

May 15, 2009

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

Re: Approval of the Pathogen TMDL for Buzzards Bay Watershed

Dear Commissioner Burt:

Thank you for submitting the Final Pathogen TMDL for the Buzzards Bay Watershed on March 26, 2009. We appreciate your extensive efforts and involvement with our office to finalize this TMDL. We believe this TMDL combined with the other pathogen watershed TMDLs in various stages of development within the Commonwealth will be a catalyst in the restoration of this and other watersheds.

The U.S. Environmental Protection Agency (EPA) has reviewed the document entitled "Final Final Pathogen TMDL for the Buzzards Bay Watershed, March 2009 (Control Number 251.1) and it is my pleasure to approve the 52 TMDLs. EPA has determined, as set forth in the enclosed review document, that these TMDLs meet 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 again to develop "pollution prevention" TMDLs on water body segments not currently impaired. This approach can encourage the maintenance and protection of existing water quality and help prevent further degradation of water bodies that are downstream or linked to other water body segments. Although EPA does not approve pollution prevention TMDLs, EPA acknowledges the establishment of these TMDLs consistent with developing information as set forth in CWA Section 303(d)(3).

Once again, please pass on to your staff in the Division of Watershed Management our congratulations for their excellent work in developing these TMDLs.

Sincerely,

/s/

Ken Moraff, Acting Director  
Office of Ecosystem Protection

Enclosure

cc: Glenn Haas, MassDEP  
Rick Dunn, MassDEP  
Steve Silva, EPA  
Mike Hill, EPA

## EPA NEW ENGLAND'S TMDL REVIEW

**DATE:** May 15, 2009

**TMDL:** Buzzards Bay Watershed Pathogen TMDL

**STATUS:** Final

**IMPAIRMENT/POLLUTANT:** Pathogen TMDL for 52 Water Body Segments (See Attachment 1)

**BACKGROUND:** Final Pathogen TMDL for the Buzzards Bay Watershed, March 2009, (Control Number: CN 251.1). The documents submitted by MassDEP as part of the record for this TMDL include:

- Final Pathogen TMDL for the Buzzards Bay Watershed, March 2009, (Control Number: CN 151.1);
- Public Meeting Information and Response to Comments, Appendix B;
- Massachusetts Surface Water Quality Standards;
- Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Manual for Massachusetts;
- Atlas of Storm water Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management, Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts.

**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

The Buzzards Bay Watershed Pathogen TMDL is designed to support reduction of waterborne disease-causing organisms, known as pathogens, to reduce public health risk. Waterborne pathogens enter surface waters from a variety of sources including sewage, the feces of warm-blooded wildlife such as barn-yard animals, pets, geese, gulls, illicit discharges of boat wastes and agricultural applications of manure. These pathogens can pose a risk to human health due to gastrointestinal illness through exposure via ingestion and contact with recreational waters, ingestion of drinking water, and consumption of filter-feeding shellfish.

The Buzzards Bay Watershed to which this TMDL applies includes 52 water bodies that are impaired for pathogens (see Attachment 1). The approach outlined in this pathogen watershed

TMDL includes two types of daily TMDL targets: 1) the establishment of concentration-based targets (expressed as the number of indicator bacteria organisms (pathogens) per 100 ml) based on the Water Quality Standards (WQS) for each discharge source by category (e.g., storm water, CSO, etc.) and 2) maximum loads (expressed as the number of indicator bacteria organisms (pathogens) per day) for each stream and embayment segment. The maximum loads are also expressed through daily loadings for each stream segment for high, medium and low stream flow conditions while the embayment segments are expressed as daily loads based on the amount of storm water flow from impervious and pervious areas contributing to the watershed.

The TMDL includes: a) monitoring data related to water quality impairments in each segment (i.e., the TMDL report provides specific data describing the range of pathogen concentrations in each water body), b) a prioritization of discharge outfall sources, river segments and embayment segments based on the concentration of pathogens present, c) a supplementary TMDL Implementation Guidance Manual that suggests ways in which the TMDL can be implemented, and d) the development of “pollution prevention” TMDLs by MassDEP (see Section 13).

The TMDL document provides monitoring data with links to additional data sources and descriptions of sources and prioritizes water body segments that will help agencies/local governments make appropriate decisions to implement this TMDL. For example, for each water body segment, there is a description of the segment and links to additional segment descriptions and additional data sources, a summary of all of the pathogen data, identification of potential sources and recommendations to address the sources. In addition, MassDEP’s decision to define small water body segments, designed to correspond to major potential sources of pollution and landuse -- further facilitates the identification and prioritization of sources of impairment.

MassDEP provides TMDL targets as concentrations (Table 7-1), and daily mass load TMDL targets (Figures 7-1a and 7-1b, and Tables 7-2a and 7-2b), but believes that concentration based targets are most useful for guiding implementation. Load allocations based on concentration are advantageous for several reasons. In particular, a concentration limit is more readily understandable to the public, and will allow interested citizens and/or watershed groups to more easily determine whether any particular source is exceeding its allocation. This is particularly true for storm water sources because the link between pathogen discharges and rainfall creates a complex relationship between loadings and flow conditions.

Finally, while not required as part of the TMDL approval process, MassDEP, in the document, “Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Manual for Massachusetts” (TMDL Implementation Guidance Manual) which accompanies the TMDL, presents a broad array of implementation tools to address pathogen control. In addition, the “Atlas of Storm water Discharges in the Buzzards Bay Watershed” identifies and priorities hundreds of potential sources with the goal of remediating specific sources in high priority areas. As discussed more fully below, Massachusetts has a variety of regulatory requirements to mitigate pathogens within the Commonwealth.

## **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 TMDL document describes the Buzzards Bay Watershed and specifically the water body segments identified as not attaining designated uses (primarily contact recreation and shellfishing) due to exceeding Massachusetts' WQS for pathogens. The document identifies a total of 52 impaired segments (Attachment 1) included on Massachusetts' 2006 Integrated 303(d) list for pathogens.

The TMDL document identifies the non-point and point sources of pathogens that are present and contribute to exceedances of Massachusetts' WQS. As set forth in Sections 4 and 5, the TMDL document articulates both general categories and specific sources of pathogen contributions from the range of possible pathogen source categories. Specific sources identified include storm water run-off, leaking sewer pipes, failing septic systems, wildlife including birds, combined sewer overflows and wastewater treatment plants. In addition, MassDEP prioritizes the segments and sources of pathogen impairment in need of mitigation measures (see Sections 5 and 6 of the TMDL document). On a broader scale, MassDEP has determined that all pathogen 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>). Approximately 24% of the Commonwealth's assessed waters are impaired for pathogens.

Sources of data collected and highlighted by MassDEP in the TMDL suggest that much information is available to assist the public in understanding the sources of pathogen contamination in the Buzzards Bay Watershed. First, ambient data collected during both dry and wet weather conditions provide an insight into the overall magnitude of sources contributing to the impairment in the Buzzards Bay Watershed. Second, MassDEP summarizes and provides links to extensive data sets that indicate the nature of the impairment and ranges of pathogens present within each water body segment. As stated above, MassDEP prioritized water body segments based on the concentration of pathogens present, use of the water body and discharge sources (see Sections 5 and 6 of the TMDL document). Moreover, since MassDEP divides the water bodies within the watershed into small, manageable segments, the link of the sources of pathogens to the impairment within each water body segment is more apparent because of the association of landuse and the types of sources of pathogens. The assessments and monitoring

that occurs in these spatially-refined water body segments allows for a higher degree of association with the sources of pollution and their ultimate remediation.

*Assessment:*

During the comment period some commenters expressed concern that the draft TMDL did not contain the most recent data available or that all of the data was not contained in the TMDL document. MassDEP made a number of changes to the final TMDL document to address those and other concerns (e.g., about the specificity of the document). In the final TMDL, MassDEP included additional site specific information, including information on specific sources of bacteria, wherever information was available. MassDEP incorporated additional information into the final TMDL including data from the Massachusetts Department of Marine Fisheries (MassDMF), Massachusetts Coastal Zone Management (MassCZM), MassDEP, Buzzards Bay National Estuary Project and the Westport River Watershed Alliance (WRWA) and with this data updated the individual summary segment tables in the Problem Assessment, Section 4.0 of the TMDL. There is a large amount of sampling data that has been collected in the Buzzards Bay watershed. Although all of the data are not physically incorporated into the document, all of the data were reviewed, data were summarized and the TMDL document provides links and references to the original sources of the data. The final TMDL includes a new Section 6.0, Prioritization and Known Sources. In this section, Table 6-1 provides a prioritized list of pathogen-impaired segments that will require additional work and remediation to attain WQS. The final TMDL document is adequate to address the description of the water bodies, pollutant of concern, pollutant sources and priority ranking and fulfills the required elements for EPA approval.

EPA concurs with MassDEP's determination to address pathogen impaired waters in the Buzzards Bay as a high priority given the growing use of the area for recreation and shellfishing. EPA concludes that the Buzzards Bay Watershed TMDL document adequately characterizes the nature of the pathogen impairments and causes by summarizing ambient pathogen and storm water outfall data including new data provided during the comment period. MassDEP has relied on the best available information including extensive ambient monitoring during both dry and wet weather conditions and information from other studies and references to characterize the source categories. EPA believes that MassDEP has consequently, appropriately documented the extent of the impairments due to pathogen contamination, as well as the types of sources that are likely to be present that are in need of abatement (see Sections 5 and 6 of the TMDL).

## **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.*

There are Class A, B, SA and SB segments of the Buzzards Bay included in this TMDL. The Massachusetts Surface Water Quality Standards include water quality criteria for fecal coliform, E. coli, total coliform and enterococci as indicator organisms of potential harmful pathogens for fresh water and fecal coliform and enterococci for marine waters. The TMDL document presents the applicable Massachusetts WQS in Section 3.0 of the document.

Section 4.0 of the TMDL document describes each of the 52 impaired water segments of the Buzzards Bay Watershed -- including the water body's designated use, applicable WQS, summary of data, sources of pathogens when available and other characteristics. This section also indicates the water quality classification (A, B, SA or SB) for each segment. The water quality criteria applicable to the A, B, SA and SB segments of the Buzzards Bay watershed are included in the TMDL document in Tables ES-1 and 7-1.

The EPA approved numeric water quality criteria for each segment are the targets upon which both the daily concentration and load TMDL targets of the TMDL are based.

#### *Assessment:*

EPA concludes that MassDEP has properly described and interpreted the applicable water quality standards to set the TMDL targets as indicated in Section 4.0 of the TMDL document. Section 4.0 describes each water body segment -- including the water body's designated use, applicable WQS, summary of data, sources of pathogens when available and other characteristics such as which segments and sources of pathogens are a priority. MassDEP is directly applying the numeric criteria in its WQS to derive the TMDL targets.

### **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 draft TMDL expressed the loading capacity as concentration targets. In response to public comments and to maximize the utility of the TMDL, MassDEP added waterbody segment

loadings to the final TMDL. Specifically, for the final TMDL, MassDEP set daily concentration TMDL (WLA/LA) targets for each one of the discharge sources by category (i.e., NPDES discharges, storm water, CSO, etc). MassDEP recommends that the concentration targets be used as the primary guide for implementation. Second, maximum daily loads were developed as a function of watershed size and run-off volume. For streams, since no USGS gages are located in this area, the maximum loads were calculated as a function of the long-term average run-off observed at USGS gages in New England (which accounts for infiltration and evapotranspiration), the watershed size and water quality standard criteria for e-coli and enterococcus applicable to each segment. For embayments, maximum daily loads were calculated as a function of the observed long-term precipitation on Cape Cod, the estimated average run-off associated within 200 feet from each embayment or the entire contributing watershed area for each segment and the most stringent water quality criteria based on segment classification (see Section 7 of the TMDL document for a more detailed description).

1) MassDEP chose to express the loading capacities in terms of concentrations (Table 7-1) set equal to or less than the WQS for several reasons. First, as stated in the TMDL, “MassDEP believes that expressing a loading capacity for bacteria in terms of concentrations set equal to the Commonwealth’s adopted criteria provides the clearest and most understandable expression of water quality goals to the public and to groups that conduct water quality monitoring.” In addition, specific water body segment data are provided that indicate the range in magnitude of the pathogen concentrations for each impaired segment. Based on the data available, MassDEP prioritized the water body segments in need of remediation (See Section 5 and 6 of the TMDL document; specifically Table 6-1, Priority Segments). In the Buzzards Bay watershed, storm water run-off, illicit connections, leaking sewer pipes, sanitary sewer overflows in sewered areas and failing septic systems are a significant cause of pathogen criteria water quality impairment.

2) MassDEP also expressed the loading capacity for rivers in terms of maximum daily loads based on the product of the flow (stream and/or storm water run-off) and the applicable State Water Quality Standard for pathogens (see Tables 7-2a and b of the TMDL document). Separate WLA and LA for each river segment were calculated for varying flow regimes based on the percent of pervious and impervious area contributing to the watershed and are provided in Table 7-2a. Table 7-2b sets out the WLA and LA for each embayment segment based on the amount of pervious and impervious area from the contributing watershed area. “MassDEP believes that expressing the loading capacity for bacteria in terms of loadings (e.g., numbers of organisms per day), although provided, is more difficult for the public to interpret and understand because the “allowable” loading number ... is very large (i.e. billions or trillions of organisms per day) and therefore cannot be easily understood in the context of the State Water Quality Standards or public health criteria” (see Section 7.1 of TMDL). Additionally, the number would vary according to flow rate since the loading capacity is dependent on stream flow and storm water rates which are constantly changing.

As stated above, MassDEP believes the concentration targets are most useful for evaluating whether a particular source is exceeding its allocation because it does not require complex simultaneous flow measurement. The mass loadings for each waterbody segment provide

information on the degree of relative assimilative capacity available in each waterbody and identify the loads necessary to meet quality standards

*Assessment:*

There is nothing in EPA's regulations that forbids expression of a TMDL in terms of multiple TMDL targets. TMDLs can be expressed in various ways, including in terms of toxicity, which is a characteristic of one or more pollutants, or by some "other appropriate measure." 40 C.F.R. § 130.2(i). The target loading capacities expressed in the TMDL document are set at levels which assure WQS will be met (criteria at point of discharge and loading based on meeting ambient water quality criteria). The concentration loading capacity is based on the concentration criteria for each water body. If all sources of pathogens are below the water quality criteria then it follows that the receiving water will meet the WQS for bacteria.

Both formats (concentration and load) express targets designed to attain the designated use of each waterbody segment based on a straight forward derivation of TMDL targets from the water quality criteria adopted by the Commonwealth. Both formats will achieve water quality criteria for both dry and wet weather and for all storm events whenever they occur (e.g. on any given day), whenever the bacteria criteria are in effect. These approaches have been used by states for TMDL development and approved by EPA in the past.

The daily maximum loads were calculated by multiplying the concentration criterion by stream flow or storm water run-off to calculate a daily mass loading. The loading capacity expressed in this way is mathematically derived to assure that the sum of the loads to the receiving water from either the stream flow and/or storm water will result in a concentration at the water quality standard.

In sum, the above loading capacity targets are directly linked to the Commonwealth's WQS' pathogen criteria to achieve the designated use of the water bodies covered by this TMDL.

#### **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 sets the target load allocations for non-NPDES regulated point sources, non-point sources and background equal to either the applicable water quality standard of the receiving water or to zero if the origin of the source is prohibited (e.g., failing septic systems) (Table7-1).

The difference between the LAs and WLAs (discussed in the next Section) is the source of the discharge and whether it is regulated under the NPDES program.

In addition, maximum daily loads were developed as a function of watershed size and run-off volume. For streams, since no USGS gages are located in this area, the maximum loads were calculated as a function of the long-term average run-off observed at USGS gages in New England (which accounts for infiltration and evapotranspiration), the watershed size and water quality standard criteria for e-coli and enterococcus applicable to each segment. The maximum daily loads as a function of stream flow and storm water run-off are broken out into LA and WLAs based on the percent of pervious and impervious area in Table 7-2a. The fraction of storm water run-off load allocated to unregulated sources (LA) was computed by multiplying the total load by the fraction of the watershed that is pervious and therefore less likely to discharge to a MS4 regulated storm sewer system. For embayments, maximum daily loads were calculated as a function of the observed long-term precipitation on Cape Cod, the estimated average run-off associated within 200 feet from each embayment or the entire contributing watershed area for each segment and the most stringent water quality criteria based on segment classification (see Section 7 of the TMDL document for a more detailed description). Similar to the methodology developed for rivers, the LA and WLA for embayment segments is proportioned based on the amount of pervious and impervious area from the contributing watershed area (see Table 7-2b).

#### *Assessment:*

As discussed in Section 3, MassDEP used the applicable numeric water quality criteria directly related to the use impairment which the TMDL is designed to address. As discussed in Section 6 under margin of safety, MassDEP set conservative targets based on meeting criteria at the point of source discharge. The aggregate mass load allocation is derived from the applicable criteria, flow and land cover data. EPA concludes that load allocations are adequately specified in the TMDL at levels necessary to attain and maintain WQS.

## **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.*

Point source discharges subject to the NPDES permit program must be addressed by the wasteload allocation component of a TMDL, as required by 40 C.F.R. § 130.2(h). MassDEP has established WLA targets for concentration (colonies/100ml) by discharge source category (Table 7-1). Discharges involving process wastewater, non-contact cooling water, and other non-storm water discharges are assigned individual concentration and mass waste load allocations pursuant to 40 C.F.R. § 130.2(h). The WLAs for non-storm water sources (e.g., wastewater treatment plants) are established as a concentration equal to the water quality criteria for each source by discharge category (see Table 7-1).

Storm water discharges 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. In the case of this pathogen TMDL, MassDEP did establish concentration (colonies/100ml) TMDL targets on a discharge by discharge basis, but daily loads (colonies/day) were established on an aggregate basis by segment because of insufficient flow data on each storm water source outfall.

The TMDL sets the target load allocations for storm water sources equal to the applicable water quality criteria of the receiving water (Table 7-1). The difference between the WLAs and LA (discussed in the previous Section) is the source of the discharge and whether it is regulated under the NPDES program.

In addition to the concentration targets, the TMDL includes maximum daily loads as a function of stream flow and the applicable WQS (Figures 7-1a and 7-1b), and separate WLAs and LAs for each river and embayment segment were calculated for varying flow regimes based on the percent of pervious and impervious area contributing to the watershed and are provided in Table 7-2a. Table 7-2b sets out the WLA and LA for each embayment segment based on the amount of pervious and impervious area from the contributing watershed area. The fraction of run-off load allocated to regulated storm water sources (WLA) was computed by multiplying the total load by the fraction of the watershed that is impervious and therefore more likely to discharge to a MS4 regulated storm sewer system.

MassDEP believes the concentration targets are most useful for guiding implementation because the concentration targets are independent of storm water flow volume.

#### *Assessment:*

MassDEP established concentration-based WLAs by applying the numeric criteria directly to each discharge. Some public comments expressed concern that the TMDL did not allocate loads to each source of pathogens on the Buzzards Bay. MassDEP has established WLA/LA targets for concentration (colonies/100ml) by discharge source category (Table 7-1), applicable to each individual source (wastewater treatment plants, CSO, storm water, etc). Individual mass loading

targets were also established for all regulated continuous sources (i.e. non-storm water related) as the product of each discharger's daily flow and the concentration target.

Aggregate mass WLAs were established for the storm water sources because it is impossible to determine with any precision or certainty the actual and projected loadings for individual discharges or groups of discharges. MassDEP divided the aggregate storm water loading targets into WLA and LA components as a function of impervious cover, which is reasonable assuming run-off from impervious cover is more likely to reach regulated MS4s. EPA's November 22, 2002 TMDL guidance suggests that it is acceptable in such cases to allocate storm water by gross allotments.

EPA concludes that the wasteload allocations are adequately specified in the TMDL at levels necessary to attain and maintain WQS.

## **6. Margin of Safety (MOS)**

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

The TMDL provides for an implicit margin of safety. The TMDL sets the target loading capacity, load allocations, and wasteload allocations equal to either the applicable water quality standard of the receiving water, or zero if the sources are prohibited. Therefore, there is a high level of confidence that the TMDL is established at levels that are consistent with the WQS. In addition, in establishing the concentration WLAs and LAs, the approach used by MassDEP does not rely on in-stream processes such as bacteria die-off and settling which are known to reduce in-stream bacteria concentrations. The loading targets are mathematically calculated based on the concentration water quality criteria to assure the numeric bacteria criteria are met for continuous dischargers as well as instream (as described above) and share the same direct connection to WQS and implicit margin of safety.

### *Assessment:*

EPA concludes that the approach used in developing the TMDL provides for an adequate implicit MOS. There is not a lack of knowledge concerning the relationship between allocations and water quality in this case, where the TMDL applies the criteria as allocations for each source. Setting the concentration TMDL targets at the water quality criteria with no allowance for in-stream bacteria die-off and settling provides an implicit margin of safety. The daily load TMDL expressions are derived from the same water quality criteria and concentration TMDL targets multiplied by the appropriate flow factor to obtain a mass TMDL expression with the same implicit MOS.

## **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 TMDL applies throughout the year when seasonal pathogen WQS apply. The WQS criteria may be applied on a seasonal basis at the discretion of the MassDEP (see 314 CMR 4.05(3)(a)4 and 4.05(3)(b)4.)

*Assessment:*

The pathogen TMDL applies over the entire season that the pathogen criteria apply. There is no reason to apply different targets on a seasonal basis because the measures implemented to meet the TMDL targets will reduce pathogen concentrations to water quality criteria levels for all seasons for which the WQS apply. Therefore, the TMDL adequately accounts for all seasons. EPA concludes that the TMDL documents have adequately addressed seasonal variability.

## **8. Monitoring Plan for TMDLs**

*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 pathogen TMDL for the Buzzards Bay Watershed is not a phased TMDL, but the document includes a description of a monitoring plan designed to measure attainment of WQS.

The TMDL and companion TMDL Implementation Guidance Manual document describe post-TMDL monitoring activities including various community efforts and MassDEP's commitment for monitoring every five years. 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 WQS, 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 Buzzards Bay Watershed Pathogen TMDL document and the identification of priority water body segments along with the TMDL Implementation Guidance Manual, "Atlas of Storm water Discharges in the Buzzards Bay Watershed" and the Buzzards Bay Comprehensive Conservation and Management Plan set forth an approach to addressing the pathogen impaired water body segments. Table 6-1 sets out the priority water body segments in need of remediation. In addition, the TMDL Implementation Guidance Manual sets forth the priority for addressing pathogen impairments based on land use and the types of pathogen sources. Moreover, the TMDL segments are small so that outfall pipe elevated bacteria data, and ambient stream data can be related back to potential sources and implementation needs.

MassDEP and EPA have historically required wastewater treatment plants to meet criteria based concentration effluent limits at the point of discharge and will continue to do so, consistent with the TMDL. Phase I and II storm water communities are or will be required to implement aggressive illicit discharge detection and elimination programs. Watershed stakeholders are providing valuable assistance in defining hot spots and sources of pathogen contamination as well as with the implementation of mitigation or preventative measures.

Through Phase 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 if it determines that such storm water discharge causes or contributes to a water quality violation, or is a significant contributor of pollutants, or where controls are needed based on a waste load in an EPA approved TMDL. MassDEP has similar authority under the Commonwealth's law.

Although the TMDL targets are expressed in a variety of numeric terms, EPA anticipates that NPDES permits for regulated storm water discharges will contain Best Management Practice (BMP) based requirements rather than numeric effluent limits. This approach is consistent with 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." The guidance states "WQBELs [water quality based effluent limits] for NPDES-regulated storm water discharges that implement WLAs in TMDLs may be expressed in

the form of best management practices (BMPs) under specified circumstances. *See* 33 U.S.C. 1342(p)(3)(B)(iii); 40 C.F.R. 122.44(k)(2)&(3)." This memorandum goes on to state:

...because storm water discharges are due to storm events that are highly variable in frequency and duration and are not easily characterized, only in rare cases will it be feasible or appropriate to establish numeric limits for municipal and small construction storm water discharges. The variability in the system and minimal data generally available make it difficult to determine with precision or certainty actual or projected loadings for individual dischargers or groups of dischargers. Therefore, EPA believes that in these situations, permit limits typically can be expressed as BMPs, and that numeric limits will be used only in rare instances. ... [i]n light of 33 U.S.C. §1342(p)(3)(B)(iii), EPA recommends that for NPDES-regulated municipal and small construction storm water discharges effluent limits should be expressed as best management practices (BMPs) or other similar requirements, rather than as numeric effluent limits. *See Interim Permitting Approach for Water Quality-Based Effluent Limitations in Storm Water Permits*, 61 *FR* 43761 (Aug. 26, 1996). The Interim Permitting Approach Policy recognizes the need for an iterative approach to control pollutants in storm water discharges. Specifically, the policy anticipates that a suite of BMPs will be used in the initial rounds of permits and that these BMPs will be tailored in subsequent rounds.

*Assessment:*

MassDEP has included an outline of implementation plans, priorities and authorities, although not a required element of the TMDL approval. EPA is taking no action on the implementation plan.

## **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 provides reasonable assurance that both point and non-point allocations will be achieved. 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 II coverage will address discharges from municipally-owned storm water drainage systems. Enforcement of regulations controlling non-point 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. These programs are more fully discussed in Sections 8 and 10 of the TMDL document.

Finally, it should be noted that MassDEP has had some experience implementing pathogen TMDLs. A previous TMDL was developed and approved by EPA for the Neponset River Watershed. The implementation recommendations outlined in that TMDL were similar to the Buzzards Bay TMDL. Since the time of approval, MassDEP has worked closely with a local watershed group (Neponset River Watershed Association) to develop a 319 project to implement the recommendations of the TMDL. The total project cost was approximately \$472,000 of which \$283,000 was provided through federal 319 funds and the additional 40% provided by the watershed association and two local communities. Although the project is not yet completed, the towns and watershed association have worked closely together to identify and install several new structural BMPs (enhanced wetland treatment, bioretention cells and vegetated buffers) to reduce storm water and bacterial inputs into Pine Tree Brook which was impaired due to pathogens.

In the spring of 2005, BMPs were installed along Pine Tree Brook. These BMPs effectively eliminated the discharges of four outfalls to Pine Tree Brook. By removing known sources of pathogens, water quality improvements are expected to occur. Additional BMPs are being evaluated for future implementation at this time. In addition, extensive public education on pet waste management has occurred in the form of fliers inserted into bills, canvassing neighborhoods and posting signs. Areas where people walked their pets were cleaned up to encourage individuals to look after their pets. The Neponset River Association has reported significant behavioral changes in the area resulting in a substantial reduction in pet waste.

In summary, MassDEP's existing programs set out a wide variety of tools communities can use to address pathogens, based on land use and the commonality of pathogen sources (e.g., combined sewer overflows (CSOs), failing septic systems, storm water and illicit connections, pet waste, etc.) Since there are only a few categories of sources of pathogens, the necessary remedial actions to address these sources are well established.

Since pathogen impairment in many communities has a significant economic impact, for example due to shellfish and beach closures, watershed stakeholders are often eager to implement measures to mitigate pathogen impairments. The TMDL provides a mechanism and incentive for community administrators to among other things seek funding, educate the public and prioritize remedial action. Moreover, for sources beyond the scope of federal and state jurisdiction (e.g., storm water not subject to Phase II NPDES regulation), this TMDL and the companion document, “*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*,” “Atlas of Storm Water Discharges in the Buzzards Bay Watershed” and the Buzzards Bay Comprehensive Conservation and Management Plan provide communities with information and tools for mitigating pathogen sources.

*Assessment:*

Although not required because MassDEP did not increase WLAs based on expected LA reductions, MassDEP has provided reasonable assurance that WQS 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.*

MassDEP publically announced the draft TMDL on July 23, 2005 and copies were distributed to key stakeholders. MassDEP also posted the draft TMDL on its website for public review on the same date. Two public informational meetings were held on August 10, 2005, to review the findings of the draft TMDL report and to solicit public comment. The public comment period began on July 23, 2005 and was extended from September 5, 2005 to September 15, 2005 when the public comment period closed. MassDEP has involved the public during the development of the TMDL and 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. As discussed above, MassDEP made a number of changes and clarifications to the final TMDL in response to comments received during the public comment period. These

modifications included the incorporation of additional monitoring data, identifying priority stream and embayment segments in need of mitigation measures and the addition of a mass-loading expression of the TMDL.

## **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 March 26, 2009, MassDEP submitted the Final Pathogen TMDL for the Buzzards Bay Watershed (Control Number: CN 251.1) and associated documents for EPA approval. The documents contained all of the elements necessary to approve the TMDL.

## **13. "Pollution Prevention" TMDL for the Buzzards Bay Watershed**

MassDEP recommends that the information contained in this TMDL guide management activities for all other waters throughout the watershed to help maintain and protect existing water quality. For these non-impaired waters, Massachusetts is proposing "pollution prevention" TMDLs consistent with CWA § 303(d)(3).

Pollution prevention TMDLs on water body segments can encourage the maintenance and protection of existing water quality and help prevent further degradation to water bodies. Although EPA does not approve pollution prevention TMDLs, EPA acknowledges the establishment of these TMDLs consistent with developing information as set forth in CWA Section 303(d)(3). Therefore, EPA's approval of the TMDL submitted by MassDEP applies only to the 52 water body segments set out in Attachment 1 that are currently listed for pathogens (bacteria) on the 2006 CWA § 303(d) list of impaired waters.

In terms of how these pollution prevention TMDLs would be implemented, MassDEP proposes that the analyses conducted for the pathogen impaired segments in this TMDL would apply to the non-impaired segments, since the sources and their characteristics are equivalent. Thus, the waste load and/or load allocation for each source and designated use would be the same as specified in the TMDL document. Therefore, the pollution prevention TMDL would have identical concentration waste load and load allocations based on the sources present and the designated uses of the water body segments.

Finally, MassDEP is also recommending that the Buzzards Bay Watershed TMDL may, in appropriate circumstances, apply to other Buzzards Bay watershed segments that are listed for pathogen impairment in subsequent Massachusetts CWA § 303(d) Integrated List of Waters. EPA agrees that for such segments, the approaches set forth in this TMDL may apply if, after

listing the waters for pathogen impairment and taking into account all relevant comments submitted on the CWA § 303(d) list, MassDEP determines with EPA approval of the CWA § 303(d) list that this TMDL should apply to future pathogen impaired segments.

**Attachment 1**  
**TMDL Addressing 52 Pathogen Impaired Water Body Segments**  
**Buzzards Bay Watershed**

<b>Segment ID</b>	<b>Segment Name</b>	<b>Segment Type</b>	<b>Segment Size<sup>1</sup></b>	<b>Segment Description</b>
MA95-40	East Branch Westport River	River	2.85 mi	Outlet Lake Noquochoke, Westport to Old County Rd. bridge, Westport
MA95-45	Snell Creek	River	0.67 mi	Drift Rd. to Marcus' Bridge in Westport
MA95-59	Snell Creek	Estuary	0.01 sq. mi.	'Marcus Bridge', Westport to confluence with East Branch Westport River, Westport
MA95-41	East Branch Westport River	Estuary	2.65 sq. mi.	Old County Road bridge, Westport to the mouth at Westport Harbor, Westport (excluding Horseneck Channel)
MA95-37	West Branch Westport River	Estuary	1.28 sq. mi.	Outlet Grays Mill Pond, Adamsville, Rhode Island to mouth at Westport Harbor, Westport
MA95-54	Westport River	Estuary	0.74 sq. mi.	From the confluence of the East and West Branches to Rhode Island Sound; Bounded by a line drawn from the southwestern point of Horseneck Point to the easternmost point near Westport Light
MA95-34	Slocums River	Estuary	0.67 sq. mi.	Confluence with Paskamanset R., Dartmouth to mouth at Buzzards Bay
MA95-44	Snell Creek	River	1.5 mi.	Headwaters west of Main Street, Westport, to Drift Road Westport
MA95-31	Acushnet River	River	2.7 mi.	Outlet New Bedford Reservoir to Hamlin Rd. culvert, Acushnet
MA95-32	Acushnet River	River	1.0 mi.	Hamlin Rd. culvert to culvert at Main St., Acushnet
MA95-33	Acushnet River	Estuary	0.32 sq. mi.	Main St. culvert to Coggeshall St. bridge, New Bedford/Fairhaven
MA95-42	New Bedford Harbor	Estuary	1.17 sq. mi.	Coggeshall St. bridge to hurricane Barrier, New Bedford/Fairhaven
MA95-63	Outer New Bedford Harbor	Estuary	5.82 sq. mi.	Hurricane Barrier to a line drawn from Wilbur Point, Fairhaven to Clarks Point, New Bedford
MA95-38	Clark Cove	Estuary	1.15 sq. mi.	Semi-enclosed waterbody landward of a line drawn between Clarks Point, New Bedford and Ricketsons Point, Dartmouth
MA95-13	Buttonwood Brook	River	3.8 mi.	Headwaters at Oakdale St., New Bedford to mouth at Apponagansett Bay, Dartmouth
MA95-39	Apponagansett Bay	Estuary	0.95 sq. mi.	From the mouth of Buttonwood Brook to a line drawn from Ricketsons Point, New Bedford to Samoset St. near North Ave., Dartmouth
MA95-35	Mattapoissett Harbor	Estuary	1.1 sq. mi.	From the mouth of the Mattapoissett R., Mattapoissett, to a line drawn from Ned Point to a point of land between Bayview Avenue and Grandview Ave., Mattapoissett
MA95-60	Mattapoissett River	Estuary	0.05 sq. mi.	From the River Road bridge, Mattapoissett to the mouth at Mattapoissett harbor, Mattapoissett
MA95-65	Nasketucket Bay	Estuary	3.7 sq. mi.	From the confluence with Little bay, Fairhaven to Buzzards bay along Causeway Road, Fairhaven and along a line from

Segment ID	Segment Name	Segment Type	Segment Size <sup>1</sup>	Segment Description
				the southern tip of Brant Island, Mattapoisett to the eastern tip of West Island, Fairhaven
MA95-56	Hammett Cove	Estuary	0.07 sq. mi.	Hammett Cove, Marion to the confluence with Sippican Harbor along a line from the southwestern most point of Little Neck to the end of the seawall on the opposite point
MA95-08	Sippican Harbor	Estuary	2.0 sq. mi.	From the confluence with Hammett Cove to the mouth at Buzzards Bay (excluding Blakenship Cove and Planning Island Cove), Marion
MA95-09	Aucoot Cove	Estuary	0.4 sq. mi.	From the confluence with Aucoot Creek, Marion to the mouth at Buzzards Bay at a line drawn between Converse Point and Joes Point, Mattapoisett
MA95-10	Hiller Cove	Estuary	0.04 sq. mi.	Area landward of a line drawn between Joes Point, Mattapoisett and the second boat dock northeast of Hiller Cove Lane, Mattapoisett
MA95-64	Little Bay	Estuary	0.36 sq. mi.	From the confluence with the Nasketucket River, Fairhaven south to the confluence with Nasketucket Bay at a line from the southernmost tip of Mirey Neck, Fairhaven to a point near Shore Drive.
MA95-07	Sippican River	Estuary	0.09 sq. mi.	County Rd. to confluence with Weweantic R., Marion/Wareham
MA95-53	Beaverdam Creek	Estuary	0.04 sq. mi.	Outlet from cranberry bogs of Rte. 6, Wareham to confluence with Weweantic River, Wareham
MA95-58	Bread and Cheese Brook	River	4.9 mi.	Headwaters, north of old Bedford Road, Westport to confluence with East Branch Westport River, Westport
MA95-05	Weweantic River	Estuary	0.62 sq. mi.	Outlet Horseshoe Pond, Wareham to mouth at Buzzards Bay, Marion/Wareham
MA95-29	Agawam River	Estuary	0.16 sq. mi.	From the Wareham WWTP to confluence with Wankinco River at the Rte. 6 bridge, Wareham
MA95-50	Wankinco River	Estuary	0.05 sq. mi.	Elm St. bridge, Wareham to confluence with the Agawam R., at a line between a point south of Mayflower Ridge Drive and a point north of the railroad tracks near Sandwich Rd., Wareham
MA95-49	Broad Marsh River	Estuary	0.16 sq. mi.	From its headwaters in a salt marsh south of Marion Rd. and Bourne Terrace, Wareham to the confluence with the Wareham R.
MA95-51	Crooked River	Estuary	0.04 sq. mi.	From the outlet of a cranberry bog, east of Indian Neck Rd., Wareham to confluence with the Wareham R., Wareham
MA95-52	Cedar Island Creek	Estuary	0.01 sq. mi.	From the headwaters near intersection of Parker Dr. and Camardo Dr., Wareham to the mouth at Marks Cove, Wareham
MA95-03	Wareham River	Estuary	1.18 sq. mi.	Rte. 6 bridge to mouth at Buzzards Bay (at an imaginary line from Cromset Point to curved point east, southeast of Long Beach point), Wareham. Includes Mark's Cove, Wareham
MA95-02	Onset Bay	Estuary	0.79 sq. mi.	Wareham

Segment ID	Segment Name	Segment Type	Segment Size <sup>1</sup>	Segment Description
MA95-01	Buttermilk Bay	Estuary	0.77 sq. mi.	Bourne/Wareham
MA95-62	Buzzards Bay	Estuary	8.0 sq. mi.	Open water area encompassed within a line drawn from Wilbur Point, Fairhaven to Clarks Point, New Bedford to Ricketson Point, Dartmouth to vicinity of Samoset St., Dartmouth down to Round Hill Point, Dartmouth, back to Wilbur Point, Fairhaven
MA95-14**	Cape Cod Canal-Estuary	Estuary	1.13 sq. mi.	Connection between Buzzards Bay and Cape Cod Bay in Bourne and Sandwich.
MA95-48	Eel Pond-Estuary	Estuary	0.03 sq. mi.	Salt water pond that discharges to Back River, Bourne.
MA95-61	Eel Pond-Estuary	Estuary	0.04 sq. mi.	Coastal pond at the head of Mattapoisset Harbor, Mattapoisset
MA95-47	Back River-Estuary	Estuary	0.08 sq. mi.	Outlet of small unnamed pond, downstream from Mill Pond, Bourne to confluence with Phinneys Harbor, Bourne (excluding Eel Pond).
MA95-15	Phinneys Harbor- Estuary	Estuary	0.73 sq. mi.	From the confluence with Back R. to its mouth at Buzzards Bay between Mashpee and Toby's Island, Bourne.
MA95-16	Pocasset River- Estuary	Estuary	0.05 sq. mi.	From the outlet of Mill Pond, Bourne to the mouth at Buzzards Bay, Bourne.
MA95-17	Pocasset Harbor- Estuary	Estuary	0.33 sq. mi.	From the confluence with Red Brook Harbor near the northern portion of Bassett's Island and Patuisett to the mouth at Buzzards Bay between Bassett's Island and Wings Neck, Bourne.
MA95-18	Red Brook Harbor- Estuary	Estuary	0.91 sq. mi.	From the confluence with Pocasset Harbor between the north Island and Patuisett to its mouth at Buzzards Bay between Bassetts island and Scraggy Neck, Bourne (including Hen Cove).
MA95-21	Herring Brook- Estuary	Estuary	0.01 sq. mi.	From its headwaters, northeast of Dale Dr. and west of Rte. 28A, to its mouth at Buzzards Bay, Falmouth.
MA95-46	Harbor Head- Estuary	Estuary	0.02 sq. mi.	The semi-enclosed body of water south of the confluence with West Falmouth Harbor at Chappaquoit Rd., Falmouth.
MA95-20	Wild Harbor- Estuary	Estuary	0.15 sq. mi.	Embayment extends from Point Road, Nyes Neck to Crow Point at the end of Bay Shore Road in North Falmouth
MA95-22	West Falmouth Harbor- Estuary	Estuary	0.29 sq. mi.	From the confluence with Harbor Head at Chappaquoit Rd., Falmouth to the mouth at Buzzards Bay at a line connecting the ends of the seawalls from Little Island and Chappaquoit Point, Falmouth (including Snug Harbor).
MA95-23	Great Sippewisset Creek- Estuary	Estuary	0.03 sq. mi.	From the outlet of Beach Pond in Great Sippewisset marsh to the mouth at Buzzards Bay, Falmouth, including the unnamed tributary from the outlet of Fresh Pond, and Quahog Pond, Falmouth.
MA95-24	Little Sippewisset Marsh- Estuary	Estuary	0.02 sq. mi.	From the headwaters north of Sippewisset Rd., Falmouth to the mouth at Buzzards Bay near Saconesset Hills, Falmouth.
MA95-25	Quissett Harbor- Estuary	Estuary	0.17 sq. mi.	The semi-enclosed body of water landward of a line drawn between The Knob and Gansett Point, Falmouth.

<sup>1</sup> Units = Miles for river segments and square miles for estuaries

\*It should be noted that in Table 4-3 above, the Mass DEP moved the last fourteen segments (starting with MA 95-14 Cape Cod Canal and ending with MA 95-25 Quissett Harbor), from the Cape Cod Watershed to the Buzzards Bay Watershed because these segments actually discharge to Buzzards Bay even though they are on the Cape Cod.