Final Pathogen TMDL for the South Coastal Watershed

August 2014

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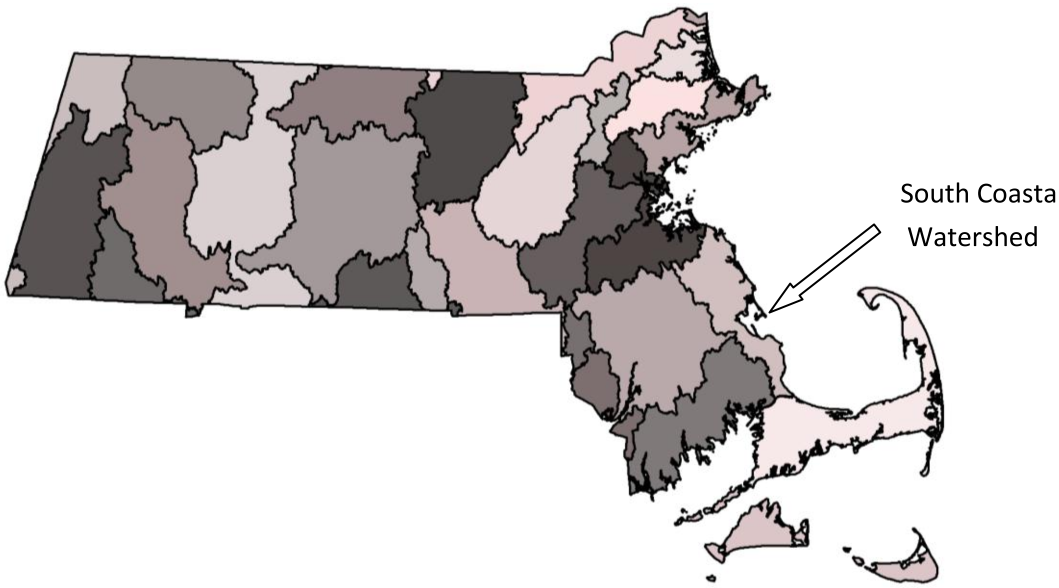

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NOTICE OF AVAILABILITY

Limited copies of this report are available at no cost by written request to:

Massachusetts Department of Environmental Protection (MassDEP)
Division of Watershed Management
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This report is also available from MassDEP's home page on the World Wide Web.

A complete list of reports published since 1963 is updated annually and printed in July. This list, titled "Publications of the Massachusetts Division of Watershed Management (DWM) – Watershed Planning Program, 1963-(current year)", is also available by writing to the DWM in Worcester.

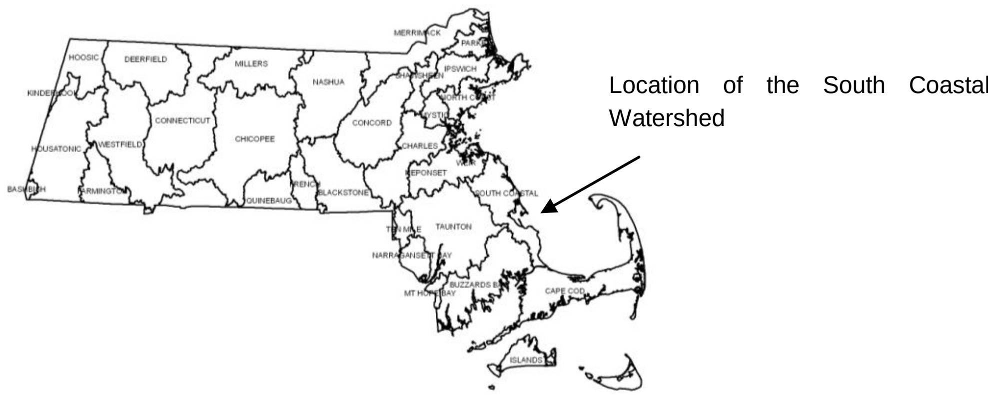
DISCLAIMER

References to trade names, commercial products, manufacturers, or distributors in this report constituted neither endorsement nor recommendations by the Division of Watershed Management for use.

Much of this document was prepared using text and general guidance from the previously approved Neponset River Basin and the Palmer River Basin Bacteria Total Maximum Daily Load documents.

Acknowledgement
This report was developed by ENSR through a partnership with Resource Triangle Institute (RTI) contracting with the United States Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection Agency under the National Watershed Protection Program. The report follows the same format and methodology for previously approved bacteria TMDLs (Charles, Cape Cod, Buzzards Bay and North Coastal).

Total Maximum Daily Loads for Pathogens within the South Coastal Watershed



Key Features: Pathogen TMDL for the South Coastal Watershed

Location: EPA Region 1

Land Type: New England Coastal

303(d) Listings: Pathogens:

Cohasset Harbor (MA94-01)
Cohasset Cove (MA94-32)
The Gulf (MA94-19)
Musquashcut Pond (MA94-33)
Scituate Harbor (MA94-02)
Ellisville Harbor (MA94-34)
French Stream (MA94-03)
Iron Mine Brook (MA94-24)
Second Herring Brook (MA94-31)
Third Herring Brook (MA94-27)
Drinkwater River (MA94-21)
North River (MA94-05)
Herring River (MA94-07)
North River (MA94-06)
South River (MA94-09)
Green Harbor (MA94-11)
Jones River (MA94-14)
Duxbury Bay (MA94-15)
Plymouth Harbor (MA94-16)
Bluefish River (MA94-30)

Data Sources: River Watch Water Quality Testing Results. North and South Rivers Watershed Association. Department of Environmental Protection, Division of Watershed Management. Massachusetts Division of Marine Fisheries. Massachusetts Coastal Zone Management.

Data Mechanism: Massachusetts Surface Water Quality Standards; The Federal BEACH Act; Massachusetts Department of Public Health Bathing Beaches; Massachusetts Division of Marine Fisheries Shellfish Sanitation and Management; Massachusetts Coastal Zone Management

Monitoring Plan: Massachusetts Watershed Five-Year Cycle; Local Volunteer Groups; Division of Marine Fisheries; Massachusetts Coastal Zone Management

Control Measures: Watershed Management; Storm Water Management (e.g., illicit discharge removals, public education/behavior modification); Combined Sewer Overflow (CSO) & Sanitary Sewer Overflow (SSO) Abatement; Agricultural and other BMPs; No Discharge Areas; By-laws; Ordinances; Septic System Maintenance/Upgrades.

Executive Summary

Purpose and Intended Audience

This document provides a framework to address bacterial and other fecal-related pollution in surface waters of Massachusetts. Fecal contamination of our surface waters is most often a direct result of the improper management of human wastes, excrement from barnyard animals, pet feces and agricultural applications of manure. It can also result from large congregations of birds such as geese and gulls. Illicit discharges of boat waste are of particular concern in coastal areas. Inappropriate disposal of human and animal wastes can degrade aquatic ecosystems and negatively affect public health. Fecal contamination can also result in closures of shellfish beds, beaches, swimming holes and drinking water supplies. The closure of such important public resources can erode quality of life and diminish property values.

Who should read this document?

The following groups and individuals can benefit from the information in this report:

a) towns and municipalities, especially Phase I and Phase II storm water communities, that are required by law to address storm water and/or combined sewage overflows (CSOs) and other sources of contamination (e.g., broken sewerage pipes and illicit connections) that contribute to a waterbody's failure to meet Massachusetts Water Quality Standards for pathogens;
b) watershed groups that wish to pursue funding to identify and/or mitigate sources of pathogens in their watersheds;
c) harbormasters, public health officials and/or municipalities that are responsible for monitoring, enforcing or otherwise mitigating fecal contamination that results in beach and/or shellfish closures or results in the failure of other surface waters to meet Massachusetts standards for pathogens;
d) citizens that wish to become more aware of pollution issues and may be interested in helping build local support for funding remediation measures.
e) government agencies that provide planning, technical assistance, and funding to groups for bacterial remediation.

South Coastal Watershed- Rivers and Estuaries

The three largest systems in the South Shore Coastal Watersheds area are the Cohasset Harbor Subwatershed, the North and South Rivers Subwatershed, and the Plymouth Bay Subwatershed (including the Jones and Eel Rivers). The smaller subwatershed areas include: Little Harbor, Scituate Harbor, the Green Harbor Subwatershed, and Ellisville Harbor. There is an area of unconsolidated small basins in the southern part of the South Shore Coastal Watersheds. Each of the three largest systems, the four smaller systems, and the area of unconsolidated small basins are briefly summarized below (Watershed Action Alliance, 2006).

Cohasset Harbor Subwatershed - The surface watershed area for this subwatershed is approximately 17.6 mi^2. A total of 3.5 river miles along three rivers (Aaron River, Herring Brook, and Bound Brook) are contained in this system. This subwatershed includes 1.03 mi^2 of estuaries (Musquashcut Pond, The Gulf, Cohasset Cove, Cohasset Harbor) and 207.5 acres of lakes.

North and South Rivers Subwatershed – This subwatershed is approximately 76 mi^2. A total of 30.6 river miles along eight rivers (French Stream, Drinkwater River, Indian Head River, Iron Mine Brook, Third Herring Brook, Second Herring Brook, First Herring Brook, and the South River) are contained in this system. This subwatershed includes 1.57 mi^2 of estuaries (North River, South River, and the Herring River) and 1,026.1 acres of lakes.

Plymouth Bay Subwatershed - This subwatershed is approximately 73.8 mi^2. A total of 8.9 river miles along two rivers (Jones River and Eel River) are contained in this system. This subwatershed includes 25.68 $mi^2$of estuaries (Jones River, Duxbury Bay, Plymouth Harbor, and Plymouth Bay) and 1,896.3 acres of lakes.

Smaller Subwatershed Areas - Little Harbor watershed area of approximately 1.7 mi^2 and 0.24 mi^2 of estuary. Scituate Harbor has a watershed area of approximately 3.5 mi^2 and 0.32 mi^2 of estuary. Green Harbor watershed area of approximately 7.7 mi^2, 5.6 miles of river, 0.08 mi^2 of estuary, and 53.5 acres of lakes. Ellisville Harbor has a watershed area of approximately 1.97 mi^2, 0.01 mi^2 of estuary, and 28.9 acres of lakes.

There is also an area of the South Shore Coastal Watershed of approximately 61.23 mi^2 south of the Plymouth Bay subwatershed and excluding the Ellisville Harbor Subwatershed. This area consists of several small coastal basins that are not interconnected by any one river. This portion of the South Shore Coastal Watersheds does not have any river segments reported for it (although it contains the Herring River); however, there are approximately 1030.1 acres of lakes assessed in this report (many of which are kettle lakes) in this area (Watershed Action Alliance, 2006).

Growth pressures continue to affect the South Coastal Watersheds (SCW), as many of its communities are ill equipped to handle the growth they face. Growth pressures are caused by population increases as well as increased encroachment on the land from land-uses as a result of increased residential construction, new commercial and industrial facilities to support the increased growth, increased municipal services, roadways, and recreational facilities and parks to support the growing populace. A 1996 Harvard University study projected an additional increase of 23 percent over the next 20 years for the SCW communities and other watersheds of Southeastern Massachusetts. The population increases as reported in Census 2000 confirmed this region as the fastest growing in the Commonwealth. For example, both Plymouth and Rockland saw significant increases during the last decade: an increase of 8.1 percent in housing in Plymouth and a population increase of 9.6 percent in Rockland. This region was described as a "region at risk" and was ranked as the fastest growing region in the Northeast. Since 1973, this growth has represented a 121 percent increase beyond all preceding development from the time of the Pilgrims (Watershed Action Alliance, 2006).

Bacteria pollution problems in the twenty segments covered in this report persist over much of the area due to a combination of mainly non- point source pollution, such as: failing septic systems, stormwater pollution from illicit connections, overland flow picking up animal (agricultural related), wildlife and pet wastes, boat and marina wastes. Failing septic systems appear to have been the highest single cause of bacteria pollution in most areas of this watershed. Most of this watershed is geographically oriented to coastal estuarine margins, which are traditionally rich in shellfishing reserves. To protect human health the water quality standards for bacteria for shellfishing areas are particularly stringent, and therefore the water quality conditions have resulted in many of these areas being closed for decades for this particular use.

Considerable progress in reducing bacteria sources has been made in many areas of this watershed. Towns such as Cohasset, Scituate, Marshfield, Duxbury, Kingston, Pembroke, and Plymouth have either received grants and/or have appropriated town funds to conduct sampling or other investigative activities to find and fix sources. Much of this has been in conjunction with Phase II Stormwater Program efforts in the MS4 areas. The North- South Rivers Watershed Association has helped facilitate action by towns, citizens and other groups to assist in these efforts. Focused restoration efforts to reduce bacterial contamination in the Plymouth Harbor/Coastal Areas, the Kingston Harbor/Jones River Estuary Areas, and the Duxbury Bay areas, have resulted in the successful reopening of many of the previously closed shellfish areas. Other closed shellfishing areas in Cohasset/ Little Harbors, Scituate Harbor, North- South River Coastal Areas, and Green Harbor are showing signs of bacteria related water quality improvements.

In August 2006, The Executive Office of Environmental Affairs formally announced that a 63 square mile area, encompassing Plymouth, Duxbury and Kingston Embayments, became a No Discharge Area, meaning that any discharge of boat sewage is prohibited. This was enacted to better protect the waters from receiving nutrient and bacterial wastes from any marine vessel operating within these waters (EOEA 2006).

In an effort to provide guidance for setting bacterial implementation priorities within the South Coastal Watershed, a summary table is provided. Table ES- 1 below provides a prioritized list of pathogen-impaired segments that will require additional bacterial source tracking work and implementation of structural and non-structural Best Management Practices (BMPs). Since limited source information and data are available in each impaired segment, a simple scheme was used to prioritize segments based on fecal coliform concentrations. High priority was assigned to those segments where either dry or wet weather concentrations (end of pipe or ambient) were equal to or greater than 10,000 cfu /100 ml. Medium priority was assigned to segments where concentrations ranged from 1,000 to 9,999 cfu/100ml. Low priority was assigned to segments where concentrations were observed less than 1,000 cfu/100 ml. MassDEP believes the higher concentrations are indicative of the potential presence or raw sewage and therefore they pose a greater risk to the public. It should be noted that in all cases, waters exceeding the water quality standards identified in Table ES- 1 are considered impaired.

Also, prioritization is adjusted upward based on proximity of waters, within the segment, to sensitive areas such as Outstanding Resource Waters (ORW's), or designated uses that require higher water quality standards than Class B, such as public water supply intakes, public swimming areas, or shellfish areas. Best professional judgment (BPJ) was used in determining this upward adjustment. Generally speaking, waters that were determined to be lower priority based on the numeric range identified above were elevated up one level of priority if that segment was adjacent to or immediately upstream of a sensitive use. An asterisk * in the priority column of the specific segment would indicate this situation.

Table ES-1. Prioritized List of Pathogen- impaired Segments (MassDEP 2012).

Segment ID	Segment Name	Segment Type	River (mile) Estuary (m^2)	Segment Description	Priority "Dry"	Priority "Wet"
MA94-32	Cohasset Cove	Estuary, SA	0.09	The waters south of a line drawn from the Bassing Beach jetty,	Low*, Shellfishing	Medium*, Shellfishing

Segment ID	Segment Name	Segment Type	River (mile) Estuary (m^2)	Segment Description	Priority "Dry"	Priority "Wet"
				Scituate westerly to the opposite shore, Cohasset not including Cohasset Cove, Cohasset/Scituate		
MA94-01	Cohasset Harbor	Estuary, SA	0.70	South of a line drawn from the northwest point of Scituate Neck, Scituate to just north of Quarry Point, Cohasset – not including Cohasset Cove	Low* (Shellfishing, Public Swimming)	Medium* (Shellfish., Public Swimming)
MA94-19	The Gulf	Estuary, SB	0.13	Headwaters, outlet Hunter's Pond, Scituate to confluence with Cohasset Cove just north of Border Street, Cohasset.	Insufficient Data*, Shellfishing	Insufficient Data*, Shellfishing
MA94-33	Musquashcut Pond	Estuary, SA	0.11	Scituate (formerly reported as MA94105)	Insufficient Data*, Shellfishing	Insufficient Data*, Shellfishing
MA94-02	Scituate Harbor	Estuary, SA	0.32	West of line drawn across the mouth of Scituate Harbor, from the elbow of the jetty southeast off Lighthouse Point to the jetty northeast of the US Coast Guard station, Scituate	Low* (Shellfishing, Public Swimming)	Medium* (Shellfishing, Public Swimming)
MA94-34	Ellisville Harbor	Estuary, SA	0.01	Plymouth	Medium* Shellfishing	Medium* Shellfishing
MA94-03	French Stream	River, B	6.1	Headwaters on southeast side of Naval Air Station, Rockland through Studleys Pond to confluence with Drinkwater River, Hanover. Miles 5.9-0.0	Low	Medium
MA94-24	Iron Mine Brook	River, B, ORW	1.4	Headwaters, north of Route 139, Hanover to the confluence with Indian Head River, Hanover.	Medium* ORW	Medium* ORW
MA94-31	Second Herring Brook	Estuary, SA, ORW	0.003	From the Second Herring Brook Pond Dam, Norwell to the confluence with the North River, Norwell.	Insufficient Data*, Shellfishing, ORW	Insufficient Data*, Shellfishing, ORW
MA94-27	Third Herring Brook	River, B, ORW	5.3	Headwaters, outlet of Jacobs Pond, Norwell/Hanover to confluence with North River, Norwell/Hanover.	Medium* ORW	Medium* ORW
MA94-21	Drinkwater River	River, B	3.5	From Whiting Street, Hanover through Forge Pond to the inlet	Medium	Medium

Segment ID	Segment Name	Segment Type	River (mile) Estuary (m^2)	Segment Description	Priority "Dry"	Priority "Wet"
				of Factory Pond, Hanover.		
MA94-05	North River	Estuary, SA, ORW	0.3	Confluence of Indian Head River and Herring Brook, Hanover/Pembroke to Route 3A (Main Street), Marshfield/Scituate.	Medium* ORW, Shellfishing	High* ORW, Shellfishing
MA94-07	Herring River	Estuary, SA	0.08	Outlet Old Oaken Bucket Pond to confluence with North River.	Low* Shellfishing	Medium* Shellfishing
MA94-09	South River	Estuary, SA, ORW	0.63	Main Street, Marshfield to confluence with North River.	Medium* ORW Shellfishing	High* ORW Shellfishing
MA94-06	North River	Estuary, SA	0.56	Route 3A (Main Street), Marshfield/Scituate to mouth at Massachusetts Bay, Scituate.	Low* Shellfishing	Medium* Shellfishing
MA94-11	Green Harbor	Estuary, SA	0.08	From the tide gates at Rte 139, Marshfield to the mouth of the harbor at MA Bay/Cape Cod Bay, Marshfield	Insufficient Data* Shellfishing	Insufficient Data* Shellfishing
MA94-14	Jones River	Estuary, SA	0.09	Elm Street, Kingston to mouth at Duxbury Bay, Kingston.	Medium* Shellfishing	Medium* Shellfishing
MA94-15	Duxbury Bay	Estuary, SA	12.7	North and west of a line drawn from Saquish Head to the tip of Plymouth Beach to High Cliff, Plymouth – excluding Back River and Bluefish River, Duxbury and Jones River, Kingston	Low* (showing improve-ment) Shellfishing	Medium* (showing improve-ment) Shellfishing
MA94-16	Plymouth Harbor	Estuary, SA	2.53	South of a line drawn from the tip of Plymouth Beach to High Cliff, Plymouth	Low* (showing improve-ment) Shellfishing	Medium* (showing improve-ment) Shellfishing
MA94-30	Bluefish River	Estuary, SA	0.07	Saltmarsh north of Harrison Street, Duxbury to mouth at Duxbury Bay, Duxbury	Medium* Shellfishing	Medium* Shellfishing

Elevated dry weather bacteria concentrations could be the result of illicit sewer connections or failing septic systems. As a result, the first priority should be given to bacteria source tracking activities in those segments where sampling activities show elevated levels of bacteria during dry weather. Identification and remediation of dry weather bacteria sources is usually more straightforward and successful than tracking and eliminating wet weather sources. If illicit bacteria sources are found and eliminated it should result in a dramatic reduction of bacteria concentration in the segment in both dry and wet-weather. Segments that remain impaired during wet weather should be evaluated for stormwater BMP implementation opportunities starting with less costly non-structural practices first (such as street sweeping, and/or managerial approaches) using local regulatory controls, and lastly, more expensive structural measures. Structural stormwater BMP implementation may require additional study to identify cost efficient and effective technology.

TMDL Overview

The Massachusetts Department of Environmental Protection (MassDEP) is responsible for monitoring the waters of the Commonwealth, identifying those waters that are impaired, and developing a plan to bring them back into compliance with the Massachusetts Water Quality Standards (WQS). The list of impaired waters, better known as the "303d list" identifies problem lakes, coastal waters and specific segments of rivers and streams and the reason for impairment.

It should be noted that all the waterbodies are influenced by seasonal variations in flow and temperature and the tidal cycles in the estuaries. All these variations will directly impact the extent to which these waterbodies are impaired.

Once a water body is identified as impaired, the MassDEP is required by the Federal Clean Water Act (CWA) to develop a "pollution budget" designed to restore the health of the impaired body of water. The process of developing this budget, generally referred to as a Total Maximum Daily Load (TMDL), includes identifying the source(s) of the pollutant from direct discharges (point sources) and indirect discharges (non-point sources), determining the maximum amount of the pollutant that can be discharged to a specific water body to achieve water quality standards, and assigning pollutant load allocations to the sources. A plan to implement the necessary pollutant reductions is essential in order to reach the ultimate goal of restoring uses and meeting the water quality standards in stream.

Pathogen TMDL: This report represents a TMDL for pathogen indicators (e.g. fecal coliform, *E. coli*, and enterococcus bacteria) in the South Coastal watershed, except Little Harbor estuary (MA94-20) in Cohasset as a TMDL has been previously prepared for this segment in 2002 (MassDEP, 2002). Certain bacteria, such as coliform, *E. coli*, and enterococcus bacteria, are indicators of contamination from sewage and/or the feces of warm-blooded wildlife (mammals and birds). Such contamination may pose a risk to human health. Therefore, in order to prevent further degradation in water quality and to ensure that waterbodies within the watershed meet state water quality standards, the TMDL establishes indicator bacteria limits and outlines corrective actions to achieve that goal.

Sources of indicator bacteria in the South Coastal watershed were found to be many and varied. Most of the bacteria sources are believed to be storm water related. Section 6 of this report provides a general summary by segment of likely bacteria sources in the South Coastal watershed. These sources include: failing septic systems, combined sewer overflows, sanitary sewer overflows, sewage pipes connected to storm drains, certain recreational activities, wildlife (including birds), domestic pets and animals, and direct overland storm water runoff. Note that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. A discussion of pathogen related control measures and best management practices are provided in the companion document: "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*".

This TMDL applies to the 20 pathogen impaired segments of the South Coastal watershed that are currently listed on the CWA § 303(d) list of impaired waters (MassDEP 2012). MassDEP recommends however, 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).

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. The waste load and/or load allocation for each source and designated use would be the same as specified herein. Therefore, the pollution prevention TMDLs would have identical waste load and load allocations based on the sources present and the designated use of the water body segment (see Table ES-2 and Table 7-1).

This South Coastal watershed TMDL may, in appropriate circumstances, also apply to segments that are listed for pathogen impairment in subsequent Massachusetts CWA § 303(d) Integrated List of Waters. For such segments, 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, the Commonwealth determines with EPA approval of the CWA § 303(d) list that this TMDL should apply to future pathogen impaired segments.

Since quantitative estimates of existing sources are generally unavailable, it is difficult to estimate the pollutant reductions for specific sources. For the illicit sources, the goal is complete elimination (100% reduction). However, overall wet weather indicator bacteria load reductions can be estimated using typical storm water bacteria concentrations. These data indicate that in general two to three orders of magnitude (i.e., greater than 90%) reductions in storm water bacteria loading will be necessary, especially in developed areas. This goal is expected to be accomplished through stepwise implementation of best management practices, such as those associated with the Phase II MS4 control program for storm water.

TMDL goals for each type of bacteria source are provided in Table ES-2. Municipalities are the primary responsible parties for eliminating many of these sources. TMDL implementation to achieve these goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows, and best management practices to mitigate storm water runoff volume. Certain towns in the watershed are classified as Urban Areas by the United States Census Bureau and are subject to the Stormwater Phase II Final Rule that requires the development and implementation of an illicit discharge detection and elimination plan. Combined sewer overflows will be addressed through the on-going long-term control plans.

In most cases, authority to regulate non-point source pollution and thus successful implementation of this TMDL is limited to local government entities and will require cooperative support from local volunteers, watershed associations, and local officials in municipal government. Those activities can take the form of expanded education, obtaining and/or providing funding, and possibly local enforcement. In some cases, such as subsurface disposal of wastewater from homes, the Commonwealth provides the framework, but the administration occurs on the local level. Federal and state funds to help implement this TMDL are available, on a competitive basis, through the Non-Point Source Control (CWA Section 319) Grants, Water Quality (CWA Section 604(b)) Grants, and the State Revolving Fund (SRF). Most financial aid requires some local match as well. The programs mentioned are administered through the MassDEP. Additional funding and resources available to assist local officials and community groups can be referenced within the Massachusetts Non-point Source Management Plan-Volume I Strategic Summary (2000) "Section VII Funding / Community Resources". This document is available on the

MassDEP's website at: www.mass.gov/eea/agencies/massdep/water/watersheds/nonpoint-source-pollution.html, or by contacting the MassDEP's Nonpoint Source Program at (508) 792-7470 to request a copy.

Table ES-2. Sources and Expectations for Limiting Bacterial Contamination in the South Coastal Watershed.

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (cfu/100 mL)[1]	Load Allocation Indicator Bacteria (cfu/100 mL)[1]
A, B, SA, SB (prohibited)	Illicit discharges to storm drains	0	Not applicable
	Leaking sanitary sewer lines	0	Not Applicable
	Failing septic systems	Not Applicable	0
A (Includes filtered water supply) & **B**	Any regulated discharge- including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges [7,9], and combined sewer overflows[6].	Either; a) E. coli <=geometric mean[5] 126 colonies per 100 mL; single sample <=235 colonies per 100 mL; or b) Enterococci geometric mean[5] <= 33 colonies per 100 mL and single sample <= 61 colonies per 100 mL	Not Applicable
	Nonpoint source stormwater runoff[4]	Not Applicable	Either a) E. coli <=geometric mean[5] 126 colonies per 100 mL; single sample <=235 colonies per 100 mL; or Enterococci geometric mean[5]<= 33 colonies per 100 mL and single sample <= 61 colonies per 100 mL
SA (approved for shellfishing)	Any regulated discharge - including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Fecal Coliform <= geometric mean, MPN, of 14 organisms per 100 mL nor shall 10% of the samples be >=28 organisms per 100 mL	Not Applicable
	Nonpoint Source Stormwater Runoff[4]	Not Applicable	Fecal Coliform <= geometric mean, MPN, of 14 organisms per 100 mL nor shall 10% of the samples be >=28 organisms per 100 mL

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (cfu/100 mL)[1]	Load Allocation Indicator Bacteria (cfu/100 mL)[1]
SA & SB[10] (Beaches[8] and non-designated shellfish areas)	Any regulated discharge - including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Enterococci - geometric mean[5] <= 35 colonies per 100 mL and single sample <= 104 colonies per 100 mL	Not Applicable
	Nonpoint Source Stormwater Runoff[4]	Not Applicable	Enterococci -geometric mean[5] <= 35 colonies per 100 mL and single sample <= 104 colonies per 100 mL
SB (approved for shellfishing w/depuration)	Any regulated discharge - including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Fecal Coliform <= median or geometric mean, MPN, of 88 organisms per 100 mL nor shall 10% of the samples be >=260 organisms per 100 mL	Not Applicable
	Nonpoint Source Stormwater Runoff[4]	Not Applicable	Fecal Coliform <= median or geometric mean, MPN, of 88 organisms per 100 mL nor shall 10% of the samples be >=260 organisms per 100 mL

[1] Waste Load Allocation (WLA) and Load Allocation (LA) refer to fecal coliform densities unless specified in table.
[2] In all samples taken during any 6 month period
[3] In 90% of the samples taken in any six month period;
[4] The expectation for WLAs and LAs for stormwater discharges is that they will be achieved through the implementation of BMPs and other controls.
[5] Geometric mean of the 5 most recent samples is used at bathing beaches. For all other waters and during the non-bathing season the geometric mean of all samples taken within the most recent six months, typically based on a minimum of five samples.
[6] Or other applicable water quality standards for CSO's
[7] Or shall be consistent with the Waste Water Treatment Plant (WWTP) National Pollutant Discharge Elimination System (NPDES) permit.
[8] Massachusetts Department of Public Health regulations (105 CMR Section 445)
[9] Seasonal disinfection may be allowed by the Department on a case-by-case basis.
[10] Segments identified as CSO have a long term control plan in place.

Note: this table represents waste load and load allocations based on water quality standards current as of the publication date of these TMDLs. If the pathogen criteria change in the future, MassDEP intends to revise the TMDL by addendum to reflect the revised criteria. Waste load allocation (WLA) as a concept in this document refers to pollutants discharged from pipes and channels that require a discharge permit (point sources). Load allocation refers to pollutants entering waterbodies through overland runoff (non point sources). A major difference between the two categories is the greater legal and regulatory control generally available to address point sources while voluntary cooperation added by incentives in some cases is the main vehicle for addressing non-point sources.

List of Figures

List of Acronyms

7Q10	Seven Day Ten Year Low Flow
ACEC	Area of Critical Environmental Concern
BMP	Best Management Practice
cfu	colony forming units
CSO	Combined Sewer Overflow
CWA	Clean Water Act, Federal
CWA § 303(d)	Section 303 (d) of the CWA and the implementing regulations at 40 CFR 130.7 require states to identify those waterbodies that are not expected to meet surface water quality standards after the implementation of technology-based controls and to prioritize and schedule them for the development of a total maximum daily load (TMDL).
CZM	Coastal Zone Management
DFW	Division of Fisheries and Wildlife
DMF	Division of Marine Fisheries
DWM	Division of Watershed Management
EEA	Executive Office of Energy and Environmental Affairs, formerly Executive Office of Environmental Affairs (EOEA)
EMC	Event Mean Concentration
EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
GIS	Geographic Information System
GPS	Global Positioning System
IDDE	Illicit Discharge Detection and Elimination System
I/I	Infiltration and Inflow
LA	Load Allocation
LID	Low Impact Development
LTCP	Long Term Control Plan
LWSC	Lynn Water and Sewer Commission
MADPH	Massachusetts Department of Public Health
MassDEP	Massachusetts Department of Environmental Protection
MEP	Maximum Extent Practicable
MEPA	Massachusetts Environmental Policy Act
MG	Million Gallons
MHD	Massachusetts Highway Department
MOS	Margin of Safety
MPN	Most Probable Number
MSD	Marine Sanitary Device
MS4	Municipal Separate Storm Sewer Systems
NDA	No Discharge Area
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
ORW	Outstanding Resource Water
POTW	Publically Owned Treatment Works
RTI	Research Triangle Institute
SBCSO	Waters occasionally subject to short-term impairment of swimming or

	other recreational uses due to untreated CSO discharges in a typical year, and the aquatic life community may suffer adverse impact yet is still generally viable. In these waters, the uses for Class SB waters are maintained after the implementation of long term control measures described in the approved CSO long term control plan.
SFP	Supplemental Facilities Plan (SFP), created to address CSOs
SMCD	Second Modified Consent Decree
SRF	State Revolving Fund
SSO	Sanitary Sewer Overflows
SWMP	Stormwater Management Plan
SWPP	Stormwater Program Plan
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USACOE	United States Army Corps of Engineers
VEMN	Voluntary Environmental Monitoring Network
WLA	Waste Load Allocation
WQA	Water Quality Assessment
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant

1.0 Introduction

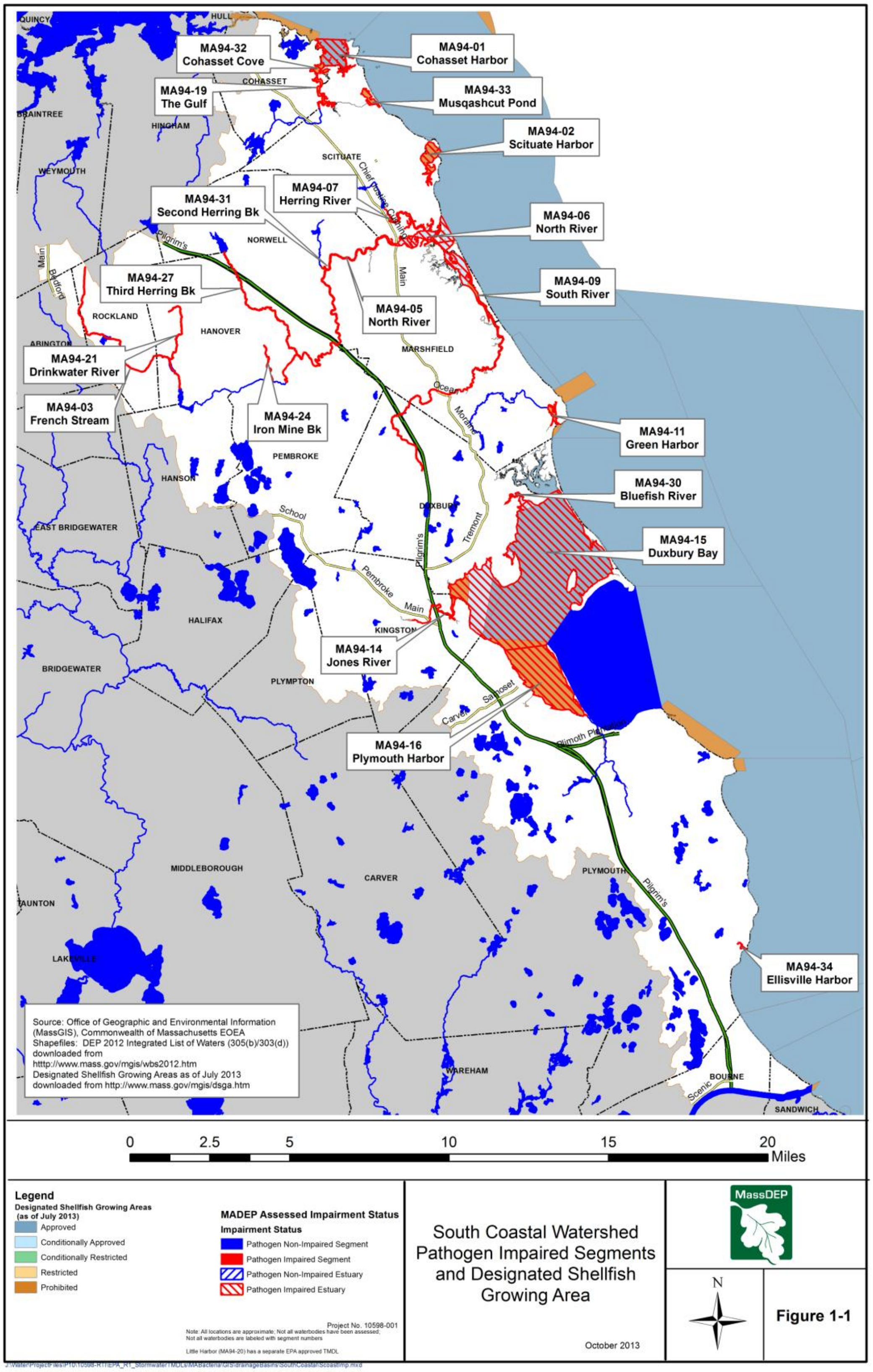
Section 303(d) of the Federal Clean Water Act (CWA) and Environmental Protection Agencies (EPA's) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to place waterbodies that do not meet established water quality standards on a list of impaired waterbodies (commonly referred to as the "303d List") and to develop Total Maximum Daily Loads (TMDLs) for listed waters and the pollutant(s) contributing to the impairment. In Massachusetts, impaired waterbodies are included in Category 5 of the "*Massachusetts Year 2012 Integrated List of Water: Part 2- Final Listing of Individual Categories of Waters*" (MassDEP 2012). Figure 1-1 provides a map of the South Coastal watershed with pathogen impaired segments indicated. As shown in Figure 1-1, 20 South Coastal waterbodies are listed as a Category 5 "impaired or threatened for one or more uses and requiring a TMDL" due to excessive indicator bacteria concentrations.

TMDLs are to be developed for water bodies that are not meeting designated uses under technology-based controls only. TMDLs determine the amount of a pollutant that a waterbody can safely assimilate without violating water quality standards. The TMDL process establishes the maximum allowable loading of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollutant sources and instream conditions. The TMDL process is designed to assist states and watershed stakeholders in the implementation of water quality-based controls specifically targeted to identified sources of pollution in order to restore and maintain the quality of their water resources (USEPA 1999). TMDLs allow watershed stewards to establish measurable water quality goals based on the difference between site-specific instream conditions and state water quality standards.

A major goal of this TMDL is to achieve meaningful environmental results with regard to the restoration of designated uses of the South Coastal waterbodies. These include water supply, shellfish harvesting, fishing, boating, and swimming. This TMDL establishes the necessary pollutant load (as defined by concentration) to achieve designated uses and water quality standards, and the companion document entitled; "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" provides guidance for the implementation of this TMDL. www.epa.gov/region1/eco/tmdl/pdfs/ImplementationGuidanceMA.pdf

Historically, water and sediment quality studies have focused on the control of point sources of pollutants (i.e., discharges from pipes and other structural conveyances) that discharge directly into well-defined hydrologic resources, such as lakes, ponds, or river segments. While this localized approach may be appropriate under certain situations, it typically fails to characterize the more subtle and chronic sources of pollutants that are widely scattered throughout a broad geographic region such as a watershed (e.g., roadway runoff, failing septic systems in high groundwater, areas of concentrated wildfowl use, fertilizers, pesticides, pet waste, and certain agricultural sources). These so called nonpoint sources of pollution often contribute significantly to the decline of water quality through their cumulative impacts. A watershed-level approach that uses the surface drainage area as the basic study unit enables managers to gain a more complete understanding of the potential pollutant sources impacting a waterbody and increases the precision of identifying local problem areas or "hot spots" which may detrimentally affect water and sediment quality. It is within this watershed-level framework that the Massachusetts Department of Environmental Protection (MassDEP) commissioned the development of watershed based TMDLs.

Figure 1-1. South Coastal Watershed and Pathogen Impaired Segments (MassDEP 2012).



1.1. Pathogens and Indicator Bacteria

The South Coastal 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 and the feces of warm-blooded wildlife. 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.

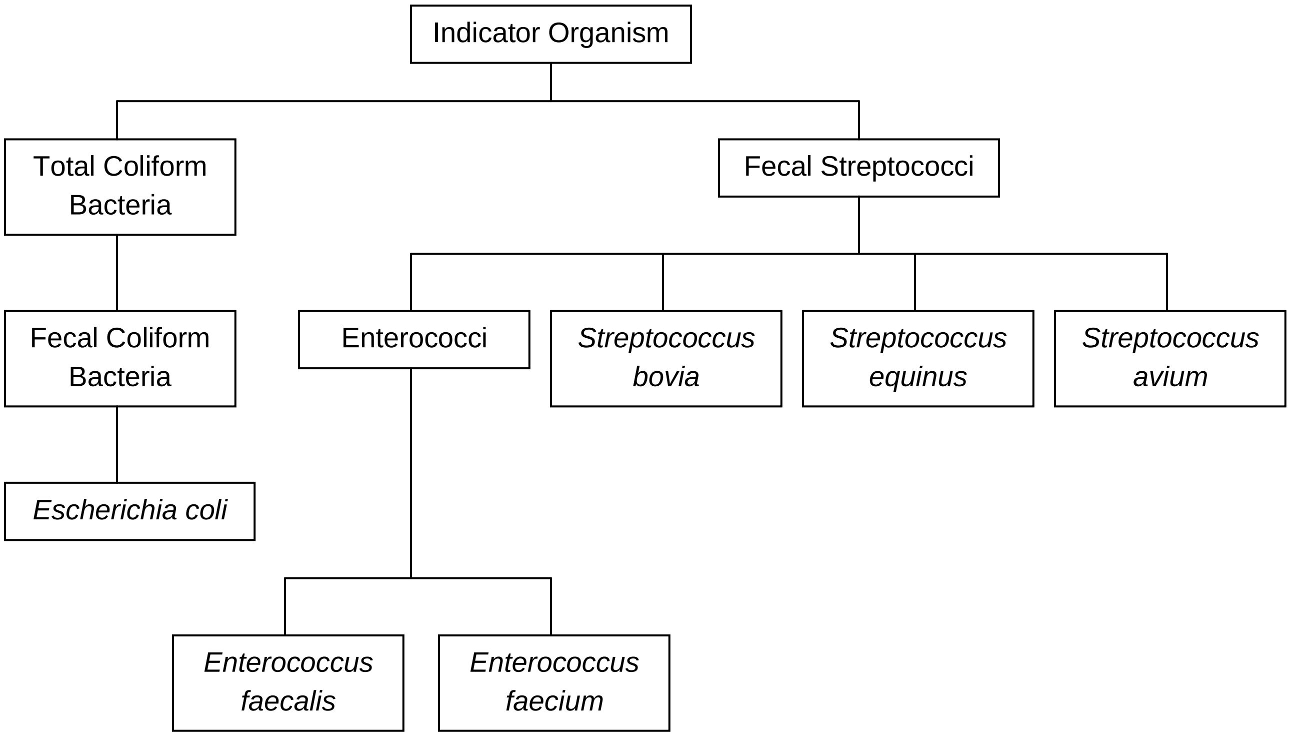
Waterborne pathogens include a broad range of bacteria and viruses that are difficult to identify and isolate. Thus, specific nonpathogenic bacteria have been identified that are typically associated with harmful pathogens in fecal contamination. These associated nonpathogenic bacteria are used as indicator bacteria as they are easier to identify and measure in the environment. High densities of indicator bacteria increase the likelihood of the presence of pathogenic organisms.

Selection of indicator bacteria is difficult as new technologies challenge current methods of detection and the strength of correlation of indicator bacteria and human illness. Currently, coliform and fecal streptococci bacteria are commonly used as indicators of potential pathogens (i.e., indicator bacteria). Coliform bacteria include total coliforms, fecal coliform and *Escherichia coli* (*E. coli*). Fecal coliform (a subset of total coliform) and *E. coli* (a subset of fecal coliform) bacteria are present in the intestinal tracts of warm blooded animals. Presence of coliform bacteria in water indicates fecal contamination and the possible presence of pathogens. Fecal streptococci bacteria are also used as indicator bacteria, specifically enterococci a subgroup of fecal streptococci. These bacteria also live in the intestinal tract of animals, but their presence is a better predictor of human gastrointestinal illness than fecal coliform since the die-off rate of enterococci is much lower (i.e., enterococci bacteria remain in the environment longer) (USEPA 2001). The relationship of indicator organisms is provided in Figure 1-2. The EPA, in the "*Ambient Water Quality Criteria for Bacteria – 1986*" document, recommends the use of *E. coli* or enterococci as potential pathogen indicators in fresh water and enterococci in marine waters (USEPA 1986).

The South Coastal watershed pathogen TMDLs have been developed using fecal coliform as an indicator bacterium for shellfish areas and *Enterococci* for bathing in marine waters and generally *E. coli* for fresh waters. Any future changes in the Massachusetts pathogen water quality standards will apply to this TMDL at the time of the standard change. Massachusetts believes that the magnitude of indicator bacteria loading reductions outlined in this TMDL will be both necessary and sufficient to attain present WQS and any future modifications to the WQS for pathogens.

Consistent with Section 303(d) of the CWA, the MassDEP has chosen to complete pathogen TMDLs for all river and estuary waterbodies in the South Coastal watershed at this time, regardless of current impairment status (i.e., for all waterbody categories in the *2012 Integrated List*). MassDEP believes a comprehensive management approach carried out by all watershed communities is needed to address the ubiquitous nature of pathogen sources present in the South Coastal watershed. Watershed-wide implementation is needed to meet WQS and restore designated uses in impaired segments while providing protection of desirable water quality in waters that are not currently impaired or not assessed.

Figure 1-2. Relationships among Indicator Organisms (USEPA 2001).



1.2. Comprehensive Watershed-based Approach to TMDL Development

As discussed below, this TMDL applies to the 20 pathogen impaired segments of the South Coastal watershed that are currently listed on the CWA § 303(d) list of impaired waters. MassDEP recommends however, 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).

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. The waste load and/or load allocation for each source and designated use would be the same as specified herein. Therefore, the pollution prevention TMDLs would have identical waste load and load allocations based on the sources present and the designated use of the water body segment (see Table ES-2 and Table 7-1).

This South Coastal watershed TMDL may, in appropriate circumstances, also apply to segments that are listed for pathogen impairment in subsequent Massachusetts CWA § 303(d) Integrated List of Waters. For such segments, 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, the Commonwealth determines with EPA approval of the CWA § 303(d) list that this TMDL should apply to future pathogen impaired segments.

There are 115 waterbody segments assessed by the MassDEP in the South Coastal watershed (Mass GIS, 2005; MassDEP 2006). These segments include 18 estuary segments, 17 river segments, and 80 lake or pond segments. Sixteen of the 18 estuary segments, and four of the 17 river segments are pathogen impaired and appear as such on the official list of impaired watershed 2012 Integrated (303(d) List) (Figure 1-1). A pathogen TMDL has been previously prepared and approved for the Little Harbor (MA94-20) estuary segment located in Cohasset (MassDEP, 2002). Pathogen impairment has been documented by the MassDEP in previous reports (e.g., *2012 Integrated List*). In this TMDL document, an overview of pathogen impairment is provided to illustrate the nature and extent of the pathogen impairment problem. Data collected by entities external to MassDEP are provided in this TMDL to help guide implementation efforts. Since pathogen impairment has been previously established only a summary of the results for external sources of data are provided herein.

The watershed based approach applied to complete the South Coastal watershed pathogen TMDL is straightforward. The approach is focused on identification of sources, source reduction, and implementation of appropriate management plans. Once identified, sources are required to meet applicable WQS for indicator bacteria or be eliminated. This approach does not include water quality analysis or other approaches designed to link ambient concentrations with source loadings. For pathogens and indicator bacteria, water quality analyses are generally resource intensive and provide results with large degrees of uncertainty. Rather, this approach focuses on sources and required load reductions, proceeding efficiently toward water quality restoration activities.

The implementation strategy for reducing indicator bacteria is an iterative process where data are gathered on an ongoing basis, sources are identified and eliminated if possible, and control measures including Best Management Practices (BMPs) are implemented, assessed and modified as needed. Measures to abate probable sources of waterborne pathogens include everything from public education, to improved storm water management, to reducing the influence from inadequate and/or failing sanitary sewer infrastructure.

1.3. TMDL Report Format

This document contains the following sections:

- Watershed Description (Section 2) - provides watershed specific information
- Water Quality Standards (Section 3) – provides a summary of current Massachusetts WQS as they relate to indicator bacteria
- Problem Assessment (Section 4) – provides an overview of indicator bacteria measurements collected in the South Coastal watershed
- Identification of Sources (Section 5) – identifies and discusses potential sources of waterborne pathogens within the South Coastal watershed
- Prioritization and Known Sources (Section 6) – identifies and discusses specific sources of waterborne pathogens and assigns pollution priorities to specific segments.
- TMDL Development (Section 7) – specifies required TMDL development components including:
    - Definitions and Equation
    - Loading Capacity
    - Load and Waste Load Allocations
    - Margin of Safety
    - Seasonal Variability

- Implementation Plan (Section 8) – describes specific implementation activities designed to remove pathogen impairment. This section and the companion "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" document should be used together to support implementing management actions.
- Monitoring Plan (Section 9) – describes recommended monitoring activities
- Reasonable Assurances (Section 10) – describes reasonable assurances the TMDL will be implemented
- Public Participation (Section 11) – describes the public participation process, and
- References (Section 12)

2.0 Watershed Description

The South Coastal watershed drains approximately 240.7 square miles of the Massachusetts' southshore. All or parts of 19 Commonwealth communities are within the South Coastal Drainage area (EOEA 2003a). The drainage boundary extends from Cohasset to Sandwich including all or part of the following communities: Cohasset, Scituate, Norwell, Hingham, Rockland, Weymouth, Hanover, Abington, Hanson, Pembroke, Duxbury, Marshfield, Kingston, Plymouth, Bourne, Sandwich, Halifax, Plympton and Whitman. The watershed is made up of several river systems, North River, South River, Jones River, Eel River, and Gulf/Bound Brook (EOEA 2003a). "The South Coastal Watersheds contain numerous wetlands, many of which are used to cultivate cranberries. There are also many small coastal plain lakes and ponds scattered throughout the basin, numbering more than 350, 56 of which cover at least ten acres." (EOEA 2003a).

The South Coastal watershed contains extensive areas of open space, rural towns, and highly urbanized communities (Table 2-1; Figure 2-1). Surface waters in the watershed are commonly used for primary and secondary contact recreation (swimming and boating), public drinking water, viewing wildlife, habitat for aquatic life, lobstering, fishing, shellfishing and beachfront. Locations of public and semi-public marine beaches are illustrated on Figure 2-2. Detailed information regarding water quality at swimming beaches (both fresh and marine waters) can be obtained from the beach quality annual reports available for download at the Massachusetts Department of Public Health website: mass.digitalhealthdepartment.com/public_21/index.cfm

It should be noted that all the waterbodies are influenced by seasonal variations in flow and temperature and the tidal cycles in the estuaries. All these variations will directly impact the extent to which these waterbodies are impaired.

Table 2-1. South Coastal Watershed Land Use as of 1999.

Land Use Category	**% of Total Watershed Area**
Pasture	0.7
Urban Open	1.3
Open Land	2.6
Cropland	0.8
Woody Perennial	2.2
Forest	48.5
Wetland/Salt Wetland	5.4
Water Based Recreation	0.3
Water	3.5
General Undeveloped Land	65.5
Spectator Recreation	<0.1
Participation Recreation	1.5
> 1/2 acre lots Residential	15.3
1/4 - 1/2 acre lots Residential	10.8
< 1/4 acre lots Residential	1.8
Multi-family Residential	0.5
Mining	0.7
Commercial	1.6

Land Use Category	% of Total Watershed Area
Industrial	0.8
Transportation	1.3
Waste Disposal	0.1
General Developed Land	34.5

Figure 2-1. South Coastal Watershed Land Use as of 1999.

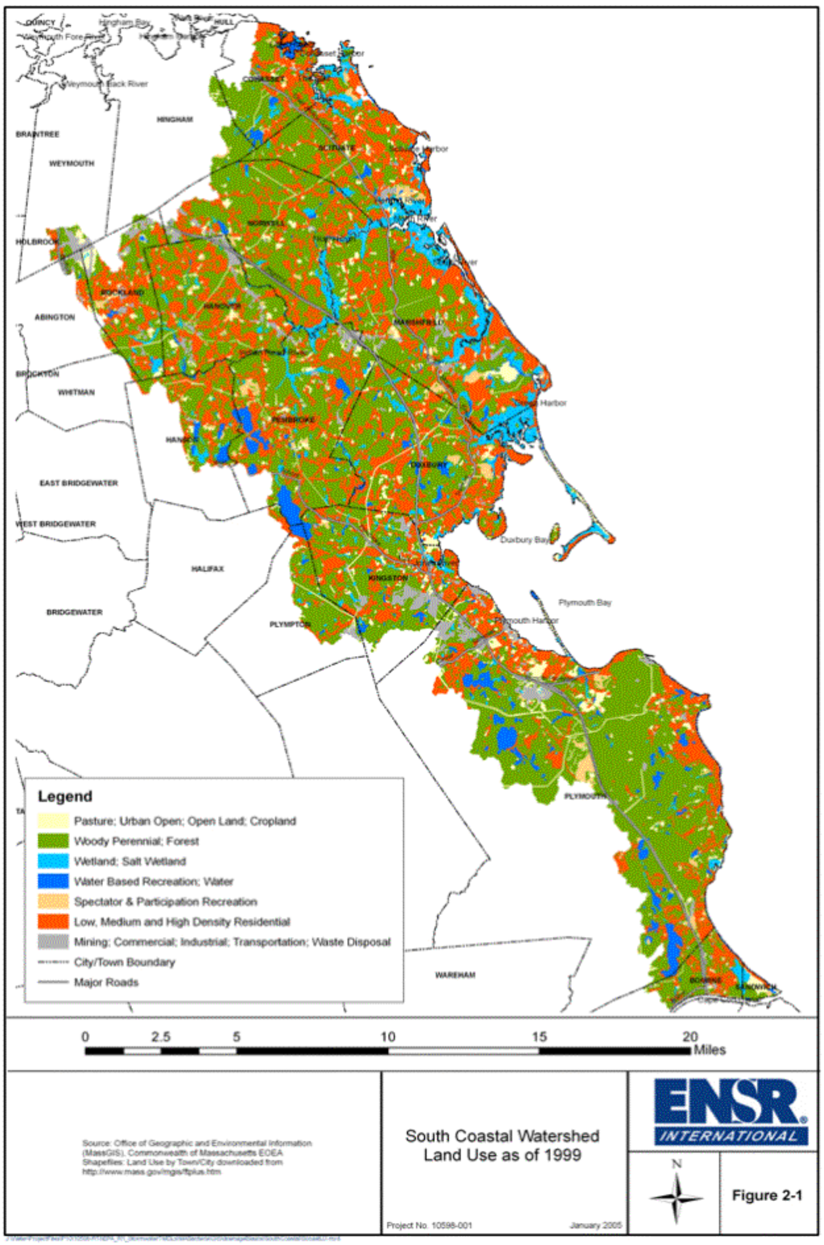


Figure 2-2. South Coastal Watershed Marine Beach Locations and Pathogen Impaired Segments.

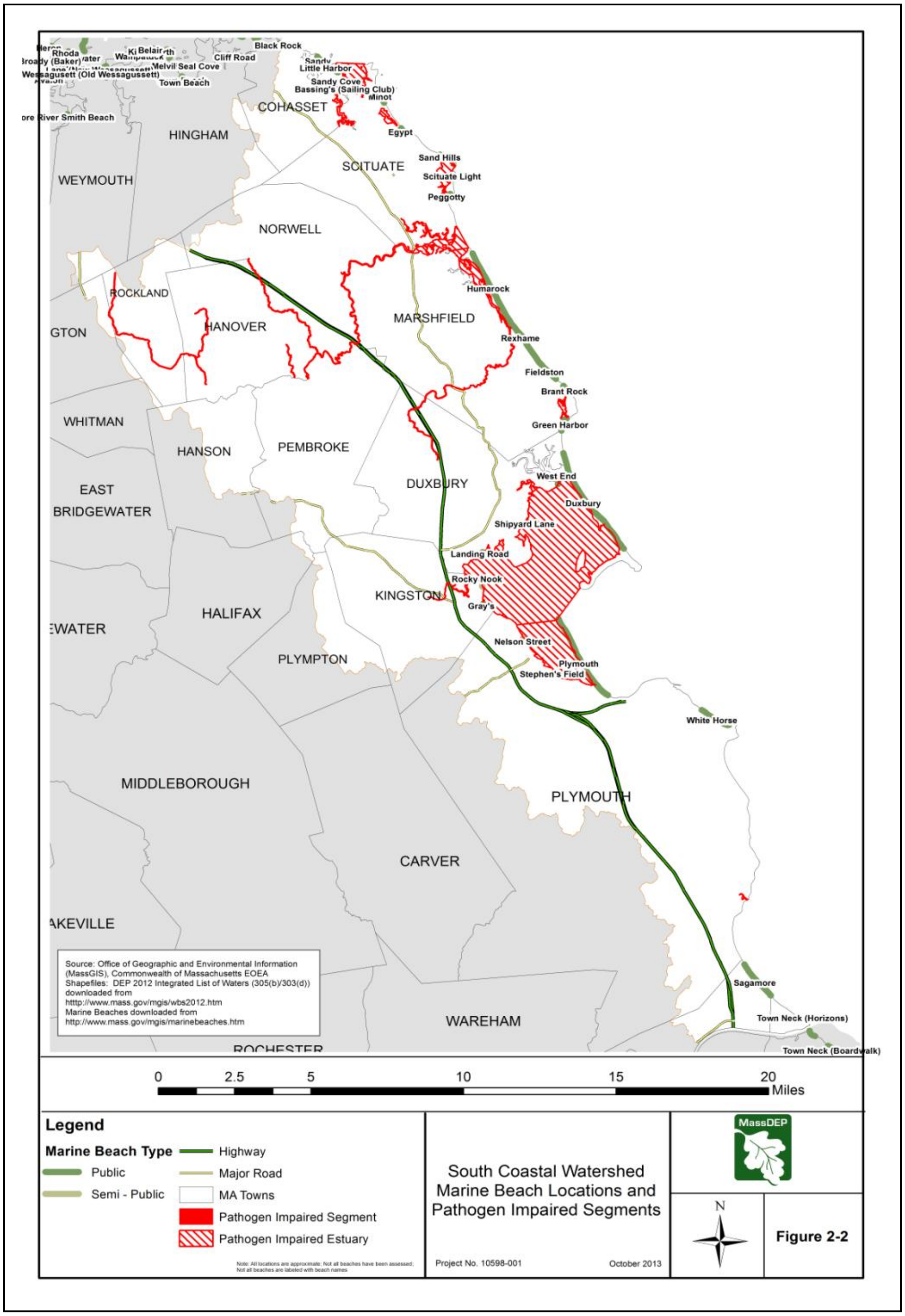
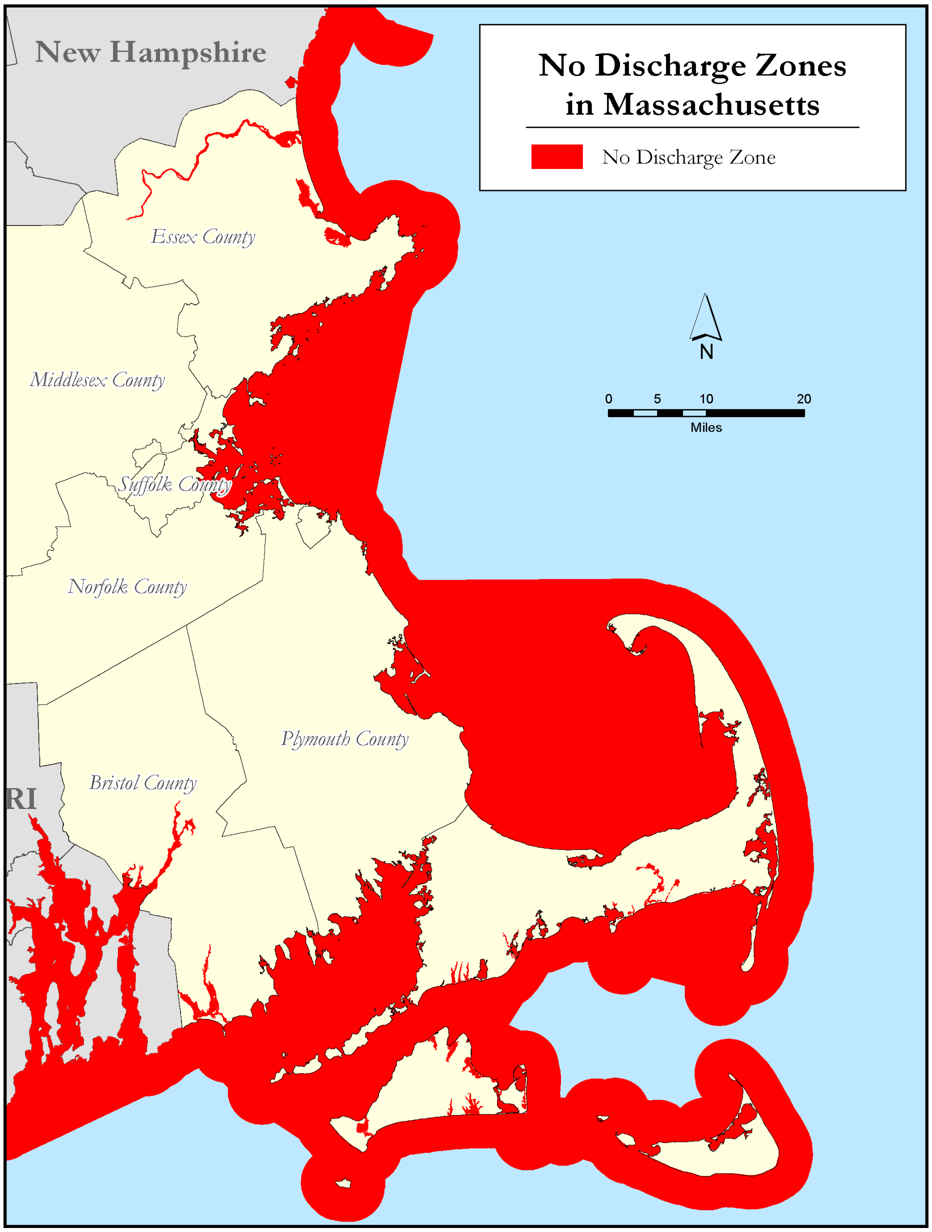


Figure 2-3. No discharge Zones in Massachusetts .



3.0 Water Quality Standards

The Surface Water Quality Standards (WQS) for the Commonwealth of Massachusetts establish chemical, physical, and biological standards for the restoration and maintenance of the most sensitive uses (MassDEP 2000b). The WQS limit the discharge of pollutants to surface waters for the protection of existing uses and attainment of designated uses in downstream and adjacent segments.

The South Coastal Watershed contains waterbodies classified as Class B, SA, and SB. According the Mass Water Quality Standards these waters should be suitable for the following uses: (1) habitat for fish, other aquatic life, wildlife, (2) primary and secondary contact recreation, (3) shellfish harvesting in approved areas , and (4) should have consistently good aesthetic value (SA should be excellent). The pathogen impairments (exceedences of Fecal coliform, enterococci, and *E. coli* bacteria criteria) associated with the waterbody's of interest in this report affect primary contact recreation and shellfishing uses. In addition there are no combined sewer overflows (CSO) receiving waters in the South Coastal watershed. Because the WQS were in transition during the development of statewide pathogen TMDLs, and were formally changed after the draft reports were produced, the new bacteria indicator standards are presented in Table ES-1, and 7-1, and can be accessed at the following web address link: www.mass.gov/eea/agencies/massdep/water/regulations/314-cmr-4-00-mass-surface-water-quality-standards.html

Fecal coliform, *Enterococci*, and *E. coli* bacteria are found in the intestinal tract of warm-blooded animals, soil, water, and certain food and wood processing wastes. "Although they are generally not harmful themselves, they indicate the possible presence of pathogenic (disease-causing) bacteria, viruses, and protozoans that also live in human and animal digestive systems" (USEPA 2004a). These bacteria are often used as indicator bacteria since it is expensive and sometimes difficult to test for the presence of individual pathogenic organisms.

Massachusetts has revised its freshwater WQS in 2007 by replacing fecal coliform with *E. coli* and *Enterococci* as the regulated indicator bacteria in freshwater systems, as recommended by the EPA in the "Ambient Water Quality Criteria for Bacteria – 1986" document (USEPA 1986). The state had previously done so for public beaches through regulations of the Massachusetts Department of Public Health as discussed below. Up until January of 2007 Massachusetts used fecal coliform as the indicator organism for all waters except for marine bathing beaches, where the Federal BEACH Act requires the use of *Enterococci*. Massachusetts adopted *E. coli* and *Enterococci* for all fresh waters and Enterococci for all marine waters, including non-bathing marine beaches. Fecal coliform will remain the indicator organism for shellfishing areas, however.

Pathogens can significantly impact humans through ingestion of, and contact with recreational waters, ingestion of drinking water, and consumption of filter-feeding shellfish. In addition to contact recreation, excessive pathogen numbers impact potable water supplies. The amount of treatment (i.e., disinfection) required to produce potable water increases with increased pathogen contamination. Such treatment may cause the generation of disinfection by-products that are also harmful to humans. Further detail on pathogen impacts can be accessed at the following EPA websites:

> Water Quality Criteria: Microbial (Pathogen)
> http://www.epa.gov/waterscience/criteria/humanhealth/microbial/index.html#advisories
> Human Health Advisories: Fish and Wildlife Consumption Advisories
> http://www.epa.gov/waterscience/fish/
> Swimming Advisories:
> http://www.epa.gov/waterscience/beaches/seasons/

The South Coastal watershed contains waterbodies classified as Class B, Class SA, and Class SB. The standards that apply to these classifications are presented in Table 7-1, and at the web address link: www.mass.gov/eea/agencies/massdep/water/regulations/314-cmr-4-00-mass-surface-water-quality-standards.html.

Commercial shellfishing growing areas are classified by the Massachusetts Division of Marine Fisheries (DMF). The classification system is provided below (MassGIS 2005). Figure 1-1 provides designated shellfish growing areas status as of July 2013.

Approved – "Open for harvest of shellfish for direct human consumption subject to local rules and state regulations." (MassGIS 2005) "The area is shown to be free of bacterial contaminants under a variety of climatological and hydrographical situations (i.e. assumed adverse pollution conditions)." (MassDEP 2002a).

Conditionally Approved – "During the time area is approved it is open for harvest of shellfish for direct human consumption subject to local rules and state regulations." (MassGIS 2005) "This classification category may be assigned for growing areas subject to intermittent and predictable microbiological contamination that may be present due to operation of a sewage treatment plant, rainfall, and/or season." (MassDEP 2002a).

Restricted – "Open for harvest of shellfish with depuration subject to local rules and state regulations or for the relay of shellfishing" (MassGIS 2005) "A classification used to identify where harvesting shall be by special license and the shellstock, following harvest, is subject to a suitable and effective treatment process through relaying or depuration. Restricted growing areas are mildly or moderately contaminated only with bacteria." (MassDEP 2002a).

Conditionally Restricted – "During the time area is restricted it is only open for the harvest of shellfish with depuration subject to local rules and state regulations." (MassGIS 2005) "A classification used to identify a growing area that meets the criteria for the restricted classification except under certain conditions described in a management plan." (MassDEP 2002a).

Management Closure – "Closed for the harvest of shellfishing Not enough testing has been done in the area to determine whether it is fit for shellfish harvest or not." (MassDEP 2002a)

Prohibited – "Closed for harvest of shellfishing" (MassGIS 2005) "A classification used to identify a growing area where the harvest of shellstock is not permitted. Growing areas must also be classified as Prohibited if there is no or insufficient information available to make a classification decision." (MassDEP 2002a) or if conditions such as poor habitat or marina's preclude the use.

In general, shellfish harvesting use is supported (i.e., non-impaired) when shellfish harvested from approved open shellfish areas are suitable for consumption without depuration and shellfish harvested from restricted shellfish areas are suitable for consumption with depuration. For an expanded discussion on the relationship between the DMF shellfish growing areas classification and the MassDEP designated use support status, please see any of the completed MassDEP Water Quality Assessment Reports available on the worldwide web (for example the "*South Shore Coastal Watershed 2001 Water Quality Assessment Report*" available at: www.mass.gov/dep/water/resources/wqassess.htm.

In addition to the WQS, the Commonwealth of Massachusetts Department of Public Health (MADPH) has established minimum standards for bathing beaches (105 CMR 445.000) under the State Sanitary Code, Chapter VII (www.mass.gov/Eeohhs2/docs/dph/regs/105cmr445.pdf). These standards have been adopted by the MassDEP as state surface WQS for fresh water and will apply to this TMDL. The MADPH bathing beach standards are generally the same as those which were recommended in the USEPA's "Ambient Water Quality Criteria for Bacteria – 1986" (USEPA 1986). The USEPA recommended the use of Enterococci as the indicator bacterium for marine recreational waters and Enterococci or *E. coli* for fresh waters. As such, the following MADPH standards have been established for bathing beaches in Massachusetts:

Marine Waters - No single Enterococci sample shall exceed 104 colonies per 100 mL and the geometric mean of the most recent five Enterococci levels within the same bathing season shall not exceed 35 colonies per 100 mL.
Freshwaters - No single *E. coli* sample shall exceed 235 colonies per 100 mL and the geometric mean of the most recent five *E. coli* samples within the same bathing season shall not exceed 126 colonies per 100 mL; or (2) No single Enterococci sample shall exceed 61 colonies per 100 mL and the geometric mean of the most recent five Enterococci samples within the same bathing season shall not exceed 33 colonies per 100 mL.

The Federal BEACH Act of 2000 established a Federal standard for marine beaches. These standards are essentially the same as the MADPH marine beach standard. The Federal BEACH Act and MADPH standards can be accessed at:
www.epa.gov/waterscience/beaches/rules/act.html, and
http://www.mass.gov/eohhs/docs/dph/regs/105cmr445.pdf, respectively.

Figure 2-2 provides the location of marine bathing beaches, where the MADPH Marine Waters and the Federal BEACH Act standards would apply. A map of freshwater beaches is not available at this time. However, a list of beaches (fresh and marine) by community with indicator bacteria data can be found in the annual reports on the testing of public and semi-public beaches provided by the MADPH. These reports are available for download from the MADPH website located at : www.mass.gov/eohhs/docs/dph/environmental/exposure/beach-reports/

4.0 Problem Assessment

Pathogen impairment has been documented at numerous locations throughout the South Coastal watershed, as shown in Figure 1-1. Excessive concentrations of indicator bacteria (e.g., fecal coliform, enterococci, E. coli etc.) can indicate the presence of sewage contamination and possible presence of pathogenic organisms. The amount of indicator bacteria and potential pathogens entering waterbodies is dependent on several factors including watershed characteristics and meteorological conditions. Indicator bacteria levels generally increase with increasing development activities, including increased impervious cover, illicit sewer connections, and failed septic systems.

Indicator bacteria levels also tend to increase with wet weather conditions as storm sewer systems overflow and/or storm water runoff carries fecal matter that has accumulated to the river via overland flow and storm water conduits. In some cases, dry weather bacteria concentrations can be higher when there is a constant source that becomes diluted during periods of precipitation, such as with illicit connections. The magnitude of these relationships is variable, however, and can be substantially different temporally and spatially throughout the United States or within each watershed.

Tables 4-1 and 4-2 provide ranges of fecal coliform concentrations in storm water associated with various land use types. Pristine areas are observed to have low indicator bacteria levels and residential areas are observed to have elevated indicator bacteria levels. Development activity generally leads to decreased water quality (e.g., pathogen impairment) in a watershed. Development-related watershed modification includes increased impervious surface area which can (USEPA 1997):

- increase flow volume,
- increase peak flow,
- increase peak flow duration,
- increase stream temperature,
- decrease base flow, and
- change sediment loading rates.

Many of the impacts associated with increased impervious surface area also result in changes in pathogen loading (e.g., increased sediment loading can result in increased pathogen loading). In addition to increased impervious surface impacts, increased human and pet densities in developed areas increase potential fecal contamination. Furthermore, storm water drainage systems and associated storm water culverts and outfall pipes often result in the channelization of streams which leads to less attenuation of pathogen pollution.

Table 4-1. Wachusett Reservoir Storm Water Sampling (as reported in MassDEP 2002b) original data provided in MDC Wachusett Storm Water Study (June 1997).

Land Use Category	Fecal Coliform Bacteria[1] (CFU / 100 mL)
Agriculture, Storm 1	110 - 21,200
Agriculture, Storm 2	200 - 56,400

“Pristine” (not developed, forest), Storm 1	0 - 51
“Pristine” (not developed, forest), Storm 2	8 - 766
High Density Residential (not sewered, on septic systems), Storm 1	30 - 29,600
High Density Residential (not sewered, on septic systems), Storm 2	430 - 122,000

1 Grab samples collected for four storms between September 15, 1999 and June 7, 2000

Table 4-2. Lower Charles River Basin Storm Water Event Mean Bacteria Concentrations (data summarized from USGS 2002)[1.]

Land Use Category	Fecal Coliform (CFU/100 mL)	Enterococcus Bacteria (CFU/100 mL)	Number of Events
Single Family Residential	2,800 – 94,000	5,500 – 87,000	8
Multifamily Residential	2,200 – 31,000	3,200 – 49,000	8
Commercial	680 – 28,000	2,100 – 35,000	8

[1] An Event Mean Concentration (EMC) is the concentration of a flow proportioned sample throughout a storm event. These samples are commonly collected using an automated sampler which can proportion sample aliquots based on flow.

Pathogen impaired estuary segments represent 64% of the total estuary area assessed, (18.4 impaired square miles; 28.9 total square miles assessed, which includes the area associated with one estuary with an existing pathogen TMDL). Pathogen impaired river segments represents 32% of the total river miles assessed (16.3 impaired miles; 51 total miles assessed). Pathogen impaired lakes- ponds (not covered in this TMDL) represent 1% of the total acreage assessed (15.9 impaired acres; 1660 acres assessed). In total, 20 river and estuary segments covered in this report, each in need of a TMDL, contain indicator bacteria concentrations in excess of the Massachusetts WQS for Class A, SA, B, or SB waterbodies ((314 CMR 4.05) and/or the BEACH Act). The basis for impairment listings is provided in the 2012 Integrated List (MassDEP 2012). Data collected by the MassDEP were used to generate the 2012 List. A list of pathogen impaired segments requiring TMDLs is provided in Table 4-3. This TMDL does not, however, apply to Little Harbor (MA94-20) in Cohasset, as a pathogen TMDL for this segment has been previously developed.

An overview of the South Coastal watershed pathogen impairments is provided in this section to illustrate the nature and extent of the impairment. Since pathogen impairment has been previously established and documented on the 2012 Integrated List, it is not necessary to provide detailed documentation of pathogen impairment herein. Data from the North and South Rivers Watershed Association (NSRWA) and MassDEP were reviewed and are summarized by segment below for illustrative purposes.

Table 4-3. South Coastal Watershed Pathogen Impaired Segments Requiring TMDLs (MassDEP 2012).

Segment ID	Segment Name	Segment Type	Size1	Segment Description
MA94-32	Cohasset Cove	Estuary	0.09	The waters south of a line drawn from the Bassing Beach jetty, Scituate westerly to the opposite shore, Cohasset not including Cohasset Cove, Cohasset/Scituate
MA94-01	Cohasset Harbor	Estuary	0.70	South of a line drawn from the northwest point of Scituate Neck, Scituate to just north of Quarry Point, Cohasset – not including Cohasset Cove
MA94-19	The Gulf	Estuary	0.13	Headwaters, outlet Hunter's Pond, Scituate to confluence with Cohasset Cove just north of Border Street, Cohasset.
MA94-33	Musquashcut Pond	Estuary	0.11	Scituate (formerly reported as MA94105)
MA94-02	Scituate Harbor	Estuary	0.32	West of line drawn across the mouth of Scituate Harbor, from the elbow of the jetty southeast off Lighthouse Point to the jetty northeast of the US Coast Guard station, Scituate
MA94-34	Ellisville Harbor	Estuary	0.01	Plymouth
MA94-03	French Stream	River	6.1	Headwaters on southeast side of Naval Air Station, Rockland through Studleys Pond to confluence with Drinkwater River, Hanover. Miles 5.9-0.0
MA94-24	Iron Mine Brook	River	1.4	Headwaters, north of Route 139, Hanover to the confluence with Indian Head River, Hanover.
MA94-31	Second Herring Brook	Estuary	0.003	From the Second Herring Brook Pond Dam, Norwell to the confluence with the North River, Norwell.
MA94-27	Third Herring Brook	River	5.3	Headwaters, outlet of Jacobs Pond, Norwell/Hanover to confluence with North River, Norwell/Hanover.
MA94-21	Drinkwater River	River	3.5	From Whiting Street, Hanover through Forge Pond to the inlet of Factory Pond, Hanover.
MA94-05	North River	Estuary	0.3	Confluence of Indian Head River and Herring Brook, Hanover/Pembroke to Route 3A (Main Street), Marshfield/Scituate.
MA94-07	Herring River	Estuary	0.08	Outlet Old Oaken Bucket Pond to confluence with North River.
MA94-09	South River	Estuary	0.63	Main Street, Marshfield to confluence with North River.
MA94-06	North River	Estuary	0.56	Route 3A (Main Street), Marshfield/Scituate to mouth at Massachusetts Bay, Scituate.
MA94-14	Jones River	Estuary	0.09	Elm Street, Kingston to mouth at Duxbury Bay, Kingston.
MA94-11	Green Harbor	Estuary	0.08	From the tidal gates at Route 139, Marshfield, to the mouth of the Harbor at MA Bay/Cape Cod Bay, Marshfield
MA94-15	Duxbury Bay	Estuary	12.7	North and west of a line drawn from Saquish Head to the tip of Plymouth Beach to High Cliff, Plymouth – excluding Back River and Bluefish River, Duxbury and Jones River, Kingston
MA94-16	Plymouth Harbor	Estuary	2.53	South of a line drawn from the tip of Plymouth Beach to High Cliff, Plymouth
MA94-30	Bluefish River	Estuary	0.07	Saltmarsh north of Harrison Street, Duxbury to mouth at Duxbury Bay, Duxbury

1 Units = Miles for river segments, square miles for estuaries, and acres for ponds

This TMDL is based on the current WQS using fecal coliform for shellfish areas, and E. coli for fresh and enterococcus for either salt or fresh water bathing respectively, as the indicator organisms. Enterococci data are provided at the bottom of each table when data are available. The MassDEP has incorporated E. coli and enterococci as indicator organisms for all waters other than shellfishing and potable water intake areas. Not all data presented herein were used to determine impairment listing, due to a variety of reasons (including data quality assurance and quality control). The MassDEP used only a subset of the available data to generate the 2012 Integrated List. Other data presented in this section are for illustrative purposes only. A pathogen TMDL has been completed for Little Harbor (MA94-20) in Cohasset.The Little Harbor TMDL is available online at: www.mass.gov/dep/water/resources/tmdls.htm.

Data from the Massachusetts Division of Marine Fisheries (DMF) were used, in part, as the basis for pathogen impairment for many of the estuarine areas (Figure 1-1). Numerous samples have been collected throughout the South Coastal watershed by the DMF. DMF has a well-established and effective shellfish monitoring program that provides quality assured data for each shellfish growing area. In addition, each growing area must have a complete sanitary survey every 12 years, a triennial evaluation every three years, and an annual review in order to maintain a shellfishing harvesting classification, with the exception of those areas already classified as Prohibited. The National Shellfish Sanitation Program establishes minimum requirements for sanitary surveys, triennial evaluations, annual reviews, and annual fecal coliform water quality monitoring, and includes identification of specific sources and assessment of effectiveness of controls and attainment of standards. "Each year water samples are collected by the DMF at 2,320 stations in 294 growing areas in Massachusetts's coastal waters at a minimum frequency of five times while open to harvesting." (MA DMF 2002). Due to the volume of data collected by the DMF, only limited DMF data are provided herein. To obtain current indicator bacteria sampling data, please contact your local city or town shellfish constable or DMF's Shellfish Project.

Water quality data collected by the North and South Rivers Watershed Association (NSRWA) has been reported to supplement the data collected by the department. Data summarized in the following subsections can be found at: http://www.nsrwa.org/programs/river_watch_monitoring.asp.
Sampling results for each year are presented in separate tables. Results are presented by location and date. Sample results exceeding the threshold for the Massachusetts threshold for swimming are presented in bold. The rainfall for the last 48 hours before the sampling is also indicated in each table in the last column.

The MADPH publishes annual reports on the testing of public and semi-public beaches for both marine and fresh waters. These documents provide water quality data for each bathing beach by community and note if there were exceedances of water quality criteria. There is also a list of communities that did not report testing results. These reports are available for download from the MADPH website either at mass.digitalhealthdepartment.com/public_21/index.cfm for marine beaches or for both marine and freshwater beaches: www.mass.gov/.../exposure/beach-reports/beach-annual-report12.pdf

Data collected by the MassDEP as part of the DWM MassDEP South Shore Coastal Watersheds 2001 Water Quality Assessment Report (MassDEP 2006), Year 2001 Water Quality Monitoring Data Technical Memorandum TM-94-1 (MassDEP 2005b), and 2006 DWM MassDEP monitoring data (MassDEP 2012) are provided along with data collected by the NSRWA data in the following section.

Cohasset Cove Segment MA94-32
This segment is a 0.09 square mile Class SA waterbody. This segment includes waters south of a line drawn from the Bassing Beach jetty, Scituate westerly to the opposite shore, Cohasset, not including Cohasset Cove, Cohasset/Scituate.

With respect to NPDES discharges, The Town of Cohasset is authorized (MA0100285 issued in October 2000) to discharge from the Cohasset Wastewater Treatment Plant (WWTP) a flow of 0.3 MGD (average monthly) of treated municipal wastewater via Outfall #001 to Cohasset Cove. This facility was upgraded in 2000 with a Zenon® Membrane Filtration process (Nye, 2005). The communities of Cohasset (MAR041032), and Scituate (MAR041060) are regulated under MS4 in the NPDES Program (MassDEP 2006). The DMF Shellfish Status Report of July 2000 indicates that Area MB10.1 (which contains this entire segment) is prohibited (MA DMF, 2013).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired presumably due to elevated fecal coliform bacteria. Pollution sources identified by DMF in this closed safety zone area include the Cohasset WWTP discharge. Additionally, the marinas, septic systems, and stormwater runoff are also potential sources.

DMF fecal coliform sampling occurred at two stations (MB10-6, MB10-10) between June 2006 and September 2010. A total 0f 31 samples had a range of 0.9- 62 cfu/100mL, with a geometric mean of 13.6 cfu/100mL (Churchill 2010). A total of 30 samples were gathered at each station during 2011 and 2012. The geometric mean for these 30 samples at Station MB10-6 (prohibited) for the 2 years was 7.4 cfu/100mL, with 20% of the samples > 31 cfu/100mL. The geometric mean for these 30 samples at Station MB10-10 (approved/closed) for the 2 years was 1.3cfu/100mL, with 0% of the samples > the 31 cfu/100mL maximum limit (Churchill, 2013). These results appear to indicate that water quality at these locations is meeting standards. The DMF classification of prohibited to shellfishing is attributed to safety zone area include the Cohasset WWTP discharge and not water quality at the locations sampled.

Weekly testing for Enterococci bacteria during the swimming season was conducted at Station MA 665375 in Cohasset Cove, right near the Bassing Sailing Club mooring area, just off the eastern shore of Cohasset Cove, Cohasset/Scituate. This sampling has been occurring almost weekly, June- August, since 2003 (106 total samples taken). Results have ranged between 2- 3,300 cfu/100mL, with a total of 4 readings > 104 cfu/100mL (MDPH 2010). Recent sampling done between January 2011 and August 2013 involved a total of 18 samples taken, with results ranging between <10- 520 cfu/100mL, with 2 readings exceeding the standards (MDPH, 2013).

The Primary and Secondary Contact Recreational and Aesthetics uses are assessed as support in Cohasset Cove since the beach was open for the majority of the bathing seasons since 2003 and no objectionable conditions have been noted.

Cohasset Harbor Segment MA94-01
This segment is a 0.7 square mile Class SA waterbody. This segment includes waters south of a line drawn from the northwestern point of Scituate Neck, Scituate to just north of Quarry Point, Cohasset not including Cohasset Cove, Cohasset/Scituate. The communities of Cohasset (MAR041032), and Scituate (MAR041060) are regulated under MS4 in the NPDES Program (MassDEP 2006). Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as support for 0.63 mi^2 of this segment, (Growing Area MB10.0), and impaired for 0.07 mi^2 of this segment, (Growing Area MB10.2 and MB10.4), due to potential pollution problems, e.g., in Area MB10.2, DMF identifies a drain pipe from Treat Pond into Sandy Pond which has elevated bacteria (MassDEP, 2006).

The DMF conducted fecal coliform sampling (15 runs) at seven stations in the harbor 2003-2005. At four stations in the support status area (0.63 mi.), the geometric mean averaged 3.9 cfu/100mL. At four stations in the impaired area (0.07 mi.), the geometric mean averaged 8.4 cfu/100mL (Churchill, 2006).

DMF sampling occurred 15 times during each of 2011 and 2012 at two closed shellfish stations, (MB10-5B and MB10-13), with a geometric mean of 3.9 cfu/100mL with 3.3% readings > 31 cfu/100mL at MB10-5B, and a geometric mean of 12.2 cfu/100mL with 26.7% readings > 31 cfu/100mL at MB10-13 (Churchill, 2013).

DMF sampling occurred 15 times during each of 2011 and 2012 at two approved stations (MB10-1, MB10-9), with a geometric mean of 1.7 cfu/100mL with 3.3% readings > 31 cfu/100mL at MB10-5B, and a geometric mean of 2.5 cfu/100mL with 3.3% readings > 31 cfu/100mL at MB10-1 (Churchill, 2013).

The DMF Shellfish Status Report of July 2000 indicates that area MB10.0 is approved (which contains 0.63 mi^2 of this segment), and the following areas totaling 0.07 mi^2 are prohibited: Sandy Cove (Area MB10.2), Whales Cove (Area MB10.4), and the Briggs Harbor system (Areas MB10.3 and MB10.5) (MA DFG 2000), (MA DMF, 2013). Potential pollution sources identified by DMF in Sandy Cove (Area MB10.2) include a pipe draining Treat Pond, which is contributing elevated bacteria. Potential pollution sources to Whales Cove (Area MB10.4) include stormdrains. Unknown sources contribute to the Briggs Harbor system (Churchill 1994 and 2005a).

Weekly testing for Enterococci bacteria during the swimming season was conducted at the Bassing Sailing Club semi-public beach along the southern shore of Cohasset Cove, Cohasset/Scituate. Enterococcus sampling at Station MA 697743, at the beach, has been occurring almost weekly June-August since 2003 (104 total samples taken). Results have ranged between 2- 199 cfu/100mL, with a total of 11 readings > 104 cfu/100mL. Beach closures due to bacteria have included 2 days in both 2005 and 2006, none in 2007, 1 day in both 2008 and 2009, and 5 closure days in 2010 (MDPH 2010). Recent sampling done between January 2011 and August 2013 involved a total of 18 samples taken, with results ranging between <10- 520 cfu/100mL, with 2 readings exceeding the standards (MDPH, 2013).

The Primary and Secondary Contact Recreational and Aesthetics uses are assessed as support in Cohasset Harbor. The beaches were open for the majority of the 2002/2003 bathing seasons and no objectionable aesthetic conditions were noted.

The Gulf MA94-19

This segment is a 0.13 square mile Class SB waterbody. This segment includes the Headwaters, outlet Hunter's Pond, Scituate to confluence with Cohasset Cove just north of Border Street, Cohasset. The communities of Cohasset (MAR041032), and Scituate (MAR041060) are regulated under MS4 in the NPDES Program (MassDEP 2006). Within the Gulf River subwatershed all of the properties in Scituate have on-site sewage disposal systems. In 2001 and 2002, some of the properties in Cohasset near The Gulf were tied into the municipal sewerage system and other properties were scheduled for connection.

The DMF has no official ambient monitoring stations within this segment, and has not been actively sampling in this segment in recent years (MA DMF 2010). The DMF Shellfish Status Report of July 2000 indicates that Area MB10.1 (which contains this entire segment) is prohibited (MA DMF, 2013). Potential pollution sources identified by DMF include septic systems and stormwater runoff. Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired presumably because of elevated fecal coliform bacteria.

Musquashcut Pond MA94-33

This segment is a 0.11 square mile Class SA waterbody. This segment is located in Scituate (formerly reported as MA94105). Because this waterbody is tidally influenced it is treated as an estuary segment for the purposes of this TMDL. The community of Scituate (MAR041060) has is regulated under MS4 in the NPDES Program (MassDEP 2006). The DMF has no official ambient monitoring stations within this segment, and has not been actively monitoring in this segment in recent years (MA DMF 2010). The DMF Shellfish Status Report of July 2000 indicates that Area MB10.1 (which contains this entire segment) is prohibited (MA DMF, 2013). Although no sampling was conducted by DMF in the pond, DMF reports that the river (downstream) has elevated bacteria (Churchill 2005a).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired presumably due to elevated fecal coliform bacteria counts. Suspected sources of bacteria, which are based on best professional judgment, include discharges from municipal separate storm sewer systems, wet weather discharges from non-point sources and failing septic systems. During both the 2001 and the 1996 DWM surveys heavy algae growth covered almost the entire pond (MassDEP 2001 field sheets). The source of impairment is thought to be associated with the flow regulation (tide gate restriction).

The Recreational and Aesthetic uses for Musquashcut Pond are assessed as impaired because of the excessive algal growth likely the result of poor tidal circulation/flushing.

Scituate Harbor Segment MA94-02

This segment is a 0.32 square mile Class SA waterbody. This segment includes waters west of a line across the mouth of Scituate Harbor, from the elbow of the jetty southeast off Lighthouse Point to the jetty northeast of the U.S. Coast Guard station, Scituate. DMF Shellfish Growing Area Status as of July 2000 was Prohibited (Figure 1-1).

With regard to NPDES permitting, Stellwagen Bank National Marine Sanctuary has a reissued permit in 2007, (MA0090531), to discharge from their facility located at 175 Edward Foster Road in Scituate an average daily flow of 230 GPD of treated sanitary wastewater via one outfall to Scituate Harbor (permit was transferred in June 2002 from the US Coast Guard). The facility consists of a simple wastewater treatment process described as a septic tank, sand filtration, and chlorination prior to discharge. The fecal coliform bacteria permit limits are 14 cfu/100mL monthly average, and 28cfu/100mL for maximum daily, with a Total Residual Chloride (TRC) limit of 1.0 mg/L maximum daily. The community of Scituate (MAR041060) is regulated under MS4 in the NPDES Program (MassDEP 2006). Within the Harbor itself, DMF discontinued ambient sampling after 1996 because the shellfish beds inside of the Harbor (MB7.0) had been closed for quite some time (MA DMF 2010), (MA DMF 2013).

The DMF conducted fecal coliform sampling (15 runs) at four stations and three stations in each of two locations just adjacent (outside) the harbor area, 2003-2005: (1) Scituate North Coastal area; (2) Scituate South Coastal area. These areas are both approved for shellfishing. At the four stations in the Scituate North coastal area (2003- 2005), the geometric mean averaged 2.5 cfu/100mL. Follow up sampling (75 samples) occurred during 2011- 2013 at the same four Scituate North stations, with a geometric mean of 0.83 cfu/100mL. At the three stations in the Scituate South Coastal area (2003- 2005) the geometric mean averaged 2.7 cfu/100mL. Follow up sampling (63 samples) occurred during 2011- 2013 at the same Scituate South three stations, with a geometric mean of 0.93 cfu/100mL. These recent results show significant improvement over the earlier period, (Churchill, 2013) and the use will be re-assed by MassDEP in future integrated reporting cycles.

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired presumably because of elevated fecal coliform bacteria. In addition to the point source discharge, potential sources of bacteria include discharges from municipal separate storm sewer systems, marina/boating sanitary on-vessel discharges, failing or inadequate septic systems, and wet weather discharges from non-point sources.

There is one semi-public beach, Scituate Light Beach, along the northeastern shore of Scituate Harbor, Scituate. During the 2012 swimming season, there were twelve Enterococcus bacteria samples taken, with one reading of 650 cfu/100mL (exceeding the standards), with one resulting posting (MDPH, 2013).

Ellisville Harbor Segment MA94-34

This segment is a 0.01 square mile Class SA estuary, located in Plymouth. The community of Plymouth (MAR041150) is regulated under MS4 in the NPDES Program (MassDEP 2006). The DMF Shellfish Status Report of July 2000 indicates that Area CCB40.0 (which contains this entire segment) is prohibited (MA DFG 2000).

Within the Harbor itself, DMF discontinued ambient sampling after 2001 because the shellfish beds inside of the Harbor had been closed up for quite some time (MA DMF 2010, MA DMF 2013). Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired because of elevated fecal coliform bacteria levels, but the source(s) of the bacteria are currently unknown.

Four stations within Ellisville Harbor were proposed for sampling as part of the South Coastal Basin Estuaries Monitoring Project (Howes and Samimy 2004). These sites included: near the head of the Harbor (Station EVH3), upper middle harbor (Station EVH4), lower middle harbor (Station EVH5) and near the mouth of the Harbor (Station EVH6) (Howes and Samimy 2004).

Fecal coliform bacteria samples were collected from the four sites on five occasions between July and September 2003 and again in 2004 (see Table 4-4 below). The fecal coliform bacteria data ranged from <10 to 530 cfu/100 ml (n=40). Ninety percent of the samples were <200 cfu/100 ml. It should be noted that elevated counts were only found at one sampling location (Station EVH4) and only in the summer of 2003 (counts ranged from 160 to 530 cfu/100 ml (Howes and Samimy 2005).

Table 4-4. MA94-34 Ellisville Harbor 2003-4 Howes & Samimy Indicator Bacteria Data Summary.

Stations	Range of Fecal Coliform (Number of Samples)
Head of the Harbor (Station EVH3), upper middle harbor (Station EVH4), lower middle harbor (Station EVH5) and near the mouth of the Harbor (Station EVH6)	<10- 530 (40)

Units = colony forming units per 100 mL (cfu/100 mL)

The Primary and Secondary Contact Recreational uses were assessed as support in Ellisville Harbor based primarily on the low fecal coliform bacteria counts.

French Stream Segment MA94-03

This segment is a 6.1 mile Class B warm water fishery extending from the headwaters on the southeast side of the Weymouth Naval Air Station in Rockland to the confluence with Drinking Water River in

Hanover. This segment includes Studleys Pond. The Town of Rockland is authorized (MA0101923 issued in August 1999) to discharge from the Rockland Wastewater Treatment Plant (WWTP) a flow of 2.5 MGD (average monthly) of treated sanitary and industrial wastewater via Outfall #001 to the French Stream. The Rockland permit for chlorination/dechlorination is year round. The communities of Rockland (MAR041058), and Hanover (MAR041036) are regulated under MS4 in the NPDES Program (MassDEP 2006).

Three locations were sampled along the French River by the MassDEP in 2001. A summary of these data are provided in Table 4-5 below. Higher levels were observed to follow rain events. MassDEP also conducted fecal coliform and E. coli sampling on five occasions between June and October 2006 at Station FS 102, at the Summer Street Crossing, Rockland, and FS 101, 300' downstream from the Rockland WWTP in Rockland. A summary of these data are also provided in Table 4-5 below (MassDEP, 2006).

Table 4-5. MA94-03 French Stream 2001 and 2006 MassDEP Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)	Range of E. coli (Number of Samples)	Range of Enterococcus (Number of Samples)
FS103 – North Avenue crossing, Rockland, 2001	83 – 2000 (4)	88 – 365 (4)	420 – 1750 (3)
FS102 – Summer Street crossing, Rockland, 2001	200 – 920 (4)	180 – 560 (4)	460 – 9000 (3)
FS101 – 300 feet downstream of unnamed tributary (Rockland WWTP discharge canal), 2001	110 – 850 (4)	90 – 440 (4)	1800 – 14000 (3)
FS102 – Summer Street crossing, Rockland, 2006	90- 1,300 (5) Geometric Mean= 455	45- 860 (5) Geometric Mean =289	Not sampled for in 2006
FS101 – 300 feet downstream of unnamed tributary (Rockland WWTP discharge canal), 2006	130- 1,600 (4) Geometric Mean= 755	50- 1,200 (4) Geometric Mean =358	Not sampled for in 2006

Units = colony forming units per 100 mL (cfu/100 mL)
Duplicate samples have been averaged and reported as a single sample

Iron Mine Brook Segment MA94-24

This segment is a 1.4 mile long Class B Outstanding Resource Water (ORW) that begins its headwaters north of Route 139, Hanover and flows to the confluence with Indian Head River, Hanover. Broadway Water Treatment Plant in Hanover holds a NPDES permit (MAG640063) to discharge supernatant from their water treatment facility to wetlands and then to Iron Mine Brook. Backwash is typically discharged to a receiving basin and the supernatant discharged to the ground. The community of Hanover (MAR041036) is regulated under MS4 in the NPDES Program (MassDEP 2006).

One location was sampled by DEP/DWM during the primary contact recreational season (1 April to 15 October) along the Iron Mine Brook (Broadway Road) by the MassDEP in 2001. MassDEP also conducted fecal coliform and E coli bacteria sampling on five occasions between June and October 2006 at Station IM 101, at Broadway Road in Hanover. A summary of these data are provided in Table 4-6 below.

Table 4-6. MA94-24 Iron Mine Brook (Mass DEP 2001, 2006) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)	Range of E coli (Number of Samples)
Broadway Road, Hanover (Station IM101), 2001	280 – 540 (3)	Not sampled for in 2001
Broadway Road, Hanover (Station IM 101), 2006	20- 760 (5) Geometric Mean =244	5- 410 (5) Geometric Mean =113

Units = colony forming units per 100 mL (cfu/100 mL)

The Primary Contact Recreational Use for Iron Mine Brook is assessed as impaired because of elevated fecal coliform bacteria counts. Although the source(s) are currently unknown, elevated counts were found during both dry and wet weather sampling conditions. Suspected sources include discharges from municipal separate storm sewer systems. Both the Secondary Contact Recreational and Aesthetic uses are assessed as support, however, based on the limited fecal coliform bacteria data and the lack of aesthetically objectionable conditions. The 2006 bacteria data suggest that primary contact uses were met and the uses will be re-assed by MassDEP in future integrated reporting cycles to evaluate the existing condition.

Second Herring Brook Segment MA94-31

This segment consists of a 0.003 square mile Class SA estuary, which runs from the Second Herring Brook Pond Dam, Norwell to the confluence with the North River. The community of Norwell (MAR041035) is regulated under MS4 in the NPDES Program (MassDEP 2006).

The DMF indicates that they have no active ambient monitoring stations within this segment, and have not been conducting any monitoring in this segment in recent years (DMF 2010). The DMF Shellfish Status Report of July 2000 indicates that Area MB5.2 (which includes this segment) is prohibited and no recent changes to this classification status have been made (MA DFG Churchill 2005b, MA DMF, 2013). Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired for this segment. It is presumed that this closure is because of elevated bacteria counts. Although the source(s) of bacteria are currently unknown, discharges from municipal separate storm sewers are suspected.

Although no bacteria samples were collected in 2001 or 2006 from this segment of Second Herring Brook, none of the four bacteria samples collected in 2001 from the upstream Second Herring Brook segment (MA94-26) near the Route 123 (Main Street) crossing, Norwell exceeded 70 cfu/100 ml. Additionally, none of the samples collected from the North River at Bridge/Union Street (near and just downstream from the confluence with Second Herring Brook) exceeded 100 cfu/100mls (MassDEP 2001a). The uses will be re-assed by MassDEP in future integrated reporting cycles to evaluate the existing condition.

Third Herring Brook Segment MA94-27

This segment is a 5.3 mile long Class B, ORW that begins its headwaters at the outlet from Jacobs Pond, Norwell/Hanover and runs to the confluence with the North River. The Pond Street Water Treatment plant in Hanover is authorized under the NPDES permit program to discharge filter backwash water to Old Pond Meadow to Third Herring Brook (MAG640043). This facility has two cement-lined lagoons to collect backwash water and usually only discharges when the lagoons are full and the sludge has settled (Billings 2005). The communities of Norwell (MAR041) and Hanover (MAR041036) are regulated under MS4 in the NPDES Program (MassDEP 2006).

One location was sampled for fecal coliform by MassDEP/ DWM during the primary contact recreational season (1 April to 15 October) along the Third Herring Brook by the MassDEP in 2001. MassDEP again conducted fecal coliform and E coli bacteria sampling on five occasions between June and October 2006 at Station TH 02, at River Street Crossing in Norwell/ Hanover. A summary of these data are also provided in Table 4-7 below.

Table 4-7. MA94-27 Third Herring Brook (MassDEP 2001, 2006) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)	Range of E coli (Number of Samples)
Tiffany Road/East Street crossing, Norwell/Hanover (Station TH101), 2001	410- 730 (3) Geometric Mean= 309	Not sampled for in 2001
River Street Crossing in Norwell/ Hanover, (Station TH02) 2006	10- 500 (5) Geometric Mean =151	20- 320 (5) Geometric Mean= 126

Units = colony forming units per 100 mL (cfu/100 mL)

The Primary Contact Recreational Use for Third Herring Brook is assessed as impaired because of elevated fecal coliform bacteria counts. Although the source(s) are currently unknown, elevated counts were found during both dry and wet weather sampling conditions. Suspected sources include discharges from municipal separate storm sewer systems. Both the Secondary Contact Recreational and Aesthetic uses are assessed as support, however, based on the limited fecal coliform bacteria data and the lack of aesthetically objectionable conditions. The 2006 bacteria data suggest that primary contact uses were met and the uses will be re-assed by MassDEP in future integrated reporting cycles to evaluate the existing condition.

Drinkwater River Segment MA94-21

This segment is a 3.5 mile long Class B warm water fishery, which begins at Whiting Street, Hanover and runs through Forge Pond to the inlet of Factory Pond, Hanover. The Abington-Rockland Joint Water Works is authorized under the NPDES permit program (permit MAG640010 issued in April 2001) to discharge backwash from the Hingham Street Water Treatment Plant in Rockland into the wetlands of Ben Mann Brook, a tributary to Cushing Brook which is a tributary to Drinkwater River. Chlorine is used in the water treatment process but is not added to the supernatant. The facility is equipped with a lagoon for backwash water. The community of Hanover (MAR041036) is regulated under MS4 in the NPDES Program (MassDEP 2006).

One location was sampled by MassDEP/ DWM during the primary contact recreational season (1 April to 15 October) along the Drinkwater River (Station DW101, Circuit St. Bridge, Hanover) by the MassDEP in 2001. MassDEP also conducted fecal coliform and E coli bacteria sampling on four occasions between June and October 2006 at that same station DW101, Circuit St. Bridge, Hanover. A summary of these data are also provided in Table 4-8 below.

Table 4-8. MA94-21 Drinkwater River (MassDEP 2001, 2006) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)	Range of E coli (Number of Samples)
near the Circuit Street Bridge, Hanover (Station DW101), 2001	590- 870 (3)	Not sampled for in 2001
near the Circuit Street Bridge, Hanover (Station DW101), 2006	320- >1,600 (5) Geometric Mean >916	150- >1,600 (5) Geometric Mean >642

Units = colony forming units per 100 mL (cfu/100 mL)

The Primary Contact Recreation Use for the Drinkwater River is assessed as impaired because of elevated fecal coliform bacteria counts. The Secondary Contact Recreation and Aesthetic uses are assessed as support for the river upstream from the confluence with French Stream but are assessed as impaired downstream from the confluence with French Stream because of objectionable conditions (excess algal growth, low Secchi disk transparency). The Rockland Municipal WWTP discharge (MA0101923) is a known source of total phosphorus. The suspected sources for bacterial contamination include stormwater and agricultural runoff.

North River Segment MA94-05

This segment is a 0.3 square mile Class SA, ORW. The segment begins at the confluence of Indian Head River and Herring Brook, Hanover/Pembroke and extends to Route 3A (Main Street), Marshfield/Scituate. The communities of Pembroke (MAR041054), Hanover (MAR041036), Marshfield (MAR041048), and Scituate (MAR041032) are regulated under MS4 in the NPDES Program (MassDEP 2006). There is a pump-out facility at Mary's Boat Livery located on the south bank of the North River on the upstream side of Route 3A. According to the boatyard operator, this facility charges a fee for its services, although it was purchased with Clean Vessel Act funds (MA DMF 2003 and Burtner 2003). The Town of Scituate was required by an Administrative Consent Order (ACO) issued by the Commonwealth of Massachusetts to meet several conditions centered on improving water quality in the North River and estuary (CEI 1998).

The DMF indicates that they have no active ambient monitoring stations within this segment, and have not been conducting any monitoring in this segment in recent years (MA DMF 2010). The DMF Shellfish Status Report of July 2000 indicates that Area MB5.2 (which contains 0.21 mi^2 of this segment) is prohibited and no recent changes to this classification status have been made (MA DMF 2013; and Churchill 2005b). The remaining 0.09 mi^2 (the most upstream reach of this segment) are not designated by DMF as a shellfish growing area. Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired for 0.21 mi^2 presumably due to elevated fecal coliform bacteria and not a designated use for the remaining 0.09 mi^2 of this segment. The source(s) of bacteria are currently unknown. However, discharges from municipal separate storm sewer systems in some areas and other wet weather discharges from non-point sources as well as marina/boating sanitary on-vessel discharges are potential sources.

Two locations were sampled along this portion of the North River by the MassDEP in 2001. MassDEP also conducted fecal coliform and E coli bacteria sampling on four occasions between June and October 2006 at Station NR 103, Route 53/139 Bridge, Hanover/Pembroke. A summary of these data are provided in Table 4-9.

Table 4-9. MA94-05 North River (MassDEP 2001, 2006) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)	Range of E. coli (Number of Samples)	Range of Enterococcus (Number of Samples)
NR103 – Rte 53/139 bridge, Hanover/Pembroke, 2001	62 – 790 (4)	70 – 450 (4)	170 – 1000 (3)
NR102 – Bridge Street/Union Street bridge, Norwell/Marshfield, 2001	14 – 100 (4)	<5 – 30 (4)	15 – 210 (3)
NR103 – Rte 53/139 bridge, Hanover/ Pembroke, 2006	55- 1,500 (5) Geometric Mean= 178	35- 1,200 (5) Geometric Mean =105	Not sampled for in 2006

Units = colony forming units per 100 mL (cfu/100 mL)

The North- South Rivers Watershed Association has sampled three points for Fecal Coliform along this segment in 2012: (1) Station #1, at the Washington St. Bridge; (2) Station #2, off Cornhill Lane; (3) Station #3 at the Union St. Bridge (Norwell Canoe Launch).

Results at Station #1 at the Washington St. Bridge in 2012 ranged 34- 400 cfu/100mL with a geometric mean of 140 cfu/100mL (6 sample total). Results at Station #2 off Cornhill Lane in 2012 ranged 34- 130 cfu/100mL, with a geometric mean of 62 cfu/100mL (6 sample total). Results at Station #3 at the Union St. Bridge in 2012 ranged between 14- 97 cfu/100mL, with a geometric mean of 27. For the NSRWA data and sampling locations, see Table 4-13 and Figure 4-1). The 2006 bacteria data suggest that primary contact uses were met and the uses will be re-assed by MassDEP in future integrated reporting cycles to evaluate the existing condition.

North River Segment MA94-06

This segment is a 0.56 square mile Class SA waterbody. The segment extends from Route 3A (Main Street), Marshfield/Scituate to the confluence with the South River, Scituate. The communities of Marshfield (MAR041048), and Scituate (MAR041060) are regulated under MS4 in the NPDES Program (MassDEP 2006).

DMF fecal coliform sampling occurred at four stations where shellfishing is conditionally approved. Stations (MB5-1, MB5-2, MB5-3, MB4-A) were sampled between January 2006 and May 2010. A total of 90 samples gathered had a range of 0.9- 51 cfu/100mL, with a geometric mean of 2.90 cfu/100mL (Churchill 2010). During each of 2011 and 2012, 15 samples were collected at each of these stations. The geometric mean ranged between 1.0 cfu/100mL at station MB5-1, 1.4 cfu/100mL at stations 2 and 3, to 2.3 cfu/100mL at station MB5-4A, with no readings above the 31 cfu/100mL standard, (Churchill, 2013). This appears to demonstrate that water quality has improved as compared to the sampling results associated with the earlier period. The uses will be re-assed by MassDEP in future integrated reporting cycles to evaluate the existing condition.

The DMF Shellfish Status Report of July 2000 indicates that Areas MB5.4, and MB5.5 (which contain 0.09 mi^2 of this segment) are prohibited and Area MB5.1, which contains 0.47 mi^2 of this segment, is conditionally approved (MA DMF 2013). It should be noted, however, that opening for Area MB5.1 was extended for an additional month (Churchill 2005b).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired presumably due to elevated fecal coliform bacteria. Although the sources of bacteria are currently unknown, discharges from municipal separate storm sewer systems in some areas and other wet weather discharges from non-point sources as well as marina/boating sanitary on-vessel discharges are potential sources.

One location was sampled by MassDEP/ DWM during the primary contact recreational season (1 April to 15 October) along the North River (MA94-06) by the MassDEP in 2001. A summary of the data are provided in Table 4-10.

Table 4-10. MA94-06 North River (MassDEP 2001) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)	Range of E. coli (Number of Samples)	Range of Enterococcus (Number of Samples)
Along river	23 –40 (4)	<5 –13 (4)	<5 –43 (3)

Units = colony forming units per 100 mL (cfu/100 mL)

The North- South Rivers Watershed Association has sampled two station points along this segment in 2012 at: (1) Station #6, at the North River Marina for Fecal Coliform; and (2) Station #7, off Damon's Point for Fecal Coliform and Enterococcus.

Fecal Coliform results in 2012 at Station #6 at the North River Marina ranged 5- 36 cfu/100mL with a geometric mean of 11 cfu/100mL (6 readings). Fecal Coliform results at Station #7 off Damon's Point ranged 7- 34 cfu/100mL with a geometric mean of 14 cfu/100mL (6 readings); and Enterococcus ranged 3- 13 cfu/100mL with a geometric mean of 7 cfu/100mL (5 readings) For NRWA data and sampling locations in 2012, see Tables 4-13, and Figure 4-1). The uses will be re-assed by MassDEP in future integrated reporting cycles to evaluate the existing condition.

Herring River Segment MA94-07

This segment is a 0.08 square mile Class SA waterbody. The segment extends the outlet of Old Oaken Bucket Pond to the confluence with North River in Scituate. The Town of Scituate is authorized (MA0102695 issued in November 2004l) to discharge from the Scituate Wastewater Treatment Plant (WWTP) (formerly improperly permitted as a groundwater discharge) 1.6 MGD (average monthly) of treated effluent disinfected using UV light via Outfall #001 to a tidal creek tributary that flows into the Herring River. In 2000 the Town of Scituate's WWTP was upgraded. The current permit expired 5/31/2011, with a renewal date of 9/27/12, effective 12/1/12. The community of Scituate is regulated (MAR041060), under MS4 in the NPDES Program (MassDEP 2006).

DMF fecal coliform sampling occurred at one station (MB5.3-2D) between January 2006 and May 2010. A total 0f 22 samples gathered had a range of 0.9- 51 cfu/100mL, with a geometric mean of 2.89 cfu/100mL (Churchill 2010). The DMF Shellfish Status Report of July 2000 indicates that Area MB5.3 (which contains this entire segment) is prohibited (MA DFG 2000) (Churchill, 2013).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired because of elevated bacteria counts. The sources include the WWTP discharge although the marina and stormwater may also contribute to the bacteria problem.

MassDEP conducted fecal coliform and E coli bacteria sampling on five occasions between June and October 2006 at Station HR01, New Driftway Road Bridge, Scituate. A summary of these data are also provided in Table 4-11 below.

Table 4-11. MA94-07 Herring River (MassDEP 2006) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)	Range of E coli (Number of Samples)	Range of Enterococcus (Number of Samples)
HR01, New Driftway Road Bridge, Scituate	120- 1,500 (5) Geometric Mean= 331	75- 720 (5) Geometric Mean= 158	40- 840 (5) Geometric Mean=181

Units = colony forming units per 100 mL (cfu/100 mL)

The North- South Rivers Watershed Association has sampled two points along this segment in 2012: , (1) Station #5, at the James Landing Marina/ Driftway Park for Fecal Coliform and Enterococcus; (2) Station #4, from a stormwater outfall pipe/ Scituate WWTP outfall pipe going into the Herring River in Scituate, for Fecal Coliform.

Fecal Coliform results at Station #5 at the James Landing Marina/ Driftway Park in 2012 ranged 3- 160 cfu/100mL, with a geometric mean of 21 cfu/100mL (6 readings), and Entrococcus ranged between 3-160 cfu/100mL with a geometric mean of 10 cfu/100mL (5 readings). Fecal Coliform results at Station #4 from a stormwater outfall pipe/ Scituate WWTP outfall pipe going into the Herring River in 2012 ranged between 0- 79 cfu/100mL, with a geometric mean of 4 cfu/100mL (6 readings). The uses will be re-assed by MassDEP in future integrated reporting cycles to evaluate the existing condition.

South River Segment MA94-09

This segment is a 0.63 square mile Class SA, ORW. The segment begins at the dam at Main Street in Marshfield to the confluence with North River in Marshfield/Scituate. The communities of Marshfield (MAR041048), and Scituate (MAR041060) are regulated under MS4 in the NPDES Program (MassDEP 2006).

The DMF Shellfish Status Report of July 2000 had indicated that Area MB6.0 (which contains this entire segment) was prohibited (MA DFG 2000). In 2011, the shellfish status in area MB6.1 (locations of stations 1, 1A, 2, 2A, 1S) was changed from prohibited to conditionally approved. Area MB6.0, (in and around station 3), and all upstream areas remain prohibited (Churchill, 2013).

Sampling was conducted as part of a stormwater management watershed assessment for a tributary to the South River in the town of Marshfield (also, see Table 4-12 below). Stormwater sampling was conducted of selected outfalls in Marshfield Center in the Willow Street drainage area on 1 June 2004. Elevated fecal coliform bacteria counts (as high as 2,500 cfu/100 ml) were found in three of the four locations sampled in 2004 (Horsley Witten Group 2004).

The DMF conducted fecal coliform sampling (15 runs) at five stations in the estuary water areas of the North River, near the confluence with the South River, 2003-2005. At three stations in the conditionally approved (shellfishing) status area (as of January 2006) the geometric mean averaged 3.9 cfu/100mL. At two stations in the impaired area (MB6.0) the geometric mean averaged 6.6 cfu/100mL (Churchill, 2006). In 2011, the shellfish status in areas at and adjacent to stations 1, 1A, 2, 2A, 1S was changed from prohibited to conditionally approved. Sampling results, (69 samples taken), during 2010 at these 5 stations had a geometric mean of < 1 cfu/100mL, with no excesses over the 28 cfu/100mL. Sampling results remained very low during 2011 and 2012 at these 5 stations. The shellfish status remained prohibited through 2012, at and adjacent to station 3. The geometric mean of sampling results at this station was 1.9 cfu/100mL (with one reading > 31 cfu/100mL) in 2010, in 2011 it was 1.0 cfu/100mL, and in 2012 it was 1.3 cfu/100mL, with no reading > 31 cfu/100mL in either of those two years.

The results above show that there have been improvements to the overall pathogen water quality, since some of the shellfishing areas have been changed in status from prohibited to conditionally approved. It is hoped that with MS4 stormwater program activities through the town of Marshfield, and boat waste management controls within this segment under the No Discharge Zone declaration in 2006, that this improvement trend will continue.

Two locations were sampled along this portion of the South River by the MassDEP in 2001. MassDEP also conducted fecal coliform and E coli bacteria sampling on five occasions between June and October 2006 at Station SR102A, Route 3A, Main Street Bridge, Marshfield. A summary of these data are also provided in Table 4-12 below. Additional data for this segment collected by the NSRWA are provided in columns titled “Willow Street Bridge” and “Julian Street Bridge” in Tables 4-13.

Table 4-12. MA94-09 South River (MassDEP 2001, 2006, Horsley Witten 2004) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)	Range of E. coli (Number of Samples)	Range of Enterococcus (Number of Samples)
SR102 – Route 3A (Main St.) bridge, Marshfield MassDEP, 2001	29 – 140 (4)	38 – 71 (4)	150 – 460 (3)
SR101 – Julian Street/Bayberry Road Bridge, Scituate/Marshfield MassDEP, 2001	15 – 170 (4)	<5 – 20 (4)	25 – 360 (3)
selected outfalls in Marshfield Center in the Willow Street drainage area (Town of Mansfield), Horsley Witten Group, 2004	<5- 2,500 (4)	N/A	N/A
SR102A-- Route 3A, Main Street Bridge, Marshfield, MassDEP, 2006	130- 240 (5) Geometric Mean=186	70-180 (5) Geometric Mean=132	75- 180 (5) Geometric Mean=107

Units = colony forming units per 100 mL (cfu/100 mL)

The North- South Rivers Watershed Association sampled two stations in 2012: (1) Station #10, at the Willow St. Bridge in Marshfield for Fecal Coliform; (2) Station #9 at the Julian St. Bridge (Marshfield) going over to Humarock, for Fecal Coliform and Enterococcus.

Fecal Coliform results at Station #10 at the Willow St. Bridge in Marshfield in 2012 ranged 93- 270 cfu/100mL, with a geometric mean of 180 cfu/100mL (6 readings). Fecal Coliform results at Station #9 at the Julian St. Bridge (Marshfield) in 2012 ranged 9- 150 cfu/100m, with a geometric mean of 35 cfu/100mL (6 readings); and Enterococcus results at Station #9 in 2012 ranged 2- 37 cfu/100mL with a geometric mean of 5 cfu/100mL (5 readings). For all 2012 data and sampling locations, see Tables 4-13, and Figure 4-1 below.

The Primary Contact Recreational Use is assessed as support for this segment of the South River based primarily on the limited data collected by DWM in the summer of 2001. This use is identified with an Alert Status, however, because of elevated fecal coliform bacteria levels in stormwater outfalls documented near Marshfield center and the occasionally elevated fecal coliform bacteria counts reported by NSRWA. Both the Secondary Contact Recreational and Aesthetic uses are assessed as support for this segment of the South River.

Figure 4-1. NSRWA River Watch Fecal Coliform Sampling Stations (from NSRWA 2004).

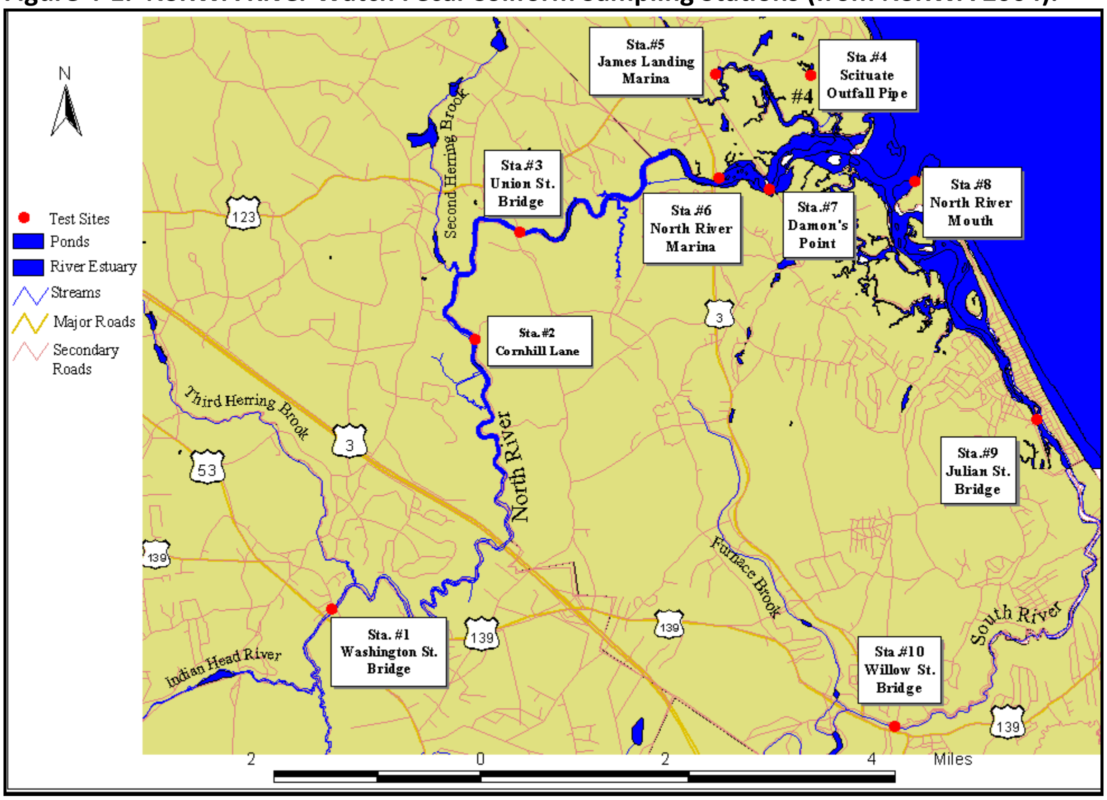


TABLE 4-13 North- South Rivers Watershed Association Bacteria Data (NSRWA, 2012)

		North River and Tributaries								
Date	Type of Bacteria	Washington Street Bridge	Corn Hill Lane	Union St. Bridge	Scituate WWTP	Drift way Park	North River Marine	Damon's Point	North River Mouth	Rainfall in last 48 hours (inch)
6/12/12	FC	34	37	14	0	10	6	8	0	0.04
	Ent					3		4		
6/27/12	FC	210	120	97	21	150	36	34	0	0.63
	Ent					160		13		
7/10/12	FC	94	34	15	0	3	5	9	1	0
	Ent					3		4		
7/26/12	FC	400	130	34	79	53	18	16	4	0.47
	Ent					15		8		
8/9/12	FC	110	48	25	2	16	8	7	1	0
	Ent					5		3		
8/23/12	FC	260	59	24	0	22	13	24	1	0
	Ent									

		South River Tributaries		
Date	Type of Bacteria	Julian Street Bridge	Willow Street Bridge	Rainfall in last 48 hours (inch)
6/12/12	FC	9	93	0.04
	Ent	2		
6/27/12	FC	150	180	0.63
	Ent	37		
7/10/12	FC	20	170	0
	Ent	2		
7/26/12	FC	52	190	0.47
	Ent	21		
8/9/12	FC	23	270	0
	Ent	1		
8/23/12	FC	56	230	0
	Ent	9		

Green Harbor Segment MA94-11

This segment is a 0.08 square mile Class SA waterbody. The segment begins at the tide gates at Route 139 in Marshfield and extends to the mouth of the harbor. The community of Marshfield (MAR041048) is regulated under MS4 in the NPDES Program (MassDEP 2006).

The DMF Shellfish Status Report of July 2000 indicates that Area MB3.0 (which contains this entire segment) is prohibited (MA DFG 2000), (MA DMF, 2013). Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired. This closure is related to elevated bacteria counts as well as the lack of a current sanitary survey (Churchill 2005c). Although the sources of bacteria are currently unknown, discharges from municipal separate storm sewers are suspected.

Within the Harbor itself, DMF discontinued ambient sampling between 2001- 2012 because the shellfish beds inside of the Harbor had been closed for quite some time (DMF 2010). However, in 2013, sampling resumed, with a total of 18 samples taken at 5 stations, (1, 2, 4, 5, 6, 7), within the Harbor, with sampling results ranging between 0.9- 19 cfu/100mL, and a geometric mean of 3.5 cfu/100mL (Churchill, 2013).

Weekly testing for Enterococci bacteria during the swimming season was conducted at the Green Harbor Beach, a public beach along the east shore of Green Harbor in Marshfield. Enterococcus sampling at Station MA 736369, at the beach, has been occurring almost weekly June- August since 2003 (104 total samples taken). Results have ranged between <2- 580 cfu/100mL, with a total of 5 readings > 104 cfu/100mL, and a geometric mean of 10.9 cfu/100mL. Beach closures due to bacteria have included 2 days in both 2005 and 2006, none in 2007, 1 day in both 2008 and 2009, and 5 closure days in 2010 (MDPH 2010). Between January, 2011 and August, 2013, there were 32 Enterococcus samples taken, with ranges between 10- 390 cfu/100mL, with 2 readings exceeding the standard, and 1 resultant posting (MDPH, 2013).

Jones River Segment MA94-14

This segment is a 0.09 square mile Class SA waterbody. The segment begins at the dam at Elm Street and extends to the mouth at Duxbury Bay in Kingston. The community of Kingston (MAR041041) is regulated under MS4 in the NPDES Program (MassDEP 2006).

DMF has indicated that they currently have no active ambient monitoring stations within this segment (DMF 2010), (Churchill, 2013). The DMF Shellfish Status Report of July 2000 indicates that Area CCB44.0 (which contains this entire segment) is prohibited (MA DFG 2000), MA DMF 2013). According to the DMF, the Jones River and in particular its “Halls Brook” tributary continue to be the single largest source of pollution to Kingston Bay. However, as a result of the recent and ongoing sewering project, dry weather fecal coliform levels at the mouth of the Jones River are generally less than 50 cfu/100 ml, although wet weather samples continue to be elevated. Despite improvements in the Jones River, “Halls Brook” (also known as “Stony Creek”) continues to be problematic. Suspected sources of pollution include septic systems in the center of town abutting the brook, and waterfowl in the surrounding wetlands (Germano 2002), (Churchill, 2013).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired. The closure is due to elevated fecal coliform bacteria counts particularly during wet weather. In addition to stormwater runoff, potential pollution sources include waterfowl, and the “Halls Brook” tributary, where either septic systems in the center of town near the brook, and waterfowl in the wetlands contribute to elevated fecal coliform bacteria counts.

Two locations were sampled along this portion of the Jones River by the MassDEP in 2001. MassDEP also conducted fecal coliform and E coli bacteria sampling on five occasions between June and October 2006 at Station JR102A, Downstream of Elm Street Bridge, Kingston. A summary of these data are also provided in Table 4-14 below.

In 2003- 2004, there was a South Coastal Basin Monitoring Grant, (604b MassDEP project) which did extensive ambient water quality sampling, including for Fecal Coliform, in the Duxbury Bay/Harbor to Plymouth Harbor areas. During 2004, one station in the estuary area of Jones River was sampled on five dates, July- September (see Table 4-14 below). Fecal Coliform results ranged between 320- 1,380 cfu/100mL (NSRWA, 2006).

Table 4-14. MA94-14 Jones River (Mass2006, DEP 2001, 2006, NSRWA 2004) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)	Range of E. coli (Number of Samples)	Range of Enterococcus (Number of Samples)
JR102 – Impoundment upstream of Elm St bridge, Kingston MassDEP, 2001	27 – 180 (4)	17 – 85 (4)	15 – 81 (3)
JR101 – Route 3A (Main St.) crossing, Kingston MassDEP, 2001	80 – 250 (4)	27 – 100 (4)	330 – 1000 (3)
one station in the estuary area of Jones River (604b Grant), NSRWA, 2004	320-1,380 (5)	Not sampled for in 2004	Not sampled for in 2004
JR102A—Downstream of Elm Street Bridge, Kingston MassDEP, 2006	25- 740 (5) Geometric Mean =168	20- 330 (5) Geometric Mean =92	Not sampled for in 2006

Units = colony forming units per 100 mL (cfu/100 mL)

The Primary and Secondary Contact Recreational and Aesthetic uses for this segment of the Jones River are assessed as support based on the fecal coliform bacteria data and the general lack of aesthetically objectionable conditions. Although the highest fecal coliform bacteria count is certainly a concern, a use impairment decision cannot be made on a single data point. Furthermore, the fecal coliform bacteria datasets for this river from both sampling years were small. Because of the occasionally elevated bacteria counts and the presence of filamentous green algae near the smelt spawning area the Recreational and Aesthetics uses are identified with an Alert Status for this segment of the Jones River.

Duxbury Bay Segment MA94-15

This segment is a 12.7 square mile Class SA waterbody. The segment includes waters north and west of a line from Saquish Head to the tip of Plymouth Beach and to High Cliff in Plymouth, excluding Back River and Bluefish River in Duxbury and Jones River in Kingston.

Battelle Duxbury Operations Wastewater Treatment Plant (WWTP) located in Duxbury, MA, is authorized (NPDES permit MA0025852 issued in August 1999 and modified in February 2000) to discharge 0.29 MGD (average monthly) of culture water used for culturing and testing marine organisms, non-toxic wastewater from laboratory sinks, and sea water return via Outfall #001 to Duxbury Bay. The permit requires effluent limits for pH and fecal coliform bacteria and requires monitoring and reporting of copper and zinc concentrations. The communities of Plymouth (MAR041150), Duxbury (MAR041034) and Kingston (MAR041041) are regulated under MS4 in the NPDES Program (MassDEP 2006).

The primary residential areas are located along the northern and western shores in Duxbury, Kingston, and Plymouth. The focus of Duxbury's village and boating activity is Snug Harbor, located in the northern portion of the bay (Churchill 2003d). There is a shared community septic system that was built to service the Snug Harbor Business District that is owned and operated by the Town of Duxbury (Duxbury 1996). There is a pump-out boat and a shore-side facility at Duxbury Town Pier. The pump-out facilities were funded by the Clean Vessel Act to provide free pump-outs (MA DMF 2003). Adjacent to Duxbury Town Pier is the town boat ramp, Duxbury Yacht Club and the Duxbury Bay Maritime School, the latter offering sailing, boat building and ecology classes to the public (Churchill 2003d).

In August 2006, The Executive Office of Environmental Affairs formally announced that a 63 square mile area, encompassing Plymouth, Duxbury and Kingston Embayments, became a No Discharge Area, meaning that any discharge of boat sewage is prohibited. This was enacted to better protect the waters from receiving nutrient and bacterial wastes from any marine vessel operating within these waters (EOEA, 2006).

The Division of Marine Fisheries classifies the shellfish growing areas within Duxbury Bay in the following manner. Areas classified as approved are CCB42.0, CCB43.1, and CCB45.0. Areas classified as conditionally approved are CCB43.3, CCB45.2, CCB46.1, and CCB46.2. Areas where shellfish harvesting is prohibited are CCB43.2, and CCB46.3 (MA DMF, 2013).

The most recent DMF surveys of potential pollution sources in Duxbury Bay is described in the December, 2011 Triennial Report (for Duxbury Bay Area CCB45), the 2008 Sanitary Survey of Duxbury Bay, and in the Kingston Bay section of the 2002 Duxbury Bay Sanitary Survey. All of these reports identified potential pollution sources from: individual septic systems; stormwater runoff directly from storm drains and as carried into the bay through Jones River and major creeks; large flocks of waterfowl present during the winter months, and pipes. The 2002 and 2008 Duxbury reports emphasize the fact that pipes primarily represent yard drains and seawall weep holes draining the high groundwater table (Germano 2002), (Kessler 2008). In the 2002 report, in the section of Duxbury Bay bordered by Duxbury Beach, thirteen pipes were identified along residential seawalls or at roadway storm drains; eight of which were tested for dry weather flow rate, salinity and fecal coliform concentration. DMF concluded the flow was from fresh water springs in the area and did not represent a problem for shellfish. All but one test result had a concentration < 10 cfu. A storm drain 100 yards from the beach had a concentration of 20 cfu. Salinity was zero and flow ranged from 0 to 3 gallons per minute.) The Battelle Labs discharge pipe also was tested. This pipe had a flow of 5 gallons per minute, a fecal coliform result of 10 cfu and salinity of 32 ppm (Churchill 2003d).

The 2008 Duxbury Sanitary Survey, and 2011 Triennial Report, indicates that septic systems, and stormwater, are the principal concerns regarding remaining bacteria related pollution problems, particularly in remaining prohibited shellfishing areas in the Bay. The reports locate and describe 28 potential septic &/or stormwater pollution source areas. The vast majority of the waters continue to have excellent water quality. The Eagle Nest Bay area still has the most pathogen related problems, but the 2008 and 2011 reports both indicate that water quality improvement progress has been made. The town of Duxbury has had an aggressive septic system repair program underway over the past few years, and is attempting to require the upgrade of non- Title V systems to meet Title V requirements. In addition, the town has been incrementally updating storm drains to further mitigate pollution runoff. The DMF still recommends the community to consider a WWTP construction option (Kessler, 2008; 2011)

Large acreage of shellfish beds in Kingston Bay that were prohibited are now conditionally available for harvesting due to the actions the Towns of Kingston and Duxbury have taken over the last few years to address impacts from individual septic systems and stormwater runoff (See details of various grant projects, with resultant improvements in overall water quality including bacteria, within this region in Section 8.1(9) of this report).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as support for 8.4 mi2 and impaired for 4.3 mi2 of this segment because of elevated fecal coliform bacteria. Pollution sources include waterfowl, stormwater runoff, and the Jones River (particularly its “Halls Brook” tributary) where either septic systems in the center of town near the brook or waterfowl in the wetlands contribute to elevated fecal coliform bacteria counts.

The DMF conducted fecal coliform sampling (15 runs) at eleven stations in the Harbor- Bay area’s 2003-2005. At nine stations in the shellfishing approved status area, the geometric mean averaged 3.2 cfu/100mL. At one station in the conditionally approved shellfishing area, the geometric mean averaged 3.6 cfu/100mL. At one station in the prohibited shellfishing area, the geometric mean averaged 6.1 cfu/100mL (Churchill, 2006).

DMF fecal coliform sampling within this segment occurred at ten shellfishing approved stations between June 2011 and December 2012. A total of 155 samples gathered had a geometric mean of 1.49 cfu/100mL, with 3 samples > than the 31 cfu/100mL. Sampling also occurred at one prohibited shellfishing station (15 samples) during 2011- 2012, with a geometric mean of 2.3cfu/100mL, with one sample > 31cfu/100mL (Churchill 2013).

In 2003- 2004, there was a South Coastal Basin Monitoring Grant, (604b MassDEP project) which did fecal coliform sampling in the Duxbury Bay/Harbor to Plymouth Harbor areas (see Table 4-15 below). During 2003 to 2005, 15 stations were sampled between July and September of each of those years, with a total of 199 samples taken, with a range of ND to 384 cfu/100mL, with a geometric mean of < 10.

Table 4-15. MA94-15 Duxbury Bay (MassDEP 2003, 2005) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)
15 stations in the Duxbury Bay/Harbor to Plymouth Harbor areas, 2003- 2005	ND- 384 (119) Geometric Mean < 10

Units = colony forming units per 100 mL (cfu/100 mL)

The Primary and Secondary Contact Recreation and Aesthetics uses are assessed as support for Duxbury Bay based on the low fecal coliform bacteria counts. The vast majority of Duxbury Bay is approved for shellfishing (indicative of low bacteria levels) and the beaches have been open for the majority of the 2002- 2012 bathing seasons (only one of the five beaches was posted once in 2002/2003). Additionally no aesthetically objectionable conditions were noted.

Plymouth Harbor Segment MA94-16

This segment is a 2.53 square mile Class SA waterbody. The segment includes waters south of a line drawn from the tip of Plymouth Beach to High Cliff in Plymouth.

The communities of Duxbury (MAR041034), and Plymouth (MAR041150) have coverage under MS4 in the NPDES Program (MassDEP 2006).

The Town of Plymouth is authorized (MA0100587 issued in November 2004) to discharge from the Plymouth Wastewater Treatment Plant (WWTP) a flow of 1.75 MGD (average monthly) of treated effluent via Outfall #001 to Plymouth Harbor consistent with the requirements of the Ocean Sanctuaries Act and to discharge the remainder of the treated volume into the ground within the Eel River sub-watershed. The WWTP on Water Street (which went online in March 1970) was abandoned after the new 5.2 MGD facility at Camelot Industrial Park became operational in May 2002.

The resultant improvements in the Kingston and the Plymouth WWTP's, plus changes in the Plymouth WWTP outfall situation have resulted in fairly remarkable improvements in embayment water quality (including bacteria levels) in both the Kingston Harbor/ Bay, and the Plymouth Harbor/ Bays areas (See Section 8.1 (10) of this report for a summary of these activities, and the general improvements in water quality, including bacteria).

A NPDES General Permit (MAG250020) was issued to Harborview Place in December 2002 to discharge non-contact cooling water via two outfalls into Plymouth Harbor. DMF sampled these outfalls (P.S. #24 and #25) in September 2003 for fecal coliform bacteria. The results were <10 cfu/100 ml and 30 cfu/100 ml. There may have been some coastal water mixing in the P.S. #25 outfall since the pipe was partially submerged and had a salinity concentration of 15 ppm.

In August 2006, The Executive Office of Environmental Affairs formally announced that a 63 square mile area, encompassing Plymouth, Duxbury and Kingston Embayments, became a No Discharge Area, meaning that any discharge of boat sewage was prohibited. This was enacted to better protect the waters from receiving nutrient and bacterial wastes from any marine vessel operating within these waters (EOEA, 2006).

The DMF Shellfish Status Report of July 2000 indicates that Area CCB42.1 (which contains this entire segment) is prohibited due to unacceptable water quality (MA DFG 2000), (MA DMF, 2013).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired because of elevated fecal coliform bacteria counts. Although some of the Harbor is closed as a safety zone (WWTP discharge/marinas), stormwater has historically contributed to the bacteria problem.

The DMF conducted fecal coliform sampling during 2003-5, (15 runs), at seven stations within the MA Plymouth Harbor segment, with the geometric mean being 7.8 cfu/100mL, with two stations having an elevated geometric mean of 12.5 and 12.8 cfu/100mL (Churchill, 2006).

DMF fecal coliform sampling occurred at four stations within the MA Plymouth Harbor segment, (CCB42-10, CCB42-11, CCB42-12, CCB42-13), between June 2006 and September 2010. A total of 66 samples gathered had a range of 0.9- 550 cfu/100mL, with a geometric mean of 9.27 cfu/100mL (Churchill 2010).

DMF fecal coliform sampling occurred at the four same stations within the MA Plymouth Harbor segment, (CCB42-10, CCB42-11, CCB42-12, CCB42-13), between June 2011 and September 2012. A total of 120 samples gathered had a geometric mean range (between stations) of 3.7- 34.1 cfu/100mL, with an overall geometric mean of 15.8 cfu/100mL. Stations CCB42-12 and CCB42-13 had geometric means of 26.6 cfu/100mL for both years, with numerous individual sample readings above 31 cfu/100mL (Churchill 2013).

In 2003- 2004, there was a South Coastal Basin Monitoring Grant, (604b MassDEP project) which did extensive ambient water quality sampling, including for Fecal Coliform, in the Duxbury Bay/Harbor to Plymouth Harbor areas (see Table 4-16 below). During 2003- 2005, 15 stations were sampled on six dates between July and September of those years for a total of 119 samples, for a range of ND-384 cfu/100mL, and a geometric mean <10 cfu/100mL. On five dates, Fecal Coliform results ranged between ND- 60 cfu/100mL with a geometric means of <10 cfu/100mL (NSRWA, 2006).

Table 4-16. MA94-16 Plymouth Harbor (MassDEP 2003, 2005) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)
15 stations in the Duxbury Bay/Harbor to Plymouth Harbor areas, 2003- 2005	ND- 384 (119), Geometric mean < 10

Units = colony forming units per 100 mL (cfu/100 mL)

The Primary and Secondary Contact Recreational and Aesthetics uses are assessed support for Plymouth Harbor based on the low fecal coliform bacteria counts, the lack of any observed objectionable conditions, and the high transparency data.

Bluefish River MA94-30

This segment is a 0.06 square mile saltmarsh SA estuary, north of Harrison Street, Duxbury to mouth at Duxbury Bay, Duxbury. The community of Duxbury (MAR041034) is regulated under MS4 in the NPDES Program (MassDEP 2006).

DMF fecal coliform sampling occurred at five stations (CCB46-1, CCB46-1D, CCB46-1E, CCB46-7, CCB46-9) between March, 2006 and October, 2010. A total of 83 samples gathered had a range of 0.9- 14 cfu/100mL, with a geometric mean of 1.88 cfu/100mL (Churchill 2010). DMF fecal coliform sampling occurred at the same five stations (CCB46-1, CCB46-1D, CCB46-1E, CCB46-7, CCB46-9) during 2011 and 2012. A total of 150 samples gathered had a geometric mean of 1.6 cfu/100mL (Churchill 2013). The DMF Shellfish Status Report of July 2000 indicates that Area CCB46.5 (which contains 0.02mi2 of this segment) is prohibited and Area CCB46.2 (which contains 0.04 mi2 of this segment) is conditionally approved (MA DFG 2000).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired due to elevated fecal coliform bacteria counts. It should be noted that three septic system pollution sources were eliminated since they have connected to the town sewer system (MA BAYS undated and Churchill 2003c). This project received an innovation award from the Massachusetts Municipal Association (MMA) in 1996 (Duxbury 1996). Although the current sources are unknown, discharges from municipal separate storm sewers are still suspected sources of bacteria.

DWM conducted bacteria sampling (fecal coliform, E coli. and Enterococci) in the Bluefish River between July and October 2001 at Station BR101, Washington Street Bridge, Duxbury. None of the fecal coliform bacteria samples exceeded 45 cfu/100 ml. Fecal coliform bacteria samples collected from the tributary to the river (locally known as the part of the Bluefish River) at Station BR102, Harrison Street Bridge, Duxbury, were higher (ranging from 120 to an estimated 1000 cfu/100 ml). A summary of these data are provided in Table 4-17.

Table 4-17. MA94-30 Bluefish River (MassDEP 2001) Indicator Bacteria Data Summary.

Station	Range of Fecal Coliform (Number of Samples)
Washington Street Bridge, Duxbury (Station BR101).	All under 45 (4)
Harrison Street Bridge, Duxbury (Station BR102)	120 – 1,000 (4)

Units = colony forming units per 100 mL (cfu/100 mL)

The Primary and Secondary Contact Recreational and Aesthetic uses for the Bluefish River are assessed as support based on the fecal coliform bacteria data and the lack of aesthetically objectionable conditions.

5.0 Potential Sources

The South Coastal watershed has 20 segments, located throughout the watershed, that are listed as pathogen impaired requiring TMDLs. These segments represent 64.0% of the estuary area, 32% of the river miles, and .01% of the lakes-pond acreage assessed. Sources of indicator bacteria in the South Coastal watershed are many and varied. Some dry weather sources may include:

- animal feeding operations,
- animal grazing in riparian zones,
- leaking sewer pipes,
- storm water drainage systems (illicit connections of sanitary sewers to storm drains),
- failing septic systems,
- wildlife, including birds,
- recreational activities, and
- illicit boat discharges.

Some wet weather sources may include:

- wildlife and domesticated animals (including pets),
- storm water runoff including municipal separate storm sewer systems (MS4),
- combined sewer overflows (CSOs), and
- sanitary sewer overflows (SSOs).

It is difficult to provide accurate quantitative estimates of indicator bacteria contributions from the various sources in the South Coastal watershed, because many of the sources are diffuse and intermittent, and extremely difficult to monitor or accurately model. Therefore, a general level of quantification according to source category is provided (e.g., see Tables 5-1 and 5-2). This approach is suitable for the TMDL analysis, because it indicates the magnitude of the sources and illustrates the need for controlling them. Additionally, many of the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they indicate a potential health risk and, therefore, must be eliminated. However, estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) is achieved for wet and dry conditions using the ambient data available that define baseline conditions (see Tables 4-4 through 4-17).

Agriculture

Land used primarily for agriculture is likely to be impacted by a number of activities that can contribute to indicator bacteria impairments of surface waters. Activities with the potential to contribute to high indicator bacteria concentrations include:

- Field application of manure,
- Runoff from grazing areas,
- Direct deposition from livestock in streams,
- Animal feeding operations,
- Leaking manure storage facilities, and
- Runoff from barnyards.

Indicator bacteria numbers are generally associated with sediment loading. Reducing sediment loading often results in a reduction of indicator bacteria loading as well. Brief summaries of some of these techniques are provided in the "Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts".

Sanitary Waste

Leaking sewer pipes, illicit sewer connections, sanitary sewer overflows (SSOs), combined sewer overflows (CSOs) and failing septic systems represent a direct threat to public health since they result in discharge of partially treated or untreated human wastes to the surrounding environment. Quantifying these sources is extremely speculative without direct monitoring of the source, because the magnitude is directly proportional to the volume of the source and its proximity to the surface water. Typical values of fecal coliform in untreated domestic wastewater range from 104 to 106 MPN/100mL (Metcalf and Eddy 1991).

Illicit sewer connections into storm drains result in direct discharges of sewage via the storm drainage system outfalls. The existence of illicit sewer connections to storm drains is well documented in many urban drainage systems, particularly older systems that may have once been combined. It is probable that numerous illicit sewer connections exist in storm drainage systems serving the older developed portions of the basin.

Monitoring of storm drain outfalls during dry weather is needed to document the presence or absence of sewage in the drainage systems. Approximately 70.3 percent of the South Coastal watershed is classified as Urban Areas by the United States Census Bureau and is therefore subject to the Stormwater Phase II Final Rule that requires the development and implementation of an illicit discharge detection and elimination plan.

Septic systems designed, installed, operated and maintained in accordance with 310 CMR 15.000: Title 5, are not significant sources of fecal coliform bacteria. Studies demonstrate that wastewater located four feet below properly functioning septic systems contain on average less than one fecal coliform bacteria organism per 100 mL (Ayres Associates 1993). Failed or non-conforming septic systems, however, can be a major contributor of fecal coliform to the South Coastal watershed. Wastes from failing septic systems enter surface waters either as direct overland flow or via groundwater. Wet weather events typically increase the rate of transport of pollutant loadings from failing septic systems to surface waters because of the wash-off effect from runoff and the increased rate of groundwater recharge.

Recreational use of waterbodies is a source of pathogen contamination. Swimmers themselves may contribute to bacterial impairment at swimming areas. When swimmers enter the water, residual fecal matter may be washed from the body and contaminate the water with pathogens. In addition, small children in diapers may contribute to contamination of the recreational waters. These sources are likely to be particularly important when the number of swimmers is high and the flushing action of waves or tides is low.

Another potential source of pathogens is the discharge of sewage from vessels with onboard toilets. These vessels are required to have a marine sanitation device (MSD) to either store or treat sewage. When MSDs are operated or maintained incorrectly they have the potential to discharge untreated or inadequately treated sewage. For example, some MSDs are simply tanks designed to hold sewage until it can be pumped out at a shore-based pump-out facility or discharged into the water more than three miles from shore. Uneducated boaters may discharge untreated sewage from these devices into near-shore waters. In addition, when MSDs designed to treat sewage are improperly maintained or operated they may malfunction and discharge inadequately treated sewage. Finally, even properly operating MSDs may discharge sewage in concentrations higher than allowed in ambient water for fishing or shellfishing. Vessels are most likely to contribute to bacterial impairment in situations where large numbers of vessels congregate in enclosed environments with low tidal flushing. Many marinas and popular anchorages are located in such environments.

In August 2006, The Executive Office of Environmental Affairs formally announced that a 63 square mile area, encompassing Plymouth, Duxbury and Kingston Embayments, became a No Discharge Area, meaning that any discharge of boat sewage was prohibited. This was enacted to better protect the waters from receiving nutrient and bacterial wastes from any marine vessel operating within these waters.

Wildlife and Pet Waste

Animals that are not pets can be a potential source of pathogens. Geese, gulls, and ducks are speculated to be a major pathogen source, particularly at lakes and storm water ponds where large resident populations have become established (Center for Watershed Protection 1999).

Household pets such as cats and dogs can be a substantial source of bacteria – as much as 23,000,000 colonies/gram, according to the Center for Watershed Protection. A rule of thumb estimate for the number of dogs is ~1 dog per 10 people producing an estimated 0.5 pound of feces per dog per day. Uncollected pet waste is then flushed from the parks, beaches and yards where pets are walked and transported into nearby waterways during wet-weather.

Storm Water

Storm water runoff is another significant contributor of pathogen pollution. As discussed above, during rain events fecal matter from domestic animals and wildlife are readily transported to surface waters via the storm water drainage systems and/or overland flow. The natural filtering capacity provided by vegetative cover and soils is dramatically reduced as urbanization occurs because of the increase in impervious areas (i.e., streets, parking lots, etc.) and stream channelization in the watershed.

Extensive storm water data have been collected and compiled both locally and nationally (e.g., Tables 4-1, 4-2, 5-1 and 5-2) in an attempt to characterize the quality of storm water. Bacteria are easily the most variable of storm water pollutants, with concentrations often varying by factors of 10 to 100 during a single storm. Considering this variability, storm water bacteria concentrations are difficult to accurately predict. Caution must be exercised when using values from single wet weather grab samples to estimate the magnitude of bacteria loading, because it is often unknown whether the sample is representative of the "true" mean. To gain an understanding of the magnitude of bacterial loading from storm water and avoid overestimating or underestimating bacteria loading, event mean concentrations (EMC) are often used. An EMC is the concentration of a flow proportioned sample throughout a storm event. These samples are commonly collected using an automated sampler which can proportion sample aliquots based on flow. Typical storm water event mean densities for various indicator bacteria in Massachusetts watersheds and nationwide are provided in Tables 5-1 and 5-2. These EMCs illustrate that storm water indicator bacteria concentrations from certain land uses (i.e., residential) are typically at levels sufficient to cause water quality problems.

Table 5-1. Lower Charles River Basin Storm Water Event Mean Bacteria Concentrations (data summarized from USGS 2002) and Necessary Reductions to Meet Class B WQS.

Land Use Category	Fecal Coliform EMC (CFU/100 mL)	Number of Events	Class B WQS[1]	Reduction to Meet WQS (%)
Single Family Residential	2,800 – 94,000	8	10% of the samples shall not exceed 400 organisms/ 100 mL	2,400 – 93,600 (85.7 – 99.6)
Multifamily Residential	2,200 – 31,000	8		1,800 – 30,600 (81.8 – 98.8)
Commercial	680 – 28,000	8		280 – 27,600 (41.2 - 98.6)

[1] Class B Standard: Shall not exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms. Used 400 to illustrate required reductions since a geometric mean of the samples were not provided.

Table 5-2. Storm Water Event Mean Fecal Coliform Concentrations (as reported in MassDEP 2002b; original data provided in Metcalf & Eddy, 1992) and Necessary Reductions to Meet Class B WQS.

Land Use Category (Metcalf & Eddy, 1992)	Fecal Coliform[1] Organisms / 100 mL	Class B WQS[2]	Reduction to Meet WQS (%)
Single Family Residential	37,000	10% of the samples shall not exceed 400 organisms/ 100 mL	36,600 (98.9)
Multifamily Residential	17,000		16,600 (97.6)
Commercial	16,000		15,600 (97.5)
Industrial	14,000		13,600 (97.1)

[1] Derived from NURP study event mean concentrations and nationwide pollutant buildup data (USEPA 1983).
[2] Class B Standard: Shall not exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms. Used 400 to illustrate required reductions since a geometric mean of the samples were not provided.

6.0 Prioritization and Known Sources

Interventions to address water quality issues have been carried out by Towns, organizations, state agencies, and citizens to resolve various water quality problems in the basin. Nutrient identification and source discovery has been the emphasis, however, measures to address nutrients, in an ancillary way, have addressed pathogen pollution and its principal sources. As the introduction states, the principal contributors seem to be failing septic systems throughout the watershed, as well as general effects of overland stormwater flows as these pick up various pollutants, such as wildlife and pet wastes, garbage wastes, manures from farm operations, etc. Particularly strident efforts are necessary in controlling pollutants such as bacteria because the geography of this basin is shaped as such that most of it is closely oriented (within a few miles) to coastal/ estuarine locations that have a high proportion of potential shellfishing usage. The standards for these potential shellfishing waters (<14 cfu/100mL fecal coliform) are far more stringent than the primary contact recreation standard for inland Class B waters (formerly < 200 cfu/100mL, now E coli <126 cfu). All the drainage areas, including rivers, streams and smaller tributaries from the inland areas, must have especially clean waters/ very low background bacteria levels in order for shellfishing beds to stay open, or to open up in presently or formerly closed areas. The following sections provide a brief review/ overview of principal bacteria sources in the segments and regions covered in this TMDL:

Cohasset Cove MA94-32

Cohasset Cove (Class SA) is a part of Cohasset Harbor MA 94-01. The DMF Shellfish Status Report of July 2000 indicates shellfishing for this area is prohibited. Potential pollution sources identified by DMF in this closed safety zone area include the Cohasset WWTP discharge and the marinas. Additionally septic systems and stormwater runoff are also potential sources (MassDEP, 2006). CZM's Coastal Non-Point Source Program has awarded Cohasset $47,000 to investigate storm water hot spots (including James Brook), conduct water quality monitoring, and design storm water BMPs to mitigate pollution in Cohasset Cove (Burtner, 2003). Suspected sources of pollution at Bassings Beach are inadequate septic systems on Bassings and/or at the Lighthouse Keeper function Hall on the hill above Parker Avenue Cut (Drysdale, 2003).

Cohasset Harbor MA 94-01

Cohasset Harbor (Class SA) includes waters south of a line drawn from the northwestern point of Scituate Neck, Scituate to just north of Quarry Point, Cohasset not including Cohasset Cove, Cohasset/Scituate. Land-use estimates (top 3, excluding water) for the 17.6 mi^2 subwatershed are Forest 58%, Residential 27%, and Wetlands 7%.

Suspected pathogen sources are: marina/boating sanitary on-vessel discharges, septic systems and discharges from municipal separate storm sewer systems. The North- South River Watershed Five Year Action Plan identified the need to develop a monitoring plan and conduct bacteria sampling to evaluate effectiveness of point (Phase II stormwater permits) and non-point source pollution control activities of the towns of Scituate and Cohasset.

The Gulf MA 94-19

This SB segment runs from Headwaters, outlet Hunters Pond, Scituate to confluence with Cohasset Cove just north of Border Street, Cohasset. Land-use estimates (top 3, excluding water) for the 15.0 mi^2 subwatershed (including the subwatersheds for MA94-18 and MA94-33): Forest 64%; Residential 24%; Wetlands 5%. The DMF Shellfish Status Report of July 2000 indicates that Area MB10.1 (which contains this entire segment) is prohibited to shellfishing (MA DFG 2000).

Potential pollution sources identified by DMF include septic systems and stormwater runoff. Within the Gulf River subwatershed, all of the properties in Scituate have on-site sewage disposal systems. In 2001 and 2002, some of the properties in Cohasset near to The Gulf were tied into the municipal sewerage system and other properties were scheduled for connection. It should also be noted that the Center for Student Coastal Research (CSCR) received a grant to conduct an assessment of non-point source pollution in the Gulf.

Musquashcut Pond MA94-33

Musquashcut Pond (Class SA) is designated as a Great Pond [brackish], separated from Massachusetts Bay by North Scituate barrier beach. The waterbody is classified by DMF as prohibited to shellfishing. It is surrounded by residential development on two other sides. Land-use estimates (top 3, excluding water) for the 0.33 mi^2 subwatershed: Residential 70%; Open Land 15%; Forest 10%.

There has been water quality problems possibly tied to failing septic systems in a couple of tributaries leading into the pond. Other suspected sources of bacteria, which are based on best professional judgment, include discharges from municipal separate storm sewer systems, and wet weather discharges from non-point sources. The Scituate DPW is currently involved in a three-phase sewer expansion program. The third phase of the project would sewer the Musquashcut Pond area (Rowland 2005).

Scituate Harbor MA 94-02

The watershed area contributing to Scituate Harbor (Class SA) has been estimated by Mass GIS to have 16% impervious surfaces cover land use. According to the Center for Watershed Protection, an area with less than 8% impervious surfaces is considered "sensitive"; 12-20% is considered "threatened"; and more than 20% is considered "non-supporting" or urbanized (CWP 1999). This data is useful for communities to take steps to prevent stormwater impacts in sensitive areas. Shellfishing is currently prohibited due to municipal point source discharge from municipal separate storm sewer systems, marina/boating sanitary on-vessel discharges, on-site septic systems, and wet weather discharges from non-point sources (MassDEP, 2006). The Lily Pond Limnology and Water's Edge Study (Aaron River Watershed) recommends watershed management controls to reduce non point pollution sources such as reviewing development plans, developing lawn fertilization packages, evaluating settling basin discharge management, and implementing stormwater retrofits (ENSR, 2003).

Stellwagen Bank National Marine Sanctuary has a reissued permit in 2007, (MA0090531), to discharge from their facility located at 175 Edward Foster Road in Scituate an average daily flow of 230 GPD of treated sanitary wastewater via one outfall to Scituate Harbor (permit was transferred in June 2002 from the US Coast Guard). The facility consists of a simple wastewater treatment process described as a septic tank, sand filtration, and chlorination prior to discharge. The fecal coliform bacteria permit limits are 14 cfu/100mL monthly average, and 28cfu/100mL for maximum daily, with a Total Residual Chloride (TRC) limit of 1.0 mg/L maximum daily.

Ellisville Harbor MA94-34

This segment is a 0.01 square mile Class SA, shellfishing waterbody located in Plymouth. The DMF Shellfish Status Report of July 2000 indicates that Area CCB40.0 (which contains this entire segment) is prohibited (MA DFG 2000). It is a designated ACEC. Land-use estimates (top 3, excluding water) for the 1.97 mi^2 subwatershed: Forest 60%; Residential 17%; Open Land 11%.

Ellisville Harbor is primarily a tidal salt marsh system with a tidal inlet that is susceptible to occlusion and migration resulting from coastal sediment transport processes (Howes and Samimy 2005). Due to dynamic coastal processes, the entrance channel to the harbor had migrated to the south, and had restricted the tidal exchange. The depth of the entrance channel had decreased significantly over the past several years and the barrier beach had caused elevation difference of several feet between the bay and the harbor. This difference resulted in restricting incoming tidal water to the last two hours of flood tide. This restricted exchange was considered to be one of the major reasons for poor water quality within the harbor (Churchill 1994). As recently as 2003, the historic inlet was reopened which has already resulted in restoration of salt marsh grass habitat in the upper wetland (Howes and Samimy 2005).

Iron Mine Brook MA94-24

This Class B segment's location runs from the Headwaters north of Route 139, Hanover to the confluence with Indian Head River, Hanover. A portion of this waterbody (wetlands contiguous with the North River wetlands) is an ORW under the North River Protective Order. The length of this segment is 1.4 miles. Land-use estimates (top 3, excluding water) for the 1.3 mi^2 subwatershed includes: Forest 53%; Residential 29%; Commercial 6%. Although the source(s) are currently unknown, elevated counts were found during both dry and wet weather sampling conditions. Suspected sources include discharges from municipal separate storm sewer systems.

Second Herring Brook MA94-31

Second Herring Brook is a Class SA, ORW encompassing 0.003 square miles. The segment runs from the Second Herring Brook Pond Dam, Norwell to the confluence with the North River, Norwell. Land-use estimates (top 3, excluding water) for the 3.7 mi^2 subwatershed include: Forest 60%; Residential 28%; Open Land 5%.

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired for this segment (MassDEP 2000). It is presumed that this closure is because of elevated bacteria counts. Although the source(s) of bacteria are currently unknown, discharges from municipal separate storm sewers are suspected.

Third Herring Brook MA94-27

The location of this Class B 5.3 mile segment runs from the headwaters, outlet from Jacobs Pond, Norwell/Hanover to confluence with North River, Norwell/Hanover. A portion of this waterbody (wetlands contiguous with the North River wetlands) is an ORW under the North River Protective Order. Land-use estimates (top 3, excluding water) for the 10.8 mi^2 subwatershed includes: Forest 57%; Residential 27%; Commercial 5%.

With the exception of a metal cable from a fence noted during one of the surveys, no other objectionable odors, deposits or any other conditions were observed by DWM personnel near the Tiffany Road/ East Street crossing, Norwell/ Hanover (Station TH101), during the surveys conducted in Third Herring Brook between June and October 2001 (MassDEP 2001a). Although the bacterial source(s) are currently unknown, elevated counts were found during both dry and wet weather sampling conditions. Suspected sources include discharges from municipal separate storm sewer systems.

Drinkwater River MA94-21

Drinkwater River is a Class B Warm Water Fishery that is 3.5 miles in length. The segment runs from Whiting Street, Hanover through Forge Pond to the inlet of Factory Pond, Hanover. Land-use estimates (top 3, excluding water) for the 21.0 mi^2 subwatershed includes: Forest 44%; Residential 35%; Open Land 7%. The Primary Contact Recreation *Use* for the Drinkwater River is assessed as impaired because of elevated fecal coliform bacteria counts. The Secondary Contact Recreation and Aesthetic uses are assessed as support for the river upstream from the confluence with French Stream, but are assessed as impaired downstream from the confluence with French Stream because of objectionable conditions (excess algal growth, low Secchi disk transparency). The Rockland Municipal WWTP discharge is a known source of total phosphorus. The plant has year-round chlorination of the effluent for removal of bacterial contamination. Other suspected sources for bacterial impairments include stormwater and agricultural runoff.

North River, Segments MA 94-05, MA94-06

Segment MA94-05 and MA94-06 on the North River are both Class SA. The 94-05 segment is designated as an ORW. All the waterbodies at risk in the North River Watershed are significantly impacted by stormwater pollutants. Based on the most recent survey data, water quality consistently does not meet state water quality standards due to the presence of pathogens in the upper and lower reaches of the North River and some of its tributaries. The upper reach of the North River is more often impacted by high fecal coliform counts and the MassDEP has assessed the upper segment of the North River as impaired for primary contact recreation. A notable hot spot for high fecal coliform counts is downstream of the confluence of the Indian Head River and the Herring Brook. The NSRWA conducted sampling in July of 2003 for fecal coliform at two sites on the Third Herring Brook: at the River Street culvert and downstream at Old Bridge Road in Hanover. Fecal coliform counts at both sites were >200 cfu/100 ml (NSRWA, 2003). These data are consistent with the MassDEP 2006 assessment of impairment for primary contact recreation for this stream, with stormwater as the cause of impairment.

The NSRWA teamed up with the MA Division of Marine Fisheries to monitor fecal coliform levels in the estuarine portion of the river. Fecal coliform counts meet shellfishing standards (14 fecal coliform per 100 ml) during the winter months (generally December through April) in portions of this area of the North River. However, summertime counts are consistently in excess of shellfishing standards and after rain events often times more than fishable/swimmable standards, and as result in the summer of 2005 public officials closed beaches to swimmers due to high bacteria counts. According to GeoSyntec, the major source of pathogens is likely to be from stormwater outfalls (two identified), illicit discharges, and failed septic systems (Geosyntec 2002).

Herring River Segment MA94-07

The Town of Scituate landfill located within 100 yards of Herring River (Class SA) was capped in 1999; leading to a marked decrease in the number of waterfowl in the area (Churchill 2003b). The Town of Scituate was required by an Administrative Consent Order (ACO) issued by the Commonwealth of Massachusetts to meet several conditions centered on improving water quality in the North River and estuary (CEI 1998). One of the areas included in the plan was First Herring Brook, since the DMF Sanitary Survey concluded that stormwater adversely impacted water quality in the North River near the Herring River. The plan recommended developing and implementing best management practices (BMPs) to control stormwater runoff in the Herring River subwatershed.

The Town of Scituate is authorized (MA0102695 issued in November 2004 but currently under appeal) to discharge from the Scituate Wastewater Treatment Plant (WWTP) (formerly improperly permitted as a groundwater discharge) 1.6 MGD (average monthly) of treated effluent disinfected using UV light via Outfall #001 to a tidal creek tributary that flows into the Herring River. In 2000 the Town of Scituate's WWTP was upgraded. A pumpout facility is located at the James Landing Marina on First Herring Brook off the Driftway (MA DMF 2003 and Burtner 2003).

French Stream MA94-03
Based on Mass GIS landuse information it is estimated that 8.1% of the total land in the French River subwatershed consists of impervious cover (Class B). A considerable portion of the stream has its headwaters area just south of the former South Weymouth Air Station. All fecal coliform samples from French Stream exceeded 200 cfu/100 mL, with the samples ranging from 230 to 2,000 cfu/100 mL (MassDEP, 2006). Higher bacteria samples were associated with wet weather sampling. A cow pasture located adjacent to the Rockland WWTP was noted as a potential source for this contamination. Cows in the pasture have direct access to the stream and discharge canal (MassDEP 2001a). This has been observed by MWI (Massachusetts Watershed Initiative) Team, and North- South River Watershed Association members since 2001.

Additionally, The Town of Rockland is authorized (MA0101923 issued in August 1999) to discharge from the Rockland Wastewater Treatment Plant (WWTP) a flow of 2.5 MGD (average monthly) of treated sanitary and industrial wastewater via Outfall #001 to the French Stream. During the MassDEP surveys in 2001, field crews noted occasional chlorine/ septic odors in the river downstream from the Rockland WWTP discharge. Chlorination- dechlorination of the discharge now occurs year-round according to the recently renewed permit.

South River MA 94-09.
The lower segment of the South River (MA 94-09) is a tidal estuary up to the Veteran's Park Memorial Park Dam (Class SA). The Primary and Secondary Contact Recreational use is identified with an alert status because of elevated fecal coliform bacteria levels in stormwater outfalls documented near Marshfield center and the occasionally elevated fecal coliform bacteria counts reported by NSRWA. The Town developed design parameters for retrofitting 10 down-town stormwater drains, ranking them according to a variety of factors including the percentage of total impervious surface area treated.

The NSRWA has sampled two stations for fecal coliform in the South River at the Willow Street and Julian Street Bridges for over ten years. High fecal coliform levels are associated with rain events, indicating stormwater runoff as the source of contamination. One-third of the town is on sewer and there are 10,000 residential users tied in to it. The Sewer 2000 project extended the sewer district to serve more homes and business downtown and along the South River, removing six hundred septic systems from the watershed. Failed septic systems in an aging development are threatening one town water supply well with increasing bacterial levels in the Blackmount area. There is a pump-out facility at White's Ferry Marina on Ferry Street, Scituate, that was funded by the Clean Vessel Act to provide free pump-outs (MA DMF 2003 and Burtner 2003).

Green Harbor River- Green Harbor MA 94-11
The Green Harbor (Class SA) and lower river areas have an estimated impervious surfaces cover of 10.3% (Mass GIS). The Town of Marshfield manages a concrete boat ramp at Town Pier Road, which has three boat launching lanes for public access, with parking for 74 trailers (MassDEP, 2006). There is a pump-out facility at Municipal Pier off of Town Pier Road, (Brant Rock) Marshfield. The pump-out was funded by the Clean Vessel Act to provide free pump-outs (MA DMF 2003 and Burtner 2003).

With respect to the Phase II Stormwater Assessment Program, there are approximately 400 outfall pipes, 4,000 catch basins and numerous detention basins that comprise the town's stormwater system. Two-thirds of the town uses on-site disposal systems, and special consideration is needed to address existing and potential problems associated with septic maintenance, inadequate sizing, and design upgrade for beach communities (Marshfield Open Space Plan, 2003). The current wastewater treatment facility is close to reaching its maximum processing capacity of 2.1 million gallons per day. By the summer in 2004, 600 sewer connections (formerly septic systems) had been added to the system. Another area in need of sewering is the Blackmount area of Marshfield. The area is located within the Webster Street aquifer (near Black Mountain Pond, the impaired pond near the headwaters of Green Harbor River). This aquifer is showing signs of increased bacterial and nitrogen levels.

The tide gates at the Route 139 dike restrict the natural flow/tidal flushing of Green Harbor. Fish passage is almost completely inhibited because of the tide gates. The tide gates have been at the Dike Street location since industrial revolution times. They consist of four separate gates that will only allow flow out. This prevents normal tidal flushing which would help to disperse pollutants. Currently the local conservation agent is working with CDM to develop a plan for partial opening in one of the gates. On a side note, since 2004, a herring run reestablished itself into the upper portion of Green Harbor River (Wennemer 2005).

Jones River Watershed MA 94-14

The Jones River watershed is approximately thirty square miles. Today land use in the Jones River (Class SA) watershed is dominated by housing and the businesses to support a consumer society. A Regional school, regional shopping mall, layover yard for the regional commuter train to Boston, a new major east-west highway, new town hall, police and fire, and local schools have all been constructed in the last fifteen years. The growth rate in Kingston has been sustained at about 30% over that same period. The Jones River watershed area is estimated to have 8.5% impervious cover by Mass GIS. The primary causes of bacterial pollution within this segment are stormwater outfalls, illicit discharges, and failing septic systems.

In 2002, GeoSyntec investigated the tidal portion of the Jones River, identifying 8 stormwater outfalls, and observed residential encroachment along the shore (GeoSyntec 2002). The 2002 Sanitary Survey of Kingston Bay identified potential pollution sources from: individual septic systems; storm water runoff directly from storm drains carried into the bay through Jones River and major creeks; and large flocks of waterfowl present during the winter months. In addition, the Stony Brook and Tussock Brook tributary areas have septic systems which are located in the center of town which likely contribute to elevated bacteria counts. Because of this, and the past chronic closure of all shellfish beds due to high levels of fecal coliform, Kingston has constructed a sewer system in its tidal area.

The Silver Lake Commons senior residential facility, Silver Lake High School, Stop & Shop Plaza, Town and Country Mobil Home Park, Independence Mall and the Town have waste water treatment plant discharge permits.

Duxbury Bay MA 94-15

The 2002 Sanitary Survey of Kingston Bay identified potential pollution sources from: individual septic systems; storm water runoff directly from storm drains and pipes that are carried into the bay through Jones River and major creeks; and large flocks of waterfowl present during the winter months. As in the Duxbury section, the pipes primarily represent yard drains and seawall weep holes draining the high groundwater table (Germano, 2002). In the section of Duxbury Bay bordered by Duxbury Beach, thirteen pipes were identified along residential seawalls or at roadway storm drains, eight of which were tested for dry weather flow rate, salinity and fecal coliform concentration. DMF concluded the flow was from fresh water springs in the area and did not represent a problem for shellfish.

Over the last few years, the towns of Kingston and Duxbury have begun to address impacts from individual septic systems and storm water runoff. Duxbury has required twenty-nine dwellings on the south side of Bay Road to connect to an upland community septic system. Both towns have also installed stormwater BMPs at a number of locations to correct storm water runoff problems. Most recently, the Town of Duxbury was awarded a CPR grant for the Snug Harbor Stormwater Mitigation Demonstration Project (FY2005). This project was completed in June 2005. This project should remediate stormwater pollution from Washington Street and Beaverbrook Lane that was identified by DMF as the primary source of pollution to Snug Harbor (MA CZM 2005). In recent years, The Town of Duxbury has received several CPR grant awards to address stormwater pollution to Kingston Harbor, with the ultimate goal of reopening shellfish beds, decreasing beach closures, and supporting diadromous fish habitat. See Section 8.1 on recent and on-going activities in the watershed (Duxbury Bay) for more specific details on these grant projects.

Because Duxbury lacks a sewer system, there is great concern that the spread of residential subdivisions will impact drinking water supplies. Septic systems encroaching on the zones of contribution to municipal wells are a pollution threat because they can discharge nitrogen and possibly bacteria into the groundwater.

Plymouth Harbor MA 94-16

The DMF Shellfish Status Report of July 2000 indicates that in Plymouth Harbor (Class SA), shellfishing is supported, indicative of low bacteria levels. Scattered populations of blue mussels are found along the shoreline, surf clams are found in waters between 10 and 30 feet, and ocean quahogs are found beyond the 60-foot depth (Churchill, 2003b). Plymouth Bay is the waters southeast of line drawn from Saquish Head to the tip of Plymouth Beach, and west of a line from Gurnet Point, to Rocky Point (10.3 square miles). The Bay was listed on the 2002 303(d) List of Impaired Waters as a Category 5 water body due to pathogens. However, the draft 2006 list indicates that the Bay supports all assessed uses (except fish consumption that wasn't assessed) (MassDEP 2006).

Plymouth Harbor was included in the report, '*Nonpoint Source Pollution Assessment of Plymouth, Kingston and Pembroke, 2001-2002'* prepared by GeoSyntec. According to this study, there were 34 outfall pipes identified during the April 2001 field inspection from local streets that drain directly into the harbor, including 15 that had observed flow. Potential nonpoint sources identified in the report include runoff from impervious surfaces, possible illicit discharges into the storm drains, and boat waste.

The Division of Marine Fisheries performed a Sanitary Survey in October 2000 that identified 13 pipes with dry weather flows. These pipes were sampled for fecal coliform concentration with the following results: 2 stations at Stephens Field and Howes Lane had bacterial concentrations too numerous to count (>1000 cfu/100 ml); the remaining 11 stations had results ranging from 20 – 160 cfu/100 ml (Churchill 2000b).

The Town of Plymouth has a comprehensive program to address bacterial pollution in Plymouth Harbor that utilizes funds from the MassDEP/EPA 319 and SRF Programs, the CZM Coastal Pollution Remediation Program and other sources. Early efforts addressed bacterial pollution from wastewater (upgrades of the WWTP) and boats (pump-out facilities). In 2001, a Stormwater Working Group comprised of town and state agency representatives was formed. They prioritized sites from the DMF Sanitary Survey based on the water quality impact and potential for successful mitigation, and have received funding to address the top four priority sites. The Town was awarded a 319 grant in 2002 to install infiltration stormwater treatment devices at Stephens Field, Howes Lane, and Lincoln Street. A CPR grant was awarded in 2003 for the fourth priority site (Samoset Street) that assessed the drainage area and designed the most appropriate stormwater BMP. Other grants and projects subsequent to this are reviewed in Section 8.1, on recent and on-going activities in the watershed (Plymouth Harbor).

The Town of Plymouth was formerly authorized to discharge from the Plymouth Wastewater Treatment Plant (WWTP), on Water Street, a flow of 1.75 MGD (average monthly) of treated effluent via outfall #001 to Plymouth Harbor consistent with the requirements of the Ocean Sanctuaries Act and to discharge the remainder of the treated volume into the ground within the Eel River sub-watershed The WWTP on Water Street (which went online in March 1970) was abandoned after the new 5.2 MGD facility at Camelot Industrial Park became operational in May 2002. The Plymouth WWTP's treated effluent, with seasonal chlorination, is directed accordingly: (1) 88.2% average annual daily flow is discharged to Plymouth Harbor and (2) 11.8% average annual daily flow is discharged to the ground (Frizzell 2004).

Bluefish River MA94-30

The location of this Class SA, 0.06 square mile segment, runs from the Saltmarsh north of Harrison Street, Duxbury to mouth at Duxbury Bay, Duxbury. Land-use estimates (top 3, excluding water) for the 2.3 mi^2 subwatershed: Residential 41%; Forest 31%**;** Open Land 18%. The DMF Shellfish Status Report of July 2000 indicates that Area CCB46.5 (which contains 0.02mi^2 of this segment) is prohibited and Area CCB46.2 (which contains 0.04 mi^2 of this segment) is conditionally approved (MA DFG 2000). Based on the DMF shellfish growing area status, the *Shellfish Harvesting Use* is assessed as impaired due to elevated fecal coliform bacteria counts. It should be noted that three septic system pollution sources were eliminated since they have connected to the town sewer system (Churchill 2003c). This project received an innovation award from the Massachusetts Municipal Association (MMA) in 1996 (Duxbury 1996). Although the current sources are unknown, discharges from municipal separate storm sewers are still suspected sources of bacteria.

Prioritization of Future Activities

In an effort to provide guidance for setting bacterial implementation priorities within the South Coastal Watershed, a summary table is provided. Table 6-1 below provides a prioritized list of pathogen-impaired segments in the South Coastal Watershed that will require additional bacterial source tracking work and implementation of structural and non-structural Best Management Practices (BMPs). Additionally, water quality improvements have been observed in several of the segments and these segments may be candidates for follow-up monitoring to determine if they should be delisted. Also, priority should be give to monitoring segments where there is insufficient information to understand the current conditions. Since limited source information and data are available in each impaired segment a simple scheme was used to prioritize segments based on fecal coliform concentrations. High priority was assigned to those segments where either dry or wet weather concentrations (end of pipe or ambient) were equal to or greater than 10,000 cfu /100 ml. Medium priority was assigned to segments where concentrations ranged from 1,000 to 9,999 cfu/100ml. Low priority was assigned to segments where concentrations were observed less than 1,000 cfu/100 ml. MassDEP believes the higher concentrations are indicative of the potential presence or raw sewage and therefore they pose a greater risk to the public. It should be noted that in all cases, waters exceeding the water quality standards identified in Table 6- 1 are considered impaired.

Also, prioritization is adjusted upward based on proximity of waters, within the segment, to sensitive areas such as Outstanding Resource Waters (ORW's), or designated uses that require higher water quality standards than Class B, such as public water supply intakes, public swimming areas, or shellfish areas. Best practical judgment was used in determining this upward adjustment. Generally speaking, waters that were determined to be lower priority based on the numeric range identified above were elevated up one level of priority if that segment were adjacent to or immediately upstream of a sensitive use. An asterisk * in the priority column of the specific segment would indicate this situation.

Table 6-1. Prioritized List of Pathogen- impaired Segments for the South Coastal Watershed.

Segment ID	Segment Name	Segment Type	Size[1]	Segment Description	Priority "Dry"	Priority "Wet"
MA94-32	Cohasset Cove	Estuary, SA	0.09	The waters south of a line drawn from the Bassing Beach jetty, Scituate westerly to the opposite shore, Cohasset not including Cohasset Cove, Cohasset/Scituate	Low*, Shellfishing	Medium*, Shellfishing
MA94-01	Cohasset Harbor	Estuary, SA	0.70	South of a line drawn from the northwest point of Scituate Neck, Scituate to just north of Quarry Point, Cohasset – not including Cohasset Cove	Low* (Shellfishing, Public Swimming)	Medium* (Shellfish., Public Swimming)
MA94-19	The Gulf	Estuary, SB	0.13	Headwaters, outlet Hunter's Pond, Scituate to confluence with Cohasset Cove just north of Border Street, Cohasset.	Insufficient Data*, Shellfishing	Insufficient Data* Shellfishing
MA94-33	Musquashcut Pond	Estuary, SA	0.11	Scituate (formerly reported as MA94105)	Insufficient Data*, Shellfishing	Insufficient Data*, Shellfishing
MA94-02	Scituate Harbor	Estuary, SA	0.32	West of line drawn across the mouth of Scituate Harbor, from the elbow of the jetty southeast off Lighthouse Point to the jetty northeast of the US Coast Guard station, Scituate	Low* (Shellfishing, Public Swimming)	Medium* (Shellfish., Public Swimming)
MA94-34	Ellisville Harbor	Estuary, SA	0.01	Plymouth	Medium* Shellfishing	Medium* Shellfishing
MA94-03	French Stream	River, B	6.1	Headwaters on southeast side of Naval Air Station, Rockland through Studleys Pond to confluence with Drinkwater River, Hanover. Miles 5.9-0.0	Low	Medium
MA94-24	Iron Mine Brook	River, B, ORW	1.4	Headwaters, north of Route 139, Hanover to the confluence with Indian Head River, Hanover.	Medium* ORW	Medium* ORW
MA94-31	Second Herring Brook	Estuary, SA, ORW	0.003	From the Second Herring Brook Pond Dam, Norwell to the confluence with the North River, Norwell.	Insufficient Data*, Shellfishing	Insufficient Data*, Shellfishing
MA94-27	Third Herring Brook	River, B, ORW	5.3	Headwaters, outlet of Jacobs Pond, Norwell/Hanover to confluence with North River, Norwell/Hanover.	Medium* ORW	Medium* ORW
MA94-21	Drinkwater River	River, B	3.5	From Whiting Street, Hanover through Forge Pond to the inlet of Factory Pond, Hanover.	Medium	Medium

Segment ID	Segment Name	Segment Type	Size[1]	Segment Description	Priority "Dry"	Priority "Wet"
MA94-05	North River	Estuary, SA, ORW	0.3	Confluence of Indian Head River and Herring Brook, Hanover/Pembroke to Route 3A (Main Street), Marshfield/Scituate.	Medium* ORW, Shell-fishing	High* ORW, Shellfishing
MA94-07	Herring River	Estuary, SA	0.08	Outlet Old Oaken Bucket Pond to confluence with North River.	Low* Shellfishing	Medium* Shellfishing
MA94-09	South River	Estuary, SA, ORW	0.63	Main Street, Marshfield to confluence with North River.	Medium* ORW Shellfishing	High* ORW Shellfishing
MA94-06	North River	Estuary, SA	0.56	Route 3A (Main Street), Marshfield/Scituate to mouth at Massachusetts Bay, Scituate.	Low* Shellfishing	Medium* Shellfishing
MA94-11	Green Harbor	Estuary, SA	0.08	From the tide gates at Rte 139, Marshfield to the mouth of the harbor at MA Bay/Cape Cod Bay, Marshfield	Insufficient Data* Shellfishing	Insufficient Data* Shellfishing
MA94-14	Jones River	Estuary, SA	0.09	Elm Street, Kingston to mouth at Duxbury Bay, Kingston.	Medium* Shellfishing	Medium* Shellfishing
MA94-15	Duxbury Bay	Estuary, SA	12.7	North and west of a line drawn from Saquish Head to the tip of Plymouth Beach to High Cliff, Plymouth – excluding Back River and Bluefish River, Duxbury and Jones River, Kingston	Low* (showing improve-ment) Shellfishing	Medium* (showing improve-ment) Shellfishing
MA94-16	Plymouth Harbor	Estuary, SA	2.53	South of a line drawn from the tip of Plymouth Beach to High Cliff, Plymouth	Low* (showing improve-ment) Shellfishing	Medium* (showing improve-ment) Shellfishing
MA94-30	Bluefish River	Estuary, SA	0.07	Saltmarsh north of Harrison Street, Duxbury to mouth at Duxbury Bay, Duxbury	Medium* Shellfishing	Medium* Shellfishing

MassDEP believes that segments ranked as high priority in Table 6-1 are indicative of the potential presence of raw sewage and therefore they pose a greater risk to the public. Elevated dry weather bacteria concentrations could be the result of illicit sewer connections or failing septic systems. As a result, the first priority should be given to bacteria source tracking activities in those segments where sampling activities show elevated levels of bacteria during dry weather. Identification and remediation of dry weather bacteria sources is usually more straightforward and successful than tracking and eliminating wet weather sources. If illicit bacteria sources are found and eliminated, it should result in a dramatic reduction of bacteria concentration in the segment in both dry and wet-weather. Segments that remain impaired during wet weather should be evaluated for stormwater BMP implementation opportunities starting with less costly non-structural practices first (such as street sweeping, and/or managerial approaches using local regulatory controls), and lastly, more expensive structural measures. Structural stormwater BMP implementation may require additional study to identify cost efficient and effective technology. Last, the segments that are showing improvement and/or where information is lacking should be candidates for follow-up monitoring to determine current conditions and evaluate whether delisting is appropriate.

7.0– Pathogen TMDL Development

Section 303 (d) of the Federal Clean Water Act (CWA) requires states to identify waters that do not meet the water quality standards on a list of impaired waterbodies. The 2012 Integrated List identifies a total of 20 river and estuary segments within the South Coastal Watershed for use impairment caused by excessive indicator bacteria concentrations.

The CWA requires each state to establish Total Maximum Daily Loads (TMDLs) for listed waters and the pollutant contributing to the impairment(s). TMDLs determine the amount of a pollutant that a waterbody can safely assimilate without violating the water quality standards. Both point and non-point pollution sources are accounted for in a TMDL analysis. EPA regulations require that point sources of pollution (those discharges from discrete pipes or conveyances) subject to NPDES permits receive a waste load allocation (WLA) specifying the amount of a pollutant they can release to the waterbody. Non-point sources of pollution (all sources of pollution other than point) receive load allocations (LA) specifying the amount of a pollutant that they can release to the waterbody. In the case of stormwater, it is often difficult to identify and distinguish between point source discharges that are subject to NPDES regulation and those that are not. Therefore, EPA has stated that it is permissible to include all point source stormwater discharges in the WLA portion of the TMDL. MassDEP has taken this approach. In accordance with the CWA, a TMDL must account for seasonal variations and a margin of safety, which accounts for any lack of knowledge concerning the relationship between effluent limitations and water quality. Thus:

TMDL = WLAs + LAs + Margin of Safety (MOS)

Where:

WLA = Waste Load Allocation which is the portion of the receiving water's loading capacity that is allocated to each existing and future point sources of pollution.

LA = Load Allocation which is the portion of the receiving water's loading capacity that is allocated to each existing and future non-point source of pollution (and point sources not subject to NPDES permits).

MOS = Margin of safety, either explicitly or implicitly.

This TMDL was uses an alternative standards-based approach, which is based on indicator bacteria concentrations, but considers the terms of the above equation. This approach is more in line with the way bacteria pollution is regulated (i.e., according to concentrations standards), however, the standard loading approach is provided as well.

7.1 General Approach: Development of TMDL Targets

For this TMDL the MassDEP developed two types of daily TMDL targets. First, MassDEP set daily concentration TMDL targets for all potential pathogen sources by category (i.e., storm water, NPDES, etc) and surface water classification. Expressing a loading capacity for bacteria in terms of concentrations set equal to the Commonwealth's adopted criteria, as provided in Table 7-1, provides the clearest and most understandable expression of water quality goals to the public and to groups that conduct water quality monitoring. MassDEP recommends that the concentration targets be used as the primary guide for implementation (see Section 7.2).

Second, MassDEP estimated the total maximum daily load for each river or stream segment as a function of flow (4 South Coastal segments). Expressing the loading capacity for bacteria in terms of loadings (e.g., numbers of organisms per day, cfu/day), although valid as a TMDL, is more difficult for the public to understand because the "allowable" loading number varies with flow over the course of the day and season. Also, the loading numbers are very large (i.e. billions or trillions of bacteria per day) and therefore difficult to interpret as they do not relate directly to the State Water Quality Standards or public health criteria.

For embayments, however, total maximum daily pathogen loads were typically calculated based on long-term average runoff volumes. Because of runoff morphology in the South Coastal watershed, for the purposes of this report, the loadings calculations for 16 estuary segments were estimated by using 1) the concentration allowed by appropriate criteria from the Massachusetts Water Quality Standards and 2) the estimated volume of runoff entering the embayment from each contributing watershed (See Section 7.3. for detailed methodology).

It is important to note that MassDEP realizes that an iterative approach to achieving compliance with this pathogen TMDL is warranted, given the vast potential number of bacteria sources, and the difficulty of identifying and removing some sources (e.g., stormwater). While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that adaptive management is needed for implementation of stormwater control measures that includes prioritization of outfalls and the application of BMPs. MassDEP believes this is approach is consistent with current EPA guidance and regulations as stated in a November 22, 2002 EPA memo from Robert Wayland (see Appendix B). Further discussion on this issue is provided in Section 8.

7.2 Waste Load Allocations (WLAs) and Load Allocations (LAs) As Daily Concentration (CFU/100 ml).

To ensure attainment with water quality standards throughout the waterbody, MassDEP emphasizes the simplest and most readily understood way of meeting the TMDL is to have a goal of bacteria sources not exceeding the WQS criteria at the point of discharge. This is also an implicit conservative approach with respect to the MOS.

Sources of indicator bacteria in the South Coastal Watershed are varied; however data indicate that most of the bacteria sources are likely stormwater related. (Sections 4, 5 and 6 of this document discuss in more detail the types of sources identified as well as their prioritization for implementation.) Point sources within the South Coastal Watershed include several wastewater treatment plants (WWTPs) and other NPDES-permitted wastewater discharges, such as Stormwater Phase II communities: (1) Waste Water Treatment Plants: Cohasset (MA0100285); Rockland (MA0101923; Scituate (MA0102695); Plymouth (MA0100587); Stellwagon Bank National Marine Sanctuary (MA0090531); (2) Phase II stormwater: Cohasset (MAR041060); Cohasset (MAR041032); Rockland (MAR041058); Hanover (MAR041036); Norwell (MAR041052); Marshfield (MAR041048); Kingston (MAR041041); Duxbury (MAR041034); Plymouth (MAR041150).

NPDES wastewater discharge WLAs for WWTPs are set at the water quality standards. All piped discharges are, by definition, point sources regardless of whether they are currently subject to the requirements of NPDES permits. Therefore, a WLA set equal to the WQS criteria will be assigned to the portion of the stormwater that discharges to surface waters via storm drains. For any illicit sources including illicit discharges to stormwater systems and sewer system overflows (SSO's) the goal is complete elimination (100% reduction). The specific goal for controlling combined sewer overflows (CSO's) is meeting water quality standards through implementation of approved Long-Term Control Plans. It is recommended that these concentration targets be used to guide implementation. The goal to attain WQS at the point of discharge is environmentally protective, and offers a practical means to identify and evaluate the effectiveness of control measures. In addition, this approach establishes clear objectives that can be easily understood by the public and others responsible for monitoring activities. Success of control efforts and subsequent conformance with TMDL will be determined by documenting that a sufficient number of bacteria samples from receiving water meet the appropriate indicator criteria (WQS) for the water body.

Table 7-1 presents the TMDL indicator bacteria WLAs and LAs for the various source categories as daily concentration targets for the South Coastal Watershed. WLAs (to address point sources of pollution) and LAs (to address non-point sources of pollution) are presented by applying both the former (fecal coliform) and recently revised (E.coli and enterococcus) WQS. The full version of the revised WQS can be accessed at: http://www.mass.gov/dep/service/regulations/314cmr04.pdf

Table 7-1. Waste Load Allocations (WLAs) and Load Allocations (LAs) as Daily Concentrations (CFU/ 100 ml).

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (cfu/100 mL)[1]	Load Allocation Indicator Bacteria (cfu/100 mL)[1]
A, B, SA, SB (prohibited)	Illicit discharges to storm drains	0	
	Leaking sanitary sewer lines	0	Not Applicable
	Failing septic systems	Not Applicable	0
A (Includes filtered water supply) & B	Any regulated discharge- including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges [7,9], and combined sewer overflows[6].	Either; E. coli <=geometric mean[5] 126 colonies per 100 mL; single sample <=235 colonies per 100 mL; or b) Enterococci geometric mean[5] <= 33 colonies per 100 mL and single sample <= 61 colonies per 100 mL	Not Applicable
	Nonpoint source stormwater runoff[4]	Not Applicable	Either E. coli <=geometric mean[5] 126 colonies per 100 mL; single sample <=235 colonies per 100 mL; or Enterococci geometric mean[5]<= 33 colonies per 100 mL and single sample <= 61 colonies per 100 mL

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (cfu/100 mL)[1]	Load Allocation Indicator Bacteria (cfu/100 mL)[1]
SA (Approved for shellfishing)	Any regulated discharge - including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Fecal Coliform <= geometric mean, MPN, of 14 organisms per 100 mL nor shall 10% of the samples be >=28 organisms per 100 mL	Not Applicable
	Nonpoint Source Stormwater Runoff[4]	Not Applicable	Fecal Coliform <= geometric mean, MPN, of 14 organisms per 100 mL nor shall 10% of the samples be >=28 organisms per 100 mL
SA & SB[10] (Beaches[8] and non-designated shellfish areas)	Any regulated discharge - including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Enterococci - geometric mean[5] <= 35 colonies per 100 mL and single sample <= 104 colonies per 100 mL	Not Applicable
	Nonpoint Source Stormwater Runoff[4]	Not Applicable	Enterococci -geometric mean[5] <= 35 colonies per 100 mL and single sample <= 104 colonies per 100 mL
SB (Approved for shellfishing w/depuration)	Any regulated discharge - including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Fecal Coliform <= median or geometric mean, MPN, of 88 organisms per 100 mL nor shall 10% of the samples be >=260 organisms per 100 mL	Not Applicable
	Nonpoint Source Stormwater Runoff[4]	Not Applicable	Fecal Coliform <= median or geometric mean, MPN, of 88 organisms per 100 mL nor shall 10% of the samples be >=260 organisms per 100 mL

[1] Waste Load Allocation (WLA) and Load Allocation (LA) refer to fecal coliform densities unless specified in table.

[2] In all samples taken during any 6 month period

[3] In 90% of the samples taken in any six month period;

[4] The expectation for WLAs and LAs for stormwater discharges is that they will be achieved through the implementation of BMPs and other controls.

[5] Geometric mean of the 5 most recent samples is used at bathing beaches. For all other waters and during the non-bathing season the geometric mean of all samples taken within the most recent six months, typically based on a minimum of five samples.

[6] Or other applicable water quality standards for CSO's

[7] Or shall be consistent with the Waste Water Treatment Plant (WWTP) National Pollutant Discharge Elimination System (NPDES) permit.

[8] Massachusetts Department of Public Health regulations (105 CMR Section 445)

[9] Seasonal disinfection may be allowed by the Department on a case-by-case basis.
[10] Segments designated as CSO have a long term control plan in place.

Note: this table represents waste load and load allocations based on water quality standards current as of the publication date of these TMDLs. If the pathogen criteria change in the future, MassDEP intends to revise the TMDL by addendum to reflect the revised criteria.

It is recommended that these concentration targets be used to guide implementation. The goal to attain WQS at the point of discharge is conservative and environmentally protective, and offers a practical means to identify and evaluate the effectiveness of control measures. In addition, this approach establishes clear objectives that can be easily understood by the public and others responsible for monitoring activities. Success of the control efforts and subsequent conformance with the TMDL can be determined by documenting that a sufficient number of valid bacteria samples from a segment meet the appropriate bacteria indicator criterion for the segment's water quality classification. Compliance will be measured by concentrations measured in the receiving water.

Potential Sources of Bacteria Contamination

Some insight on potential sources of bacteria is gained using dry or wet weather bacteria concentrations as a benchmark for reductions. Where a segment is identified as having high dry weather concentrations, sources such as permitted discharges, failing septic tanks, illicit sanitary sewers connected to storm drains, and/or leaking sewers may be the primary contributors. Where elevated levels are observed during wet weather, potential sources may include flooded septic systems, surcharging sewers (combined sewer overflows or sanitary sewer overflows), and/or stormwater runoff. In urban areas, sources of elevated bacteria concentrations can include runoff in areas with high populations of domestic animals or pets. In agricultural areas, sources may include runoff from farms, poorly managed manure piles or areas where wild animals or birds congregate. Other potential sources may include sanitary sewers connected to storm drains that result in flow that is retarded until the storm drain is flushed during wet weather. Sections 4, 5 and 6 of this document discuss in more detail the types of sources identified as well as their prioritization for implementation.

7.3 TMDL Expressed as Daily Load (CFU/Day)

The following section describes the approach for deriving allowable daily bacteria loads for the South Coastal Watershed.

7.3.1 Rivers

Flow in rivers and streams are highly variable. Nearly all are familiar with seeing the same river as a raging torrent and at another time as just a trickle. In many areas, seasonal patterns are evident. A common pattern is high flow in the spring when winter snow melts and spring rains swell rivers. Summer time generally is a period of low flows except for the extreme events of heavy rainfall storms up the scale to hurricanes. Across the United States, the US Geological Survey and others maintain a network of stream gages that measure these flows on a continuous basis thus providing quantitative values to the qualitative scenes described above. These flow measurements are reported in terms of a volume of water passing the gage in a given time period. Often the reported values are in cubic feet per second. A cubic foot of water is 7.48 gallons, and flows can range from less than a cubic foot per second to many thousands of cubic feet per second depending on the time of year and the size of the river or stream. The size of the river or stream and the amount of water that it usually carries is determined by the area of land it drains (known as a watershed), the type of land in the watershed, and the amount of precipitation that falls on the watershed. A common way that USGS reports flow is the cubic feet per second (cfs) averaged over a day since flow can vary even over the course of a day.

In addition to quantity, there is of course a quality aspect to water. Most chemical constituents are measured in terms of weight per volume, generally using the metric system with milligrams (mg) per liter (L) as the units. A milligram is one thousandth of a gram, 28 of which weigh one ounce. A liter is slightly more than a quart, so there are 3.76 L in a gallon. The total amount of material is called mass and is the quantity in a given volume of water. For instance, if a liter of water had 16 milligrams of salt and one evaporated all of the water, the 16 milligrams of salt would remain. A volume of two liters with the same 16 mg/L of salt would yield 32 milligrams of salt upon evaporation of the water. So, the total amount of material in a volume of water is the combination of the amount (volume) of water and the concentration of the substance being assessed. These two characteristics, in compatible units, are multiplied to determine the quantity of the material present. In the case of a river or stream, the total amount of material passing a gaging station in a day is the total volume multiplied by the concentration of the chemical being assessed. This quantity often is referred to as "load", and if the time frame is a day, the quantity is called the "daily load". If a year is used as the time frame it is called a "yearly" or "annual" load.

Bacteria also can be discussed in terms of concentrations and loads. However, the common way of expressing concentrations of bacteria are in terms of numbers rather than weight (although one could use weight). Bacteria standards for water are written in terms of concentrations, and while the method of determining the concentrations can be by direct count or estimated through the outcome of some reaction, it is numbers that are judged to be in a given volume of water. Once again, the load is determined by the concentration multiplied by the volume of water. As can be seen, changes in concentration and/or changes in flow result in changes in the loads. Also, maximum loads can increase and if flow increases in proportion, the concentration will remain the same. For instance, if the total number of bacteria entering a section of stream doubles, but the flow also doubles, the concentration remains the same. This means that as flow increases, allowable load can increase so that concentration remains constant (or lower if dilution occurs) while continuing to meet the water quality criterion. In its simplest application, this is the concept of the flow duration curve approach. At each given flow, the maximum load that can enter and still meet the concentration criterion is set. If the numbers of bacteria entering are higher than this allowable number, then a reduction is needed. As a practical matter, determining the flow at each sampling point is resource intensive, expensive and generally is not done. Given this, however, some estimates of flow can be derived from USGS gages in the watershed or in nearby similar watersheds if there is no gage in the impaired stream.

The pollutant loading that a waterbody can safely assimilate is expressed as either mass-per-time, toxicity or some other appropriate measure (40 CFR § 130.2)1. Typically, TMDLs are expressed as total maximum daily loads. Expressing stormwater pathogen TMDLs in terms of daily loads is difficult to interpret given the very high numbers of indicator bacteria and the magnitude of the allowable load is dependent on flow conditions and, therefore, will vary as flow rates change. For example, a very high load of indicator bacteria is allowable if the volume of water that transports indicator bacteria is also high. Conversely, a relatively low load of indicator bacteria may exceed the water quality standard if flow rates are low. Given the intermittent nature of stormwater related discharges, MassDEP believes it is appropriate to express stormwater-dominated indicator bacteria TMDLs proportional to flow for flows greater than 7Q10. This approach is appropriate for stormwater TMDLs because of the intermittent nature of stormwater discharges. However, the WLAs for continuous discharges are not set based on the receiving water's proportional flow, but rather, are based on the criteria multiplied by the permitted effluent flow (applying the appropriate conversion factor). Because the water quality standard is also expressed in terms of the concentration of organisms per 100 mL, the acceptable in-stream daily load or TMDL is the product of that flow and the criterion.

In recognition that bacteria loads from stormwater are flow dependent, the total TMDL can be calculated as a function of flow, and allocated to different source categories, as shown in the following equation:

TMDL = WQS x QT = WLA + LA + MOS + NB

Where:
WLA = allowable load for point source categories (including piped stormwater)
LA = allowable load for nonpoint source categories
QT = stream flow on any given day when >7Q10
MOS = margin of safety
NB = natural background conditions
WQS = Massachusetts Water Quality Standard criterion

There are 20 South Coastal segments included in this report that are pathogen impaired that are currently listed on the CWA § 303(d) list of impaired waters. These segments consist of 16 marine segments which are pathogen impaired (Class SA). The Four (4) Class B freshwater river segments include French Stream (MA94-03), Iron Mine Brook (MA94-24), Third Herring Brook (MA94-27) and Drink Water River (MA94-21).

7.3.2 Embayments

For the 16 South Coastal estuary- embayments, the allowable loading was estimated using the same methodology employed in the North Coastal and Buzzards Bay Pathogen TMDL Reports, (MassDEP 2012, 2009). These segments along the coastline are dominated by sandy, well drained soils, which have been largely formed by tidal action from the ocean. Many embayments in the South Coastal watershed are fed by a surface water feature such as a river or stream. The landuse, associated with many of the South Coastal embayment subwaterheds, is comprised largely of urbanized or heavily populated suburbanized areas, (see Figure 2-1) which represent at least 50% of the land-use in the watershed. Many of these areas make up communities with a fairly high percentage of impervious cover. As a result, the method for estimating allowable loading for the 16 South Coastal estuary- embayments was calculated by multiplying the concentration allowed by the Massachusetts Water Quality Standards by the estimated volume of runoff entering from each contributing watershed. Runoff estimates for the region were extracted from historical precipitation and runoff records maintained by the USGS and the Massachusetts Department of Conservation and Recreation (DCR). DCR precipitation records from 1915-2007 for the entire Eastern Coastal Area of Massachusetts (including the South Coastal area) show an average precipitation for the region of 45.7 inches per year (3.8 ft/year) (DCR 2010 http://www.mass.gov/dcr/watersupply/rainfall/). USGS maintains a gage network throughout the state of Massachusetts. Runoff records take into account water that is lost to evapotranspiration or infiltration processes. The average runoff for the State of Massachusetts is 2.0 feet per year based on a period of record form 1905-2007 (personal communication (Wilcock, David 2008). The estimated volume of runoff entering from each contributing watershed was conservatively estimated by assumed that all precipitation to impervious areas runs directly off into a local waterway (average runoff value of 45.7 inches per year or 3.8 feet). In previous areas a conservative estimate of 24 inches per year (2.0 feet) was used which represents the 50 percentile of runoff values observed at USGS gages in New England (Hydrologic Unit 1) based on long-term records (1905-2007).

These runoff values were multiplied by the contributing watershed acreage and the most stringent water quality standard for each segment to calculate the allowable load or total number of bacteria per year (cfu/year). The daily TMDL was then calculated by dividing the allowable annual load by the number of days, on average, that it rains. Since it rains once every three to four days the annual load was divided by 105 days per year with rainfall to calculate the daily load. Precipitation data were based on information interpreted from the National Oceanic and Atmospheric Administration (NOAA) at http://cdo.ncdc.noaa.gov/ancsum/ACS.

The 105 days per year of rainfall represents an average of the total number of days of precipitation >0.01". It is assumed that precipitation less than 0.01 inches either adsorbs into the ground or evaporates and therefore does not runoff. Finally, the total daily load allocation was then split into wasteload and load allocations based on the ratio of impervious to pervious land within each watershed.

7.3.3 Water Quality Criteria

The water quality criteria used to develop the TMDL was based on the most stringent designated use identified in the Massachusetts Water Quality Standards. In the case of the South Coastal Watershed the principal and most sensitive uses include primary contact recreation and shellfishing use. A summary of the relevant water quality criteria that apply to the South Coastal watershed are summarized in Table 7-2.

Table 7-2. Water Quality Targets for South Coastal Watershed.

Waterbody Use	**Shellfishing Criterion (apply in DMF approved areas)**		**Primary Contact Recreation Criterion**			
	Fecal coliform (cfu/100LmL)		E. coli (cfu/100mL)		Enteroccoci (cfu/100mL)	
Waterbody Class	Geometric Mean	10% of samples not to exceed	Geometric Mean	Single Sample Maximum d	Geometric Mean	Single Sample Maximum d
A (filtered Public Water Supply)	None	None	126 [a]	235 [a]	33[b]	61[b]
B	None	None	126 [a]	235 [a]	33[b]	61[b]
SA	14 [c]	28 [c]	None	None	35 [b]	104 [b]
SB	88 [c]	260 [c]	None	None	35 [b]	104 [b]

[a] e.coli is the indicator, [b] enterococci is the indicator, [c] Fecal coliform is the indicator, [d] 25% of samples not to exceed. MassDEP is basing the TMDL on the recently (1/07) revised Massachusetts Water Quality Standards for the indicator organisms (E. coli and enterococci). The full version of the revised standards can be found at: http://mass.gov/dep/water/laws/regulati.htm#wqual

Primary contact recreation criteria apply to all fresh water systems and will pertain for all river segments in the South Coastal watershed. For marine segments shellfishing criteria are the most stringent and will be applied to those marine segments that are actively managed by DMF for shellfishing in accordance with the requirement of the NSSF. Many of the waterbodies in the South Coastal watershed have been prohibited to commercial shellfishing since at least the year 2000. It is unclear as of the date of this report whether all these prohibitions are due to water quality, health risk (dense population, number of WWTP outfalls, mooring fields, marinas), or insufficient data to make a determination.

7.3.4 Calculating the TMDL as Daily Loads (Colonies/Day)

MassDEP believes it is appropriate to express indicator bacteria TMDLs proportional to flow. Because the water quality standard is also expressed in terms of the concentration of organisms per 100 mL, the acceptable in-stream daily load or TMDL is the product of that flow and the water quality standard criterion, which is the same approach used for any pollutant with a numerical criterion. In the case of estuary- embayments, contributing watershed runoff is the flow that is being used to determine the maximum daily load.

The TMDL is calculated based on flow or volume and the concentration of the applicable Massachusetts water quality standard criterion for bacteria in the river. Once the flow or volume is estimated, the total maximum daily load of bacteria in numbers per day is derived by multiplying the estimated flow or runoff volume by the water quality standard criterion for the indicator bacteria. The actual allowable load of bacteria in fresh water systems where the primary contact recreation standard applies, in numbers of bacteria per day, varies with flow at or above 7Q10 in each segment (as presented in Figure 7-1a [when e.coli is the indicator], Figure 7-1b [when enterococci is the indicator]. This approach sets a target for reducing the loads so that water quality criteria for indicator bacteria are met at all flows equal to or greater than 7Q10.

Example calculations for determining the TMDL are provided as follows:

For Rivers: The TMDL associated each 1.0 cubic foot per second of flow to meet a water quality standard of 126 cfu/100 ml (E.coli, Class A or B,) or 33 cfu/100 mL (enteroccoci Class A or B,) is derived as follows:

River Segment (E. coli, Class A or B) TMDL= (0.02832 m3/sec) x (86,400 sec/day) x (1,000 liters/m3) x (1,000 ml/liter) x (126 cfu/100ml) = 3.08 x 10^9 cfu/day.

River Segment (enteroccoci, Class A or B) TMDL= (0.02832 m3/sec) x (86,400 sec/day) x (1,000 liters/m3) x (1,000 ml/liter) x (33 cfu/100ml) = 8.07 x 10^8 cfu/day.

For River segments the TMDL is proportioned between the WLA and LA by multiplying the daily load by the percent impervious for the WLA, and by multiplying the daily load by the percent pervious for the contributing watershed for the LA. Table 7-3 summarizes the TMDL for the fresh water segments in the South Coastal Watershed.

Figure 7-1a: TMDL: E. coli Rivers

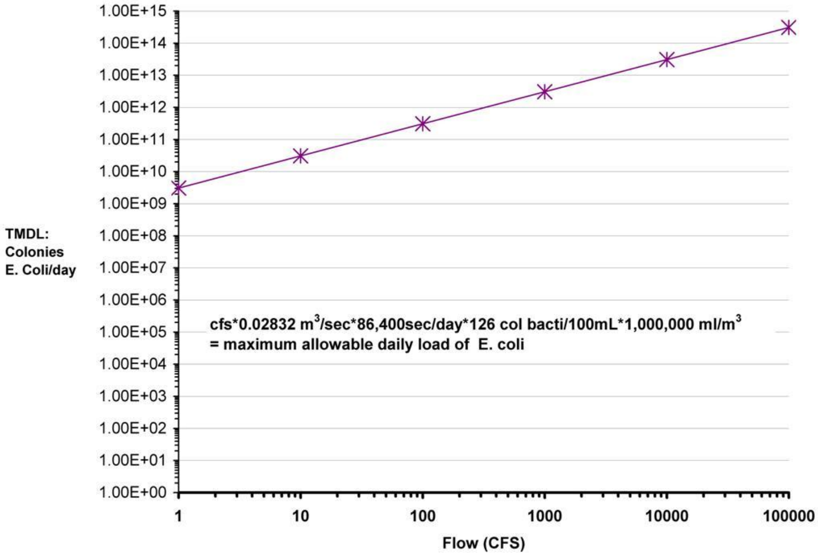


Figure 7-1b:TMDL: Entercoccus Rivers

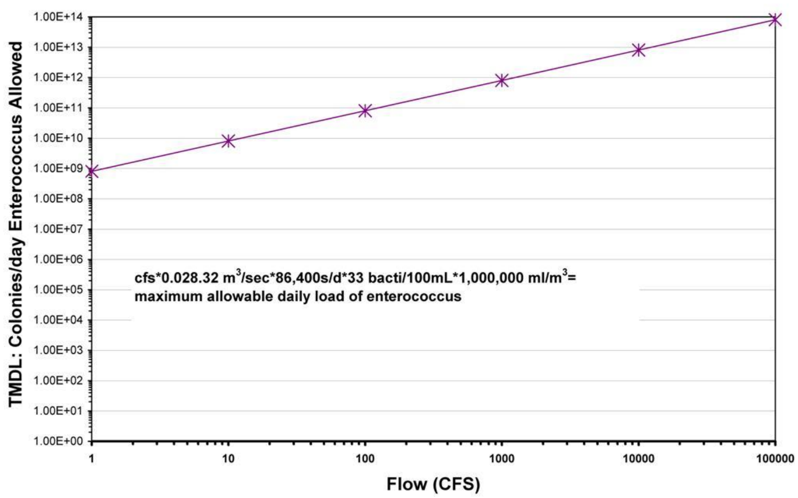


Table 7-3: WLA and LA TMDL (Rivers) By Segment (CFU/Day).

Segment[2], Waterbody/WQS Classification	TMDL Allocation[1]	FLOW, cfs					
	WLA / LA	1	10	100	1,000	10,000	100,000
MA94-03 French Stream, B	18.1%	5.59E+08	5.59E+09	5.59E+10	5.59E+11	5.59E+12	5.59E+13
	81.9%	2.53E+09	2.53E+10	2.53E+11	2.53E+12	2.53E+13	2.53E+14
MA94-24 Iron Mine Brook, B	10.3%	3.18E+08	3.18E+09	3.18E+10	3.18E+11	3.18E+12	3.18E+13
	89.7%	2.77E+09	2.77E+10	2.77E+11	2.77E+12	2.77E+13	2.77E+14
MA94-27 Third Herring Brook, B	11.6%	3.58E+08	3.58E+09	3.58E+10	3.58E+11	3.58E+12	3.58E+13
	88.4%	2.73E+09	2.73E+10	2.73E+11	2.73E+12	2.73E+13	2.73E+14
MA94-21 Drink-water River, B	15.3%	4.72E+08	4.72E+09	4.72E+10	4.72E+11	4.72E+12	4.72E+13
	84.7%	2.61E+09	2.61E+10	2.61E+11	2.61E+12	2.61E+13	2.61E+14

[1] TMDL allocation: % surface area of segment watershed for WLA (impervious) and LA (pervious), respectively

[2] All Class B segments based on 126 E. coli/100ml water quality standard

__For Embayments__

For embayments the size of the watershed contributing to the flow must be accounted for. The following equation illustrates the calculation that applies to the estuarine segments.

Embayment TMDL = (1 acre) x (43,560 ft^2/acre) x ((2.0 ft (% pervious area) + 3.8 ft (% impervious area)/105 days)) x (7.48 gallons/ft^3) x (3.78 liters/gallon) x (Applicable WQ Standard cfu/100 ml) x (1000 ml/l)

Similar to the River TMDL calculation, the embayment TMDL is proportion between the WLA and LA by multiplying the daily load by the percent impervious for the WLA, and by multiplying the daily load by the percent pervious for the contributing watershed for the LA. Table 7-4 summarizes the TMDL for the marine segments in the South Coastal Watershed.

Table 7-4: WLA and LA TMDL by Embayment for the South Coastal Watershed (CFU/Day).

South Coastal Segment[2], Waterbody/ WQS Classification	TMDL[1] WLA	WQS/ Indicator	Watershed size (Acres)	TMDL (cfu/day)	WLA	LA
	LA	(cfu/100mL)				
Cohasset Cove, MA94-32, SA	6.5%	F. coliform	10,411	3.36E+12	2.18E+11	3.14E+12
	93.5%	14				
Cohasset Harbor, MA94-01, SA	6.5%	F. coliform	236	7.62E+10	4.95E+09	7.12E+10
	93.5%	14				
The Gulf, MA 94-19, SB	8.900%	F. coliform	3,756	7.43E+12	6.61E+11	1.59E+12
	91.1%	88				

South Coastal Segment[2], Waterbody/ WQS Classification	TMDL[1] WLA	WQS/ Indicator	Watershed size (Acres)	TMDL (cfu/day)	WLA	LA
	LA	(cfu/100mL)				
Musquashcut Pond, MA94-33, SA	21.4%	F. coliform	56	1.53E+10	3.26E+09	1.20E+10
	78.6%	14				
Scituate Harbor, MA94-02, SA	17.4%	F. coliform	118	3.37E+10	5.87E+09	2.79E+10
	82.6%	14				
Ellisville Harbor, MA94-34, SA	3.3%	F. coliform	24	8.01E+09	2.64E+08	7.74E+09
	96.7%	14				
Second Herring Brook, MA94-31, SA	6.0%	F. coliform	2,346	7.61E+11	4.57E+10	7.16E+11
	94.0%	14				
North River, MA94-05, SA	10.2%	F. coliform	47,241	1.47E+13	1.50E+12	1.32E+13
	89.8%	14				
Herring River, MA94-07, SA	7.9%	F. coliform	4,512	1.44E+12	1.13E+11	1.32E+12
	92.1%	14				
South River, MA94-09, SA	9.1%	F. coliform	445	1.40E+11	1.27E+10	1.27E+11
	90.9%	14				
North River, MA94-06, SA	9.7%	F. coliform	53,894	1.68E+13	1.63E+12	1.52E+13
	90.3%	14				
Green Harbor, MA94-11, SA	12.0%	F. coliform	67	2.04E+10	2.45E+09	1.79E+10
	88.0%	14				
Jones River, MA94-14, SA	7.9%	F. coliform	19,198	6.11E+12	4.82E+11	5.62E+12
	92.1%	14				
Duxbury Bay, MA94-15, SA	8.7%	F. coliform	27,673	8.73E+12	7.59E+11	7.97E+12
	91.3%	14				
Plymouth Harbor, MA94-16, SA	28.6%	F. coliform	17,792	4.41E+12	1.26E+12	3.15E+12
	71.4%	14				
Bluefish River, MA94-30, SA	26.5%	F. coliform	70	1.79E+10	4.73E+09	1.31E+10
	73.5%	14				

[1] TMDL allocation: % surface area of segment watershed for WLA (impervious) and LA (pervious), respectively[2] Class SA calculations based on 14 fecal coliform/100ml,

7.3.5 – Wasteload Allocations (WLAs) and Load Allocations (LAs)

There are several WWTPs and other NPDES-permitted wastewater discharges within the watershed. NPDES wastewater discharge WLAs are set at the WQS. In addition there are numerous storm water discharges from storm drainage systems throughout the watershed. All piped discharges are, by definition, point sources regardless of whether they are currently subject to the requirements of NPDES permits. Therefore, a WLA set equal to the WQS will be assigned to the portion of the storm water that discharges to surface waters via storm drains.

WLAs and LAs are identified for all known source categories including both dry and wet weather sources for Class SA, B segments within the South Coastal watershed. Establishing WLAs and LAs that only address dry weather indicator bacteria sources would not ensure attainment of standards because of the significant contribution of wet weather indicator bacteria sources to excesses to WQS. Illicit sewer connections and deteriorating sewers leaking to storm drainage systems represent the primary dry weather point sources of indicator bacteria, while failing septic systems and possibly leaking sewer lines represent the non-point sources. Wet weather point sources include discharges from storm water drainage systems (including MS4s) and sanitary sewer overflows (SSOs). Wet weather non-point sources primarily include diffuse storm water runoff.

7.3.6 Stormwater Contribution

Part of the stormwater contribution originates from point sources and is included in the waste load allocation, and part comes from non-point sources and is included in the load allocation of the TMDL. The fraction of the runoff load attributed to the waste load allocation is estimated from the fraction of the watershed that has impervious cover because storm water from impervious cover is more likely to be diverted, collected and conveyed to the receiving water by storm water collection systems than non-impervious areas. The fraction of the TMDL associated with the wasteload allocation was estimated, using MassGIS and the algorithm within it to estimate the extent of impervious surface. The wasteload allocation was then defined by multiplying the TMDL for each segment by the percent of imperviousness in each watershed. Likewise the load allocation was estimated using the percent pervious cover in each watershed. MassDEP believes this approach is conservative because it assumes that all runoff from impervious areas actually makes it to the waterbody segment in question, which may or may not always be the case.

Land use information from MassGIS was used to estimate the extent of impervious surface for each impaired segment. For example land use associated with, the Third Herring Brook (part of the South Coastal Watershed) is 11.6% impervious and 88.4% pervious. Thus, 11.6% of the acceptable bacteria load at a given flow is assigned as waste load allocation while 88.4% of the total load represents the load allocation. Therefore, in a segment for which the average daily flow on the Third Herring Brook (class B) of 10 cfs, the allowable bacteria waste load (standard = E.coli at 126 cfu/100 ml) for that day and location or segment is 3.58×10^{9} E. coli/day (from Figure 7-1a) and the allowable load allocation is 2.73×10^{10} E. coli/day .

Also as previously indicated, the allowable stormwater load for bacteria varies with receiving water flow. In order to calculate the allowable daily load (TMDL), flow must be taken into account. To estimate the flow for an ungaged location or segment, flows at a gage in the watershed or nearby watershed can be prorated based on drainage area. The USGS also has a web-based application at water.usgs.gov/osw/streamstats/ungaged.html for Massachusetts that incorporates ungaged flow estimations.

7.4 Application of the TMDL To Unimpaired or Currently Unassessed Segments

This TMDL applies to the 20 pathogen impaired segments of the South Coastal Watershed that are currently listed on the 2008 CWA § 303(d) list of impaired waters. MassDEP recommends however, 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).

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. The concentration waste load and/or load allocation for each source and designated use would be the same as specified herein. Therefore, the pollution prevention TMDLs would have identical waste load and load allocations based on the sources present and the designated use of the water body segment (see Table 7.1). Any discharge would need to be consistent with the applicable waste load allocations, as well as the anti-degradation provision of the Massachusetts Water Quality Standards.

This South Coastal Watershed TMDL may, in appropriate circumstances, also apply to segments that are listed for pathogen impairment in subsequent Massachusetts CWA § 303(d) Integrated List of Waters. For such segments, 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, the Commonwealth determines with EPA approval of the CWA § 303(d) list that this TMDL should apply to future pathogen impaired segments.

7.5 – Margin of Safety

This section addresses the incorporation of a Margin of Safety (MOS) in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can either be implicit (i.e., incorporated into the TMDL analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS, through inclusion of two conservative assumptions. First, the TMDL does not account for mixing in the receiving waters and assumes that zero dilution is available. Realistically, influent water will mix with the receiving water and become diluted below the water quality standard, provided that the receiving water concentration does not exceed the TMDL concentration. Second, the goal of attaining standards at the point of discharge does not account for losses due to die-off and settling of indicator bacteria that are known to occur.

7.6– Seasonal Variability

In addition to a Margin of Safety, TMDLs must also account for seasonal variability. Pathogen sources to South Coastal Watershed waters arise from a mixture of continuous and wet-weather driven sources, and there may be no single critical condition that is protective for all other conditions. This TMDL has set WLAs and LAs for all known and suspected source categories equal to the Massachusetts WQS independent of seasonal and climatic conditions. This will ensure the attainment of water quality standards regardless of seasonal and climatic conditions. Controls that are necessary will be in place throughout the year, protecting water quality at all times. However, for discharges that do not affect shellfish beds, intakes for water supplies and primary contact recreation is not taking place (i.e., during the winter months) seasonal disinfection is permitted for NPDES point source discharges.

8.0 Implementation Plan

Setting and achieving TMDLs should be an iterative process, with realistic goals over a reasonable timeframe and adjustment as warranted based on ongoing monitoring. The concentrations set out in the TMDL represent reductions that will require substantial time and financial commitment to be attained. A comprehensive control strategy is needed to address the numerous and diverse sources of pathogens in the South Coastal watershed.

Elevated dry weather bacteria concentrations could be the result of illicit sewer connections, leaking sewer pipes, sanitary sewer overflows, or failing septic systems. These sources are illegal and must be eliminated, so first priority overall should be given to bacteria source tracking activities to investigate potential illicit bacteria sources in segments impaired by bacteria during dry weather. Tracking and remediation of dry weather bacteria sources is usually more straightforward and successful than tracking and eliminating wet weather sources. If illicit bacteria sources are found and eliminated it should result in a dramatic reduction of bacteria concentration in the segment in both dry and wet weather. A comprehensive program is needed to ensure illicit sources are identified and that appropriate actions will be taken to eliminate them.

Storm water runoff represents another major source of pathogens in the South Coastal watershed, and the current level of control is inadequate for standards to be attained in several segments. Improving storm water runoff quality is essential for restoring water quality and recreational uses. It may not be cost effective or even possible to track and identify all wet weather sources of bacteria, therefore, segments impaired during wet weather should be evaluated for stormwater BMP implementation opportunities starting with intensive application of less costly non-structural practices (such as street sweeping, and/or managerial strategies using local controls). Periodic monitoring to evaluate the success of these practices should be performed and, depending on the degree of success of the non-structural storm water BMPs, more expensive structural controls may become necessary to meet water quality standards. This adaptive management approach to controlling stormwater contamination is the most practical and cost effective strategy to reduce pathogen loadings as well as loadings of other storm water pollutants (e.g., nutrients and sediments) contributing to use impairment in the South Coastal watershed.

The controls of several types of pathogen sources will be required as part of the comprehensive strategy. Many of the sources in the South Coastal watershed including sewer connections to drainage systems, leaking sewer pipes, sanitary sewer overflows, and failing septic systems, are prohibited and must be eliminated. Individual sources must be first identified in the field before they can be abated. Pinpointing sources typically requires extensive monitoring of the receiving waters and tributary storm water drainage systems during both dry and wet weather conditions. A comprehensive program is needed to ensure illicit sources are identified and that appropriate actions will be taken to eliminate them.

For these reasons, a basin-wide implementation strategy is recommended. The strategy includes a mandatory program for implementing storm water BMPs and eliminating illicit sources. The "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" was developed to support implementation of pathogen TMDLs. TMDL implementation-related tasks are shown in Table 8-1. The MassDEP working with EPA, NSRWA, Massachusetts Bay Program (MBP), and other team partners shall make every reasonable effort to assure implementation of this TMDL. These stakeholders can provide valuable assistance in defining hot spots and sources of pathogen contamination as well as the implementation of mitigation or preventative measures.

Table 8-1. Tasks for Implementing the South Coastal TMDL for Bacteria.

Task	Organization
Writing TMDL	MassDEP/EPA
TMDL public meeting	MassDEP/EPA
Response to public comment	MassDEP
Organization, contacts with volunteer groups	MassDEP/NSRWA/JRWA/ERWA
Development of comprehensive storm water management programs including identification and implementation of BMPs	South Coastal Watershed Communities, where applicable
Illicit discharge detection and elimination	South Coastal Watershed Communities and NSRWA, JRWA, and ERWA where applicable
Leaking sewer pipes and sanitary sewer overflows	South Coastal Watershed Communities, where applicable
CSO management	South Coastal Watershed Communities, where applicable
Inspection and upgrade of on-site sewage disposal systems as needed	Homeowners, South Coastal Watershed Communities (Boards of Health)
Organize implementation; work with stakeholders and local officials to identify remedial measures and potential funding sources	South Coastal Watershed Communities, NSRWA, and MBP
Organize and implement education and outreach program	South Coastal Watershed Communities, NSRWA, JRWA, ERWA, and MBP
Write grant and loan funding proposals	MassDEP, South Coastal Watershed Communities, NSRWA, and MBP
Inclusion of TMDL recommendations in Executive Office of Environmental Affairs (EOEA) Watershed Action Plan	EOEA
Surface Water Monitoring	MassDEP, South Coastal Watershed Communities, NSRWA, JRWA, ERWA, Division of Marine Fisheries, Coastal Zone Management
Provide periodic status reports on implementation of remedial activities	South Coastal Watershed Communities and MBP

8.1 Summary of Activities within the South Coastal Watershed

Data supporting this TMDL indicate that indicator bacteria enter the South Coastal watershed from a number of contributing sources under a variety of conditions. Activities that are currently ongoing and/or planned to ensure that the TMDL can be implemented are summarized in the following subsections. The "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" provides additional details on the implementation of pathogen control measures summarized in the following subsections as well as additional measures not provided herein, such as by-law, ordinances and public outreach and education.

There are several organizations in the South Coastal watershed that are working to improve water quality within the basin:

- The North and South Rivers Watershed Association (NSRWA) – The NSRWA seeks to identify sources of pollution to the watershed and remove the impact. The NSRWA also strives to educate the local population on issues surrounding their watershed (NSRWA 2005).
- The Massachusetts Bays Program (MBP) – The MBP, established in 1988, provides technical support focused on determining and preventing pollution problems in the Bays.
- The Massachusetts Office of Coastal Zone Management (CZM) – The mission of CZM "… is to balance the impacts of human activity with the protection of coastal and marine resources. As a networked program, CZM was specifically established to work with other state agencies, federal agencies, local governments, academic institutions, nonprofit groups, and the general public to promote sound management of the Massachusetts coast. CZM is funded primarily through the Commonwealth of Massachusetts, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Environmental Protection Agency (EPA)." (CZM 2005b).
- Also included as active organizations in this watershed are the Jones River Watershed Association (JRWA) and the Eel River Watershed Association (ERWA).

Through the MBP, a Massachusetts Bays Comprehensive Conservation & Management Plan (MBP 2003) has been developed. This plan lists the following initiatives intended to protect and enhance shellfishing and the progress of these initiatives:

- Conduct three Sanitary Survey Training Sessions annually-one each on the North Shore, Metro Boston/South Shore, and Cape Cod-to educate local shellfish constables and health officers on the proper technique for identifying and evaluating pathogen inputs into shellfish harvesting areas (progress: full). Local partner: Division of Marine Fisheries

- Develop and administer a local Shellfish Management Grants Program to help communities finance the development and implementation of affective local shellfish management plans (progress: substantial). Local partner: Division of Marine Fisheries

- Continue and expand the Shellfish Bed Restoration Program to restore and protect shellfish beds impacted by non-point source pollution (progress: moderate). Local partner: Shellfish Bed Restoration Program

- Through the Shellfish Clean Water Initiative, complete an Interagency Agreement defining agency roles and contributions to protect shellfish resources from pollution sources (progress: new). Local partner: Office of Coastal Zone Management.

In 1990, Congress added the Coastal Nonpoint Source Pollution Control Program to the Reauthorization of the Coastal Zone Management Act. "This legislation gives states the opportunity to work with federal agencies and already existing programs to develop and implement enforceable measures to restore and protect coastal waters from NPS [nonpoint source] pollution. The legislation also gives states the flexibility to design measures that are both environmentally and economically sound. The Massachusetts Coastal Zone Management Office [CZM] and the Department of Environmental

Protection [MassDEP], in cooperation with a variety of other state agencies, are responsible for developing the Coastal Nonpoint Source Pollution Control Program for the Commonwealth." (CZM 2005b)

Through the Coastal Nonpoint Pollution Control Program, CZM is working with federal and state agencies, local officials, industry representatives, environmentalists, and the public to develop enforceable measures to restore and protect coastal waters from nonpoint source (NPS) pollution, which is currently the number one pollution problem in U.S. coastal waters. NPS pollution occurs when contaminants are picked up by rain water and snow melt and carried over land, in groundwater, or through drainage systems to the nearest waterbody.

Two grant programs administered by CZM support the implementation of the Coastal Nonpoint Pollution Control Program.

- The Coastal Pollutant Remediation (CPR) Grant Program provides funding to municipalities in Massachusetts coastal watersheds to reduce stormwater impacts from roads, highways, or parking areas and to install municipal boat pumpout facilities.

- The Coastal Nonpoint Source Pollution (Coastal NPS) Grant Program complements CPR and addresses more general areas of nonpoint source control. These grants to municipalities, as well as other public and non-profit groups, can be used for the following types of projects: assessment, identification, and characterization of nonpoint sources; targeted assessment of the municipal stormwater drainage system (runoff from municipal roadways, parking lots and bridges); the development of transferable tools (nonstructural best management practices), such as guidance documents, model by-laws, and land use planning strategies to improve nonpoint source control and management; and the implementation of innovative and unique demonstration projects.

Both the CPR and Coastal NPS grant programs have been developed to provide resources to municipalities for assessing and managing nonpoint sources of pollution. Projects funded through these grants can stand-alone or they can be discrete components of multi-year projects. For example, a municipality might use Coastal NPS funds to identify pollution sources in a subwatershed during year one of a project, and then apply for CPR funds to develop best management practices to remediate the identified roadway related pollutants during year two. CZM encourages the incorporation of long-term, progressive pollution mitigation planning components into proposals for both programs.

Also as part of the Coastal Nonpoint Pollution Control Program, CZM developed the *Massachusetts Clean Marina Guide*. This reference for owners and operators of marine boating facilities provides information on cost-effective strategies and practices aimed at reducing marina and boating impacts on the coastal environment (CZM 2005c).

For more information regarding CZM programs and grants, please visit their website at http://www.mass.gov/czm/czm.htm

Other recent and on- going activities in the watershed include:

(1) Cohasset Cove, and Cohasset Harbor- The town of Cohasset is authorized (October 2000) to discharge from the Cohasset Wastewater Treatment Plant (WWTP) a flow of 0.3 MGD (average monthly) of treated municipal wastewater via outfall #001 to Cohasset Cove. The facility was upgraded in 2000 to an advanced secondary wastewater treatment plant. In 2000, Cohasset extended its sewer system to include over 750 houses in the vicinity of Peppermint Brook (Lefebvre 2003). Upgrades include improved denitrification, a membrane filtration system that does not allow passage of bacteria and an ultraviolet disinfection chamber, an anoxic tank that improves the denitrification of waste water and a back-up generator. CZM's Coastal Non-Point Source Program has awarded Cohasset $47,000 to investigate storm water hot spots (including James Brook), conduct water quality monitoring, and design storm water BMPs to mitigate pollution in Cohasset Cove (Burtner, 2004). In 2003, a 319 $425,000 Grant Project, #03-12/319 "Stormwater BMP's for Peppermint Brook and Lily Pond", was awarded to Cohasset, to implement BMP stormwater control devices that incorporate Low Impact Development (LID) practices to best reduce pollutant loadings (including bacteria) to Lily Pond, a public water supply for the town that provides 90% of the drinking water supply. Structural BMP improvement options include hooded catch basins, bioretention facilities, rain gardens, roadside swales with biofilters, and spill containment facilities. Outreach and education of the results will be announced throughout the watershed. During 2010- 2013, a $300,000 319 Grant Project "Stormwater Best Management Practices: Little Harbor, Cohasset Cove, and Cohasset Harbor" focussed on (BMP) controls to address and alleviate problems associated with nonpoint source (NPS) pollution within Cohasset Harbor, Cohasset Cove and James Brook watersheds. This included development and implementation of low impact development (LID) techniques such as bioretention, permeable pavement, vegetated swales, and infiltration (with pre-treatment), to be sited on public lands and/or within public rights-of-way in areas of concentrated stormwater runoff. These techniques will treat runoff prior to discharge into James Brook, Stuart Brook, Elms Meadow Wellfield (Zone II), Jacobs Meadow Salt Marsh, Cohasset Cove, and Cohasset Harbor.

(2) Scituate Harbor- All waters along the Coast of Massachusetts have been officially declared as EPA designated vessel No Discharge Areas (NDA), including waters within the Harbor area. This should greatly assist in the reduction of pathogen pollution within this segment. There are two locations for general boat access on Scituate Harbor: at a boat ramp on Jericho Road, and at Town Pier on Cole Parkway. The Town of Scituate manages a concrete boat ramp with 2 launching lanes at Jericho Road for general access. The Town also operates a boat pump-out facility located at the Town Pier on Cole Parkway that includes a shore-side facility and a pump-out boat. Both were funded by the Clean Vessel Act to provide free pump-outs. Waterline Mooring has a second pump-out boat that was funded by the Clean Vessel Act to provide free pump-outs. The harbor hosts a commercial fishing fleet. When fish and fish products are loaded and unloaded from commercial fishing vessels, steps should be taken to minimize fish waste runoff directly into the harbor. The Stellwagen Bank National Marine Sanctuary should hook up to sewer as planned during fall of 2006.

(3) Upstream of the Herring and North Rivers, Scituate - Old Oaken Bucket Pond and upstream Tack Factory Pond, which are part of First Herring Brook, both serve as a source for the Herring River and ultimately the North River (both listed as impaired on the 303d list for pathogens). There was a Section 319 $129,300 Grant Project (98-08/319) "Protection of First Herring Brook" to disconnect nine direct stormwater discharges in highly developed areas of the First Herring Brook subwatershed and install infiltration BMP's, to do pre and post project monitoring, and to incorporate the infiltration system designs as standard specifications in Scituate's local regulations for developers to follow. Another Section 319 $250,128 Grant Project (05-09/319), **"**Old Oaken Bucket Pond Watershed NPS Improvements", selected five locations within the Old Oaken Bucket Pond (in the First Herring Brook subwatershed) to install LID elements/BMPs, focusing on the installation of multiple rain gardens for stormwater control, and treatment/ infiltration of

roadway runoff. Additional components in these LID elements included an infiltration trench and the installation of several leaching catch basins. These BMPs will reduce nonpoint source pollutants (including pathogens) currently entering Old Oaken Bucket Pond, the First Herring Brook, and ultimately the Herring River and North River. A third Section 319 $429,700 Grant Project (06-05/319),"First Herring Brook Low Impact Development Stormwater Enhancements" focused efforts in further upstream Tack Factory Pond (from Old Oaken Bucket Pond) on First Herring Brook to reduce urban stormwater runoff through the installation of stormwater devices and Low Impact Development Best Management Practices at eight locations around the Pond. This work is expected to further enhance nonpoint and pathogen pollutant reductions downstream in the Herring and North Rivers.

(4) Herring River- A Section 319 $183,274 Grant Project (06-06/319), "Herring River Coastal Low Impact Development Project", installed two BMP's to aid in the treatment of stormwater, reduce runoff, promote infiltration and enhance groundwater recharge near Driftway Park in Scituate. Pet waste from the dog park was targeted for better control though an outreach and education program. The goal of the project is to reduce NPS pollution in the Herring and ultimately the North River.

(5) North River, and South River Watershed areas, continued work by the towns of Scituate, Norwell, Hanover, Marshfield to improve the operation of Title V septic systems, and/ or sewer tie-ins and elimination of failing septic systems is resulting in bacterial contamination reductions. In addition, all related Phase II stormwater pollutant reductions for nutrients/ sediments are helping in the control of bacteria pollution. Back in 1990, a $35,000 319 Grant was conducted by the North- South Rivers Watershed Association to examine five tributaries to these rivers for bacterial contamination, and to implement NPS controls at two sites on the North River. In 2012, Marshfield was awarded a $52,000 CPR grant from CZM for BMP design and implementation at two locations on the South River. This grant builds upon assessment and design work funded by MassDEP's 604b grant program and seeks to maintain and improve shellfish habitat (MA CZM, 2013). All waters along the Coast of Massachusetts have been officially declared as an EPA designated vessel No Discharge Areas (NDA), including waters within these segment areas. This should greatly assist in further reduction of pathogen pollution.

(6) The Green River/ Harbor the Town of Marshfield manages a concrete boat ramp with three launching lanes at Town Pier Road for general access, with parking for 74 trailers (MassDEP, 2006). All waters along the Coast of Massachusetts have been officially declared as an EPA designated vessel No Discharge Areas (NDA), including waters within this segment area. This should greatly assist in the reduction of pathogen pollution in this segment. There is a pump-out facility at Municipal Pier off of Town Pier Road, (Brant Rock) Marshfield. The pump-out was funded by the Clean Vessel Act to provide free pump-outs (MA DMF 2003 and Burtner 2003).

(7) Jones River Watershed. In 1994, a $159,733 Section 319 Grant Project, (94/09), "Jones River/ Billington Sea Nonpoint Source Pollution Control Project", was awarded to the RC&D Area Council to reduce nutrient and pathogen loading from existing on- site septic systems (OSSS), and prevent pollution from newly to be constructed on- site systems by applying new management and construction measures to address proper siting, design, and installation of the new systems. In the Lower Jones River area, sewage disposal consisted of a very high proportion of subsurface Title V disposal systems and septic systems. Because of this, and the chronic closure of all shellfish beds due to high levels of fecal coliform, Kingston has constructed a sewer system and upgraded its WWTP in its tidal area. Kingston has required more than four hundred houses in the Rocky Nook and Jones River areas to connect to this newly upgraded wastewater treatment plant in Kingston utilizing SRF funds awarded by MassDEP (MassDEP, 2013).

In 2002, the town of Kingston installed deep sump catch basins, a drainage conduit, and a pre-treatment and infiltration system at Cole Street (Rocky Nook) utilizing CPR grant funds. In 2013, Kingston was awarded a $124,000 CPR grant from CZM for BMP design and construction at two outfalls to mitigate bacteria and improve shellfish classifications in the Jones River estuary. This work was also supported by a MassDEP 604b grant, (MA CZM, 2013).The town of Kingston is preparing for Phase II construction that will expand sewer service to additional areas that are tributaries to the Bay. A $125,000 Section 319 Grant Project, (01-08), resulted in the construction of storm water improvements at Gray's Beach (on the shores of Kingston Bay), which included construction of swales, sand filters, curbing and deep sump catch basins, (MassDEP, 2006). The focus of this work was to re-direct stormwater away from the beach and improve water quality (including bacteria) in both the beach and estuary areas so that closed shellfishing beds might re-open. A $254,732 Section 319 Grant Project, (05-07), focused on retrofitting the Kingston Intermediate School with various LID techniques designed under a previous 319 project, (04-03/319), to help improve the water quality (including pathogens) of the Jones River Watershed and reestablish the site's natural hydrology. In 2013, Kingston was awarded a $124,000 CPR grant from CZM for BMP design and construction at two outfalls to mitigate bacteria and improve shellfish classifications in the Jones River estuary. This work was also supported by a MassDEP 604b grant (MA CZM, 2013).

(8) Large acreages of shellfish beds in Kingston and Duxbury Bay that were prohibited are now conditionally available for harvesting due to the actions that the Towns of Kingston and Duxbury have taken over the last few years to address impacts from individual septic systems and storm water runoff. Duxbury has required twenty-nine dwellings on the south side of Bay Road to connect to an upland community septic system. In the Duxbury Bay area, soft shell calms and razor clams can now be found in commercial quantities on the large inter-tidal flats along the Duxbury side of the Bay. Bay scallops have also been found. Most of the shellfish beds are healthy due in part to an aggressive shellfish propagation and cultivation program administered by the Duxbury Harbormaster/Coastal Resources Department and the Massachusetts Division of Marine Fisheries. The program involves ongoing water quality sampling in and around shellfish beds, reseeding, and monitoring of contaminated beds.

Areas formerly closed, such as the Bluefish River and Eagle's Nest Bay have been opened conditionally (November 1st to May 1st). Kingston Bay is now partially open. These improvements are also partially due to completion of the shared community sewage disposal systems along the Bluefish River and the Snug Harbor area. Also, the past five years has seen a steady improvement in the health of Duxbury's finfishery. Important commercial and recreational species include Bluefish, Striped Bass, Taugtog, and Fluke. In 2005, the Town of Duxbury was awarded a CPR grant for the Snug Harbor Stormwater Mitigation Demonstration Project. This project was designed to help remediate stormwater pollution from Washington Street and Beaverbrook Lane that was formerly identified by DMF as the primary source of pollution to Snug Harbor (MA CZM 2005). In recent years, The Town of Duxbury has received several other CPR grant awards to address stormwater pollution to Kingston Harbor, with the ultimate goal of reopening shellfish beds, decreasing beach closures, and supporting diadromous fish habitat. In 2007 and 2008, Duxbury was awarded by MA CZM $125,000 and $119,000, respectively, to install BMPs to address stormwater to the Halls Corner section of The Nook (part of Kingston Bay). In 2009 and 2010, Duxbury was awarded $115,000 and $120,000, respectively, to install three BMPs at Crescent Street, to mitigate stormwater discharges to The Nook. In 2012, Duxbury was awarded $121,000 for the first phase of a BMP to address stormwater pollution at three locations along Bay Road (another area within The Nook watershed). The assessment for this project was funded by a MassDEP 604b grant. Finally, in 2013, Duxbury received $124,000 to install the BMPs on Bay Road, (MA CZM, 2013).

It should be noted that the towns of Duxbury and Kingston co-sponsored a 2005 application to EOEA for a boat sewage No Discharge Zone for Duxbury/Kingston/Plymouth bays and harbors. EOEA granted the request in August, 2006. This should be of great help in reducing pathogen pollution within these waters.

(9) Plymouth Harbor and Bays areas, The Town of Plymouth has a comprehensive program to address bacterial pollution in Plymouth Harbor that utilizes funds from the MassDEP/EPA 319 and SRF Programs, the CZM Coastal Pollution Remediation Program and other sources. Early efforts addressed bacterial pollution from wastewater (upgrades of the WWTP) and boats (pump-out facilities). In 2001, a Stormwater Working Group comprised of town and state agency representatives was formed. This group prioritized sites from the DMF Sanitary Survey, based on the water quality impact and potential for successful mitigation. It has received funding to address the top four priority sites.

The Town was awarded a $435,000 Section 319 Grant, (02/09), in 2002 to design and install three major infiltration stormwater treatment devices (for removal of bacteria specifically) at Stephens Field, Howes Lane and Lincoln Street, with pre and post water quality monitoring to insure success in the measures installed. Another $280,292 Section 319 Grant Project, (03/11), was awarded to the town in 2003, entitled, “Billington Sea Stormwater Remediation”. The prime purpose of this project was to mitigate the adverse impacts (bacteria, total phosphorus, suspended solids, and nitrogen) of stormwater runoff through the implementation of BMP’s (deep sump/ hooded catch basins followed by infiltration galleys) along Billington Sea Road and Black Cat Road. The project included outreach, education and a marketing approach to promote watershed friendly landscaping practices throughout the immediate area. Another $208,050 Section 319 Grant project, (04/03), “Stormwater Retrofits for Samoset St. Outfalls to Plymouth Harbor”, constructed bioretention facilities at three priority sites which were designed to capture and treat surface runoff. Designs for the work were produced under a 2003 Coastal Pollution Remediation grant from the CZM program. The principal pollutant of concern to control was bacteria.

It should be noted that the town co-sponsored a 2005 application to EOEA for a boat sewage “No Discharge Zone” to be declared for Duxbury/Kingston/Plymouth bays and harbors. EOEA granted the request in August, 2006. This should be of great help in reducing pathogen pollution within these waters.

A CPR grant was awarded in 2003 for a top priority site (Samoset Street) that assessed the drainage area and designed the most appropriate stormwater BMP. A 319 Grant, (04/03 covered above), was awarded in 2005 for the purpose of implementing the BMP designs for the Samoset Street site. There will be water quality monitoring performed in accordance with an approved QAPP before and after installation of the 319 funded BMPs to measure project success.

In 2009, the Town of Plymouth received a $125,000 CPR grant for bio-retention BMPs along Town Brook. In 2011, The Town received a $46,000 CPR grant for design and construction of a stormwater management system along Pond Road to mitigate pollution from stormwater entering the Cape Cod Canal. In 2012, the Town received a CPR grant of $103,000 to implement a suite of BMPs to reduce nutrients and bacteria in stormwater runoff from 10 acres of impervious surface from roads and residences around Great Herring Pond, Bournedale Brook, and the Cape Cod Canal, (MA CZM, 2013).

The Town of Plymouth was authorized to discharge from the Plymouth Wastewater Treatment Plant (WWTP) a flow of 1.75 MGD (average monthly) of treated effluent via outfall #001 to Plymouth Harbor. This old plant on Water Street (which went online in March 1970) was abandoned after the new 5.2

MGD facility at Camelot Industrial Park became operational in May 2002. The Plymouth WWTP's treated effluent is directed accordingly: (1) 88.2% average annual daily flow is discharged to Plymouth Harbor and (2) 11.8% average annual daily flow is discharged to the ground (Frizzell 2004). This relatively new sequencing batch reactor facility performs year-round nitrification for ammonia-nitrogen reduction and denitrification for the reduction of total nitrogen (Carvello 2004). The previous facility only nitrified ammonia-nitrogen (MassDEP, 2006). Effective effluent chlorination and de-chlorination are performed year- round.

The resultant improvements in the Kingston and the Plymouth WWTP's, and changes in the Plymouth WWTP outfall, plus completion of the multitude of 319 and CPR Grant projects, have resulted in remarkable improvements in embayment water quality (including bacteria levels) in both the Kingston Harbor/ Bay, and the Plymouth Harbor/ Bays areas. Over 1,000 acres in the Kingston Harbor area has been opened to shellfishing in the past three years. Soft- shell clams, quahogs, cherrystones, littlenecks, razor clams and oysters can be found in Kingston's beds, which are open four days a week from May 1- October 31. Hard shell clams can be dug year- round. The new- upgraded WWTP at Camelot Park in Plymouth has contributed to the cleanup of Plymouth harbor, which has allowed over 800 acres of previously closed shellfishing beds to become open in the outer section of the harbor.

In addition to the projects above, there have been additional EPA/MassDEP grants awarded for projects to improve water quality, including bacteria, throughout the watershed:

(A) A $109,645 Section 319 Grant Project, (00-17/319), "Local Development of Stormwater BMP's on Residential Property: Overcoming Barriers to Implementation". This was an outreach and education project to promote good housekeeping practices and BMP's (including Low Impact Development BMP's) to mitigate and control stormwater runoff and contaminants (including bacteria) on typical residential properties, through brochures, workshops, surveys, and other medians to communicate such information effectively.

(B) A $194,448 Section 319 Grant Project, (01-19). This grant was awarded to the town of Pembroke to design, properly permit, and construct effective stormwater controls at twenty- nine locations on Oldham and Furnace Ponds in the town of Pembroke. This includes development and distribution of educational brochures on lawn care, fertilizer use, removal of pet waste, and waterfowl management.

(C) A $356,910 Section 319 Grant Project, (03-03/319), "South Coastal Inter-Municipal Water Quality Improvement Project". This was a project for the towns of Pembroke, Hanover, and Hanson to principally purchase a Johnston 605 PM-10 vacuum street sweeper to remove roadside sediment, nutrients, toxics, and pathogen related pollutants that currently enter stormwater infrastructure, and to develop and institute a strategic street sweeping program to target the 15, 303d- listed waterbodies (for sediments, nutrients, phosphorus, and pathogens) within the boundaries of the three towns. This includes a follow-up monitoring and public outreach program to document and communicate effectiveness of these measures.

(D) A $126,600 Section 319 Project, (04-03/319), "Low Impact Development Training and Technical Assistance for Local Decision Makers". This project involved the four towns of Plymouth, Kingston, Pembroke, and Hanover, providing training and technical assistance to these towns to promote and implement LID techniques through changes in local regulations, and by actually implementing one conceptual LID design in each of the communities. The principal focus of the design relates to hydrology by using design techniques that store, infiltrate, evaporate, and detain runoff.

(E) A P$85,240 project 2003-04, Section 604(b) Grants, "Estuaries Monitoring Program: Duxbury, Kingston, and Plymouth Coastal Waters". This grant was awarded to the Town of Kingston to provide water quality and flow data to support the MA Estuaries Program assessment of these three town's coastal waters, including Jones River, Ellisville Harbor, Eel River, and Town Brook. Water quality data that are gathered include nutrients and bacteria, which are to be used to determine future water quality improvements in the various bays and harbors in these communities.

8.2 Agriculture

A number of techniques have been developed to reduce the contribution of agricultural activities to pathogen contamination. There are also many methods intended to reduce sediment loads from agricultural lands. Ancillary to these land uses are those activities associated with recreational activities, such as golf courses and ball fields. Since bacteria are often associated with sediments, these techniques are also likely to result in a reduction in bacterial loads in run off as well. Techniques generally include BMPs for field application of manure, animal feeding operations, barnyards, and managing animal grazing areas. Brief summaries of some of these techniques are provided in the "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*".

8.3 Illicit Sewer Connections, Failing Infrastructure and CSOs

Elimination of illicit sewer connections and repairing failing infrastructure are of extreme importance. EPA's Phase II rule specifies an MS4 community must develop, implement, and enforce a storm water management program that is designed to reduce the discharge of pollutants to the maximum extent practicable, protect water quality, and satisfy the applicable water quality requirements of the Clean Water Act. Illicit discharge detection and elimination (IDDE) is one of the six minimum control measures that must be included in the storm water management program. The other control measures are:

- Public education and outreach on storm water impacts
- Public involvement and participation
- Construction site storm water runoff control
- Post-construction storm water management in new development and redevelopment
- Pollution prevention and good housekeeping for municipal operations

As part of their applications for Phase II permit coverage, MS4 communities must identify the best management practices they will use to comply with each of these six minimum control measures and the measurable goals they have set for each measure.

In general, a comprehensive IDDE Program must contain the following four elements:

1) Develop (if not already completed) a storm sewer system map showing the location of all outfalls, and the names and location of all waters of the United States that receive discharges from those outfalls.

2) Develop and promulgate municipal regulations that require the municipality to comply with Phase II regulations including prohibition of illicit discharges and appropriate enforcement mechanisms.

3) Develop and implement a plan to detect and address illicit discharges, including illegal dumping, to the system. EPA recommends that the plan include the following four components: locating priority

areas; tracing the source of an illicit discharge; removing the source of an illicit discharge; and program evaluation and assessment.

4) Inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste. IDDE outreach can be integrated into the broader stormwater outreach program for the community. Fulfilling the outreach requirement for IDDE helps the MS4 community to comply with this mandatory element of the stormwater program.

Communities that are not covered under the Phase II rule (i.e., not designated as MS4 communities) are encouraged to implement a program for detecting and eliminating sewage discharges to storm sewer systems including illicit sewer connections. Implementation of the Phase II rule (USEPA 2000), whether voluntarily or mandated will help communities achieve bacteria TMDLs.

Guidance for implementing an illicit discharge detection and elimination program is available from several documents. EPA New England developed a specific plan for the Lower Charles River (USEPA 2004b) to identify and eliminate illicit discharges (both dry and wet weather) to their separate storm sewer systems. Although originally prepared for the Charles River Watershed it may be applicable to other watersheds throughout the Commonwealth, however, it represents just one of the approved methodologies available. More generic guidance is provided in a document prepared for EPA by the Center for Watershed Protection and the University of Alabama entitled Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments (EPA 2004c). In addition, practical guidance for municipalities is provided in a New England Interstate Water Pollution Control Commission publication entitled Illicit Discharge Detection and Elimination Manual, A Handbook for Municipalities (NEIWPCC 2003). Implementation of the protocol outlined in these guidance documents satisfies the Illicit Discharge Detection and Elimination requirement of the NPDES program.

8.4 Storm Water Runoff

Storm water runoff can be categorized in two forms 1) point source discharges and 2) non-point source discharges (includes sheet flow or direct runoff). Many point source storm water discharges are regulated under the NPDES Phase I and Phase II permitting programs when discharged to a Waters of the United States. Municipalities that operate regulated municipal separate storm sewer systems (MS4s) must develop and implement a storm water management plan (SWMP), which must employ and set measurable goals for the following six minimum control measures:

1. public education and outreach particularly on the proper disposal of pet waste,
2. public participation/involvement,
3. illicit discharge detection and elimination,
4. construction site runoff control,
5. post construction runoff control, and
6. pollution prevention/good housekeeping.

Portions of towns in this watershed are classified as Urban Areas by the United States Census Bureau and are subject to the Stormwater Phase II Final Rule. This rule requires the development and implementation of an illicit discharge detection and elimination plan.

The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.

Non-point source discharges are generally characterized as sheetflow runoff and are not categorically regulated under the NPDES program and can be difficult to manage. However, some of the same principles for mitigating point source impacts may be applicable. Individual municipalities not regulated under the Phase I or II should implement the exact same six minimum control measures minimizing storm water contamination.

A list of the municipalities in Massachusetts regulated by the Phase II Rule, as well as the Notices of Intent, and report summaries for each municipality for each of the years 2003- 2013 can be viewed at http://www.epa.gov/region1/npdes/stormwater/2003-permit-archives.html.

A review of the progress in the Phase II Stormwater program for each community residing within the South Coastal watershed follows (US EPA, 2013). It should be noted that in the case of this particular watershed, it is clear that the Towns of Cohasset, Marshfield, and Kingston have made significant progress in implementing an effective Phase II program in their communities.

Cohasset- Greenscapes public education literature has been mailed out to all households, and is available in the local Board of Health Office, and the Town Library. The Board of Health agent has been writing about stormwater issues in the weekly "Health Notes" column, as well as in the letters to the editor column in the town newspaper. The Board of Health chairs the Water Resources Protection Committee, parts of which have branched out to form the Cohasset Stormwater Management Committee, which is comprised of the heads of the Conservation Commission, Planning Board, Engineering Department, Board of Health, etc. The Board of Health also initiated formation of the Health of Harbor Committee, which is addressing concerns, such as shellfishing bed closures. Through these committees, the public is becoming much more knowledgeable about stormwater related issues.

Through a CZM grant of $46,430 awarded in 2007, plus community matching funds, a stormwater related BMP design and implementation project involving the James Brook/ Cohasset Harbor areas was implemented. Specifically, BMP's were designed to capture and minimize runoff flows and pollutant loadings going into Jacobs Meadow, Salt Marsh, and Cohasset Cove. The Center for Student Coastal Research and Watershed Academy, a volunteer program, was formed under this grant, which has shown excellent results thus far by involving students in gathering bacteria and other water quality samples, particularly during and after storm events in Cohasset Harbor, Little Harbor, and the Gulf River. As a result, the Center has produced the report, "Study of Sources and Trends of Pollution in Cohasset Harbor, Little River and Gulf River". This report suggests the existence of significant sewage impacts into the Gulf River that have impacts in Cohasset's Little Harbor area.

Failing septic systems in need of being tied- in to the existing sewer system were identified. During 2006, the town signed an agreement of judgment with MassDEP to connect all homes in the Little Harbor Watershed to the municipal sewer. As of 2009, the town has completed several upgrades at the Cohasset WWTP treatment plant to accommodate the increased loads from these tie-ins, and other increased loads from other parts of town. This has minimized any bacteria related discharges to Little Harbor. In conjunction with this, the town received a $250,000 MassDEP 319 Grant in 2007 to complement ongoing sewer tie- in work by implementing NPS BMPs in the Little Harbor area. This work commenced in 2008 under Phase I, and expanded in 2009 under Phase II. Also, in 2007, another grant was received (from CZM) for LID BMP design and implementation in the James Brook Watershed.

Another $300,000 MassDEP grant was awarded in 2009 to further BMP work in Little Harbor, as well as the Cohasset Cove and Cohasset Harbor areas. As of 2010, over 40 stormwater BMPs have been installed as a result of five separate State and Federal grant awards within this segment.

During 2009, the town began implementation of a stormwater by- law, which includes illicit connection control procedures. Regulations under this by- law include the application review of proposed small projects which result in an increase of 500 square feet or greater of new impervious surface areas, any significant increase of new stormwater runoff, and recommendations for best management practices in the management, collection, and treatment of stormwater runoff volumes within the town. The town of Cohasset has implemented numerous municipal stormwater management projects in order to reduce the impacts from stormwater runoff and water quality impacts to receiving wetland resource areas, including both freshwater and coastal wetland resource areas. In 2013, the town began a sewer replacement project at Jacobs Meadow, which is an extensive wetland resource area in Cohasset consisting of freshwater and coastal wetlands in a 100 year flood zone area. This is located in a riverfront area, hydrologically connected to Cohasset Harbor (coastal/marine waters) by James Brook, a perennial river which flows through Jacobs Meadow to the coastal/marine waters of Cohasset Harbor in Cohasset. Jacobs Meadow is subject to both the flooding events and flooding impacts from upstream/upgradient flooding from James Brook, and from coastal flooding/coastal storm surge impacts from the downstream coastal/marine waters of Cohasset Harbor during storm events. The sewer replacement project will help eliminate the leakage of septic wastewater flows into Jacobs Meadow, James Brook, and Cohasset Harbor. In 2013, the Town of Cohasset recently completed the construction of two rain garden projects: one at Cushing Street/Norfolk Road (Elms Meadow), and the other at Lighthouse Lane (Cohasset Harbor). Another rain garden project is proposed at Beach Street, located directly adjacent and upgradient to Little Harbor.

Scituate- With public education, stormwater related water protection information has been put on the town website twice per year, fact sheets and posters have been made available in the town hall, and displays placed in town offices. A stormwater hotline has been set up to record concerned callers. There was a river cleanup for the first time in Herring Brook in May, 2006. All stormdrain outfalls have been mapped on GIS, and 30% of all the outfalls had been sampled as of the end of 2006. By 2009, over 200 outfalls had been screened, inspected, with a number of dry weather flows sampled for bacteria. An illicit connection prohibition ordinance was passed during the spring of 2008, which prohibits discharge of wastewater or pollution without treatment into any natural outlet. The local town DPW enforces illicit connection components of this ordinance. In 2007, the town received a 319 Grant to recommend BMPs to be constructed in priority areas. With housekeeping, the street sweeping program nets 90 cubic yards of debris each year between April and October. In 2011, 1,500 catch basins were cleaned. The town acknowledges the existence of a Draft Bacteria TMDL, by indicating that the town must develop a water quality strategy for all 303d listed waters, which includes pollution identification, and a pollution control plan for the stormwater drainage system in the community. In 2011, the town hired an IT Manager, who will coordinate the purchase of GPS equipment to aid in finding Illicit connections. The 2013 town meeting appropriated $50,000 for future illicit connections identification work. In addition, as of 2013, 290 properties in the Musquashcut Pond area with old or failing septic systems were scheduled for sewer tie-ins over the next several years.

Norwell- As of early 2008, the town had been working with the North- South River Watershed, and the Weymouth- Weir Watershed Associations to seek funding from SRF, 319, 604b, and any other available grant sources for stormwater pollution control efforts. Only a $300,000 SRF loan has been awarded to date. With respect to future illicit connection detection work, the town has utilized some of the SRF monies to proceed with catch basin/ outfall/ and conveyance GIS mapping utilizing aerial photography. The GIS mapping effort was completed during 2009. One of the results of the completed mapping was the commencement, during 2009- 2010, of priority outfall/ conveyance inspection and testing, particularly with dry weather flows. Housekeeping efforts include semi- annual street sweeping, and annual cleaning of all catch basins. The town acknowledges the existence of a Draft Bacteria TMDL, indicating that it must develop a water quality strategy for all 303d listed waters, develop a water quality control model, and categorize (via mapping) the stormwater drainage system in the community. Activities performed during 2012-13 focused on construction of BMPs within 2 major roadways in town, updating the MS4 map showing stormwater conveyance connectivity, updating the stormwater bylaws, drafting plans for IDDE and O & M for infrastructure, and distributing an informational stormwater flyer throughout town.

Rockland- Public education efforts have involved developing a partnering relationship with the North-South River Watershed Association. Information transfer with citizens has involved the Water Department sending out quarterly mailings on stormwater, and providing information on the town's website. The subject focus in these mailings is protection of the town's drinking water supplies. Stormwater system identification has included catch basin, outfall, and receiving water GIS mapping, which began in 2006, and is continuing in 2007-8. Water quality testing of outfalls on public property began with 3 sites in 2004, and has since continued with at least several outfalls tested each year during 2005-13. As of 2007, by- laws governing stormwater and illicit connections had been drafted and reviewed, with revisions incorporated. This was passed in 2010 at town meeting. During 2008 and 2009, the town actively began an effort to work with local watershed organizations to research the best technology and approaches to achieve stormwater pollution controls. Street sweeping has occurred semi- annually, and catch basin cleaning has occurred on a yearly basis. The town acknowledges the existence of a Draft Bacteria TMDL, saying that it must develop a water quality strategy for all 303d listed waters, develop a water quality control model, and categorize (through mapping) the stormwater drainage system in the community. During 2012-13, drain connectivity mapping was expanded to areas lacking information, so that 80% of the town is now GIS- mapped. During 2012, sampling occurred at 13 historically monitored locations, with 3 locations having elevated E coli results. During 2013, the town plans to do follow-up investigation at these sites.

Hanover- Public engagement and education has involved partnering with local watershed associations, with particular efforts to develop alternative funding (besides town funding) for stormwater control efforts. During 2004, the town received SRF support to begin GIS mapping of all stormwater conveyances and outfalls. In 2006, the town's stormwater activities consisted of developing local funding support for water quality testing, as well as conducting a wastewater and land- use study in conjunction with pollution source identification efforts in the Hanover portion of the North River Watershed. This work was continued in 2009. Stormwater system identification has involved completing the effort (during 2008) of mapping all major catch basins and outfalls on GIS. One of the results of this has been the identification of over 100 missing catch basins. An illicit connection control regulation by-law review was completed, with a component officially incorporated into the town's stormwater regulations in Spring, 2009. Housekeeping includes semi- annual street sweeping, and annual catch basin cleaning. During 2012-13, refinement of GIS mapping continued, with emphasis of more accurate drain pipe connectivity throughout the system. Also, significant during 2012- 2013 was a second complete review of illicit detection bylaws, with a refined version developed, to be considered for adoption at town meeting in 2013.

Marshfield- Public education activities have included working with the North- South River Watershed Association, and the Greenspace Alliance programs. The town DPW consulted with these two watershed organizations on the town's proposed stormwater management action plan. The town's water quality annual report has developed a stormwater component, and the town's website has water quality information, with monthly updates, on the DPW's operational plan regarding implementation of stormwater controls. In March, 2007, funding was received from MACZM for a special project on the Green Harbor River to implement BMPs (tidal gates), which will change tidal patterns in Upper Green Harbor and improve water quality in this water body. Another project begun in 2008 involved the town DPW, volunteer students, CZM personnel, and the NSRWA, who conducted water quality sampling studies in the North and South Rivers portion of the town. As of 2008, stormwater system identification efforts have included a major GIS mapping/ fly-over effort (with GPS) during 2007, which has resulted in the location of 962 outfalls, 3,200 catch basins and 1,200 manholes. This will be useful in troubleshooting pollution and drainage problems in the town. Housekeeping includes annual street sweeping, which begins in the early Spring of each year. The town subcontracted the cleaning of 400-900 catch basins in each of the years 2005-10, while town DPW personnel cleaned the remainder of the catch basins each year. The town has combined efforts with Duxbury and Plymouth to develop a model stormwater by- law. As of 2008, town meeting had passed a final stormwater control by- law which included regulations on controlling illicit connections to the existing stormwater system. This by-law was modified and approved in 2011 as a water resources protection by-law, requiring all construction site approvals/permits to go through the Planning Board. During 2012, 85 potential illicit connection sites were screened. The town received a CPR grant of $51,980 in 2012 to develop plans for bio-retention areas for 3 sites, (out of 30 sites formerly surveyed/screened by the NSRWA and CEI Consultants), and to actually implement a plan at one of the sites.

Pembroke- Public education efforts have involved stormwater messages being aired on the local cable TV every two weeks, distribution of NPS pollution posters in all schools and town departments, stormwater information in consumer confidence reports, and the town's stormwater management plan being made available on its website for public review. An active stormwater advisory committee has been meeting quarterly. Also, the town has been co-sponsoring an annual volunteer river cleanup day. Stormwater system identification activities have included the completion of GIS mapping of all outfalls, catch basins, and stormdrain manholes by the end of 2007. Improvement of the town's overall stormwater management capabilities has included the development of a stormwater bylaw protocol (including an EPA approved illicit connection control component) during 2007, with formal approval of this bylaw at town meeting during 2008. The illicit connection component includes methods for identifying priority areas, and methodologies for locating and dealing with illicit discharges. In 2012-13, the town has continued to actively enforce this component. Housekeeping has included the sweeping of all streets in the early Spring, and the cleaning of 1,200- 1,900 catch basins each year. Along with regular housekeeping efforts, several dozen catch basins have been retrofitted/ repaired in the Furnace Pond/ Oldham Pond areas. During 2012, the Pembroke Highway Department swept approximately 52 miles of roadway (all roads at least once). The Town cleans their catch basins on a continuing basis. During 2012, 1,462 catch basins were cleaned.

Duxbury- Public education has included: (1) placing stormwater drainage posters in the schools and public offices in town; (2) mailing pamphlets on controlling stormwater in water bills; (3) making the Duxbury stormwater management plan available on the town's website (including the harbormasters report on boat waste control); (4) providing dog waste education pamphlets and disposal stations at public parks; and, (5) providing planning board information on control of stormwater runoff in new sub-division building efforts. As of 2008 the town, through consultants, had begun to create a stormwater drainage map series (with GIS data layers), including outfalls, catch basins, and manholes. Substantial progress on this work continued during 2009 and 2010. A GPS unit was purchased to facilitate the conveyance location efforts. In 2006, the town received a $100,000 CZM Grant to sample outfalls coming from Bay Road Area into Kingston Bay, and to coordinate Bay Area monitoring with DMF. This resulted in DMF and the town Board of Health identifying and rectifying 3 illicit discharges coming into the Bay. In 2007, another CZM Grant, consisting of $125,000, was awarded for BMP installation in the Halls Corner/ Bay Road, and Depot/ Chestnut Street areas. These activities should result in water quality improvements in Kingston Bay. During 2009- 2010, the town Conservation Agent continued to work with DMF to do bacteria sampling in Duxbury and Kingston Bays, and at the same time attempt to identify illicit connections in the same areas. An additional $50,000 CZM Grant, (plus town approval of $50,000 matching funds), was awarded during 2008- 2009 to continue installing stormwater management control devices on outfall flows in the Hall's Corner and Bay Road areas, which ultimately drain into Snug Harbor. Part of the project involved combined efforts of the town, CZM, Mass Bays Program, NRCS, and property owners to put in stormwater BMP retrofit devices on selected outfalls. During 2012- 2013, the town focused on several stormwater related projects: (1) drafting a new IDDE plan, which included revision of its MS4 map book; (2) drafting SWPPPs for its highway garage and transfer station; (3) conducting stormwater related inspections, and making follow-up recommendations at 27 of its municipal facilities; (4) implementation of a stormwater BMP along Bay Road. During 2012, all streets were swept at least twice, and 1,400 catch basins were cleaned.

Kingston- Excellent progress on stormwater controls has been made in this town. There have been a lot of coordination efforts between the town, the Jones River Watershed Association, the North- South River Watershed Association, the Regional Planning Association, and the Silver Lake School District/ Kingston Intermediate School. To help reach the town's public outreach/ education goals, the town received a CZM grant to study LID concepts by reviewing local building/ land development regulations. The town also worked with the Jones River Watershed Association to get a grant in 2006 from the SE MA Environmental Education Alliance for the project, "Our Watershed Learning Project". This project resulted in the construction of the Jones River Marine Ecology Center for the main purpose of being a demonstration site for long- term stewardship of the Jones River- Cape Cod Bays areas, in order to get individuals involved with these efforts. A MassDEP 604b grant was received by the same two groups in 2007 to do a two year water quality monitoring effort in the Kingston estuary areas.

With illicit discharge detection concerns, there has been a sewering effort going on in several areas that have been problematic with failing septic systems. By October, 2007, the town had been placed on the MassDEP high priority list for SRF Funding to implement stormwater BMP controls, and the town had committed a $323,000 match to complement these efforts. SRF and match funds were used during 2007 to hire Environmental Partners Group (EPG), Inc., to help direct stormwater related activities for the town. EPG helped facilitate: (1) better management of illicit connection control efforts, through flyovers of the entire town, and digitalized data base mapping (web based) for all stormwater conveyances, drains, and outfalls using color orthographic techniques; (2) actual screening of all known dry weather outfall flows, and actual E coli sampling of 12 stormwater outlet pipes and 13 stream culverts; (3) research illicit discharge control by-law models in place in area towns, and recommend the appropriate model for Kingston; and (4) formalize a stormwater committee and workgroup that is effective with respect to Phase II Program goals, including development and implementation of an effective stormwater management plan. The Town Trust has purchased and installed pet waste disposal stations. With housekeeping efforts, town meeting in 2008 appropriated $279,000 for the purchase of a vactor truck for better street sweeping efforts.

During the March 2009 to March 2010 permit term, the town of Kingston continued its relationship with Environmental Partners Group (EPR), Inc. with funding provided by the earlier SRF loan and town match, in order to continue to meet and address the Phase II Stormwater Permit. In April 2009, mapping and screening initiatives were completed by EPR. In 2009, new GIS shapefiles of Kingston's stormwater infrastructure and parcel data were uploaded to the town's GIS system. The consultant commenced a regulatory review of local by- laws relating to stormwater in 2009, and continued this task to completion in 2010, and made recommendations to the town.

In April, 2013, the annual town meeting approved a SW management by- law for construction and post construction runoff, as well as control of illicit connections. In June, 2012, both Kingston and Duxbury were awarded a Gulf of Maine Visionary Award for collaborating SW remediation projects to improve water quality in the bay. In August, 2012, the town was awarded a $48,620 MassDEP 604(b) grant to conduct monitoring within the town center area of Kingston, and for finalizing engineering plans for stormwater remediation at priority sites identified through a 2011 MA Bays Research and Planning grant. Additionally, in November, 2012, the town was awarded a $124,495 EEA CPR grant to implement priority stormwater BMPs at two locations that discharge to the Jones River estuary. This represents the first phase of a multi-phase project to mitigate SW impacts, improve water quality, and open more shellfishing areas in Kingston Bay. During 2006, the EOEA declared Kingston, Duxbury, Plymouth Harbors and Bay Area's a No- Discharge Area for boat wastes.

Plympton- no report available for 2004-13.

Plymouth- Public education efforts in Plymouth have included the development and distribution of a stormwater flyer to all schools and public buildings. In 2008, the town established a stormwater web-page in the town website, and it purchased SUASCO produced education materials to distribute throughout town. There is a stormwater educational task force which has facilitated activities such as: airing stormwater messages on the local cable, and conducting 1-2 stormwater related workshops in the community per year. As of 2009, all conveyances, outfalls, catch basins and manholes in town had been mapped. Volunteer monitoring efforts have occurred through the town's natural resource officer. There are efforts underway to establish a stormwater task force committee through advertisements and interviews.

The town received a $15,000 grant in 2007 to facilitate a water quality monitoring effort involving for local pond associations. In 2009, additional funds were sought to continue and expand these monitoring efforts. The Public Works Department screened suspected outfalls during 2007- 8. As of March, 2008, revamped sewer rules in Section 12 of the Sewer Division Rules and regulations were put in place, including guidance for dealing with illicit discharges going into stormwater drainage conveyances. During 2008- 2012, the town engineer along with engineering interns have been attempting to uncover illicit connections during routine GPS mapping of catch basins, stormwater conveyances, and outfalls. Over the same time period, housekeeping activities included annual street sweeping, and the cleaning of up to 2,000 catch basins annually.

During 2011- 2012, the town reorganized the Environmental Management Department into the Department of Marine and Environmental Affairs and hired a Director to oversee environmental and stormwater related efforts. One of the first tasks was to develop a professional SW brochure, containing tips on reducing pollutants in stormwater runoff. Workshops on the brochure were carried out, and the brochure was distributed to over 500 residents in key targeted locales within the town. The new

Department began to also oversee environmental aspects on many of the important town projects, e.g., the $1.4 million Eel River Restoration Project. During 2012- 2013, the Public Works, and Engineering Departments were actively involved with 14 major stormwater drainage and catch basin retrofit projects throughout town.

8.5 Failing Septic Systems

Septic system bacteria contributions to the South Coastal watershed may be reduced in the future through septic system maintenance and/or replacement. Additionally, the implementation of Title 5, which requires inspection of private sewage disposal systems before property ownership is transferred, before building expansion approvals, or before changes in use of properties are approved, will aid in the discovery of poorly operating or failing systems. Because systems which fail must be repaired or upgraded, it is expected that the bacteria load from septic systems will be significantly reduced in the future. Regulatory and educational materials for septic system installation, maintenance and alternative technologies are provided by the MassDEP on the worldwide web at: www.mass.gov/dep/water/wastewater/septicsy.htm.

8.6 Wastewater Treatment Plants

WWTP discharges are regulated under the NPDES program when the effluent is released to surface waters. Each WWTP has an effluent limit included in its NPDES or groundwater permit. Some NPDES permits are listed on the following website: www.epa.gov/region1/npdes/permits_listing_ma.html. Groundwater permits are available at http://www.mass.gov/dep/brp/gw/gwhome.htm.

8.7 Recreational Waters Use Management

Recreational waters receive pathogen inputs from swimmers and boats. To reduce swimmers' contribution to pathogen impairment, shower facilities can be made available, and bathers should be encouraged to shower prior to swimming. In addition, parents should check and change young children's diapers when they are dirty. Options for controlling pathogen contamination from boats include:

- designation of the entire basin coastline as a No Discharge Area (NDA),
- supporting installation of pump-out facilities for boat sewage,
- educating boat owners on the proper operation and maintenance of marine sanitation devices (MSDs), and
- encouraging marina owners to provide clean and safe onshore restrooms and pump-out facilities.

Currently much of the areas proximal to the South Coastal watershed were recently, (2006), established as "no discharge area" (NDA). This includes Duxbury Bay, Kingston Bay, and Plymouth Bay. This designation by the Commonwealth of Massachusetts and approved by the EPA provides protection of this area by a Federal Law which prohibits the release of raw or treated sewage from vessels into navigable waters of the U.S. The law is enforced by the Massachusetts Environmental Police. The Massachusetts CZM and Massachusetts Environmental Law Enforcement are actively pursuing an amendment to State regulations allowing for the institution of fines up to $2000 for violations within a NDA (USEPA 2010).

8.8 Funding/Community Resources

A complete list of funding sources for implementation of non-point source pollution is provided in Section VII of the Massachusetts Nonpoint Source Management Plan Volume I (MassDEP 2000b) available on line at: www.mass.gov/dep/water/resources/nonpoint.htm. This list includes specific programs available for non-point source management and resources available for communities to manage local growth and development. The State Revolving Fund (SRF) provides low interest loans to communities for certain capital costs associated with building or improving wastewater treatment facilities. In addition, many communities in Massachusetts sponsor low cost loans through the SRF for homeowners to repair or upgrade failing septic systems. State monies are also available through the Massachusetts Office of coastal Management's Coastal Pollutant Remediation, Coastal Nonpoint Source Pollution Control and Coastal Monitoring grant programs

8.9 Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts

For a more complete discussion on ways to mitigate pathogen water pollution, see the "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts". The guidance can be downloaded at:*
http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/impguide.pdf

9.0 Monitoring Plan

The long term monitoring plan for the South Coastal watershed includes several components:

1. continue with the current monitoring of the South Coastal watershed (local watershed conservation organizations, local governments, DMF),
2. continue with MassDEP watershed five-year cycle monitoring,
3. monitor areas within the watershed where data are lacking or absent to determine if the waterbody meets the use criteria,
4. monitor areas where BMPs and other control strategies have been implemented or discharges have been removed to assess the effectiveness of the modification or elimination,
5. assemble data collected by each monitoring entity to formulate a concise report where the basin is assessed as a whole and an evaluation of BMPs can be made, and
6. add/remove/modify BMPs as needed based on monitoring results.

The monitoring plan is an ever changing document that requires flexibility to add, change or delete sampling locations, sampling frequency, methods and analysis. At the minimum, all monitoring should be conducted with a focus on:

- capturing water quality conditions under varied weather conditions,
- establishing sampling locations in an effort to pin-point sources,
- researching new and proven technologies for separating human from animal bacteria sources, and
- assessing efficacy of BMPs
- Evaluating whether water quality is improving.

10.0 Reasonable Assurances

Reasonable assurances that the TMDL will be implemented include both application and enforcement of current regulations, availability of financial incentives including low or no-interest loans to communities for wastewater treatment facilities through the State Revolving Fund (SRF), and the various local, state and federal programs for pollution control. Storm water NPDES permit coverage is designed to address discharges from municipal owned storm water drainage systems. Enforcement of regulations controlling non-point discharges includes local enforcement of the state Wetlands Protection Act and Rivers Protection Act, Title 5 regulations for septic systems and various local regulations including zoning regulations. Financial incentives include Federal monies available under the CWA Section 319 NPS program and the CWA Section 604b and 104b programs, which are provided as part of the Performance Partnership Agreement between MassDEP and the EPA. Additional financial incentives include state income tax credits for Title 5 upgrades, and low interest loans for Title 5 septic system upgrades through municipalities participating in this portion of the state revolving fund program.

A brief summary of many of MassDEP's tools and regulatory programs to address common bacterial sources is presented below.

10.1 Overarching Tools

Massachusetts Clean Water Act: The MA Clean Water Act (M.G.L. Chapter 21, sections 26-53) provides MassDEP with specific and broad authority to develop regulations to address both point and non-point sources of pollution. There are numerous regulatory and financial programs, including those identified in the preceding paragraph, that have been established to directly and indirectly address pathogen impairments throughout the state. Several of them are briefly described below. The MA Clean Water Act can be found at the following URL. http://www.mass.gov/legis/laws/mgl/21-26.htm

Surface Water Quality Standards (314 CMR 4.0): The MA Water Quality Standards (WQS) assign designated uses and establish water quality criteria to meet those uses. Water body classifications (Class A, B, and C, for freshwater and SA, SB, and SC for marine waters) are established to protect each class of designated uses. In addition, bacteria criteria are established for each individual classification. The MA Surface Water Quality Standards can be found http://www.mass.gov/dep/water/laws/regulati.htm#wqual

Ground Water Quality Standards (314 CMR 6.0): These standards consist of groundwater classifications, which designate and assign the uses for various groundwaters of the Commonwealth that must be maintained and protected. Like the surface water quality standards the groundwater standards provide specific ground water quality criteria necessary to sustain the designated uses and/or maintain existing groundwater quality. The MA Ground Water Quality Standards can be found http://www.mass.gov/dep/water/laws/regulati.htm#wqual

River Protection Act: In 1996 MA passed the Rivers Protection Act. The purposes of the Act were to protect the private or public water supply; to protect the ground water; to provide flood control; to prevent storm damage; to prevent pollution; to protect land containing shellfish; to protect wildlife habitat; and to protect the fisheries. The provisions of the Act are implemented through the Wetlands Protection Regulations, which establish up to a 200-foot setback from rivers in the Commonwealth to control construction activity and protect the items listed above. Although this Act does not directly reduce pathogen discharges it indirectly controls many sources of pathogens close to water bodies. More information on the Rivers Protection Act can be found on MassDEPs web site at http://www.mass.gov/dep/water/laws/laws.htm

10.2 Additional Tools to Address Combined Sewer Overflows (CSO's)

CSO Program/Policy: Massachusetts, in concert with EPA Region 1, has established a detailed CSO abatement program and policy. CSO discharges are regulated by the Commonwealth in several ways. Like any discharge of pollutants, CSOs must have an NPDES/MA Surface Water Discharge Permit under federal and state regulations. Municipalities and districts seeking funding for wastewater treatment, including CSO abatement, must comply with the facilities planning process at 310 CMR 41.00. Entities obtaining funding or exceeding specific thresholds must also comply with the Massachusetts Environmental Policy Act (MEPA) regulations at 301 CMR 11.00. Each of these regulations contains substantive and procedural requirements. Because both MEPA and facilities planning require the evaluation of alternatives, these processes are routinely coordinated.

All permits for a CSO discharge must comply with Massachusetts Surface Water Quality Standards at 314 CMR 4.00. The water quality standards establish goals for waters of the Commonwealth, and provide the basis for water quality-based effluent limitations in NPDES permits. Any discharge, including CSO discharges, is allowed only if it meets the criteria and the antidegradation standard for the receiving segment. EPA's 1994 CSO Control Policy revised some features of its 1989 version to provide greater flexibility by allowing a minimal number of overflows, which are compatible with the water quality goals of the Clean Water Act. MassDEP's 1995 regulatory revisions correspondingly decreased reliance on partial use designation as the sole regulatory vehicle to support CSO abatement plans1.

In all cases, NPDES/MA permits require the nine minimum controls necessary to meet technology-based limitations as specified in the 1994 EPA Policy. The nine controls may be summarized as; operate and maintain properly; maximize storage, minimize overflows, maximize flows to Publicly Owned Treatment Works (POTW), prohibit dry weather CSO's, control solids and floatables, institute pollution prevention programs, notify the public of impacts, and observe monitoring and reporting requirements. The nine minimum controls may be supplemented with additional treatment requirements, such as screening and disinfection, on a case-by-case basis. The Department's goal is to eliminate adverse CSO impacts and attain the highest water quality achievable. Separation or relocation of CSOs is required wherever it can be achieved based on an economic and technical evaluation.

As untreated CSOs cause violations of water quality standards, and thus are in violation of NPDES permits, all of the state's CSO permittees are under enforcement orders to both eliminate the CSO or plan, design, and construct CSO abatement facilities. Each long-term control plan must identify and achieve the highest feasible level of control. The process also requires the permittee to comply with any approved TMDL.

[1] DEP's 1990 CSO Policy was based on EPA's 1989 CSO Control Policy and established the goal of eliminating adverse impacts from CSOs, using partial use designation where removal or relocation was not feasible. The three month design storm was identified as the minimum technology-based effluent limitation, which would result in untreated overflows an average of four times a year. Abatement measures to meet these minimum standards were necessary for a CSO discharge to be eligible for partial use designation. Presumably, all CSOs exceeding this standard required downgrading to Class C or SC status. No partial use designations or downgrades to Class C were actually made, but the process was perceived as administratively cumbersome.

Presently, there are twenty–four (24) CSO communities in the Commonwealth.

10.3 Additional Tools to Address Failed Septic Systems

Septic System Regulations (Title 5): The MassDEP has regulations in place that require minimum standards for the design of individual septic systems. Those regulations ensure, in part, protection for nearby surface and groundwaters from bacterial contamination. The regulations also provide minimum standards for replacing failed and inadequate systems. The Department has established a mandatory requirement that all septic systems must be inspected and upgraded to meet Title 5 requirements at the time of sale or transfer of the each property.

10.4 Additional Tools to Address Stormwater

Stormwater is regulated through both federal and state programs. Those programs include, but are not limited to, the federal and state Phase I and Phase II NPDES stormwater program, and, at the state level, the Wetlands Protection Act (MGL Chapter 130, Section 40), the state water quality standards, and the various permitting programs previously identified.

Federal Phase 1 & 2 Stormwater Regulations: Existing stromwater discharges are regulated under the federal and state Phase 1 and Phase II stormwater program. In MA there are two Phase 1 communities, Boston and Worcester. Both communities have been issued individual permits to address stromwater discharges. In addition, 237 communities in MA are covered by Phase II. Phase II is intended to further reduce adverse impacts to water quality and aquatic habitat by instituting use controls on the unregulated sources of stormwater discharges that have the greatest likelihood of causing continued environmental degradation including those from municipal separate storm sewer systems (MS4s) and discharges from construction activity.

The Phase II Final Rule, published in the Federal Register on December 8, 1999, requires permittees to determine whether or not stormwater discharges from any part of the MS4 contribute, either directly or indirectly, to a 303(d) listed waterbody. Operators of regulated MS4s are required to design stormwater management programs to 1) reduce the discharge of pollutants to the “maximum extent practicable” (MEP), 2) protect water quality, and 3) satisfy the appropriate water quality requirements of the Clean Water Act. Implementation of the MEP standard typically requires the development and implementation of BMPs and the achievement of measureable goals to satisfy each of the six minimum control measures. Those measures include 1) public outreach and education, 2) public participation, 3) illicit discharge detection and elimination, 4) construction site runoff control, 5) post-construction runoff control, and 6) pollution prevention/good housekeeping. In addition, each permittee must determine if a TMDL has been developed and approved for any water body into which an MS4 discharges. If a TMDL has been approved then the permittee must comply with the TMDL including the application of BMPs or other performance requirements. The permittee’s must report annually on all control measures currently being implemented or planned to be implemented to control pollutants of concern identified in TMDLs. Finally, the Department has the authority to issue an individual permit to achieve water quality objectives. Links to the MA Phase II permit and other stormwater control guidance can be found at: http://www.mass.gov/dep/water/wastewater/stormwat.htm

A full list of Phase II communities in MA can be found at: http://www.mass.gov/dep/water/laws/p2help.htm

The MassDEP Wetlands regulations (310 CMR 10.0) direct issuing authorities to enforce the MassDEP Stormwater Management Policy, place conditions on the quantity and quality of point source discharges, and to control erosion and sedimentation. The Stormwater Management Policy was issued under the authority of the 310 CMR 10.0. The policy and its accompanying Stormwater Performance Standards apply to new and redevelopment projects where there may be an alteration to a wetland resource area or within 100 feet of a wetland resource (buffer zone). The policy requires the application of structural and/or non-structural BMPs to control suspended solids, which have associated co-benefits for bacteria removal. A stormwater handbook was developed to promote consistent interpretation of the Stormwater Management Policy and Performance Standards: Volume 1: Stormwater Policy Handbook and Volume 2: Stormwater Technical Handbook can be found along with the Stormwater Policy at: http://www.mass.gov/dep/water/laws/policies.htm#storm

10.5 Financial Tools

Nonpoint Source Control Program: MassDEP has established a non-point source program and grant program to address non-point source pollution sources statewide. The Department has developed a Nonpoint Source Management Plan that sets forth an integrated strategy and identifies important programs to prevent, control, and reduce pollution from nonpoint sources and more importantly to protect and restore the quality of waters in the Commonwealth. The Clean Water Act, Section 319, specifies the contents of the management plan. The plan is an implementation strategy for BMPs with attention given to funding sources and schedules. Statewide implementation of the Management Plan is being accomplished through a wide variety of federal, state, local, and non-profit programs and partnerships. It includes partnering with the Massachusetts Coastal Zone Management on the implementation of Section 6217 program. That program outlines both short and long term strategies to address urban areas and stormwater, marinas and recreational boating, agriculture, forestry, hydromodification, and wetland restoration and assessment. The CZM 6217 program also addresses TMDLs and nitrogen sensitive embayments and is crafted to reduce water quality impairments and restore segments not meeting state standards.

In addition, the state is partnering with the Natural Resource Conservation Service (NRCS) to provide implementation incentives through the national Farm Bill. As a result of this effort, NRCS now prioritizes its Environmental Quality Incentive Program (EQIP) funds based on MassDEP's list of impaired waters. The program also provides high priority points to those projects designed to address TMDL recommendations. Over the past several years EQIP funds have been used throughout the Commonwealth to address water quality goals through the application of structural and non-structural BMPs.

MA, in conjunction with EPA, also provides a grant program to implement nonpoint source BMPs that address water quality goals. The section 319 funding provided by EPA is used to apply needed implementation measures and provide high priority points for projects that are designed to address 303d listed waters and to implement TMDLs. MassDEP has funded numerous projects through 319 that were designed to address stormwater and bacteria related impairments. It is estimated that 75% of all projects funded since 2002 were designed to address bacteria related impairments.

The 319 program also provides additional assistance in the form of guidance. The Department is in the process of updating the Massachusetts' Nonpoint Source Management Manual that will provide detailed guidance in the form of BMPs by landuse to address various water quality impairments and associated pollutants.

Finally, it should be noted that the approach and process outlined for implementing this TMDL has been previously demonstrated with documented success. A previous TMDL, which utilized this approach was developed and approved by EPA for the Neponset River Watershed. The recommendations outlined in that TMDL were similar to the current proposal. Since the time of approval, MassDEP 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.

Other examples include the Little Harbor in Cohasset and the Shawsheen River. Similar TMDLs were developed in these areas. In Little Harbor, the TMDL was used as the primary tool to obtain local approval and funding to design and install sewers around Little Harbor and other additional areas of Town impacted by sewerage contamination. Presently, the Town is seeking additional state funding to construct the sewers. In the Shawsheen Watershed the TMDL was used to obtain a state grant to identify and prioritize specific stormwater discharges for remediation. In addition, MassDEP has received a grant to a conduct additional sampling and refine field and laboratory techniques that will allow us to differentiate between human and non-human sources that will be useful statewide. MassDEP and EPA Region 1 are also working on a compliance & enforcement strategy to address the worst sources.
Additional information related to the non-point source program, including the Management Plan can be found at: http://www.mass.gov/dep/water/resources/nonpoint.htm.

State Revolving Fund: The State Revolving Fund (SRF) Program provides low interest loans to eligible applicants for the abatement of water pollution problems across the Commonwealth. MassDEP has issued millions of dollars in loans for the planning and construction of CSO facilities and to address stormwater pollution. Loans have also been distributed to municipal governments statewide to upgrade and replace failed Title 5 systems. These programs all demonstrate the State's commitment to assist local governments in implementing the TMDL recommendations. Additional information about the SRF Program is located at: http://www.mass.gov/dep/water/wastewater/wastewat.htm#srf.

In summary, MassDEP's approach and existing programs set out a wide variety of tools both MassDEP and 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. MassDEP's authority combined with the programs identified above provide sufficient reasonable assurance that implementation of remedial actions will take place.

11.0 Public Participation

Two public meetings were held at 3 p.m. and 7pm. at the MassDEP-SERO, Lakeville on 8/10/2005 to present the Bacteria TMDL and to collect public comments. The public comment period began on July 23, 2005 and ended on August 26, 2005. The attendance list, public comments, and the MassDEP responses are attached as Appendix A. The final TMDL will be sent to U.S. EPA Region 1 in Boston for final approval.

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Appendix A

PUBLIC PARTICIPATION

Section II RESPONSE TO COMMENTS ON THE DRAFT PATHOGEN TMDL FOR THE SOUTH COASTAL WATERSHED

Public Meeting Announcement Published in the Monitor	7/23/2005
Date of Public Meeting	8/10/2005
Location of Public Meeting	DEP-SERO, Lakeville
Times of Public Meeting	3 P.M. and 7 P.M.

SOUTH COASTAL WATERSHED DRAFT PATHOGEN TMDL PUBLIC MEETING ATTENDEES

Date 8/10/2005 Time 3 PM

Name	Organization
1. Ben Bryant	Coalition for SOUTH COASTAL
2. A. Antoniello	DPW Scituate
3. Jason Burtner	CZM
4. Mike Hill	EPA
5. Bill Fitzgerald	DPW Franklin/Citizen Taunton
6. Cathal O'Brien	DPW Water Taunton
7. Lawrence Perry	Lakeville Health Agent
8. Newton Newman	Lloyd Center Dartmouth

Date 8/10/2005 Time 7 P.M

Name	Organization
1. Sara Grady	NSRWA/Mass Bays
2. Steve Silva	EPA

This appendix provides detailed responses to comments received during the public comment process. MassDEP received many comments/questions that were of a general nature (i.e. related to terminology, statewide programs, the TMDL development process and regulations, etc.) while others were watershed specific. Responses to both are presented in the following sections.

General Comments:

1. Question: On the slide titled "components of a TMDL" what does "WLA" and "LA" stand for.

Response: Waste load allocation (WLA) refers to pollutants discharged from pipes and channels that require a discharge permit (point sources). Load allocation (LA) refers to pollutants entering waterbodies through overland runoff (non point sources). A major difference between the two categories is the greater legal and regulatory control generally available to address point sources while voluntary cooperation added by incentives in some cases is the main vehicle for addressing non-point sources.

2. Question: What is the Septic System Program?

Response: Cities and Towns can establish a small revolving fund to help finance repairs and necessary upgrades to septic systems. The initial funding is from the Commonwealth's State, Revolving Fund Program (SRF). These programs generally offer reduced interest rate loans to homeowners to conduct such improvements. Many communities have taken advantage of this effort. A discussion of the septic system programs may be seen in the TMDL companion document "A TMDL Implementation Guidance Manual for Massachusetts" under Section 3.2.

3. Question: What is the WQS for non-contact recreation in terms of bacteria?

Response: The Massachusetts Surface Water Quality Standards, 314 CMR 4.00 (WQS), do not have any waters designated for "non-contact recreation." All Massachusetts surface waters currently are designated in the WQS for both primary and secondary contact recreation, among other uses. The bacteria criteria protect waters for their most sensitive uses, accordingly, the recreation based bacteria criteria for all Class A, SA, B and SB waters are protective of primary contact recreation. While the WQS do contain C and SC water classifications, with associated criteria, which are described to include waters designated for secondary contact recreation, there are no waters assigned to these classes. The bacteria criteria for Class C fresh waters are: "The geometric mean of all E. coli samples taken within the most recent six months shall not exceed 630 colonies per 100 ml, typically based on a minimum of five samples, and 10% of such samples shall not exceed 1260 colonies per 100 ml. This criterion may be applied on a seasonal basis at the discretion of the Department."

The Class C geometric mean bacteria criterion is five times the Class A and B geometric mean bacteria criterion for primary contact recreation. The WQS take the same approach with the Class SC bacteria criteria, that is, the SC geometric mean is five times that for SA and SB waters. With respect to bacteria criteria for secondary contact recreational waters, EPA has guidance that "states and authorized tribes may wish to adopt a criterion five times that of the geometric mean component of the criterion adopted to protect primary contact recreation, similar to the approach states and authorized tribes have used historically in the adoption of secondary contact criterion for fecal coliforms." Note that in the Massachusetts WQS, secondary contact recreation is defined to include water contact that is "incidental" so that contact incidental to such activities as boating and fishing would be anticipated.

4. Question: On the topic of DNA testing for bacterial source tracking what is MassDEP doing or planning to do?

Response: DNA testing is a promising but as yet not fully reliable tool in distinguishing between human and other sources of fecal bacteria. When perfected, this tool will be extremely valuable in helping target sources of pathogens and remedial actions. At the same time, one needs to recognize that even if the source of the bacteria is identified as non-human, any concentrations exceeding the criteria still impair the use, such as swimming or shellfishing, associated with those criteria. MassDEP is already working with our Wall Experiment Station to help develop reliable techniques to address this issue. Once developed MassDEP will include those techniques into our sampling programs, however, we hope local monitoring programs will also benefit from them.

5. Question: What is the current thought on e coli / entero bacteria survival and reproduction in the environment, especially in wetlands?

Response: There are reports that indicator bacteria can survive in sediment longer than they can in water. This may be a result of being protected from predators. Also, there is some indication that reproduction may occur in wetlands, but until wildlife sources can be ruled out through, for example, a reliable DNA testing, this possibility needs to be treated with caution. Also, die off of indicator bacteria tends to be more rapid in warm water than in cold.

6. Question: For the implementation phase of TMDLs who will do the regular progress reporting and who will pay for it?

Response: Phase I and Phase II municipalities already do regular reporting and provide annual status reports on their efforts. Any additional information can be coupled with existing reporting requirements and monitoring results to determine the success and failure of implementation measures. For non-Phase II municipalities it gets more difficult and MassDEP may have to work directly with each community or possibly add communities with known impairments to the Phase II list. The TMDL does not require volunteer groups, watershed organizations or towns to submit periodic reports - it is not mandatory. The MassDEP is relying on self interest and a sense of duty for communities to move ahead with the needed controls facilitated by some state aid. The MassDEP feels that the cooperative approach is the most desirable and effective but also believes that we possess broad regulatory authority to require action if and when it is deemed appropriate.

7. Question: How does the Phase II program and TMDL program coordinate with each other?

Response: The National Pollutant discharge Elimination System (NPDES) Stormwater Phase II General Permit Program became effective in Massachusetts in March 2003. The permit requires the regulated entities to develop, implement and enforce a stormwater management program (SWMP) that effectively reduces or prevents the discharge of pollutants into receiving waters to the Maximum Extent Practicable (MEP). Stormwater discharges must also comply with meeting state water quality standards. The Phase II permit uses a best management practice framework and measurable goals to meet MEP and water quality standards. A requirement of the permit is that if a TMDL has been approved for any water body into which the small municipal separate storm sewer system (MS4) discharges, the permittee must determine whether the approved TMDL is for a pollutant likely to be found in stormwater discharges from the MS4. If the TMDL includes a pollutant waste load allocation, best management practices (BMPs) or other performance standards for stormwater discharges, the permittee must incorporate them into their SWMP. The permittee must assess whether the pollutant reduction required by the TMDL is being met by existing stormwater management control measures in their SWMP or if additional control measures are necessary. As TMDLs are developed and approved, permittees' stormwater management programs and annual reports must include a description of the BMPs that will be used to control the pollutant(s) of concern, to the maximum extent practicable. Annual reports filed by the permittee should highlight the status or progress of control measures currently being implemented or plans for implementation in the future. Records should be kept concerning assessments or inspections of the appropriate control measures and how the pollutant reductions will be met.

8. Question: Will Communities be liable for meeting bacteria water quality standards for bacteria at the point of discharge?

Response: No. While this is the goal stated in the TMDL, compliance with the water quality standards is judged by in-stream measurements. For instance, in an extreme case, it could be possible for a community to meet this criterion in their storm drains and yet still be responsible for reducing the impacts of overland runoff if the in-stream concentrations of bacteria exceeded the water quality standard. So no matter how the TMDL is expressed, compliance is measured by the concentrations in the ambient water.

This approach is consistent with current EPA guidance and regulations. As stated in the November 22, 2002 Wayland/Hanlon memorandum (TMDL Appendix B, Attachment A), "WQBELs for NPDES-regulated stormwater 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)" (TMDL Appendix B, Attachment A Wayland/Hanlon memo, page 2). This memorandum goes on to state:

"...because stormwater 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 stormwater 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" (TMDL Appendix B, Attachment A Wayland, Hanlon memorandum, November 22, 2002, page 4).

The TMDL attempts to be clear on the expectation that BMPs will be used to achieve WQS as stated in the Wayland/Hanlon memorandum: "If it is determined that a BMP approach (including an iterative BMP approach) is appropriate to meet the stormwater component of the TMDL, EPA recommends that the TMDL reflect this." (TMDL Appendix B, Attachment A Wayland, Hanlon memorandum, page 5). Consistent with this, the Massachusetts' pathogen TMDLs state that BMPs may be used to meet WQS. The actual WLA and LA for stormwater will still be expressed as a concentration-based/WQS limit which will be used to guide BMP implementation. The attainment of WQS, however, will be assessed through ambient monitoring.

In stormwater TMDLs, the issue of whether WQSs will be met is an ongoing issue and can never be answered with 100% assurance. MassDEP believes that the BMP-based, iterative approach for addressing pathogens is appropriate for stormwater. Indeed, "the policy outlined in [the Wayland/Hanlon] memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and non-structural BMPs) that address stormwater discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality" (TMDL Appendix B, Attachment A Wayland, Hanlon memorandum, page 5).

A more detailed discussion / explanation of this response can be found in TMDL Appendix B, Attachment A, a memorandum titled "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs" by Robert H. Wayland and James A. Hanlon of EPA (11/22/02)..

9. Question: What are the regulatory hooks for this TMDL in regards to non-point sources?

Response: In general, the MassDEP is pursuing a cooperative approach in addressing non-point sources of contamination by bacteria. A total of 239 cities and towns in Massachusetts do have legal requirements to implement best management practices under their general NPDES storm-water permits. In addition, failing septic systems are required to be corrected once the local Board of Health becomes aware of them and at the time of property transfer should required inspections reveal a problem. Other activities, such as farming involving livestock, are the subject of cooperative control efforts through such organizations as the Natural Resources Conservation Service (NRCS) which has a long history of providing both technical advice and matching funds for instituting best management practices on farms. While MassDEP has broad legal authority to address non-point source pollution and enforcement tools available for use for cases of egregious neglect, it intends to fully pursue cooperative efforts which it feels offer the most promise for improving water quality.

10. Question: Why is there little mention in the draft TMDL reports on incorporation of LID (Low Impact Development) principles as a way through implementation to control Bacteria pollution?

Response: Part of the Statewide TMDL project was to produce an accompanying TMDL implementation guidance document for all the TMDL reports, "Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Document for MA". There is an entire section in that document (Section D.4) that discusses LID principles and TMDL implementation in detail.

11. Question: What about flow issues and TMDL requirements?

Response: Although flow can have both positive and negative impacts on water quality, flow is not a pollutant and therefore is not covered by a TMDL. TMDLs are required for each "pollutant" causing water quality impairments.

12. Question: Is there a way that the TMDL can be integrated with grants, and can the grants be targeted at TMDL implementation?

Response: The 319 Grant program is a major funding program providing up to $2 million per year in grants in MA. TMDL implementation is a high priority in the 319 program. In fact, projects designed to address TMDL requirements are given higher priority points during project evaluation.

The 319 grant program RFP Includes this language: "Category 4a Waters: TMDL and draft TMDL implementation projects – The 319 program prioritizes funding for projects that will implement Massachusetts' Total Maximum Daily Load (TMDL) analyses. Many rivers, streams and water bodies in the Commonwealth are impaired and thus do not meet Massachusetts' Surface Water Quality Standards. The goal of the TMDL Program is to determine the likely cause(s) of those impairments and develop an analysis (the TMDL) that lists those cause(s)."

Several comments were also directed towards the complications associated with applying for and reporting details that are required with state grant programs. The MassDEP is sympathetic to the paper work requirements of State and Federal grant programs. The MassDEP will review the body of requirements to assess what streamlining may be possible. At the same time, the MassDEP underscores that accountability for spending public funds continues to be an important and required component of any grant program.

13. Question: How will implementation of the TMDL address the major problem of post- construction run-off?

Response: Proper design and implementation of stormwater systems during construction will address both pre and post-construction runoff issues and thus eliminate future problems. Post-construction runoff is also one of the six minimum control measures that Phase II communities are required to include in their stormwater management program in order to meet the conditions of their National Pollutant Discharge Elimination System (NPDES) permit. In short, Phase II communities are required to:
Develop and implement strategies which include structural and/or nonstructural best management practices (BMPs);
Have an ordinance or other regulatory mechanism requiring the implementation of post-construction runoff controls to the extent allowable under State or local law;
Ensure adequate long-term operation and maintenance controls; and
Determine the appropriate best management practices (BMPs) and measurable goals for their minimum control measure.

The general permit implementing the Phase II requirements also contains requirements for permittees that discharge into receiving waters with an approved TMDL. In summary, municipalities covered under Phase II are required to incorporate and implement measures and controls into their plans that are consistent with an established TMDL and any conditions necessary for consistency with the assumptions and requirements of the TMDL.

It should be noted that there are a number of other permitting programs that regulate pre/post construction run-off including the construction general permit, wetlands requirements and the Mass DEP General Stormwater permit that is in the process of being developed.

14. Question: How does a pollution prevention TMDL work?

Response: MassDEP recommends that the information contained in the pathogen TMDLs guide management activities for all other waters throughout the watershed to help maintain and protect existing water quality. For non-impaired waters, Massachusetts is proposing "pollution prevention TMDLs" consistent with CWA s. 303(d)(3). Pollution prevention TMDLs encourage the Commonwealth, communities and citizens to maintain and protect existing water quality. Moreover it is easier and less costly in the long term to prevent impairments rather than retrofit controls and best management practices to clean up pollution problems. The goal of this approach is take a more proactive role to water quality management.

The analyses methods employed for the pathogen impaired segments in this TMDL would apply to the non-impaired segments, since the sources and their characteristics are similar. The waste load and/or load allocation for each source and designated use would be the same as specified in the TMDL documents. Therefore, the pollution prevention TMDLs would have comparable waste load and load allocations based on the sources present and the designated use of the waterbody segment.

The TMDLs may, in appropriate circumstances, also apply to segments that are listed for pathogen impairment in subsequent Massachusetts CWA s. 303(d) Integrated List of Waters. For such segments, this TMDL may apply if, after listing the waters for pathogen impairment and taking into account all relevant comments submitted on the CWA's 303(d) list, the Commonwealth determines with EPA approval of the CWA's 303(d) list that this TMDL should apply to future pathogen impaired segments.

Pollution prevention best management practices form the backbone of stormwater management strategies. Operation and maintenance should be an integral component of all stormwater management programs. This applies equally well with the Phase II Program as well as TMDLs. A detailed discussion of this subject and the BMPs involved can be found in the TMDL companion document "Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Document for Massachusetts" in Section 3.

It should also be noted that sometimes the MassDEP will develop a "preventative" TMDL. Preventative TMDLs are not required by Federal law, however, MassDEP does establish them on occasion to prevent waters from becoming impaired or where it is necessary to maintain waters at a certain level of water quality to meet the goals of a TMDL where the impaired water body is downstream from a non-impaired segment. In simple terms a preventative TMDL establishes goals to prevent degradation of good water quality.

15. Comment: The TMDL methodology uses concentrations based on water quality standards to establish TMDL loads, not traditional "loads".

Response: The TMDL has been revised to provide not only a concentration based approach but also a loading approach. It should be noted, however, that MassDEP believes that a concentration-based approach is consistent with EPA regulations and more importantly more understandable to the public and easier to assess through monitoring activities. Clean Water Act Section 130.2(i) states that "TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure". The TMDL in this case is set at the water quality standard. Pathogen water quality standards (which are expressed as concentrations) are based on human health, which is different from many of the other pollutants. It is important to know immediately when monitoring is conducted if the waterbody is safe for human use, without calculating a "load" by multiplying the concentration by the flow – a complex function involving variable storm flow, dilution, proximity to source, etc.

The expectation to attain water quality standards at the point of discharge is conservative and thus protective, and offers a practical means to identify and evaluate the effectiveness of control measures. In addition, this approach establishes clear objectives that can be easily understood by the public and individuals responsible for monitoring activities.

MassDEP believes that it is difficult to provide accurate quantitative loading estimates of indicator bacteria contributions from the various sources because many of the sources are diffuse and intermittent, and flow is highly variable. However, based on public comment we have included loads for each segment based on variable flow conditions and the water quality standards. Because of the high variability of bacteria and flows experienced over time, loads are extremely difficult to monitor and model. Therefore, "loadings" of bacteria are less accurate than a concentration-based approach and do not provide a way to quickly verify if you are achieving the TMDL.

16. Comment: There is concern with the "cookie-cutter" nature of the draft TMDL. Particularly the lack of any determination about the causes and contributions to pathogen impairment for specific river and stream segments.

Response: The MassDEP feels the pathogen TMDL approach is justified because of the commonality of sources affecting the impaired segments and the commonality of best management practices used to abate and control those sources. The MassDEP monitoring efforts are targeted towards the in-stream ambient water quality and not towards tracking down the various sources causing any impairments. It should be noted however that MassDEP has conducted additional efforts to try to identify sources where information was available. Based on this additional information, MassDEP added tables to help identify and prioritize important segments and sources where that information was known. Also MassDEP revised Section 7 of the document to include segment-by-segment load allocations and estimated the percent reduction required to meet standards. All of these actions were intended to provide additional guidance on potential sources and areas of concern and to help target future activities.

17. Comment: While Table 8-1 of each TMDL lists the Tasks that the agencies (MassDEP/EPA) believe need to be achieved, it isn't clear exactly how these tasks line up with and address the eight sources of impairment listed in Table 7-1. CZM recommends that the final TMDL be more specific and couple the Implementation Plan tasks with the known or expected sources of contamination. This would make the document more useful to a community

Response: All of the sources of impairments listed in Table 7-1 are addressed in Table 8-1, the text of Sections 6, 7,or 8, or both. Because Table 7-1 and 8-1 serve slightly different purposes it was not intended that the tasks needed to align with and exactly address the eight sources of impairment.

18. Comment: While the text in sections 8.1-8.7 of each TMDL describe some actions that can address the sources in Table 7-1, the issue of failing infrastructure is only mentioned in a sub-section title and in the text, but not addressed in any detail.

Response: Failing infrastructure is a very broad term, and is addressed, in part in such discussions as those on leaking sewer pipes, sanitary sewer overflows, and failed septic systems. It is outside of the scope of the TMDL documents to detail every possible type of infrastructure failure. Nonetheless, additional information is provided in the TMDL companion document titled: "Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Document for Massachusetts."

19. Comment: There is a need for more specific information about what individual communities are currently doing and how much more effort is required (e.g., how many more miles of pipe need to be inspected for illegal connections in a specific community).

Response: MassDEP and the EPA recognize that the municipalities have done, and are continuing to do, a tremendous amount of work to control bacterial contamination of surface waters. The TMDL has been expanded to provide additional examples of that overall effort. However, the additional discussion is not designed nor intended to include an exhaustive listing of all the work required by each municipality to finalize this effort and provide as status of that work. Programs, such as Phase II

Stormwater, require such status reports, and those will be very valuable in assessing priorities and future work. Phase II reports for each community are available on EPAs website: http://www.epa.gov/ne/npdes/stormwater/2003-permit-archives.html

20. Comment: There are no milestones to which individual communities should aim (e.g., all stormwater lines upstream of known contamination inspected for illegal connections in five years). As another example, Section 8.0 of each TMDL states that “The strategy includes a mandatory program for implementing stormwater BMPs and eliminating illicit sources” but it is not clear over what timeframe a community should be acting.

Response: MassDEP recognizes that the addition of timelines in the TMDLs would appear to strengthen the documents; however, the complexity of each source coupled with the many types of sources which vary by municipality simply does not lend itself to the TMDL framework and therefore must be achieved through other programmatic measures.

For example, the Phase II stormwater program required all communities to submit an application and plan in 2003. That plan must address the six minimum control measures and establish regulatory mechanisms to implement pre/post construction runoff controls and illicit discharge detection and elimination (IDDE) by 2008. Status reports are developed annually to report their progress on achieving that goal. Complete implementation, however, will likely take many more years.

A second example would be the control of combined sewer overflows (CSOs). Many municipalities are required by NPDES permits to develop and implement initial measures (commonly referred to as the Nine Minimum Controls (NMCs) and long-term control plans to address the issue. Since CSO discharges are defined as a point source under the Clean Water Act, an NPDES permit must be jointly issued by EPA and MassDEP for those discharges. The permit sets forth the requirements for implementation and assessment of the EPA mandated NMCs and the requirement for developing a long-term CSO control strategy. Many municipalities are under enforcement orders by EPA and MassDEP that outline timelines for reaching the objectives of the long-term control plan.

21. Comment: Under “Control Measures” does “Watershed Management” include NPDES permitting?

Response: Stormwater management includes NPDES Phase I and II and could include additional permitting actions were deemed necessary and appropriate. Properly functioning wastewater treatment plants already have permit limitations equal to the water quality standards and as such are not generally a source of bacteria that would result in water quality exceedences therefore they are not included as a control measure.

22. Comment: Absent from each report under “Who should read this document?” are the government agencies that provide planning, technical assistance, and funding to groups to remediate bacterial problems.

Response: The TMDL report has been edited to include groups and individuals that can benefit from the information in this report. It is beyond the scope of the TMDL to provide an exhaustive list of agencies that provide funding and support. Chapter 8.0, however, includes a link to this information, which is provided in the Massachusetts Nonpoint Source Strategy.

23. Comment: For coastal watersheds the section that describes funding sources should include grant programs available through the Massachusetts Office of Coastal Zone Management.

Response: Please see response to comment #22.

24. Comment: Table ES-1 and the similar tables throughout the report do not list B(CSO) or as a surface water classification – this classification and its associated loadings allocations are missing. Although the footnote to the table refers to Long term CSO Control Plans, the relationship between the TMDL, LTCP, and the B(CSO) water classification are unclear.

Response: The 1995 revisions to the MA Water Quality Standards created a B (CSO) water quality category by establishing regulatory significance for the notation “CSO” shown in the “Other Restriction” column at 314 CMR 4.06 for impacted segments. The B (CSO) designation was given, after public review and comment, to those waters where total elimination of CSOs was not economically feasible and could lead to substantial and widespread economic and social impact and the impacts from remaining CSO discharges were minor. Although a high level of control must be achieved, Class B standards may not be met during infrequent, large storm events.

The goal of the TMDL and the long-term control plan is to minimize impacts to the maximum extent feasible, attain the highest water quality achievable, and to protect critical uses. Given this, the TMDL establishes in Table ES-1 (as well as other tables) the goal of meeting class B standards in CSO impacted waters but recognizes that this criteria cannot be met at all times and therefore defers to the EPA and MassDEP approved long-term control CSO plan to define the infrequent occasions when the criteria may not be met.

25. Comment: The implementation of new bacteria water quality criteria into NPDES permits should be determined during the permit writing process rather than by the TMDL process – and that should be made clear in the TMDL document.

Response: MassDEP agrees that implementation of new bacteria water quality criteria should be incorporated into the permitting process as well as the state Water Quality Standards. This is already the case. The criteria are also being included in the TMDL because it is a required element of the TMDL process. Readers / users of the bacteria TMDL reports should be aware that new water quality standards were developed and included in the December 29, 2006 revisions to 314 CMR 4.00: Massachusetts Surface Water Quality Standards. These standards have been included in the final Pathogen TMDL for the South Coastal Watershed.

26. Comment: Coastal resources are significantly impacted from the stormwater run-off from Mass Highway roads. This goes beyond the control of municipalities to upgrade and is often beyond the capability of local groups to monitor. MHD (Massachusetts Highway Department (Mass Highway)) continues to evade stormwater standards and it is thus our opinion that MHD deserves special recognition, complete with implementation strategy to upgrade the drainage systems along its web of asphalt.

Response: Mass Highway is included in the Stormwater Phase II Program, and as such is responsible for completing the six minimum controls mandated by that program, i.e., public education and outreach, public involvement and participation, illicit discharge detection and elimination, construction site stormwater runoff control, post construction stormwater management, and good housekeeping in operations. EPA and MassDEP have authorized MassHighway to discharge stormwater from its designated Small MS4 in accordance with its issued permit. However, as of January 2006, EPA has not approved of MassHighwy's SWMP and as a result has not authorized stormwater or allowable non-stormwater discharges from any portion of MassHighway's regulated Small MS4 that could potentially affect species populations or habitat in the North Coastal Watershed.

27. Comment: The current 303d list of impaired waters – is it the 2002 or the 2004 list?

Response: It is the 2010 list. The 2010 list was recently approved by EPA. All of the pathogen TMDLs will apply to the current 2010 303d list and all future EPA approved 303d lists.

28. Comment: Does the NPDES non-delegated state status of Massachusetts affect the TMDLs in any way?

Response: No. The MassDEP and EPA work closely together and the non-delegated status will not affect the TMDLs. The EPA has not written any of the pathogen TMDLs but has helped fund them.

29. Comment: The TMDL report does not tell the watershed associations anything they didn't already know.

Response: True. The MassDEP is taking a cooperative approach and by working together as a team (federal, state, local, watershed groups) we can make progress in addressing bacterial problems – especially stormwater related bacterial problems.

30. Comment: What will the MassDEP do now for communities that they have not already been doing?

Response: Grants that can be used for implementation (such as the 319 grants) will be targeted toward TMDL implementation. Also, the more TMDLs a state completes and gets approved by EPA the more funding it will receive from EPA and thus the more TMDL implementation it can initiate.

31. Comment: The State Revolving Fund (SRF) should support municipalities with TMDLs and Phase II status a lot more.

Response: As with any grant program, there are some very competitive projects looking for funds from the SRF. A lot of these are the traditional sewage treatment plants and sewering projects which are very expensive. The SRF currently does allocate funds to stormwater related projects and gives higher priority points to projects developed in response to TMDLs.

32. Comment: Who will be doing the TMDL implementation?

Response: Each pathogen TMDL report has a section on implementation which includes a table that generally lists the various tasks and the responsible entity. Most of the implementation tasks will fall on the authority of the municipalities. Probably two of the larger tasks in urban areas include implementing stormwater BMPs and eliminating illicit sources. The document "Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts" was developed to support implementation of pathogen TMDLs. The MassDEP working with EPA and other team partners shall make every reasonable effort to assure implementation of the TMDLs.

33. Comment: Several watershed groups believe that active and effective implementation and enforcement is essential to carry out the objectives in the pathogen TMDLs. They define effective implementation as the MassDEP partnering with them and municipalities to identify funding opportunities to develop stormwater management plans, implement Title 5 upgrades, and repair failing sewer infrastructure. The groups define effective enforcement as active MassDEP application of Title 5 regulations and implementation of Stormwater Phase II permitting requirements for Phase II municipalities.

Response: The MassDEP has every intention of assisting watershed groups and municipalities with implementing the high priority aspects of the pathogen TMDLs, including identification of possible funding sources. With respect to Title 5 regulations and the Phase II program requirements, the MassDEP will continue to emphasize and assist entities with activities that lead to compliance with those program requirements.

34. Comment: The MassDEP Division of Watershed Management (DWM) should network implementation planning efforts in the coastal watersheds with the Coastal Zone Management's (CZM) Coastal Remediation Grant Program and the EPA Coastal Nonpoint Source Grant Program. Also, the DWM should make the pathogen TMDL presentation to the Mass Bays Group, and network with them in regards to coordinating implementation tasks.

Response: This is a good comment. The MassDEP DWM intends, through its basin planning program, to do both.

35. Comment: Why are specific segments or tributaries of watersheds addressed in the Draft TMDL but not all of the segments?

Response: In accordance with the EPA regulations governing TMDL requirements, only segments that are included on the state's 303(d) list of impaired waterbodies need to be included in any TMDL.

36. Comment: When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source reductions will occur; EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures can achieve expected load reductions in order for the TMDL to be approvable.

Response: Section 10.0, Reasonable Assurances, should provide these assurances. This section has been drastically expanded in the Final version of the Draft Pathogen TMDL reports. The revised section 10.0 describes all of the appropriate state programs and their enabling statutes and relevant regulations which actively address nonpoint source pollution impacting waters of the Commonwealth. Many of these programs involve municipality first line defense mechanisms such as the Wetlands Protection Act (which includes the Rivers Protection Act). This expanded section also covers grant programs available to municipalities to control and abate nonpoint source pollution such as 319 grants, 604b grants, 104b(3) funds, 6217 coastal nonpoint source grants, low interest loans for septic system upgrades, state revolving fund grants, and many others.

37. Comment: The Draft TMDLs indicate that for non-impaired waters the TMDL proposes "pollution prevention BMPs". The term is not defined in any state regulation and the origin of the term is unclear.

Response: An explanation of pollution prevention BMPs can be found in the pathogen TMDL companion document "Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Manual for Massachusetts". Section 3.1 of that manual describes pollution prevention as one of the six control measures for minimizing stormwater contamination under the EPA Phase I or II Stormwater Control Program. Control Measure #6, "Pollution Prevention / Good Housekeeping" involves a number of activities such as maintenance of structural and nonstructural stormwater controls, controls for reducing pollutants from roads, municipal yards and lots, street sweeping and catch basin cleaning, and control of pet waste. Also, the term "pollution prevention" can include a far wider range of pollution control activities to prevent bacterial pollution at the source. For instance, under Phase I and II, minimum control measures #4 and #5, construction site and post construction site runoff controls, would encompass many pollution prevention type BMP measures. Proper septic system maintenance and numerous agricultural land use measures can also be considered pollution prevention activities. Further information may be found in Sections 3.0, 4.0, and 5.0 in the Guidance Manual.

38. Comment: EPA regulations require that a TMDL include Load Allocations (LAs) which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. s.130.2(g)). Where possible, load allocations should be described separately for natural background and nonpoint sources. The Draft TMDL makes no such allocation. Also, EPA regulations require that a TMDL include Waste Load Allocations (WLAs) which identify the portion of the loading capacity allocated to individual existing and future point sources. The Draft TMDL makes no such allocation. Because it makes no estimate of the TMDL, it makes no WLA for point sources.

Response: This comment (and several others which addressed the same topic) relates to the establishment and allocation of an acceptable pollutant load so that water quality standards can be met and maintained (see response to comment 9 & 16). As touched upon elsewhere in this document, TMDLs can be expressed in a variety of ways so long as they are rational. MassDEP has chosen to use concentration as the metric for bacteria TMDLs for several reasons. First, there is a numeric standard that can be used. Second, and more important, bacteria, unlike some other pollutants, can increase with flow rather than decrease. As such, the bacteria load applicable at low flow (7Q10) would be very stringent if applied to higher flows. In essence, this TMDL recognizes that higher loads are likely at higher flows and therefore the emphasis is on meeting the in-stream water quality.

Watershed Specific Comments / Responses

South Coastal Basin TMDL PLAN
Comments of Pine DuBois, Executive Director, Jones River Watershed Association

The Jones River Watershed Association has been working to protect, enhance and restore the water quality and natural habitats within the 30-square mile Jones River Watershed even prior to its incorporation in 1986. In 2002, the organization expanded its mission to include the protection and long term ecological stewardship of Cape Cod Bay. In 2003, JRWA purchased the only private marina in the Jones River estuary, the site of the historic Jones River shipyards, and established a supporting non-profit organization, the Jones River Marine Ecology Center. The Ecology Center was given ownership to the property, now called Jones River Landing. The Watershed Association and Marine Ecology Center are developing the facility as an environmental heritage center. The groups are dedicated to improving the water quality and habitat health throughout the Jones River watershed, its estuary, and Cape Cod Bay.

Throughout its history the Watershed Association has performed studies in the river from shoreline survey, year long stream flow measurements, macro invertebrate assessment to assess river health, implemented stormwater remediation projects in the estuary, and performed year long baseline water quality assessments. The Association's work helped to convince the town of Kingston to finally sewer its coastal area. We also evaluate major development projects and make comments to the appropriate boards. We are, by most standards, a small organization—yet, like the Jones River, we believe our influence in felt in a larger region.

In our work with the South Coastal basin team during the years of the Mass Watershed Initiative, we initiated the study of the Jones River Watershed, ultimately performed by GZA; and were influential in the Geo-Syntec Report on Plymouth, Kingston and Pembroke 303(d) listed waters. We collaborated on many other projects (South Coastal Basin Open Space Plan and others). The Watershed Association is a founding member of the Watershed Action Alliance of Southeastern Massachusetts and participates with other regional and statewide groups.

Following are comments for consideration relative to the Draft Pathogen TMDL for the South Coastal Watershed.

1. Comment: piii-p.7 Pathogen TMDL- suggest in this paragraph that some discussion is given to the relative significance of the varying level or volume in the receiving water when pathogens are introduced either through stormwater or other means.

Response: A paragraph has been added.

2. Comment: Perhaps a paragraph can be added to 2.0 Description, p. 6 that discusses the seasonal fluctuations, changes in temperature, volume of base flow, and tidal cycle in the estuary that influence the severity of the introduced pathogen on the resource. If, for example, a heavy rain follows an extended dry period and run off to the estuary occurs at low tide, impact on the water quality could be more extreme then otherwise expected, as occurred recently when most beaches were closed.

Response: The description has been modified.

3. Comment: Also, emphasis should be provided somewhere regarding the need to develop the means to analyze water samples in order to render quicker and more useful information. Lack of quick analysis protocol is a serious problem that prevents timely public and environmental protection actions.

Response: Relative to bacteria MA DEP agrees that a quicker analysis protocol is a serious problem in finding and eliminating bacteria sources. Just by its nature finding bacteria sources is time consuming and costly. The MassDEP is however taking several steps to help address this issue. First, the Division of Watershed Management (DWM) has, a bacteria source tracking program which is intended to develop a specific protocol to track and identify bacterial sources. Second, DWM is working with the Wall Experiment Station (WES) on a protocol to help differentiate between human and non-human sources. For more information you can contact Chris Duerring at the Division of Watershed Management (508-767-2861).

4. Comment: The Description in 2.0 fails to include the Eel River as a major river in the basin. Without criteria for assessing what constitute a "major" river, this appears as an oversight.

Also suggest that the following paragraph says "….habitat for aquatic life, fishing, lobstering, shellfishing and beachfront."

Response: Wording has been added to the TMDL to clarify these areas.

5. Comment: p. 26 and in the tables of reference to "MA 94-14 the Jones River.
We need clarification regarding where DEP is calling the "mouth" of Jones River. If, as we presume, and according to the Rivers Act mapping of the coastal river by the Department, the mouth of the river is at the tip of Rocky Nook as it extends to the opposite shore—then we would prefer that DEP indicate that the mouth of the Jones River is in Kingston Bay. As we locally refer to the Kingston portion of the bay as Kingston Bay and the Duxbury line begins at the 42 parallel, beyond the mouth of the river. Or, say the Jones River (is polluted) from Elm St. to Duxbury Bay meaning beyond the mouth of the river—which is accurate, because the channel of the river extends beyond the mouth and at least as far as Goose Point in Duxbury Bay, where the waters continue to be polluted.

Response: MassDEP delineates the mouth of the Jones River from Rocky Nook Point to the opposite shore where the Kingston town line intercepts the coastline. The waterbody segment which it drains into is referred to as Duxbury Bay by DEP on our list of impaired waters and water quality assessment reports. This includes Kingston Bay, Plymouth Harbor, and Duxbury Bay

6. Comment: 5.0 Potential Sources
While we agree with what is written in this section, we offer the following observation of regular activities in the Jones River estuary.

- Weekly lawn mowing along the banks of the estuary with grass clippings sometimes dumped by the bagful into the river or on the bank so as to wash out with the rising tide.
- Collected cat litter boxes dumped on a pile of brush and grass clippings and seen later floating out with the tide.
- Agricultural ditching to improve cranberry bog flow directly connected to the river. All pesticides, fungicides, fertilizer and goose poop directed to the river.

It is impossible to name all of the various insults, however, these particularly egregious practices which go on despite being visible and known, points to the need to suggest that property management in general should be highlighted. It is not just wet or dry weather, it is tidal impacts as well that determines when and how much pollution impacts the water quality. Manure piles upstream in the watershed are bad as well, and are typically found at the edges of property close to wetland areas. And, we have found that recreational fields are a source for high nitrogen and likely bacteria contamination which results from the long forgotten under drains built into field to help them dry faster. Many athletic fields in Kingston are built in former wetland areas, with drains directed to the storm system. Only recently has the Watershed Association become aware of these influences. We believe they deserve mention and further investigation as dramatic inputs of pathogens can come from these sources.

Response: The MassDEP agrees it is impossible to name all of the various insults. The lists are intended to be more general than suggested in the comment.

7. Comment: 7.0 -7.2 Pathogen TMDL Development

It seems that the standards will be protective; however, we are troubled by the difficulty of collecting samples in non-point source environments (such as the pile of debris with cat waste that floats out with the tide). Do we take a sample from the pile or the water? Or is the evidence of the pile enough to bring change in the practice? (Not so far.) It seems that the Margin of Safety does not take into consideration that as the waste moves downstream and is joined with other waste streams that the TMDL can be exceeded as mixing and dilution occurs and the tide influences the direction of flow. Time of year influences can include the amount of fresh water mixing in the estuary as well as the temperature of the water.

Response: The Water Quality Standards are applied in the ambient water such as a stream , lake or embayment. As such, the sample should be taken in the water close to the source to determine compliance with the standard. Source characterization is a key component of implementing this TMDL, so the most appropriate control measure can be put in place. MassDEP agrees the evidence of the pile should be enough to bring change in the practice. The change can be accomplished by developing local by-laws and providing education to the uniformed to address the issue.

8. Comment: It is better to assume that contact recreation occurs also in the winter months. Boating and fishing occurs all year long and even the New Year's Day polar bear plunges are increasing in popularity.

Response: So noted.

9. Comment: Table 8-1 Implementation Tasks
It is troubling that the DEP TMDL Implementation Plan seems to ignore that other watershed groups such as the Jones River and Eel River, as well as others, have given considerable effort to address water quality concerns in their home watersheds, some for decades. Assigning the tasks of volunteer and organization coordination, detection of illicit connections, grant writing, and surface monitoring to one watershed group does a disservice to these other organizations and damages these grassroots efforts. Rather, DEP should seek to fund these organizations to tackle the problems in their home base, working with their watershed communities and in this way cultivate long term hometown environmental stewardship.

The Jones River Watershed Association is and has been dedicated to improving the quality of the water and natural habitats within its home watershed and in the south coastal region. While we do not want to be interpreted as being parochial or territorial, we do want our years of effort and dedication to our mission to be recognized. We feel that speaking to "the three major organizations" listed while ignoring the efforts of many others serves to narrow the focus on what will be improved, and will ultimately result in less improvement. Groups equally dedicated to the mission of improving water quality will not have the financial support necessary to get the job done, because they have not been named in the implementation strategy. We believe that it is important to recognize and applaud all the efforts and not to falsely imply that MBP or CZM could do their work without the other organizations, or that NSRWA can take care of the level of effort necessary address and the problems from Scituate to Sandwich.

Response: The first paragraph of 8-1 and Table 8-1 have been modified to reflect your good work. It is not DEP's intent to exclude the hard work of these or other organizations devoted to helping solve this wide spread problem.

10. Comment: Regarding Section **8**.2- Agriculture
We suggest that this section be expanded to include “Recreation” such as athletic ball fields and golf courses. Run off from these areas, as noted above, are direct and often very severe.

Response: An additional paragraph has been added to address this comment.

11. Comment: Regarding-- 9.0 Monitoring Plan
Monitoring requires money for analysis. Frequency of monitoring and targets should be discussed. Protocols for investigating waste stream, education and remediation procedures, evaluation of the influence of dams, manipulated flows, and derelict or abandoned structures and the like need to be developed and offered to monitoring groups. Towns require strategic assistance with appropriate by-laws. Data capture and compilation has to occur somewhere. Who is responsible for the “ever changing” monitoring plan? Where is the repository for information? This section does not seem complete or very useful.

Response: MassDEP Staff are available to assist communities and volunteer groups as they strive to implement adaptive management alternatives where possible and appropriate. This can and does incorporate local monitoring efforts during the development of water quality assessment reports however MassDEP does not have the resources to compile and manage all the raw data from the many volunteer groups across the state. This must be a local function.

12. Comment: Errata?
p.20 There seems to be a typo in the first paragraph third to last line—should “collaborate” really mean “corroborate”?

Response: This correction has been made.

13. CZM Comment:
p. 40, second paragraph, second bullet, In the first sentence discussion of the Massachusetts Bays Program’s (MBP) role, please replace “scientific research” with “technical support.” Also, please remove the last two sentences in this bullet that refer to MBP educating local officials and providing training to volunteers. The North and South Rivers Watershed Association, an organization that receives technical assistance from MBP, fulfills these roles.

Response: These corrections have been made.

APPENDIX B

(EPA: Robert Wayland Guidance): Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460
OFFICE OF WATER

MEMORANDUM
SUBJECT: Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs

FROM: Robert H. Wayland, III, Director
Office of Wetlands, Oceans and Watersheds

James A. Hanlon, Director
Office of Wastewater Management

TO: Water Division Directors
Regions 1 - 10

This memorandum clarifies existing EPA regulatory requirements for, and provides guidance on, establishing wasteload allocations (WLAs) for storm water discharges in total maximum daily loads (TMDLs) approved or established by EPA. It also addresses the establishment of water quality-based effluent limits (WQBELs) and conditions in National Pollutant Discharge Elimination System (NPDES) permits based on the WLAs for storm water discharges in TMDLs. The key points presented in this memorandum are as follows:
NPDES-regulated storm water discharges must be addressed by the wasteload allocation component of a TMDL. See 40 C.F.R. § 130.2(h).
NPDES-regulated storm water discharges may not be addressed by the load allocation (LA) component of a TMDL. See 40 C.F.R. § 130.2 (g) & (h).

Storm water discharges from sources that are not currently subject to NPDES regulation may be addressed by the load allocation component of a TMDL. See 40 C.F.R. § 130.2(g).

It may be reasonable to express allocations for NPDES-regulated storm water discharges from multiple point sources as a single categorical wasteload allocation when data and information are insufficient to assign each source or outfall individual WLAs. See 40 C.F.R. § 130.2(i). In cases where wasteload allocations are developed for categories of discharges, these categories should be defined as narrowly as available information allows.

The WLAs and LAs are to be expressed in numeric form in the TMDL. See 40 C.F.R. § 130.2(h) & (i). EPA expects TMDL authorities to make separate allocations to NPDES- regulated storm water discharges (in

the form of WLAs) and unregulated storm water (in the form of LAs). EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability in the system.
NPDES permit conditions must be consistent with the assumptions and requirements of available WLAs. See 40 C.F.R. § 122.44(d)(1)(vii)(B).

WQBELs 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). If BMPs alone adequately implement the WLAs, then additional controls are not necessary.

EPA expects that most WQBELs for NPDES-regulated municipal and small construction storm water discharges will be in the form of BMPs, and that numeric limits will be used only in rare instances.
When a non-numeric water quality-based effluent limit is imposed, the permit's administrative record, including the fact sheet when one is required, needs to support that the BMPs are expected to be sufficient to implement the WLA in the TMDL. See 40 C.F.R. §§ 124.8, 124.9 & 124.18.

The NPDES permit must also specify the monitoring necessary to determine compliance with effluent limitations. See 40 C.F.R. § 122.44(i). Where effluent limits are specified as BMPs, the permit should also specify the monitoring necessary to assess if the expected load reductions attributed to BMP implementation are achieved (e.g., BMP performance data).
The permit should also provide a mechanism to make adjustments to the required BMPs as necessary to ensure their adequate performance.

This memorandum is organized as follows:
(I). Regulatory basis for including NPDES-regulated storm water discharges in WLAs in TMDLs;
(II). Options for addressing storm water in TMDLs; and
(III). Determining effluent limits in NPDES permits for storm water discharges consistent with the WLA
(I). Regulatory Basis for Including NPDES-regulated Storm Water Discharges in WLAs in TMDLs
As part of the 1987 amendments to the CWA, Congress added Section 402(p) to the Act to cover discharges composed entirely of storm water. Section 402(p)(2) of the Act requires permit coverage for discharges associated with industrial activity and discharges from large and medium municipal separate storm sewer systems (MS4), i.e., systems serving a population over 250,000 or systems serving a population between 100,000 and 250,000, respectively. These discharges are referred to as Phase I MS4 discharges.

In addition, the Administrator was directed to study and issue regulations that designate additional storm water discharges, other than those regulated under Phase I, to be regulated in order to protect water quality. EPA issued regulations on December 8, 1999 (64 FR 68722), expanding the NPDES storm water program to include discharges from smaller MS4s (including all systems within "urbanized areas" and other systems serving populations less than 100,000) and storm water discharges from construction sites that disturb one to five acres, with opportunities for area-specific exclusions. This program expansion is referred to as Phase II.

Section 402(p) also specifies the levels of control to be incorporated into NPDES storm water permits depending on the source (industrial versus municipal storm water). Permits for storm water discharges associated with industrial activity are to require compliance with all applicable provisions of Sections 301 and 402 of the CWA, i.e., all technology-based and water quality-based requirements. See 33 U.S.C. §1342(p)(3)(A). Permits for discharges from MS4s, however, "shall require controls to reduce the discharge of pollutants to the maximum extent practicable ... and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants." See 33 U.S.C. §1342(p)(3)(B)(iii).

Storm water discharges that are regulated under Phase I or Phase II of the NPDES storm water program are point sources that must be included in the WLA portion of a TMDL. See 40 C.F.R. § 130.2(h). Storm water discharges that are not currently subject to Phase I or Phase II of the NPDES storm water program are not required to obtain NPDES permits. 33 U.S.C. §1342(p)(1) & (p)(6). Therefore, for regulatory purposes, they are analogous to nonpoint sources and may be included in the LA portion of a TMDL. See 40 C.F.R. § 130.2(g).

(II). Options for Addressing Storm Water in TMDLs

Decisions about allocations of pollutant loads within a TMDL are driven by the quantity and quality of existing and readily available water quality data. The amount of storm water data available for a TMDL varies from location to location. Nevertheless, EPA expects TMDL authorities will make separate aggregate allocations to NPDES-regulated storm water discharges

(in the form of WLAs) and unregulated storm water (in the form of LAs). It may be reasonable to quantify the allocations through estimates or extrapolations, based either on knowledge of land use patterns and associated literature values for pollutant loadings or on actual, albeit limited, loading information. EPA recognizes that these allocations might be fairly rudimentary because of data limitations.

EPA also 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 this situation, EPA recommends expressing the wasteload allocation in the TMDL as either a single number for all NPDES-regulated storm water discharges, or when information allows, as different WLAs for different identifiable categories, e.g., municipal storm water as distinguished from storm water discharges from construction sites or municipal storm water discharges from City A as distinguished from City B. These categories should be defined as narrowly as available information allows (e.g., for municipalities, separate WLAs for each municipality and for industrial sources, separate WLAs for different types of industrial storm water sources or dischargers).

(III). Determining Effluent Limits in NPDES Permits for Storm Water Discharges Consistent with the WLA

Where a TMDL has been approved, NPDES permits must contain effluent limits and conditions consistent with the requirements and assumptions of the wasteload allocations in the TMDL. See 40 CFR § 122.44(d)(1)(vii)(B). Effluent limitations to control the discharge of pollutants generally are expressed in numerical form. However, in 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.

EPA's policy recognizes that 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 and 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.

Under certain circumstances, BMPs are an appropriate form of effluent limits to control pollutants in storm water. See 40 CFR § 122.44(k)(2) & (3). If it is determined that a BMP approach (including an iterative BMP approach) is appropriate to meet the storm water component of the TMDL, EPA recommends that the TMDL reflect this.

EPA expects that the NPDES permitting authority will review the information provided by the TMDL, see 40 C.F.R. § 122.44(d)(1)(vii)(B), and determine whether the effluent limit is appropriately expressed using a BMP approach (including an iterative BMP approach) or a numeric limit. Where BMPs are used, EPA recommends that the permit provide a mechanism to require use of expanded or better-tailored BMPs when monitoring demonstrates they are necessary to implement the WLA and protect water quality.

Where the NPDES permitting authority allows for a choice of BMPs, a discussion of the BMP selection and assumptions needs to be included in the permit's administrative record, including the fact sheet when one is required. 40 C.F.R.§§ 124.8, 124.9 & 124.18. For general permits, this may be included in the storm water pollution prevention plan required by the permit. See 40 C.F.R. § 122.28. Permitting authorities may require the permittee to provide supporting information, such as how the permittee designed its management plan to address the WLA(s). See 40 C.F.R. § 122.28. The NPDES permit must require the monitoring necessary to assure compliance with permit limitations, although the permitting authority has the discretion under EPA's regulations to decide the frequency of such monitoring. See 40 CFR § 122.44(i). EPA recommends that such permits require collecting data on the actual performance of the BMPs. These additional data may provide a basis for revised management measures. The monitoring data are likely to have other uses as well. For example, the monitoring data might indicate if it is necessary to adjust the BMPs. Any monitoring for storm water required as part of the permit should be consistent with the state's overall assessment and monitoring strategy.

The policy outlined in this memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and non-structural BMPs) that address storm water discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality. This approach is further supported by the recent report from the National Research Council (NRC), Assessing the TMDL Approach to Water Quality Management (National Academy Press, 2001). The NRC report recommends an approach that includes "adaptive implementation," i.e., "a cyclical process in which TMDL plans are periodically assessed for their achievement of water quality standards" . . . and adjustments made as necessary. NRC Report at ES-5.

This memorandum discusses existing requirements of the Clean Water Act (CWA) and codified in the TMDL and NPDES implementing regulations. Those CWA provisions and regulations contain legally binding requirements. This document describes these requirements; it does not substitute for those provisions or regulations. The recommendations in this memorandum are not binding; indeed, there may be other approaches that would be appropriate in particular situations. When EPA makes a TMDL or permitting decision, it will make each decision on a case-by-case basis and will be guided by the applicable requirements of the CWA and implementing regulations, taking into account comments and information presented at that time by interested persons regarding the appropriateness of applying these recommendations to the particular situation. EPA may change this guidance in the future.

If you have any questions please feel free to contact us or Linda Boornazian, Director of the Water Permits Division or Charles Sutfin, Director of the Assessment and Watershed Protection Division.
cc:
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