

EPA - NEW ENGLAND'S REVIEW of MASSACHUSETTS'
BARE HILL POND TMDL

TMDL: (Bare Hill Pond - Harvard, MA - Total Phosphorus)
Date: November 1, 1999

IMPAIRMENT/POLLUTANT: Nuisance aquatic plant growth due in part to excessive nutrient loading. The TMDL is proposed for total phosphorus.

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BACKGROUND: The Massachusetts Department of Environmental Protection (MADEP) submitted to EPA-New England the *Total Maximum Daily Load for Total Phosphorus, dated September, 1999*. The TMDL was submitted under a cover letter dated September 3, 1998 requesting review and approval by EPA - New England. The submittal was received by EPA - New England on September 9, 1999. Following is a summary of EPA's review which explains how the TMDL submission satisfies the statutory and regulatory requirements of TMDLs in accordance with Section 303(d) and 40 CFR Part 130. In addition to reviewing the TMDL document, EPA-New England also reviewed the July 1987 report by Whitman & Howard, Inc., *Diagnostic/Feasibility Study, Bare Hill Pond, Harvard, Massachusetts* which provides the technical basis for the TMDL.

REVIEW ELEMENTS OF TMDLs

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. § 130 describe the statutory and regulatory requirements for approvable TMDLs. The following information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation.

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

The TMDL analytical document must identify the waterbody as it appears on the State/Tribe's 303(d) list, the pollutant of concern and the priority ranking of the waterbody. The TMDL submittal must include a description of the point and nonpoint sources of the pollutant of concern, including the magnitude and location of the sources. Where it is possible to separate natural background from nonpoint sources, a description of the natural background must be provided, including the magnitude and location of the source(s). Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation. The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as: (1) the assumed distribution of land use in the watershed; (2) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources; (3) present and future growth trends, if taken into consideration in preparing the TMDL; and, (4) explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such

as percent fines and turbidity for sediment impairments, or chlorophyll a and phosphorus loadings for excess algae.

The Bare Hill Pond TMDL adequately describes the waterbody and the cause of impairment as identified in the 1998 303(d) list. The document describes the pollutant of concern, total phosphorus, and identifies the magnitude and location of phosphorus sources according to subcategories which include five contributing subwatersheds, direct atmospheric deposition to the lake, groundwater, and internal sediment recycling. A mass-balance nutrient budget approach based on monitoring of tributaries and in-lake total phosphorus was used to estimate existing loadings. For informational purposes only, an estimate of phosphorus loading according to land use categories using information from literature is also provided in the document. MA chose the mass balance approach as the basis for characterizing existing pollutant loading because it relies on actual monitoring data of the lake and tributaries rather than loading values from the literature. Although EPA considers both approaches to be valid for estimating nonpoint source pollutant loadings, EPA believes MA's decision to use an approach that relies largely on actual monitoring data of Bare Hill Pond to be reasonable.

Natural background loadings were not distinguished from the total nonpoint source load. In this case, not separating natural background is reasonable because of the approach used to estimate loadings by subwatershed and the limited and general nature of the information available (land use categories) related to potential phosphorus sources to Bare Hill Pond. Without more detailed site-specific information on nonpoint source loading, it is very difficult to meaningfully separate natural background from the total nonpoint source load and, attempting to do so, would add little value to the analysis.

Important assumptions made in developing the TMDL are discussed and include the relationships among phosphorus loading, excessive aquatic weed growth, and potential algal blooms. Additionally, the document describes the basis (review of census data) for assuming that phosphorus loading has not significantly changed since 1987 when the monitoring was completed.

EPA concludes that the TMDL document has adequately characterized Bare Hill Pond, the impairment and its causes. MA has relied on best available information including the 1987 Diagnostic/Feasibility (D/F) study and recent information collected by ENSR (1998) to develop the TMDL. EPA believes that the technical approach used by MA, including pollutant loading characterization and defining the loading capacity, are reasonable and consistent with widely accepted methods commonly used in lake nutrient management studies.

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

The TMDL submittal must include a description of the applicable State/Tribe water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy. Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation. A numeric water quality target for the TMDL (a quantitative value used to measure whether or not the applicable water quality standard is attained) must

be identified. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression, usually site specific, must be developed from a narrative criterion and a description of the process used to derive the target must be included in the submittal.

The Bare Hill Pond TMDL describes the applicable water quality standards which include narrative criteria as well as designated uses (see TMDL pages 7 & 8). MADEP has interpreted its narrative criteria for Bare Hill Pond by selecting a quantitative water quality target using in-lake total phosphorus (TP). The TP target was set at a level of 30 ppb which MADEP predicts will help prevent the proliferation of nuisance aquatic macrophytes and, in combination with in-lake management techniques such as harvesting, will result in the attainment of Water Quality Standards. In addition, MADEP is confident that the 30 ppb in-lake TP target will prevent excessive algal blooms where there is a current threat of declining water quality due to increased phosphorus and lowered visibility. The basis for selecting the numeric target is provided in the TMDL and includes the use of typical TP levels for lakes in the same eco-region as Bear Hill Pond in conjunction with actual in-lake TP and chlorophyll *a* data.

EPA concludes that MA has properly presented its water quality standards and has made a reasonable interpretation of the narrative water quality criteria in the standards. Based on the review of the in-lake data and MA's rationale, EPA concludes that the 30 ppb TP target in conjunction with in-lake management practices to control nuisance macrophytes will attain water quality standards. In addition, EPA concludes that the 30 ppb TP target will prevent excessive algal blooms from occurring in Bare Hill Pond and reverse the apparent declining water quality trend related to elevated phosphorus and reduced visibility.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

As described in EPA guidance, a TMDL identifies the loading capacity of a waterbody for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a water can receive without violating water quality standards (40 C.F.R. § 130.2(f)). The loadings are required to be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. § 130.2(I)). The TMDL submittal must identify the waterbody's loading capacity for the applicable pollutant and describe the rationale for the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In most instances, this method will be a water quality model. Supporting documentation for the TMDL analysis must also be contained in the submittal, including the basis for assumptions, strengths and weaknesses in the analytical process, results from water quality modeling, etc. Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation.

In many circumstances, a critical condition must be described and related to physical conditions in the waterbody as part of the analysis of loading capacity (40 C.F.R. § 130.7(c)(1)). The critical condition can be thought of as the "worst case" scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence. Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet

water quality standards.

The loading capacity for Bare Hill Pond was set at 538 kg/yr of total phosphorus in order to reduce average in-lake TP concentrations to 30 ppb (see TMDL pages 8-10). The loading capacity was set to protect water quality and support uses during *critical conditions* which, for Bare Hill Pond, occurs during the summer season when environmental conditions (e.g., higher temperatures, increased light intensity, etc.) are most favorable for aquatic plant growth. Attainment of Water Quality Standards will rely on the use of in-lake management practices to control rooted macrophytes in combination with reducing phosphorus loading from the watershed.

The approach used by MADEP to link water quality to pollutant loading for Bare Hill Pond is widely used among lake managers in New England. Most of the lake diagnostic/feasibility studies conducted throughout Massachusetts and New England have followed similar approaches. For Bare Hill Pond the Dillon-Rigler (1974) empirical lake model was used to establish this link and to estimate the loading capacity. MADEP justifies the use of this model because Bare Hill Pond falls within range of the calibration data-set for lake area, mean depth, and areal phosphorus loading that was used to develop the model (see TMDL page 10).

The Bare Hill Pond submittal includes documentation supporting the technical approach and key assumptions used in the analysis. The TMDL document discusses some of the limitations that are inherent in analyses involving nonpoint pollution sources and aquatic macrophytes in lakes. Additionally, EPA is familiar with the strengths and weaknesses associated with such an analysis. Principal strengths include the use of existing data in conjunction with an empirical model to predict in-lake water quality. Empirical models, such as the Dillon-Rigler model used in this analysis, are based on extensive data from lakes with similar characteristics that demonstrate the relationship between pollutant loading and lake water quality. Weaknesses in the approach relate primarily to the lack of site-specific information related to pollution sources and the relationship between pollutant loadings and aquatic macrophyte growth in Bare Hill Pond. This second weakness is due primarily to the complexity of the natural processes involved with the growth of aquatic plants in lake environs.

As indicated, the Bare Hill Pond TMDL is expressed in terms of allowable annual loadings of total phosphorus rather than daily loadings. As specified in 40 CFR 130.2(i), TMDLs may be expressed in terms of either mass per unit time, toxicity or other appropriate measure. MADEP justifies setting an annual load, as opposed to a daily load, because Bare Hill Pond's overall water quality including excessive aquatic plant growth is a function of long-term average pollutant loadings rather than short term daily loadings. The same is true for many lakes with long detention times like Bare Hill Pond and, especially where pollutant loading is solely from nonpoint sources. Bare Hill Pond has a detention time of approximately 0.7 years, which means that pollutants entering the pond will remain in the pond for a long time (similar to the detention time).

EPA-New England concludes that the loading capacity has been appropriately set at a level necessary to attain (in combination with in-lake management practices) and maintain applicable water quality standards. Additionally, MADEP has used a reasonable and widely accepted approach

to establish the relationship between pollutant loading and water quality. EPA New England also concurs with expressing the TMDL as an annual loading based on the reasons provided by MA.

4. Load Allocations (LAs)

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

If the TMDL concludes that there are no nonpoint sources and/or natural background, or the TMDL recommends a zero load allocation, the LA must be expressed as zero. If the TMDL recommends a zero LA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero LA implies an allocation only to point sources will result in attainment of the applicable water quality standard, and all nonpoint and background sources will be removed.

The Bare Hill Pond TMDL sets the total of all load allocations for existing and future (see TMDL pg.9) nonpoint sources to 511 kg/yr total phosphorus. Loads are allocated according to major subwatersheds, atmosphere deposition, and groundwater discharging directly to Bare Hill Pond. EPA-New England concludes that load allocations are adequately specified in the TMDL at levels necessary to attain and maintain water quality standards.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to existing and future point sources (40 C.F.R. § 130.2(h)). If no point sources are present or if the TMDL recommends a zero WLA for point sources, the WLA must be expressed as zero. If the TMDL recommends a zero WLA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero WLA implies an allocation only to nonpoint sources and background will result in attainment of the applicable water quality standard, and all point sources will be removed.

In preparing the wasteload allocations, it is not necessary that each individual point source be assigned a portion of the allocation of pollutant loading capacity. When the source is a minor discharger of the pollutant of concern or if the source is contained within an aggregated general permit, an aggregated WLA can be assigned to the group of facilities. But it is necessary to allocate the loading capacity among individual point sources as necessary to meet the water quality standard.

The TMDL submittal should also discuss whether a point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur. In such cases, the State/Tribe will need to demonstrate reasonable assurance that the nonpoint source reductions will occur within a reasonable time.

The Bare Hill Pond watershed does not include any point sources, and therefore, the WLA is zero kg/yr (see TMDL page 9). EPA-New England concludes that the WLA component of the TMDL

is appropriately set equal to zero based on MADEP's determination that there are no point sources present in the watershed.

6. Margin of Safety (MOS)

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

The Bare Hill Pond TMDL includes an explicit MOS of 5% (27 kg/yr) which has been set aside as unallocated (Page 9). In addition, MADEP believes (personal communication with Mark Mattson, 10/13/99) that in setting the numeric in-lake TP value to 30 ppb, a significant implicit MOS has also been provided. MADEP's rationale for including the 5% explicit MOS relates to the considerable uncertainty of the relationship between pollutant loading and aquatic macrophyte growth. MADEP states that a primary factor contributing to the extensive and dense aquatic macrophyte growth relates to the favorable conditions in Bare Hill Pond which provide an ideal habitat for the natural growth of rooted macrophytes. MADEP believes (personal communication with Mark Mattson) that phosphorus loading from the watershed is a secondary and a relatively minor factor contributing to the excessive growth of rooted macrophytes in Bare Hill Pond. Furthermore, future monitoring activities are planned to evaluate the adequacy of the TMDL in combination with in-lake management practices to control macrophytes in attaining water quality standards. MADEP states that if the post-implementation monitoring indicates the TMDL is inadequate then the TMDL will be revised accordingly.

EPA-New England concludes that adequate MOS (both implicit and explicit) is provided in the TMDL to address the rooted macrophyte problem and the threat of nuisance algal blooms. The adequacy of MOS to address the threat of algal blooms is easily supported by a review of the in-lake TP and chlorophyll *a* data which indicate that Bare Hill Pond is not experiencing nuisance levels of algae despite an estimated average in-lake TP concentration of 44 ppb.

Regarding the rooted macrophyte problem, EPA-New England concludes that the significant reductions proposed in the TMDL (279 kg/yr or 35%), including the 5% explicit MOS, provides adequate MOS to minimize the impacts of phosphorus loading on excessive macrophyte growth. We agree with MADEP's position that the extensive shallow areas of Bare Hill Pond provide an ideal habitat for abundant macrophyte growth and that excessive pollutant loading from the watershed is a relatively minor contributing factor. Under any scenario, in-lake management to control macrophytes is believed to be an essential component of a plan to attain water quality standards. No amount of pollutant reduction alone is expected to control the rooted macrophytes to levels that will fully support uses and attain water quality standards.

EPA-New England agrees that MADEP's commitment to conduct post-implementation monitoring

to re-assess the adequacy of the TMDL (and revise it if necessary) helps to address the uncertainty of the relationship between phosphorus loading and macrophyte growth and provides some level of assurance that standards will ultimately be met in Bare Hill Pond.

7. Seasonal Variation

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

The Bare Hill Pond TMDL (see TMDL page 10) was developed to be protective of the most environmentally sensitive period (summer season), when conditions are most favorable for plant growth. Therefore, the TMDL will also be protective of water quality during all other seasons. In addition, because of the long hydraulic detention time of Bare Hill Pond, anticipated phosphorus controls are expected to be in place throughout the year or during the season when the source becomes active in order to protect water quality. Thus, source controls will achieve pollutant reductions whenever sources are active and will, therefore, protect water quality throughout the year.

EPA-New England concludes that seasonal variations have been adequately accounted for in the TMDL.

8. Monitoring Plan for TMDLs Developed Under the Phased Approach

EPA's 1991 document, Guidance for Water Quality-Based Decisions: The TMDL Process (EPA 440/4-91-001), recommends a monitoring plan when a TMDL is developed under the phased approach. The guidance recommends that a TMDL developed under the phased approach also should provide assurances that nonpoint source controls will achieve expected load reductions. The phased approach is appropriate when a TMDL involves both point and nonpoint sources and the point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur. EPA's guidance provides that a TMDL developed under the phased approach should include a monitoring plan that describes the additional data to be collected to determine if the load reductions required by the TMDL lead to attainment of water quality standards.

MADEP will continue to support long term monitoring of Bare Hill Pond (see TMDL page 16) to evaluate the efficacy of the controls and the adequacy of the TMDL. The document describes the extent of MADEP's proposed monitoring and its schedule to occur in year two of the five-year watershed cycle for the Nashua Basin. Also, MA will work with and encourage the Bare Hill Pond Watershed Association to monitor the lake (annually) and identify pollution sources in the watershed. In addition to evaluating the adequacy of the TMDL, monitoring to identify pollutant sources) is considered to be an essential component of the implementation plan.

EPA-New England concludes that the proposed monitoring by MADEP together with the on-going annual volunteer monitoring (secchi disk readings at a minimum) will be sufficient to evaluate the adequacy of the TMDL during the next 10 to 15 years. Collection of annual in-lake TP data by the

Bare Hill Pond Watershed Association that are of acceptable quality to MADEP will greatly facilitate MA's ability to evaluate the effectiveness of controls and the adequacy of the TMDL.

9. Implementation Plans

On August 8, 1997, Bob Perciasepe (EPA Assistant Administrator for the Office of Water) issued a memorandum, "New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs)," that directs Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired solely or primarily by nonpoint sources. To this end, the memorandum asks that Regions assist States/Tribes in developing implementation plans that include reasonable assurances that the nonpoint source load allocations established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. The memorandum also includes a discussion of renewed focus on the public participation process and recognition of other relevant watershed management processes used in the TMDL process. Although implementation plans are not approved by EPA, they help establish the basis for EPA's approval of TMDLs.

The Bare Hill Pond TMDL implementation plan is described in pages 10, 11, 12 and 14. The plan outlines a process for collecting additional information to identify phosphorus sources, provide watershed residents with nonpoint source pollution and lake water quality education, and give guidance to apply for grant and loan funding to control sources once they are identified. Tasks and responsible parties are identified in Table 2 (page 14).

The document also discusses the necessity for in-lake management practices to control the macrophytes to acceptable levels. These practices may include water-level manipulation, harvesting and dredging. In-lake management practices are considered a necessary component of a restoration plan to attain water quality standards because of the extensive shallow-water areas in Bare Hill Pond that are ideal for rooted macrophyte growth. Current in-lake harvesting practices and lake-water level manipulation will continue to address excessive plant growth. In addition, ENSR has developed a management plan (1998) that recommends additional measures to control the rooted plants. MADEP states that the current and proposed in-lake management practices are sufficient to attain water quality standards (see TMDL page 39).

10. Reasonable Assurances

EPA guidance calls for reasonable assurances when TMDLs are developed for waters impaired by both point and nonpoint sources. In a water impaired by both point and nonpoint sources, where a point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur, reasonable assurance that the nonpoint source reductions will happen must be explained in order for the TMDL to be approvable. This information is necessary for EPA to determine that the load and wasteload allocations will achieve water quality standards.

In a water impaired solely by nonpoint sources, reasonable assurances that load reductions will be achieved are not required in order for a TMDL to be approvable. However, for such nonpoint source-only waters, States/Tribes are strongly encouraged to provide reasonable assurances regarding achievement of load allocations in the implementation plans described in section 9, above. As described in the August 8, 1997 Perciasepe memorandum, such reasonable assurances should be included in State/Tribe implementation

plans and “may be non-regulatory, regulatory, or incentive-based, consistent with applicable laws and programs.”

The Bare Hill Pond TMDL **document** does not specifically discuss reasonable assurances for achieving the pollutant reduction goals of the TMDL. However, the responsible groups for nine of the eleven implementation tasks related to phosphorus reduction are either MADEP or the watershed team which is led by the MA Executive Office of Environmental Affairs. EPA-New England has the opportunity through the Performance Partnership Agreement (PPA) process to work with MA to provide reasonable assurances for implementing the Bare Hill Pond TMDL. The responsible groups for the other two tasks, related primarily to outreach programs and developing funding proposals, include the Bare Hill Pond Watershed Association and the Nashua Watershed Association, both of which have demonstrated in the past a strong commitment to addressing water quality issues.

Regarding in-lake management practices, harvesting of macrophytes and lake-water level manipulation are ongoing practices conducted by the Town of Harvard. Considering the Town of Harvard’s and the Bare Hill Pond Watershed Association’s past and current performance of implementing these practices, EPA-New England believes there is reasonable assurance that these practices will continue in the future.

11. Public Participation

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

Inadequate public participation could be a basis for disapproving a TMDL; however, where EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

The public participation process for Bare Hill Pond TMDL is described on page 16 of the document. MADEP provided ample opportunity for public comment and held a public meeting on July 25, 1999. Appendix II of the final submittal provides both the written and verbal comments and MADEP’s response to those comments.

EPA-New England concludes that MADEP has done an excellent job involving the public during the development of the TMDL, and has provided adequate opportunities for the public to comment on the TMDL. Additionally, MADEP has provided, in the final submittal, a clear record of comments received and MADEP’s responses to those comments. EPA-New England concludes, based on a review of Appendix II, that MADEP has adequately responded to all public comments.

