically as possible, and determines or estimates how much each source must reduce its contribution in order to meet the maximum allowable pollutant load. The sum of all contributions must be less than the maximum daily load.

It should be noted that not all TMDLs involve simple single-pollutant load analysis. Dissolved oxygen, for example, is affected by a number of pollutants and conditions that may vary substantially among water bodies. Biological impairments may result from habitat degradation or unstable hydrology, conditions not generally thought of as “pollution.”

What is the process for completing TMDLs?

As noted above, the CWA Section 303 establishes water quality standards and TMDL programs. Section 303(d) of the CWA requires states to publish, every two years, an updated list of streams
and lakes that fail to meet their designated uses because of excess pollutants. These water bodies are considered impaired for their uses.

The list, known as the 303(d) list, is based on violations of water quality standards and is organized by river basin. States must establish priority rankings for waters on the lists and develop TMDLs for listed waters. Minnesota’s 303(d) list can be found on the MPCA website at: www.pca.state.mn.us/water/tmdl/index.html. The Guidance Manual for Assessing the Quality of Minnesota’s Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List explains the MPCA’s process for assessing water bodies for the 305(b) report and the 303(d) impaired waters list. The guidance manual is also on the MPCA website at: www.pca.state.mn.us/publications/wq-iw1-04.pdf.

The CWA requires a completed TMDL for each water identified on a state’s impaired waters list. Lake or river reaches with multiple impairments require multiple TMDLs. States have the primary responsibility for developing TMDLs and submitting them to the EPA for review and approval. If the EPA disapproves a TMDL, the EPA is required to establish the TMDL.

The process for completing a TMDL study is complex and varies significantly from project to project. Many variables determine scope of a project, including:

- Number of pollutant sources;
- Type of pollutant and size of the watershed;
- Amount of existing data;
- Relationship of one impairment to others in the same or nearby water bodies;
- Extent of stakeholder involvement; and/or
- Availability of necessary resources.

Is public participation critical throughout the TMDL process?
The MPCA is expected to provide opportunities for stakeholders to be involved from the earliest stages of the project. Potential stakeholders include local:

- Watershed residents;
- Government officials;
- Wastewater operators;
- Farmers and ranchers;
- Business and industry representatives, especially those holding state or federal water quality permits; and
- Conservationists and environmentalists.
While the focus of stakeholder involvement should be on residents or businesses in the affected watershed, statewide or national organizations, such as agriculture commodity groups, may be able to assist in recruiting of stakeholders.

The EPA requires that, at a minimum, the public must have an opportunity to review and comment on TMDLs before they are formally submitted to the EPA for approval. Every TMDL is formally public noticed in Minnesota with a minimum 30-day comment period.

After the EPA approves a TMDL, a detailed implementation plan is finalized to meet the TMDL’s pollutant load allocation and achieve the needed reductions to restore water quality. Many factors may increase the amount of time and financial resources needed for restoration, including:

- Severity of impairment;
- Accuracy of source allocation; and
- Contributions from natural or background sources.

**Who is responsible for doing TMDLs?**

The MPCA is ultimately responsible for completing and submitting TMDLs to the EPA. However, stakeholders play a critical role in developing and implementing TMDLs. Locally-driven projects are most likely to succeed in achieving water quality goals because local communities often best understand the sources of water quality problems and their effective solutions. Stakeholders’ work to develop and implement TMDLs is key to restoring and maintaining rivers, streams and lakes.

For nearly two decades, the MPCA has contracted with counties, watershed districts, soil and water conservation districts, and other local organizations to diagnose and help restore lakes and streams polluted from non-point sources. This watershed work was completed through the Agency’s Clean Water Partnership and Clean Water Act Section 319 programs. Many local government agencies have gained considerable expertise in watershed work and public involvement, in part due to this experience. Building on this success, the MPCA will provide grant contracts to qualified local governments and watershed organizations to lead an estimated two-thirds of TMDL projects. The MPCA will direct the remaining projects. The contracts cover staffing, equipment, lab costs and other project expenses.

In addition, scientific and technical experts at the MPCA and other agencies provide valuable information and insight. Consultants, under a master contract with the state, are available to provide technical expertise to the local groups assisting with data collection, modeling and developing draft reports.

The MPCA estimates that nearly 95 percent of all the state’s TMDL funding for study completion will be passed through to local governments and contractors. The MPCA provides oversight, technical assistance and training to ensure that regulatory and scientific requirements are met. The MPCA submits final TMDLs for the EPA’s approval.
C. Minnesota Clean Water Legacy Act

In 2006, the Clean Water Legacy Act (Chapter 114D) was enacted with the purpose “to protect, restore, and preserve the quality of Minnesota’s surface waters by providing authority, direction, and resources to achieve and maintain water quality standards for surface waters as required by section 303(d) of the federal Clean Water Act, United States Code, title 33, section 1313(d), and applicable federal regulations.”

In essence, the Clean Water Legacy Act (CWLA) is Minnesota’s response to federal CWA requirements to address impaired waters through the TMDL process. The CWLA provides important direction in several areas that are directly relevant to the completion of sound TMDL studies. The web link to the CWLA is www.revisor.leg.state.mn.us/bin/getpub.php?type=s&num=114D.

Of particular prominence in the CWLA are directives and provisions related to coordination and cooperation among public agencies, and the meaningful engagement of the public and stakeholders, in developing TMDLs. Subdivision 1. of 114D.35, for example, reads as follows:

Public agencies and private entities involved in the implementation of this chapter shall encourage participation by the public and stakeholders, including local citizens, landowners and managers, and public and private organizations, in the identification of impaired waters, in developing TMDLs, and in planning, priority setting, and implementing restoration of impaired waters. In particular, the Pollution Control Agency shall make reasonable efforts to provide timely information to the public and to stakeholders about impaired waters that have been identified by the agency. The agency shall seek broad and early public and stakeholder participation in scoping the activities necessary to develop a TMDL, including the scientific models, methods, and approaches to be used in TMDL development, and to implement restoration pursuant to section 114D.15, subdivision 7.

As such, MPCA staff and others working on bacteria TMDL projects should pay particularly close attention to Part III, Section L, Public Participation, and make full use of tools such the “TMDLs Underway” web page on the MPCA web site at: www.pca.state.mn.us/water/tmdl/tmdl-development.html.

Part III, Section D, Load Allocations, describes load allocations as the portion of the loading capacity attributable to existing and future non-point sources and to natural background. It also contains the EPA recommendation that the two sources be separated where possible. The CWLA contains a definition of “natural background” that may help guide the process of making this separation. That definition, contained in subdivision 10 of 114D.15, reads:

“Natural background” means characteristics of the water body resulting from the multiplicity of factors in nature, including climate and ecosystem dynamics, that affect the chemical or biological conditions in a water body, but does not include measurable and distinguishable pollution that is attributable to human activity or influence.
A final area where the CWLA that is especially relevant to this protocol document is the directive contained in subdivision 1 of 114D.25 that states:

A TMDL must include a statement of the facts and scientific data supporting the TMDL and a list of potential implementation options, including: (1) a range of estimates of costs of implementation of the TMDL; and (2) for point sources, the individual waste load data and the estimated cost of compliance addressed by the TMDL.

While the EPA does not require or approve implementation plans, meeting this directive to develop cost estimates may necessitate substantial implementation-related assessment during the TMDL study phase, rather than as a separate process after the TMDL has been completed and approved by the EPA.

The research aspect of the CWLA is also worth noting. The CWLA provides funding to the Minnesota Department of Agriculture (MDA) to oversee and coordinate research related to potential agricultural contributions to water quality impairment. Bacteria are one area where work has already begun. Information on the status of research will be available at: [www.mda.state.mn.us/](http://www.mda.state.mn.us/). Beyond the MDA research, the Clean Water Council (an advisory group established to help carry out the CWLA) has proposed establishing a broader research inventory for TMDL project staff and stakeholders. This proposal has yet to be implemented, although the literature references in this and other protocols, and in many TMDL studies, already serve this research inventory function to some degree.

**D. Site-Specific Approaches**

The Clean Water Act, federal regulations, Minnesota’s State Water Pollution Control Act, and Minnesota’s water quality rules establish opportunities to use site-specific approaches to address water quality impairments. These may be appropriate for some water bodies where numeric criteria different from those in the water quality standards are necessary or sufficient to protect designated beneficial uses. Site-specific options allow the MPCA to consider data on local water body characteristics to apply more precise numeric standards to protect the beneficial uses of the water body. A detailed discussion of site-specific approaches is contained in the companion TMDL protocol for lakes impaired by excessive nutrients. The MPCA does not anticipate that site-specific approaches will be applied frequently, especially in the area of bacteria TMDLs.

**II. Bacteria TMDL Background**

**A. Introduction**

In 2001, the EPA published the document “Protocol for Developing Pathogen TMDLs – First Edition” (sometimes referred to as the “orange book” for its bright cover). The MPCA staff, local watershed projects, and consultants have made extensive use of the orange book for several bacteria TMDL projects that have been recently completed or are underway. The orange book will continue to be an important reference.
This protocol draws on several completed bacteria TMDL projects, including both the original (MPCA, 2002) and revised (MPCA, 2006) versions of a report titled “Regional Total Maximum Daily Load Evaluation of Fecal Coliform Bacteria Impairments in the Lower Mississippi River Basin in Minnesota.” The revised version addressed a challenge in federal court to the EPA’s approval of the original. Among other issues, the attempt to consolidate data from multiple impaired stream/river reaches into a basin-wide TMDL expression raised objections. The revised version follows the “letter of the law” in that TMDL expressions are presented individually for each listed impaired reach. While the MPCA still believes that it is generally appropriate for TMDL studies to deal with multiple impairment listings within a watershed or basin, it is clear that each individual listing covered in the report will require its own TMDL expression.

There is a great deal of complexity and uncertainty related to the sources and pathways of bacteria in surface waters, and the behavior of the bacteria once in the water. Even expensive long-term projects will not necessarily resolve all the uncertainty. As such, the MPCA believes that some technical and scientific analysis can be combined with iterative “best professional judgment” processes to produce TMDLs that are scientifically and legally sound, and provide clear direction for water quality improvement, even as some uncertainty remains.

In developing bacteria TMDLs, the MPCA encourages the consideration of some aspects (e.g., pollutant source identification) of a stressor identification process (EPA 2000) that was developed for biological integrity assessments, but may also be used for other impairments. The stressor identification process entails evaluating data to identify the pollutants of concern by looking for evidence of strong linkages between stressor sources and the water quality impairment via one or more source generation and transport processes. If a strong linkage to one or two sources or causal factors can be made with the existing information, the project may be able to proceed to the next step in the TMDL development process. In many or most cases, however, impaired waters in Minnesota are impacted by a complex array of pollutants and other stressors.

When the data do not offer cause and effect relationships or adequate information to eliminate a potential source from further consideration, then the EPA stressor identification guidance recommends using a weight of evidence approach. Weight of evidence (sometimes called “strength of evidence”) is best explained as sufficient circumstantial evidence to convince the reasonable decision maker that the source is or is not a primary candidate in the stress. Certain key requirements must be met before a source can be considered for further evaluation. These include:

- Does the source contain or emit the critical parameters?
- Is there a causal pathway to the reach in question?
- Is the key parameter(s) persistent enough to impact the reach in question?
- Does the source discharge the key parameters in the same time period that the impairment occurs over?

Only when the answers to these questions are positive should further investigation be done to quantify or estimate the relative potential and actual loadings that do occur.
In many cases, cause-effect linkages will be obscured by a combination of stressor sources impacting bacteria levels through multiple processes. The stressor identification process should then be used in with the data gaps evaluation to lay out a monitoring plan (water and watershed) that will provide the additional data and information needed to either eliminate or select the sources causing the bacteria problems in the stream.

If data evaluation suggests that the bacteria impairment is caused by an obvious and dominating stressor and that it can be readily mitigated through voluntary actions or the use of existing regulatory authorities (e.g., a NPDES discharge permit), there may be reason to consider implementing the mitigation directly and monitoring for improvements in water quality before making a decision to continue through the TMDL development process. If the mitigation corrects the bacteria impairment, this situation would also become a candidate for de-listing.

References


B. Pathogens in Rivers and Streams and Impacts on Designated Uses

Bacteria, viruses, and other microorganisms are almost universally present in the environment, including in soil and water. Some also live in the bodies of humans and other animals. Most are beneficial, serving as food for larger organisms, and playing critical roles in biogeochemical cycles, such as organic matter decomposition, fixation of nitrogen, and digestion of food. A few types of microorganisms are harmful; they are known as pathogens. If ingested, pathogens can cause sickness or even death.
Two closely related bacteria groups, fecal coliform and Escherichia coli (E. coli), have been used for decades as “indicator organisms” in the areas of water pollution control and water quality monitoring. They provide an indication of the possible presence of pathogens, which in turn pose a potential health risk. E. coli is a sub-group of fecal coliform, and is virtually always present in water when fecal coliform is present. Fecal coliform or E. coli are represented in surface water quality standards in most states, including Minnesota. Both are typically expressed as organisms, counts, or colony forming units (CFU) per 100 ml of water.

As explained in the next section, Minnesota has changed from fecal coliform to E. coli in its water quality standards. This change is based primarily on EPA guidance, which suggests a stronger correlation between E. coli and gastrointestinal illness (USEPA, 1986). While some would argue that E. coli is a poor indicator of human health risk, others would say it’s the best indicator currently available for practical application. The EPA and other researchers are continuing to evaluate alternatives, including enterococci and DNA-based methods.

Fecal coliform bacteria (including E. coli) are found in rivers and streams throughout the state of Minnesota. Concentrations tend to be lower in northeast and northcentral Minnesota, and higher in the south and northwest (Heiskary and McCollor, 1993). As is the case with many water pollutants, the behavior of fecal bacteria in the environment is complex and not completely understood. Factors affecting bacteria densities include (Barbe and Francis, 1995; Baxter-Potter and Gilliland, 1988; Eleria and Vogel, 2005):

- Seasonality;
- Stream flow;
- Water temperature
- Hydrologic proximity of pollution sources
- Livestock management practices
- Wildlife activity
- Age of fecal material
- Sewage and stormwater management practices; and
- Rainfall.

In addition, bacteria survival for extended periods of time in stream sediments (Burkholder et al., 1997; Davies et al., 1995; Davis et al., 2005; Marino and Gannon, 1991) has been documented, as has growth in sediments (Davies et al., 1995; Howell et al., 1996; Hendricks and Morrison, 1967). As such, the strong relationships between suspended solids/turbidity and bacteria (Pettibone and Irvine, 1996) may be related both to watershed sources and re-suspension of stream sediments (Mallin et al., 1997). Despite the potential for growth of bacteria in stream sediments, die-off is still the dominant process (Davies et al, 1995; Easton et al., 2005; Howell et al., 1996). Thus, external inputs are the ultimate drivers of bacteria levels in river and streams.

Because E. coli develop in the digestive systems of warm-blooded animals, external inputs of bacteria are associated with human, pet, livestock, and wildlife waste. Numerous studies have documented inputs from each of these sources in both urban and rural environments.
Pathways include:

- Direct conduits to surface waters, such as illicit septic system connections, wastewater treatment facility discharge points, and urban stormwater systems;
- Spills or runoff from livestock housing or manure storage facilities (Mallin et al., 1997);
- Runoff or movement through soil from agricultural lands that receive manure applications (Edwards et al., 1997; Jamieson et al., 2002; McMurry et al., 1998);
- Runoff of wildlife droppings; and
- Direct deposition into waterways by wildlife or grazing animals (Sherer et al., 1988; LaWare and Rifai, 2006).

Manure management strategies, including manure storage and pretreatment (e.g., composting), timing and rate of application, and application method, all have the potential to reduce bacteria transport via overland runoff or through the soil profile (Jamieson et al., 2002).

Most streams and rivers in Minnesota are designated by law to support full or partial body-contact recreational uses, such as swimming, wading, boating, and angling. Bacterial water quality standards are set as a means of judging whether these uses are fully supported or impaired. When these standards are violated, the water is deemed impaired and not fully supporting the designated use. People using impaired waters for recreation are at risk for exposure to pathogens at a level deemed unacceptable by state law. The actual numbers of people made ill in Minnesota from pathogens in surface water is not clearly understood. Most gastrointestinal illness, the most likely illness to be associated with surface water pathogens, goes unreported. Outbreaks that are documented are typically associated with designated swimming beach areas where a number of bathers become ill.

Although bacteria water quality standards apply to all waters in Minnesota, the MPCA generally focuses its assessment work on rivers and streams, rather than lakes. One notable exception to this is Lake Superior, where beaches are monitored as part of a special Great Lakes program. There are several reasons for this. First, bacteria levels in lakes generally tend to be lower than those seen in streams and rivers. Secondly, the types of bacteria sources over which the MPCA has the clearest authority are more likely to discharge directly to a stream or river than a lake. If the stream or river feeds a lake, bacteria levels are often much reduced by the time it reaches the lake. Finally, when bacterial contamination does occur in a lake, it is often associated with designated swimming beaches, and the source may be a beach user (e.g., small child with a leaky diaper). Local health authorities have traditionally had control over designated swimming beaches, and sometimes administer monitoring programs.

References


C. Change to E. coli Standard

The MPCA revises Minnesota Rules chapter 7050, Water Quality, every three years. The revision process completed in May 2008 included the replacement of the fecal coliform bacteriological standard with E. coli. The new E. coli water quality standard became effective in Minnesota Water Quality Rule Ch. 7050 on March 17, 2008, and was subsequently approved by the EPA on May 23, 2008. Future aquatic recreation assessments, starting with the 2010 assessments and delisting reviews, will be done using only E. coli data. This change has been made because of the variability in the E. coli/fecal coliform statistical relationship and to emphasize the message that current and future monitoring for aquatic recreation use support should be based on the newly adopted E. coli water quality standard. Exceptions to this exclusive use of E. coli data will be made only in special cases.

In these special cases, fecal coliform measurements will be converted to E. coli measurements at a ratio of 200 to 126. Given recent monitoring data, the MPCA considers this ratio conservative and should result in relatively few false positive indications of impairment. For TMDL projects, historical fecal coliform data can likewise be converted to “equivalent” E. coli values, if deemed necessary, using the same ratio of 200 to 126. However, a recent analysis of paired E. coli and fecal coliform data in the STORET database from across Minnesota shows that the E. coli/fecal coliform relationship exhibits substantial variability, likely influenced by factors such as geographical location and lab analytical method. In many or most TMDL projects, there will be no need to convert data.

To minimize disruption for permittees, NPDES permits for wastewater discharges of sanitary wastes will retain fecal coliform effluent limits. These effluent limits are part of Minnesota’s definition of minimum, technology-based treatment required of all discharges that treat domestic wastewater (Minn. R. 7053.0215, subp. 1). The effluent limits are considered equivalent to the E. coli water quality standard, which essentially guarantees that the facility won’t cause an exceedance of the standard as long as the discharger complies with the permit limit.

For More Information

For the specific water quality standards changes and general water quality standards information, please visit: www.pca.state.mn.us/water/standards/rule change.html.
D. Before Starting the TMDL

Because the 303(d) assessment and listing process is data driven, a minimum amount of fecal coliform or E. coli data is required and will exist for any water body listed on the impaired waters list, due to elevated bacteria levels. The data that led to the bacteria listing or listings, plus additional relevant water quality or watershed data and information, should be analyzed prior to, or early in the TMDL process with the following purposes in mind:

- Validation of the 303(d) listing. While the assessment and listing process, as outlined in the guidance document found at www.pca.state.mn.us/publications/wq-iw1-04.pdf, is quite rigorous, errors have occurred. Perhaps more importantly, additional data may have been collected that may, in some cases, suggest that a listing decision should be revisited.

- Determination of the severity of the impairment. If a water body is only slightly impaired, it may be approached differently than a water body that violates water quality standards frequently and by a large margin.

- Detection of patterns in the data. Is there a clear relationship to flow or season? If multiple years of data have been collected, does there appear to be any kind of a trend over time? Are bacteria levels correlated to other measures of water quality, such as turbidity?

- Assessment of variability. While bacteria data are in general highly variable, are there clear differences from one site to another in a watershed? Are there seasonal or flow-related dimensions to the variability? Box and whisker plots are good tools for comparing data and variability.

In the analysis of existing bacteria and related data, it is important to assess why and how the data were collected. Data collection efforts focusing on storm events or known pollution hot spots will produce different results than more randomized sampling approaches.

Table 1 and Figures 1-4 are examples from the North Branch Sunrise River Project (2006) of formats and techniques for analyzing and displaying bacteria data. The load duration curve shown in Figure 8 of Part III, Section K, Implementation, is also a useful format for looking at the relationship between streamflow and bacteria. Finally, it is often useful to display data in a geographic context, as shown in Figure 5.

Although the review and analysis of existing data should be done prior to the finalization of a TMDL study work plan, the results of this work are important and should be included in the TMDL study. This could be covered in the background, or in a distinct “characterization of current water quality conditions” section.
Table 1 – Fecal coliform water quality standards violations (1997-1998), North Branch of the Sunrise River at Station SUN-5.

<table>
<thead>
<tr>
<th>Month/Year</th>
<th>Number of Samples</th>
<th>Range (orgs/100 mL)</th>
<th>Geometric Mean (orgs/100 mL)</th>
<th>No. Samples Exceeding 2,000 orgs/100 mL</th>
<th>Water Quality Standard Exceeded?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 1997</td>
<td>6*</td>
<td>240 - 680</td>
<td>353</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>Sept 1997</td>
<td>5</td>
<td>190 - 740</td>
<td>338</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>May 1998</td>
<td>4</td>
<td>36 - 240</td>
<td>92</td>
<td>0</td>
<td>insufficient samples</td>
</tr>
<tr>
<td>June 1998</td>
<td>5</td>
<td>140 - 340</td>
<td>218</td>
<td>0</td>
<td>No</td>
</tr>
<tr>
<td>July 1998</td>
<td>5</td>
<td>150 - 1200</td>
<td>418</td>
<td>0</td>
<td>X</td>
</tr>
</tbody>
</table>

*Includes two samples from late July 1997.

Figure 1 – North Branch Sunrise River Fecal Coliform Monitoring Data Summary. Station SUN-15 and SUN-05 (1998 and 2002/2003)

“Median” = 50th percentile; “25% - 75%” = Range of 25th through 75th percentiles (interquartile range); “Non-outlier range” includes those values within +/- 1.5 x interquartile range; “Outliers” and “Extremes” use an outlier coefficient of 1.5: Outliers are greater (or less) than the upper (or lower) box value + 1.5 x height of the box, and outliers are greater (or less) than the upper (or lower) box value + 3 x height of the box.
Figure 2 - Fecal coliform geometric means by month, 2002-2003 data combined

* Sample size (N) < 5

Standard = 200 org/100 mL.
A sampling event was considered wet if 0.5 inches of precipitation or more fell in the preceding 24 hours, or if 1.0 inches of precipitation or more fell in the preceding 48 hours. 

**The 95% confidence interval (CI) refers to the range of values in which the true geometric mean is likely to lie, and is used here to represent the degree of variability in the data within each category. The 95% confidence refers to the method used to construct the interval estimate; that is, the sampling approach. Hypothetically, if 100 different agencies all monitored this stream for fecal coliform during the same time period and subsequently used their data to construct confidence intervals, 95% of these intervals would capture the true geometric mean.**
*Flow data are only available for site SUN-5.
Figure 5.

Straight River Watershed Sampling & Flow Sites

- Falls Creek
- West Headwaters
- Middle Straight River
- Mud Creek
- Rush Creek
- Medford Creek
- Crane Creek
- Turtle Creek
- Upper Straight River
- East Headwaters
- East Headwaters
- Falls Creek
- West Headwaters
- Middle Straight River
- Mud Creek
- Rush Creek
- Medford Creek
- Crane Creek
- Turtle Creek
- Upper Straight River
- East Headwaters
- East Headwaters

USGS flow site

- USGS flow site

Sampling sites

Impaired reach streams

Rivers

Subwatersheds

Fecal coliform overall geometric means

Sampling sites

Impaired reach streams

Rivers

Subwatersheds

0 10 Miles
Based on the analysis of existing data, plus other factors, decisions will need to be made as to whether additional water quality monitoring is called for. The following should be considered:

- What is the nature of the existing data? How much data is available? Where and when was it collected? How was it collected, and by whom?

- What are the potential pollutant sources in the watershed and does the existing data sufficiently characterize them? Would a “nested” monitoring design be appropriate for larger watersheds?

- Is it possible or likely that additional monitoring would support the de-listing of an impairment? The de-listing process is described in the assessment guidance document found at www.pca.state.mn.us/publications/wq-tw1-04.pdf

- Are data available from similar nearby water bodies that could be used to fill gaps in understanding?

- Are there questions in the minds of stakeholders that might be at least partially answered through additional monitoring? These questions often focus on a particular suspected source of bacteria, such as, geese, sediments, urban runoff, etc.

If a decision is made to conduct additional monitoring, the scope of this monitoring will need to be defined. Streamflow and bacteria monitoring aimed at more clearly understanding the nature and severity of an impairment, or in developing loading estimates, will require at least one full season, and perhaps two or more in most cases. Monitoring to garner additional information on a specific suspected source might be completed in a much shorter time frame.

References


E. Rigor

Rigor, as used in the TMDL process, means the strictness or rigidity of the science and professional judgment being applied. The use of extreme rigor comes with a high time, staff, and financial resource cost, while lax rigor may not be sufficient to develop an adequate study or allow for successful defense if a TMDL is challenged. In designing a TMDL work plan, project managers need to carefully consider the level of rigor needed in order to anticipate resource needs. This may be best accomplished through an iterative process during initial project development and scoping work. In other words, it may be difficult to develop a sound TMDL work plan without a good deal of upfront effort.

Depending on the conditions of a given impaired water body, characteristics of its watershed, and decisions on rigor, the level of effort necessary for TMDL development will vary considerably. TMDLs can range from basic dilution calculations for water quality-based effluent limits to complex multi-source, time-varying water quality modeling analyses. The EPA suggests determining the level of effort on a case-by-case basis, in consultation with stakeholders, depending on factors such as:

- Water body type;
- Watershed size and complexity;
- Scientific understanding of the problem;
- Nature of the pollutants involved;
- Extent of available data;
- Number and types of sources; and
- Potential cost of controls needed to correct the water quality problem(s).

TMDLs should be based on available water quality data, supplementary information, and investigative studies. In many cases, simple analytical approaches provide an adequate basis for pollutant assessment and implementation planning. In some situations, however, complex analyses and modeling are necessary to better understand the relationship between pollutant loading and water body impairments. When information necessary to draw conclusions on the relationship between pollutant loading and water quality is limited, TMDLs may be developed through a phased or “adaptive management” approach. Such an approach allows for the establishment of the TMDL while additional data collection and analysis are conducted. Thus, the TMDL provides a description of likely pollution sources and an estimate of necessary load reductions based upon available data and information. An adaptive management approach is most appropriate in situations where there is some uncertainty about pollution sources and the magnitude of pollution reductions. It is less appropriate where there is substantial uncertainty about pollution sources.

TMDL generation should not be viewed as a one-time effort that results in pollution source identification and allowable loading estimates that are absolutely accurate. However, the effectiveness of a TMDL in improving water quality is greatly enhanced when there is adequate information and accurate estimates. Especially when dealing with waters that are impaired by non-point sources, as variability is inevitable. Providing that a TMDL utilizes available data and

Minnesota Pollution Control Agency 20
information along with a sound and rational technical approach, the TMDL can successfully support the implementation of appropriate pollutant control activities, even when based upon limited information and rough estimates. The TMDL process for such waters will serve as an overall plan or road map that will be the basis for mobilizing stakeholders and ultimately improving water quality. Actions likely to result from initial TMDL implementation include:

- Additional monitoring to fill data gaps;
- More complete and thorough identification of pollutant sources within the watershed;
- Initiation or expansion of public education programs; and
- Implementation of best management practices.

In bacteria TMDLs, rigor is particularly critical in the area of assessing bacteria transport processes. The mere presence of sources in a watershed does not equate to bacterial pollution of surface waters. Methods to evaluate pathways and delivery mechanisms from source to surface water should be a part of all bacteria TMDLs.

**Part III: Bacteria TMDL Submittal Requirements**

For an approvable bacteria TMDL, the final report must meet both federal requirements and state protocols. Each major component of a TMDL is described in this section and includes:

- Federal requirements (shown in boxes and in Appendix A), which are used by the EPA as a basis for reviewing and approving TMDLs; and
- Minnesota’s protocols as required by the MPCA.

In addition, the reader should also refer to “MPCA’s TMDL Checklist” in Part III, Section O, which is used by reviewers to determine the adequacy of draft TMDLs prior to submittal to the EPA.

**EPA Guidelines for Reviewing TMDLs Under Existing Regulations Issued in 1992**

Section 303(d) of the Clean Water Act (CWA) and EPA’s implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb “must” below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term “should” below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable. These TMDL review guidelines are not themselves regulations. They are an attempt to summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. Any differences between these guidelines and EPA’s TMDL regulations should be resolved in favor of the regulations themselves.
A. Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

**Federal Requirements:**
The TMDL submittal should identify the waterbody as it appears on the State’s/Tribe’s 303(d) list. The waterbody should be identified/geo-referenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the waterbody and specify the link between the pollutant of concern and the water quality standard.

The TMDL submittal should include an identification of the point and non-point sources of the pollutant of concern, including location of the source(s) and the quantity of the loading, e.g., lbs/per day. The TMDL should provide the identification numbers of the National Pollutant Discharge Elimination System (NPDES) permits within the waterbody. Where it is possible to separate natural background from non-point sources, the TMDL should include a description of the natural background. This information is necessary for the EPA’s review of the load and waste load allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

1. The spatial extent of the watershed in which the impaired waterbody is located;
2. The assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);
3. Population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;
4. Present and future growth trends, if taken into consideration in preparing the TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and
5. An explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters, such as percent fines and turbidity for sediment impairments, chlorophyll and phosphorus loadings for excess algae, length of riparian buffer, or number of acres of best management practices.

**Protocol for Minnesota Bacteria TMDLs**
See Minnesota’s TMDL Checklist in Part III, Section O for background information needed in addition to the federal requirements.
B. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

**Federal Requirements:**
The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the anti-degradation policy. (40 C.F.R. §130.7(c)(1)). The EPA needs this information to review the loading capacity determination, and load and waste load allocations, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s) - a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as Dissolved Oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target.

**Protocol for Minnesota Bacteria TMDLs**

Minnesota’s 303(d) assessment guidance was originally developed as a part of the 2002 water quality rule revision. This guidance provides details on data requirements, assessment methodology, and water quality threshold values. The updated document titled, “Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment - 305(b) Report and 303(d) List,” may be found on the MPCA’s web site at: [http://www.pca.state.mn.us/publications/wq-iw1-04.pdf](http://www.pca.state.mn.us/publications/wq-iw1-04.pdf).

The fecal coliform standard contained both monthly geometric mean (200 orgs./100 ml. fecal for class 2B) and “upper 10th percentile” (400 orgs./100ml. for class 2A and 2000 orgs./1000ml. for class 2B) criteria. The new E. coli standard maintains both criteria, but eliminates the distinction between class 2A and 2B. The preamble of the coastal recreational water rule (EPA, 2004) states, “The geometric mean is the more relevant value for ensuring that appropriate actions are taken to protect and improve water quality because it is a more reliable measure, being less subject to random variation.” This language was used in the “Revised Regional Total Maximum Daily Load Evaluation of Fecal Coliform Impairments in the Lower Mississippi River Basin in Minnesota” (MPCA, 2006) to support calculating the TMDL based on the monthly geometric mean portion of the standard. Both the monthly geometric mean criterion and the maximum or upper 10th percentile criterion must be maintained in order to meet the water quality standards but, in most cases, the loading capacity calculations and TMDL allocations will focus on the geometric mean part of the water quality standard, unless the impairment is mainly associated with violations of the upper 10th percentile criterion.
C. Loading Capacity - Linking Water Quality and Pollutant Sources

**Federal Requirements:**
A TMDL must identify the loading capacity of a waterbody for the applicable pollutant. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

The pollutant loadings may be expressed as either mass-per-time, toxicity, or other appropriate measure (40 C.F.R. §130.2(i)). If the TMDL is expressed in terms other than a daily load, e.g., an annual load, the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen. The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions, a discussion of strengths and weaknesses in the analytical process, and results from any water quality modeling. The EPA needs this information to review the loading capacity determination and load and waste load allocations, which are required by regulation.

The TMDLs must take into account critical conditions for stream flow, loading, and water quality parameters as part of the analysis of loading capacity. (40 C.F.R. §130.7(c)(1) ). The TMDLs should define applicable critical conditions and describe their approach to estimating both point and nonpoint source loadings under such critical conditions. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

**Protocol for Minnesota Bacteria TMDLs**

For impaired water bodies, the loading capacity will provide a target for the overall pollutant reductions that are necessary to attain water quality standards or achieve designated use for recreation, fisheries, drinking water supplies, aesthetics, and wildlife. In general, impaired waters have exceeded their assimilative capacities and will require reductions of watershed pollutant loading.

Bacterial loading capacity is directly proportional to flow in a stream or river. Thus, calculating loading capacity over the range of possible flow conditions requires a reliable, long-term flow record applicable to an impaired reach. If done appropriately, flows may be extrapolated from streams with long-term gage records to ungaged reaches. Decisions on extrapolations should consider watershed scale, soils and geology, drainage practices, and precipitation patterns. Shorter-term flow records (e.g., four to five years) may be acceptable, provided the years monitored reasonably represent the expected range of flow conditions. Evaluation of how representative this shorter timeframe is may be done by reviewing a nearby long-term gage’s flow record and comparing that gage’s long-term flow duration curve with the curve for just the shorter-term years’ record for that same gage.
With the focus on the monthly geometric mean portion of the water quality standard, loading capacity should be expressed as a **monthly load**. This load can be calculated as the product of total monthly flow and 126 organisms/100 ml (the monthly geometric mean criterion). This will generally result in values in the trillions of organisms per month. As an alternative to scientific notation, these numbers may be expressed as T-orgs./mo. Conversions are shown in Table 2.

The EPA has suggested two alternatives for capturing the variability inherent in monthly loading capacity (MPCA, 2006 – loading capacity appendix). The first alternative establishes a representative flow, and loading capacity based on that flow, for each calendar month April through October. The second approach establishes loading capacities for five different flow zones (low, dry, mid-range, moist, high). The EPA recommended the second alternative, referred to as the duration curve approach.

Table 3 is an example of monthly flow data from a long-term U.S. Geological Survey (USGS) gage site. The flow values shown in this table are used to develop a flow duration curve (Figure 6) and, when multiplied by the monthly geometric mean fecal coliform water quality standard, a loading capacity curve (Figure 7).

**Table 2. Monthly Load Conversions (Cleland, 2006)**

| Load (org/month) = Concentration (org/100mL) * Flow (cfs) * Factor |
|---------------------|--------------------------|-----------------|
| multiply by 3785.2 to convert | mL per gallon | org / 100 gallon |
| divide by 100 to convert | gallon per ft³ | org / ft³ |
| multiply by 7.48 to convert | seconds per day | ft³ / day |
| multiply by 86,400 to convert | days per month | ft³ / month |
| multiply by 30 to convert | (org/100mL) * ft³ / sec | org / month |
Table 3. Monthly Flow Data Examples (Cleland, 2006)

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Summary Statistics (cfs/sq.mi.)

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Figure 6. (Cleland, 2005)

**Vermillion River near Farmington**

**Flow Duration Curve**

*Site: VR-32.5*

![Flow Duration Curve](image)

Figure 7. (Cleland, 2005)

**Vermillion River near Farmington**

**Fecal Coliform Loading Capacity Curve**

*Site: VR-32.5*

![Fecal Coliform Loading Capacity Curve](image)

Table 4 shows monthly loading capacities (first row of numbers) derived from the loading capacity curve. The values for each zone represent the point on the curve at the middle of each zone (arrows in Figure 7). Although only five points are displayed in Table 4, the loading capacity (and component WLAs and LAs) can be calculated and determined for any point along the whole curve.
Table 4. Monthly Loading Capacities

| Drainage Area (square miles): | 142 |
| USGS gage used to develop flow zones and loading capacities: | Vermillion River near Empire |
| % MS4 Urban: | 28% |
| Total WWTF Design Flow (mgd): | 29.59 |
| Flow Zone | High | Moist | Mid | Dry* | Low* |
| TOTAL MONTHLYLOADING CAPACITY | 34.79 | 16.95 | 10.29 | 6.13 | 3.64 |
| Wasteload Allocation | | | | | |
| Permitted Wastewater Treatment Facilities | 6.72 | 6.72 | 6.72 | | |
| Communities Subject to MS4 NPDES Requirements | 5.99 | 1.57 | 0.36 | | |
| Livestock Facilities Requiring NPDES Permits | 0 | 0 | 0 | 0.00 | 0.00 |
| Straight Pipe Septic Systems | 0 | 0 | 0 | 0.00 | 0.00 |
| Load Allocation | 15.34 | 4.02 | 0.92 | | |
| Margin of Safety | 6.74 | 4.64 | 2.29 | | |

| TOTAL MONTHLYLOADING CAPACITY | 100% | 100% | 100% | 100% | 100% |
| Wasteload Allocation | | | | | |
| Permitted Wastewater Treatment Facilities | 19.3% | 39.6% | 65.3% | | |
| Communities Subject to MS4 NPDES Requirements | 17.2% | 9.3% | 3.5% | | |
| Livestock Facilities Requiring NPDES Permits | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Straight Pipe Septic Systems | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Load Allocation | 44.1% | 23.7% | 9.0% | | |
| Margin of Safety | 19.4% | 27.4% | 22.3% | | |

*note - WWTF design flow exceeded dry and low flow; Allocation = (flow contribution from source) X (200 orgs./100ml.); see Sect. 5.1

In addition to monthly loading capacities, the EPA requires that loading capacity also be expressed as daily load. This requirement stems from a 2006 court ruling: D.C. Circuit Court of Appeals decision in Friends of the Earth, Inc., v. EPA, et al., No. 05-5015. There is significant flexibility in defining daily loads, if technically suitable for the pollutant and water body in question.

Given that the E. coli standard contains a monthly geometric mean component that is viewed by the EPA as a sound indicator of bacteria in surface waters, the MPCA recommends retaining a monthly basis for bacteria TMDLs. Different methods for translating monthly loads to daily loads may be proposed in individual TMDL studies. For example, some approved TMDLs have expressed loads in terms of “daily loads averaged over a calendar month,” which allows use of daily flow values and also acknowledges the monthly nature of the standard. Alternatively, a TMDL might be expressed as a combination of monthly and daily loading capacities. The daily loading component would be based on the upper 10th percentile portion of the standard. In simplified terms, such a TMDL might be expressed as:

\[
\text{Loading Capacity} = \ X \text{ organisms per month, and no more than } 1/3 \ X \text{ organisms per day}
\]

The MPCA believes that the load duration approach described in this section, combined with bacteria data analysis described in Part II, Section D and Part III, Section K, satisfies the EPA requirement to take into account “critical conditions for stream flow, loading, and water quality parameters.” In a given TMDL study, critical conditions might involve low flows and “point” sources of bacteria, higher flows and non-point sources, or both.

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1 upper 10th percentile criterion is 10 times geometric mean criterion; assume 30 days in a month; thus 10 x 1/30 of the monthly loading capacity = 10/30 or 1/3 of monthly capacity.
References


D. Load Allocations

Federal Requirements:
EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future non-point sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. § 130.2(g)). Where possible, load allocations should be described separately for natural background and nonpoint sources.

Protocol for Minnesota Bacteria TMDLs

The process for determining pollutant allocations (load allocations, waste load allocations, margin of safety, and reserve capacity) in a TMDL involves technical analysis and evaluation, as well as stakeholder input.

The load allocation (LA) is divided among those sources of pollutant loading not associated with a point or permitted source. Point sources include any activity or facility requiring an NPDES permit, septic systems that discharge directly to surface waters (straight-pipe septic systems), or non-septic system. Once the WLA, MOS, and reserve capacity are determined for a given reach and flow, the remaining loading capacity is considered load allocation. The LA includes nonpoint pollution sources that are not subject to NPDES permit requirements, as well as “natural background” sources. The nonpoint pollution sources are largely related to:

- Livestock production;
- Inadequate human wastewater treatment other than straight-pipe systems; and
- Runoff from developed areas not covered by municipal stormwater permits.

Natural background sources include:

- Wildlife-generated bacteria; and
- Normal hydrologic processes that may deliver the bacteria to waters.
While not absolutely required, projects may include information, data, or modeling analysis that supports numeric allocation among multiple LA sub-categories. Alternatively, projects might simply discuss the range of sources included in a LA category, and perhaps provide at least a qualitative ranking of the relative importance of each to aid in implementation planning. The latter option may be preferred, unless there is clearly something to be gained by numeric LA for sub-categories.

E. Waste Load Allocations

**Federal Requirements:**

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit.

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL.

If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permittees should be notified of any deviations from the initial individual WLAs contained in the TMDL. The EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

**Protocol for Minnesota Bacteria TMDLs**

In addition to the technical aspects of determining WLAs as outlined below, the process may also involve intensive stakeholder and policy-making efforts. Minnesota’s framework for this work is presented in Part III, Section L.

- **WLA Sources**

  All relevant sources that are covered by a NPDES permit plus certain septic systems are to be considered in the WLA. These sources, for the purpose of the TMDL, should be referred to as point sources.
Point Sources include:

- Publicly owned treatment works (POTWs) and other wastewater treatment facility (WWTF) permittees with discrete discharges and explicit numeric discharge limits need to be included in the WLA.

- NPDES stormwater permits, including for those communities designated as Phase I and Phase II Municipal Separate Storm Sewer System (MS4s) and for industrial stormwater (if deemed necessary) are to be part of the WLA.

- Straight-pipe septic systems: However, straight-pipe septic systems are illegal and un-permitted, and, as such, are assigned a zero WLA.

- Livestock facilities that have been issued NPDES permits are assigned a zero WLA. This is consistent with the conditions of the permits, which allow no pollutant discharge from the livestock housing facilities and associated site. Discharge of bacteria from fields where manure has been land applied may occur at times. Such discharges are covered under the LA portion of the TMDLs, provided the manure is applied in accordance with manure management provisions of the permit.

It is important to note that all relevant NPDES wastewater and MS4 permits in an impaired reach watershed need to be listed individually in the TMDL document. To the extent possible and practical, individual WLAs should be established for these NPDES dischargers.

Industrial stormwater is generally not considered to contribute to bacteria impairments and should not receive a WLA. Industrial stormwater permits may get an individual WLA when deemed necessary.

If upgrades to WWTFs and/or substantial changes to the NPDES permits issued to these facilities are occurring (or projected to occur) during TMDL development, compliance schedules should be discussed in the TMDL report. If not explicitly discussed, the expectation will likely be compliance within the five-year permit cycle (see further discussion in compliance schedule section below).

**Water Quality Based Effluent Limits**

As noted in the federal requirements in the box above, NPDES permits must be consistent with the assumptions and requirements of a TMDL’s WLA. In bacteria TMDLs, this is currently the case for WWTF permits that require treatment to 200 fecal coliform orgs./100 mls (equivalent to 126 org./100 ml E. coli.). For regulated MS4s, the WLA and water quality-based effluent limits will typically be expressed in the form of best management practice (BMPs).
• **Estimating WLA Loads and Allocations**

**Wastewater point sources:**

For POTWs and industrial wastewater facilities that have monitoring requirements, it is feasible to estimate their current bacteria loading. The relative contribution of point versus nonpoint sources can be informative for stakeholders and the public. However, since most facilities generally operate in compliance with bacteria discharge standards, it may be more informative to summarize compliance history in a way that highlights violations, including wastewater bypasses. The MPCA staff can provide this information.

**MS4 Storm Water:**

Even for those regulated MS4s communities with some urban water monitoring in place, it is difficult to estimate current bacteria loads. Guidance issued in 2002 from the EPA does provide some relevant information: “Establishing Total Maximum Daily Load (TMDL) Waste Load Allocations (WLAs) for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs” (November 22, 2002), online at www.epa.gov/npdes/pubs/final-wwtmdl.pdf. The MPCA policy for setting WLAs for permitted stormwater may also be helpful and is available at www.pca.state.mn.us/publications/wq-strm7-01.pdf.

The WLA should be expressed in bacteria loading terms. The WLA might also be expressed as a percent reduction; if so, the TMDL should clarify the baseline conditions from which the reductions will be applied.

The EPA notes that it may be reasonable to express NPDES-regulated stormwater discharges from multiple point sources as a single categorical WLA when data and information are insufficient to assign each source or outfall individual WLAs. More specifically, the WLA in the TMDL can be expressed as either: 1) a single number for all NPDES-regulated stormwater discharges; or 2) when information allows, as different WLAs for different categories, such as all MS4s separated out from industrial stormwater and treated either in aggregate or as individual MS4s (City A versus City B).

In keeping with this guidance, the MPCA expects that many WLAs for regulated MS4s will be made in the aggregate by categorical sector because of the insufficient quantity and quality of existing water quality data on each individual MS4. However, if enough data exists, it is strongly encouraged that an individual WLA be set for each MS4 discharger. Examples of these two options from the companion Lakes TMDL Protocol are the following:

- **Sector-wide allocation:** For example, a TMDL could find that all regulated MS4 sources together can contribute a total of 30 trillion organisms/month (T-orgs./mo.). All MS4s would be evaluated together to achieve the WLA.
Individual allocation: If a city-by-city WLA approach for MS4s is preferred, the MPCA proposes that the WLA be expressed on a per unit area basis applied uniformly for all MS4s. There are several methods for dividing the WLA among cities and these are described in MPCA’s Implementation Plan guidance for permitted MS4 stormwater, online at www.pca.state.mn.us/water/stormwater/impairedwaters.html.

Construction Storm Water:

Construction stormwater is not considered to be an important source of bacteria. Construction stormwater should, therefore, not receive a WLA.

Industrial Storm Water:

Industrial stormwater is not considered to be an important source of bacteria in most cases. Industrial stormwater should, therefore, not receive a WLA, except in special circumstances.

• A Suggested Process for Bacteria TMDL WLA

Continuous discharge WWTF allocations are calculated by multiplying wet-weather design flows for all facilities in an impaired reach watershed by the permitted discharge limit (typically 200 organisms per 100 ml). Design flows are available through the MPCA wastewater program from the DELTA database. Because wet-weather design flows represent a “maximum” flow for a facility, these allocations are conservative in that they are substantially greater than what is actually required. This approach builds the case for an implicit MOS for these facilities. There may be situations where WWTF wet-weather design flows exceed minimum stream flow for the low or dry flow zones. On paper, this would suggest that the WWTF is exceeding its loading capacity. Of course, actual WWTF flow can never exceed stream flow as it is a component of stream flow. If such situations arise, a clear explanation will be required. In Table 4, for example, allocations for these conditions are defined as a formula rather than a set number (see footnote).

For non-continuous discharge NPDES-permitted facilities, flow volumes and discharge periods need to be determined. Wastewater treatment stabilization pond systems, for example, typically discharge over a one to two-week period in the spring and in the fall. The discharge rate is typically defined as a drawdown of no more than six inches per day.

As noted above, straight-pipe septic systems are illegal and un-permitted and, as such, are assigned a zero WLA. Assigning a zero WLA means these systems must be eliminated through local and state regulatory and non-regulatory actions described in the implementation plan.
As noted above, livestock facilities that have been issued NPDES permits are assigned a zero WLA. This is consistent with the conditions of the permits, which allow no pollutant discharge from the livestock housing facilities and associated site. Discharge of bacteria from fields where manure has been land applied may occur at times. Such discharges are covered under the LA portion of the TMDLs, provided the manure is applied in accordance with manure management provisions of the permit.

Once the WWTF WLAs are determined, they, along with the MOS, are subtracted from the total loading capacity. The remaining capacity is divided between MS4 and industrial stormwater permits (WLA), and all other nonpoint sources (LA). In the absence of detailed information, this division may be based on the percentage of land in an impaired reach watershed covered by MS4 permits\(^2\). For example, if 10 percent of an impaired reach watershed is covered by one or more MS4 permits, 10 percent of the remaining capacity is allocated to those permits. Although crude, this is a reasonable way to allocate between MS4 permits and all other nonpoint sources in that it holds rural and urban fecal coliform sources to the same “standard.”

Certain projects may include information, data, or modeling analysis that supports a more refined allocation (i.e., additional source categories) than that produced from the process outlined above. A primary advantage of a more refined allocation is the potential for more targeted implementation. Whether or not a given project established additional allocation categories, it should be noted that, to the extent possible, all relevant NPDES permits in an impaired reach watershed need to be listed individually in the TMDL document. Additionally, to the extent possible and practical, individual WLAs should be established for NPDES permittees with discrete discharges and explicit numeric discharge limits. For example, the 6.72 T-rgs./month allocated to WWTFs in Table 4 represents the total of several facilities for which WLAs would be summarized in a separate table.

- **NPDES Permit Compliance Schedules and Water Quality Trading**

  Federal regulations set requirements for NPDES permit compliance schedules to meet effluent limits. In general, there are two expectations:

  - Each NPDES permit must meet effluent requirements; and
  - The compliance schedule for meeting the requirements should be within one permit cycle.

  Despite these expectations, there is flexibility in setting permit compliance schedules to meet TMDL WLAs in certain situations. It is important that TMDL project teams discuss these situations with the MPCA permitting staff as WLAs are being developed to ensure that compliance schedules are set appropriately.

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\(^2\) Most MS4 urban areas subject to permit requirements are determined from 2000 U.S. Census information. These areas are not necessarily the same as municipal boundaries. To account for future growth, wasteload allocations could be based on larger municipal boundaries, or expansion area designations.
Compliance Options for Wastewater Facility Permits

As noted above, there is an expectation for all WWTF NPDES permits to meet the TMDL WLAs in the first five-year permit cycle. However, there can be exceptions to this process when justified:

- **Multiple TMDLs in the Same Watershed:** When NPDES permitted facilities may have to comply with more than one TMDL for the same pollutant parameter but are on different completion timelines, a longer compliance schedule may be necessary. This is to ensure that facility upgrades are made to meet the most restrictive TMDL WLA (i.e., the TMDL that may require more restrictive limits or longer seasonal application of the limits).

  For example, a facility may need to address both wet-weather bypasses to comply with a bacteria TMDL, and seasonal phosphorus effluent concentrations to meet an excess nutrient TMDL. Setting milestone markers until the other TMDL studies are completed will minimize the occurrence of new or expanding systems being built that are immediately required to upgrade again to meet a more restrictive TMDL. It is important to discuss this type of justification, including expected timelines for milestones and steps necessary to meet them, in the TMDL report to clarify how NPDES permit compliance schedules will meet the TMDL’s WLA.

- **Pollutant Trading and Watershed Permits:** For NPDES-permitted WWTFs that may not be able to meet a TMDL WLA, two options are emerging: pollutant trading and watershed permitting.

  A policy for the first option, pollutant trading, is being developed by the MPCA. Trading enables entities located upstream of a given impairment to work together to cumulatively achieve the WLA. Some MPCA staff have suggested that trading does not seem as relevant for bacteria as for other water quality parameters.

  The second option, a watershed permit, allows all NPDES activities to be sequenced and considered on a cumulative basis in a watershed. In this process, a cumulative problem can be solved by sequencing all the NPDES permits to implement a specified set of reductions across a given timeframe. This process can accelerate implementation schedules and set reductions at an equitable level.

  It is important that if either of these alternatives is factored into final TMDL implementation strategies to meet a WLA, they are discussed in the TMDL report. This inclusion will provide guidance on permit compliance schedules and/or the use of more flexible compliance alternatives.
Compliance Options for Storm Water Permits

The TMDL WLAs for regulated MS4s should reflect the timing required to implement BMPs. In general, it should be assumed that multiple permit schedules will be needed to meet TMDL reduction targets, and the regulated MS4 needs to make progress in each permit cycle to meet a WLA. Progress indicators include establishing a stormwater program, doing good housekeeping, addressing retrofits and new development, prevention and education, and structural BMPs.

If the TMDL implementation plan has enough data to set reduction milestone timelines and goals, then the stormwater pollution prevention plan (SWPPP) for each permit cycle can reference the implementation plan and the milestones to justify its compliance with the TMDL. Other options are also possible:

- **Phased TMDLs:** For instances where the TMDL study has significant uncertainty about stormwater loadings and management practices to effectively address that loading, an EPA memorandum dated August 2, 2006, entitled “Clarification Regarding ’Phased’ Total Maximum Daily Loads” (www.epa.gov/owow/tmdl/tmdl_clarification_letter.pdf) outlines acceptable methods to discuss “phased” approaches in the TMDL study. As noted in the memo, “phased TMDLs be limited to TMDLs that, for scheduling reasons, need to be established despite significant data uncertainty and where the State expects the loading capacity and allocation scheme will be revised in the near future as additional information is collected.” The memo also cites examples of situations where this may apply. As with any TMDL, each phase must be established to attain and maintain the applicable water quality standard and would require re-approval by EPA if the loading capacity, WLAs, or LAs are revised.

  For stormwater TMDLs using a phased approach, collection of missing data needed to assess loading or management practices would be required through a SWPPP. This approach should be clearly discussed in the TMDL report.

- **Pollutant Trading:** The TMDL should specifically authorize trading if it is considered to be a useful option to achieve desired goals. The EPA is developing an approach for stormwater pollutant trading. A few pilot programs at the national level are testing the situations that would provide clarity on how and when stormwater pollutant trading would be allowed. The MPCA will develop options in this area, as well. As noted earlier, some MPCA staff has suggested that trading does not seem as relevant for bacteria as for other water quality parameters.

References

“Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs” (November 22, 2002); www.epa.gov/npdes/pubs/final-wwtmdl.pdf.
F. Margin of Safety

**Federal Requirements:**
The statute and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and waste load allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1) ). The EPA’s 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

**Protocol for Minnesota Bacteria TMDLs**
The rationale for selecting the MOS and its adequacy must be included in the TMDL submittal. As indicated in the federal requirement, an explicit MOS would include setting a portion of the loading capacity aside as the MOS (i.e., not allocated to any source). Examples of an implicit MOS include the use of conservative assumptions in selecting a numeric water quality target and data analysis techniques.

The basic purpose of the MOS component of the TMDL equation is to estimate uncertainty to allow the project a reasonably high likelihood of success. As such, MOS encompasses two primary factors affecting these outcomes: variability and uncertainty.

- “Variability” refers to the fluctuations in measured values for a given parameter:
  - Spatially – within a watershed or along a stream length; and
  - Temporally – seasonal and year-to-year changes, possibly induced by climatic conditions and biological factors.

- “Uncertainty” refers to prediction error resulting from limits in the data and predictive models. Walker (2001 & 2003) has provided detailed discussions of these subjects and the reader is directed to these articles for more detail on the topic.

The MOS should not encompass future growth or allocations of reserve capacity. These aspects of assimilation capacity should be dealt with as a separate allocation explicitly stated as a part of the formal TMDL process.

**MOS Options for Bacteria TMDLs**

With this revision (2009) of the protocol document, the MPCA is recommending a simplified MOS approach for most bacteria TMDLs. This approach would involve setting a constant (e.g., 10 percent) explicit MOS, augmented with language describing implicit MOS factors, if any exist. Some supporting reasoning and justification for the explicit MOS will need to be provided.
Previously, this document described a process of calculating the MOS based on flow variability represented in the flow duration curves (Figure 7). In this process, the MOS is calculated based on the difference in loading between the median flow and minimum flow in each zone, represented in Figure 7 as the area between the arrow and the next vertical line to the right.

For the low flow zone, this reflects the lowest monthly April through October flow observed over the period of record for the gage site used to develop loading capacities for each impaired reach. A disadvantage of this approach is that the calculated MOS can be large, taking up perhaps 50 percent or more of the available loading capacity in some cases. Also, by focusing on the midpoints of each flow zone we may be creating the misimpression that only those points are relevant to establishing or evaluating allowable loading. In actuality, the whole curve represents the allowable loading.

Some conservative assumptions and factors to consider for implicit MOS include documentation that a NPDES-permitted facility discharges wastewater with a bacterial concentration substantially below its permit limit or clear evidence of bacteria die-off between a discharge point and an impaired reach. For the example shown in Table 4, in which the MOS for the dry and low flow zones is shown as “na,” please note that the MPCA prefers to use “implicit” for those unique situations and provide appropriate justification.

References


G. Reserve Capacity (Allocation for Future Growth)

Federal Requirements:
Implied under LA and WLA requirements as the “portion of the loading capacity attributed to existing and future sources.”

Protocol for Minnesota Bacteria TMDLs

Reserve Capacity (RC) is that portion of the TMDL that accommodates new future loads. The MPCA’s policy on reserve capacity is that all TMDL projects consider it and the final report should clearly describe the rationale for a decision regarding this issue.
RC can be ascribed singly to the WLA, the LA, or both, as in the case of new and expanding WWTFs, future MS4s, and/or land use changes. In the case of MS4s, it is preferred to accommodate future growth in the WLA, based on larger municipal boundaries or expansion area designations, if appropriate. It is preferred that non-permitted MS4s likely to require permit coverage in the future be included in the WLA, rather than the RC. If growth is not accommodated in the WLA, or if an allocation for RC is not included, either no new future loads are anticipated or allowed, or increased loads must be accommodated by pollutant trading or other offsetting reductions.

If future loads are to be accommodated by trading only, a discussion of a viable trading program and the implications to new loads should be included. A typical 20-year planning timeline for consideration of reserve capacity is recommended.

Reserve capacity-related considerations relative to major sources of bacteria are discussed below.

**Straight-Pipe Septic Systems and Un-sewered Communities**

As a result of state and local rules, ordinances, and programs, the number of straight-pipe septic systems will decrease over time. Because these systems constitute illegal discharges, they are not provided a LA. As such, other elements of the TMDL allocation will not change as these systems are eliminated and reserve capacity for such discharges would be inappropriate as well. Un-sewered communities, which may have a variety of problems, including straight-pipe connections, may be upgraded to permitted sewered communities and, as such, would ultimately need some WLA capacity to accommodate them. For these situations, either setting aside some RC or increasing the WLA would be appropriate.

**Wastewater Treatment Facilities**

Flows at some WWTFs are likely to increase over time with growth in the populations they serve. New facilities may also be constructed. To accommodate this growth a reserve capacity can be established. As an alternative to setting aside reserve capacity, the MPCA is exploring the possibility of adjusting upward the loading capacity side of the TMDL equation. This is based on the recognition that these discharges add flow, not just bacteria, and what bacteria are added is at a level at or below the water quality standard. It is possible that population trends in some communities will be downward. To the extent that wastewater discharges for these communities is also reduced, additional capacity would be available.

**Municipal Separate Storm Sewer Systems (MS4s)**

With a few exceptions, expansion of stormwater systems of the current NPDES-permitted MS4 communities in Minnesota is likely to occur. In addition, new MS4 communities may be designated. As expansion or new designation of communities occurs, MS4 WLAs may also need to be increased. If this occurs, the logical response would be to reduce the nonpoint source load allocation proportionally. This makes sense because expansion of urban areas effectively reduces the amount of agricultural and other land that contributes to nonpoint source runoff. RC could be
allocated in anticipation of such MS4 expansion or may be accommodated in the WLA. Accommodating this growth in the WLA is the preferred approach.

**Nonpoint Sources**

Setting aside an explicit reserve capacity for nonpoint sources (e.g., livestock) is not necessary because the LA category is already defined as including current and future sources. There is no real advantage in separately creating a reserved amount of LA for the future and, in fact, would be difficult to fairly administer. Instead, it makes more sense to require that any expansion of nonpoint sources will need to comply with the LA provided in this report.

In recently approved Minnesota bacteria TMDL studies, no explicit RC was allocated to account for human or livestock population growth. These documents did discuss RC and indicate that the MPCA will monitor population growth, urban expansion, and changes in agriculture, and reopen the TMDL if and when adjustments to allocations may be required.

The TMDL report should provide the basis for the amount of RC, guidelines for making RC available to new loads, and the means to replenishing RC when it has been depleted. Replenishing RC can be accomplished through the following options:

- **WWTF sources**
  - Concentration adjustments – reallocation, based on concentration effluent limits at the given design flow;
  - Flow adjustments – reallocation of allowed design flow at the given concentration; or
  - Mass adjustments – mass-based effluent limit.

- **Nonpoint sources and MS4s**
  - Additional BMP implementation;
  - Reducing watershed loads.

- **General**
  - Reducing the MOS through greater understanding of load response conditions.

It is anticipated that RC issues will largely be a policy discussion that requires input from all affected parties and consideration of future loads in the watershed. Policy considerations for allocating RC to new loads should be based on equitable and consistent criteria.

In the case of WWTFs, it may not be completely possible to anticipate all new future loads. An example of this would be those loads from new, unplanned, industrial sources. If this appears to be a likely scenario, an increased RC over that anticipated to be necessary may be warranted. If RC is allocated in a bacteria TMDL, provisions for tracking its use over time should be discussed in the TMDL report.
H. Seasonal Variation

**Federal Requirements:**
The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL **must** describe the method chosen for including seasonal variations. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

**Protocol for Minnesota Bacteria TMDLs**

In Minnesota, bacteria standards apply from April through October (May through October for Class 7 waters). Over this time frame, there is substantial seasonal variability in bacteria levels in water bodies. This variability is the result of a variety of factors, including precipitation patterns, stream temperature, wildlife dynamics, and the seasonal nature of agricultural practices. The types of analyses described in Part II, Section D and Part III, Section K can help to define the seasonal changes in both water quality and sources.

I. Reasonable Assurances

**Federal Requirements:**
When a TMDL is developed for waters impaired by point sources only, the issuance of a National Pollutant Discharge Elimination System (NPDES) permit(s) provides the reasonable assurance that the waste load allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available waste load allocation" in an approved TMDL.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and waste load allocations, has been established at a level necessary to implement water quality standards.

The EPA’s August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.
**Protocol for Minnesota Bacteria TMDLs**

Generally, reasonable assurances include descriptions of the regulatory and non-regulatory efforts at the state and local levels that will likely result in reductions from the LA portion of the TMDL. Reasonable assurances also include the identification of potential or likely funding sources that will enable reductions from the LA.

The following list of scenarios describes when to include reasonable assurances in the TMDL submittal:

- **Nonpoint source only TMDLs (LA only)**
  
  Although the EPA does not require reasonable assurances in this type of TMDL, the MPCA requires a description of reasonable assurances for nonpoint only TMDLs. Reasonable assurances in these types of TMDLs allow the MPCA to evaluate the potential options available to enable reductions from nonpoint sources.

- **TMDLs with offsets in the WLA from the LA**
  
  The EPA requires reasonable assurances in this situation in order to approve the TMDL. This is clarified in the 1991 EPA guidance document “Guidance for Water Quality-Based Decisions: The TMDL Process.” The guidance addresses waters impaired by both point and nonpoint sources where the WLA to point sources is predicated on nonpoint source loading reductions (i.e., where point sources receive a more generous WLA because the TMDL assumes that a larger share of load reductions will come from nonpoint sources). In such cases, some additional provisions in the TMDL, such as a schedule and description of the implementation mechanisms for nonpoint source control measures, are needed to provide reasonable assurance that the nonpoint source measures will achieve the expected load reductions. Such additional provisions are also needed in this type of TMDL to assure compliance with the federal regulations at 40 CFR § 130.2(i), which provide that in order for WLAs to be made less stringent, more stringent load allocations must be “practicable.”

- **TMDLs without offsets in the WLA from the LA**
  
  Although the EPA does not require reasonable assurances in this type of TMDL, the MPCA requires a description of reasonable assurances. Reasonable assurances in these types of TMDLs allow the MPCA to evaluate the potential options available to enable reductions from nonpoint sources.

- **TMDLs with wastewater permittees in the WLA**
  
  Reasonable assurances are not required for wastewater permittees because federal regulations require that permits with numeric effluent limits comply with the WLA in the TMDL.
• **TMDLs with required and discretionary MS4 stormwater permittees in the WLA**

As noted in the box above, the NPDES permit requirements must be consistent with the assumptions and requirements of available WLAs. Because permits for required and discretionary MS4s do not contain numeric limits, the MPCA requires an MS4 to provide reasonable assurances in the following manner:

“If a USEPA-approved TMDL(s) has been developed, you must review the adequacy of your Stormwater Pollution Prevention Program to meet the TMDL’s Waste Load Allocation set for stormwater sources. If the Stormwater Pollution Prevention Program is not meeting the applicable requirements, schedules, and objectives of the TMDL, you must modify your Stormwater Pollution Prevention Program, as appropriate, within 18 months after the TMDL is approved.”

This permit language should be cited in the reasonable assurance section of the TMDL.

**References**

MS4 permit requirements: www.pca.state.mn.us/water/stormwater/stormwater-ms4.html#requirements

**J. Monitoring Plan to Track TMDL Effectiveness**

**Federal Requirements:**
EPA’s 1991 document, Guidance for Water Quality-Based Decisions: The TMDL Process (EPA 440/4-91-001) http://www.epa.gov/OWOW/tmdl/decisions/ recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.

**Protocol for Minnesota Bacteria TMDLs**

Monitoring in TMDLs is defined minimally as including three components of work:

- Tracking the adoption of implementation activities;
- Monitoring the effectiveness of individual and/or sets of implementation measures; and
- Resource monitoring for evaluating impairment.
Each TMDL implementation plan is to identify how each monitoring component will be addressed during and after project implementation. Development of the monitoring plan should be done in conjunction with related TMDLs (locale and/or parameter) and the overall impaired waters program, as no single project is likely to provide complete monitoring for all three components.

At this time, the responsibility and source of funds for implementation and post-implementation monitoring has not been defined. Monitoring occurring during an implementation project is apt to be funded as part of the implementation project, especially if funded with 319 or CWLA funds. Requirements and funding for post-project monitoring has not been fully discussed.

Monitoring requirements for NPDES permitted facilities will be defined in the NPDES permits. Discharging NPDES facilities typically are required to monitor discharges from their facilities and sometimes are required to monitor the receiving water. Specific information can be obtained from the MPCA Municipal and Industrial Divisions.

Monitoring related to stormwater (MS4s and industrial) will be directed by the NPDES stormwater permits and associated SWPPPs. Additional discussion and layout of monitoring activities is needed between the TMDL and stormwater programs.

Monitoring related to nonpoint sources of pollution has a somewhat broader possible scope than NPDES and stormwater related monitoring; although stormwater monitoring shares many of the issues dealt with in nonpoint source management. The adoption of implementation measures (BMPs) should be tracked in terms of number, size, and location. Practices funded by CWLA and 319 funds must be reported via the eLink database managed by the Board of Water and Soil Resources (BWSR). Long-term monitoring of the individual water resource, especially after an implementation project ends, will likely occur via on-going and/or new ambient monitoring programs. The MPCA will continue, and plans to expand, its Minnesota Milestone ambient monitoring program. Expanded assessment monitoring will include the addition of flow monitoring sites. Local and individual monitoring efforts should also be encouraged.

Effectiveness monitoring for evaluating the effectiveness of individual or sets of implementation measures is probably the most difficult type of monitoring to complete. Effectiveness monitoring typically requires at least six years of pre- and post-implementation monitoring to ensure an adequate database for recording a change in water quality. Special monitoring designs, such as paired watersheds and upstream/downstream, are preferred to help lower the variability caused by other factors that can affect the measured water quality. The MPCA technical staff has proposed the use of water monitoring in selected reference or demonstration watersheds, combined with targeted effectiveness monitoring projects for evaluation of the overall impaired waters program, rather than expecting effectiveness monitoring to occur in individual projects. At some point, however, all impaired water bodies will need to be revisited with water testing to determine if the impairment still exists. Under the evolving MPCA One Water framework, this would occur at least every 10 years.
Water monitoring will include a combination of biological, physical, and chemical monitoring approaches to fully describe health of the water system. As with any monitoring plan, monitoring plans in TMDLs should be appropriately designed to meet the desired information goals. This is especially important as adaptive management is applied in TMDLs and decisions regarding necessary follow-up and possible revisions in the TMDLs are evaluated (see schematic on next page). In addition, it is also recommended that the reader review the EPA’s clarifying guidance (www.epa.gov/owow/tmdl/tmdl_clarification_letter.pdf) on three situations where follow-up monitoring strategies are needed to provide assurances that nonpoint source controls will be achieved. These three situations are “phased TMDLs,” “adaptive implementation,” and “staged implementation.”

In July of 2008, the University of Minnesota completed a report titled “Developing an Effectiveness Tracking and Reporting Framework for Implementing the Clean Water Legacy Act.” This report, while it addresses tracking at a somewhat higher level than individual TMDL projects, contains some information that may be useful. It is available at http://wrc.umn.edu/outreach/cwltracking.

**Monitoring Change**

Tracking of water quality changes over time, resulting from the implementation of watershed, lake, and stream rehabilitations, can be reasonably accomplished with due consideration of time lags, geographic scale, monitoring approaches, and quality assurance. As a part of this, one must consider normal seasonal variation (intra-year) and the year-to-year (inter-year) variability that naturally occurs in river and streams.

- **Time Lags - before and after BMP implementation monitoring**

  Over the course of a watershed management effort, there can be significant time periods that occur from the time of recognition of water quality problems, rehabilitation of key watershed areas, and improvement of water quality. Projects usually begin with a one to three-year diagnostic study, coupled with building requisite local partnerships. Additional time is needed for public notices and contracts leading up to the planning and design of watershed corrective actions. Actions may take many years to accomplish, during which time new water quality issues may arise.

- **Geographic Scale and Rehabilitation Sequencing**

  The size of the contributing watershed to a given stream, lake, or reservoir will be a large determinant in the time and effort needed to effect improved water quality. Smaller watersheds can be typically expected to respond more quickly to watershed corrective measures. Large watershed projects are encouraged to develop smaller, more optimal detection tracking project areas.
Quality assurance plans are required for TMDL projects to ensure that appropriate field and laboratory procedures are employed. Use of certified labs is a part of this quality assurance process. Other typical quality assurance aspects include consideration of:

- Accuracy as a function of methods (field and laboratory);
- Precision as a function of methods, and sample frequency; and
- Probability of detecting change as a function of precision, variability, and duration of sampling, much of which was described in previous sections of this document (text from Lakes protocol).

Due to the variable nature of river and stream water quality and the magnitude of bacteria reductions that may be needed to attain water quality standards, monitoring plans will need to be coordinated with potentially long-term implementation efforts. Implementation practice tracking must occur throughout implementation. If the extent of BMP implementation is not documented, it will be difficult or impossible to evaluate reasons for success or failure in reaching targeted bacteria levels. Intensive re-assessment of water quality, however, may not start until after a sustained period of implementation that is projected to improve water quality.

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**Schematic of TMDL Adaptive Management (Walker, 2001)**

**References**

K. Implementation

**Federal Requirements:**
EPA policy encourages Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. In addition, EPA policy recognizes that other relevant watershed management processes may be used in the TMDL process. EPA is not required to and does not approve TMDL implementation plans.

**Protocol for Minnesota Bacteria TMDLs**

Projects must include, in the written TMDL that is submitted to MPCA, broad implementation strategies. Projects are required to submit a separate, more detailed, implementation plan document to the MPCA within one year of the TMDL’s approval by the EPA. The MPCA project managers will be able to provide more information and guidance. The implementation plan document is not approved by the EPA.

The Clean Water Legacy Act, Minn. Stat. § 114D.25, subd. 1, requires that a TMDL include a range of cost estimates for implementation of the TMDL and, for point sources, the individual waste load data and estimated cost of compliance with the TMDL. Cost of compliance can be estimated through SSTS inventories, and discussions with WWTF and MS4 permittees. It should be emphasized that it is appropriate to provide a cost range in this estimate, which may be refined after the TMDL is approved and a detailed implementation plan is developed.

In the implementation plan section, the broad implementation strategies, activity areas, and mechanisms for achieving bacteria loading reductions should be identified. The implementation plan section should identify:

- How the public will be involved;
- What mechanisms, such as financial assistance, ordinances, etc., exist or are proposed for development;
- How progress will be monitored, including water testing, BMP tracking, etc.;
- What bacteria reduction BMPs are likely to be applied;
- What planning tools or processes will be used to achieve nonpoint source reductions;
- What planning tools, processes, or ordinances are in-place or will be proposed to control point sources; and
- What educational and cooperative efforts among stakeholders, landowners, and agencies exist or are proposed for development.

There are several recently published documents, research papers, and informational guides that discuss effective BMPs for reducing bacteria and pathogens in waters. Below is a listing of some of these information sources.
For permitted MS4s, this section of the TMDL should provide an overview of activities that will be refined in the implementation plan. Providing this information will help enhance reasonable assurance, including:

- The current BMPs that are planned (to be refined during implementation planning and SWPPP development);
- The current schedule (i.e., how many permit cycles) for putting BMPs in place; and
- Expected range of potential reductions, based on literature, which can be achieved for each category of BMP (citizen education program, stormwater ponds, etc.).

Additional information on MS4 requirements and implementation options can be found at [www.pca.state.mn.us/water/stormwater/impairedwaters.html](http://www.pca.state.mn.us/water/stormwater/impairedwaters.html).

An effective process of developing both broad and refined implementation strategies will likely require water quality and watershed data assessment that goes beyond what is minimally required for EPA approval of TMDLs. This assessment involves connecting bacteria loading capacity and allocations to in-stream water quality as a means to gage the magnitude of implementation effort. It also involves connecting bacteria allocations to contributions from different sources.

**Connecting Loading Capacity and Allocation to In-stream Water Quality for Implementation Planning and Tracking Purposes**

Assuming the data for the project was collected at an appropriate frequency and over a range of years, then the question of how polluted or impaired is the water would likely be answered in an existing data analysis section of the TMDL report. The next logical step would be to address the following questions:

- What magnitude of load reductions might be necessary for each impaired reach to meet water quality standards?
- Is water quality at each impaired reach improving or declining?
Regarding the second question, most project datasets will not cover enough years to provide good trend analysis. There are several monitoring sites throughout the state that have long-term data that can provide valuable information. The inherent variability in bacterial data, however, creates a challenge for legitimate statistical trend analysis.

To get at the first question, plots or other statistical representations of the data can be compared to the numeric criteria portion of the bacteria water quality standard in ways that provide some sense of the magnitude of the impairment (e.g., “just over the standard” or “exceeds the standard by a factor of 10”). One possible way to convey a semi-quantitative approximation of the reduction needed is the simple equation:

\[
\frac{(\text{Monthly Geometric Mean} - \text{Standard})}{\text{Monthly Geometric Mean}} \times 100
\]

Example: \((315 - 126)/315 \times 100 = 60\) percent reduction needed

Obviously, this does not factor flow and, therefore, actual loading into the estimate, so it is only a gross approximation, at best, and it should be made clear in the report that such a figure is not substituting for the more formal TMDL calculations. Using a load calculation program such as FLUX is inappropriate for bacterial data. A single, very high sample (e.g., 30,000 orgs./100 ml) during high flow could easily make up nearly all the calculated seasonal load.

Perhaps one of the best tools to portray the magnitude of the impairment in relation to the standard may be a load duration curve. This curve combines the water quality data with the flow duration curve data to graphically illustrate the flow zones in which above-standard loads occur. Using a load duration curve requires a flow record and bacteria sampling history that covers the range of flow conditions. Figure 8 shows the target load at each flow percentile and the actual load represented by the data points. Data can also be coded to highlight those samples representing specific months or storm events. Analysis of a load duration curve can be useful in drawing conclusions regarding the timing of the impairment and using the information to guide implementation strategies. For more information on duration curves, see Part III, Section C.
Figure 8.

**Dry Weather Cr; Headwaters to Chippewa R**

**Load Duration Curve** (1999 - 2005 Monitoring Data)

**Site 19**

CRWP Data & Gage Duration Interval  

98 square miles
Connecting the Allocation to “Current” Contributions From Different Sources for Implementation Planning Purposes

It is known that E. coli bacteria originate in the digestive systems of warm-blooded animals. As such, the primary sources of E. coli are limited to humans, livestock, pets and wildlife. In a broader sense, the “sources” that contribute to impairments of rivers and streams encompass a host of intermediate reservoirs and pathways, including soil, stream sediment, different types of livestock, feedlots, pastures, crop fields, wastewater treatment systems of all types, urban stormwater conveyances, wildlife staging areas, and others. Some key questions relating to the E. coli sources that may be contributing to an impairment include:

- What are the most significant sources contributing to an impairment?
- How much are different sources each contributing to an impairment?
- How does weather and climate impact different sources (e.g., rainfall runoff)?
- What sources should be considered part of the “natural background” for a river or stream?
- How much reduction is possible or practical from different sources?
- What portion of fecal matter from a given source actually reaches surface waters?
- What are the pathways of a given source to a surface water body?
- Is a given source meeting its allocation?

With the exception of WWTFs which have relatively predictable and monitored discharges, it is difficult to answer these questions in a quantitative manner. Nevertheless, attempts should be made to address the questions in qualitative ways.

Table 5 brings the following main potential sources into the analysis:

- Municipal wastewater;
- Septic systems
- Grazing livestock
- Urban stormwater
- Feedlots; and
- Field-applied manure.
In this table, these sources are portrayed in terms of “implementation opportunities” and are associated with the likely flow zones in which they would be effective. Using this table, in conjunction with the load duration curve, local stakeholder knowledge, and other information, a project team can start to rule in or out some sources and potentially rank them from most significant to least significant, as well as point toward some implementation strategies.

Table 5. Implementation Opportunities

<table>
<thead>
<tr>
<th>Implementation Opportunities</th>
<th>Duration Curve Zone</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Wastewater bypass elimination plans</td>
<td>Municipal NPDES</td>
</tr>
<tr>
<td>On-site wastewater management</td>
<td>Pasture management and riparian protection</td>
</tr>
<tr>
<td>Urban stormwater management</td>
<td>Open lot agreements</td>
</tr>
<tr>
<td>Manure management</td>
<td></td>
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</tbody>
</table>

Adapted from Revised SE Regional Fecal Coliform TMDL, Appendix A.

A more quantitative analysis than is shown in Table 5 may be possible. It should be acknowledged, however, that the highly variable and complex nature of bacteria in the environment is unlikely to be revealed, even with very robust and data-intensive models. As such, the MPCA is not confident at this time that such models are worth the time and expense for this task. While water resource managers should remain open to using new and improved modeling techniques, other options should be considered.

Various “simple” assessment tools have been used elsewhere in the United States and could provide some insights and ballpark estimates of sources and possible delivery mechanisms. Typically, these tools require:

- An inventory of sources
- Information on source practices (e.g., manure management methods); and
- Contain default values for fate and transport of fecal material (which can be adjusted for local conditions).

A number of bacteria TMDLs approved in Minnesota have used or adapted a simple assessment method presented in the original SE Regional Fecal Coliform TMDL (Oct 2002). This method begins with an inventory of livestock, human and wildlife sources, and further subdivides the fecal material for some categories into various subcategories or settings. The fecal material available for entry into the streams and waterways is then estimated through assignment of delivery potentials.
While the MPCA continues to support quantitative source inventory work, the MPCA no longer recommends the use of numeric delivery percentages unless they can be supported by relevant research. As an alternative, the Agency recommends qualitative “risk assessment” approaches that can be tailored to individual TMDL projects. Different sources would be assigned a categorical (e.g., low, medium, high) risk of delivery or transport to surface waters. The risk factors would then be used in conjunction with source inventory work to suggest the overall threat to surface waters from a particular source. If a source is both prevalent in a watershed and has a high delivery risk, it would be identified as a priority. Conversely, sources that are not prevalent, or have low delivery risk, would be lower priorities for implementation activities.

For MS4 communities, the TMDL will probably need to decide on whether permit requirements will help answer the questions presented above. Also, the TMDL document and implementation plan may need to emphasize that it could take several permit cycles to arrive at answers.

**Bacteria Source Tracking**

If the risk assessment and source inventory approaches are deemed inadequate, it may be appropriate to try additional source identification tools, such as Bacterial Source Tracking (BST). BST is a “toolbox” of microbiological and chemical techniques to determine sources of fecal bacteria in environmental water samples. By identifying specific sources of nonpoint pollution, BST can help enhance water quality protection or restoration efforts. Also, BST data provide critical support and calibration points to improve watershed modeling. BST is considered part of Microbial Source Tracking (MST), which includes not only bacteria, but also protozoa and viruses.

BST methods can be subdivided into three basic groups: chemical, phenotypic and genotypic. In the past, the only way to identify the host origin was to study observable characteristics of bacteria (phenotypic markers). In recent years, it has become possible to differentiate subspecies based on their DNA. This process is called genotyping.

Chemical methods detect compounds linked to human wastewater. It is assumed that if these compounds are detected, there must be a human source associated with the contamination.

Phenotypic methods measure the type and quantity of substances produced by fecal bacteria. Compared with molecular methods, these methods require less training for lab personnel, have a lower cost per bacterial isolate, and can process hundreds of isolates per week. Highly contaminated sites may need several hundred isolates for the results to be representative of the fecal population in the sample. Molecular and non-molecular methods can validate each other. For example, a phenotypic method can process a large number of isolates, and a molecular method can confirm the results on a few isolates.
Genotypic methods are referred to as “DNA fingerprinting” and rely on the unique genetic makeup of different strains (subspecies) of fecal bacteria. Although fecal bacteria in any two animals are genetically the same, the key to genotypic tests is finding differences in the genetic makeup against a background of similarities. The distinctions between fecal bacteria from different animals (including humans) occur because the intestinal environments and diet are not the same; hence, bacteria have evolved differences that can be related to the source. Genotypic techniques require that DNA be carefully extracted, purified and quantified.

At this point, no single BST method is capable of identifying specific sources in all situations. Targeted sampling, as a prelude to BST, is recommended. If BST is needed, then a “toolbox” approach is best. Targeted sampling often eliminates the need for BST, or at least narrows the scope and number of samples that have to be taken. BST can reliably determine if fecal bacteria came from human or animal sources. If the bacteria are from animal sources, BST will differentiate between livestock and wildlife, but less reliably. It is unknown at this time if BST can eventually achieve distinctions between different types of livestock (e.g., cattle and horses), wildlife (e.g., deer and waterfowl), or pets (e.g., dogs and cats). Future research will likely improve the accuracy of BST methods and their cost. Until then, targeted sampling provides the ability to limit the scope and the number of BST tests required.

References

MPCA’s TMDL stormwater website:
www.pca.state.mn.us/water/stormwater/impairedwaters.html

University of Georgia, Bulletin 1242-7/ September 2004: Bacterial Source Tracking.

L. Public Participation

Federal Requirements:
EPA policy is that there should be full and meaningful public participation in the TMDL development process. The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii) ). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. §130.7(d)(2) ).

Provision of inadequate public participation may be a basis for disapproving a TMDL. If EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.
Protocol for Bacteria TMDLs

An active stakeholder and public participation process is required throughout the development of every TMDL, from the development of the project work plan to the approval of final pollutant load allocations and public notice process. The ultimate success of the project largely depends on the effectiveness of this process and development of practical, pragmatic solutions with stakeholders. It is critical that diverse stakeholders affected by any given TMDL project (and those who must implement it) share a common understanding of the problem and the solution.

In the Clean Water Legacy Act, Minn. Stat. § 114D, public participation is defined and required in TMDL projects. Minn. Stat. § 114D.35, subd 1, states:

Public agencies and private entities involved in the implementation of this chapter shall encourage participation by the public and stakeholders, including local citizens, landowners and managers, and public and private organizations, in the identification of impaired waters, in developing TMDLs, and in planning, priority setting, and implementing restoration of impaired waters. In particular, the Pollution Control Agency shall make reasonable efforts to provide timely information to the public and to stakeholders about impaired waters that have been identified by the agency. The agency shall seek broad and early public and stakeholder participation in scoping the activities necessary to develop a TMDL, including the scientific models, methods, and approaches to be used in TMDL development, and to implement restoration pursuant to section 114D.15, subdivision 7.

The MPCA highly recommends engaging the public using various media methods, involvement levels, and activities. The MPCA is available to assist with designing and implementing the public participation. There are four common methods to publicizing TMDL activities: printed media, internet sources, displays, and events. Projects are not limited to these activities and are encouraged to facilitate and offer several opportunities for the public.

- **Printed Media:** This can be an effective tool to communicate general information to the public. Newspapers, newsletters, posters, and brochures can present basic TMDL facts. The MPCA works with projects to develop a fact sheet for each TMDL.

- **Internet Sources:** A good website can be useful for communicating results, progress, and reports. The MPCA has developed a TMDL website where individual project web pages display meeting dates, documents, and maps. Several state associations and other state agencies also promote and inform the public on TMDL events and information.

- **Displays:** Designing a display using posters or a display board for use at fairs, public events, and local community gatherings promotes the project. The MPCA has posters that highlight nonpoint source information, agricultural practices, impaired waters, and the TMDL process. These resources are available for TMDL projects.
Events: Many TMDL projects utilize stakeholder advisory committees, technical committees, and public meetings to involve the public and stakeholders. The committees should be developed as soon as the project begins to facilitate stakeholders needs, increase effectiveness, and meet the requirements of Minn. Stat. § 114D.35. A TMDL communication tool kit is available from the MPCA project managers. The kit includes a public meeting planning checklist, templates for press releases, fact sheet, PowerPoint presentations, meeting sign-in form, and a tip sheet for hiring a facilitator.

Stakeholder advisory committees provide the opportunity for the public to engage in the project at the decision-making level. Key areas for stakeholder input and recommendations include communication with the broader public, information on the condition and use of the water bodies in question, general or specific identification of pollutant sources, and prioritization of remedies.

An additional area of stakeholder involvement is in the LA process. Within the legal constraints under which the MPCA operates, factors such as feasibility, practicality, cost-effectiveness, and equity may all be considered in determining LAs. The level of specificity of the allocations will have a strong influence on the nature of this task. For example, if it is decided that a single load allocation figure will be used for all nonpoint sources in a watershed, it will not be necessary to determine precisely how much of that allocation should be provided to a specific source, such as wildlife or failing septic systems.

A TMDL Report must be public noticed for 30 days before it is sent to the EPA for final approval. The public notice process is led by the MPCA and coordinated with the local government contractor and consultant.

In general, the following are the basic steps to the public notice process:

- The MPCA public information staff and project manager prepare a public notice package, to include draft TMDL, fact sheet, public notice, and news release.

Public Comment Period

- The draft TMDL must be on public notice for a minimum of 30 days.
- The public notice must be published in the State Register and the MPCA web site.
- The notice should also be mailed or e-mailed to a list of interested parties for the project, and must be mailed to a statewide list of interested parties.
- During the 30-day public notice period, the public has four opportunities to express comments, concerns, and issues:
  - Written comments: The public can submit written comments on the conditions of the draft TMDL report.
  - Public informational meeting: A public informational meeting is an informal meeting that the MPCA may hold to solicit public comment and statements on matters before the MPCA, and to help clarify and resolve issues.
  - Petition for a contested case hearing: A contested case hearing is a formal evidentiary hearing before an administrative law judge.
• Petition for MPCA’s Citizens’ Board approval: The public can request that the MPCA Citizens’ Board consider the TMDL Report approval.
  ➢ It is common to host a public meeting during the public notice period, but not required. This is based on the level of public participation and outreach during other phases of the project.

• Public comments: All written public comments must be provided to the EPA with the submission of the TMDL. Copies of each response must also be submitted.

• Final MPCA approvals (either by the Commissioner or the Citizens’ Board). The Clean Water Legacy Act (Minn. Stat. § 114D.25, subd. 3) requires at least 30 days between public notice closing and submission to the EPA.

• At the conclusion of the 30 days, the TMDL is submitted to the EPA for final approval.

Ultimately, a successful public participation process will help ensure that the TMDL is sent to the EPA on schedule and has the stakeholder support needed to launch effective implementation.

Local government contractors will have a primary role throughout the public participation process. In general, local government should be prepared to be engaged in these public participation activities:

• Help identify stakeholders that represent diverse public and private interests in affected watersheds on the Stakeholder Advisory Group for the project.

• Conduct public outreach and education activities at key points throughout the project.
• Prepare a section of the TMDL report that describes public participation activities and events.

• Coordinate with the MPCA, as needed, to assist in the formal public notice process for the draft TMDL, including:
  ➢ Organizing one or more public meetings;
  ➢ Responding to comments received during the process; and
  ➢ Documenting the process, and packaging public outreach materials for inclusion in the final TMDL submittal.

References

M. Submittal Letter

Federal Requirements:
A submittal letter should be included with the TMDL submittal, and should specify whether the TMDL is being submitted for a technical review or final review and approval. Each final TMDL submitted to the EPA should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final review and approval, should contain such identifying information as the name and location of the water body, and the pollutant(s) of concern.

Protocol for Bacteria TMDLs

The submittal letter is written by the MPCA and signed by the Commissioner. In addition, the final TMDL report and any other documents that are a necessary part of the TMDL submittal are ultimately approved by the Commissioner.

N. Administrative Record

Federal Requirements:
While not a necessary part of the submittal to EPA, the State/Tribe should also prepare an administrative record containing documents that support the establishment of and calculations/allocations in the TMDL. Components of the record should include all materials relied upon by the State/Tribe to develop and support the calculations/allocations in the TMDL, including any data, analyses, or scientific/technical references that were used, records of correspondence with stakeholders and EPA, responses to public comments, and other supporting materials. This record is needed to facilitate public and/or EPA review of the TMDL.

Protocol for Bacteria TMDLs

The MPCA project manager and administrative staff will gather and file all necessary documents for the administrative record.

O. The MPCA’s Checklist for Reviewing TMDLs

This final checklist outlines the basic needs for all TMDLs and summarizes many of the requirements described in this document. It is used by the MPCA management prior to submittal to the EPA, and should be used by TMDL preparers as a resource to ensure the completeness of the final report. The checklist should be viewed as including the minimum elements of a TMDL required by the EPA. This protocol, for example, outlines a more robust stakeholder process than suggested in the checklist.
# TMDL REVIEW CHECKLIST

<table>
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<th>TMDL Project Name:</th>
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</table>

**MPCA Technical Team Review:**

(List of Reviewers) ________ (Date)

**MPCA Project Manager:**

(Print name) (Signature) ________ (Date)

**MPCA Supervisor:**

(Print name) (Signature) ________ (Date)

**MPCA Regional Manager:**

(Print name) (Signature) ________ (Date)

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<th>EPA/MPCA Required Elements</th>
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<th>TMDL Page #</th>
<th>Comments (Supervisor) Adequate?</th>
<th>Comments (Regional Manager) Adequate?</th>
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</table>
| **Summary Information**    | • Summary Table – EPA required

  • Executive Summary – MPCA required. Brief narrative that describes the sections below. |
| **Location**               | Drainage Basin, Part of State, County, etc. |
| **303(d) Listing Information** | Describe the waterbody as it is identified on the State/Tribe’s 303(d) list:

  • Waterbody name, description and ID# for each river segment, lake or wetland

  • Impaired Beneficial Use(s) – List use(s) with source citation(s)

  • Impairment/TMDL Pollutant(s) of Concern (e.g., nutrients: phosphorus; biota: sediment)

  • Priority ranking of the waterbody (i.e. schedule)

  • Original listing year |

<p>| <strong>Applicable Water Quality Standards/ Numeric Targets</strong> | List all applicable WQS/Targets with source citations. If the TMDL is based on a target other than a numeric water quality criterion, a description of the process used to derive the target must be included in the submittal. |</p>
<table>
<thead>
<tr>
<th>Loading Capacity (expressed as daily load)</th>
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<tbody>
<tr>
<td>Identify the waterbody’s loading capacity for the applicable pollutant. Identify the critical condition. For each pollutant: LC = X/day; and Critical Condition Summary</td>
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<thead>
<tr>
<th>Wasteload Allocation</th>
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<tr>
<td>Portion of the loading capacity allocated to existing and future point sources [40 CFR §130.2(h)]. Total WLA = X/day, for each pollutant</td>
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<thead>
<tr>
<th>Source</th>
<th>Permit #</th>
<th>Individual WLA</th>
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<tbody>
<tr>
<td>CAFO A</td>
<td></td>
<td></td>
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<tr>
<td>CAFO B</td>
<td></td>
<td></td>
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<tr>
<td>Permitted Stormwater (i.e. MS4, constr.)</td>
<td></td>
<td></td>
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<tr>
<td>Straight Pipe Septic</td>
<td>NA</td>
<td></td>
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<tr>
<td>WWTP A</td>
<td></td>
<td></td>
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<tr>
<td>WWTP B</td>
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<tr>
<td>Reserve Capacity? (and related discussion in report)</td>
<td>NA</td>
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</tbody>
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<thead>
<tr>
<th>Load Allocation</th>
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<tbody>
<tr>
<td>Identify the portion of the loading capacity allocated to existing and future nonpoint sources and to natural background if possible [40 CFR § 130.2(g)]. Total LA = X/day, for each pollutant</td>
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</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>LA</th>
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<tbody>
<tr>
<td>NP Source A</td>
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<tr>
<td>NP Source B</td>
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<tr>
<td>Natural Background?</td>
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<table>
<thead>
<tr>
<th>Margin of Safety</th>
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<tbody>
<tr>
<td>Include a MOS to account for any lack of knowledge concerning the relationship</td>
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<tr>
<td><strong>Bacteria TMDL Protocols and Submittal Requirements – Draft 03/23/09</strong></td>
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<td>------------------------------------------------</td>
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<tr>
<td>between load and wasteload allocations and water quality [CWA §303(d)(1)(C), 40 CFR §130.7(c)(1)].</td>
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<tr>
<td><strong>Identify and explain the implicit or explicit MOS for each pollutant</strong></td>
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<tr>
<td><strong>Seasonal Variation</strong></td>
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<tr>
<td>Statute and regulations require that a TMDL be established with consideration of seasonal variation. The method chosen for including seasonal variation in the TMDL should be described [CWA §303(d)(1)(C), 40 CFR §130.7(c)(1)].</td>
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<tr>
<td><strong>Seasonal Variation Summary for each pollutant</strong></td>
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<tr>
<td><strong>Reasonable Assurance</strong></td>
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<tr>
<td>Summarize Reasonable Assurance</td>
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<tr>
<td>Note: In a water impaired by both point and nonpoint sources, where a point source is given a less stringent WLA based on an assumption that NPS load reductions will occur, reasonable assurance that the NPS reductions will happen must be explained.</td>
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<tr>
<td>In a water impaired solely by NPS, reasonable assurance that load reductions will be achieved are not required (by EPA) in order for a TMDL to be approved.</td>
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<tr>
<td><strong>Monitoring</strong></td>
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<tr>
<td>Monitoring Plan included?</td>
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<tr>
<td>Note: EPA does not approve effectiveness monitoring plans but providing a general plan is helpful to meet reasonable assurance requirements for nonpoint source reductions. A monitoring plan should describe the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.</td>
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<tr>
<td><strong>Implementation</strong></td>
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<tr>
<td>1. Implementation Strategy included?</td>
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<tr>
<td>The MPCA requires a general implementation strategy or framework in the TMDL.</td>
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Minnesota Pollution Control Agency
Note: Projects are required to submit a separate, more detailed implementation plan to MPCA within one year of the TMDL’s approval by EPA.

2. **Cost estimate included?**
The Clean Water Legacy Act requires that a TMDL include an overall approximation ("…a range of estimates") of the cost to implement a TMDL [MN Statutes 2007, section 114D.25].

Note: EPA is not required to and does not approve TMDL implementation plans.

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<tr>
<th>Public Participation</th>
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<tbody>
<tr>
<td>• Public Comment period (dates)</td>
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<tr>
<td>• Comments received?</td>
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<tr>
<td>• Summary of other key elements of public participation process</td>
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</tbody>
</table>

Note: EPA regulations require public review [40 CFR §130.7(c)(1)(ii), 40 CFR §25] consistent with State or Tribe’s own continuing planning process and public participation requirements.
Part IV. Appendices

Appendix A.

Guidelines for Reviewing TMDLs Under Existing Regulations Issued in 1992

Section 303(d) of the Clean Water Act (CWA) and EPA’s implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for the EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb “must” below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for the EPA to determine if a submitted TMDL is approvable. These TMDL review guidelines are not themselves regulations. They are an attempt to summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. Any differences between these guidelines and the EPA’s TMDL regulations should be resolved in favor of the regulations, themselves. A one-page checklist of the review elements may be found on the last page of this document.

1. Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal should identify the waterbody as it appears on the state’s/tribe’s 303(d) list. The waterbody should be identified/georeferenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the waterbody and specify the link between the pollutant of concern and the water quality standard (see section 2 below).

The TMDL submittal should include an identification of the point and nonpoint sources of the pollutant of concern, including location of the source(s) and the quantity of the loading (e.g., lbs/per day). The TMDL should provide the identification numbers of the NPDES permits within the waterbody. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of the natural background. This information is necessary for the EPA’s review of the LAs and WLAs, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

(1) the spatial extent of the watershed in which the impaired waterbody is located;
(2) the assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;
(4) present and future growth trends, if taken into consideration in preparing the TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and
an explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters, such as percent fines and turbidity for sediment impairments, chlorophyll, and phosphorus loadings for excess algae, length of riparian buffer, or number of acres of best management practices.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the anti-degradation policy. (40 C.F.R. § 130.7(c)(1)). The EPA needs this information to review the loading capacity determination, and LAs and WLAs, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s), a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as dissolved oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a waterbody for the applicable pollutant. The EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. § 130.2(f) ).

The pollutant loadings may be expressed as either mass-per-time, toxicity, or other appropriate measure (40 C.F.R. § 130.2(i)). If the TMDL is expressed in terms other than a daily load (e.g., an annual load) the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen. The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions, a discussion of strengths and weaknesses in the analytical process, and results from any water quality modeling. The EPA needs this information to review the loading capacity determination, and LAs and WLAs, which are required by regulation.

TMDLs must take into account critical conditions for stream flow, loading, and water quality parameters as part of the analysis of loading capacity. (40 C.F.R. § 130.7(c)(1) ). TMDLs should
define applicable critical conditions and describe their approach to estimating both point and nonpoint source loadings under such critical conditions. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings (e.g., meteorological conditions and land use distribution).

4. Load Allocations

The EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. LAs may range from reasonably accurate estimates to gross allotments (40 C.F.R. § 130.2(g) ). Where possible, LAs should be described separately for natural background and nonpoint sources.

5. Waste Load Allocations

The EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. § 130.2(h), 40 C.F.R. § 130.2(i) ). In some cases, WLAs may cover more than one discharger (e.g., if the source is contained within a general permit).

The individual WLAs may take the form of uniform percentage reductions or individual mass-based limitations for dischargers where it can be shown that this solution meets water quality standards and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL. If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permittees should be notified of any deviations from the initial individual WLAs contained in the TMDL. The EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

6. Margin of Safety

The statute and regulations require that a TMDL include a MOS to account for any lack of knowledge concerning the relationship between LAs and WLAs and water quality (CWA/ § 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1) ). The EPA’s 1991 TMDL Guidance explains that the MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis), or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS). If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.
7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variations (CWA § 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1) ).

8. Reasonable Assurances

When a TMDL is developed for waters impaired by point sources only, the issuance of a NPDES permit(s) provides the reasonable assurance that the WLAs contained in the TMDL will be achieved. This is because 40 C.F.R. § 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with “the assumptions and requirements of any available waste load allocation” in an approved TMDL.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, the EPA’s 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for the EPA to determine that the TMDL, including the LAs and WLAs, has been established at a level necessary to implement water quality standards.

The EPA’s August 1997 TMDL Guidance also directs regions to work with states to achieve TMDL LAs in waters impaired only by nonpoint sources. However, the EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.

9. Monitoring Plan to Track TMDL Effectiveness

The EPA’s 1991 document “Guidance for Water Quality-Based Decisions: The TMDL Process” (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.

10. Implementation

The EPA policy encourages regions to work in partnership with states/tribes to achieve nonpoint source LAs established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist states/tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. In addition, the EPA policy recognizes that other relevant
watershed management processes may be used in the TMDL process. The EPA is not required
to, and does not approve TMDL implementation plans.

11. Public Participation

The EPA policy is that there should be full and meaningful public participation in the TMDL
development process. The TMDL regulations require that each state/tribe must subject
calculations to establish TMDLs to public review consistent with its own continuing planning
process (40 C.F.R. § 130.7(c)(1)(ii) ). In guidance, the EPA has explained that final TMDLs
submitted to the EPA for review and approval should describe the state’s/tribe’s public
participation process, including a summary of significant comments and the state’s/tribe’s
responses to those comments. When the EPA establishes a TMDL, EPA regulations require the
EPA to publish a notice seeking public comment (40 C.F.R. § 130.7(d)(2) ).

Provision of inadequate public participation may be a basis for disapproving a TMDL. If the
EPA determines that a state/tribe has not provided adequate public participation, the EPA may
defer its approval action until adequate public participation has been provided for, either by the
state/tribe or by the EPA.

12. Submittal Letter

A submittal letter should be included with the TMDL submittal and should specify whether the
TMDL is being submitted for a technical review or final review and approval. Each final TMDL
submitted to the EPA should be accompanied by a submittal letter that explicitly states that the
submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA
review and approval. This clearly establishes the state’s/tribe’s intent to submit, and the EPA’s
duty to review the TMDL under the statute. The submittal letter, whether for technical review or
final review and approval, should contain such identifying information as the name and location
of the waterbody and the pollutant(s) of concern.

13. Administrative Record

While not required, the state/tribe should also prepare an administrative record containing
documents that support the establishment of and calculations/allocations in the TMDL.
Components of the record should include:

- All materials relied upon by the state/tribe to develop and support the
calculations/allocations in the TMDL
  - Including any data, analyses, or scientific/technical references that were used
- Records of correspondence with stakeholders and the EPA
- Responses to public comments
- Other supporting materials

This record is needed to facilitate public and/or EPA review of the TMDL.
## TMDL Review Checklist

<table>
<thead>
<tr>
<th>Review Element</th>
<th>Adequate?</th>
<th>Recommendations/Comments</th>
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<tbody>
<tr>
<td>Submittal Letter</td>
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<tr>
<td>Identification of Waterbody, Pollutant of Concern, Pollutant Sources, &amp; Priority Ranking</td>
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<tr>
<td>Applicable Water Quality Standards &amp; Numeric Targets</td>
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<td>Loading Capacity</td>
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<td>Load Allocations (LAs)</td>
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<td>Waste Load Allocations (WLAs)</td>
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<td>Margin of Safety (MOS)</td>
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<td>Seasonal Variation</td>
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<tr>
<td>Reasonable Assurances: through NPDES permits or if WLAs depend on LAs</td>
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<tr>
<td>Public Participation</td>
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<td>Technical Analysis/Supporting Documentation</td>
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<td>Information entered into TMDL Tracking System</td>
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<td>Other Comments</td>
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