

June 18, 2003

Brooke Barnes  
Maine Department of Environmental Protection  
#17 State House Station  
Augusta, Maine 04333-0017

**SUBJECT: Notification of Approval of Highland (Duck) Lake TMDL**

Dear Mr. Barnes:

Thank you for your submittal of the Highland (Duck) Lake Total Maximum Daily Load (TMDL) for total phosphorus. This Cumberland County waterbody is included on Maine's 1998 303(d) list due to excessive nutrient loading, and, due to increased level of interest, has become a high priority for TMDL development to address algae blooms.

The U.S. Environmental Protection Agency (EPA) hereby approves Maine's June 9, 2003 Highland (Duck) Lake TMDL received electronically on June 10, 2003. EPA has determined that this TMDL meets the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). Attached is a copy of our approval documentation.

We are very pleased with the quality of your TMDL submittal. Your staff have done an excellent job of preparing a comprehensive and informative TMDL report on this heavily used lake with regulated stormwater impacts. My staff and I look forward to continued cooperation with the ME DEP in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

Sincerely,

Linda M. Murphy, Director  
Office of Ecosystem Protection

cc: David Courtemanch, ME DEP  
David Halliwell, ME DEP

## EPA NEW ENGLAND'S TMDL REVIEW

**TMDL:** **Highland Lake (Duck Pond)**, Cumberland County, Maine  
(ME ID#607 3734 located in Falmouth, Windham, and Westbrook, ME)  
1998 303(d) list: Trend; <2008-11 TMDL development.

**STATUS:** Final

**IMPAIRMENT/POLLUTANT:** Gradual decline in water quality (trend) due to excessive nutrient loading. The TMDL is proposed for total phosphorus (TP).

**BACKGROUND:** The Maine Department of Environmental Protection ( ME DEP) submitted to EPA New England the final Highland Lake (Duck Pond) TMDL for total phosphorus (TP) with a transmittal letter dated May 21, 2003; a subsequent final corrected report dated June 9, 2003 was received electronically on June 10, 2003. All of EPA's October 23, 2002 comments (10/23/02, 6/3/03) that were significant were addressed in the final submission.

The following review explains how the TMDL submission meets the statutory and regulatory requirements of TMDLs in accordance with Sec. 303(d) of the Clean Water Act, and 40 CFR Part 130.

**REVIEWERS:** Jennie Bridge (617-918-1685) [bridge.jennie@epa.gov](mailto:bridge.jennie@epa.gov)  
Alison Simcox (617-918-1684) [simcox.alison@epa.gov](mailto:simcox.alison@epa.gov)

## 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.*

Highland Lake, known locally as Duck Pond, is a deep, non-colored lake that stratifies seasonally (dimictic) and, historically, has had excellent water quality for salmonids. The lake receives heavy year-round recreational use and is on ME DEP's list of Lakes Most At Risk From Development due to rapid population growth rates in the surrounding towns and the sensitive nature of the waterbody (page 11 TMDL report). ME DEP is concerned that increasing nutrient levels and hypolimnetic oxygen depletion may eliminate suitable habitat for coldwater fisheries (page 27 TMDL report). Highland Lake's sole outlet stream is Mill Brook, a major tributary of the Presumpscot River which flows into Casco Bay. Highland Lake was moved ahead of the 1998 schedule for TMDL development (2008-201 to 2001-2) due to increased public interest in the watershed (ME DEP 12/23/02 letter to EPA).

The Highland Lake TMDL describes the waterbody and the cause of impairment as identified in the 1998 303(d) list. Historically, there has been a gradual decline in water quality and clarity due to nutrient enrichment, although there are "no prevalent nuisance summer algal blooms" (page 27 TMDL report). The lake's priority ranking for TMDL development was moved ahead of the 1998 schedule "due to the high level of interest in this particular lake watershed" (12/23/02 final TMDL cover letter). The TMDL report describes the pollutant of concern, total phosphorus, and magnitude of phosphorus sources from atmospheric deposition (10.6%) and from sixteen subcategories of land use within the watershed which include: agricultural practices, residential development, septic systems, roads, and non-cultural uses (see Table 3 page 30 of TMDL report). Information on population and growth characteristics is provided (pages 10-11, TMDL report). Internal sediment recycling is evaluated (pages 33 TMDL report).

ME DEP provides an explanation and analytical basis for expressing the TMDL for nuisance algae blooms through the surrogate measure of phosphorus loadings, also using measures of Secchi disk transparency (SDT) and chlorophyll a. (See page 4, in general, and page 27, in detail, of TMDL report. See also section 2 below which documents ME's water quality standards.)

ME DEP explains that it was not possible to separate natural background from nonpoint sources (page 28 TMDL report). In this case, not separating natural background is reasonable because of the limited and general nature of the information available (land use categories) related to potential phosphorus sources to the lake. Without more detailed site-specific information on nonpoint source loading, it would be very difficult to separate natural background from the total nonpoint source load, and attempting to do so would add little value to the analysis.

**Assessment:** EPA New England concludes that the ME DEP has done an adequate job of characterizing the lake's sources of impairment.

## **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 Highland Lake TMDL describes the applicable narrative water quality standards (see page 28 TMDL report). The report defines applicable narrative criteria, designated uses, and antidegradation policy. Highland Lake is a non-colored lake (average color 17 SPU) and does not meet water quality standards due to a significant decline in water transparency trends over time, combined with monitored annual summertime hypolimnetic dissolved oxygen deficiencies (page 28).

ME DEP identifies a numeric water quality target for the TMDL of **10 ppb** total phosphorus (TP) (287 kg TP/yr) which ME DEP predicts will result in the attainment of water quality standards (page 28 TMDL report). The numeric in-lake target was selected using best professional judgment based on available water quality data (average epilimnion grab/core samples) corresponding to continued maintenance of non-bloom conditions, as reflected in measures of both Secchi disk transparency (>2.0 meters) and chlorophyll-a (<8.0 ppb) (page 28).

**Assessment:** EPA New England concludes that ME DEP has properly presented its water quality standards and has made a reasonable interpretation of the narrative water quality criteria in the standards when setting a numeric water quality target.

The 10 ppb target concentration was selected based on review of statewide water quality data for lakes with low levels of apparent color (<26 SPU), lake-specific data, and on water quality goals of ME DEP. EPA New England is satisfied that this review was thorough and, based on our review, EPA concurs that the available data support the conclusion that an in-lake concentration of 10 ug/l will attain Maine's water quality standards.

### **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 Highland Lake is set at **287 kg TP/yr**. (See page 31-32 TMDL report). The loading capacity is set to protect water quality and support uses during critical conditions which occur during the summer season when environmental conditions (e.g., higher temperatures, increased light intensity, etc.) are most favorable for aquatic plant growth (page 33-4 TMDL report). ME DEP's calculation of the current external loading of TP averages 414 kg annually (which includes 32.5 kg from future development) (page 31 TMDL report); so a 127 kg TP/yr load reduction is needed to attain water quality standards.

ME DEP links water quality to phosphorus loading by (1) picking a target in-lake phosphorus level based on historic state-wide and in-lake water quality data (page 31 TMDL report), (2) using an empirical phosphorus retention model, calibrated to in-lake phosphorus concentration data to determine the pollutant loading corresponding to the desired water quality in the lake (see page 33 TMDL report), and (3) comparing the loading target to existing phosphorus loadings estimated by applying phosphorus export coefficients to land area with specified land uses (see Table 3, page 30 TMDL report). These analytical methods are widely recognized as appropriate for lake TMDL development.

ME DEP explains that the justification for expressing the loading capacity as an annual load, as opposed to a daily load, lies in the lake basins relatively long hydraulic residence time (0.70 flushes per year) (page 31 TMDL report).

**Assessment:** EPA New England concludes that the loading capacity has been appropriately set at a level necessary to attain and maintain applicable water quality standards. The TMDL is based on a reasonable and widely accepted approach for establishing the relationship between pollutant loading and water quality in lakes.

EPA New England also concurs with expressing the TMDL as an annual loading based on the reason provided by ME DEP (hydraulic residence time).

#### **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.*

ME DEP calculates that the load allocation for Highland Lake must be limited to **132 kg TP/yr** in order to achieve the in-lake target goal of 10 ppb TP (page 34 TMDL report). The TMDL allocates this load allocation as a gross allotment to existing and future nonpoint sources and to

natural background. (See following section on WLA for regulated stormwater allocation.) ME DEP does not think that internal sediment-derived phosphorus mass is a major problem in Highland Lake, given the relatively low levels of phosphorus in the water column absence of nuisance algae blooms. However, without external load reduction, internal sediment recycling of phosphorus is expected to become more apparent in future years (Page 32).

**Assessment:** EPA New England concludes that the load allocation is adequately specified in the TMDL at a level necessary to attain and maintain water quality standards. The degree of load reductions necessary to achieve the in-lake phosphorus levels is based in part on an estimate of current loadings.

## 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 WLA for regulated stormwater for Highland Lake is **155 kg/year of TP** (page 34 TMDL report). All three towns in the Highland Lake watershed (Windham, Falmouth, and Westbrook) have regulated urbanized areas that are subject to ME DEP's NPDES phase II stormwater program; the entire watershed to the west of the lake, and a significant shoreline portion of the watershed to the north of Highland Lake fall within the regulated "urbanized area". Using the assumption that the regulated areas are the source of all urban runoff, ME DEP calculates the WLA for the Highland Lake watershed based on the same TP export percentage from all urban development land use categories (Table 3, page 30 TMDL report). Since 54% of the current sources of phosphorous to the lake are from urban development, the WLA is therefore 54% of the loading capacity for the lake (0.54 x 287).

**Assessment:** EPA New England concurs that the WLA component of the TMDL is appropriately set based on ME DEP's assumptions from their analysis of current land use area and calculations on the contribution of soon-to-be regulated stormwater 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 Highland Lake TMDL includes an implicit margin of safety (MOS) through the relatively conservative selection of the numeric water quality target of 10 ppb as well as the selection of relatively conservative phosphorus export loading coefficients for cultural pollution sources (Table 3, page 30 TMDL report). Based on both historical records and ME DEP's analysis of a state-wide limnological database for non-colored (or <26 SPU lakes), ME DEP believes that a target of 10 ug/l is a highly conservative goal because "summer nuisance algae blooms (growth of algae which causes Secchi disk transparency to be less than 2 meters) are more likely to occur at 18 ppb or above. The difference between the in-lake target of 10 ppb and 17 ppb represents a 41% (199 kg TP/yr) implicit margin of safety based on water clarity alone (page 34 TMDL report).

**Assessment:** EPA New England concludes that adequate MOS (roughly 41%) is provided for the following reasons: (1) EPA believes a significant implicit MOS is provided in the selection of an in-lake TP concentration of 10 ppb based on a state-wide data base for lakes of low apparent color, and (2) the adequacy of this MOS is supported by in-lake data.

## **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 Highland Lake TMDL considered seasonal variations because the allowable annual load was developed to be protective of the most sensitive time of year - during the summer, when conditions most favor the growth of algae and aquatic macrophytes (page 34 TMDL report). The TMDL is protective of all seasons, given Highland Lake's average hydraulic retention time of 0.7 flushes/year, and the fact that BMPs implemented (implemented and proposed) have been designed to address TP loading during all seasons.

**Assessment:** EPA New England concludes that seasonal variation has been adequately accounted for in the TMDL because the TMDL was developed to be protective of the most environmentally sensitive period, the summer season. In addition, phosphorus controls are expected to be in place throughout the year so that these controls will reduce pollution whenever sources are active.

## **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.*

The Highland Lake TMDL describes the history of volunteer monitoring (since 1974), and explains that the Maine Volunteer Lakes Monitoring Program (MVLMP), in cooperation with ME DEP, and the Highland Lake Association will continue the long-term water quality monitoring of Highland Lake monthly from May to October. The data will be used to track seasonal and inter-annual variation and long term trends in water quality in the lake (see page 24 TMDL report). A post-TMDL status update report will be prepared 5-10 years after TMDL approval.

**Assessment:** EPA New England concludes that the ongoing monitoring by the Volunteer Lakes Monitoring Program (VLMP) in cooperation with ME DEP is sufficient to evaluate 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.*

ME DEP outlines a phosphorus control action plan that summarizes recent and current NPS/BMP efforts and provides recommendation for future work (pages 20-24 TMDL report). Specific recommendations include implementing the existing Highland Lake watershed management plan (last survey done 1997-1998). Other specific recommendations are for BMPs and actions to reduce external TP loadings from forestry, shoreline residential, septic systems, camp and private roads, and municipal actions to ensure compliance with local and state water quality laws and ordinances.

**Comment:** Addressed, though not required.

## **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.”*

ME DEP addresses reasonable assurances by (1) providing information on recent surveys to identify high priority problem sites in the watershed (page 20 TMDL report), (2) stating that Highland Lake is fortunate in having very active and responsible organizations in place to deal with water quality issues, and (3) stating that “adequate tools are in place for the continued protection and improvement of the Highland Lake watershed and lake water quality. (page 24 TMDL report).

**Comment:** Addressed, though not required.

## **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 the Highland Lake TMDL is described on pages 34-36 of the report. ME DEP issued public notice of the public review draft TMDL availability on **September 29<sup>th</sup>** and October 13<sup>th</sup> via local newspapers, and on ME DEP’s Internet web site (<http://www.state.me.us/dep/blwq/comment.htm>), following a preliminary review by interested stakeholder agency and groups (Sept 10-24 involving Depts. of Agriculture, Conservation, Forestry Service, CCSWCD, NRCS, and Highland Lake Association). ME DEP and MACD staff also prepared materials for and participated in several local education/outreach meetings with lakeshore residents in 2001 – 2002. The public comment period deadline was October 28, 2002. There were 5 respondents during ME DEP’s 2-week preliminary stakeholder review in September 2002, and one additional comment received during the subsequent 30-day public review period. ME DEP provides comments and responses in appendix C of the TMDL report (page 36-43 TMDL report).

**Assessment:** EPA New England concludes that ME DEP has done an adequate job of involving the public during the development of the TMDL, provided adequate opportunities for the public to comment on the TMDL, and provided reasonable responses to the public comments.



In-house distribution:

Jennie Bridge  
Alison Simcox  
Ann Williams  
Steve Silva

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