DAILY TMDL SUITABILITY ISSUES

Prepared for

NATIONAL ASSOCIATION OF CLEAN WATER AGENCIES

NACWA White Paper

A Clear Commitment to America's Waters

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Executive Summary

The Court of Appeals for the District of Columbia Circuit ("D.C. Circuit") recently has called into question states' abilities to develop Total Maximum Daily Loads ("TMDLs") that are expressed in terms of anything other than "daily" loadings of pollutants to a waterbody. The Court's decision was based on EPA's 1978 determination that all pollutants are suitable for daily load calculations. Despite the Court's holding, the U.S. Environmental Protection Agency ("EPA") has a history of developing and approving TMDLs containing non-daily load expressions, even after its 1978 determination. More recently, EPA issued guidance in response to the D.C. Circuit's ruling indicating that daily loads can also be accompanied by non-daily load expressions, which can then be used for implementation purposes. In light of EPA's historical rationale and recent guidance, National Association of Clean Water Agencies ("NACWA") members may have arguments to present to state water quality authorities requesting them to address TMDL issues on their receiving waters in a non-daily format.

Various EPA guidance documents indicate that daily calculations are not the best way to address certain types of pollutants, even though the technical means may be available to measure loadings on a daily level. Other types of pollutants may present barriers to technically accurate pollutant reduction or measurement. Viewing the array of EPA guidance (including EPA's most recent guidance allowing non-daily and daily load expressions together), NACWA members have solid rationales with which to encourage states to focus TMDL implementation on non-daily expressions for certain pollutants, even when daily expressions are included in TMDLs.

State and EPA TMDLs illustrate a number of situations in which non-daily loads are most appropriate. Particularly relevant to wastewater treatment facilities are mercury, pathogen, and nutrient TMDLs that have historically been expressed in non-daily terms. A pollutant may be unsuitable for daily load calculations as a general matter, such as when the applicable water quality criteria are expressed in non-daily terms, or when critical loadings occur only during certain seasons of the year. A pollutant may also be unsuitable for daily load calculations in particular situations where the proper technical conditions are not present, such as when sources cannot be accurately characterized) even if it might be suitable as a general matter. This paper includes both general and technical arguments that can be used to demonstrate that daily loads are not appropriate. Although the paper focuses on mercury, nutrients and pathogens as examples, the arguments and language presented here may also be useful to address legacy pollutants, suspended solids, or other pollutants that may cause similar issues at your treatment facility.

Because the non-daily arguments will not always be successful, some alternatives are presented in this paper, which include approaching the state with options for listing the waterbody as impaired. EPA guidance and a few state listing examples indicate that some pollutant types may not lend themselves to immediate TMDL development. Other pollutant loadings, such as mercury, may be so dominated by one type of source (*i.e.*, air deposition), that developing daily loads for other sources would be impractical and unnecessary.

This paper starts with a checklist of non-daily arguments that may apply, depending on your particular circumstances. The checklist headings are hyperlinks to the detailed discussion of the various arguments included later in this paper. Where helpful language can be found in example TMDLs, we have included that language in the Appendix. We hope that this will be a valuable tool that provides options for NACWA members facing difficult TMDL situations, where daily loads are not necessarily appropriate.

CHECKLIST OF NON-DAILY ARGUMENTS

Based on the information contained in EPA guidance and EPA and state TMDLs discussed in detail in the paper, the following checklist summarizes the non-daily or suitability arguments that can be made for mercury, pathogens and nutrients.

I. Mercury

A. General Suitability Arguments—Daily TMDL Should Not Be Developed

- No meaningful relationship between daily load and adverse affects to human health or wildlife resulting from long-term rather than acute Mercury exposure
- Daily loads not relevant to achievement of chronic water quality standards
  - Fish tissue criteria calculated using long-term bioaccumulation factors (BAFs) to account for substantial seasonal and life-cycle variability in fish
- Daily load calculation not relevant to actual mercury loads or control of those loads
  - Ongoing point and nonpoint discharges result primarily from highly variable wet weather events or atmospheric deposition
  - Mercury loading from erosion of contaminated soil related to wet weather events and stream flow
  - Mercury loading from wet and dry air deposition
  - Mercury loading from interaction of surface water with contaminated sediments related to flow and hydraulic conditions
  - Mercury loads from point and nonpoint dischargers best controlled through best management practices, which are not accurately measured on a daily basis
- Daily load reductions cannot be technically or economically achieved or adequately measured

B. Technical Issues—Daily TMDL Can Be Developed Only Under Proper Technical Conditions

- Proper technical conditions do not exist to calculate daily TMDLs or wasteload allocations
  - Limited data available to adequately quantify mercury loading from erosion, air deposition, sediments
  - Insufficient data available to correlate daily loadings with violations of water column or fish tissue criteria
- Limited water quality modeling capability due to significant variability in daily loading and lack of meaningful daily data

II. Nutrients

A. General Suitability Arguments—Daily TMDL Should Not Be Developed

- Wet weather impairments are not appropriately addressed through daily loads
  - Significant daily and seasonal variability not adequately reflected in daily loads
  - Control of wet weather sources not implemented on daily basis
- Nutrient impacts directly correlated to the residence time in waterbody

B. Technical Issues—Daily TMDL Can Be Developed Only Under Proper Technical Conditions

- Proper technical conditions may not exist to calculate daily TMDLs or wasteload allocations for chronic impairments or impairments caused by wet weather point and nonpoint sources
  - Insufficient data to characterize and quantify wet weather sources
  - Wet weather data highly variable, dependent on magnitude and duration of storm event
  - Pollutant concentrations vary during storm event (tend to be higher during first flush)
  - Data generally reflect characteristics of storm event rather than accurately measuring loadings
  - Storm duration may be shorter than duration of aquatic toxicity tests
  - Insufficient data to quantify the amount and effects of nonpoint sources
  - Insufficient data for models to correlate daily loadings with violations of chronic water column criteria
  - Flow rates
  - Water and sediment depths
  - Length of stream
  - Solids in water column and sediments
  - Sedimentation and re-suspension velocities
  - Diffusive exchange
  - Water column and sediment partition coefficients
  - Sedimentation rates
  - Total suspended solids
  - Wet weather data
  - Total vs. dissolved nutrient data
    - Steady state modeling insufficient to calculate daily loads and wasteload allocations
  - Ambient, point source, and nonpoint source nutrient concentrations variable at low flow
  - Lack of necessary data representing daily (24-hour) averaging period

- Models generating loads for monthly, seasonal, or wet weather time intervals cannot reflect daily variability in site conditions
- Possible issues concerning technical and economic feasibility of control or measurement on daily basis

III. Pathogens

A. General Suitability

- Wet weather dominated so naturally variable
  - Critical condition only in high flow (Big Walnut Creek 2005; Cedar River 2005)
- WQS and WQC expressions do not coincide with daily determinations
  - Usually seasonal standards and criteria only (South Branch Yellow Medicine)
  - Often measured as a monthly average of pathogen concentration/density (Wolf River 2002; Little Vermillion 2006; Lower Eel 2005, Cedar River 2005)

B. Technical Suitability

- Nonpoint sources often dominate and are difficult to clearly identify (South Branch Yellow Medicine)
- Appropriate flow data necessary to accurately do daily calculation (Cedar River 2005)
- Implementation may be better suited for BMPs (Campbell Creek)

IV. Listing Options Where Daily TMDL Not Appropriate

- Category 4(B): Water quality impairment will be addressed through programs other than the TMDL program
- North Carolina Approach: Encourage state to create new listing category for situations presenting technical suitability issues
- Category 5M for states that have mercury reduction programs.

V. Flexibility Within a Daily TMDL

If a state or EPA is developing a TMDL for a pollutant that is not really suitable for a daily TMDL calculation, EPA guidance can be used to encourage the agency to incorporate as much flexibility as possible:

- Daily TMDLs should be expressed in the most appropriate manner—daily minimum, maximum, or average, including seasonal or wet weather variations.
- Daily load calculations should be supplemented with loadings expressed using the most appropriate timeframe for the pollutant— as weekly, seasonal, monthly, or annual averages.
- Daily TMDLs should be implemented through permit limits establishing using the most appropriate timeframe— long-term or seasonal averages—or BMPs, if appropriate.

DISCUSSION

I. Introduction

The Court of Appeals for the D.C. Circuit recently held that all total maximum daily loads ("TMDLs") must be expressed as "daily" loads in order to comply with the Clean Water Act ("CWA"). *Friends of the Earth v. EPA*, 446 F.3d 140 (D.C. Cir. 2006). The court rejected EPA's practice of establishing and approving TMDLs expressed in terms of monthly, seasonal, or annual average loading for certain pollutants. The opinion was based in part on a 1978 EPA determination that all pollutants, under the proper technical conditions, are suitable for TMDL calculations. Although the court indicated that EPA was free to revisit that determination for pollutants for which long-term or seasonal loads are more appropriate, EPA appears reluctant to do so. EPA is now advising all states and EPA regions to express all future TMDLs as daily loads, and to include daily load expressions in any prior non-daily TMDLs that are revised in the future.

This paper discusses the factors relevant in determining the suitability of pollutants for TMDL calculations, and specifically addresses arguments that may be helpful in opposing the establishment of daily TMDLs for mercury, nutrients and pathogens, which might result in daily limits in wastewater discharge permits.

II. Background

The CWA requires states to identify impaired waters—those that do not meet established water quality standards:[1] States are further required to develop TMDLs to address the identified impairments, but only for those pollutants suitable for TMDL calculation.[2] TMDLs establish, among other things, wasteload allocations ("WLAs") for point source dischargers contributing to the impairment. Wastewater discharge permits issued under the National Pollutant Discharge Elimination System ("NPDES") program must comply with applicable TMDLs.[3] The CWA further requires EPA to specifically identify those pollutants suitable for TMDLs.[4] Pursuant to this requirement, EPA in 1978 identified "all pollutants, <u>under proper technical conditions</u>, as being suitable for the calculation of total maximum daily loads."[5]

After EPA's 1978 determination, it defined "TMDL" to include not just daily loads, but other appropriate expressions of the loads necessary to achieve water quality standards. That definition states that "TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure."[6] Using that definition, EPA issued and approved non-daily TMDLs for a variety of pollutants. This approach was upheld by the Second Circuit in *Natural Resources Defense Council v. Muszynski*, 268 F.3d 91 (2d Cir. 2001), but it has now been rejected by the D.C. Circuit in *Friends of the Earth*. The United States Supreme Court has refused to resolve this conflict between the circuits, and although EPA could interpret the *Friends of the Earth* opinion as applicable only within the jurisdiction of that court—Washington, D.C.—EPA has chosen to follow the requirements of that opinion nationwide.

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[1] CWA 303(d)(1)(A), 33 USC 1313 (d)(1)(A).
[2] CWA 303(d)(1)(C); 33 USC 1313(d)(1)(C) (emphasis added).
[3] 40 CFR 122.44(d)(1)(vii).
[4] CWA 304(a)(2); 33 USC 1314(a)(2).
[5] 43 Fed. Reg. 60,662 (Dec. 28, 1978) (emphasis added).
[6] 40 CFR 1302(i).

III. "Proper Technical Conditions" for TMDL Calculation

EPA's determination that all pollutants were suitable for TMDL calculation went unchallenged, perhaps due to EPA's practice of establishing alternative TMDLs for pollutants that were not necessarily suitable for daily TMDLs, such as PCBs, mercury, nutrients, and others. Because EPA will likely require all future TMDLs—including those for mercury, pathogens and nutrients—to be expressed in daily terms, it may be appropriate to revisit that blanket determination in specific circumstances. Support for such an effort can be found in statements made by EPA as part of the 1978 determination, as well as in later rulemaking efforts, federal guidance documents, and court filings.

A. 1978 Suitability Determination

EPA determined that all pollutants are suitable for TMDL calculation, but only under "proper technical conditions."[7] EPA explained that such conditions necessarily vary depending on particular waterbody and pollutant characteristics, and declined to identify specific suitable pollutants in order to allow states maximum flexibility in the application of state resources to TMDL development:

> "Proper technical conditions" refers to the availability of the analytical methods, modeling techniques and data base necessary to develop a technically defensible TMDL. These elements will vary in their level of sophistication depending on the nature of the pollutant and characteristics of the segment in question. They must be determined on a case-by-case basis. It is impossible to detail the proper technical conditions for all pollutants in all situations. Moreover, EPA does not want to preclude States from developing their own approaches.
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> A few commenters felt that some pollutants are not suitable for TMDL calculations because adequate analytical methods or modeling techniques do not yet exist. The Agency believes that TMDLs can be determined for any pollutant. EPA recognizes that proper techniques do not exist for all pollutants in all situations; however, proper techniques can be developed for any pollutant given adequate resources. A limited list of specific pollutants would be too restrictive because it might preclude the States from determining TMDLs for other pollutants for which proper techniques can be developed.[8]
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> Since TMDL calculations are made on a case-by-case basis, the States are free to use their judgment in classifying a pollutant as either conservative or nonconservative, based on the characteristics of the segment in question. Also, EPA recognizes that N-TMDLs are affected by a number of factors including chemical and biological processes in the aquatic

[7] 43 Fed. Reg. 60,662 (Dec. 28, 1978).
[8] 43 Fed. Reg. at 60,662-63.

> environment, and the States will be free to use their judgment in weighing these factors.[9]

Such language indicates that EPA intended states to exercise discretion in determining whether the proper technical conditions were available to develop a technically defensible TMDL in a given situation. For example, EPA indicated in its proposed determination that the method of TMDL calculation for conservative pollutants would generally be different than the method required for nonconservative pollutants.[10] For nonconservative pollutants, proper TMDL calculation would require modeling to account for a number of variables, including flow or volume of the receiving body of water, flow from dischargers, and the configuration of discharge locations on the body of water.[11] All of these factors require sophisticated techniques and mathematical modeling, which may not be available in all instances.

B. <u>1985 Water Quality Planning and Management Rulemaking</u>

EPA regulatory language also promotes using non-daily expression in certain instances. it's the Water Quality Planning and Management Rule in 1985 recognizes the need for TMDLs to be expressed in non-daily terms and allows them to exist as long as compliance with water quality standards is achieved.[12] EPA ultimately defined TMDL to allow non-daily load expressions by noting that "TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure."[13] This definition remains in current EPA regulations at 40 CFR 130.2(i).

C. <u>2000 TMDL Rulemaking</u>

During 1999 and 2000, EPA proposed and adopted a revised TMDL Rule, which was ultimately withdrawn. Although that rule is no longer in effect, EPA's preamble language described a number of situations in which a daily TMDL expression was not appropriate. EPA justified the changes based on past attempts to establish TMDLs for some pollutants where the pollutant characteristics and their applicable standards made "daily" loads simply not technically appropriate for implementing water quality standards.[14] These arguments can be reused to help justify focusing on the non-daily load aspect to your state water quality authority.

When it proposed the rule, EPA explained generally that "[t]he technical approach used to develop TMDLs varies according to the pollutant of concern, the type of waterbody, and the type and number of pollutant sources….It is important that a TMDL be expressed in terms that are appropriate to the characteristics of the waterbody and pollutant combination."[15] EPA then provided examples of TMDLs (i.e., phosphorus, sediment, and temperature) that should be expressed in terms other than daily because the pollutants do not lend themselves to daily regulation.

EPA illustrated that daily phosphorus loads, for example, would not provide the allocation of phosphorus necessary to attain or maintain water quality standards because, while it might cover

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[9] 43 Fed. Reg. at 60,663.
[10] 43 Fed. Reg. 42,303, 42,304 (Sep. 20, 1978).
[11] *Id.*
[12] 50 Fed. Reg. 1773, 1776 (Jan. 11, 1985).
[13] 50 Fed. Reg. at 1780 (emphasis added).
[14] 65 Fed. Reg. 43,586, 43,623-29 (Jul. 13, 2000).
[15] 64 Fed. Reg. 46,012, 46,030-31 (Aug. 23, 1999).

current loads, it would not account for the amount of the pollutant stored in the lake or reservoir.[16] Daily loads for phosphorus would also not be appropriate because they would not account for seasonal and climatic events, which are important parts of the phosphorus cycle.[17] Similarly, sediment TMDLs would not be best addressed through daily loads because daily loads would not address "the variability of sediment loadings due to flows related to rainfall or snowmelt, the natural background sediment loads carried by the waterbody, channel characteristics and aquatic life needs."[18] Daily sediment load restrictions also would not reflect the "natural background load, the variability in loadings over time and season, or the amount of pollutant load reduction needed to maintain sediment loads within the natural limits and requirements of the waterbody to attain or maintain water quality standards."[19] Last, EPA noted that "temperature is another example of a pollutant where other than daily loads may be the most appropriate expression of an allocation established as part of a TMDL."[20] Temperature has climatic and seasonal variation that makes daily loads difficult to calculate accurately. As such, EPA noted that "[a] daily load of heat and the resultant temperature in the waterbody is not as important as maintaining the range required by the aquatic life through different seasons and climatological events."[21] Therefore, temperature is also better expressed in non-daily terms to preserve the needed temperature ranges throughout the seasons.[22]

In order to address the need for such non-daily load expressions, EPA proposed that TMDLs be expressed as daily, monthly, seasonal, or annual loads as needed, to ensure that the TMDL attains and maintains water quality standards.[23] After receiving adverse comments, however, EPA indicated that it would instead use the existing definition of TMDL to support non-daily TMDLs to avoid misuse of its language to justify some TMDLs that do not in fact attain and maintain water quality standards in all seasons and for all flows.[24] Despite its withdrawal of language specifically allowing monthly, seasonal, and annual load expressions, EPA affirmed its belief that such approaches were necessary in certain instances as long as they are sufficient to eliminate the impairment, addressing all aspects of the water quality standard and the adverse effects of the pollutant in question.[25]

D. EPA Guidance Documents

Early EPA guidance concerning TMDL development was fairly basic with respect to load expression, because EPA operated under the assumption that, despite its 1978 Suitability Determination, it was not restricted to actual "daily" load expressions. All of this guidance remains in effect today, even though the *Friends of the Earth* decision calls EPA's conclusions (i.e., that non-daily expression is appropriate) into question. More importantly, the rationale that EPA used in these guidance documents provide multiple examples of EPA's belief that certain pollutants, in at least some circumstances, are not appropriate for daily load calculation. To that end, much of EPA's past rationale may be useful in convincing your state that your pollutant of concern and your waterbody are not amenable to following a "daily" load regime.

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[16] 64 Fed. Reg. at 46,031.
[17] *Id.*
[18] *Id.*
[19] *Id.*
[20] *Id.*
[21] *Id.*
[22] *Id.*
[23] Proposed 40 CFR 130.34, 64 Fed. Reg. at 46,051.
[24] 65 Fed. Reg. at 43,629.
[25] 65 Fed. Reg. at 43,629-30.

1. General EPA TMDL Guidance

EPA has long acknowledged that TMDLs could be expressed in terms of either mass per time, toxicity, or other appropriate measure, depending on the applicable water quality standard.[26] In addition to weekly, monthly, or seasonal loads, EPA indicated that some TMDLs may be expressed as "an estimate of the percent reduction in discharge of the pollutant of concern which is needed to attain water quality standards."[27] For TMDLs establishing non-daily loads, EPA indicates that an explanation would be required:

> 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.[28]

EPA emphasized the need to develop technically defensible TMDLs, but generally did not consider suitability in the context of determining whether a technically defensible TMDL could be developed. In fact, EPA's early approach recommended using a phased approach to TMDL development—with a very conservative margin of safety—to address any gaps in the data and information:

> For traditional water pollution problems, such as dissolved oxygen depletion and nutrient enrichment, there are well validated models that can predict effects with known levels of uncertainty. This is not true for such non-traditional pollution problems as urban stormwater runoff and pollutants that involve sediment and bioaccumulative pathways. Predictive modeling for these problems therefore uses conservative assumptions, but in many cases the degree of certainty cannot be well quantified until more data becomes available to develop sensitivity analyses and model comparisons. For TMDLs involving these non-traditional problems, the margins of safety should be increased and additional monitoring required to verify attainment of water quality standards and provide data needed to recalculate the TMDL, if necessary.[29]

Perhaps due to its flexible interpretation concerning the appropriateness of non-daily TMDLs, EPA apparently did not contemplate a situation where a TMDL could not be developed, even in the absence of necessary data and information. In an early flow chart depicting the TMDL process, EPA asked the question, "Is information adequate to determine load reductions?" If the answer was "No," EPA indicated that a phased TMDL should be developed and implemented concurrently with additional data collection and monitoring, so that the TMDL could be revised in the future.[30] The margin of safety was viewed as adequate to account for uncertainty caused by a lack of data or modeling:

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[26] *Technical Support Document for Water Quality-based Toxics Control* (EPA 505/2-90-001, Mar. 1991) at p. 67; *Guidance for Water Quality-based Decisions: The TMDL Process* (EPA 440/4-91-001, Apr. 1991) at p. 6; *Guidance for Developing TMDLs in California* (EPA Region 9, Jan. 7, 2000) at p. 3.
[27] *Guidance for Developing TMDLs in California* at p. 5.
[28] *Guidelines for Reviewing TMDLs Under Existing Regulations Issued in 1992* (EPA, May 20, 2002).
[29] *Guidance for Water Quality-based Decisions: The TMDL Process* at p. 15.
[30] *Id.* at p. 21.

> The margin of safety is to take into account any uncertainties related to development of the water quality-based control, including any uncertainties in pollutant loadings, ambient conditions, and the model analysis.[31]

2. Model Selection Guidance

EPA guidance for model selection in TMDL development expands on suitability considerations, with respect to "proper technical conditions" for TMDL calculation.[32] EPA's *Compendium of Tools for Watershed Assessment and TMDL Development* "provide[s] watershed managers and other users with information helpful in selecting [models to assess and predict conditions of waterbodies] appropriate to their needs and resources."[33] According to that Modeling Guidance, the appropriateness of a selected model can depend on a number of factors, including: the type of source, the geographic area, the type of pollutant, the type of waterbody, the type of TMDL to be developed (*i.e.*, phased TMDL), and experience using a particular model.[34] This guidance provides a good analytical tool for demonstrating that daily TMDL expression is not always appropriate.

Under this guidance, the appropriate model for a NACWA member's receiving water generally depends on the stage of TMDL development.[35] Within each stage there are different considerations and criteria that make one type of model more appropriate than another. For example, the Modeling Guidance notes criteria that lead to TMDL model selection, "such as value of resource considered, data needs, application cost, accuracy required, type of pollutants/stressors considered, management consideration and user experience."[36] More importantly, EPA notes that improper model selection (*i.e.*, models maladapted for a given situation) can adversely affect TMDL development.[37] As discussed below, NACWA members limited to certain "simple" or "steady-state" models may wish to emphasize these core considerations when dealing with their states as TMDLs are being developed.

The Modeling Guidance breaks watershed assessment models into three categories, each with different capabilities, detail and accuracy: watershed loading, receiving water, and ecological.[38] Within each category of model, the Modeling Guidance subcategorizes the various models with respect to simplicity/comprehensiveness. Within the realm of watershed loading models, EPA identifies "Simple Method" models that are "used when *data limitations and budget and time constraints* preclude the use of complex models."[39] Simple Method models may be more appropriate for pollutants such as nutrients entering long-residence-time waterbodies (*i.e.*, lakes or reservoirs), because they use large simulation steps to provide long-term averages or annual estimates. Simple Method models also are appropriate for long-residence-time waterbodies because they often neglect temporal variability.[40] Conversely, these factors do not work well with water quality problems for which loadings of shorter duration are important.[41] Thus, when Simple Method models are the best

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[31] *Technical Support Document for Water Quality-based Toxics Control* (EPA 505/2-90-001, Mar. 1991) at p. 68.
[32] 43 Fed. Reg. at 60,662.
[33] EPA 841-B-97-006, *Compendium of Tools for Watershed Assessment and TMDL Development* ("Modeling Guidance") (May 1997) at p. iii.
[34] *Id.* at p. 1.
[35] *Id.* at pp. 61-62.
[36] *Id.* p. 1.
[37] *Id.* at p. 61.
[38] *Id.* at p. 1.
[39] *Id.* at p. 10 (emphasis added).
[40] *Id.* at p. 11.
[41] *Id.* at p. 11; *See also*, *Protocol for Developing Nutrient TMDLs*, EPA 841-B-99-007, First Edition (November 1999)

option for a particular receiving water (using the factors noted above) they will typically generate mean annual rather than daily values.[42]

In addition to analyzing the loading into the watershed, the Modeling Guidance recommends that watershed managers analyze the interplay between the loading models and models addressing the effects of pollution on the waterbody ("Pollution Effects Models").[43] The Pollution Effects Models are also subcategorized based on hydrodynamic impact, spatial domain, temporal domain, transport process properties, inputs amounts, and variables indicating the state of the waterbody.[44] The simplistic or "steady-state models" are noted as being more appropriate for traditional point sources (*i.e.*, where biodegradable pollutant discharges are the major concern). On the other hand, more complex waterbody effects modeling is more appropriate when dealing with toxics or eutrophication issues.[45] Similar to Simple Method watershed loading models, the Modeling Guidance notes that the simple "steady-state" waterbody effects modeling types are limited in that they are not appropriate for addressing variability, such as, time-variable nonpoint source loads or where waterbodies that experience short-term violations of acute criteria (*e.g.*, storm or CSO events).[46]

For NACWA members facing a TMDL, this guidance demonstrates EPA awareness of innate differences in each TMDL situation, which ultimately dictate how the impairment should be addressed (*i.e.*, what models are most appropriate). Because of that awareness, EPA continues to recommend model selections tailored to a variety of situations and NACWA members can use that recommendation to support non-daily expressions for their waterbody if appropriate. Unlike the Court's decision in *Friends of the Earth,* which would suggest that only complex models giving daily loads are required, EPA specifically notes that "no one model is ideal."[47] Thus, NACWA members should continue to emphasize EPA guidance indicating that the appropriately selected model will depend on the circumstances surrounding the TMDL, and that certain load modeling capabilities may be limited to results expressed in non-daily terms (*i.e.*, the effects of nutrient loadings).

3. Pollutant-Specific Guidance

EPA has offered technical and substantive guidance for TMDLs that advocate non-daily load expressions for certain types of pollutants. Though this guidance focuses on a few relevant pollutant types, the concepts are not confined to these pollutants. NACWA members may find that other pollutants pose similar concerns for TMDL development as those identified by EPA.

For example, EPA has issued a protocol for nutrient TMDLs on lakes and rivers that provides considerations for "the type of impairment (e.g., violation of a numeric criterion versus designated use impairment), the physical, biological, and chemical processes occurring in the waterbody and its watershed, the size of the watershed, the number of sources, the data and resources available, and the types and costs of actions needed to implement the TMDL."[48] The appropriate nutrient TMDL

("Nutrient Protocol") at 5-9.

[42] Alternatively, a watershed manager could select to use "Mid-range" or "Detailed" Models, if the circumstances are appropriate. Mid-range Models and Detailed Models are more focused than Simple Methods and would not likely analyze pollutants on an annual average. The fact that there exists a variety of modeling methods provides further evidence that waterbodies/situations can be appropriately analyzed on a number of levels.

[43] *Id.* at p. 7

[44] *Id.* at p. 24.

[45] *Id.* at p. 23.

[46] *Id.* at p. 25.

[47] *Id.* at p. 62.

[48] Nutrient Protocol at p. 2-6.

expression may also depend on the various forms of a pollutant (*e.g*., particulate and organic nitrogen are less important in the short term because they must be converted to a usable form, available phosphorus most important for short-residence-time streams and total phosphorus most important for long-residence-time lakes).[49] Also, in connection with pollutant forms, the Nutrient Protocol notes that nutrient bioavailability, and therefore effects, may vary based on the residence time for waterbody subject to the TMDL (*e.g.*, rivers with shorter residence times do not allow for effective decomposition of organic phosphorus).[50]

The Nutrient Protocol also describes the importance of analyzing "the seasonal or annual variability in loadings, particularly where significant contributions are made by precipitation-driven nonpoint sources."[51] According to EPA, the temporal variation of nutrient loadings and critical summer growth conditions typically dictate the amount of algal growth in streams:

> TMDLs must consider temporal (e.g., seasonal or interannual) variations in discharge rates, receiving water flows, and designated use impacts. These considerations are especially important for stream nutrient TMDLs because both point and nonpoint nutrient sources can discharge at different rates during different time periods and plant growth can vary considerably by season. A frequent critical period for a nutrient stream TMDL is the summer low-flow, high-temperature period, because these conditions are favorable for nuisance plant growth. Critical conditions also can occur during other times of the year, however. For example, in the fall, upstream organic carbon sources from phytoplankton and aquatic plants can result in large depressions in levels of dissolved oxygen. Spring floods that pick up large amounts of organic debris from adjacent floodplains also can result in severe dissolved oxygen depletion or phytoplankton blooms (USEPA, 1995a).[52]

Lakes and reservoirs have different characteristics that impact algal growth:

> Seasonal variations are also important for lake nutrient TMDLs. For example, a key aspect of plant dynamics in temperate lakes is the magnitude of the spring phytoplankton bloom. Algal growth typically is greatly reduced or negligible during the winter low light and temperatures; it then usually increases during the spring under increasing sunlight. The spring maximum is generally short-lived (less than one to two months) and a period of low algal numbers and biomass often follows that can extend throughout the summer (Wetzel, 1983). The effects of nutrient inputs to reservoir main stems also may vary with the reservoir's thermal regime and hence with the time of year. The mixing of in-flows during winter and spring may affect the entire waterbody, while in-flows during stratified periods may enter as underflow and might not affect the photic zone, especially in bottom-discharging reservoirs.[53]

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[49] *Id.* at p. 2-4.
[50] *Id.* at p. 5-2.
[51] *Id.* at p. 7-2.
[52] *Id.* at p. 3-5.
[53] *Id.*

The key EPA conclusion from these nutrient examples is that "[i]n receiving waters with longer residence times, including some lakes and estuaries, it is appropriate to estimate loads monthly or even annually."[54] NACWA members may find that the residence time and characteristics of other pollutants may be analogous to nutrients and can use that comparison when discussing TMDL development with their state.

The Nutrient Protocol also addresses the technical appropriateness of TMDL development, particularly with respect to modeling and analytical limitations noted in EPA's Modeling Guidance. Some factors reiterated by EPA for nutrients include "[p]hysical and hydraulic characteristics of the waterbody (e.g., lake versus stream); [t]emporal representation needs. (Are seasonal averages sufficient, or must dynamic events on a shorter time scale be evaluated?); [s]patial representation needs. (Are there significant spatial variations in the indicator and does spatial variability in the waterbody need to be represented?); [u]ser requirements (including availability of resources, time constraints, and staff familiarity with specific analysis techniques); [s]takeholder interests and outreach needs; [and] [d]egree of accuracy needed."[55]

Other pollutants addressed by EPA include fecal coliform, *E.coli*, and other bacteria in EPA's Pathogen Protocol.[56] The Pathogen Protocol describes the difficulties of pathogen TMDL development, especially dealing with variability caused by such factors as nonpoint source identification and the proper conditions for pathogen growth:

> Pathogenic organisms are one of many types of pollutants generated at a source (point or nonpoint) and then transported by a pipe, storm water runoff, groundwater, or other mechanism to a body of water. Identifying these sources and tracking the movement of pathogens is often a difficult and resource-intensive task.[57]
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> The primary rural nonpoint source for pathogens is confined animal operations, in which large quantities of fecal matter are produced. Livestock excrement from barnyards, pastures, rangelands, feedlots, and uncontrolled manure storage areas is a significant nonpoint source of bacteria, viruses, and protozoal cysts. The occurrence and degree of fecal indicator and pathogen loads from livestock are linked to temporally and spatially variable hydrologic factors such as rainfall and runoff except when manure is deposited directly into a waterbody (Edwards et al.,1997).[58]
>
> ***
>
> Determining what happens to the microorganisms once they reach the waterbody is often as challenging as identifying and tracking their sources. As living organisms they require certain conditions to survive, grow, and reproduce. Thus, risks to human health can be increased or decreased depending on water temperature and other factors associated with the waterbody. Many factors influence the die-off rate of viruses, bacteria, and protozoans in the environment. These factors include

[54] *Id.* at p. 5-6.
[55] *Id.* at pp. 6-1 - 6-2
[56] *Protocol for Developing Pathogen TMDLs*, EPA 841-R-00-002, First Edition (January 2001).
[57] *Id.* at p. 2-5.
[58] *Id.* at p. 2-6.

> sunlight, temperature, moisture conditions, salinity, soil conditions, waterbody conditions, settling, association with particles, and encystation. Many other factors affect the die-off rate of pathogens, but not all are described in this protocol. Some of these other factors include the age of the fecal deposit, pH, starvation, structural damage, chemical damage, predation (Davies-Colley et al., 1994), osmotic stress in moving from fresh to marine waters, nutrient deficiencies, turbidity (water clarity), variation of spectral quality of sunlight, microbial composition of effluents, and oxygen concentrations.[59]

Among other things, these factors present different temporal considerations when developing a TMDL according to source behavior. For example, EPA notes that "point sources or continuous loading sources (e.g., wastewater treatment plants) tend to have the greatest impact on stream water quality under low-flow, dry weather conditions, when dilution is minimal."[60] Conversely, EPA finds that nonpoint source loadings are typically precipitation driven and that the "[m]aximum impacts from rain-related nonpoint source loading generally occurs at high flows."[61] EPA recommends a number of options that may be appropriate for dealing with temporal issues:

> Varying sources can result in multiple critical conditions. In some cases, it may be necessary to evaluate a TMDL under a variety of conditions to account for the different times of greatest impact from sources (e.g., low flow and high flow). Analysts may want to identify the different critical conditions and evaluate them separately. Another option is to develop the TMDL for a time period that encompasses all of the possible critical conditions. For example, develop a TMDL based on various flow rates or develop separate TMDL allocations for different seasons. When using dynamic modeling, a representative time period can be chosen for the TMDL development to represent conditions likely to occur (i.e., a year with wet and dry seasons, a multiple-year period to account for meteorologic and source variations).[62]
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> Seasonal variations are also important for pathogen TMDLs. In-stream concentrations of bacterial indicators and pathogens vary over the course of the year in response to many factors, including weather and source characteristics. For example, the coliform removal efficiency may be lower during winter months, resulting in less die-off than in warmer months. Source behavior may also influence the seasonal variability of bacterial loading in a watershed. Significant bacterial loads can originate from agricultural land receiving land application of manure; however, farmers may only spread manure during the spring season, resulting in high spring loads and lower summer, fall and winter loads.[63]
>
> Several states have bacterial indicator standards that vary based on season. These standards usually correspond with the seasonal use designation (e.g., primary contact recreation for summer months and

[59] *Id.* at p. 2-7.
[60] *Id.* at p. 3-4.
[61] *Id.*
[62] *Id.* at pp. 3-4 - 3-5.
[63] *Id.* at p.3-5.

> secondary recreation for the non-summer months). TMDLs are developed for waters exceeding the applicable water quality standards and are applied according to the conditions of those standards (e.g., criteria set for the season or flow). Therefore, if a waterbody exceeds a seasonal designated or existing use or criterion, a TMDL is developed and applied on a corresponding seasonal basis.[64]

Hence, EPA again recognizes that it is unlikely that a State could address all pathogen TMDLs in a daily format. In this instance, EPA notes that pathogen allocations within a TMDL are more appropriately expressed as organism count, resulting concentration or BMPs in lieu of an effluent limitation, rather than mass per time (*i.e.*, g/day).[65]

In general, both the EPA Nutrient Protocol and the EPA Pathogen Protocol recognize that there is a range of appropriate methods to address TMDL development.[66] In recognizing this range, EPA expands on the notion that TMDL development should be flexible and that applying a rigid "cookbook" approach is not appropriate:

> TMDL analysts should be resourceful and creative in selecting TMDL approaches and should learn from the results of similar analytical efforts. The degree of analysis required for each component of TMDL development (e.g., selection of indicators and targets, source analysis, link between sources and water quality, and allocations) can range from simple, screening-level approaches based on limited data to detailed investigations that might need several months or even years to complete. Various interrelated factors will affect the degree of analysis for each approach: the type of impairment (e.g., violation of a numeric criterion versus designated use impairment); the physical, biological, and chemical processes occurring in the waterbody and its watershed; the size of the watershed; the number of sources; the data and resources available; and the types and costs of actions needed to implement the TMDL.[67]
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> Decisions regarding the extent of the analysis must always be made on a site-specific basis as part of a comprehensive problem-solving approach. TMDLs are essentially a problem-solving process to which no "cookbook" approach can be applied. Not only will different TMDL

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[64] *Id.*
[65] *Id.* at 7-1, 7-3.
[66] A third protocol was published by EPA tailored specifically to developing Sediment TMDLs. *Protocol for Developing Sediment TMDLs*, EPA 841-B-99-04, First Edition (October 1999) ("Sediment Protocol"). EPA notes that there are a number of factors that should be considered in selecting TMDL allocation methods, including: types of sources and management options, equity issues, variability of loads and impacts, margin of safety issues, future growth, need for stakeholder involvement and public outreach, and implementation and reasonable assurance issues. *Id.* at pp. 7-1 thru 7-3. Using those factors, EPA recommends that an acceptable approach to sediment load and wasteload allocation is to "set allocations for relatively long time steps (e.g., average annual sediment load per square mile) expressed as a multiyear rolling average (e.g., 10-year rolling average for Redwood Creek, California TMDL)." *Id.* at p. 7-4. EPA believes that such an approach would account for the inevitable variability in sediment loadings over time (*i.e.*, in response to precipitation patterns). *Id.* Other appropriate allocation methods noted by EPA include percentage reduction targets and allocations based on performance of actions or practices. These allocation options are also considered appropriate for addressing the "uncertainties and variabilities in the analysis of [a] dynamic watershed." Sediment Protocol at p. 7-4.
[67] *Id.* at p. 2-6.

> studies vary in complexity, but the degree of complexity in the methods used *within* individual TMDL components also may vary substantially. Simpler approaches can save time and expense and can be applied by a wider range of personnel. Simple approaches also generally are easier to understand than more detailed analyses.[68]
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> * * *
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> A variety of approaches to developing a TMDL are justifiable as long as they adequately identify the load reductions or other actions needed to restore designated or existing uses. Because all situations requiring development of a TMDL are different, one cannot specify that if X and Y are true a certain approach must be used. Site-specific factors should always be taken into account and an appropriate balance struck between cost and time issues and the benefits of additional analyses.[69]

On the regional level, EPA has developed nutrient TMDL guidance providing further justification for non-daily load expression. In New England, EPA has recognized that certain pollutants may not lend themselves to daily implementation measures. As a result, non-daily load expressions may be appropriate in that region, as long as the state provides adequate rational for using non-daily loads:

> As the term implies, TMDLs are typically expressed as total maximum daily loads. Where the TMDL is expressed in terms other than daily load, there should be an explanation as to why such an approach is appropriate. For example, in the case of many lakes, it is appropriate and justifiable to express a nutrient TMDL in terms of allowable annual loadings because long-term average pollutant loadings are typically more critical to overall lake quality. The hydraulic residence time is a critical concept for lakes, as it influences so many aspects of lake condition and pollutant processing. The hydraulic residence time is almost never on a scale of a day, but rather on a scale of weeks, months, or sometimes years. For many New England lakes, long hydraulic residence times justify expressing the TMDL in terms of annual loading. However, regardless of hydraulic residence time, an annual scale may be reasonable where the lack of information prevents any kind of meaningful monthly or seasonal analysis. Also, most of the available empirical lake models use annual loads rather than daily loads to estimate in-lake concentrations, and the overall accuracy of an analysis involving nonpoint source loading and lake water quality typically improves as the averaging period for estimating nonpoint source loading and lake water quality increases.[70]

The EPA New England Nutrient Guidance indicates that divergence from daily nutrient loads for lakes is appropriate "because long-term average pollutant loadings are typically more critical to overall lake water quality."[71] Also, non-daily loads are more appropriate under EPA's determination because the most relevant and "critical" factor for nutrients is the hydraulic residence

[68] *Id.*
[69] Pathogen Protocol at pp. 2-12, 6-2,
[70] *Regional Guidance on Submittal Requirements for Lake and Reservoir Nutrient TMDLs* (EPA New England Region, Nov. 1999) at pp. 6-7.
[71] *Id.* at pp. 6-7.

time of the pollutant, which is "almost *never* on a scale of a day, but rather on a scale of weeks, months, or sometimes years."[72] Thus, pollutants with long hydraulic residence times and long-term impacts should more appropriately be addressed in something other than daily load expressions. This regional guidance will be of particular use to NACWA members in the New England area; however, the concepts can be used in other regions as well.

4. Wet Weather Source Guidance

Some NACWA members may find themselves soon to be subject to TMDLs including wet weather sources in the loading considerations. In such instances, NACWA members may use EPA guidance on wet weather load allocations as another example of situations where EPA approves focusing on something other than daily load expressions.

In EPA guidance for "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on those WLAs" ("Stormwater Memo") indicates that load expressions for stormwater are best implemented in terms of best management practices ("BMPs").[73] The Stormwater Memo does not directly address the load expressions for permitted stormwater sources (*i.e.*, Municipal Separate Storm Sewer Systems or MS4s). Instead, the Agency focuses on the implementation of the loadings into NPDES permits. EPA specifically acknowledged that stormwater TMDLs might present significant difficulties due to lack of necessary data and information, and therefore, recommended that BMPs take the place of numeric limits in stormwater permits:

> …EPA's policy recognizes that because storm water discharges are due to storm events that are highly variable in frequency and duration and are not easily characterized, *only in rare cases will it be feasible or appropriate to establish numeric limits for municipal and small construction storm water discharges*. The variability in the system and minimal data generally available make it difficult to determine with precision or certainty actual and projected loadings for individual dischargers or groups of dischargers.[74]

When addressing stormwater sources, EPA recommends that TMDLs be established using a phased or iterative approach that could include group wasteload allocations for permitted stormwater discharges, with implementation through NPDES permit limitations expressed as best management practices (BMPs).[75] NACWA members facing TMDLs dominated by stormwater sources will find this guidance particularly helpful in encouraging states to address the loadings through BMPs rather than trying to predict the actual loadings (daily or not) for individual discharges.[76]

5. Waterbody Type Guidance

The appropriate TMDL and corresponding WLAs for a particular waterbody may also depend on the waterbody itself, at least for some pollutants (*i.e.*, nutrients). After EPA's 1978 suitability

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[72] *Id.*
[73] Memorandum from Robert H. Wayland, III and James A. Hanlon to EPA Regional Water Division Directors: *Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs* (Nov. 22, 2002).
[74] Stormwater Memo at p. 4 (emphasis added).
[75] *Id.* at pp. 4-5.
[76] *Id.*

determination, EPA has since recognized different considerations for TMDL development and WLA[77] development based on whether discharges occur to rivers, streams, lakes, or estuaries. To date, at least four relevant "Technical Guidance Manuals" have been developed by EPA.[78] These manuals indicate that appropriate nutrient model selection depends on a number of factors that may not be amenable to reaching daily load results.

The Stream and River Nutrient WLA Guidance notes that spatial definition is an important factor for determining the appropriate model for stream or river nutrient loadings. EPA notes that "[t]he need for incorporating additional [modeling] dimensions will influence the model selection process:"[79]

> For most waste load allocation studies for streams and rivers, a one dimensional analysis framework will be appropriate. Wide and/or deep rivers may provide exceptions, and the determination of a need to utilize 2 or even 3 dimensional frameworks should be based on the geomorphology of the river an on a review of any available water quality data.[80]
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> Impounded rivers will quite often require an analysis using more than one dimension.[81]
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> Deep rivers will sometimes show significant dissolved oxygen gradients because of the combination of sediment oxygen demand influences on the lower levels and algal productivity in the near-surface areas.[82]

The Stream and River Nutrient WLA Guidance also notes that temporal differences influence the appropriate WLA determination:

> [D]ifferent water quality problems have different time scales. The time scale associated with dissolved oxygen is on the order of days to weeks, which is shorter than the month to seasonal time scale related to nutrient associated problems. The selection of a steady-state or time-variable model should be determined on the basis of the water quality variable of

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77 WLA refers to TMDL allocation procedures, as well as, non-TMDL WLA development. Although non-TMDL WLA development is not directly applicable to NACWA TMDL issues, the processes and discussions within these documents remains useful as published EPA recognition that waterbody types influence what is appropriate and suitable for nutrient load analyses.

78 EPA 823-B-97-002, *Technical Guidance Manual for Performing TMDLs. Book II, Streams and Rivers: Part 1. BOD/Dissolved Oxygen and Nutrient/Eutrophication* (March 1997) ("Stream and River Nutrient TMDL Guidance"); EPA 823-R-92-003, *Technical Guidance Manual for Performing Waste Load Allocations. Book III, Estuaries: Part 2. Application of Estuarine Waste Load Allocation Models* (May 1990) ("Estuary WLA Guidance"); *Technical Guidance Manual for Performing Waste Load Allocations. Book II, Streams and Rivers: Chapter 2. Nutrient/Eutrophication Impacts* (November 1983) ("Stream and River Nutrient WLA Guidance"); *Technical Guidance Manual for Performing Waste Load Allocations. Book IV, Lakes and Impoundments: Chapter 2. Nutrient/Eutrophication Impacts* (August 1983) ("Lake and Impoundments Nutrient WLA Guidance").

79 Stream and River Nutrient WLA Guidance at p. 3-5.

80 *Id.*

81 *Id.*

82 *Id.*

> concern, the available data base, and the major mechanisms affecting that variable.[83]

EPA later consolidated the concepts from the Stream and River Nutrient WLA Guidance and another guidance document to form a document applicable specifically to TMDLs and resulting load assignments (*i.e.*, Stream and River Nutrient TMDL Guidance). In particular, the Stream and River Nutrient TMDL Guidance notes that TMDLs on streams or rivers must account for fate and transport characteristics of the waterbody and how those characteristics modify stream concentrations:

> When a pollutant is discharged into a flowing stream or river, it is subject to fate and transport processes that modify stream concentrations. The principle factors determining stream concentrations are advection [downstream inflow process of a pollutant], dispersion [varying vertical and lateral travel velocities of a pollutant within a stream], and reaction [pollutant reaction to other environmental substances].[84]

The EPA Regional Nutrient guidance discussed earlier addresses the different assimilative capacity considerations for lakes. EPA Regional Nutrient Guidance indicates that lakes have an assimilative capacity for nutrients that makes non-daily load expression appropriate, at least in the New England area:

> [A] lake nutrient TMDL expressed as an annual load and developed to be protective of the most sensitive time of year will ensure attainment with water quality standards during all seasons…For lakes with very short detention times and pollutant sources that vary significantly among seasons it may be appropriate to set more than one TMDL to address seasonal variation. This practice is common in riverine systems with respect to maintaining dissolved oxygen levels where the loading capacity varies considerably between the winter and summer seasons.[85]

E. EPA Legal Briefs

In the litigation context, EPA also has offered arguments that can be used by NACWA members to support using non-daily load expressions for certain pollutants in certain instances. More importantly, EPA's arguments demonstrate affirmative EPA action supporting non-daily TMDL expression.

For example, in its brief supporting the non-daily TMDLs developed for the Anacostia River, EPA noted the factors for determining the most appropriate time frame for a particular TMDL as: (1) the physical characteristics of the waterbody, such as the speed that water moves through the waterbody, (2) the nature of the pollutant and how it impacts water quality, (3) the manner and frequency that the pollutant enters the waterbody, and (4) the optimum approach to controlling the sources of the pollutant to achieve water quality standards.[86] Using these factors, EPA determined

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[83] *Id.* at p. 3-6.
[84] Stream and River Nutrient TMDL Guidance at p. 2-4.
[85] *Regional Guidance on Submittal Requirements for Lake and Reservoir Nutrient TMDLs* (EPA New England Region, Nov. 1999) at pp. 8-9.
[86] Initial Brief for the Federal Appellees at p. 27, *Friends of the Earth v. EPA,* 446 F.3d 140 (D.C. Cir. 2006), citing 65 Fed. Reg. 43,586, 43,629-30 (July 13, 2000); 64 Fed. Reg. 46,102, 46,031 (Aug. 23, 1999).

that the adverse effects of TSS in the Anacostia River occurred only seasonally, so a seasonal TMDL was appropriate.[87] In addition, EPA indicated that the stormwater-related nature of BOD impairment on the Anacostia justified a non-daily approach:

> The District concluded, and EPA agreed, that expressing the BOD TMDL in terms of annual average loads of BOD, phosphorus and nitrogen, rather than a daily or seasonal load, was a reasonable way of assuring achievement of the water quality standard for dissolved oxygen. The District noted that "there is no continuous permitted point source loads that contribute to the dissolved oxygen problem. The problem is due to a precipitation-induced pollution load. The sequence of multiple storms along with the magnitude and timing of individual storms is more of a determining factor than stream flow." Further, a variety of different circumstances at different times of the year contribute to the dissolved oxygen problem, including storms upstream that bring large loads, storms that increase flow and cause BOD stored in stream bed sediment to become resuspended in the water column, and loads that are deposited in the stream bed during cold months that start to decompose as the water temperatures rise in the spring. Thus, the District noted, "[t]here does not appear to be a reason to establish seasonal loads but rather annual loads for wet weather events." EPA concurred, noting that "[t]he TMDLs are expressed as average annual loads recognizing that for these precipitation driven events, the event mean concentration is the limiting parameter."[88]

Even though EPA's stance was not accepted by the D.C. Circuit, this language and other language within EPA's brief provides a well-structured argument advocating non-daily TMDL expression. NACWA members with receiving waters that relate to the Anacostia's situation may find EPA's arguments especially helpful in negotiations with their states.

IV. Example TMDLs for Pollutants Relevant to Wastewater Treatment Facilities

Based on the significant flexibility contained in EPA regulations and early guidance concerning alternative load expressions, many non-daily TMDLs have been developed by both states and the EPA itself. Justifying non-daily TMDLs generally depends not on analytical methods, modeling techniques, or database issues involved in a suitability analysis, but instead on more general threshold issues— the nature of the impairment, sources, and available controls, as well as the time period expressed in the applicable water quality standard.

The Second Circuit agrees that non-daily approaches are justified, and allowable under the Clean Water Act:

> In the case of each pollutant, effective regulation requires agencies to determine how the pollutant enters, interacts with, and, at a certain level or under certain conditions, adversely impacts an affected waterbody. In the case of highly toxic pollutants that may work harmful effects upon a

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87 Initial Brief for the Federal Appellees at pp. 28-29, *Friends of the Earth v. EPA*, 446 F.3d 140 (D.C. Cir. 2006).
88 Initial Brief for the Federal Appellees at pp. 13-14, *Friends of the Earth v. EPA*, 446 F.3d 140 (D.C. Cir. 2006).

> waterbody almost immediately when present at small levels, close regulation at a daily level may be most appropriate. In the case of other pollutants, like phosphorus, the amounts waterbodies can tolerate vary depending upon the waterbody and the season of the year, while the harmful consequences of excessive amounts may not occur immediately. …for some pollutants, effective regulation may best occur by some other periodic measure than a diurnal one. Accordingly, we agree with EPA that a "total maximum daily load" may be expressed by another measure of mass per time, where such an alternative measure best serves the purpose of effective regulation of pollutant levels in waterbodies.[89]

In light of the D.C. Circuit opinion and EPA's insistence that all future TMDLs be daily, these types of issues might now be used to support a determination that a particular pollutant is not suitable for calculation of a daily TMDL in your particular waterbody.

In addition, existing TMDLs provide an overview of analytical methods, modeling techniques, and data that might be required to establish a technically defensible daily TMDL. Evaluating these factors in the past might have resulted in an alternative load expression, a phased TMDL to allow necessary data to be gathered, a larger margin of safety, or non-numeric implementation plans. These results should continue under the current program, but must also be accompanied by a daily load expression. However, if the proper technical conditions do not exist in certain situations, a daily TMDL should not be developed, even if general suitability concerns are satisfied.

Some highlights of existing TMDL approaches for three pollutants—mercury, nutrients, and pathogens—are discussed below. For TMDLs containing helpful language, portions of the TMDLs are included in the Appendix. The discussion of each parameter is divided into two parts. The first deals with general suitability issues concerning the nature of impairments, sources, controls, and water quality standards, which might indicate that a daily TMDL should not be attempted, regardless of the quantity and quality of available data. The second part focuses on more specific technical suitability issues, which include data and information that should be gathered if a daily TMDL is being developed. If certain necessary technical information is absent, a daily TMDL should not be developed until that information becomes available. Both sets of issues can be used to support a determination that the pollutant is not suitable for a daily TMDL calculation, either generally or under specific conditions.

A. Mercury TMDLs

The nature of certain pollutants, including mercury, makes them unsuitable for daily loads due to the general suitability issues suggested by the *Muszynski* court rather the issue of whether the proper technical conditions can ever be achieved to support daily mercury TMDLs. As a result, a good argument can be made that daily load expressions are simply not an appropriate mechanism to implement TMDLs for waterbodies impaired by these pollutants, regardless of any technical conditions. If your state, however, believes that mercury daily TMDLs can be calculated under the proper technical conditions, the state must be certain that those conditions are actually present before attempting a daily TMDL.

[89] *NRDC v. Muszynski*, 268 F.3d 91, 98-99 (2d Cir. 2001).

1. General Suitability Issues

Both EPA and states have established TMDLs to address mercury impairments. Most impairments result from atmospheric deposition and stormwater runoff, as well as other nonpoint sources such as sediment releases. The few significant point source discharges of mercury are primarily related to stormwater, with the exception of a very small number of facilities that incidentally generate mercury wastewater discharges. Because of the relatively unique nature of these impairments, mercury TMDLs are developed differently than those for most conventional pollutants discharged by point sources.

a. Daily load not relevant to impacts on wildlife and human health

The Deep Creek TMDL generally describes the impacts of mercury:

> In fish tissue, mercury is not usually found in concentrations high enough to cause fish to exhibit signs of toxicity, but the mercury in sport fish (trophic level 4) can present a potential health risk to humans. The health risk to humans represented by the mercury content in consumed fish tissue is due to methylmercury. Typically, almost all of the mercury found in fish tissue (90 to 95%) is in the methylmercury form. Mercury chemistry in the environment is complex and not totally understood. Mercury exhibits properties of a metal, specifically, persistence in the environment because it is not chemically broken down beyond the elemental mercury form (Hg^0) or its ionic forms (Hg^+ and Hg^{+2}). It also has properties similar to a hydrophobic organic chemical due to its ability to be methlyated through a bacterial process. Methylation of mercury can occur in water, sediment, and soil solution under anaerobic conditions and, to a lesser extent, under aerobic conditions. In water, methylation occurs mainly at the water-sediment interface and at the oxic-anoxic boundary within the water column. Methylmercury is readily taken up by organisms and will bioaccumulate, as it has a strong affinity for muscle tissue. It is effectively transferred through the food web, with tissue concentrations magnifying at each trophic level.[90]

Accordingly, when considering human health risks or potential effects on wildlife, water quality criteria for mercury focus almost exclusively on chronic (*i.e.*, long duration) food chain exposures, in contrast to acute (*i.e.*, short duration) water column exposures for other pollutants of concern, such as most metals. Mercury water quality criteria are designed to protect against adverse effects that occur over long periods of exposure, which generally results from the consumption of fish tissue, where mercury in the water column and the food chain bioaccumulate over time. Thus, mercury TMDLs expressed and implemented on shorter time frames are not reasonably related to the natural impacts of mercury to the environment and human health.

To complicate matters, mercury criteria may not always be expressed in the best terms for protecting human health and/or the environment. EPA recommends, and some states have established, direct fish tissue criteria for certain bioaccumulative pollutants, such as mercury and PCBs.[91] Most chronic

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[90] *Total Maximum Daily Load for Deep Creek Lake, Garrett County, Maryland* (December 27, 2002) ("Deep Creek TMDL") at p. 6.

[91] EPA-823-B-04-001, *Draft Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion* (August 2006) ("Draft Mercury Guidance") at p. 12.

water quality criteria for mercury, however, are based on a fish tissue concentration that is converted to a water column concentration, in order to determine loading rate.[92] Converting or translating fish tissue concentrations to water column concentrations requires using bioaccumulation factors ("BAFs") (general or site-specific) that try to account for the temporal and spatial variability of fish tissue uptake of mercury; which is the only likely pathway to impacting human health or the environment (*i.e.*, consumption). The Draft Mercury Guidance provides factors influencing bioaccumulation to consider when states translate fish tissue concentrations to water column concentrations. These factors include: the age or size of the organism; food web structure; water quality parameters such as pH, DOC, sulfate, alkalinity, and dissolved oxygen; mercury loadings history; proximity to wetlands, watershed land use characteristics; and waterbody productivity, morphology, and hydrology.[93] EPA's Draft Mercury Guidance also indicates that translating fish tissue criteria to water column criteria can be complicated by "[t]he bioaccumulation of nonionic organic chemicals [which] can also be affected by a number of the[] same physico-chemical factors (e.g., loading history, food web structure, dissolved oxygen, DOC)."[94]

Using these factors, EPA generally recommends three different approaches to translate a concentration of methylmercury in fish tissue to a concentration of methylmercury in ambient water: 1. Use site-specific methylmercury BAFs derived from field studies; 2. Use a scientifically defensible bioaccumulation model; or 3. When derivation of site-specific field-measured BAFs or use of a model are not feasible, use national methylmercury BAFs derived from empirical data.[95] However, EPA notes, and NACWA members may wish to emphasize, that BAF development is costly and unreliable. Also, converting fish-tissue concentrations to water concentrations "requires assessment of methylmercury bioaccumulation on a state or tribal geographic scale…[t]hus, the uncertainty associated with differential bioaccumulation…will be embedded in the state or tribal water-based criterion."[96] TMDLs based on such uncertain terms and translations should not be promoted.

Other considerations noted by EPA include those for translating water quality criteria based on potential wildlife effects.[97] For those translations, EPA recommends taking into account the fact that exposure durations of at least one year are typically evaluated for the most sensitive species (e.g., avian species or mink) and are averaged over the period of at least one year.[98] Thus, as with human health criteria, wildlife criteria include average fish consumption rates by wildlife over the exposure duration of at least one year, as well as a long-term average BAF.[99]

Regardless of the criteria expression, the primary conclusion for mercury TMDLs (and other similar pollutants) is that evaluating mercury loadings to water, is most appropriate over a long-term period to match the chronic exposure period used to evaluate mercury uptake by fish and subsequent consumption by people or wildlife (*i.e.*, at least one year). The maximum release of mercury on any one day is not a determining factor, unless it results in a water concentration exceeding an acute (*i.e.,* short-term duration) water quality criterion, which is typically at least an order of magnitude less stringent than the long-term chronic criterion.

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[92] *Id.* at p. 14.
[93] *Id.*
[94] *Id.* at p. 16.
[95] *Id.* at p. 17.
[96] *Id.* at p. 15.
[97] *Wildlife Exposure Factors Handbook, Volume 1* (EPA 600/R-93-187a, 1993); *Great Lakes Water Quality Initiative Criteria Document for Protection of Wildlife: DDT; Mercury; 2,3,7,8-TCDD; PCBs* (EPA 820-B-95-008, 1995).
[98] *Id.*
[99] *Id.*

For more, specific language used by States in TMDLs regarding appropriate interpretation of mercury criteria, refer to the Appendix.

b. Variability in mercury loadings

The nature of mercury water quality criteria above do not represent the only factors that justify focusing on non-daily loads for implementation purposes . Variations in mercury loadings that cannot be accounted for in a daily TMDL and the uncertainty of bioaccumulative effects, have been used to support the development of annual TMDLs (*i.e.,* seasonal wet weather loadings fluctuating with amount and distribution of rainfall).[100] In addition, implementation of mercury TMDLs—through natural attenuation processes and air emission control measures—takes effect over a long time-period, and is not amenable to a daily load calculation.

Alternatively, NACWA members may be able to convince their states to implement TMDLs through a percent reduction, rather than a daily, weekly or monthly load. For example, this may be an appropriate alternative where the source of the contamination is diverse and spread out (*i.e.,* nonpoint sources) because "it might not be feasible or useful to derive an allocation in mass per unit time" for those sources.[101]

Of course, some states have found it appropriate to develop mercury TMDLs expressed as daily loads. In these cases, however, the daily load itself is somewhat artificial, and bears no real relationship to the nature of the impairment or achievement of water quality standards. Most mercury TMDLs—including daily mercury TMDLs—are developed to address nonpoint impairments, and are *implemented* through controls on air pollution, nonpoint source controls, sediment or soil remediation activities, or natural attenuation.[102] Pollutant loadings are not controlled on a daily basis, and compliance with a calculated daily load cannot be measured in any meaningful way. As a result, daily TMDL implementation measures are generally not appropriate to address mercury impairments.

2. Technical Suitability Issues

Supplementing the general suitability arguments above for NACWA members, are technical conditions that may make daily TMDL implementation inappropriate. Even if the agency believes that a daily TMDL may be an appropriate mechanism to address mercury, a daily TMDL is not technically defensible if the necessary analytical methods, modeling techniques, and database are not available.

a. Characterization of sources

One of the first steps in developing a technically defensible TMDL consists of characterizing nonpoint sources and point sources.[103] Characterizing non-point sources (*i.e.*, atmospheric deposition, wet weather runoff, natural background loadings and sediment

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[100] *Total Maximum Daily Load (TMDL) Development for Total Mercury Fish Tissue in Brier Creek (Located in the Savannah River Basin) Including Listing Segment: Brier Creek - GA Highway 305 to Confluence Savannah River,* EPA Region 4 (August 2004) ("Brier Creek TMDL").

[101] *Total Maximum Daily Load for Mercury in McPhee & Narraguinep Reservoirs, Colorado: Phase I* (December 2003)("McPhee and Narraguinep TMDL")

[102] *See, e.g., Deep Creek* TMDL; *DRAFT Northeast Regional Total Maximum Daily Load* (April 11, 2007) ("Draft Northeast TMDL")

[103] *Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/Dissolved Oxygen and Nutrients/Eutrophication* (EPA 823-B-97-002 (1997).

disruption/redistribution)[104] includes determining the quantity (loading) and quality (concentration) of the pollutants of concern.[105] The primary source for most mercury loadings to impaired waters is the atmospheric deposition of mercury, where mercury in ambient air enters the water through wet deposition, dry deposition, and net gas exchange. Each of these processes must be evaluated to fully characterize nonpoint source loading.[106] For one, wet and dry deposition varies both regionally and by season, depending on atmospheric concentration, fraction in particle phase, deposition velocity, and surface area. Atmospheric concentration can also be affected by the presence of hazardous waste incinerators.[107] The actual contribution from atmospheric deposition may be greater when other delayed depositional loadings to the sub-basins are considered (*i.e.*, snowpack melt).[108] Volatilization of mercury to and from surface water could also reduce or contribute to loading, so also must be analyzed.[109]

The State of Minnesota has a unique state-wide approach to addressing air deposition in its EPA-approved state-wide mercury TMDL.[110] The Minnesota Statewide TMDL was developed because a vast majority of Minnesota waters impaired for mercury are impaired do to atmospheric deposition. To address such a situation, the Minnesota Pollution Control Agency ("MPCA") determined that it is better to provide a state-wide mercury goal that can be achieved through implementation measures, such as, mercury minimization plans for point sources or controlling air emissions.[111] Similar to other mercury TMDLs, this innovative approach does not fit well with daily load determinations "because the concern in this TMDL study is the long term accumulation of mercury rather than the short term acute toxicity events."[112] Also, atmospheric deposition is found to be too variable for accurate daily load considerations:

> Seasonal variations and "… critical conditions for stream flow, loading, and water quality parameters" are discussed in 40 CFR 130.7(c)(1). Fish accumulate enough mercury over the years of their lifespan to become a health hazard to humans and wildlife. Mercury deposition and water concentrations fluctuate based on seasonal rainfall patterns; however,

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104 One state notes that mercury also may be subject to unique considerations besides atmospheric deposition, such as biological recycling caused by forest fires, based on the geographic region in which the waterbody lies. *See* McPhee and Narraguinep TMDL at p. 20.

105 *Draft Final Mercury TMDL for Alamo Lake, AZ* (December 2005) ("Draft Alamo Lake TMDL") at p. 1. Note: this TMDL expresses the loadings in daily terms.

106 *Total Maximum Daily Load (TMDL) Development for Total Mercury in the Satilla Watershed Including Listing Segments of the Satilla River: Satilla River: US Highway 84/GA Highway 38 to 6 miles downstream of Hwy 15/121 Satilla River; 6 miles downstream of GA Highway 15 to Bullhead Bluff; Dupree Creek; Purvis Creek; Terry Creek; Turtle River System; Gibson Creek*, EPA Region 4 (February 28, 2002) ("Satilla River TMDL") at p. 19; McPhee and Narraguinep TMDL at p. 24.

107 EPA 452R97003, *Mercury Study Report to Congress Volume I* (1997); *Total Maximum Daily Load (TMDL) for Total Mercury in Fish Tissue in the Middle & Lower Savannah River Watershed for Segments: Clarks Hill Lake Dam to Steven's Creek Dam; Steven's Creek Dam to US Highway 78/278; US Highway 78/278 to Johnson's Landing; Johnson's Landing to Brier Creek; Brier Creek to Tide Gate*, EPA Region 4 (February 28, 2001) ("Savannah River TMDL") at pp. 57-58.

108 McPhee and Narraguinep TMDL at p. 23.

109 *See, e.g.*, Draft Northeast TMDL at n. 1.

110 *Minnesota Statewide Total Maximum Daily Load* (March 27, 2007) ("Minnesota Statewide TMDL").

111 *Id.* at p. 37.

112 *Id.* at p. 35. Note that MPCA provides a daily expression of the allowable mercury loading to the state's waters. There is some confusion between the various sections as to which expression dictates the TMDL, however, a majority of the language within the TMDL indicates that MPCA intends to focus on the annual loadings of mercury. If MPCA intends for the daily loads to dictate the TMDL (i.e., not meant as an alternative expression calculated by dividing the annual loading by 365) then this TMDL may not be as helpful in convincing EPA or a state that non-daily loads are inappropriate. However, the language cited in this document may be useful to a certain extent, as language noting that non-daily loads are *more* appropriate in state-wide TMDL development.

> seasonal variations are not significant to this TMDL because it is expressed as an average annual load. The mercury concentration in the fish represents an integration of all temporal variation up to the time of sample collection. Variability among fish because of differences in size, diet, habitat, and other undefined factors are expected to be greater in sum than seasonal variability.[113]

On an even grander scale, New England states developed a similar concept that applies not only to mercury loadings within an entire state, but to multiple states in the region.[114] The Northeast TMDL establishes loads as a range and sets three phases for implementation because "[n]ot enough data are currently available to accurately assess reductions from out-of-region sources."[115] Similar to the Minnesota Statewide TMDL, the Northeast TMDL provides both an annual and a daily load expression. However, the it focuses the TMDL discussion on annual load application and makes clear that the annual load remains most appropriate for mercury impairments because of the importance of mercury accumulation in fish, which occurs over a long time-period.[116]

Point sources are not often a major source of mercury into waterbodies. Characterization of point sources would include determination of the quantity and quality for the pollutants of concern from an inventory of single location inputs such as permitted effluent outfalls and wet weather discharges via discrete conveyance structures.[117]

b. Characterization of mercury loading variability

Mercury loadings may be highly variable, and should be well-understood before establishing a daily load. For example, mercury loadings often fluctuate based on the amount and distribution of rainfall, and the variability of localized and distant atmospheric sources.[118] As a result, mercury loadings will be greater in certain seasons (*i.e.*, the winter and spring seasons when rainfall is higher) than in other seasons.[119] The critical stream flow to evaluate may depend on the type of source predominant in the watershed.

c. Characterization of fish tissue concentrations

Fish tissue concentrations determine the extent of any impairment, as well as the time required to achieve any TMDL (generally the removal of a fish consumption advisory). Fish tissue data should cover the range of factors so that any variability is adequately characterized. The data should also be site-specific. Published uptake and elimination rates derived from laboratory studies may not reflect field conditions, limiting their use for the prediction of contaminant behavior.

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113 *Id.* at p. 41.

114 *Northeast Regional Mercury TMDL* (October 24, 2007) ("Northeast TMDL"), approved by EPA December 20, 2007.

115 *Id.* at p. xii.

116 *Id.* at p. 22.

117 *Guidance for Water-Quality-based Decisions: The TMDL Process* (EPA 440/4-91-001, 1991).

118 Brier Creek TMDL; *Total Maximum Daily Load (TMDL) Development for Total Mercury in the Withlacoochee Watershed Including Listed Segments of the Withlacoochee River: Withlacoochee River: Headwaters to New River, New River to Bay Branch, Bay Branch to Little River, Little River to State Line; Banks Lake; Turkey Branch*. EPA Region 4 (February 28, 2002) ("Withlacoochee River TMDL") at p. 17.

119 *Id.*

d. Characterization of mercury reduction processes

It is also important to understand any physical attenuation processes that may reduce mercury loadings over time. These include burial by clean sedimentation and flushing of contaminated sediments during high flow events. Mercury removal rates may be dependent on the flow, volume, and depth of the reservoir, suspended solids concentration, concentration of mercury, settling velocity, resuspension velocity, and toxic decay coefficient. As noted in the draft Alamo Lake TMDL:

> The results of this study show that mercury is naturally present in the watershed in association with volcanic and granitic rocks, their soil derivatives, and in geothermal springs. Runoff from historic gold mining areas shows elevated mercury levels but more work is needed to survey and identify specific sources. Most of the mercury is delivered to the lake in large watershed runoff events, such as was experienced in the fall/winter of 2004/2005. Air deposition appears to play a lesser role (contributing about 15%) but local air monitoring is needed to confirm this projection.[120]

e. Conclusion

The technical issues discussed above should be fully understood and addressed to develop a technically defensible daily TMDL. If NACWA members find that any of these issues are not fully understood, then it should approach the state or EPA and suggest that mercury (or other similar pollutant) is not suitable for daily TMDL development, at least until the proper technical conditions are satisfied.

B. Nutrient TMDLs

Nutrient TMDLs provide another example of pollutants that simply do not always have daily loadings that are important for protecting human health and the environment, and that require daily TMDLs. Nutrient loadings can be controlled and measured on daily terms in many instances, and a daily load expression within the TMDL may be appropriate and acceptable in certain instances. However, some situations such as nutrient impairments from stormwater loadings are not appropriately addressed on daily terms. Thus, in many situations a daily nutrient load may NOT be appropriate and acceptable. The suitability arguments for nutrients will vary from proper technical conditions to general suitability, depending on the specific characteristics of the TMDL and the waterbody.

1. General Suitability Issues

Nutrient TMDLs are expressed in terms of daily loads more often than those for mercury. The adverse effects of nutrients can occur over shorter periods, and water quality standards can include shorter-term expressions/criteria. As such, in many cases, EPA and the states have developed daily nutrient TMDLs.[121]

Other impairments, however, result primarily from stormwater discharges or other nonpoint sources, such as agricultural runoff, which are more appropriately addressed through non-daily

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[120] Draft Alamo Lake TMDL at p. 1.

[121] *See e.g., Leipsic River Watershed Proposed TMDLs* (August 2006) ("Leipsic TMDL").

TMDLs. For example, nutrient impairments caused by contaminated agricultural runoff and sheet and rill erosion from a site are may be more appropriately addressed through non-daily loads and implementations measures.[122]

For similar reasons, other situations should prompt non-daily TMDL expressions because nutrient impact is only seasonal (*i.e.*, summer low flow months). In such situations, NACWA members can argue that a TMDL can adequately protect the water quality for a waterbody without addressing non-seasonal loadings:

> The seasonal load that Half Moon Lake can receive and still meet the summer mean phosphorus concentration goal of 52 ug/l is 102 kg (225 pounds) which represents an overall 65% reduction in the phosphorus load (Table 2). Mean in-lake phosphorus concentrations above this level would likely result in continued severe algal blooms and use impairments.[123]
>
> ***
>
> As the term implies, TMDLs are often expressed as maximum daily loads. However, TMDLs may be expressed in other terms when appropriate. In this case, the TMDL is expressed as an allowable seasonal load of phosphorus to or within the lake. Since the major use impairments (and water quality standards violations) occur during the summer months, a seasonal (June - August) load is most appropriate for Half Moon Lake. However, proposed management activities to address phosphorus loading would generally provide benefits to the lake year-round.[124]

The seasonal loading decision often stems from the fact that the determined "critical condition" for nutrients in the waterbody revolve around summertime conditions when algae growing season exists (*i.e.*, summer base flow conditions for phosphorus)[125]

Once the critical condition is identified (*e.g.*, summertime/seasonal), that critical condition represents an appropriate baseline for TMDL development, regardless of whether the non-critical condition (*i.e.*, non-algae-growing season) has similar pollutant levels. Previously approved TMDLs allow the state to focus on the critical condition even when the non-critical condition levels do not differ from the critical condition levels.[126] The same is especially true for nutrient loadings coming predominantly from point source discharges (*i.e.*, POTWs), because they are relatively static discharges which allow the nutrient impacts to be addressed according to the natural seasonal characteristics.[127] Conversely, if a nutrient impairment is caused primarily by stormwater discharges,

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[122] *Total Maximum Daily Loads for Wagon Train Lake -- Lancaster County Nebraska: Sediment and Phosphorus* (September 2002) ("Wagon Train Lake TMDL") at p. 11.

[123] *Phosphorus Total Maximum Daily Load (TMDL) for Half Moon Lake, Eau Claire, Wisconsin* (June 22, 2004) ("Half Moon Lake TMDL") at p. 7.

[124] *Id.* at p. 9.

[125] *Sediment and Phosphorus TMDLs for Castle Rock (Fenimore) Creek and Gunderson Valley Creek, Wisconsin* (June 8, 2004) ("Castle Rock TMDL") at p. 4.

[126] *Id.* at pp. 8-9.

[127] *Assabet River Total Maximum Daily Load for Total Phosphorus, SuAsCo Watershed, Massachusetts. Report Number MA82B-01-2004-01; Control Number CN 201.0* (2004) ("Assabet River TMDL") at pp. 5-6.

a daily TMDL may not be appropriate, regardless of the availability of necessary analytical methods, modeling techniques, and data. If so, the agency should not develop a daily nutrient TMDL.[128]

As noted in the EPA Nutrient Protocol and other EPA nutrient guidance, the impacts of nutrient loadings on a waterbody also depend on the residence time of that pollutant in the waterbody. Residence time refers to the persistence of a pollutant within the water, and dictates the time frame in which a pollutant can impact a stream. For waterbodies with longer residence times (*i.e.*, low flows that allow the pollutant remains longer) the annual loadings have been found to be the most appropriate because the waterbody responds over longer periods of time, rather than immediate responses.[129]

2. Technical Suitability Issues

If dry weather discharges are involved in an impairment, a daily TMDL may be theoretically appropriate, provided the proper technical conditions exist. In the absence of such conditions, however, the agency should refrain from establishing a daily TMDL.

a. Characterization of sources

It is necessary to identify the specific pollutant sources[130] and determine whether the TMDL properly accounts for these sources (*i.e.*, sources have been sufficiently quantified to support allocation and permitting decisions for the watershed). As discussed above, pollutant sources within a watershed are classified in a TMDL as non-point sources and point sources, each of which need to be characterized.[131]

Characterizing both point and non-point sources requires a determination of the quantity (loading) and quality (concentration) for the pollutants of concern. Examples of non-point sources would include inputs that cannot easily be identified by a single location such as atmospheric deposition, sediments, and wet weather event runoff (prevalent for nutrient TMDLs). Point source identification requires determining the quantity and quality for the pollutants of concern from an inventory of single location inputs such as permitted effluent outfalls and wet weather discharges via discrete conveyance structures.[132] Unless and until the pollutant sources can be accurately characterized, a TMDL should not be developed (daily expression or not).

b. Modeling of dry vs. wet weather impacts

Additional data may be required depending upon the model selected for determination of load allocations and the consideration of wet-weather conditions.[133] Many of the assumptions for determining water quality standards are not valid for stormwater exposures. Concentrations of nutrients are typically not constant during a storm event and tend to be higher during the start of

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[128] *Lake Champlain Phosphorus TMDL* (September 22, 2005) ("Lake Champlain TMDL") at p. 20.
[129] *Charleston Side Channel Reservoir Total Maximum Daily Load Report, Coles County, Illinois: Doc No. IEPA/BOW/03-013* (August 2003) ("Charleston Side Channel TMDL") at p. 30; Lake Champlain TMDL at p. 45.
[130] *Guidance for Water Quality-based Decisions: The TMDL Process* (EPA 440/4-91-001, Apr. 1991).
[131] *Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/Dissolved Oxygen and Nutrients/Eutrophication* (EPA 823-B-97-002 (1997).
[132] *Guidance for Water Quality-based Decisions: The TMDL Process* (EPA 440/4-91-001, Apr. 1991).
[133] *Compendium of Watershed-Scale Models for TMDL Development* (EPA 841-R-92-002, 1992); *Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/Dissolved Oxygen and Nutrients/Eutrophication* (EPA 823-B-97-002 (1997).

the storm. Environmental conditions are not constant, and the duration of the storm is frequently much shorter than used for aquatic toxicity tests.[134]

Alternatives that may more appropriately address variability in receiving water quality, and variability of stormwater quality, may include seasonal or other temporal evaluation of receiving water flow and quality based on hydrologic duration curves.[135] Similarly, load duration curves can be used to assess conditions within the watershed and to determine how long the loading capacity is actually being exceeded for point sources, storm water, and non-point sources.[136] This facilitates TMDL development that considers factors that ensure adequate water quality across a range of flow and water quality conditions.

Modeling for wet weather requires information concerning the length, slope, mean depth and channel widths for each reach, land use data, hourly rainfall data, loading processes for each land use and associations with sediment, sediments washed off by rain, transport, deposition, and scour of sediments in the stream channels, in-stream TSS concentrations, potency factors characterizing relationships between sediment and the pollutant, overall water balance high-flow/low-flow distribution, storm flows, and seasonal variation.[137]

C. Pathogens

Pathogen impairments may also face technical issues for daily TMDL development; however, like mercury above, development of daily pathogen TMDLs is less appropriate due primarily to general suitability issues.

1. General Suitability

The nature of pathogen impairment of a waterbody usually involves variable sources such as stormwater discharges, which, like many other pollutants (*i.e.*, sediment) does not typically have a "daily" discharge that requires a daily load restriction. Furthermore, many state pathogen water quality standards that drive TMDL development are concentration-based limits that are not even applicable on a mass-based level, let alone a daily load level. EPA has recognized these characteristics in a number of non-daily TMDLs that it has developed or approved over the years. NACWA members can use the justifications in these TMDLs to convince states to focus on the appropriate time-frame for pathogens and other similar pollutants.

a. Variability in pathogen loadings

A primary concern for daily pathogen load calculations is whether they are appropriate in light of natural variability of pathogen TMDLs due to wet weather loadings. Pathogens often times do not directly discharge to a waterbody until storm events wash pathogens that have accumulated on land during dry conditions. Where this is the case, the loading of pathogens on a given day would be dependent on whether there was a storm event on that day and the size of that storm event. Thus, as many NACWA members are aware, daily loads often are inappropriate because most areas, if not

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134 *NPDES Storm Water Sampling Guidance Document* (EPA 833-B-92-001, 1992).
135 *TMDL Development from the "bottom up" – Part III: Duration Curves and Wet-Weather Assessments* (B. Cleland, America's Clean Water Foundation, Sept. 15, 2003).
136 *Compendium of Watershed-Scale Models for TMDL Development* (EPA 841-R-92-002, 1992).
137 *Total Maximum Daily Loads for Metals: Los Angeles River and Tributaries*, EPA Region 9 (June 2, 2005) ("Los Angeles River TMDL") at pp. 43-44.

all, do not have rain events every day. More importantly, it is impossible to predict exactly when and where a storm event will affect the area.

When dealing with high flow stormwater loading of pathogens to a waterbody, some load expressions are better left as percent reductions rather than load limits. This allows the TMDL to focus on implementation measures rather than requiring a concrete "daily" limit, which is not realistic to impose upon stormwater:

> WLAs for stormwater discharges are typically expressed as "percent reduction" because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges also differs from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the "maximum extent practical" through the implementation of BMPs.[138]
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> This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. TMDLs for the Cedar River are expressed in terms of counts per 100 mL and percent reduction, and represent the maximum fecal or total coliform load the creek can assimilate and maintain the coliform criteria [citation omitted]**.**[139]

Alternatively, load expressions for predominantly wet weather impairments can be separated into loads identified by the relevant discharge season (*i.e.*, lbs/day in the summer) rather than a single loading applicable throughout the entire year.[140] Similarly, seasonal load expressions have been found to be more appropriate where the critical condition for a waterbody exists only under certain low flow conditions (*i.e.,* during the summer dry period). In those situations, the appropriate TMDL expression should coincide with the relevant season and flow conditions rather than incorporating an artificial daily load.[141] Seasonal pathogen allocations are appropriate both for free-flowing waters (*i.e.,* rivers and stream) and lakes.[142]

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[138] *TMDL Report: Fecal and Total Coliform TMDLs for the Cedar River (WBID 2262)* (June 2005) ("Cedar River TMDL") at p. 32.

[139] *Id.* (emphasis in original).

[140] *South Branch Yellow Medicine River Fecal Coliform Total Maximum Daily Load Report* (September 2004) ("Yellow Medicine River TMDL") at pp. 27, 30-33; *See also, Skillet Fork Watershed TMDL* (May 2006) ("Skillet Fork TMDL"); *Final TMDLs for Fecal Coliform Bacteria, Chlorides, Sulfates, Total Dissolved Solids (TDS), Sediment, Total Suspended Solids (TSS), and Turbidity for Selected Subsegments in the Terrebonne Basin, Louisiana* (September 25, 2006) ("Terrebonne TMDL") at p. v (On the basis of the analyses of water quality criteria, most fecal coliform bacteria TMDLs were developed on a seasonal basis (i.e., calculating allowable loads and percent reductions for both summer and winter)).

[141] *Total Maximum Daily Loads for the Big Walnut Creek Watershed* (August 19, 2005) ("Big Walnut Creek TMDL") at pp. 39-42.

[142] *Total Maximum Daily Loads (TMDLs) for Fecal Coliform Bacteria in the Waters of Campbell Creek and Campbell Lake in Anchorage, Alaska* (May 2006) ("Campbell Creek TMDL") at p. 56.

Moreover, in some instances daily load calculation may remain inappropriate for pathogen TMDLs even when the loading of pathogens comes from a mixture of wet and dry sources. This is because defining a critical condition may be more difficult under some circumstances , which makes a number of load definitions potentially appropriate "as long as they are distributed properly throughout the watershed.[143]

b. Non-daily water quality standards and criteria

As noted previously, one of the repercussions of the *Friends of the Earth* decision would be to require states or EPA to assign daily load allocations within a watershed in order to meet non-daily water quality standards. While technically feasible in some instances, this practice may be inappropriate for pathogen-impaired waterbodies with non-daily water quality standards or criteria.

Water quality criteria are commonly comprised of three components: magnitude, duration, and frequency. The definitions of these components are provided in EPA's 2006 Integrated Report Guidance ("IRG"):[144]

- **Criterion-Magnitude** (or Criterion-Concentration): That element of a numeric water quality criterion specifying acceptable ambient levels of a pollutant or other indicator. Most criterion magnitudes are expressed as concentrations (e.g., milligrams/liter), though magnitudes for some parameters are expressed differently (*e.g.*, pH and temperature).

- **Criterion-Duration:** The period of time (averaging period) over which ambient data are averaged for comparison with a criterion-magnitude. For example, certain EPA criteria for protection of aquatic life are expressed, in part, as 4-day average concentrations of a particular pollutant (i.e., the criterion-duration is 4 days). Criteria expressed as a "concentration not to surpass (supersede, exceed, etc.)" are often called "instantaneous criteria," in that their duration or averaging period is just a second (instant).

- **Criterion-Frequency:** That element of a numeric criterion describing how often waterbody conditions can surpass the combined magnitude and duration components (i.e., specifying the allowed number of excursions that can occur within a certain period time (i.e., the acceptable rate of excursions). For example, certain EPA aquatic life criteria are stated as "the 4-day average concentration of the pollutant shall not supersede ___ µg/L more often than once every 3 years, on average." Here, the criterion frequency is "once every 3 years, on average."

All three dimensions are critical to appropriate TMDL development, according to the National Research Council (2001) in their report "Assessing the TMDL Approach to Water Quality Management:"

> Careful consideration of the three dimensions of the criterion is also critical to the development of appropriate TMDLs. In the law, the letter "d" in TMDL refers to a daily load, which has been interpreted literally in some legal cases. However, for many pollutants, the load determined over a longer time period (e.g., a season or year) is more relevant to securing the designated use. Examples of this are nutrient and sediment

[143] *Total Maximum Daily Load for Escherichia coli (E. coli) for the Lower Eel River Watershed, Clay, Owen, Greene, Vigo, and Sullivan Counties, Indiana* (February 24,2005) ("Lower Eel River TMDL") at p. 6.
[144] *Guidance for 2006 Assessment, Listing, and Reporting Requirements Pursuant to Sections 303(d), 305(b), and 314 of the Clean Water Act* available at http://www.epa.gov/owow/tmdl/2006IRG/report/2006irg-glossary.pdf.

> criteria, where the duration component of the criterion is generally not stated as "daily."[145]

However, it is the magnitude and frequency components of most pathogen criteria that make them unsuitable for daily TMDLs (*i.e.*, monthly/seasonal average colony counts per Liter).[146] As described below, relevant magnitudes for pathogen-related criteria are typically specified as a concentration rather than a mass-based limit; thus, making daily loading an inappropriate control.

Also, the duration of state bacteria standards and criteria often do not apply on a daily basis, which makes any daily calculation artificial and unnecessary. Even if bacteria were expressed on a mass load basis, there is no direct way to express a daily load that will result in compliance with a criterion that is evaluated over a longer time period. Theoretically, the maximum daily load could be set at the same level as the allowable load for a longer time period, as long as the provision is made that the overall load for the longer time period is met. For example, if the appropriate duration for a pollutant criterion was one year and the maximum allowable load was 365 x/year, the maximum daily load on any given day could be 365 x/day *as long as the cumulative annual load was not greater than 365 tons.* Such a calculation is artificial, however, because of the variability noted above. The same concept would apply to pathogen criteria that apply only on seasonal bases.

Accordingly, where states have water quality standards that applies only part of the year the TMDLs should coincide with the water quality standard expression:

> According to Minn. R. ch. 7050.0430, the South Branch of the Yellow Medicine River is characterized as, 'Unlisted Waters which are classified as 2B, 3B, 4A, 4B, 5, and 6 waters." The Class 2B standards apply to the South Branch of the Yellow Medicine River because it is most restrictive. Class 2B waters support indigenous fish and associated aquatic communities, and recreation use. Minn. R. ch. 7050.0222 subp. 4 and 5, Fecal Coliform water quality standard for Class 2B, states that fecal coliform shall not exceed 200 organisms per 100 milliliters as a geometric mean of not less than five samples in any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 2,000 organisms per 100 milliliters. *The standard applies only between April 1 and October 31.*[147]
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> A "Bacteria Matrix" spreadsheet matrix approach was used to simulate the existing loading contributions in two scenarios: 1) wet conditions; and 2) during spring, summer, and fall seasons. The contributions from each of seven sources are derived from Table 4.6. The "assumed shares" for each season and for each source contribution is calculated using the geometric mean fecal coliform concentration at all sites for spring (April-May), summer (June-August), and fall (September), and the average flows at site 1 for each season.[148]

Alternatively, your state water quality criteria may be expressed as a monthly average of pathogen concentration/density. In those situations, it may be more appropriate to establish TMDLs

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[145] National Research Council "*Assessing the TMDL Approach to Water Quality Management*" (2001) at pp. 44-46.
[146] *Id.*
[147] Yellow Medicine River TMDL at p. 11 (emphasis added); *See also,* Big Walnut Creek TMDL.
[148] *Id.* at p. 31 (citation omitted).

expressed as concentrations rather than a daily load, as potentially required now by the *Friends of the Earth* decision:

> For most pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). For *E. coli* indicators, however, mass is not an appropriate measure because *E. coli* is expressed in terms of organism counts (or resulting concentration) (USEPA, 2001). The geometric mean *E. coli* WQS allows for the best characterization of the watershed. Therefore, this *E. coli* TMDL is concentration-based consistent with 327 IAC 5-2-11.1(b) and 40 CFR, Section 130.2 (i) and the TMDL is equal to the geometric mean *E. coli* WQS for each month of the recreational season (April 1st through October 31st).[149]
>
> The pollutant loading that a waterbody can safely assimilate is expressed as either mass-per-time, toxicity or some other appropriate measure (40 C.F.R. § 130.2(i)). Typically, TMDLs are expressed as total maximum daily loads. However, Mass DEP believes it is appropriate to express bacteria TMDLs in terms of concentration because the fecal coliform standard is also expressed in terms of the concentration of organisms per 100 ml. Since source concentrations may not be directly added, the previous equation does not apply. To ensure attainment with Massachusetts' water quality standards for bacteria, the goal of this TMDL is to have all sources (at their point of discharge to the receiving water) equal to or less than the standard. Expressing the TMDL in terms of daily loads is difficult to interpret given the very high numbers of bacteria and the variation in flow conditions. Therefore, the magnitude of the bacteria load that is allowable within water quality standards will vary as flow rates change. For example, a very high number of bacteria may be allowable if the volume of water that transports the bacteria is high too provided water quality standards are still met. Conversely, a relatively low number of bacteria may exceed the water quality standard if flow rates are low. For all the above reasons the TMDL is simply set equal to the standard…[150]
>
> The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR 5130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measure. The TMDLs for the listed streams in the Wolf River watershed are expressed as counts/30-days. This load represents the total load the stream can assimilate in a 30-day period and maintain the water quality criterion of 200 counts/100mL.[151]

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[149] Lower Eel River TMDL at p. 8.

[150] *Bacteria Total Maximum Daily Load for Frost Fish Creek, Chatham, Massachusetts.* Report Number: MA96-49-2004-01, Control Number: CN207.0 (March 2005) ("Frost Fish Creek TMDL") at p. 45.

[151] *Total Maximum Daily Load (TMDL) for Fecal Coliform in Wolf River, Fletcher Creek, Cyprus Creek, and Grissum Creek Located in the Wolf River Watershed (HUC 0801 021 0), Shelby & Fayette Counties, Tennessee* ("Wolf River TMDL") at p. 15.

2. Technical Suitability

In addition to the general unsuitability of pathogens for daily TMDL expression, pathogen TMDL calculations may have technical nuances that make daily load expression unsuitable and inappropriate to implement. These technical suitability issues are more site-specific in nature and may not apply to all situations. However, these issues, if applicable, may be used as additional arguments opposing daily pathogen TMDLs.

a. Characterization of sources

As noted above, pathogen loads into a waterbody are highly dependent on wet weather events and come primarily from nonpoint sources. Nonpoint source loadings can come from a variety of origins, including wildlife usage, general agricultural runoff, loading contributions from other tributaries or stream, and unidentified leaking septic systems. Also, fecal coliform, from any source, is difficult to trace back to a specific source. Thus, when dealing with such a variety of sources, whose loadings depend on unpredictable wet weather events, and where the pollutant is not directly traceable back to a particular source, the appropriate load restrictions for a source within the watershed tend to be difficult to clearly identify. For example, it may be necessary for states to make assumptions about the origins of the fecal coliform loadings to attempt to calculate an appropriate loading based on those assumptions. In those situations, the resulting calculations will represent average conditions at best, which should not be used as a baseline for daily load expression.[152]

Even where pathogen sources are more readily identifiable, there may continue to be difficulty addressing the sources in daily terms. In particular, where wildlife and/or waterfowl nonpoint source loadings (*i.e.,* goose droppings) entering the water through stormwater runoff are the primary contributors of pathogens to the water, states have found it difficult to justify a daily load.[153] In these instances, the difficulty in identifying reductions and addressing the primary source of the pathogen loading, in part, has led states to establish non-daily load expression (*i.e.*, concentration based load) or to not implement a load because wildlife loads are naturally occurring:

b. Implementation through BMPs not suitable for daily load calculation

Other circumstances may make the technical application of a daily or even an annual load in permits too difficult to be justified. In those instances (*e.g.*, stormwater-based discharges), EPA guidance recommends that the loadings be controlled through BMPs rather than application of a numeric load calculated in a TMDL. In other words, EPA advises to focus primarily on implementing the TMDL rather than the expressing the loadings within the document:

> …because storm water discharges are due to storm events that are highly variable in frequency and duration and are not easily characterized, EPA's policy recognizes that only in rare cases will it be feasible or appropriate to establish numeric limits for municipal and small construction storm water discharges. Therefore, EPA recommends that for NPDES-regulated municipal and small construction stormwater discharges effluent limits should be expressed as BMPs or other similar

152 Yellow Medicine River TMDL at p. 20.

153 *Total Maximum Daily Load (TMDL) Study for Bacteria in Sand Dam Village Pond Town Beach, Troy, New Hampshire* ("Sand Dam Village Pond Town Beach TMDL") (September 19, 2006) at p. 19; *See also, Total Maximum Daily Load (TMDL) Study for Bacteria in Mill Pond Town Beach, Washington, NH* (September 25, 2006) ("Mill Pond Town Beach TMDL") at pp. 16-19; Frost Fish Creek TMDL at pp. 17, 40.

> requirements, rather than as numeric effluent limits. The policy recognizes the need for an iterative approach to control pollutants in storm water discharges. Specifically, the policy anticipates that a suite of BMPs will be used in the initial rounds of permits and that these BMPs will be tailored in subsequent rounds.[154]

D. Using Suitability Arguments

As noted throughout the preceding sections, the general and technical issues for mercury, pathogens and nutrients can be used during TMDL development negotiations, in challenging specific TMDLs, during permit negotiations and appeals, during development of state and federal policies concerning mercury, pathogen or nutrients impairments, or to request that the state change its listing methodology to add a category for unsuitable pollutants. In addition, remember that the arguments provided for mercury, nutrients, and pathogens can be modified to fit other pollutants posing similar issues.

V. Listing Options

If a pollutant is impairing a particular waterbody, but not suitable for development of a daily TMDL, then NACWA members can encourage states to consider alternatives for listing impaired waters on the 303(d) List that might avoid the development of inappropriate TMDLs. The listing strategy may depend on the types of issues used to make the suitability determination. If more general concerns result in the conclusion that a daily TMDL is simply not appropriate to address a particular impairment, then the water should probably be listed in Category 4(B). This category was developed by EPA to include impairments that will be addressed outside the TMDL program, such as through remediation efforts under CERCLA and RCRA.[155]

If a daily TMDL is possible, but the proper technical conditions are not present, the state should determine whether the proper technical conditions might be satisfied in the future, such as through gathering additional data or developing more sophisticated modeling techniques. If so, one option is to leave the water in Category 5 (waters that are impaired and require a TMDL), but to schedule the water for TMDL development well in the future to allow time for the proper technical conditions to become available. If it is not clear when—or even whether—the proper technical conditions can be satisfied, the best approach may be to develop a separate listing category that would allow the state defer TMDL development.

North Carolina has established a listing category for waters that are impaired, but where the proper technical conditions do not yet exist to develop a TMDL:

> As described in the Federal Register, "proper technical conditions refers to the availability of the analytical methods, modeling techniques and data base necessary to develop a technically defensible TMDL. These elements will vary in their level of sophistication depending on the nature of the pollutant and characteristics of the segment in question" (43 FR 60662, December 28, 1978). These are waters that would otherwise be in Category 5 of the integrated list. As previously noted, EPA has

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[154] Campbell Creek TMDL at p. 57.

[155] *See, e.g., Guidance for 2004 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act* (EPA TMDL-01-03, Jul. 21, 2003).

> recognized that in some specific situations the data, analyses, or models are not available to establish a TMDL. North Carolina seeks EPA technical guidance in developing technically defensible TMDLs for these waters. Open water and ocean hydrology fecal coliform impaired shellfishing waters are included in this category.[156]

Specific to mercury, EPA recently has issued listing guidance that suggests that states list waterbodies impaired for mercury due primarily to atmospheric deposition in a separate category (*i.e.*, 5m), allowing the state to defer TMDL development.[157] The 5m Guidance allows and suggests such a deferral for states with existing mercury reduction programs, because EPA "acknowledges the complexity in developing TMDLs for waters impaired by mercury mainly from atmospheric sources" and recognizes that "[d]eveloping TMDLs for mercury-impaired waters poses many technical and programmatic challenges."[158] In other words, EPA recognizes that developing technically appropriate TMDLs is important and that states should not rush to develop TMDLs without strong technical support for them. Also, the 5m Guidance recognizes that waters atmospherically impaired by mercury may, over time, respond to other mercury reduction measures that may obviate the need to develop a TMDL.[159]

VI. Non-Suitability Alternatives—EPA "Daily" TMDL Guidance

If the suitability arguments set forth above are unsuccessful as to a particular TMDL, there are still opportunities for regulatory relief under new EPA guidance, which provides flexibility in developing daily TMDLs, and which allows daily TMDL implementation through non-daily permit limits.[160] First, EPA indicated that states have flexibility in what "daily" loads actually look like:

> Because water quality standards are expressed in a variety of ways and because pollutants and water bodies have different characteristics, EPA believes that there is some flexibility in how the daily time increments may be expressed.
>
> If consistent with the applicable water quality standard and technically suitable for the pollutant and water body type in question, a TMDL and associate load allocations and wasteload allocations may be expressed as both minimum and maximum daily loads, or as average daily loads.
>
> …it may also be appropriate for the TMDL and associated load allocations and wasteload allocations to be expressed in terms of differing maximum daily values depending on the season of the year, stream flow (e.g., wet v. dry weather conditions) or other factors.

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156 *North Carolina Water Quality Assessment and Impaired Waters List* (North Carolina Department of Environment and Natural Resources, 2004) at p. 42.

157 *Listing Waters Impaired by Atmospheric Mercury Under Clean Water Act Section 303(d): Voluntary Subcategory 5m for States with Comprehensive Mercury Reduction Programs* (March 8, 2007) ("5m Guidance") at p. 4.

158 *Id.* at pp. 1, 3.

159 However, EPA notes that it does not intend to imply that it believes mercury TMDLs to be inappropriate or unnecessary. In fact, EPA states that mercury TMDL development *may be* appropriate in instances where waterbodies are NOT impaired primarily by atmospheric deposition, where the sources of mercury loadings are not well known, or where there is a complex mix of sources. *Id.* at p. 6.

160 *Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in* Friends of the Earth, Inc. v. EPA, et al., *No. 05-5015 (April 25, 2006) and Implications for NPDES Permits* (EPA, Nov. 15, 2006) ("'Daily' Load Guidance").

> In situations where pollutant loads, water body flows, or other environmental factors are highly dynamic, it may be appropriate for TMDLs and associated allocations to be expressed as functions of controlling factors such as water body flow. For example, a load-duration curve approach to expressing a TMDL and associated allocations might be appropriate, provided it clearly identifies the allowable daily pollutant load for any given day as a function of flow occurring that day.
>
> For TMDLs that are expressed as a concentration of a pollutant, a possible approach would be to use a table and/or graph to express the TMDL as daily loads for a range of possible daily stream flows. The in-stream water quality criterion multiplied by daily stream flow and the appropriate conversion factor would translate the applicable criterion into a daily target (TMDL).[161]

In furtherance of the 'Daily' Load Guidance, EPA has drafted additional guidance concerning the development and expression of daily loads for certain pollutants, based on the load-duration curve approach and typical averaging periods for certain criteria, waterbody type, and source type combinations.[162] The Load Duration Curve Guidance correlates allowable water quality concentrations with the flow regime present at any given time, because "stream flow patterns affect changes in water quality over the course of a year (i.e., seasonal variation that must be considered in TMDL development)."[163] As a result, the load restriction at any given time will depend on the current flow of the waterbody, the numeric water quality target, and a conversion factor for the pollutant.[164] Of course, where no numeric criteria exist, load duration curves become more difficult to incorporate into a TMDL (i.e., sediment or nutrients).[165]

According to EPA, load duration curves can be beneficial to NACWA members because they technically incorporate a daily load (as required in the D.C. Circuit by *Friends of the Earth* and recommended for all jurisdictions by EPA), but allows for adjustments to reflect differences in the types of sources that may be dominant under various flow conditions:

> For instance, in effluent dominated streams wastewater treatment facilities (WWTFs) exert a significant influence on water quality at low flows. Under a duration curve framework, the allocation or portion of the loading capacity attributed to WWTFs can be greater in the low flow zone. Similarly, runoff from nonpoint sources tends to dominate water quality under high flow conditions. Thus, the allocation or portion of the loading capacity for nonpoint sources can be greater under moist and high flow conditions using a duration curve framework.[166]

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[161] *Id.*

[162] EPA 841-B-07-006, *An Approach for Using Load Duration Curves in the Development of TMDLs* (August 2007) ("Load Duration Curve Guidance") available at http://www.epa.gov/owow/tmdl/techsupp.html.

[163] *Id.* at p. i; *See also* Lower Eel River TMDL. However, the Load Duration Curve Guidance notes that the load duration curve process is a generalization for the waterbody, which does not take into account specific fate and transport characteristics that may vary under different circumstances.

[164] *Id.* at pp. 3-4, 11.

[165] *Id.*

[166] *Id.* at p. 7.

* * *

> Storm water and nonpoint sources of pollutants, on the other hand, present a greater challenge because pollutants are transported to surface waters by a variety of mechanisms (e.g., runoff, snowmelt, groundwater infiltration). Best management practices (BMPs) generally focus on source control and/or delivery reduction. Common methods in use to develop either WLAs for storm water or load allocations for nonpoint sources are also applicable under a duration curve framework.[167]

* * *

> Under the duration curve framework, the loading capacity is essentially the curve itself.[168]

The Load Duration Curve Guidance indicates, and state TMDLs concur, that load duration curves are most appropriately used when flow is the primary driver in pollutant loadings (*i.e.*, wet-weather events), because they can identify an appropriate load to apply when the water flow spikes due to storm events:

> Typically, the calculation of a TMDL on a daily basis requires definition of the critical hydrologic condition. The condition that is critical is dependent upon what hydrologic condition is the most problematic. If the sources of pollution discharge continuously, then low flow, when the potential for pollution is the least, may be critical. If the sources of pollution are precipitation driven, then the critical condition may be high flow when runoff dominates. Since the sources of pathogenic organisms loading in the Big Walnut Creek Basin are numerous as well as variable, it was important to address the entire range of hydrologic conditions in the pathogen TMDL.
>
> For this reason, the acute condition pathogen TMDL was developed using a load duration curve (LDC). A load duration curve is plot of percentile flow versus daily allowable load. Percentile flow is a traditional cumulative relative frequency, with one distinct variation. The cumulative relative frequency of a value in a population of data is typically calculated with the data population sorted in ascending order. However, the percentile flow value is determined with the population of data sorted in descending order. As a result the percentile flow data does not represent the percent of the total distribution that the value exceeds, rather is expressed the percent of time the value will be exceeded.[169]

However, as noted in the Load Duration Curve Guidance, load duration curves may be limited by requisite appropriate source characterization and flow data to accurately do daily calculation:

> In order to develop flow duration curves, water quality duration curves, and load duration curves, continuous flow data is required. Three

[167] *Id.* at p. 8.
[168] *Id.* at p. 11.
[169] Big Walnut Creek TMDL at p. 34.

> United States Geological Survey (USGS) gages…were used for the development of the *E. coli* duration curves analysis for the Lower Eel River watershed TMDL…In order to obtain an estimated flow at the various sample sites on the Eel River, the drainage area for each sample site is calculated where duration curve analysis will be conducted.[170]
>
> The methodology used for this TMDL was the "percent reduction" methodology. The Department generally prefers to use the load duration curve or "Kansas" method for coliform TMDLs, but this method could not be used because there are limited stream flow information available for the Cedar River. To determine the TMDL, the percent reduction that would be required for each of the exceedances to meet applicable criteria was determined, and the median value of all of these reductions determined the overall required reduction, and therefore the TMDL.[171]

Nonetheless, load duration curves provide potential solutions for NACWA members seeking to ensure fair TMDL loadings in states that insist on incorporating a "daily" load expression.

EPA's 'Daily' Load Guidance also suggests that states may include non-daily load expressions within the TMDL, to *supplement* the daily load calculation, rather than to pick one expression over the other:

> In certain circumstances (e.g., impairments caused by storm water), or where the applicable water quality criteria are expressed as a long-term average, it may be appropriate for TMDL documents or their supporting analysis to clearly set forth the implementation-related assumptions underlying any wasteload allocation expressed as a 'daily' load.
>
> To facilitate implementation of such a load in water bodies where the applicable water quality standard is expressed in non-daily terms, it may be appropriate for the TMDL documentation to include, in addition to wasteload allocations expressed in daily time increments, wasteload allocations expressed as weekly, monthly, seasonal, annual, or other appropriate time increments.[172]

EPA follows up on that concept with subsequent guidance recognizing that non-daily load expressions are still appropriate for certain pollutants regardless of the requirement to include daily loads:

> For a variety of reasons, EPA recognizes that it might continue to be appropriate and necessary to identify non-daily allocations in TMDL development despite the need to also identify daily loads. For parameters such as sediment, for which narrative water quality criteria often apply, attainment of WQS [water quality standards] cannot always be judged on a daily basis. Assessment of cumulative loading impacts is necessary to understand how to achieve WQS and to estimate the allowable loading capacity; therefore identifying long-term allocations for

[170] *Id.*
[171] Cedar River TMDL at p. 21.
[172] 'Daily' Load Guidance at p. 2.

> such situations is appropriate and informative from a management perspective. For TMDLs in which it is determined that a non-daily allocation is more meaningful in understanding the pollutant/waterbody dynamics, EPA recommends that practitioners identify and include such an allocation, as well as a daily load expression with the final TMDL submission.[173]

However, EPA indicates that including both daily and non-daily expressions in a TMDL (where appropriate) will address the *Friends of the Earth* case concerns but retain states' discretion to implement daily TMDLs through non-daily permit limits:

> EPA does not believe that the D.C. Circuit Court decision requires any changes in the way WLAs are currently implemented in…NPDES permits. Water quality-based effluent limits (WQBELs) in NPDES permits that implement WLAs in approved TMDLs must be "consistent with the assumptions and requirements of any available WLA for the discharge." [internal citation omitted]. Note that these provisions do not require that effluent limits in NPDES permits be expressed in a form that is identical to the form in which the wasteload allocation for the discharge is expressed in a TMDL.[174]
>
> To facilitate implementation of the TMDL, one of the stated 'assumptions' of a TMDLs daily load or daily wasteload allocation might be that, for purposes of NPDES implementation in an appropriate context (e.g., storm water), the permit writer has the flexibility to express the permit's effluent limitation using a time frame in keeping with, and appropriate to, the water body and pollutant in question and the applicable water quality standard.[175]

Some states have already incorporated this concept into TMDLs by noting that they established a daily load to address the *Friends of the Earth* case, but that daily load is not the official load for the waterbody:

> To satisfy recent legal challenges on how TMDLs should be expressed, a TMDL in terms of the maximum allowable load per day, (i.e., billions of *E. coli* per day) is provided in Appendix C. As shown in Appendix C, the TMDL is a function of flow through the Beach swimming area. Although it is possible to express a TMDL in terms of a load per day, NHDES believes that the best way to express this TMDL is in terms of concentration (counts / 100 mL); reasons for this are provided below:
>
> - The units are consistent with how bacteria water quality criteria are expressed;
> - The units are consistent with how compliance with ambient bacteria water quality criteria will be determined;

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173 U.S. EPA Office of Wetlands, Oceans, & Watersheds, *DRAFT Options for Expressing Daily Loads in TMDLs* (June 22, 2007) ("Draft TMDL Expression Guidance").
174 Draft TMDL Expression Guidance at p. viii.
175 'Daily' Load Guidance at p. 2.

- It is simpler and easier for the public to understand;
- Progress towards compliance is easier to measure and track than a TMDL expressed in *E. coli*/day which requires an estimate of flow as well as concentration; and
- Like the bacteria water quality criteria, a TMDL expressed in terms of concentration would be applicable during all times of the year.[176]

Alternatively, EPA also believes that it is possible to coordinate the daily and non-daily load expressions based on similar data and similar non-daily considerations, such that the daily expression could be appropriately used for implementation. The Draft TMDL Expression Guidance "aims to help practitioners develop a daily load expression that is meaningful, useful and consistent with the analysis used to calculate the non-daily TMDL and corresponding loading capacity."[177] There are three steps identified by EPA as important to deriving a daily load from a non-daily load: (1) evaluate the technical approach used to develop the non-daily load; (2) create a daily load dataset (i.e., using a load duration model or dynamic model); and (3) identify the most appropriate daily load expression to reflect the longer-term TMDL allocations, based on the practitioner's knowledge of the system (e.g., static vs. variable expressions).[178] Factors to consider when selecting daily loads for TMDLs that would normally incorporate only non-daily expressions, include: data availability, assumptions made during the non-daily analysis, the time period addressed by the non-daily allocation, management implications, critical loading conditions, and pollutant sources and behavior.[179]

If a state or EPA is developing a TMDL for a pollutant that is not really suitable for a daily TMDL calculation, the EPA guidance can be used to encourage the agency to incorporate as much flexibility into the daily TMDL as possible, by using daily averages that include seasonal or wet weather variations, and by supplementing the daily TMDL with monthly, annual, or seasonal load calculations. Finally, daily TMDLs can be implemented through permit limits establishing using long-term or seasonal averages, or non-numeric BMPs, if appropriate.

It is important to note that the legality of the TMDL/permitting approach in the new EPA guidance has not yet been tested. Environmental groups contend that daily load TMDLs are legally required, and that permits issued to implement those TMDLs must include daily limits. It is expected that they will contest non-daily limits that are issued pursuant to the EPA guidance. It should also be noted that the EPA guidance is not mandatory. Thus, it is still possible that a state will choose not to include daily loads in its TMDLs, since the only jurisdiction that is currently required to do so is the District of Columbia, due to the *Friends of the Earth* case.[180] If a non-daily TMDL is issued, environmental groups may choose to challenge it on the same grounds as in the *Friends of the Earth* case. On the other hand, if a state chooses to calculate only daily loads in its TMDLs, the regulated parties could raise challenges using the general and technical suitability arguments set forth above.

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[176] Sand Dam Village Town Beach TMDL at pp. 24-25.
[177] Draft TMDL Expression Guidance at p. 1.
[178] *Id.* at pp. 4-9.
[179] *Id.* at pp. 4, 23.
[180] The New York Department of Environmental Conservation has indicated that since the *Muszynski* case is still binding law in the Second Circuit, it will continue issuing non-daily TMDLs when appropriate.

APPENDIX: EXAMPLE STATE TMDL SUITABILITY LANGUAGE

I. Mercury TMDL Language

A number of states discuss appropriate TMDL expression in terms of the short term vs. long term effects. For example, certain TMDLs note that acute conditions rarely occur with mercury:

> Critical conditions are not a concern in this analysis because acute conditions are not a concern at the observed concentrations and the allowable concentrations of mercury are based on human fish consumption over a long time period, which averages out critical events. Also, the TMDL is protective of human health from fish consumption at all times, so that any "critical conditions" within that time frame are considered. Finally, the TMDL level established to be protective of human health is more conservative than the mercury levels to protect environmental resources, implying that critical conditions for environmental resources are also addressed by the previous logic that is applied to human health.[181]

> The annual average load is of primary significance because mercury bioaccumulation and the resulting risk to human health that results from mercury consumption is a long-term phenomenon. Therefore, shorter seasonal inputs are less meaningful than total annual loads over many years. The use of annual loads allows for integration of short-term or seasonal variability.[182]

Also, State TMDL language notes that the key factors used in developing chronic water quality criteria for mercury reflect long-term average concentrations in water, rather than maximum daily concentrations in water. As a result, states have developed TMDLs on a long-term basis:

> The analysis is based on long-term averages. Although many factors might vary over a given year, the effect is averaged out over several years during which fish accumulate mercury. An analysis of the length and weight of individual fish used in the BAF calculation indicates they were of legal (keepable) size and the average age was approximately five years.The averaging effect of long-term bioaccumulation is reflected in the analysis and supports the use of an average annual AAWCC and average annual load. Specifically, the fish tissue concentration at the time of sampling is the result of long-term accumulation in fish that are several years old. The bioaccumulation factor is, in turn, computed on the basis of this long-term accumulation. An AAWCC is then calculated based on the relationship between the BAF, water column mercury concentration ratios and risk parameters related to fish consumption. Finally, the average annual loading values for the waterbody are calculated to meet the AAWCC.[183]

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181 Deep Creek TMDL at p. 14.
182 *Id.*
183 *Id.*; *Total Maximum Daily Load of Mercury for Savage River Reservoir, Garrett County, Maryland* (2002) ("Savage River

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The reader should also note that, although this analysis presents a loading limit, the fish tissue concentration depends on mercury water column concentration, not on load. Thus, annual loads alone do not determine fish tissue concentrations; that is, if a fish is exposed to the same concentration of mercury, but more water or less water of the same concentration passes through the reservoir due to seasonal differences in rainfall, the fish tissue accumulation will be the same. This understanding is important when interpreting future information to evaluate the success of implementing controls to achieve the TMDL.[184]

***

Federal regulations [40 CFR §130.7(c)(1)] require that TMDLs take into consideration seasonal variability in applicable standards. These TMDLs are presented as annual average loads because Hg bioaccumulates over the life of the fish and the resulting risk to human health from fish consumption cannot be effectively quantified on a daily or weekly basis. While there are various seasonal characteristics that affect mercury concentrations in the Louisiana coastal zone such as wet deposition being greater in the winter and spring seasons and methylation of mercury being more active during the summer, daily or weekly inputs are less meaningful than total annual loads over many years. Summer is also the period when large areas of the Gulf of Mexico west of the Mississippi River experience hypoxia (low oxygen conditions) (Rabalais, *et al*. 1997), which is conducive to methylation. Based on the enhanced methylation and higher predator feeding rates during this period, mercury bioaccumulation is expected to be greatest during the summer (USEPA 2002). However, given the long depuration times for fish and relatively mild winters in coastal Louisiana, seasonal changes in fish tissue mercury body burden are expected to be relatively small. Inherent variability of mercury concentrations between individual fish of the same and/or different size categories is expected to be greater than seasonal variability (USEPA 2002).[185]

***

Fish bioaccumulate mercury over their life spans. Therefore, the most relevant target for evaluating load reductions is the average MeHg concentration in lake water over time. The concentrations in the water column at equilibrium are a function of the influent loads and the net impacts of kinetics. Further, Alamo Lake experiences significant sequestration of mercury due to burial in the sediment. As the kinetic parameters are not changed for the scenarios, the response to reduced loading at equilibrium should be approximately linear. A variety of scenarios were run with watershed loads set to a fixed fraction of the

TMDL") at p. 14.

[184] *Id.*

[185] *TMDLs for Mercury in Fish Tissue for Coastal Bays and Gulf Waters of Louisiana: Subsegments 010901, 021102, 042209, 070601, 110701, 120806* (June 2005) ("Louisiana Gulf TMDLs") at p. 7-5.

> estimated existing load, with no alteration to the existing atmospheric load…As expected, the response is nearly linear.[186]

Hence, it is not scientifically defensible to apply such long-term average factors to peak concentrations on any given day. The exposure durations used to determine the chronic water quality criteria for mercury are not amenable or appropriate for an accurate determination for a "daily" exposure.

With respect to naturally variable mercury loads, states have determined that a daily load is less important that the long-term impact from bioaccumulation:

> Wet deposition is greatest in the winter and spring seasons. Mercury is expected to fluctuate based on the amount and distribution of rainfall, and variability of localized and distant atmospheric sources. While a maximum daily load is established in this TMDL, the average annual load is of greatest significance since mercury bioaccumulation and the resulting risk to human health that results from mercury consumption is a long-term process. Thus, daily or weekly inputs are less meaningful than total annual loads over many years. The use of an annual load allows for integration of short-term or seasonal variability.[187]

According to some TMDLs, mercury may most appropriately be expressed as a percent reduction, rather than a daily, weekly, monthly or yearly load. In many instances, this is because of the source of the contamination (*i.e.,* nonpoint sources):

> A TMDL represents the total loading rate of a pollutant that can be discharged to a waterbody without exceeding the applicable water quality standards. The TMDL can be expressed as the total mass or quantity of a pollutant that can enter the waterbody within a unit of time. In most cases, the TMDL determines the total allowable loading capacity for a constituent and divides it among the various known contributors in the watershed as wasteload (i.e., point source discharge) and load (i.e., nonpoint source) allocations. The TMDL also accounts for natural background sources and provides a margin of safety. For some nonpoint sources it might not be feasible or useful to derive an allocation in mass per unit time. In such cases, a percent reduction in pollutant discharge may be proposed.[188]

The majority of examples of non-point sources of mercury noted in mercury TMDLs include inputs that cannot easily be identified by a single location (point source) such as atmospheric deposition, wet weather event runoff, natural background loadings and sediment disruption/redistribution:

> The results…show that mercury is naturally present in the watershed in association with volcanic and granitic rocks, their soil derivatives, and in geothermal springs. Runoff from historic gold mining areas shows elevated mercury levels but more work is needed to survey and identify specific sources. Most of the mercury is delivered to the lake in large

[186] Draft Alamo Lake TMDL at p. 39.
[187] Brier Creek Hg TMDL 2004
[188] McPhee and Narraguinep TMDL.

> watershed runoff events, such as was experienced in the fall/winter of 2004/2005. Air deposition appears to play a lesser role (contributing about 15%) but local air monitoring is needed to confirm this projection. [189]

When dealing with wide-ranging atmospheric sources in State-wide TMDL, implementation measures rather than numeric loadings are most appropriate:

> Although wastewater point sources are very minor contributors to the total mercury load, the MPCA will continue to pursue mercury reductions from these sources through mercury minimization plans and other permit conditions. For mercury emission sources, sector-specific reduction milestones are presented, along with an outline of regulatory and non-regulatory mercury reduction strategies to be considered in the detailed implementation planning. The Great Lakes Initiative (GLI) requires wastewater dischargers in the Lake Superior basin to meet a mercury water quality standard of 1.3 ng/L and implementation of this mercury TMDL does not in any way supersede or conflict with the GLI requirements.[190]
>
> The WLA is by region and is not specific to each source, thereby providing a cap for the region that includes reserve capacity. Rather than assign an allocation to each source based on their current design capacity, continued mercury reduction will be encouraged through mercury minimization plans and enhanced phosphorus removal. EPA has determined, as a matter of policy, that NPDES point sources known to discharge mercury at levels above the amount present in the source water should reduce their loadings of mercury using appropriate, cost-effective, mercury minimization measures to ensure that the total aggregate point source mercury discharges are at a level equal to or less than the WLA specified in this TMDL. The reserve capacity in the WLA allows for permitting of additional wastewater discharges, but does not preclude the requirement of mercury minimization plans. [191]

On an even larger scale, Northeastern states may eventually be subject to a regional TMDL that allocates loads as follows:

> The mercury TMDL for the region ranges from 1,732 to 2,296 kg/yr, or 4.75 to 6.29 kg/d. This is divided into a wasteload allocation of 20 to 27 kg/yr and a load allocation of 1,712 to 2,269 kg/yr. The load allocation for natural sources is 1,626 kg/yr, leaving an anthropogenic load allocation of 86 to 643 kg/yr. Implementation of this goal is divided into three phases. Phase I, from 1998 to 2003, sets a goal of 50 percent reduction, from in-region and out-of-region sources, from the 1998 baseline. With in-region reductions of 1,549 achieved as of 2002, the in-region reduction goal has been exceeded. Phase II, from 2003 to 2010,

[189] Draft Alamo Lake TMDL at p. 1. Note: this TMDL expresses the loadings in daily terms.
[190] Minnesota Statewide TMDL at p. x.
[191] Minnesota Statewide TMDL. at p. 37.

> sets a goal of 75 percent reduction. This leaves 20 kg/yr for in-region reductions necessary to meet this target. In 2010, mercury emissions, deposition, and fish tissue concentration data will be reevaluated in order to assess progress and set a timeline and goal for Phase III to make remaining necessary reductions to meet water quality standards. Not enough data are currently available to accurately assess reductions from out-of-region sources.[192]
>
> * * *
>
> Because this TMDL addresses mercury accumulation in fish over long periods of time, annual loads are more appropriate for expressing mercury loading goals. Therefore, the calculations are based on annual loads. However, in order to comply with current EPA guidance, the TMDL is also expressed as a daily load.[193]

II. Nutrients

Some State nutrient TMDLs have concluded that nutrients are important only on a seasonal or other critical basis; thus justifying TMDL expressions that apply only to the those critical times:

> The overall water quality goal for Half Moon Lake is to reduce phosphorus concentrations in the lake sufficiently to decrease the severity and frequency of algal blooms. The goal proposed by the Task Force and WDNR staff is to achieve a mean summer in-lake chlorophyll-a concentration of 30 ug/l compared to the current level of 82 ug/l. This level of chlorophyll-a reduction would require a 52% decrease in the mean, summer in-lake total phosphorus concentration from 109 ug/l to 52 ug/l. Consequently, the water quality numeric goal is to achieve a summer lake mean epilimnetic phosphorus concentration of 52 ug/l in Half Moon Lake.[194]
>
> The in-lake phosphorus concentration goal represents a mean growing season (June – August) epilimnetic concentration. This goal is based on local public input and best professional judgment of WDNR staff using available monitoring data and modeling tools.[195]
>
> ***
>
> The seasonal load that Half Moon Lake can receive and still meet the summer mean phosphorus concentration goal of 52 ug/l is 102 kg (225 pounds) which represents an overall 65% reduction in the phosphorus load (Table 2). Mean in-lake phosphorus concentrations above this level would likely result in continued severe algal blooms and use impairments.[196]

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192 *Id.* at p. xii.
193 *Id.* at p. 22.
194 *Phosphorus Total Maximum Daily Load (TMDL) for Half Moon Lake, Eau Claire, Wisconsin* ("Half Moon Lake TMDL") (June 22, 2004) at p. 7.
195 *Id.*
196 *Id.*

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> As the term implies, TMDLs are often expressed as maximum daily loads. However, TMDLs may be expressed in other terms when appropriate. In this case, the TMDL is expressed as an allowable seasonal load of phosphorus to or within the lake. Since the major use impairments (and water quality standards violations) occur during the summer months, a seasonal (June - August) load is most appropriate for Half Moon Lake. However, proposed management activities to address phosphorus loading would generally provide benefits to the lake year-round.[197]

For the Castle Creek TMDL this resulted in a daily load for the critical season:

> For purposes of these TMDLs the growing season mean is used to determine the load capacity. This is done with the recognition that there are not significant difference [sic] between the growing season mean and the July-August mean. Using the 75th percentile of the growing season mean values, a value of 0.095 mg/l was selected.[198]
>
> To translate the 75th percentile concentration into loads, the average flow was calculated for the same period of time. The average 2001 growing season flow for Castle Rock Creek at Homer Road was 5.9 cfs; and for Gunderson Valley Creek 0.8 cfs. The corresponding total phosphorus loads are as follows:
>
> - Castle Rock Creek at Baumgartner Road (included as an intermediate site due to a substantial amount of data at this site) = 2.5 lbs/day
> - Castle Rock Creek at Homer Road = 3.0 lbs/day
> - Gunderson Valley Creek = 0.42 lbs/day
>
> These average growing season loads are for baseflow conditions. They represent the residual effect of runoff event loads. Based on the runoff event concentrations, it is readily apparent that the vast majority of the event load is carried through Gunderson Valley Creek and Castle Rock Creek and only a portion remains in the stream. The portion that remains, however, is causing the filamentous algae growth and the diel oxygen swings in the streams.[199]

Massachusetts offers seasonal rationale for the non-daily loads established for the Assabet River TMDL, especially where the phosphorus loadings come predominantly from point source discharges:

> The evaluation of nutrient loadings during 6 intensive field surveys found that point sources contributed the majority of nutrient loadings to the Assabet River during most surveys. Point sources were found to be

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[197] *Id.* at p. 9.
[198] *Id.* at p. 8.
[199] *Id.* at p. 9.

> the dominant source of biologically available phosphorus (i.e., ortho-phosphorus) during all 6 surveys representing 88% to 98% of the overall available phosphorus load. The study also identified that about 90% of the point source loading is in the dissolved form that is available for direct uptake by the plant community. If not taken up by plants, the dissolved phosphorus will pass through the system and not accumulate. As a result, it is assumed that non-summer time POTW discharges during other seasons and particularly high flow months will not be retained in the system for use during the growing season. Therefore, only seasonal phosphorus removal at the POTWs is warranted and effluents limits for total phosphorus will be applicable from April 1 through October 31; during the non-growing season, November 1 – March 31, effluent limits for phosphorus *will not be in effect*; however, due to concerns that particulate phosphorus, if discharged, may potentially settle in downstream impoundments during this timeframe, the POTWs will be required to optimize their treatment process to remove particulate phosphorus and conduct effluent monitoring for both total and dissolved phosphorus to support future permitting decisions.[200]
>
> ***
>
> The most consistent sources of phosphorus loading to the Assabet River are the four major POTWs in Westborough, Marlborough, Hudson, and Maynard. While non-point sources must be considered, the seasonality of the eutrophication problem, as manifested by nuisance aquatic plant growth, is most directly related to the presently high loadings of phosphorus from the POTWs combined with limited inflow from groundwater during the natural growing season for aquatic vegetation. This combination is especially important during periods of low flow and especially at 7Q10. During the growing season, non-point source contributions of phosphorus, other than from sediment phosphorus flux, are generally minor compared to the consistent contribution from the POTWs.[201]

Nutrient loadings from stormwater and other variable sources provide different considerations:

> Since sources such as CSOs and stormwater outfalls discharge to receiving waters via discreet conveyances, they are by definition point sources for regulatory purposes under the Clean Water Act. However, unlike domestic sewage or industrial wastewater, the stormwater-related sources listed above originate as nonpoint source runoff. Nonpoint source runoff is driven by brief and intermittent rainstorms or snowmelt events, and is highly variable in quantity and phosphorus content from one event to the next. Monitoring and accounting for phosphorus loads in stormwater runoff is technically difficult and expensive because of the variable nature of these events, making it difficult to assign and enforce facility-specific effluent limits. Data are not available from CSOs and stormwater outfalls to characterize their individual phosphorus loads for

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[200] *Assabet River Total Maximum Daily Load for Total Phosphorus, SuAsCo Watershed, Massachusetts.* Report Number MA82B-01-2004-01; Control Number CN 201.0 ("Assabet River TMDL") (2004) at pp. 5-6.
[201] *Id.* at p. 19

> the purpose of the TMDL. Because of these monitoring difficulties and the geographic scale of the Lake Champlain Phosphorus TMDL, it was not technically feasible to separate the allocations for phosphorus sources requiring NPDES permits from more general nonpoint source load allocation categories based on land use.[202]

Resident time of nutrients within a waterbody will also dictate the appropriate TMDL load expression because certain circumstances allow pollutants to remain for longer periods of time and increase algae growth (i.e., low flow conditions):

> Section 303(d)(1)(C) of the Clean Water Act and USEPA's regulations at 40 CFR 130.7(c)(1) require that a TMDL be established that addresses seasonal variations normally found in natural systems. For the CSCR, the impact of seasonal and other short-term variability in loading is damped out by the fact that it is the long-term average TP concentrations that drives the biotic response. Since the residence time of the CSCR is greater than one year, the TMDL can be adequately expressed in terms of an annual average load.[203]
>
> As the term implies, TMDLs are often expressed as maximum daily loads. However, as specified in 40 CFR 130.2(i), TMDLs may be expressed in other terms when appropriate. For Lake Champlain, the TMDL is expressed in terms of allowable annual loadings of phosphorus. Although critical conditions occur during the summer season in some lake segments when algae growth is more likely to interfere with uses, water quality in Lake Champlain is generally not sensitive to daily or short term loading. With a water residence time of about two years (Vermont DEC and New York State DEC), the lake generally responds to loadings that occur over longer periods of time (e.g., annual loads).[204]

III. Pathogens

Pathogen TMDLs can be expressed as reductions according to the variable loads that occur throughout the year. For example, the Yellow Medicine River TMDL broke the year down to wet and dry conditions to establish the appropriate load:

> The driving force for fecal coliform delivery to the stream is rainfall events and the runoff produced during and following a rainfall event. The 2001 data from the 25 sites were queried into storm event and quiescent stream conditions. The results of the query showed huge increases in stream concentrations during storm events and dramatically lower concentrations during non-event flow regimes…As can be seen, all 25 stations are below the TMDL limit of 200 organisms/100ml during quiescent periods, the highest at 161 organisms/100ml, and conversely, all stations with single exception show impairment during storm events. This suggests readily available fecal coliform sources throughout the sub-

[202] Lake Champlain TMDL at p. 20.
[203] Charleston Side Channel TMDL at p. 30.
[204] Lake Champlain TMDL at p. 45.

> watershed, and storm event driven runoff as the primary delivery mechanism.[205]
>
> * * *
>
> The arithmetic mean of the sum of the monthly geomeans was used to calculate the means for both the wet/dry and seasonal conditions. Taking the mean of geomeans is an appropriate methodology to partition wet/dry and seasonal conditions from a monthly standard stated as a geomean according to the best professional judgment of MPCA staff. Average flows for spring, summer and fall were used to determine loads. Because the reductions are provided in terms of percent in this spreadsheet method they are not effected by the flows. The required reductions would not change had other than average flows , e.g., high flows, been used. This approach is thought to be robust due to the fact that, with a single exception, all stations sampled during the years 1999 and 2001 exceeded the standard, and all stations exceeded the standard during wet conditions. The flows used were from site 1, which is the outflow of the TMDL target area and represents the total drainage of the sub-watershed.[206]
>
> * * *
>
> These spreadsheet models indicate that, based on 1999-2001 fecal coliform concentrations and average flow conditions for the South Branch TMDL subwatershed, the daily fecal coliform loads are Summer: 7.41 x 1011. To meet water quality goals the allowable daily fecal coliform loads in the sub-watershed are Summer: 3.67 x 1011. In terms of wet and dry conditions, as defined above, the fecal coliform loads are Wet: 4.34 x 1012. To meet water quality goals the allowable daily fecal coliform loads in the sub-watershed are Wet: 9.84 x 1011.[207]
>
> From a seasonal point of view, a 51% reduction is required to bring the summer fecal concentrations to the water quality goal, and from a wet and dry condition point of view, a 78% reduction is required to meet the WQG during wet conditions. The wet weather reduction of 78% is applied to all seasons. Meeting the load reductions under wet conditions will meet the standard under all conditions.[208]

The same concept applies to other critical conditions for a pollutant within a waterbody, such as the flow conditions necessary for pathogen growth/survival:

> The critical condition for pathogens is the summer dry period when flows are lowest, and thus the potential for dilution is the lowest. Summer is also the period when the probability of recreational contact is

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[205] Yellow Medicine River TMDL at p. 27; *See also,* Skillet Fork TMDL.
[206] *Id.* at p. 30; *See also* Terrebonne TMDL at p. v (On the basis of the analyses of water quality criteria, most fecal coliform bacteria TMDLs were developed on a seasonal basis (i.e., calculating allowable loads and percent reductions for both summer and winter)).
[207] *Id.* at p. 33.
[208] *Id.*

> the highest. For these reasons recreational use designations are only applicable in the period May 1 to October 15. Pathogen TMDLs were developed for the same May to October time-period in consideration of the critical condition, and for agreement with…WQS.[209]

In those situations, the State of Ohio has determined that the appropriate TMDL expression should coincide with the critical conditions:

> The existing load was defined as the sum of the individual source loads. For the purpose of this study, surface runoff, point source dischargers, home sewage treatment systems (HSTS), cattle in stream, combined sewer overflow (CSO), sanitary sewer overflow (SSO), and upstream flow were considered potential sources. Individual source loads, TMDLs, and allocations are all expressed in colony forming units (cfu) per season.[210]

Alaska found that seasonal variability also applies equally to lakes:

> Fecal coliform concentrations and loading to Campbell Creek and Campbell Lake vary seasonally, likely due to variations in weather and source activity. To account for this seasonality, this TMDL establishes seasonal allocations. Seasonal allocations represent loads allocated to time periods of similar weather, runoff, and instream conditions and can help to identify times of greatest impairment and focus TMDL implementation efforts by identifying times needing greater load reductions, as illustrated in Figure 6-3.[211]

Where the seasonality or a critical period is NOT easily identified, then states have found that any number of TMDL expressions could be appropriate as long as they are explained and evenly distributed throughout the watershed:

> The TMDL represents the maximum loading that can be assimilated by the waterbody while still achieving the Water Quality Standard (WQS). As indicated in the Numeric Targets section of this document, the target for this *E. coli* TMDL is 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1st through October 31st. Concurrent with the selection of a numeric concentration endpoint, TMDL development also defines the critical conditions that will be used when defining allowable levels.[212]
>
> Many TMDLs are designed as the set of critical conditions that, when addressed by appropriate controls, will ensure attainment of the WQS for the pollutant. For example, the critical conditions for the control of point sources in Indiana are given in 327 IAC 5-2-11.1(b). In general, the 7-day average low flow in 10 years (Q7, 10) for a stream is used as the design

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[209] Big Walnut Creek TMDL at p. 42.
[210] *Id.* at pp. 39-40.
[211] Campbell Creek TMDL at p. 56.
[212] Lower Eel River TMDL at p. 6.

> condition for point source dischargers. However, *E. coli* sources to the Eel River watershed arise from a mixture of dry and wet weather-driven conditions and there is no single critical condition that would achieve the *E. coli* WQS. For the Lower Eel River watershed and the contributing sources, there are a number of different allowable loads that will ensure compliance, as long as they are distributed properly throughout the watershed.[213]

Pathogen TMDLs can also present technical barriers to developing daily TMDLs. This is most evident where there is inadequate data, thus requiring a state to make assumptions about the origin of the pollutant:

> The assessment of fecal coliform sources within a watershed, and establishing the cause-effect relationship between the watershed sources, the transport mechanisms, and the subsequent stream loading is very complex and difficult to quantify. The problem is further exacerbated by the nature of the fecal coliform bacteria. Their survival rate in the terrestrial and aquatic environments is poorly understood, and confounds efforts to track their sources.[214]
>
> * * *
>
> In order to assess potential contributions of fecal coliform from different sources a number of assumptions were made regarding where the fecal coliform bacteria "start out', i.e., where they are deposited or otherwise reside on the landscape. These assumptions translate livestock type and numbers into different settings or situations, e.g., overgrazed pasture, and indicate how much of the fecal coliform from a given source might ultimately end up in a stream or river. The assumptions are very gross and are intended to represent "average" conditions in the sub-watershed. The assumptions were adopted from available information from the following sources, Generic Environmental Impact Statement on Animal Agriculture (e.g. Mulla et al. 2001), and professional judgment from MPCA and YMRWD staffs.[215]

However, even when the sources can be characterized, a daily load may still be unjustified:

> Figure 9 shows a plot of *E. coli* concentration for the wet and dry samples. As shown, *E. coli* concentrations vary greatly under both wet and dry conditions with some samples being above and some below the criterion although the average wet weather concentration was slightly higher than the dry weather (261 vs 202 cts / 100 ml). This suggests that in order to restore water quality in the Beach swimming area, it will be necessary to focus on both dry and wet weather sources of bacteria. [216]

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[213] *Id.*
[214] Yellow Medicine River TMDL at p. 20.
[215] *Id.*
[216] *Total Maximum Daily Load (TMDL) Study for Bacteria in Sand Dam Village Pond Town Beach, Troy, New Hampshire* ("Sand Dam Village Pond Town Beach TMDL") (September 19, 2006) at p. 19; *See also, Total Maximum Daily Load (TMDL) Study for Bacteria in Mill Pond Town Beach, Washington, NH* ("Mill Pond Town Beach TMDL") (September 25, 2006) at pp. 16-19.

> Although violations occur during dry weather, Figure 10 shows that when precipitation exceeds approximately 0.25 inches of rain within the previous 24 hours, bacteria concentration almost always exceed the single sample criterion of 88 cts/ 100 ml. Consequently, as a minimum, it is recommended that the Beach be closed when rainfall exceeds 0.25 inches.[217]
>
> Results of the ribotyping study indicate that the majority of the bacteria at Sand Dam Village Pond Town Beach is from geese. These findings are supported by visual observations by goose droppings as well as sightings of numerous geese in the area of the Beach. These findings are also supported by Table 7 which is a comparison of bacteria concentrations in scat (i.e., feces) from various sources. As shown, scat from geese is over 37 times more concentrated than the other sources tested. This implies that it would take less scat from geese to cause a violation of bacteria standards in surface waters as compared to other sources such as sheep, duck, horses, and goats.[218]

For the Frost Fish Creek TMDL, the most likely sources were waterfowl and wildlife generated pathogens entering the waterbody through stormwater runoff:

> The State of Massachusetts utilizes a fecal coliform standard of 14 CFU /100 mL for maintaining open and fishable shellfish resource areas. This standard has been exceeded frequently at multiple sampling stations in each sampling year. These observations support the contention that the system has a chronic contamination issue. In addition, the whole of the data suggests bacterial inputs in both the spring and winter. The most likely sources of fecal coliform bacteria are waterfowl and other wildlife throughout the upper basin and stormwater runoff from roads and paved surfaces near the tidal inlet at Rt. 28.[219]
>
> * * *
>
> It is important to consider that tidal influence on these stations is significant and bacterial contamination may be transported to these stations on the ebb or flood tide. However, it is certain that there is bacterial contamination carried down from the upper portion of the inner basin of upper Frost Fish Creek on the ebbing tide. This latter contamination is likely closely related to the land use of that portion of Frost Fish Creek (predominantly open space supportive of waterfowl and wildlife). This possibility is emphasized by the fact that bacterial exceedances under summer conditions are also high at stations…up gradient of the stations proximal to Route 28. Both stations…are located on a section of Frost Fish Creek with a public service land use designation. It has been confirmed that the land use is open space as maintained by the Chatham Conservation Foundation and as such, is likely habitat for avian populations or wildlife during summer months. Under winter conditions, bacterial exceedances are moderate in

[217] *Id.*
[218] *Id.*
[219] Frost Fish Creek TMDL at p. 17

> comparison to summer conditions…, however,…bacterial contamination is still apparent albeit lower than in the summer.[220]

Stormwater-based loadings can present similar issues, and have been found by states to justify BMPs and other implementation measures as more appropriate than numeric loadings:

> According to EPA policy on addressing regulated stormwater in TMDLs (USEPA, 2002), wasteload allocations can be translated to effluent limitations in the applicable permit through the use of BMPs. The following discussion summarizes information contained in USEPA (2002).[221]
>
> NPDES permits must contain effluent limits and conditions consistent with the requirements and assumptions of the wasteload allocations in the relevant approved TMDL. Typically, those effluent limitations to control the discharge of pollutants are expressed in numerical form. However, because storm water discharges are due to storm events that are highly variable in frequency and duration and are not easily characterized, EPA's policy recognizes that only in rare cases will it be feasible or appropriate to establish numeric limits for municipal and small construction storm water discharges. Therefore, EPA recommends that for NPDES-regulated municipal and small construction stormwater discharges effluent limits should be expressed as BMPs or other similar requirements, rather than as numeric effluent limits. The policy recognizes the need for an iterative approach to control pollutants in storm water discharges. Specifically, the policy anticipates that a suite of BMPs will be used in the initial rounds of permits and that these BMPs will be tailored in subsequent rounds.[222]
>
> Appropriate BMPs will be identified for implementation in the Campbell Creek and Campbell Lake watershed in the relevant stormwater permit. The implementation of these TMDLs will be a locally led process and will consider the site-specific characteristics of the watershed as well as past management activities and local experience. The information included in this section is provided as a potential framework for developing the implementation plan to reduce fecal coliform levels and achieve water quality goals for which the TMDL allocation was developed.[223]

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220 *Id.* at p. 40.
221 Campbell Creek TMDL at p. 57.
222 *Id.*
223 *Id.*