Exhibit A

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
1 Congress Street, Suite 1100
Boston, MA 02114-2023

October 17, 2007

Laurie Burt, Commissioner
Department of Environmental Protection
1 Winter Street
Boston, MA 02108

Re: Approval of the Nutrient (Phosphorus) TMDL for the Lower Charles River

Dear Commissioner Burt:

Thank you for submitting the Final Nutrient TMDL for the Lower Charles River on July 6, 2007. We appreciate your extensive efforts and involvement with our office to finalize this TMDL. We believe this TMDL combined with the recently approved pathogen TMDL for the Charles River watershed and other TMDLs in various stages of development on the Charles River will be a catalyst in the restoration of the Charles River Watershed.

The U.S. Environmental Protection Agency (EPA) has reviewed the document entitled "Final Total Maximum Daily Load for Nutrients in the Lower Charles River Basin, Massachusetts CN 301.0" and it is my pleasure to approve this TMDL. EPA has determined, as set forth in the enclosed review document, that this TMDL meets the requirements of Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 Code of Federal Regulations (CFR) Part 130.

We commend your efforts in this important step to address nutrient related impacts to the Lower Charles River. We look forward to working with you on the implementation of this TMDL which recommends that comprehensive management programs be developed to address a wide variety of nutrient sources utilizing an array of control practices including illicit discharge detection and elimination, pollution prevention practices and implementation of storm water best management practices.

Please pass on to your staff in the Division of Watershed Management our congratulations for their excellent work in developing this TMDL.

Sincerely,

/s/

Stephen S. Perkins, Director
Office of Ecosystem Protection

Enclosure

cc: Arleen O'Donnell, MassDEP
Glenn Haas, MassDEP

Rick Dunn, MassDEP
Ann Williams, EPA
Ken Moraff, EPA
Steve Silva, EPA
Mike Hill, EPA

EPA NEW ENGLAND'S TMDL REVIEW

DATE: October 15, 2007

TMDL: Lower Charles River Basin Nutrient (Phosphorus) TMDL

STATUS: Final

IMPAIRMENT/POLLUTANT: Nutrient (Phosphorus) TMDL for 1 Water Body Segment – Lower Charles River - MA72-08_2004. The TMDL was developed to address accelerated eutrophication of the Lower Charles River and the CWA Section 303(d) listed water quality impairments resulting from nutrients and nuisance aquatic plants; associated water clarity impairments such as turbidity, taste odor and color; and to some extent organic enrichment/dissolved oxygen. The TMDL also addresses pH which is a cause of impairment identified during the TMDL analysis and is not presently listed on the 303(d) list.

BACKGROUND: The Final TMDL report entitled *Final Total Maximum Daily Load for Nutrients (Phosphorus) In the Lower Charles River Basin, Massachusetts (Control Number: 301.0)* was submitted to EPA under cover letter dated July 6, 2007.

The Massachusetts Department of Environmental Protection ("MassDEP") provided the draft TMDL report to EPA on March 5, 2007. The Draft TMDL was made available for public review and comment between March 7, 2007 and April 20, 2007 and a public meeting was held on March 22, 2007 to present the results of the TMDL Study. References cited in the Final TMDL Report (see Section 10) were reviewed and considered by EPA during the review and approval of this TMDL. In particular, the water quality model of the Lower Charles River developed for this TMDL is documented in a separate report, *A Hydrodynamic and Water Quality Model for the Lower Charles River, Massachusetts* (Tetra Tech, Inc. and Numeric Environmental Services, 2006). The water quality model represents a major component of the technical basis for the TMDL. Additional information reviewed and considered by EPA during the review of the TMDL is identified in Attachment A.

REVIEWER: Mike Hill, telephone number 617.918.1398, e-mail address: hill.michael@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

Introduction

A total maximum daily load ("TMDL") identifies the amount of a pollutant the receiving water can assimilate without violating water quality criteria or impairing the designated uses. Phosphorus is causing and/or contributing to the excessive algal biomass in the Lower Charles River, impairing recreation and aquatic life uses. Since there are no numeric criteria available for phosphorus in the Lower Charles, it was necessary to calculate a numerical endpoint to address the excessive algal biomass due to nutrient enrichment of the Lower Charles River. A surrogate water quality target was used to calculate the phosphorus loading capacity and the pollutant load reductions that are needed to fully attain the designated uses and the eutrophication-related water quality criteria for the river. Chlorophyll *a* was chosen as the surrogate water quality target used to define the assimilative capacity of the Lower Charles River. The chlorophyll *a* target is set at a level that MassDEP has determined will attain all applicable Class B narrative (nutrients, aesthetics, solids, color, and turbidity) and numeric criteria (dissolved oxygen ("DO") in the photic zone of the upper water column[1] and pH) as specified in the Massachusetts Water Quality Standards ("MAWQS").

A water quality model of the Lower Charles River was developed to simulate the cause and effect relationship between phosphorus loadings and algal growth in the Lower Charles River Watershed. The development of the model, including the estimation of pollutant loads, model set-up, and model calibration/validation, is presented in the report entitled *A Hydrodynamic and Water Quality Model for the Lower Charles River, Massachusetts* (Tetra Tech, Inc. and Numeric Environmental Services, 2006).

Phosphorus loading allocations are summarized into three broad categories: (1) watershed upstream of the Watertown Dam, (2) non-combined sewer overflow ("CSO") drainage areas that discharge directly or via tributaries to the Lower Charles River and (3) CSO discharges. Individual loading allocations are provided for CSO discharges to the Lower Charles River and the wastewater treatment facilities ("WWTFs") which are located in the upstream watershed.

The phosphorus load at the Watertown Dam represents all sources of phosphorus in the upstream watershed including the WWTFs, storm water drainage systems, and nonpoint sources that discharge into waters that flow eventually into the Lower Charles River over the dam. The non-CSO drainage areas that discharge directly or via tributaries to the Lower Charles River represent point and nonpoint nutrient sources that discharge to the major tributaries and other smaller

[1]Dissolved oxygen criteria are not attained in the bottom waters of the downstream portion of the Lower Charles due to a combination of factors, one of which is the decomposition of excessive algal biomass. However, reducing algal biomass alone will not result in attainment of the DO criteria in the bottom waters because of vertical stratification of the water column and the lack of exchange between the oxygenated surface layer and the bottom layer. While reduced algal biomass consistent with achieving the TMDL's seasonal chlorophyll *a* target will substantially reduce diurnal variation in DO concentrations and supersaturated DO conditions in the upper water column, it will not result in attainment of the DO criteria in the bottom water.

drainage systems. Aggregate allocations for contributing sources in the lower watershed are identified for (1) Stony Brook watershed, (2) Muddy River watershed, (3) Laundry Brook watershed, (4) Faneuil Brook watershed, and (5) a grouping of all other drainage systems that discharge directly or via tributaries to the Lower Charles.

The TMDL also provides land-cover based estimates of phosphorus loadings from sources that contribute to both the loading from the upstream watershed at Watertown Dam and the watersheds (excluding drainage areas served by combined sewers) that drain directly or via tributaries to the Lower Charles River (downstream watershed). The land-cover based phosphorus loading estimates were adjusted to match the measured phosphorus loads for the TMDL study period, calendar years 1998-2002. Also, the TMDL report presents the reductions in phosphorus loadings for the various land-cover types (e.g., high-density residential, commercial, etc.) that are needed to meet the loading capacity determined in the TMDL study. The land-cover based phosphorus loadings for the TMDL study period (1998-2002) and the reductions needed to achieve the water quality goals identified in the TMDL are presented by land-cover category for each community that has drainage areas contributing to the Charles River.

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.

A. Description of Waterbody and Background Information

The TMDL document provides a description of the Lower Charles River, including location, physical characteristics, watershed characteristics, and tributary information. It also provides background information on the development of the TMDL. The TMDL explains why the Lower Charles River (Watertown Dam to the New Charles River Dam) does not attain designated recreational and aquatic life uses and MAWQS for nutrients and noxious aquatic plants, low DO, and water clarity-related criteria such as solids, turbidity, and color. The final TMDL identifies the impaired segment, MA72-08, and the nutrient-related causes of impairment, on the most recent EPA approved CWA Section 303(d) list (Massachusetts' 2006 Integrated 303(d) list).

B. Pollutant of Concern

The TMDL demonstrates that phosphorus is the pollutant of concern through analyses of water quality data and the use of the water quality model. The document provides summaries of extensive water quality data collected from the Lower Charles that clearly document the presence of regularly occurring algal blooms and elevated levels of phosphorus in the Lower Charles River during warm-weather growing seasons. Moreover, the TMDL provides information from several credible references including EPA's guidance documents on national nutrient criteria development and technical reports supporting the development of nutrient criteria for Chesapeake Bay and the State of Vermont. Together the ambient water quality data and the cited references clearly show that the levels of algae in the Lower Charles River are indicative of poor water quality resulting from nutrient enrichment.

C. Pollutant Sources

The TMDL document identifies, describes, and generally quantifies several categories of point sources and nonpoint sources of phosphorus to the Lower Charles River. The sources include point and nonpoint source storm water runoff, illicit sanitary sewage discharges, CSOs, WWTFs, and nonpoint sources such as groundwater inflow from the watershed. Aggregate sources identified by watershed areas and consistent with the aggregate allocations discussed above are well quantified as are the individual sources from CSOs and WWTFs.

D. Priority Ranking

MassDEP has determined that all nutrient impaired segments in the Commonwealth are a high priority (see Massachusetts Integrated List of Waters at: http://www.mass.gov/dep/water/priorities/priorities.htm). The TMDL explains the high importance of Lower Charles River as a recreational resource to the greater Boston area.

Assessment: EPA concludes that the TMDL document meets the requirements for describing the waterbodies, pollutant of concern, pollutant sources, and priority ranking.

EPA concurs with MassDEP's determination to address the nutrient impaired Lower Charles River as a high priority given the extensive use of the river for recreation and the vulnerability of aquatic life to toxic cyanobacteria ("blue-green algae") blooms that have been documented to occur during the summers of 2006 and 2007. EPA concludes that the Lower Charles River TMDL document adequately characterizes the nature of the phosphorus impairments and causes including the occurrence of toxic cyanobacteria blooms that impair both recreational and aquatic life uses. MassDEP has relied on the best available information including extensive ambient monitoring data collected during both dry and wet weather conditions, comprehensive modeling and credible information from other studies and references to characterize the source categories. EPA concludes that the TMDL has appropriately documented the extent of the impairments due to phosphorus contamination, as well as the types of sources that are likely to be present that are in need of abatement (see Section 3 of the TMDL report).

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.

Sections 1 and 2 of the TMDL document describe the Lower Charles River in detail. Section 1.3 indicates that the segment is designated by the MAWQS as a Class B water body. The TMDL identifies the water quality criteria that are not being attained due to nutrient enrichment of the Lower Charles River. Specifically, the relevant MAWQS are DO – 314 CMR § 4.05: Classes and Criteria (3)(b)(1); pH -- 314 CMR § 4.05: Classes and Criteria (3)(b)(3); Solids -- 314 CMR § 4.05: Classes and Criteria (3)(b)(5); color and turbidity -- 314 CMR: 4.05: Classes and Criteria (3)(b)(6); Aesthetics -- 314 CMR § 4.05: Classes and Criteria (5)(a); and nutrients -- 314 CMR § 4.05: Classes and Criteria (5)(c).

The pollutant of concern for this TMDL is phosphorus because it is either directly causing and/or contributing to excessive algal biomass in this water body segment. Regular occurrences of severe algal blooms in the warm-weather growing season cause objectionable aesthetic impacts, reduced water clarity from increased solids, turbidity, and color, excessive growth of nuisance aquatic plants, elevated pH, and large diurnal swings in DO concentrations in the upper water column, and contribute to anoxic (low DO levels) bottom waters that do not support aquatic life.

Water quality data indicate that the Lower Charles River is undergoing accelerated or cultural eutrophication – which is the process of producing abundant plant life because of excessive pollutant inputs from human activities. The algal blooms in the lower Charles River are directly responsible for degrading the aesthetic quality of the river and its designated recreational and aquatic life uses. Analysis of extensive quality-assured water quality data from the Lower Charles show that phosphorus is the pollutant of concern related to cultural eutrophication and the aforementioned water quality impairments. Moreover, the calibrated water quality model developed for the Lower Charles has successfully simulated the link between phosphorus loading and algal biomass levels in the Lower Charles and further confirms that phosphorus is the pollutant of concern.

Since the MAWQS include only a narrative nutrient criterion for the Lower Charles River at present, the TMDL establishes a numeric chlorophyll *a* target for the Lower Charles to represent the level of algal biomass that will enable MAWQS attainment. Chlorophyll *a* was chosen as the surrogate water quality target because it is the photosynthetic pigment found in algae and is, therefore, a direct indicator of algal biomass. With the use of the calibrated model and a numeric chlorophyll *a* target, the allowable amount of phosphorus loading to the Lower Charles was estimated.

For this TMDL, the chlorophyll *a* target is a seasonal (June - October) average concentration of 10µg/l. The TMDL explains the basis for the numeric target which was derived from a weight of evidence approach using site-specific water quality data, trophic classification guidelines from the literature, and the results of user perception based studies available from the literature that relate algal biomass, represented as chlorophyll *a,* to perceived aesthetic water quality impairments. The target was set at a level that would not only result in attainment of the narrative eutrophication standard but would also ensure attainment of the other applicable criteria affected by algae levels in the Lower Charles (i.e., aesthetics, solids, turbidity, and color that affect water clarity, pH , and DO in the hypolimnion).

The TMDL explains why the chosen target is expected to attain water quality standards using a weight of evidence approach which includes a quantitative analysis. The quantitative analysis consists of using site-specific chlorophyll *a* and secchi disk depth data collected from the Lower Charles and performing a one-sided probability test on the data sets to estimate what threshold value of chorophyll *a* would not likely cause or contribute to nonattainment of designated recreational uses, as interpreted by secchi disk depth measurements.

MassDEP interprets a waterbody to be supporting recreational uses when at least 90% of the secchi disk depths from a seasonal data set are four feet or greater. The result of the one-sided probability test indicates, with a 90% confidence level, that chlorophyll *a* concentrations of **less than or equal to 20.5 µg/l** would not likely cause secchi disk depths to be less than four feet. The TMDL presents the results of an analysis of the Lower Charles River chlorophyll *a* data that shows a strong relationship between seasonal mean chlorophyll *a* values and seasonal 90th percentile chlorophyll *a* values (see Figure 5-1 of the TMDL). A linear regression model of this relationship was used to estimate the seasonal 90th percentile chlorophyll *a* value that would correspond to the target seasonal mean chlorophyll *a* value of 10 µg/l. Using a seasonal chlorophyll *a* target of 10 µg/l, the model estimates the seasonal 90th percentile chlorophyll *a* value (i.e., 9 out of 10 measurements) to be 18.9 µg/l. The seasonal 90th percentile chlorophyll *a* value of 18.9 µg/l indicates that 90 percent of the chlorophyll *a* concentrations during a season would be 18.9 µg/l or less. Because this value is less than 20.5 µg/l, the seasonal mean target value of 10 µg/l has been determined to be sufficient to result in attainment of the recreational uses as assessed by secchi disk depth measurements.

The TMDL further supports the target by relying on trophic classification guidelines from several sources in the literature (see Section 10 of the TMDL report) and the results of the user-perception based studies conducted elsewhere. With respect to waterbodies and aquatic plant biomass, plant productivity is represented as a continuum from low to high. This primary productivity continuum is typically divided into three general trophic groups or classifications: (1) oligotrophic (low plant biomass production); (2) mesotrophic (moderate plant biomass production); and (3) eutrophic (high plant biomass production). Generally, water quality conditions follow the trophic continuum in that water quality declines as a waterbody becomes more eutrophic due, in large part, to the presence of increased plant biomass.

The seasonal chlorophyll *a* target of 10 µg/l selected for the Lower Charles falls on the border between the mesotrophic (moderate plant biomass production) and eutrophic (high plant biomass production) classifications. The chlorophyll *a* target represents a notable shift in primary productivity and trophic status for the Lower Charles from highly productive to moderately productive as seasonal mean chlorophyll *a* concentrations are projected to decline from 22.1 µg/l to 9.8 µg/l. Similarly, seasonal mean phosphorus concentrations for the Lower Charles are projected to decrease from an average of 65 µg/l to 28 µg/l, which corresponds well with the mesotrophic classification using phosphorus as an indicator. The projected significant reduction in plant biomass that will occur as a result of the 56% reduction in seasonal average chlorophyll *a* (22.1 µg/l to 9.8 µg/l), should result in significant improvements in related water quality conditions sufficient to attain MAWQS.

The TMDL cites user-perception based studies as another important source of information used in the development of the chlorophyll *a* target and to evaluate its adequacy for meeting MAWQS in the Lower Charles River. The information reviewed for this TMDL indicates that chlorophyll *a* concentrations higher than 20 µg/l have consistently resulted in perceived aesthetic impairments among users of other waters that have been evaluated. The TMDL compares the estimated 90th percentile chlorophyll *a* value of 18.9 µg/l for the Lower Charles, which corresponds to the seasonal mean target of 10 µg/l, to the levels of chlorophyll *a* that consistently caused aesthetic impairments in the waters studied (e.g., greater than 20 µg/l) and determined that the seasonal target would be sufficient to attain aesthetic-related criteria for the Lower Charles.

Cyanobacteria ("blue-green algae") blooms are of particular concern for the Lower Charles and impair both recreational and aquatic life uses. Severe blooms have occurred during the summers of 2006 and 2007. Pages 77 and 78 of the TMDL discuss the anticipated reduction in blue-green biomass that would be associated with achieving the TMDL chlorophyll *a* target. The TMDL explains that the prevalence of blue-green algae and the amount of biomass is strongly correlated with phosphorus concentrations. The amount of blue-green algae in the Lower Charles will be reduced when summer season phosphorus concentrations are reduced. As indicated above, achieving the seasonal chlorophyll *a* target will result in reducing the seasonal phosphorus concentration in the Lower Charles from 65 µg/l to 28 µg/l, which is just below the range reported in the literature of 30 µg/l to 100 µg/l of phosphorus where blue-green biomass increases rapidly with increasing concentrations. Also, the TMDL relies on actual chlorophyll *a* and blue-green cell counts from the Lower Charles to further support the assertion that the target chlorophyll *a* concentration would be sufficient to keep blue-green biomass from exceeding noxious and toxic levels.

The TMDL explains the relationship between algal biomass and diurnal variations in DO and pH in the upper water column of the Lower Charles. There are numeric criteria for both of these parameters in the MAWQS. The TMDL projects the seasonal chlorophyll *a* target will address both the high values of DO super-saturation (e.g., 168%) and the exceedences of the upper end of the allowable pH range (6.5-8.3). This projection is supported by an analysis of water quality data (chlorophyll *a*, DO and pH) collected from the Lower Charles and the projected significant reduction in algal biomass associated with achieving the seasonal target. While the TMDL

chlorophyll *a* target is believed to be sufficient to reduce DO super-saturation, it will not entirely address DO violations that occur in the bottom waters of the downstream portion of the Lower Charles (see below).

Dissolved oxygen criteria are not attained in the bottom waters of the downstream portion of the Lower Charles due to a combination of factors, one of which is the decomposition of excessive algal biomass. However, reducing algal biomass alone will not result in attainment of the DO criteria in the bottom waters because of vertical stratification of the water column and the lack of exchange between the oxygenated surface layer and the bottom layer. While the reduced algal biomass associated with achieving the TMDL's seasonal chlorophyll *a* target of 10 µg/l will substantially reduce diurnal variation in DO concentrations and supersaturated DO conditions in the upper water column, it will not result in attainment of the DO criteria in the bottom water. Consequently, DO will continue to be a cause of nonattainment for the Lower Charles River and will not be removed from Massachusetts' 303(d) list.

Assessment: EPA concludes that MassDEP has properly described its water quality standards, the relevant criteria and uses, and its basis for using a surrogate chlorophyll *a* water quality target to relate algal biomass to use impairments. EPA concludes that the development of the chlorophyll *a* target for the TMDL has further confirmed the extent of the impaired condition of the Lower Charles due to algae blooms. Comparisons of chlorophyll *a* levels observed in the Lower Charles River to trophic classification guidelines from several researchers show that the Lower Charles is on the higher end of the trophic continuum (plant productivity) and well into the eutrophic grouping that is indicative of poor water quality. Furthermore, the chlorophyll *a* concentrations observed in the Lower Charles are regularly well above levels reported in user-perception based studies that would indicate algal related aesthetic impairments.

EPA also concludes that for the Lower Charles River the seasonal chlorophyll *a* target of 10 µg/l is a reasonable number and sufficiently protective for supporting designated uses that are presently impaired due to excessive algal biomass. EPA finds that MassDEP has properly described and interpreted the applicable water quality standards to set the TMDL target as indicated in Section 3 and 5.1 of the TMDL document. EPA's conclusion is based on the weight of evidence presented in the TMDL along with other information concerning nutrient enrichment of surface waters. The additional information considered is referenced in Section 10 of the Final TMDL report and in Attachment A of this document. EPA finds that the following factors support the selection of the seasonal chlorophyll *a* target for attaining the narrative nutrient, aesthetic, solids, turbidity, and color criteria, as well as the numeric criteria for pH and for DO in the upper water column of the Lower Charles.

A) MassDEP has provided a credible site-specific quantitative demonstration to show that the numeric targets will attain recreational uses in the Lower Charles as assessed by secchi disk depth measurements. Secchi disk depth measurements are used to assess water clarity conditions and attainment of narrative criteria related to solids, turbidity and to some extent aesthetic impacts related to color and suspended algae.

B) A seasonal chlorophyll *a* target of 10 µg/l for the Lower Charles would represent a *substantial shift along the trophic continuum* by reducing plant productivity from currently high levels (well into the eutrophic classification) to more moderate levels associated with the upper end of the mesotrophic classification. EPA finds that substantial reduction in plant biomass production would result in notable improvements to the water quality of the Lower Charles. EPA also finds, based on all the factors described in this document, that the projected improved water quality conditions will be sufficient to support designated uses and attain the relevant criteria, with the one exception of attaining the DO criteria in the bottom waters of the downstream portion of the Lower Charles (see E below).

C) MassDEP's use of the results of user-perception based aesthetic impairment studies conducted on other waters to assist in the evaluation of attainment of aesthetic criteria and recreational uses in the Lower Charles River was reasonable. Although the studies were conducted for waters that may have different characteristics than the Lower Charles, EPA concurs with MassDEP that the information is very useful for relating chlorophyll *a* levels to aesthetic impairments, especially since such information is not available for the Lower Charles. EPA also agrees with MassDEP's position of not relying entirely on the user-perception based studies for developing the Lower Charles target because of the differences in water quality characteristics among the waters studied. Nevertheless, the results of the studies which show that aesthetic impairments were consistently perceived when chlorophyll *a* concentrations were more than 20 µg/l indicate that the Lower Charles's seasonal average chlorophyll *a* target of 10 µg/l and its associated seasonal 90^{th} percentile chlorophyll *a* value of 18.9 µg/l support the position that the target is sufficient to attain aesthetic criteria.

D) EPA agrees with MassDEP's assertion that the seasonal average target chlorophyll *a* concentration will be sufficient to keep blue-green biomass from exceeding noxious and toxic levels in the Lower Charles. EPA finds that MassDEP has presented reasonable evidence to support this assertion. The significant reduction in seasonal phosphorus concentrations in the Lower Charles (65 µg/l to 28 µg/l) associated with achieving the seasonal chlorophyll *a* target is projected to drop phosphorus concentrations to levels that are below the low end of the range reported in the literature (30 µg/l to 100 µg/l) where blue-green biomass increases rapidly with increasing concentrations. Moreover, water quality data collected from the Lower Charles, specifically the low phosphorus concentrations, relatively low chlorophyll *a* concentrations and low blue-green cell counts that were measured simultaneously in the Lower Charles during a portion of the summer of 2002 provide site-specific evidence to further support this position.

E) The chlorophyll *a*, DO and pH data presented in the TMDL along with the projected reduction in algal biomass associated with achieving the seasonal chlorophyll *a* target provide reasonable evidence that the pH criteria will be met

and that DO super-saturation will be reduced to levels that will not directly threaten or impair aquatic life uses. Because DO criteria are not projected to be attained in the bottom waters of the downstream portion of the Lower Charles, EPA finds that low DO will continue to be a cause of nonattainment in the bottom waters of the downstream portion of the Lower Charles River and should not be removed from Massachusetts' 303(d) list.

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.

A. Seasonal Chlorophyll *a* Target

For this TMDL, a water quality model of the Lower Charles River was developed to simulate the cause and effect relationship between pollutant loadings and algal growth. Based on data analyses and modeling results, phosphorus was determined to be the pollutant of concern. Phosphorus loads were established using the water quality model to meet the seasonally averaged chlorophyll *a* target concentration of 10µg/l. The seasonal chlorophyll *a* target is set for the critical summer season when conditions for algal growth are optimal (i.e., high sunlight intensitiy, increased temperatures, and increased water detention times in the Lower Charles). A seasonal target is used in this TMDL because it is consistent with the suitability of using the water quality model which has been determined to perform well for predicting seasonal averages, and it is consistent with literature guidelines for trophic classifications.

B. Water Quality Model

The model was developed and calibrated using climatic, hydrologic, and pollutant loading conditions for the period of January 1, 1998 to December 31, 2002. The model was reviewed by MassDEP, EPA and a model review committee which included an Expert Review Panel comprised of modeling and water quality experts. The modeling contractors Tetra Tech, Inc. and Numeric Environmental Services considered and addressed comments on the draft model during

development of the final model. During this model review process, the Expert Panel, MassDEP and EPA concluded that the model was suitable for developing the nutrient TMDL for the Lower Charles.

As stated in Section 5.1 of the TMDL:

> The Lower Charles River model was specifically developed for this TMDL to simulate algal dynamics in the Lower Charles River from Watertown Dam to Boston Harbor in response to pollutant loadings from watershed sources. The model simulates water column and sediment nutrient cycling and algae dynamics coupled with three-dimensional transport in the Lower Charles River.

Daily pollutant loadings for numerous sources that in total represent *all sources* contributing phosphorus to the Lower Charles were quantified and used in the development of the model. The model report provides the details on the methodologies used to develop the daily time-series pollutant loadings used in the model, which are based on calibrated hydrologic models, water quality monitoring studies, flow gauging records, and discharge monitoring data. MassDEP, EPA and the Expert Panel concurred on the approaches used to quantify pollutant loading during development of the model.

Model simulations were performed using daily time steps for the five year period 1998 to 2002. The simulations included an initial start-up period prior to January 1, 1998 to ensure that initial conditions were properly reflected in the five year model simulations. Using the daily modeling output, daily, monthly, seasonal and annual loadings and water quality conditions could be determined (e.g., seasonal average chlorophyll *a* concentrations). The model was calibrated using available water quality data for the five year period with special focus on the critical recreational season. Simulations were performed to reduce the phosphorus inputs to levels that would result in meeting the seasonal average chlorophyll *a* concentration of 10 µg/l.

Because of the long term simulation period used and the water-quality and sediment processes represented in the model, particularly the sediment component, the model is capable of predicting the seasonal chlorophyll *a* concentrations (June – October) based on the phosphorus loadings that occur throughout the year. In fact, the seasonal chlorophyll *a* concentration for the critical seasonal was found to be sensitive to phosphorus inputs that occur in other seasons (e.g., winter). As a result, the phosphorus loading capacity was expressed in terms of allowable annual loadings and a distribution of allowable maximum daily loadings (see E and F below). The annual loading capacity and the distribution of the allowable maximum daily loadings are two ways of describing the allowable phosphorus loading conditions, or loading capacity, needed to meet the seasonal chlorophyll *a* target of 10 µg/l.

C. Phosphorus Sources

The TMDL document describes the natural and background loads as well as the many anthropogenic sources of phosphorus in the watershed. The TMDL describes the elevated sources of phosphorus from storm water runoff from different land cover categories (e.g.,

residential and commercial), as well as from tributaries to the Charles River (e.g., Laundry Brook, Faneuil Brook, Muddy River and Stony Brook). The TMDL document describes the potential contribution of nutrients from illicit discharges of sewage to storm drainage systems that discharge to the Charles and quantifies nutrient loadings from CSOs that occasionally discharge to the Lower Charles River. Finally, the document quantifies the substantial contribution of phosphorus loading that comes from the upstream watershed above the Watertown Dam.

D. Critical Conditions

Based on existing water quality data and confirmed by modeling results, the critical time period for the Lower Charles River is the summer season when algal blooms are most severe and also when algal abundance is controlled by the amount of phosphorus in the river. This period coincides with warm–weather temperatures, higher solar light inputs, and reduced river flows that provide for ample detention times in the Lower Charles for algae populations to grow. The TMDL explains that during the warm-weather season there are multiple critical conditions for algae growth in the Lower Charles that relate primarily to the climatic conditions. The critical conditions range from long periods of no rain with high temperatures and low cloud cover to frequently occurring rainfall during which nutrient loadings, needed for accelerated algal growth, are regularly introduced to the River. As a result, actual climatic conditions for the period of 1998-2002 were used to define the phosphorus loading capacity for the Lower Charles.

E. Allowable Annual Phosphorus Loadings

As indicated above in section 3.B., the modeling determined that the phosphorus reductions at the specified levels need to be accomplished throughout the year because some of the phosphorus discharged during the non-critical season (November – May) contributes to the growth of algae during the critical season (June – October). As a result the TMDL expresses the phosphorus loading capacity in terms of both an annual loading and a distribution of allowable maximum daily phosphorus loadings.

Table 5-3 in the TMDL indicates that the annual phosphorus loading capacity in the Lower Charles River is 19,544 kilograms per year based on hydrologic and climatic conditions of 1998 through 2002. The TMDL describes the basis for using this five year period which includes its representation of a number of critical climatic conditions. In addition, the longer averaging period provides for better model performance. Table 5.1 shows that the seasonal chlorophyll *a* target will be met if the total annual phosphorus load is reduced by 45 percent from the upper watershed and 60 percent from all other non-CSO inputs to the Lower Charles River. This scenario includes a 96 percent reduction in annual phosphorus load from CSOs. This scenario results in an estimated seasonal average chlorophyll *a* level of 9.8 µg/l in the downstream portion of the Lower Charles River where conditions are most optimal for algae growth. Overall, after an explicit 5 percent Margin of Safety is included, the net reduction in overall annual phosphorus load discharged to the Lower Charles is 54 percent (see Table 5-3).

F. Distribution of Allowable Maximum Daily Loadings.

Frequency distribution curves for maximum daily phosphorus loadings (i.e., phosphorus load duration curves) were established for existing and the proposed TMDL loading conditions. The frequency distribution curves represent the percentage of time that a value of daily phosphorus loading to the Lower Charles River is estimated to be exceeded or would be exceeded for the TMDL loading condition. Due to the dynamic conditions of the Lower Charles, the multiple types of critical conditions that occur in the Lower Charles, and the long term impacts of phosphorus loading on water quality, the use of frequency duration curves was determined to be the best way of representing allowable maximum daily phosphorus loading to the Lower Charles.

The phosphorus load duration curves were generated using the water quality model and reflect the distributions of phosphorus loading for existing conditions (1998-2002) and future loadings that are needed to achieve the seasonal chlorophyll *a* target determined for the TMDL. The model output used to develop the TMDL curve is the same output used to calculate the allowable annual load of 19544 kg/yr. Table 5-2 summarizes points on the curves for existing and proposed TMDL conditions. Because of the highly variable and dynamic conditions in the River, MassDEP determined that multiple maximum daily load values, rather than a single steady state daily value, would better define allowable loading conditions. Thus, as indicated by both the curves and values in Figure 5-2 and Table 5-2 respectively, a frequency distribution of daily phosphorus loadings is used in this TMDL to define the maximum daily phosphorus loading capacity for the Lower Charles River to address eutrophication. Maximum daily phosphorus loads that are consistent with the frequency distribution for the proposed TMDL condition shown in Figure 5-2 must be achieved in order to reduce algal blooms and attain applicable water quality standards. The particular load on any given day may vary, as long as the frequency distribution over the course of a year (i.e., the number of days during which the loads cannot exceed the specified amounts) is met.

Assessment:

EPA concludes that MassDEP has adequately documented the suitability of the model for relating algal growth to phosphorus loading and for use in establishing the phosphorus loading capacity of the Lower Charles River based on not exceeding acceptable levels of algal biomass, expressed as chlorophyll *a*. EPA concurs with the application of the model using the five year simulation period (1998-2002) to predict seasonal averages because of the model's improved performance for longer averaging periods. This approach is consistent with the identified strength of the model to perform well for seasonal averaging periods.

EPA concludes that MassDEP has properly accounted for critical conditions by establishing the seasonal chlorophyll *a* target for the warm-weather growing season when conditions for algae growth are optimal and when use impacts are most severe. EPA also agrees with MassDEP's choice of establishing the loading capacity using the 1998-2002 period in the model simulations because this period includes varying critical conditions that can occur in the Lower Charles River during growing seasons. The TMDL adequately documents the varying critical conditions in the

Lower Charles River which range from hot dry summers to summer seasons with regularly occurring rainfall.

EPA concludes that the average annual phosphorus loading capacity expressed in the TMDL (19,544 kg/yr) and the conditions set forth in the phosphorus load duration curve (for the TMDL; Figure 5-2 and Table 5-2) are sufficient for meeting the seasonal chlorophyll *a* target and attaining MAWQS. EPA agrees with MassDEP's assessment that because of the variability in receiving water conditions, and the fact that the water quality is more sensitive to long terms loads rather than single day loads, it is appropriate to express the daily phosphorus loads as a load duration curve that reflects the distribution of allowable daily loads and reductions that are needed throughout the year. On an annual basis, the total of the allowable daily loads presented in Figure 5-2 is equal to the allowable annual loading of 19,544 kg/yr. The annual loading capacity and the distribution of allowable maximum daily phosphorus loadings are both well supported ways to define the allowable phosphorus loading capacity for the Lower Charles. EPA further agrees that for purposes of implementation, it is appropriate to rely on the annual loading capacity. This is because the daily load distribution curve is not really capable of being applied on a daily basis. As MassDEP notes in the TMDL document, while there is a "total maximum daily load applicable to each day of the year.... [p]recisely which days fall into each category is not relevant, so long as the appropriate TMDL is achieved for the appropriate number of days."

The TMDL demonstrates the need for applying phosphorus reductions throughout the year because of the nature of phosphorus attenuation in the Lower Charles River system. As indicated in the modeling results, some of the phosphorus discharged during times of the year when algae growth is minimal (e.g., the winter season) is stored within the river system and later becomes available to algae during the critical growing season. Through the use of the water quality model, the relationship between seasonal chlorophyll *a* and allowable phosphorus loading, based on both an annual and daily basis, has been successfully demonstrated in the modeling report.

The TMDL adequately demonstrates that the allowable phosphorus loading, linked to the phosphorus sources in the watershed, is set at a level that is necessary to achieve the chlorophyll *a* target and, hence, the MAWQS during the most critical time of the year – June 1 through October 31. As discussed above, EPA agrees that it is appropriate for phosphorus reductions to be year round in order to achieve the seasonal chlorophyll *a* target.

EPA agrees with MassDEP in expressing the chlorophyll *a* target as a seasonal average for the following reasons: (1) use of a seasonal average best corresponds with the use of monitoring data that is typically available for performing water quality and use support assessments in that seasonal averages can be much more readily determined than infrequently occurring 90^{th} percentile values or peak values; (2) much of the information related to assessing tropic status and related water quality conditions is based on annual and seasonal data analyses; (3) the accuracy of the model is much higher and more credible for estimating seasonal chlorophyll *a* averages than for predicting instantaneous values; (4) there are consistent statistical relationships between seasonal average chlorophyll *a* and less frequently occurring higher values (e.g., 90^{th} percentile) so that using an appropriate seasonal average can also indirectly protect against the occurrence of unacceptable high chlorophyll *a* levels; and (5) it is consistent with established

approaches used by EPA and states for interpreting nutrient-related water quality data for criteria development.

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 TMDL reports that the level of information available for this TMDL is suitable for quantifying total phosphorus loadings from large watershed areas that include regulated storm water and non-storm water point sources, nonpoint sources, and unregulated storm water point sources. However, MassDEP concludes that there is currently insufficient information and detail available to confidently apportion the total phosphorus loading from the various watershed areas to the regulated and non-regulated storm water source categories within the watershed areas. As a result, the phosphorus load contribution from nonpoint sources and non-regulated point sources of storm water cannot be distinguished from the load contribution from regulated point sources. Consequently, nonpoint sources and unregulated point sources of storm water are combined with the regulated storm water discharges and are covered by the wasteload allocations (WLAs) in the TMDL. Therefore, the LAs are set at zero.

As discussed below in Section 5, the TMDL presents individual and aggregate allocations as WLAs. Individual allocations were assigned to CSOs and WWTFs while aggregate allocations represent loadings from several watershed areas that drain to the Lower Charles River (e.g., the watershed upstream of the Watertown Dam). The major nonpoint source categories that contribute phosphorus to the Lower Charles River and are included in the aggregate allocations are groundwater recharge and diffuse overland flow. In addition, there are numerous storm water drainage systems in the Charles River watershed that are not regulated by the NPDES permit program and could be classified as LAs. Again, the lack of specific information on all of the nonpoint sources makes it difficult to confidently apportion the total phosphorus loadings from the various watershed areas to the regulated and non-regulated NPDES areas. Therefore, this TMDL does not specify load allocations because the load contributions from regulated point sources cannot be accurately distinguished from the nonpoint sources.

Assessment:

EPA concludes that MassDEP's rationale for setting the LAs to zero and grouping the nonpoint sources and currently unregulated storm water point sources with regulated storm water point sources is reasonable for the reasons presented in Section 5.2.4 of the Final TMDL. Specifically,

EPA agrees that, at present, there is insufficient information to separate nonpoint sources and point sources for the purpose of setting LAs that would be representative of allocations for only nonpoint and unregulated storm water point sources. Moreover, EPA agrees that it is appropriate for MassDEP to express the aggregate allocations as WLAs rather than LAs because of their inclusion of storm water sources covered by the NPDES Program which require WLAs.

EPA also finds that the level of detail used by MassDEP in aggregating sources is reasonable and is based on best available information. The aggregation of sources presented in the TMDL document has allowed MassDEP to determine accurate loading estimates, based on extensive data sets, and assign necessary phosphorus load allocations. EPA finds that the aggregate allocations provide reasonably accurate estimates of the magnitude of total nutrient load reductions that are needed from logical groupings of sources to the Lower Charles River.

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 TMDL expresses the loading capacity in terms of an allowable annual phosphorus load and a distribution of allowable daily loads. The WLAs for this TMDL are expressed as annual loads primarily to ease the interpretation and implementation of the WLAs. For example, using an annual basis, the WLA can be expressed as one value rather than a distribution of daily load values, which would be difficult to interpret. Also, because of the modeling approach used for this TMDL, the annual WLAs together replicate the distribution of the allowable daily loads presented in Figure 5-2. As discussed above, year round reductions in phosphorus load are needed to attain the seasonal chlorophyll *a* target. In order to interpret whether specific implementation control plans will be consistent with phosphorus load reductions outlined in the TMDL, the plans should be evaluated for their ability to achieve the annual reductions.

EPA interprets 40 C.F.R. §130.2(h) to require that allocations for point source discharges subject to the requirement for a NPDES permit must be included in the wasteload allocation portion of the TMDL. Tables 5-6 and 5-7 of the TMDL document identify the specific waste load allocation for each CSO that may discharge to the Lower Charles River and the wastewater treatment facilities that discharge phosphorus to the upper Charles River, respectively.

Individual WLAs for the six WWTFs are included in the TMDL for the growing season, non-growing season and for the year. As stated in the TMDL document, "[t]he WLAs are consistent with allowable phosphorus loadings specified in the existing NPDES permits for four of the facilities that require year-round treatment for phosphorus (Milford, Medfield, Wrentham Development Center, and Pine Brook Country Club)." The WLAs for the other two facilities, Charles River PCD and MCI Norfolk-Walpole, include allowable loads for the growing season, non-growing season and year although these facilities do not have non-growing season NPDES phosphorus limits yet. In addition, aggregate waste load allocations are expressed for watershed areas and include all of the other sources including storm water that contribute phosphorus to the Lower Charles River and that do not have individual WLAs (see Table 5-8).

Portions of the Charles River watershed include the following types of NPDES permitted storm water discharges:

- Discharges subject to Phase 1 and 2 municipal separate storm sewer system (MS4) permits
- Discharges subject to certain individual storm water permits
- Discharges subject to Phase 1 and 2 construction site storm water permits
- Discharges subject to permits for storm water associated with industrial activities

As discussed above, there are also some areas within the Charles River watershed that generate nonpoint source runoff and point source runoff not subject to NPDES permits. Discharges from nonpoint sources and point sources not regulated by the NPDES program normally receive load allocations rather than wasteload allocations. In the case of storm water, however, where it is often difficult to identify and distinguish between discharges subject to NPDES and those that are not, EPA has stated that it is permissible to include all storm water discharges from a particular land use category in the wasteload allocation portion of the TMDL.

For the Charles River watershed, insufficient data are currently available to separate out the parcels that generate storm water that are not subject to NPDES permits and to calculate the phosphorus loads from these parcels. Therefore, the wasteload allocation includes runoff from the NPDES regulated storm water point sources listed above, runoff from nonpoint sources, and runoff from non-NPDES regulated point sources such as commercial areas and small construction sites (under an acre).

The runoff from all sources was lumped into an aggregate wasteload allocation. The rationale for this aggregate allocation is described below.

As indicated above, 40 C.F.R. § 130.2(h) provides that point source discharges must be addressed by the wasteload allocation component of a TMDL. Discharges involving process wastewater, non-contact cooling water, and other non-storm water discharges are assigned individual waste load allocations pursuant to this regulation. Storm water discharges, however, are less amenable to individual wasteload allocations. In recognition of this fact, EPA's November 22, 2002 guidance entitled "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm water Sources and NPDES Permit Requirements

Based on Those WLAs," provides that it is reasonable to express allocations for NPDES-regulated storm water discharges from multiple point sources as a single categorical or aggregate wasteload allocation when data and information are insufficient to assign each source or outfall individual WLAs. EPA's guidance recognizes that the available data and information usually are not detailed enough to determine waste load allocations for NPDES-regulated storm water discharges on an outfall-specific basis.

In the case of Charles River, MassDEP has determined there is currently insufficient information and detail available to confidently apportion the total phosphorus loading to individual sources within the watershed areas. Therefore, MassDEP has not assigned each source or outfall individual WLAs. Table 5-8 of the TMDL document sets forth the WLAs for the contributing source areas for the upstream watershed, direct tributary streams and other drainage systems that discharge directly into the Lower Charles River.

While the WLAs are expressed in terms of aggregates, MassDEP does provide substantial information in the implementation section of the TMDL document that provides guidance for implementing the needed reductions in the watershed and interpreting the aggregate WLAs. The implementation section presents the results of a land cover phosphorus loading analysis to characterize the relative importance of various sources within the watershed. The analysis provides the relative magnitude of phosphorus loadings and reductions that will be needed from different land-cover source areas including likely nonpoint source areas (e.g., open land).

Phosphorus loads and reductions are presented for major land cover categories for the entire Charles River watershed and for each community that has drainage areas contributing to the Charles River. The estimated land cover phosphorus loads were based on export loading factors from the literature and were adjusted to match the measured phosphorus load to the Lower Charles River for the study period (1998 to 2002). Using the allowable TMDL load, phosphorus load reductions were determined by land cover category and expressed for the entire watershed and by community.

Assessment: Ideally, if data are available, separate wasteload allocations for each NPDES storm water discharge would be established. Given the data limitations discussed above, however, it is acceptable to group all NPDES eligible storm water discharges into aggregate wasteload allocations. In addition, given the difficulty of separating out regulated from unregulated storm water discharges in this case (as described above), it is also acceptable to include both discharges subject to NPDES as well as nonpoint source runoff in this aggregate wasteload category.

EPA concludes that the wasteload allocations are adequately specified in the TMDL at levels that will reduce phosphorus sufficiently to meet the chlorophyll *a* target and hence, attain and maintain MAWQS. As required, the TMDL presents individual WLAs for individually permitted point sources (WWTFs and CSOs) that discharge phosphorus to the Charles River. For this case, EPA finds it reasonable to assign aggregate WLAs for other phosphorus sources present in Charles River watershed. Moreover, EPA concludes that the level of aggregation is consistent with level of information currently available to quantify phosphorus loading to the Lower Charles River.

Additionally, while EPA does not approve implementation plans, we note that the land cover phosphorus loading analysis provides useful information for supporting the magnitude of storm water source reductions that are needed for the Charles River. The analysis is based on credible information including watershed delineations, community boundaries, land use mapping and phosphorus export loading factors from published literature. Moreover, the land-cover load estimates had only to be adjusted slightly, less than 1%, to agree with the measured phosphorus loads to Lower Charles. The land cover loading analysis supports the identified need for storm water phosphorus reductions from specific land cover categories (particularly those with high percent impervious cover) and provides useful guidance for interpreting the aggregate WLAs.

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.

As stated in the TMDL document, the TMDL provides for an explicit margin of safety of 5% of the calculated loading capacity to account for uncertainty (see Table 5.3 of the TMDL). An additional explicit MOS is provided by assigning allocations that will result in 45% and 60% phosphorus load reductions from the upstream watershed at Watertown Dam and the drainages of watershed areas that are contributing to the Lower Charles River, respectively (see Table 5-1 of the TMDL; the resulting overall phosphorus reductions from combining the two watersheds is 54%). This reduction scenario results in achieving a seasonal average chlorophyll *a* concentration of 9.8 µg/l (2 % lower than the target of 10 µg/l). Although this represents only 0.2 µg/l, the corresponding mass of phosphorus is quite significant.

In addition, there are the following areas of implicit MOS described in Section 5.5 of the TMDL document.

> 1) Modeling results suggest that, following implementation of nutrient load reduction scenarios, the sediment nutrient pool and subsequent sediment nutrient releases will gradually decrease over a period of 10 or more years. However, only 5 years of this sediment nutrient "wind-down" were included explicitly in the TMDL scenario modeling.
>
> 2) The higher chlorophyll *a* target, 90th percentile of 18.9 µg/l, is 1.6 µg/l lower than the calculated chlorophyll *a* concentration needed to meet MassDEP's water quality related clarity goal of 20.5 µg/l.

Assessment: EPA concludes that the TMDL documentation provides an adequate MOS. The use of an explicit MOS discussed above, and implicit MOS, accomplished primarily through the use of environmentally conservative assumptions in the modeling analyses, are reasonable for this

TMDL because the TMDL is based on extensive data sets and rigorous studies and models of phosphorus loadings and land use analyses (e.g., by USGS and MWRA).

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 Clean Water Act and implementing regulations require that a TMDL be established with consideration of seasonal variations. The approach and methodology used for developing this TMDL addresses seasonal variation because it reflects the impact of daily loading conditions that occured during a five year period, 1998-2002. The goal of this TMDL is to meet the chlorophyll *a* water quality target during the growing season because this represents critical conditions when algal blooms are typically most severe in the Lower Charles River and have the greatest impact on designated uses. The modeling analysis reflects water quality impacts that result from loadings that occur throughout the year. While phosphorus reductions are based on achieving an overall average seasonal chlorophyll *a* concentration of 10 µg/l by using the average of model results for the five growing seasons (June 1 through October 31 of 1998-2002), the TMDL calls for year round load reductions because some of the loading that occurs during the non-summer season contribute to the algal blooms during the critical season.

Assessment: Based on the approach used in developing this TMDL which accounts for daily loading for a five year period and given that the controls necessary to achieve the overall 54% reduction in phosphorus will be effective throughout the year, EPA concludes that the seasonal variation has been adequately accounted for in the TMDL. Also, the critical conditions used in the development of this TMDL has set allowable phosphorus allocations at levels that will protect water quality throughout the year from algal blooms and ensure that eutrophication-related water quality standards will be met year round.

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), and EPA's 2006 guidance, Clarification Regarding "Phased" Total Maximum Daily Loads, recommend a monitoring plan when a TMDL is developed using the phased approach. The guidance indicates that a State may use the phased approach for situations where TMDLs need to be developed despite significant data uncertainty and where the State expects that the loading capacity and allocation scheme will be revised in the near future. EPA's guidance provides that a TMDL developed under the phased approach should include, in addition to the other TMDL elements, a monitoring plan that describes the additional data to be collected and a scheduled timeframe for revision of the TMDL.

The phosphorus TMDL for the Lower Charles River is not a phased TMDL, but the document includes a description of a monitoring plan designed to measure attainment of MAWQS.

The TMDL document describes post-TMDL monitoring activities including various community efforts and MassDEP's commitment for monitoring every five years. In addition, EPA and MWRA will continue their ambient monitoring programs for the Lower Charles River. The

monitoring plan is designed to identify and eliminate specific sources and track improvements in water quality. In addition, the TMDL document recommends additional monitoring that should be conducted.

Assessment: EPA concludes that the anticipated monitoring by and in cooperation with MassDEP is sufficient to evaluate the adequacy of progress toward attainment of MAWQS, 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 implementation plan set out in the TMDL document describes the types of activities that will be necessary to achieve the large reductions in phosphorus loading that are necessary to meet MAWQS including CSO abatement and wastewater treatment. While EPA does not approve or disapprove TMDL implementation plans, we note that the plan contains useful information to guide local, state, and federal permitting and other decisions related to discharges that contain phosphorus. For example, as discussed above, a land cover phosphorus loading analysis was conducted to provide insight into understanding where high phosphorus loadings are likely to be occurring and where reductions will be needed in order to meet the allowable phosphorus load. Also, this analysis provides guidance for interpreting the aggregate WLAs presented in the TMDL by presenting load reductions by land cover for each community with watershed areas contributing to the Charles River.

Due to the magnitude of the phosphorus load reduction required, 54 percent, the implementation plan recommends that comprehensive management programs be developed (or continued for CSOs and the WWTFs) to address a wide variety of sources using a variety of control practices including illicit discharge detection and elimination, pollution prevention practices, and implementation of storm water best management practices.

The plan identifies recommended components of a storm water management program, and includes comprehensive inventorying and characterization of the drainage areas, phosphorus source prioritization, increased good housekeeping practices, pollutant prevention activities involving fertilizer use and leaf litter control, and application of non-structural and structural storm water BMPs. The plan recommends certain types of BMPs that have promise for achieving large phosphorus reductions in the Charles River watershed, such as infiltration practices, bioretention/filtration, and use of high efficiency vacuum sweepers for paved surfaces.

The most successful programs will likely address both storm water sources that are currently regulated under the NPDES permit program and those that are not. The watershed communities will likely find many opportunities after carrying out the drainage area inventory and characterization process to implement highly cost effective control practices to reduce phosphorus loading from areas that are not currently covered by NPDES permits. Considering the likely extent of watershed area that is non-regulated, it will be prudent and will likely be critical to the success of achieving the phosphorus load reduction targets that the developers of the storm water management plans consider both regulated and non-regulated drainage areas.

The implementation plan also discusses the general requirements of the NPDES storm water permitting program. Phase I and II storm water communities are or will be required to implement aggressive illicit discharge detection and elimination (IDDE) programs. Watershed stakeholders are providing valuable assistance in defining hot spots and sources of contamination as well as with the implementation of mitigation or preventative measures. The plan provides a recommended protocol for carrying out comprehensive IDDE programs.

Through Phase I and II NPDES regulations, EPA has the authority to 1) require general and/or individual permits for many types of storm water discharges and 2) enforce storm water permits to assure adequate progress in storm water pollution abatement is being made. In addition, EPA has the authority to require non-regulated point source storm water discharges to obtain NPDES permits either individually or by category on a geographical basis, if it determines that such storm water discharges cause or contribute to a water quality violation, are significant contributors of pollutants, or where controls are needed based on a wasteload allocation in an EPA approved TMDL. MassDEP has similar authority under the Commonwealth's law.

Assessment: EPA is taking no action on the implementation plan but notes that MassDEP has identified a number of recommended controls, BMPs and strategies to address excessive nutrient loading in the Lower Charles River.

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 non-point source load reduction would occur, MassDEP indicates that both point and non-point source allocation reductions will be necessary to meet MAWQS. The TMDL will be

implemented through enforcement of regulations, availability of financial incentives and local, state and federal programs for pollution control. Combined sewer overflows and wastewater treatment facilities are regulated under existing NPDES and Commonwealth permits. Communities subject to storm water NPDES permit Phase I and II coverage will address discharges from municipally-owned storm water drainage systems. Regulations that control some point source and nonpoint source storm water discharges include local implementation of the Commonwealth's Wetlands Protection Act, the Rivers Protection Act, Title 5 regulations for septic systems and other local regulations. Financial incentives include federal and state funds available under Sections 319 and 104(b) programs of the CWA as well as the State Revolving Loan Program. Other potential funds and assistance are available through Massachusetts' Department of Agriculture's Enhancement Program and the United States Department of Agriculture's Natural Resources Conservation Services. Additional financial incentives include income tax credits for Title 5 upgrades and low interest loans for Title 5 septic system upgrades available through municipalities participating in this portion of the state revolving loan fund program.

As stated above, MassDEP has in place a number of state regulatory and financial programs that will help to assure implementation of the TMDL will be achieved.

The TMDL provides a mechanism and incentive for community administrators to, among other things, seek funding, educate the public, and prioritize remedial actions. Moreover, for sources beyond the scope of federal and state jurisdiction (e.g., nonpoint source runoff), this TMDL provides communities with information for mitigating phosphorus sources.

Assessment: Although not required because MassDEP did not establish less stringent WLAs in reliance on greater load reductions from nonpoint sources, EPA concludes that MassDEP has provided reasonable assurance that MAWQS will be met.

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.

One public informational meeting was held on March 22, 2007 to review the findings of the draft TMDL report and to solicit public comment. MassDEP provided public notice with a public comment period starting on March 7, 2007 and ending on April 20, 2007, accommodating a request for an extension of the deadline. MassDEP has provided ample opportunity for the public to comment. Finally, MassDEP has provided a comprehensive record of the comments received and provided clear responses to those comments.

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

12. Submittal 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: On July 6, 2007, MassDEP submitted the final Phosphorus TMDL for the Lower Charles River (Control Number CN 301.0) for EPA approval. The document contained all of the elements necessary to approve the TMDL.

Attachment A

Additional Records Considered in EPA's Review of the Lower Charles River TMDL for Phosphorus

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