UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
5 Post Office Square, Suite 100
Boston, MA 02109-3912

June 10, 2011

Kenneth L. Kimmell, Commissioner
Department of Environmental Protection
1 Winter Street
Boston, MA 02108

SUBJECT: **Notification of Approval of Upper/Middle Charles River TMDL**

Dear Commissioner Kimmell:

Thank you for your Department's submittal of the *Total Maximum Daily Load (TMDL) for Nutrients in the Upper/Middle Charles River, Massachusetts*. This TMDL report provides total phosphorus TMDLs for 31 Class B waterbody segments, 30 of which are included on Massachusetts's 2008 303(d) list, and one segment that is addressed as a protective TMDL. The purposes of the TMDLs are to address aquatic life use, recreational use, and aesthetic impairments in the river due to excessive nutrient loading from wastewater discharges and significant storm water runoff.

The U.S. Environmental Protection Agency (EPA) hereby approves Massachusetts's June 3, 2011 Upper/Middle Charles River TMDLs. EPA has determined that these TMDLs meet 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 from the Division of Watershed Management, and commend your efforts to address nutrient-related impacts to the Upper/Middle Charles River. My staff and I look forward to continued cooperation with the Massachusetts DEP in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

Sincerely,

/s/

Stephen S. Perkins, Director
Office of Ecosystem Protection

cc (electronic): Ann Lowery, Deputy Assistant Commissioner, BRP
w/attachments Kevin Brander, Northeast Regional Office
Rick Dunn, MassDEP/DWM-Watershed Planning Program
Kim Groff, MassDEP/DWM-WPP
Elaine Hartman, MassDEP/DWM-WPP
Bob Zimmerman, Kate Bowditch, Nigel Pickering, CRWA

EPA NEW ENGLAND'S TMDL REVIEW

TMDL: **Upper/Middle Charles River, Massachusetts**, Control Number: CN 272.0. HUC and 2008 303(d) listings and one unlisted mainstem segment: See attached Table 1. for list of 31 Class B waterbody segments, including 9 mainstem, 11 tributary segments, and 11 connected ponds;
Scheduled for TMDL development 2008.

STATUS: Final

IMPAIRMENT/POLLUTANT: **Upper/Middle Charles River**: Aquatic life and recreational uses, and aesthetic impairments measured by water quality criteria for Class B waters (including phosphorus/eutrophication/nutrient enrichment (28), macrophytes/algae (16), dissolved oxygen (12), dissolved oxygen saturation (4), and turbidity/transparency (10); sources include significant stormwater runoff and wastewater discharges. Point source/nonpoint source TMDLs are calculated for **total phosphorus.**

BACKGROUND: The Massachusetts Department of Environmental Protection (MassDEP) submitted to EPA New England the final *Upper/Middle Charles River, Massachusetts, TMDL* (report Control Number: CN 272.0) electronically with a transmittal letter dated September 27, 2010, and a revised final report/clarification memo on June 3, 2011. All of EPA's comments were taken into account in the final submission.

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

REVIEWERS: Jennie Bridge (617-918-1685) e-mail: bridge.jennie@epa.gov and
Mark Voorhees (617-918-1537) e-mail: voorhees.mark@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.

The Charles River starts above Echo Lake in Hopkinton, MA and flows about 79 miles in a north-easterly direction to the coast, flowing through many of the surrounding Boston communities before discharging into Boston Harbor. A separate phosphorus TMDL report was approved October 17, 2007 for the Lower Charles River, the most downstream Charles River segment between the Watertown Dam and Boston Harbor (308 square mile drainage area and 9 miles long). For the purposes of the Upper/Middle basin TMDL report for the Charles River, the Upper Charles is the 45-mile stretch above the USGS Dover Gauge (182 square mile drainage area). The Middle Charles is the 25-mile section of river between the USGS Dover Gauge and the Watertown Dam (84 square mile drainage area).

The Upper/Middle Charles River is comprised of 31 Class B waterbody segments including 30 segments listed as impaired in the 2008 MA Integrated List. Of these 30 segments, eight mainstem segments, eleven tributaries, and eleven ponds connected to tributaries are impaired by various different combinations of eleven different 303(d) listing causes, including phosphorus/eutrophication/enrichment, macrophytes/algae, dissolved oxygen, and turbidity/transparency (Table 1 pages 15-17 TMDL report). One additional mainstem segment is not currently listed as impaired, but is included in the TMDL report as a protective measure, since segments up and downstream are impaired.

In the Upper/Middle Charles River, visual evidence and data show significant impairment by large extents of algae and aquatic plant growth resulting from excessive nutrients (pages 8 and 45 TMDL report). Regular occurrences of severe algal blooms during summer months have been observed to reduce water clarity, which interferes with recreational uses, and contributes to

anoxic bottom waters that do not support aquatic life. The two primary sources of pollutants are stormwater runoff (from developed watersheds and background), and discharges from six active municipal wastewater treatment facilities.

The TMDL document describes the primary pollutant of concern as total phosphorus. The type, magnitude and location of potential sources were determined using land use-based watershed modeling, and water quality modeling. Source assessment of phosphorus loads yielded the following results: stormwater from developed areas (48%), background stormwater (26%), wastewater discharges (19%), sediment release (6%), and atmospheric deposition (1%) (pages 48-49 TMDL report).

MassDEP provides an explanation and analytical basis for assessing the TMDLs for recreational and aquatic life impairment through the use of a surrogate pollutant (**total phosphorus**), a weight-of-evidence approach in considering all nutrient-related parameters (nutrient concentrations, DO, and chlorophyll *a*), and an HSPF (Hydrologic Simulation Program – Fortran) watershed/water quality model (pages 12, and 47 TMDL report). Water quality monitoring and flow gauging conducted specifically for the TMDLs involved two rounds of dry- and wet-weather sampling, and five years of flow measurements at both tributary and main-stem sites; substantial water quality, flow and climatic data from other sources were used as well. Since the TMDLs for the Upper/Middle Charles must meet specific water quality targets for each river segment (especially in impounded waters and below wastewater treatment discharges) *and* must produce an outlet phosphorus load that satisfies the Lower Charles TMDL inlet load of 15,109 kg/yr, an HSPF model was used to evaluate a number of management scenarios to assist selection of the optimum allocation scenario to meet all the TMDL targets.

MassDEP has determined that all nutrient-impaired segments in the Commonwealth are a high priority, and the Upper Charles River was specifically listed in the table updating the estimated TMDL schedule for FY08-10 (pp. 28-29, *Final Massachusetts Year 2008 Integrated List of Waters*, December 2008). The TMDL report explains the importance of the Upper/Middle Charles River in achieving water quality throughout the basin.

Assessment: EPA New England concludes that the MassDEP has done an adequate job of describing the TMDL waterbody segments, pollutants of concern, and identifying and characterizing 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 Upper/Middle Charles River TMDL report describes the applicable water quality standards for narrative and numeric criteria for nutrient-related parameters used to measure attainment of the designated uses, and anti-degradation policy (pages 2 and 19 TMDL report). The Upper/Middle Charles River segments are listed as Class B waters. Massachusetts water quality standards specify that Class B waters are designated as providing and supporting habitat for fish and other aquatic wildlife, and for primary and secondary contact recreation, and shall have consistently good aesthetic value [Massachusetts 314 CMR 4.0].

MassDEP uses total phosphorus as a measure of point and nonpoint source impacts resulting in violation of the Commonwealth's nutrient-related criteria for Class B waters. Since Massachusetts does not have numeric standards for total phosphorus, numeric targets for the Upper/Middle Charles River were developed from the water quality standards using best professional judgment (BPJ), and a weight-of-evidence approach based on selected causal and response nutrient water quality metrics and guidance values and all available information (see Table ES-2/Table 5, pages 4 and 23 TMDL report).

The water quality targets chosen for modeling the Upper/Middle Charles TMDLs are presented in Table 15 of the final TMDL document (page 52 TMDL report). The minimum daily target (<5 mg/L) for dissolved oxygen was taken from Massachusetts water quality standards; the maximum daily saturation target (<125%) was developed using best professional judgment, and was applied in the Assabet River nutrient TMDLs; the target chlorophyll-*a* value (<10 ug/L) was the same target applied in the Lower Charles TMDL (page 23 TMDL report).

Since Massachusetts does not yet have numeric criteria for nutrients, MassDEP selected three in-stream total phosphorus targets from the EPA national guidance, *Quality Criteria for Water-1986*, which were derived to prevent the development of biological nuisances and to control accelerated or cultural eutrophication in surface waters. Table 15 identifies the three target **total phosphorus** levels used to develop the TMDLs as follows: (1) **0.1 mg/L** [100 µg/L] for free flowing streams; (2) **0.05 mg/L** [50 µg/L] for locations entering lakes and impoundments; and (3) **0.025 mg/L** [25 µg/L] for lakes and impoundments. The Upper/Middle Charles River HSPF model was specifically developed to conduct water quality evaluations of critical river segments and critical periods using the chosen water quality targets (pages 54-56 TMDL report).

Assessment: EPA New England concludes that MassDEP has properly presented its water quality standards, the relevant criteria and uses, and its basis for using literature values, best professional judgment, and "weight-of-evidence" approach when setting phosphorus water quality targets expected to attain Class B water quality standards. In the absence of having state-adopted numeric phosphorus criteria, EPA Region 1 currently relies on these same levels as the basis for deriving water quality based effluent limits (WQBELs) for phosphorus from POTW discharges to surface waters in Massachusetts and New Hampshire. Similar to setting WQBELs in POTW discharge permits, the Upper/Middle Charles River TMDLs were set to achieve these levels under critical low flow conditions. EPA Region 1 finds that the in-stream phosphorus

targets used for developing these TMDLs are set at levels that will result in attainment of MA WQS.

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 of the Upper/Middle Charles River segments for nutrients is set at a numeric target level for total phosphorus using a two-tiered evaluation (pages 51-56 TMDL report). First, the annual **total phosphorus** load at the Watertown Dam outlet must meet the inlet load specified in the Lower Charles TMDL of **15,109 kg/yr**. Second, the phosphorus load must be low enough to achieve instream water quality targets and control response variables for excess nutrients and algal biomass in the river during low flow conditions and WWTF design-flows. An HSPF model was used to run different scenarios to determine one which would meet both evaluation tiers. The final choice resulted in a slightly lower total loading capacity of 14,968 kg/yr TP (pages 70 and 72, Tables 19 and 20/ES4 TMDL report). Modeling confirmed that significant reductions in phosphorus loading are necessary. The difference between the required 15,109 TMDL loading capacity and final model scenario resulting in 14,968 is 141 kg/yr, and represents a portion of the margin of safety for the Upper/Middle Charles River TMDLs, as described below in Section 6.

The modeled loading capacity of 14,968 kg/yr is set to protect water quality and support uses during *critical conditions*, which are defined by an adaptation of the 7Q10 low flow approach which identifies the worst seven-day water quality condition by reach under all flow situations in a given period. These stressful conditions may occur throughout the year, at various flows, and depend on the biological requirements of the life stage of resident aquatic organisms. MassDEP explains that the dynamic nature of streamflow, loads, impoundments, and residence time in the Upper/Middle Charles River results in each reach having its own "critical" period (pages 55-56

TMDL report).

These complexities of critical conditions in flowing water impaired by stormwater runoff are a major consideration in expressing the TMDLs in terms of an **annual load**. The TMDL loads are also expressed in terms of **daily maximum load** (see page 73, Figure 13 TMDL report). The graphic display of the daily phosphorus loads shows that the total phosphorus TMDL waste load reductions must be applied uniformly and consistently throughout the year under all load conditions.

The HSPF model (Bicknell, et al., 1993) developed for use in the Upper/Middle Charles TMDL study was calibrated to field conditions for the period 2002-2005 and validated by comparing it with continuous DO data from a prior survey (CDM, 1997) (page 57 TMDL report). The HSPF model was used to analyze total loads and losses of phosphorus in the Upper/Middle Charles for the period 1998-2002 (page 47 TMDL report). This five-year period was chosen to match the period used for the load calculations in the Lower Charles TMDL.

The predicted phosphorus loads were summed over the summer months (Apr-Oct, lb/period) and the full year (Jan-Dec, lb/yr). The total *wastewater* phosphorous load was estimated by summing the daily loads from the six WWTFs, and finally converting to metric units (kg/time period). The total *stormwater* phosphorus load was estimated from the hydrologic response units (HRUs) by using the calibrated HSPF model to generate the monthly phosphorus loads for groundwater and surface runoff components, then accumulating the load across months and HRUs (page 48 TMDL report).

Losses of phosphorus throughout the system due to diversions and internal transient losses (uptake and settling) are significant and are listed as a total loss figure of -5,625 kg/yr (page 72, Table 20/ES4 TMDL report). For purposes of TMDL development, this total loss figure can be applied to the total sums of the WLA and LA assigned to meet the loading capacity assigned by the Lower Charles TMDL.

MassDEP explains in detail the assumptions, strength and limitations of the analytical process involving the HSPF model and the approach used to evaluate loading capacities associated with various scenarios (reflecting different levels of point source and nonpoint source reductions on water quality in the critical reaches). Discussions in the TMDL report address analyses of phosphorus loads, losses, water quality target selection and evaluation, critical and excluded reaches, and critical low flow and high flow periods (pages 46-69 TMDL report).

Assessment:

EPA concludes that MassDEP has properly accounted for critical conditions, and has adequately documented the suitability of the model for establishing the total phosphorus loading capacity of the Upper/Middle Charles River, based on exceeding neither the loading capacity assigned by the Lower Charles River TMDL, nor the instream water quality targets chosen to meet MA WQS within each stream segment. Since stormwater runoff occurs throughout the year, with different

environmental effects, at both low and high flows, critical conditions for aquatic life protection are not limited to particular flow conditions or time of year. EPA concludes that critical conditions are adequately accounted for because the TMDL targets directly address the effect of stormwater runoff in the watershed as well as WWTF discharges, and thus the range of impacts under varying critical conditions at different flows. 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 TMDLs are based on a calibrated model designed to establish the relationship between pollutant loading, system losses, and water quality in point-source and nonpoint source-impaired waters. For this TMDL study, system losses were calculated based on flow gauging and water quality monitoring data. The system losses are due to the regular occurrence of river flow diversions from the upper Charles River watershed to the Neponset River watershed via Mother Brook, and the burial of a portion of phosphorus that settles into the rivers bottom sediments. The TMDL report demonstrates that these losses are important components of the overall phosphorus budget for the Charles River watershed and needed to be estimated and accounted for in the allocation process in order to adequately represent water quality conditions.

TMDL Time Increment / Daily Loading

EPA's November 15, 2006 guidance entitled *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*, recommends that TMDL submittals express allocations in terms of daily time increments. In this case, the TMDLs' pollutant targets are expressed in terms of a daily increment, as well as in terms of an annual load. EPA New England concurs with expressing the TMDLs as annual loads based on the reasons provided by MassDEP (critical conditions occurring at various flows and pollutant loads throughout the year).

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.

MassDEP sets load allocations for total phosphorus for benthic loads from sediment flux (1,769 kg/yr), atmospheric deposition (316 kg/yr), and water/wetland (126 kg/yr). The estimated reduction for sediment flux is 25%, which is anticipated as a result of watershed load reductions associated with the wasteload allocations for the WWTFs and the regulated storm water

discharges. The estimated reductions in annual loads for atmospheric deposition and water/wetland are 0%.

Assessment: EPA New England concludes that the load allocations for total phosphorus are adequately specified in the TMDL report at levels necessary to attain and maintain water quality standards. The degrees of load reductions necessary to achieve the in-stream phosphorus levels are based on estimates of current loadings. EPA agrees that benthic flux is appropriately included in the LA because, in this case, it is assumed that natural attenuation will accomplish the necessary reductions, once the wastewater and stormwater sources are controlled to the point that the concentration of total phosphorus is lowered in the water column.

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.

Wastewater WLA

The final modeling scenario load of 14, 948 kg/yr, which meets the Lower Charles TMDL target phosphorus load of 15,109 kg/yr at the Watertown Dam, is based on implementing summer/winter effluent limits for both major and minor wastewater treatment facilities of 0.1/0.3 mg/L (page 75 and Table 19, page 70, TMDL report). This means that three active mainstem and three tributary WWTFs will be required to meet summer (April-Oct total phosphorus limits of 0.1 mg/L, and winter (Nov-Mar) total phosphorus limits of 0.3 mg/L (pages 13 & 92 TMDL report.) MassDEP explains that additional summertime TP reductions are necessary to address water quality problems in critical reaches of the Upper/Middle Charles River watershed, and winter time reductions are necessary to meet the Lower Charles TMDL load requirement at the Watertown Dam. This TMDL report's wastewater portion of the WLA for the Upper/Middle Charles accounts for the fact that facilities can discharge up to their currently permitted flows.

Stormwater WLA

This TMDL report sets phosphorus allocations for regulated stormwater because all municipalities in the watershed are, either in whole or in part, subject to the Phase II NPDES

stormwater regulations governing municipally-owned separate stormwater sewer systems (MS4s) (page 85 TMDL report). NPDES permits are also required for stormwater associated with construction activities disturbing greater than one acre of land and stormwater associated with certain industrial activities (page 73 TMDL report). WLAs for the regulated stormwater are assigned to land uses where stormwater loads are dominated by regulated sources, including areas of low, medium, and high residential, commercial/industrial, and transportation (airports, docks, divided highway, freight, storage, railroads, as defined by MassGIS, see page 75 TMDL report). These WLAs require phosphorus load reductions of 35% from open/agriculture areas, 45% from low density residential, and 65% reduction from all intense land uses (medium, high density, and multi-family residential, commercial/industrial, and transportation). A WLA was also assigned for forested areas with the potential for loads from regulated sources such as roads, but included the assumption of zero reductions.

Assessment: EPA New England concurs that the WLA component of the TMDL report is appropriately set, and the wasteload allocations are adequately specified in the TMDL report at levels that will reduce phosphorus sufficiently to meet the water quality targets and hence, attain and maintain MA WQS. As required, the TMDL report presents individual WLAs for individually-permitted point sources (WWTFs) that discharge phosphorus to the Upper/Middle Charles River. For this case, EPA finds it reasonable to assign aggregate WLAs for other phosphorus sources present in the Upper/Middle Charles River watershed where it is not possible to identify specific land covers discharging to MS4s from non-MS4 and nonpoint sources. EPA also concurs with the inclusion of forested areas in the WLA because forested areas in this portion of MA are highly fragmented by roads and other impervious areas, some of which may be part of regulated MS4 systems. Moreover, EPA concludes that the level of aggregation is consistent with level of information currently available to quantify phosphorus loading to the Upper/Middle Charles River. EPA notes that expansion of development activities have the potential to increase runoff and associated pollutants. To ensure that the TMDL targets are attained, future development activities will need to meet the TMDL targets.

6. Margin of Safety

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 Upper/Middle Charles River TMDLs include both cxplicit and implicit margins of safety (MOS). One margin of safety included in the Upper/Middle Charles TMDL report is **141 kg/yr**, which represents the difference between the Lower Charles TMDL allocation for the Upper Middle Charles, and the chosen TMDL modeling scenario for the Upper/Middle Charles (15,109 – 14,968 = 141).

Another explicit MOS for the Upper/Middle Charles of 757 kg/yr is inherited from the Lower Charles TMDL. The Lower Charles TMDL included an explicit 5% MOS, and a portion of the MOS for the Lower Charles also applies proportionally to the Upper/Middle Charles TMDL in order to account for the Upper/Middle Charles watershed load to the Watertown Dam of 15,109 kg/yr. MassDEP notes that the combined explicit MOS (898 kg/yr) represents an explicit MOS of 6%.

MassDEP also explains several additional sources of implicit MOS based on conservative modeling and analytical assumptions. These implicit MOS result from: (1) the difference in the assumed reduction and the expected long-term reduction in sediment efflux rates for phosphorus, (2) the fact that each reach was analyzed individually for the mean, 90th percentile, and 7-day extreme value for the target water quality parameters, rather than just looking at averages over multiple reaches, and (3) The analysis period used for the reaches (2002) is considered to be representative of low flow or near-7Q10 conditions and should capture the worst case conditions associated with WWTF discharges.

Assessment: EPA New England concludes that adequate MOS is provided. Both the explicit MOS discussed above, and the implicit MOS, accomplished primarily through the use of environmentally conservative assumption in the modeling analyses, are reasonable for this TMDL report because the TMDLs are based on extensive data sets and rigorous studies and models of phosphorus loading and land use analyses.

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)).

Seasonal variation is considered for the Upper/Lower Charles TMDL study through the time periods chosen for model runs which, together, cover the widest possible range of seasonal variability that could be encountered in the watershed (page 79 TMDL report). The model was run for the period 1994-2005, and focused on the period of 1998-2002 for phosphorus loads and April – October, and 2002 for reach responses. The 1998-2002 period was carefully selected to represent the variability in flow conditions, while the summer of 2002 was chosen to represent the worst-case water quality response.

Assessment: EPA New England concludes that seasonal variation has been adequately accounted for in the TMDL report because the TMDLs were developed to protect water quality year round, and especially during summertime, when warmer temperatures promote higher algae growths and result in higher dissolved oxygen demands. Seasonal fluctuations in flow, and varying contributions of nutrients are taken into account. In addition, nutrient controls are expected to be in place through the year so that these controls will reduce pollution whenever sources are active.

8. Monitoring Plan

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.

MassDEP explains that a detailed monitoring plan still needs to be developed, and recommends that water quality and flow monitoring programs in the Upper/Middle Charles River should be continued in order to assess progress towards and success of obtaining the TMDLs' water quality goals (pages viii and 90 TMDL report). DEP also recommends both monitoring of BMP pilot projects to determine removal effectiveness, as well as instream monitoring to capture spatial, seasonal, and climatic variability, and periodic vegetative surveys to determine impacts of phosphorus reduction on biomass in critical reaches.

Assessment: EPA New England concludes that the anticipated monitoring in cooperation with and by MassDEP is sufficient to evaluate the adequacy of the TMDLs, although not a required element of EPA's TMDL approval process.

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 Upper/Middle Charles River TMDL report describes an implementation plan which lays out a recommended approach to achieve allocated loads using an adaptive management approach that identifies immediate implementation activities, as well as a framework for making continued progress in reducing pollutant loads over the long term, from WWTF discharges and stormwater, which account for 93% of the total annual phosphorus load (pages 80-93 TMDL report). Reductions in phosphorus loading from three major and three minor WWTFs will be implemented via NPDES permits with new TP effluent limitations. TP reductions in stormwater sources will be implemented through the use of best management practices (BMPs) to reduce phosphorus from runoff (page viii TMDL report). (EPA has proposed a new draft general permit, known as the *North Coastal MS4 General Permit*, which updates pollution control measures to control excessive pollution from stormwater runoff, and would apply to 84 communities in Eastern Mass including

communities in the Charles River watershed.) MassDEP also describes the 2009 Upper Charles River Basin pilot study which determined the optimal combination of structural BMPs for the most cost effective collection needed to attain the reduction targets in the TMDL report.

Assessment: 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."

Although no regulated point source was given a less stringent allocation based on the assumption that nonpoint source load reduction would occur, MassDEP indicates that both point and nonpoint source allocation reductions will be necessary to meet MA WQS. MassDEP points to the Department's authority combined with a range of specific programs that provide sufficient reasonable assurance that implementation of remedial actions in the Upper/Middle Charles watershed will take place. Assurances include both application and enforcement of current regulations and other regulatory vehicles, availability of low or no-interest loans to communities for wastewater treatment facilities through the State Revolving Fund (SRF), other financial incentives for nonpoint sources and unregulated stormwater, and various local, state and federal programs for pollution control (pages 94-99 TMDL report).

Assessment: Addressed, though not required, since this TMDL report does not establish less stringent WLAs in reliance on greater load reductions from nonpoint sources.

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 Upper/Middle Charles River TMDL report is described in the report (see page 100 TMDL report). The public review draft was distributed for public review on September 30th with a solicitation of comments open until November 30th, 2009. A public meeting was held at the Mass Horticultural Society Elm Bank Reservation in Wellesley, MA on October 29, 2009 from 4 to 7 PM. The meeting was attended by 25 stakeholders, including agency and organization representatives and individuals. MassDEP has provided ample opportunity for the public to comment. Finally, MassDEP has provided a comprehensive record and summary of the comments received, and provided clear responses to those comments.

MassDEP's summary of and response to public comments are included in Appendix A-1 (pages 2-52). Written comments were received from the Conservation Law Foundation; Charles River Conservancy; Mass. Coalition for Water Resources Stewardship (MCWRS); NAIOP Mass. (Commercial Real Estate Development Association); Mass Department of Transportation (Highway Division); Comprehensive Environmental, Inc. (on behalf of the Towns of Franklin and Millis); and Camp Dresser & McKee (on behalf of the Charles River Pollution Control District).

Assessment: EPA New England concludes that MassDEP has done a sufficient job of involving the public during the development of the TMDLs, provided adequate opportunities for the public to comment on the TMDL report, and has fully addressed comments received as set forth in the response to comment section of the TMDL document.

EPA concurs with MassDEP's response to CLF's comment on the impacts of climate change. The Intergovernmental Panel on Climate Change (IPCC), among other entities, anticipates that one of the primary consequences of the increase in greenhouse gas concentrations driving climate change will be deviations in atmospheric temperature and precipitation patterns from their historic norms in many areas. These climate changes, in turn, may affect key parameters influencing water quality such as flow and water temperature. Any substantial future increases in stormwater flow and associated pollutants due to climate change in New England may require additional implementation efforts to achieve the ultimate TMDL goal. The TMDL targets and/or implementation plan recommendations may need to be revised if future ambient monitoring continues to document non-attainment of water quality standards.

12. Transmittal Letter

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

Assessment: MassDEP's letter of June 3, 2011, (forwarding the final revised report) indicates that the TMDL report is being formally submitted for EPA approval.

Data for Entry in EPA's National TMDL Tracking System and Regional Web Page							
TMDL Water Body Name *	**Upper/Middle Charles River**						
Number of TMDLs*	30						
Type of Pollutant(s) *	Nutrients (Phosphorus)						
Number of listed causes (from 303(d) list)	70						
Any Information/prevention TMDLs (Y/N)	Yes (1)						
Lead State	Massachusetts, (MA)						
TMDL Status	Final						
Individual TMDLs listed in attached list (one line per segment-pollutant combination)							
TMDLSegment name	**TMDL Segment ID #**	**TMDL Pollutant ID# & name**	**TMDL Impairment Cause(s)**	**Pollutant Endpoint**	**Unlisted ?**	**NPDES Point Source & ID#**	**Segment still listed for something else? (Y/N)**
30 segments of the Upper/Middle Charles River	MA – *See attached list (pages 15-17 TMDL report)*	515 (Total Phosphorus)	*See attached list (pages 15-17 TMDL report)*	Total Phosphorus: <0.1 mg/L flowing waters; <0.05 mg/L on entering lakes or reservoirs; <0.025 mg/L in impounded reaches. *(see annotations on attached list)*	No	Milford- MA0100579 CRPCD- MA0102598 Medfield- MA0100978 MCI Norfolk- MA0102253 Wrentham Dev Ctr- MA0102113 Pine Brook Country Club- MA0032212 MS4 General Stormwater Permits	Y(25) N(5) *See attached list, (pages 15-17 TMDL report)*
303(d) Protective TMDL							
Charles River (7239050)	MA72-04_2008	515 (Total Phosphorus)	N/A	<0.05 mg/L on entering lakes or reservoirs	Yes	(same as above)	Y
TMDL Water Pollution Type	Point & Nonpoint Source (Stormwater)						
Cycle (list date)	2008						
Establishment Date (approval)*	Jun 10, 2011						
EPA Developed	No						
Towns affected*	Medway, Millis, Needham, Waltham, Wellesley, and portions of Arlington, Ashland, Bellingham, Belmont, Boston, Brookline, Dedham, Dover, Foxborough, Franklin, Holliston, Hopedale, Hopkinton, Lexington, Lincoln, Medfield, Mendon, Milford, Natick, Newton, Norfolk, Sherborn, Walpole, Watertown, Wayland, Weston, Westwood, and Wrentham.						

* = These data fields used in webpage entries

Table 1. Impaired Waters in the Upper/Middle Charles River Watershed

Mainstem				
Waterbody	**DEP ID**	**Description**	**Size**	**Impairments**
Charles River (7239050)	MA72-01_2008	Headwaters, outlet Echo Lake,	2.5 miles	Low flow alterations
		Hopkinton to Dilla Street		Other flow regime alterations
		(just upstream of Cedar Swamp Pond)		**Dissolved Oxygen**
		Milford.		Mercury in Fish Tissue
Milford Pond, Charles River	MA72016_2008	Also known as Cedar Swamp, Milford	99.0 acres	Non-native Aquatic Plants
				Dissolved Oxygen
Charles River (7239050)	MA72-33_2008 (formerly	Outlet Cedar Swamp Pond, Milford to	2.0 miles	Escherichia coli
		the Milford WWTF discharge,		Physical substrate habitat alterations
		Hopedale.		**Nutrient/Eutrophication Biological Indicators**
Charles River (7239050)	MA72-03_2008	Milford WWTF discharge, Hopedale to	3.4 miles	DDT
		outlet Box Pond		**Dissolved oxygen saturation**
		(formerly segment MA72008),		Escherichia coli [5/22/2007CN156.0]
		Bellingham.		**Excess Algal Growth**
				Organic Enrichment Sewage Biological Indicators
				Phosphorus Total
Charles River (7239050)	MA72-04_2008**	Outlet Box Pond, Bellingham to inlet	11.5 miles	Escherichia coli [5/22/2007CN156.0]
		Populatic Pond, Norfolk/Medway.		Fishes Bioassessments
				Other flow regime alterations
				Mercury in Fish Tissue
				Other*
Populatic Pond, Chalres	MA72096_2008	Norfolk	41.9 acres	**Dissolved oxygen saturation**
				Excess Algal Growth
				Dissolved Oxygen
				Nutrient/Eutrophication Biological Indicators
				Mercury in Fish Tissue [12/20/2007NEHgTMDL]
Charles River (7239050)	MA72-05_2008	Outlet Populatic Pond,	18.1 miles	**Dissolved oxygen saturation**
		Norfolk/Medway to South Natick Dam,		**Excess Algal Growth**
		Natick.		Non-native Aquatic Plants
				Dissolved Oxygen
				Turbidity
				Nutrient/Eutrophication Biological Indicators
				Phosphorus Total
				Mercury in Fish Tissue
				Aquatic Macroinvertebrate Bioassessments
Charles River (7239050)	MA72-06_2008	South Natick Dam, Natick to	8.4 miles	DDT
		Chestnut Street, Needham/Dover.		Eurasian Water Milfoil, Myriophyllum spicatum
				Excess Algal Growth
				Fishes Bioassessments
				Non-native Aquatic Plants
				Other flow regime alterations
				Nutrient/Eutrophication Biological Indicators
				Phosphorus Total
				PCB in Fish Tissue
				Other
Charles River (7239050)	MA72-07_2008	Chestnut Street, Needham to	24.8 miles	DDT
		Watertown Dam, Watertown.		Escherichia coli [5/22/2007CN156.0]
				FishPassage Barrier
				Fishes Bioassessments
				Non-native Aquatic Plants
				Other flow regime alterations
				Nutrient/Eutrophication Biological Indicators
				Phosphorus Total
				PCB in Fish Tissue

Note: Impairments addressed in this TMDL highlighted in bold

*Does not require a TMDL

** Segment MA-72-04 included as a Protective TMDL

Table 1. List of Impaired Waters in the Upper/Middle Charles River Watershed (cont.)

Tributary Segments				
Waterbody	**DEP ID**	**Description**	**Size**	**Impairments**
Alder Brook (7239475)	MA72-22_2008	Headwaters northwest of the Route 135 and South Street intersection, Needham to the confluence with the Charles River, Needham.	0.28 miles	**Nutrient/Eutrophication Biological Indicators** Aquatic Macroinvertebrate Bioassessments
Beaver Brook (7239125)	MA72-28_2008	Headwaters, north of Route 2, Lexington through culverting to Charles River, Waltham.	5.5 miles	Escherichia coli [5/22/2007CN156.0] **Excess Algal Growth** Non-native Aquatic Plants Other anthropogenic substrate alterations Other flow regime alterations **Dissolved Oxygen** Sedimentation/Siltation **Turbidity** **Organic Enrichment Sewage Biological Indicators** Taste and Odor **Phosphorus Total**
Cheese Cake Brook (7239100)	MA72-29_2008	Emerges south of Route 16, Newton to confluence with the Charles River, Newton.	1.4 miles	**Dissolved oxygen saturation** Escherichia coli [5/22/2007CN156.0] **Excess Algal Growth** Other anthropogenic substrate alterations **Phosphorus Total** Alteration in streamside or littoral vegetative covers
Fuller Brook (7239625)	MA72-18_2008	Headwater south of Route 135, Needham to confluence with Waban Brook, Wellesley.	4.3 miles	Escherichia coli [5/22/2007CN156.0] Physical substrate habitat alterations Sedimentation/Siltation **Nutrient/Eutrophication Biological Indicators**
Rock Meadow Brook (7239500)	MA72-21_2008	Headwaters in Fisher Meadow, Westwood through Stevens Pond and Lee Pond, Westwood to confluence with Charles River, Dedham.	3.8 miles	**Excess Algal Growth [5/22/2007CN156.0]** **Dissolved Oxygen** **Nutrient/Eutrophication Biological Indicators** **Phosphorus Total** **Aquatic Plants Macrophytes** Aquatic Macroinvertebrate Bioassessments
Rosemary Brook (7239325)	MA72-25_2008	Headwaters, outlet Rosemary Lake, Needham to confluence with the Charles River, Wellesley.	3.3 miles	**Dissolved Oxygen** **Phosphorus Total**
Sawmill Brook (7239400)	MA72-23_2008	Headwaters, Newton to confluence with Charles River, Boston.	2.4 miles	Chloride Escherichia coli [5/22/2007CN156.0] **Dissolved Oxygen** **Organic Enrichment Sewage Biological Indicators** **Phosphorus Total**
South Meadow Brook (7239375)	MA72-24_2008	From emergence west of Parker Street, Newton to confluence with the Charles River, Newton (sections culverted).	1.7 miles	Debris/Floatables/Trash Escherichia coli [5/22/2007CN156.0] **Dissolved Oxygen** Physical substrate habitat alterations **Turbidity** **Phosphorus Total** Bottom Deposits
Trout Brook (7239575)	MA72-19_2008	Headwaters, outlet Channings Pond, Dover to confluence with Charles River, Dover.	2.8 miles	Temperature, water **Nutrient/Eutrophication Biological Indicators**
Stop River (7239925)	MA72-09_2008	Headwaters near Dedham Street (Route 1A), Wrentham to Norfolk-Walpole MCI discharge, Norfolk (through Highland Lake formerly segment MA72047).	5.6 miles	**-Oxygen, Dissolved** **-Phosphorus (Total)** -Ambient Bioassays -- Chronic Aquatic Toxicity
Stop River (7239925)	MA72-10_2008	Norfolk-Walpole MCI discharge, Norfolk to confluence with Charles River, Medfield.	4.2 miles	-Escherichia coli [5/22/2007-CN156.0] -Temperature, water **-Organic Enrichment (Sewage) Biological Indicators** **-Phosphorus (Total)**

* Impairments addressed in this TMDL highlighted in bold

Table 1. List of Impaired Waters in the Upper/Middle Charles River Watershed (cont.)

Onstream Ponds				
Waterbody	**DEP ID**	**Description**	**Size**	**Impairments**
Factory Pond, Bogastow Bk (72037)	MA72037_2008	Holliston	9.7 acres	Non-native Aquatic Plants
				Aquatic Plants Macrophytes
Franklin Reservoir NE, Miller Bk (72095)	MA72095_2008	Franklin	21.0 acres	**Turbidity**
				Aquatic Plants Macrophytes
Franklin Reservoir SE, Miller Bk (72032)	MA72032_2008	Franklin	13.1 acres	**Turbidity**
				Aquatic Plants Macrophytes
Hardys Pond, Beaver Bk (72045)	MA72045_2008	Waltham	42.8 acres	**Excess Algal Growth**
				Non-native Aquatic Plants
				Turbidity
				Phosphorus Total
Houghton Pond, Bogastow Bk (72050)	MA72050_2008	Holliston	17.5 acres	**Excess Algal Growth**
				Non-native Aquatic Plants
				Turbidity
Linden Pond, Bogastow Bk (72063)	MA72063_2008	Holliston	1.4 acres	**Turbidity**
				Aquatic Plants Macrophytes
Lymans Pond, Unnamed Trib (72070)	MA72070_2008	Dover	4.4 acres	**Turbidity**
				Aquatic Plants Macrophytes
Mirror Lake, Stony Bk (72078)	MA72078_2008	Wrentham/Norfolk	61.6 acres	Non-native Aquatic Plants
				Secchi disk transparency
				Nutrient/Eutrophication Biological Indicators
				Phosphorus Total
Lake Pearl, Eagle Bk (72092)	MA72092_2008	Wrentham	237 acres	Eurasian Water Milfoil, Myriophyllum spicatum
				Non-native Aquatic Plants
				Dissolved Oxygen
Uncas Pond, Uncas Bk (72122)	MA72122_2008	Franklin	17.3 acres	Non-native Aquatic Plants
				Dissolved Oxygen
Lake Winthrop, Winthrop Canal (72140)	MA72140_2008	Holliston	131 acres	Non-native Aquatic Plants
				2,3,7,8Tetrachlorodibenzopdioxin only
				Aquatic Plants Macrophytes

* Impairments addressed in this TMDL highlighted in bold