2005

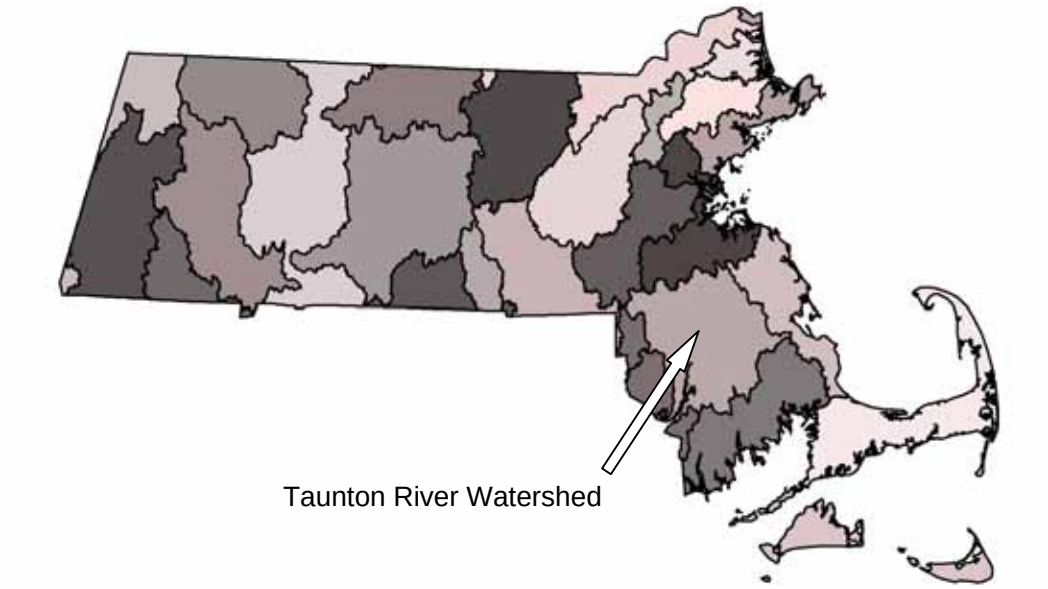
# Draft Pathogen TMDL for the Taunton River Watershed

Massachusetts Department of Environmental Protection

USEPA New England Region 1

ENSR International

# Draft Pathogen TMDL for the Taunton River Watershed

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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 (MADEP)
Division of Watershed Management
627 Main Street
Worcester, Massachusetts 01608

This report is also available from MADEP'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.

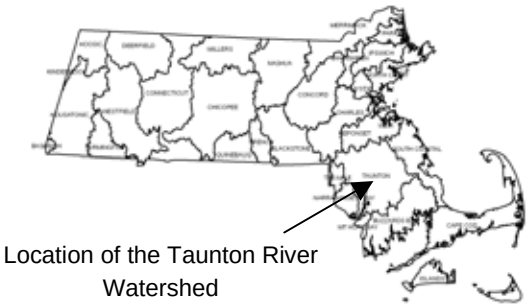
DISCLAIMER

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.

**Draft Total Maximum Daily Loads for Pathogens within the Taunton River Watershed**




**Key Features:** Pathogen TMDL for the Taunton River Watershed

**Location:** EPA Region 1

**Land Type:** New England Coastal

**303(d) Listings**: Pathogens

Assonet River (MA62-20);
Matfield River (MA62-32);
Rumford River (MA62-15) was divided into two segments in the 2001 Water Quality Assessment Report: (MA62-39) and (MA62-40); (MA62-15) no longer exists
Salisbury Brook (MA62-08);
Salisbury Plain River (MA62-05, MA62-06);
Taunton River (MA62-02, MA62-03, MA62-04);
Threemile River (MA62-16) was divided into two segments in the 2001 Water Quality Assessment Report: (MA62-56) and (MA62-57); (MA62-16) no longer exists
Trout Brook (MA62-07);
Wading River (MA62-17) was divided into two segments in the 2001 Water Quality Assessment Report: (MA62-47) and (MA62-49); (MA62-17) no longer exists

**Data Sources:** MADEP "Taunton River Watershed 2001 Water Quality Assessment Report"

**Data Mechanism:** Massachusetts Surface Water Quality Standards for Fecal Coliform; 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

**Control Measures:** Watershed Management; Storm Water Management (e.g., illicit discharge removals, public education/behavior modification); CSO & SSO Abatement; 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.

## TMDL Overview

The Massachusetts Department of Environmental Protection (MADEP) 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.

Once a water body is identified as impaired, the MADEP 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 meet water quality standards, and assigning pollutant load allocations to the sources. A plan to implement the necessary pollutant reductions is essential to the ultimate achievement of meeting the water quality standards.

**Pathogen TMDL:** This report represents a TMDL for pathogen indicators (e.g. fecal coliform, *E. coli*, and enterococcus bacteria) in the Taunton River watershed. 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 Taunton River watershed were found to be many and varied. Most of the bacteria sources are believed to be storm water related. Table ES-1 provides a general compilation of likely bacteria sources in the Taunton River watershed including failing septic systems, combined sewer overflows (CSO), sanitary sewer overflows (SSO), sewer pipes connected to storm drains, certain recreational activities, wildlife including birds along with 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 15 pathogen impaired segments of the Taunton River watershed that are currently listed on the CWA § 303(d) list of impaired waters. MADEP 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-1 and Table 6-1).

This Taunton River 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 accurate 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 fecal coliform loading will be necessary, especially in developed areas. This goal is expected to be accomplished through implementation of best management practices, such as those associated with the Phase II control program for storm water.

TMDL goals for each type of bacteria source are provided in Table ES-1. 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. Among federal and state funds to help implement this TMDL are, on a competitive basis, the Non-Point Source Control (CWA Section 319) Grants, Water Quality (CWA Section 604(b)) Grants, and the State Revolving (Loan) Fund Program (SRF). Most financial aid requires some local match as well. The programs mentioned are administered through the MADEP. 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 MADEP’s website at: www.state.ma.us/dep/brp/wm/wmpubs.htm, or by contacting the MADEP’s Nonpoint Source Program at (508) 792-7470 to request a copy.

**Table ES-1. Sources and Expectations for Limiting Bacterial Contamination in the Taunton River 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 | Illicit discharges to storm drains | 0 | N/A |
| A, B, SA, SB | Leaking sanitary sewer lines | 0 | N/A |
| A, B, SA, SB | Failing septic systems | N/A | 0 |
| A | NPDES – WWTP | Not to exceed an arithmetic mean of 20 organisms in any set of representative samples, nor shall 10% of the samples exceed 100 organisms[2] | N/A |
| A | Storm water runoff Phase I and II | Not to exceed an arithmetic mean of 20 organisms in any set of representative samples, nor shall 10% of the samples exceed 100 organisms[3] | N/A |
| A | Direct storm water runoff not regulated by NPDES and livestock, wildlife & pets | N/A | Not to exceed an arithmetic mean of 20 organisms in any set of representative samples, nor shall 10% of the samples exceed 100 organisms[3] |
| B & Not Designated for Shellfishing SA & SB | CSOs | Shall not exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms[4] | N/A |
| B & Not Designated for Shellfishing SA & SB | NPDES – WWTP | Shall not exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms[2] | N/A |
| B & Not Designated for Shellfishing SA & SB | Storm water runoff Phase I and II | Not to exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms[3] | N/A |
| B & Not Designated for Shellfishing SA & SB | Direct storm water runoff not regulated by NPDES and livestock, wildlife & pets | N/A | Not to exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms[3] |

| Surface Water Classification | Pathogen Source | Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1] | Load Allocation Indicator Bacteria (CFU/100 mL)[1] |
|---|---|---|---|
| SA Designated Shellfishing Areas | NPDES – WWTP | Not to exceed a geometric mean of 14 organisms in any set of representative samples, nor shall 10% of the samples exceed 43 organisms[2] | N/A |
| SA Designated Shellfishing Areas | Storm water Runoff Phase I and II | Not to exceed a geometric mean of 14 organisms in any set of representative samples, nor shall 10% of the samples exceed 43 organisms[3] | N/A |
| SA Designated Shellfishing Areas | Direct storm water runoff not regulated by NPDES and livestock, wildlife & pets | N/A | Not to exceed a geometric mean of 14 organisms in any set of representative samples, nor shall 10% of the samples exceed 43 organisms[3] |
| SB Designated Shellfishing Areas | CSOs | Not to exceed a geometric mean of 88 organisms in any set of representative samples, nor shall 10% of the samples exceed 260 organisms[4] | N/A |
| SB Designated Shellfishing Areas | NPDES – WWTP | Not to exceed a geometric mean of 88 organisms in any set of representative samples, nor shall 10% of the samples exceed 260 organisms[2] | N/A |
| SB Designated Shellfishing Areas | Storm water runoff Phase I and II | Not to exceed a geometric mean of 88 organisms in any set of representative samples, nor shall 10% of the samples exceed 260 organisms[3] | N/A |
| SB Designated Shellfishing Areas | Direct storm water runoff not regulated by NPDES and livestock, wildlife & pets | N/A | Not to exceed a geometric mean of 88 organisms in any set of representative samples, nor shall 10% of the samples exceed 260 organisms[3] |
| Marine Beaches[5] | All Sources | Enterococci not to exceed a geometric mean of 35 colonies in a statistically significant number of samples, nor shall any single sample exceed 104 colonies | Enterococci not to exceed a geometric mean of 35 colonies in a statistically significant number of samples, nor shall any single sample exceed 104 colonies |

| Surface Water Classification | Pathogen Source | Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1] | Load Allocation Indicator Bacteria (CFU/100 mL)[1] |
|---|---|---|---|
| Fresh Water Beaches[6] | All Sources | Enterococci not to exceed a geometric mean of 33 colonies of the five most recent samples within the same bathing season, nor shall any single sample exceed 61 colonies<br>OR<br>*E. coli* not to exceed a geometric mean of 126 colonies of the five most recent samples within the same bathing season, nor shall any single sample exceed 235 colonies | Enterococci not to exceed a geometric mean of 33 colonies of the five most recent samples within the same bathing season, nor shall any single sample exceed 61 colonies<br>OR<br>*E. coli* not to exceed a geometric mean of 126 colonies of the five most recent samples within the same bathing season, nor shall any single sample exceed 235 colonies |

N/A means not applicable

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

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

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

[4] Or shall be consistent with an approved Long Term Control Plan (LTCP) for Combined Sewer Overflow (CSO) abatement. If the level of control specified in the LTCP is less than what is necessary to attain Class B water quality standards, then the above criteria apply unless MADEP has proposed and EPA has approved water quality standards revisions for the receiving water.

[5] Federal Beaches Environmental Assessment and Coastal Health Act of 2000 (BEACH Act) Water Quality Criteria

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

Note: this table represents waste load and load reductions based on water quality standards current as of the publication date of these TMDLs, any future changes made to the Massachusetts water quality standards will become the governing water quality standards for these TMDLs.

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# 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 2002 Integrated List of Water: Part 2- Final Listing of Individual Categories of Waters*" (*2002 List*; MADEP 2003). Figure 1-1 provides a map of the Taunton River watershed with pathogen impaired segments indicated. Please note that not all segments have been assessed by the Massachusetts Department of Environmental Protection (MADEP) for pathogen impairment. As shown in Figure 1-1, 15 of the Taunton River 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 or were determined to be pathogen impaired in the "*Taunton River Watershed 2001 Water Quality Assessment Report*" (MADEP WQA; MADEP 2005).

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 water body 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 designated uses of the Taunton River watershed waterbodies. These include water supply, shellfish harvesting, fishing, boating, and swimming. This TMDL establishes the necessary pollutant load to achieve designated uses and water quality standard 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.

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

**Figure 1-1. Taunton River Watershed and Pathogen Impaired Segments**

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 MADEP commissioned the development of watershed based TMDLs.

## 1.1. Pathogens and Indicator Bacteria

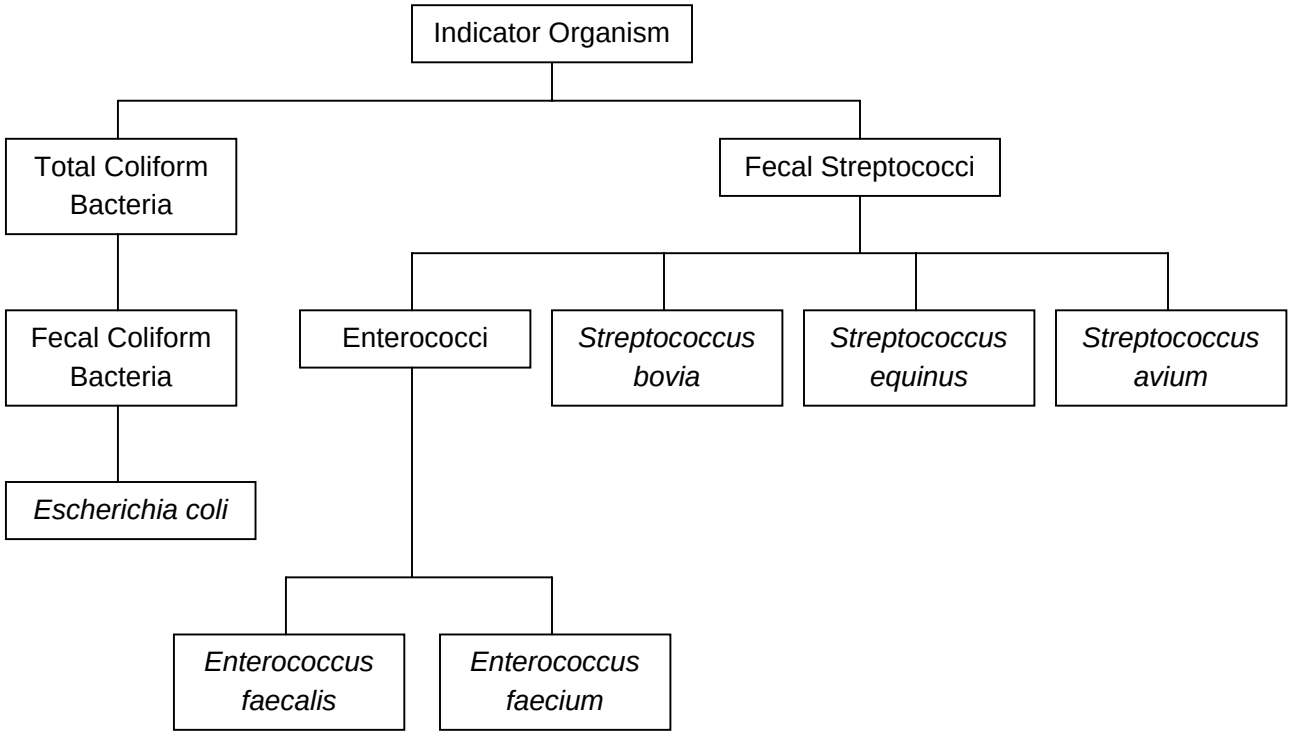
The Taunton River watershed pathogen TMDL is designed to support reduction of waterborne disease-causing organisms, known as pathogens, to reduce public health risk. Waterborne pathogens enter surface waters from a variety of sources including sewage and the feces of warm-blooded wildlife. These pathogens 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).

Massachusetts uses fecal coliform and enterococci as indicator organisms of potential harmful pathogens. The WQS that apply to fresh water are currently based on fecal coliform concentration but will be replaced with *E. coli.* Fecal coliform are also used by the Massachusetts Division of Marine Fisheries (DMF) in their classification of shellfish growing areas. Fecal coliform as the indicator organism for shellfish growing area status is not expected to change at this time. Enterococci are used as the indicator organism for marine beaches, as required by the Beaches Environmental Assessment and Coastal Act of 2000 (BEACH Act), an amendment to the CWA.

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




The Taunton River watershed pathogen TMDLs have been developed using fecal coliform as an indicator bacterium for fresh and marine waters and enterococci for marine beaches. Any changes in the Massachusetts pathogen water quality standard 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.

## 1.2. Comprehensive Watershed-based Approach to TMDL Development

Consistent with Section 303(d) of the CWA, the MADEP has chosen to complete pathogen TMDLs for all waterbodies in the Taunton River watershed at this time, regardless of current impairment status (i.e., for all waterbody categories in the *2002 List*). MADEP believes a comprehensive management approach carried out by all watershed communities is needed to address the ubiquitous nature of pathogen sources present in the Taunton River 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.

As discussed below, this TMDL applies to the 15 pathogen impaired segments of the Taunton River watershed that are currently listed on the CWA § 303(d) list of impaired waters and determined to be pathogen impaired in the "*Taunton River Watershed 2001 Water Quality Assessment Report*"

(MADEP WQA; MADEP 2005) (see Figure 1-1, Table 4-3). MADEP 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-1 and Table 6-1).

This Taunton River 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 15 pathogen impaired segments assessed by the MADEP in the Taunton River watershed. These impaired segments consist of four estuaries and 11 river segments (Figure 1-1). Pathogen impairment has been documented by the MADEP in previous reports, including the MADEP WQA, resulting in the impairment determination. In this TMDL document, an overview of pathogen impairment is provided to illustrate the nature and extent of the pathogen impairment problem. Additional data, not collected by the MADEP or used to determine impairment status, may also be provided in this TMDL to illustrate the pathogen problem. Since pathogen impairment has been previously established only a summary is provided herein.

The watershed based approach applied to complete the Taunton River 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 Taunton River watershed
- Identification of Sources (Section 5) – identifies and discusses potential sources of waterborne pathogens within the Taunton River watershed.
- TMDL Development (Section 6) – specifies required TMDL development components including:
    - Definitions and Equation
    - Loading Capacity
    - Load and Waste Load Allocations
    - Margin of Safety
    - Seasonal Variability
- Implementation Plan (Section 7) – 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 8) – describes recommended monitoring activities
- Reasonable Assurances (Section 9) – describes reasonable assurances the TMDL will be implemented
- Public Participation (Section 10) – describes the public participation process, and
- References (Section 11)

## 2.0 Watershed Description

The Taunton River watershed, covering 562 square miles and including all or part of 40 cities and towns, is the second largest river watershed in Massachusetts. The watershed contains 94 square miles of wetlands and 12,883 acres of lakes. The area is known for having highly productive cranberry bogs. Development in the watershed is concentrated in the northern portion of the watershed and along the southern end of the Taunton River. Land use within the watershed is primarily undeveloped (Table 2-1; Figure 2-1).

The landscape of the Taunton River watershed is characterized by low hills and flat areas. "The Taunton River has one of the flattest courses in the state, falling approximately 21 feet over its length; this level terrain creates extensive wetlands throughout the watershed" (MADEP 2005). For most of its length, the River is a slow moving channel approximately 80 feet across. Downstream of the confluence with the Three Mile River, the Taunton widens into a broad tidal estuary.

Significant natural and cultural resources exist in the Taunton River watershed that warrant special protection. The Hockomock Swamp and Canoe River Aquifer have been established as Areas of Critical Environmental Concern (ACECs). Projects within ACECs are subject to state agency jurisdiction and are reviewed in greater detail to avoid deleterious impacts to these sensitive environments. In addition, the Upper Taunton River is the subject of a congressionally authorized Wild and Scenic River Study.

The Taunton River watershed waters are commonly used for primary and secondary contact recreation (swimming and boating), fishing, wildlife viewing, habitat for aquatic life, industrial cooling, shellfish harvesting, irrigation, agricultural uses, beachfront, and potable water.

Information regarding swimming beaches can be obtained from the beach quality annual reports available for download at the Massachusetts Department of Public Health website (http://www.mass.gov/dph/beha/tox/reports/beach/beaches.htm). Public and semi-public marine beach locations are provided on Figure 2-2.

**Table 2-1. Taunton River Watershed Basin Land Use as of 1999.**

| Land Use Category | % of Total Watershed Area |
|---|---|
| Pasture | 1.8 |
| Urban Open | 1.7 |
| Open Land | 3.3 |
| Cropland | 3.8 |
| Woody Perennial | 1.9 |
| Forest | 51.1 |
| Wetland/Salt Wetland | 3.0 |
| Water Based Recreation | <0.1 |
| Water | 3.8 |
| **General Undeveloped Land** | 70.5 |
| Spectator Recreation | <0.1 |
| Participation Recreation | 1.2 |
| > 1/2 acre lots Residential | 10.0 |
| 1/4 - 1/2 acre lots Residential | 10.4 |
| < 1/4 acre lots Residential | 2.0 |
| Multi-family Residential | 0.6 |
| Mining | 0.6 |
| Commercial | 1.4 |
| Industrial | 1.6 |
| Transportation | 1.5 |
| Waste Disposal | 0.3 |
| **General Developed Land** | 29.5 |

**Figure 2-1 Taunton River Watershed Land Use as of 1999.**

**Figure 2-2. Taunton River Watershed Marine Beach Locations and Pathogen Impaired Segments.**

## 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 (MADEP 2000a). 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.

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 2004b). 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 is planning to revise its freshwater WQS by replacing fecal coliform with *E. coli* and enterococci as the regulated indicator bacteria, as recommended by the EPA in the "*Ambient Water Quality Criteria for Bacteria – 1986*" document (USEPA 1986). The state has already done so for public beaches through regulations of the Massachusetts Department of Public Health as discussed below. Currently, Massachusetts uses 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 anticipates adopting *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. The Taunton River watershed pathogen TMDL has been developed using fecal coliform as the pathogen indicator for fresh and marine waters and enterococci for marine beaches, but the goal of removing pathogen impairment of this TMDL will remain applicable when Massachusetts adopts new indicator bacteria criteria into its WQS. 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.

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/ost/humanhealth/microbial/microbial.html
- Human Health Advisories:
  - Fish and Wildlife Consumption Advisories
    http://www.epa.gov/ebtpages/humaadvisofishandwildlifeconsumption.html

- Swimming Advisories
  http://www.epa.gov/ebtpages/humaadvisoswimmingadvisories.html

The Taunton River watershed contains waterbodies classified as Class A, Class B, Class SA, and Class SB. The corresponding WQS for each class are as follows:

> Class A waterbodies - fecal coliform bacteria shall not exceed an arithmetic mean of 20 organisms per 100 mL in any representative set of samples, nor shall 10% of the samples exceed 100 organisms per 100 mL.
>
> Class B, Class SA, and SB not designated for shellfishing - the geometric mean of a representative set of fecal coliform samples shall not exceed 200 organisms per 100 mL and no more than 10% of the samples shall exceed 400 organisms per 100 mL. The MADEP may apply these standards on a seasonal basis for waters classified as Class B, and Class SA and SB not designated for shellfishing.
>
> Class SA waters approved for open shellfishing - the geometric mean of a representative set of fecal coliform samples shall not exceed 14 organisms per 100 mL and no more than 10% of the samples shall exceed 43 organisms per 100 mL.
>
> Class SB waters approved for open shellfishing - the geometric mean of a representative set of fecal coliform samples shall not exceed 88 organisms per 100 mL and no more than 10% of the samples shall exceed 260 organisms per 100 mL.

Shellfish 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 1, 2000.

> **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).” (MADEP 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.” (MADEP 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.” (MADEP 2002a)

**Restricted** – "Open for harvest of shellfish with depuration subject to local rules and state regulations or for the relay of shellfish." (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." (MADEP 2002a)

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

**Prohibited –** "Closed for harvest of shellfish." (MassGIS 2005) "A classification used to identify a growing area where the harvest of shellstock is not permitted. Growing area waters are so badly contaminated that no reasonable amount of treatment will make the shellfish safe for human consumption. Growing areas must also be classified as Prohibited if there is no or insufficient information available to make a classification decision." (MADEP 2002a)

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 MADEP designated use support status, please see the "*Taunton River Watershed 2001 Water Quality Assessment Report*" (MADEP WQA; MADEP 2005).

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/dph/dcs/bb4_01.pdf). These standards will soon be adopted by the MADEP as state surface WQS for fresh water and these standards will subsequently apply to this TMDL. The MADPH bathing beach standards are generally the same as those which were recommended in the "*Ambient Water Quality Criteria for Bacteria – 1986"* document published by the EPA (USEPA 1986). In the above referenced document, the EPA 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 - (1) 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 - (1) 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 (i.e., single sample not to exceed 104 cfu/100mL and geometric mean of a statistically sufficient number of samples not to exceed 35 cfu/100mL). The Federal BEACH Act and MADPH standards can be accessed on the worldwide web at http://www.epa.gov/waterscience/beaches/act.html and www.mass.gov/dph/dcs/bb4_01.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 http://www.mass.gov/dph/beha/tox/reports/beach/beaches.htm.

# 4.0 Problem Assessment

Pathogen impairment has been documented at numerous locations throughout the Taunton River 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 MADEP 2002b) original data provided in MDC Wachusett Storm Water Study (June 1997).**

| Land Use Category | Fecal Coliform Bacteria[1] Organisms / 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 100% of the total estuary area assessed (7.9 square miles; MassGIS 2005). Pathogen impaired river segments represent 28.8% of the total river miles assessed (56.5 miles of 195.9 total river miles; MassGIS 2005). In total, 15 segments, each in need of a TMDL, contain indicator bacteria concentrations in excess of the Massachusetts WQS for Class A, B, or SB waterbodies (314 CMR 4.05)[1], the MADPH standard for bathing beaches[2], and/or the BEACH Act[3]. The basis for impairment listings is provided in the *2002 List* (MADEP 2003). Data presented in the WQA and other data collected by the MADEP were used to generate the *2002 List*.

Following the release of the *2002 List*, three segments in the Taunton watershed were divided and assigned new segment numbers in the MADEP WQA. The following illustrates the difference between the impaired segment numbers and description between the *2002 List* and the MADEP WQA:

- Rumford River segment listed as MA62-15 in the *2002 List* was divided. These two new segments are listed in the WQA (MADEP 2005) as segment MA62-39 and MA62-40.
- Threemile River segment listed as MA62-16 in the *2002 List* was divided. These two new segments are listed in the WQA (MADEP 2005) as a river segment MA62-56 and an estuary segment MA62-57.
- Wading River segment listed as MA62-17 in the *2002 List* was divided. These two new segments are listed in the WQA (MADEP 2005) as segment MA62-47 and segment MA62-49.

A list of pathogen impaired segments is provided in Table 4-3 and includes the new segment numbers defined in the MADEP WQA. Segments are listed and discussed in hydrologic order (upstream to downstream) in the following sections. Additional details regarding each impaired segment including water withdrawals, discharges, use assessments and recommendations to meet use criteria are provided in the MADEP WQA.

---

[1] Class A: Fecal coliform bacteria shall not exceed an arithmetic mean of 20 organisms per 100 mL in any representative set of samples, nor shall 10% of the samples exceed 100 organisms per 100 mL.
Class SA (Shellfishing approved): Fecal coliform bacteria shall not exceed an arithmetic mean of 14 organisms per 100 mL in any representative set of samples, nor shall 10% of the samples exceed 43 organisms per 100 mL.
Class SB (Shellfishing approved): Fecal coliform bacteria shall not exceed an arithmetic mean of 88 organisms per 100 mL in any representative set of samples, nor shall 10% of the samples exceed 260 organisms per 100 mL.
Class B, Class SA & Class SB (waters not designated for shellfishing): Fecal coliform bacteria shall not exceed a geometric mean of 200 organisms per 100 mL in any representative set of samples, nor shall 10% of the samples exceed 400 organisms per 100 mL. The MADEP may apply these standards on a seasonal basis.

[2] Freshwater bathing beaches: 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 No single enterococci sample shall exceed 61 colonies per 100 mL and the geometric mean of the most recent five (5) enterococci samples within the same bathing season shall not exceed 33 colonies per 100 mL.
Marine bathing beaches: 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.

[3] BEACH Act - Marine bathing beaches: 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.

**Table 4-3. Taunton River Pathogen Impaired Segments (adapted from MADEP 2005).**

| Segment ID | Segment Name | Segment Type | Segment Size[1] | Segment Description |
|---|---|---|---|---|
| **Matfield River Subwatershed** | | | | |
| MA62-08 | Salisbury Brook | River | 2.5 | Outlet of Cross Pond, Brockton to the confluence with Trout Brook forming the Salisbury Plain River, Brockton |
| MA62-07 | Trout Brook | River | 3.4 | Source northeast of Argyle Avenue and west of Conrail Line, Avon to the confluence with the Salisbury Brook forming the Salisbury Plain River, Brockton |
| MA62-05 | Salisbury Plain River | River | 2.4 | Confluence of Trout and Salisbury brooks, Brockton to the Brockton AWRF discharge, Brockton |
| MA62-06 | Salisbury Plain River | River | 2.3 | Brockton AWRF discharge, Brockton to the confluence with Beaver Brook forming the Matfield River, East Bridgewater |
| MA62-32 | Matfield River | River | 6.7 | Confluence of Beaver Brook and Salisbury Plain River East Bridgewater to the confluence with the Town River and Taunton River, Bridgewater |
| **Threemile River Subwatershed** | | | | |
| MA62-39 | Rumford River | River | 8.0 | Outlet Gavin Pond, Sharon to inlet of Norton Reservoir, Mansfield |
| MA62-40 | Rumford River | River | 4.5 | Outlet Norton Reservoir, Norton to confluence with Wading and Threemile rivers, Norton |
| MA62-47 | Wading River | River | 4.2 | Source in wetland north of West Street, Foxborough to Balcom Street, Mansfield |
| MA62-49 | Wading River | River | 9.7 | Balcom Street, Mansfield to confluence with Threemile River, Norton |
| MA62-56 | Threemile River | River | 12.8 | Confluence of Wading and Rumford rivers, Norton to impoundment spillway behind 66 South Street (Harodite Finishing), Taunton |
| MA62-57 | Threemile River | Estuary | 0.02 | Impoundment spillway behind 66 South Street (Harodite Finishing), Taunton to confluence with Taunton River, Taunton/Dighton |
| **Assonet River Subwatershed** | | | | |
| MA62-20 | Assonet River | Estuary | 0.82 | Tisdal Dam , Freetown to the confluence with the Taunton River, Freetown |
| **Mainstem Taunton River** | | | | |
| MA62-02 | Taunton River | Estuary | 0.29 | Route 24 Bridge, Taunton/Raynham to Berkley Bridge, Dighton/Berkley |
| MA62-03 | Taunton River | Estuary | 0.92 | Berkley Bridge, Dighton/Berkley to confluence with Assonet River at a line from Sandy Point, Somerset northeasterly to the southwestern tip of Assonet Neck, Berkley |
| MA62-04 | Taunton River | Estuary | 2.65 | Confluence with Assonet River at a line from Sandy Point, Somerset northeasterly to the southwestern tip of Assonet Neck, Berkley to mouth at Braga Bridge, Somerset/Fall River |

[1] Units = Miles for river segments and square miles for estuaries

An overview of the Taunton River watershed pathogen impairment 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 *2002 List* and in the MADEP WQA, it is not necessary to provide detailed documentation of pathogen impairment herein. Data from the MADEP WQA and other organizations were reviewed and are summarized by segment below for illustrative purposes.

This TMDL was based on the current WQS using fecal coliform as an indicator organism for fresh and marine waters and enteroccoci for marine beaches. Enterococci data are provided at the bottom of each table when data are available. The MADEP is in the process of developing new WQS incorporating *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 MADEP used only a subset of the available data to generate the *2002 List*. Other data presented in this section are for illustrative purposes only.

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 Taunton River 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" (DMF 2002). Due to the volume of data collected by the DMF, these data are not provided herein. For the most recent indicator bacteria sampling data, please contact your local city or town shellfish constable or DMF's Shellfish Project.

Data summarized in the following subsections can be found at:

- **MADEP WQA 2005** – Taunton River Watershed 2001 Water Quality Assessment Report-Draft Version. When finalized the report should be available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm.
- **City of Taunton 2003** – Annual Water Quality Report for the City of Taunton, Taunton River & Tributaries 2002

Data for each impaired segment are summarized in a narrative or presented in tables. The summary data tables for each segment contain the data source and the dates data were collected (i.e., DWM 2001). The type of bacteria data is indicated in the column heading. Depending on the information available, the tables may display different fields.

Data tables may contain:

- "Site Description" – column provides a short narrative description of the sampling location
- "Geometric Mean" – column provides the geometric mean for the samples collected
- "Range" – indicates the range of values obtained for the samples collected
- "n" – provides the number of samples collected at that site over the time frame

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 can be downloaded from http://www.mass.gov/dph/beha/tox/reports/beach/beaches.htm. Marine and freshwater beach status is highly variable and is therefore not provided in each segment description. Please see the MADPH annual beach report for specific details regarding swimming beaches.

The purpose of this section of the report is to briefly describe the impaired waterbody segments in the Taunton River watershed. For more information on any of these segments, see the "*Taunton River Watershed 2001 Water Quality Assessment Report*" on the MADEP website: http://www.mass.gov/dep/brp/wm/wqassess.htm.

## Matfield River Subwatershed

### Salisbury Brook Segment MA62-08

This 2.5 mile Class B river segment extends from the outlet of Cross Pond, Brockton to its confluence with Trout Brook. There are no regulated water withdrawals or National Pollutant Discharge Elimination System (NPDES) permitted discharges listed for this segment's drainage area in the WQA.

Environmental Science Services (ESS) sampled the river at five stations between June and November 2002 during both dry and wet weather. Results of this sampling are presented in Table 4-4.

**Table 4-4. Salsibury Brook (Segment MA62-08) Bacteria Concentrations (ESS 2003 as referenced in MADEP 2005).**

| | | Fecal Coliform (cfu/100 ml) | | *E. coli* (cfu/100 ml) | |
|---|---|---|---|---|---|
| **Station Description** | **n** | **Range** | **Geometric Mean** | **Range** | **Geometric Mean** |
| **ESS 2002** | | | | | |
| Elmwood Avenue, Brockton | 5 | 70-10,000 | 933 | 70-10,000 | 913 |
| Near Belmont Avenue, Brockton | 3 | 1,400-20,000 | NA | 1,400-20,000 | NA |
| Near Montgomery Street, Brockton | 3 | 310-13,000 | NA | <100-11,000 | NA |
| Near Chester Street, Brockton | 5 | 2,700-44,000 | 13,035 | 2,400-42,000 | 11,667 |
| Near Otis Street, Brockton | 5 | 1,700-20,000 | 5,930 | 800-18,000 | 3,941 |

**Trout Brook Segment MA62-07**

This 3.4 mile Class B, warm water fishery extends from the source northeast of Argyle Avenue and west of Conrail Line to the confluence with Salisbury Brook. The Avon Water Department is authorized to withdraw groundwater within this segment. Avon Custom Mixing Services Inc. is authorized to discharge treated sanitary effluent and combined non-contact cooling water and storm water to this segment. This facility has had occasional violations of its fecal coliform bacteria limits (Ahsan 2005 as cited in MADEP 2005).

ESS sampled the river at four stations between June and November 2002 during both dry and wet weather. Results of this sampling are presented in Table 4-5 below.

**Table 4-5. Trout Brook (Segment MA62-07) Bacteria Concentrations (ESS 2003 as referenced in MADEP 2005).**

| | | Fecal Coliform (cfu/100 ml) | | *E. coli* (cfu/100 ml) | |
|---|---|---|---|---|---|
| **Station Description** | **n** | **Range** | **Geometric Mean** | **Range** | **Geometric Mean** |
| **ESS 2002** | | | | | |
| Studley Avenue, off of North Montello Street, Brockton | 3 | 1,100-9,600 | NA | 1,000-8,400 | NA |
| East Ashland Street, Brockton | 5 | 120 - 16,000 | 1,829 | 70 -10,000 | 1,344 |
| Court Street, Brockton | 3 | 4,200-48,000 | NA | 4,000-22,000 | NA |
| Crescent Street, Brockton | 5 | 1,200-64,000 | 8,020 | 1,200-55,000 | 6,643 |

**Salisbury Plain River Segment MA62-05**

This 2.4 mile Class B river segment extends from the confluence of the Trout and Salisbury Brooks to the Brockton Advanced Water Reclamation Facility (AWRF) discharge. The Brockton Department of Public Works Water Division and Churchill Linen Service are authorized to withdraw groundwater from this segment's drainage area. There are no NPDES permitted discharges in this segment.

ESS sampled the river at two stations between June and November 2002 during both dry and wet weather. Results of this sampling are presented in Table 4-6 below.

**Table 4-6. Salisbury Plain River (Segment MA62-05) Bacteria Concentrations (ESS 2003 as referenced in MADEP 2005).**

| | | Fecal Coliform (cfu/100 ml) | | *E. coli* (cfu/100 ml) | |
|---|---|---|---|---|---|
| **Station Description** | **n** | **Range** | **Geometric Mean** | **Range** | **Geometric Mean** |
| **ESS 2002** | | | | | |
| Near Plain Street, Brockton | 5 | 2,000-20,000 | 5,168 | 900-13,000 | 3,572 |
| Behind 1690 Main Street, Brockton | 3 | 2,300-5,800 | NA | 2,000-5,000 | NA |

**Salisbury Plain River Segment MA62-06**

This 2.3 mile Class B, warm water fishery extends from the Brockton ARWF discharge to the confluence with Beaver Brook, East Bridgewater. The West Bridgewater Water Department is authorized to withdraw groundwater from this segment's drainage area. The City of Brockton has a NPDES permit to discharge treated sanitary and industrial wastewater to this segment.

ESS sampled one station near Belmont Street in West Bridgewater between June and August 2002 during both dry and wet weather. Results of this sampling are presented in Table 4-7.

**Table 4-7. Salisbury Plain River (Segment MA62-06) Bacteria Concentrations (ESS 2003 as referenced in MADEP 2005).**

| | Fecal Coliform (cfu/100 ml) | | *E. coli* (cfu/100 ml) | |
|---|---|---|---|---|
| **Station Description** | **Range** | **Geometric Mean** | **Range** | **Geometric Mean** |
| **ESS 2002** | | | | |
| Near Belmont Street, West Bridgewater | 65-14,000 | 632 | 62-14,000 | 626 |

The number of samples collected were not provided in the WQA

**Matfield River Segment MA62-32**

This 6.7 mile Class B, warm water fishery extends from the confluence of Beaver Brook and the Salisbury Plain River, East Bridgewater to the confluence with the Town River and the Taunton River, Bridgewater. The 1,008 acres of cranberry bog in this segment's drainage area use an estimated 9.0 million gallons per day (MGD) of water. There are three authorized water withdrawals in this segment: C.N. Smith Farm Inc., and the Bridgewater Water and East Bridgewater Water Departments. The East Bridgewater Public Schools have a NPDES permit to discharge treated effluent to an unnamed tributary to the Matfield River.

ESS sampled the river at five stations in East Bridgewater between June and September 2002 during both dry and wet weather. Results of this sampling are presented in Table 4-8 below.

**Table 4-8. Matfield River (Segment MA62-32) Bacteria Concentrations (ESS 2003 as referenced in MADEP 2005).**

| | | Fecal Coliform (cfu/100 ml) | | *E. coli* (cfu/100 ml) | |
|---|---|---|---|---|---|
| **Station Description** | **n** | **Range** | **Geometric Mean** | **Range** | **Geometric Mean** |
| **ESS 2002** | | | | | |
| Near West Union Street | 5 | 55-3,900 | 490 | 51-3,700 | 465 |
| Near Route 18/Route 106 intersections | 5 | 110-18,000 | 1,287 | 110-5,000 | 967 |
| Near High Street Bridge | 5 | 43-2,300 | 383 | 40-2,200 | 292 |

## Threemile River Subwatershed

### Rumford River Segment MA62-39

This 8.0 mile Class B river segment extends from the outlet of Gavins Pond to the inlet of Norton Reservoir, Mansfield. This section of the river was previously part of segment MA62-15. There are two authorized groundwater withdrawals in this segment: the Sharon Water Department and the Foxborough Water Department. There are 23 acres of cranberry bogs in this segments drainage area using a conservatively estimated 0.2 MGD of water. The former Gorham Silver Company is applying for a NPDES permit to discharge to a wetland near this segment.

Between July and September 2001, the MADEP Division of Water Management (DWM) collected bacteria samples from one station along this river segment during dry weather. Results of this effort are summarized in Table 4-9 below.

**Table 4-9. Matfield River (Segment MA62-32) Bacteria Concentrations.**

| Station Description | n | Fecal Coliform (cfu/100ml) | *E. coli* (cfu/100ml) | Enterococci (cfu/100ml) |
|---|---|---|---|---|
| **MADEP DWM 2001** | | | | |
| Spring Street, Mansfield | 3 | 25-190 | 15-100 | 30-710 |

### Rumford River Segment MA62-40

This 4.5 mile Class B river segment extends from the outlet of Norton Reservoir, Norton to the confluence with the Wading and Threemile rivers. This section of the river was previously part of segment MA62-15. The Tournament Players Club is authorized to withdraw groundwater from this segment's drainage area. Wheaton College is permitted to discharge sanitary wastewater and cooling water.

Between July and September 2001, the MADEP DWM collected bacteria samples from two stations along this river segment during dry weather. Results of this effort are summarized in Table 4-10 below.

**Table 4-10. Rumford River (Segment MA62-40) Bacteria Concentrations.**

| Station Description | n | Fecal Coliform (cfu/100ml) | *E. coli* (cfu/100ml) | Enterococci (cfu/100ml) |
|---|---|---|---|---|
| **MADEP DWM 2001** | | | | |
| Near Reservoir Street, Norton | 3 | 35-300 | 10-60 | 60-300 |
| Near Rte 456, Norton | 2 | 75-110 | 35-40 | 100-500 |

**Wading River Segment MA62-47**

This 4.2 mile Class A river segment extends from the source in a wetland north of West Street, Foxborough to Balcolm Street, Mansfield. This section of the river was previously part of segment MA62-17. There are 15 acres of cranberry bogs in this segment's drainage area using a conservative estimate of 0.1 MGD. There are five authorized water withdrawal in this segment:

- Wrentham Water Division is authorized to withdraw groundwater.
- Plainville Water Department is authorized to withdraw groundwater.
- Law Greenhouses and Gardens is authorized to withdraw surface water.
- Foxborough Water Department is authorized to withdraw groundwater.
- Attleboro Department of Public Works is authorized to withdraw surface water.

There are no NPDES permitted discharges to this segment.

In August 2001, the MADEP DWM collected one sample at one station along the river. Results of this effort are summarized in Table 4-11 below.

**Table 4-11. Wading River (Segment MA62-47) Bacteria Concentrations**

| Station Description | Fecal Coliform (cfu/100ml) | *E. coli* (cfu/100ml) | Enterococci (cfu/100ml) |
|---|---|---|---|
| **MADEP DWM 2001** | | | |
| **Near West Street, Mansfield** | **590** | **300** | **450** |

**Wading River Segment MA62-49**

This 9.7 mile Class B, warm water fishery extends from Balcom Street, Mansfield to the confluence with the Threemile River, Norton. This section of the river was previously part of segment MA62-17. There are two authorized groundwater withdrawals in this segment: Mansfield Water Department and Texas Instruments. The 18 acres of cranberry bogs in this segment's drainage area use a conservatively estimated 0.2 MGD of water. "However, 15 acres of this cranberry acreage is located in the subwatershed for Segment MA62-47, which is in the upper portion of this watershed" (MADEP 2005). There are three NPDES permitted discharges currently discharging to this segment:

- Sinclair Manufacturing Company is authorized to discharge non-contact cooling water into Chartley Brook, a tributary of this segment.
- Tweave Inc. is permitted to discharge treated process wastewater to the Wading River.
- Sun Chemical Corporation/GPI Division discharges non-contact cooling water to a tributary of this segment.

The MADEP DWM collected samples for bacteria from the Wading River and Hodges Brook (a tributary to this segment) at four stations between June and September 2001 and from the outlet of Chartley Pond (a tributary) in August and September 2001. All samples were collected during dry weather. Results are summarized in Table 4-12.

**Table 4-12. Wading River (Segment MA62-49) Bacteria Concentrations**

| Station Description | n | Fecal Coliform (cfu/100ml) | *E. coli* (cfu/100ml) | Enterococci (cfu/100ml) |
|---|---|---|---|---|
| **MADEP DWM 2001** | | | | |
| Wading River at Walker Street, Norton | 1 | 460 | 190 | 690 |
| Wading River at Route 123, Norton | 3 | 50-860 | 20-85 | 50-5,000 |
| Hodges Brook at road crossing upstream of the confluence with the Wading River | 2 | 130-740 | 38-290 | 230-1,000 |
| Wading River near Route 140, Norton | 3 | 55-110 | 25-50 | 33-190 |
| Outlet of Chartley Pond, Norton | 2 | 22-90 | <5-17 | <5-370 |

**Threemile River Segment MA62-56**

This 12.8 mile Class B, warm water fishery extends from the confluence of the Wading and Rumford rivers, Norton to the impoundment spillway behind 66 South Street (Harodite Finishing), Taunton. This section of the river was previously part of segment MA62-16. There are two authorized water withdrawals in this segment: Norton Water Department and Harodite Finishing Company. The 100 acres of cranberry bogs in this subwatershed use a conservatively estimated 0.9 MGD of water. "However, 23 acres of this cranberry acreage is located in the subwatershed for Segment MA62-39, MA62-37, and MA62-49, which are in the upper portion of this watershed" (MADEP 2005). There are three NPDES permitted discharges to this segment:

- The Town of Mansfield is authorized to discharge treated municipal and industrial wastewater.
- BIW Cable Systems is authorized to discharge processed wastewater and wastewater from the electrical test tank.
- Harodite Finishing Co. is authorized to discharge non-contact cooling water.

In July, August, and September 2001, the MADEP DWM collected samples for bacteria from one station on this segment during dry weather. Results of this effort are summarized in Table 4-13 below.

**Table 4-13. Threemile River (Segment MA62-56) Bacteria Concentrations.**

| Station Description | n | Fecal Coliform (cfu/100ml) | *E. coli* (cfu/100ml) | Enterococci (cfu/100ml) |
|---|---|---|---|---|
| **MADEP DWM 2001** | | | | |
| Harvey Street, Taunton | 3 | 130-220 | 24-110 | 76-350 |

**Threemile River Segment MA62-57**

This 0.02 square mile Class B segment extends from the impoundment spillway behind 66 South Street, Taunton to the confluence with Taunton River. It is proposed for re-classification as Class SB shellfishing (restricted). This section of the river was previously part of segment MA62-16. The 100 acres of cranberry bogs in this subwatershed use a conservatively estimated 0.9 MGD of water.

These bogs are entirely within the subwatershed for this segment. There are no NPDES permitted discharges to this segment listed in the WQA.

Shellfish status is impaired for this segment. Designated shellfish growing areas status as of July 2000 is provided in Figure 1-1.

## Assonet River Subwatershed

### Assonet River Segment MA62-20

This 0.82 square mile Class SA segment extends from the Tisdale Dam (north of Route 79/Elm Street intersection), Freetown to the confluence with the Taunton River, Freetown. The Town Line Farm is authorized to withdraw surface water from this segment. In addition, there are 413 acres of cranberry bogs in this subwatershed using a conservatively estimated 3.7 MGD. "However, 403 acres of this cranberry acreage is located in the subwatershed for segment MA62-42, MA62-44, and MA62-19 which are in the upper portion of this subwatershed" (MADEP 2005). There are no NPDES permitted discharges to this segment listed in the WQA.

The shellfish harvesting use area is impaired in this entire segment. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1.

The DWM collected one sample from an unnamed tributary to this segment during dry weather in 2001, which had a fecal coliform count of 5 cfu/100 mL, an *E. coli* count of <5 and an enterococci count of 14 cfu/100mL.

## Mainstem Taunton River

### Taunton River Segment MA62-02

This 0.29 square mile Class SB shellfishing restricted segment extends from the Route 24 Bridge in Taunton/Raynham to the Berkely Bridge in Dighton/Berkely. The 5,504 acres of cranberry bogs in this subwatershed use a conservatively estimated 49.14 MGD of water. "However, 4,762 acres of this cranberry acreage is located in the subwatershed for Segment MA62-01 that is in the upper portion of this subwatershed" (MADEP 2005). There are two NPDES permitted discharges currently discharging to this segment:

- The City of Taunton is authorized to discharge treated industrial and sanitary wastewater and storm water. During wet weather, the City discharges wastewater and storm water from one combined sewer overflow (CSO) outfall.
- The Taunton Municipal Lighting Plant (TMLP) electric power generating facility is authorized to discharge blowdown from a cooling tower, traveling screen backwash water, and discharge of trash rack spray nozzles.

Shellfish harvesting use is assessed as impaired in this segment. Designated shellfish growing areas status as of July 2000 is provided in Figure 1-1.

**Taunton River Segment MA62-03**

This 0.92 square mile Class SB, shellfishing restricted, segment extends from the Berkely Bridge, Dighton/Berkley to the confluence with the Assonet River at a line from Sandy Point, Somerset northeasterly to the southwestern tip of Assonet Neck, Berkley. The 5,505 acres of cranberry bogs in this subwatershed use a conservatively estimated 49.15 MGD of water. "However, 5,504 acres of this cranberry acreage is located in the subwatershed for segments MA62-01 and MA62-02 that are in the upper portion of this subwatershed" (MADEP 2005). There are no active NPDES permitted discharges to this segment listed in the WQA.

Shellfish harvesting use is assessed as impaired in this segment. Designated shellfish growing areas status as of July 2000 is provided in Figure 1-1.

**Taunton River Segment MA62-04**

This 2.65 square mile Class SB, shellfishing restricted, segment extends from the confluence with the Assonet River at a line from Sandy Point, Somerset northeasterly to the southwestern tip of Assonet Neck, Berkley to the mouth at Braga Bridge, Somerset/Fall River. The 5,917 acres of cranberry bogs in this subwatershed use a conservatively estimated 52.83 MGD of water. "However, 5,505 acres of this cranberry acreage is located in the subwatershed for segments MA62-01, MA62-02, and MA62-03 that are in the upper portion of this subwatershed" (MADEP 2005). There are four NPDES permitted discharges to this segment:

- Somerset Power LLC and Somerset Operations Inc. are authorized to discharge condenser cooling water, treated wastewater, and storm water runoff to this segment.
- Fall River Marine Terminal LLC is permitted to discharge groundwater remediation wastewater, storm water, and contact water.
- The Town of Somerset is authorized to discharge treated municipal wastewater.
- The City of Fall River is authorized to discharge from four CSO outfalls to this segment of the Taunton River.

Shellfish harvesting use is assessed as impaired in this segment. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1.

# 5.0 Potential Sources

The Taunton River watershed has 15 segments, located throughout the watershed, that are listed as pathogen impaired in the *2002 List* and the MADEP WQA requiring TMDLs. These segments represent 100% of the estuary area and 28.8% of the river miles assessed. Sources of indicator bacteria in the Taunton River watershed are many and varied. A significant amount of work has been done in the last decade to improve the water quality in the Taunton River watershed.

Largely through the efforts of the Division of Marine Fisheries (DMF), the ESS Group Inc, and MADEP field staff, numerous point and non-point sources of fecal contamination have been identified. Table 5-1 summarizes the river segments impaired due to measured indicator bacteria densities and identifies some of the suspected and known sources identified in the WQA.

Some dry weather sources include:

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

Some wet weather sources 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 Taunton River 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 5-2 and 5-3). 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 extensive ambient data available that define baseline conditions (see segment summary tables and MADEP 2005).

**Table 5-1. Some of the Potential Sources of Bacteria in Pathogen Impaired Segments in the Taunton River Watershed.**

| Segment | Segment Name | Potential Sources |
|---|---|---|
| **Matfield River Subwatershed** | | |
| MA62-08 | Salisbury Brook | MS4s, illicit connections to storm sewers, high density urban areas |
| MA62-07 | Trout Brook | MS4s, illicit connections to storm sewers, high density urban areas |
| MA62-05 | Salisbury Plain River | MS4s, illicit connections to storm sewers, high density urban areas |
| MA62-06 | Salisbury Plain River | MS4s, high density urban areas |
| MA62-32 | Matfield River | Municipal point sources, MS4s |
| **Threemile River Subwatershed** | | |
| MA62-39 | Rumford River | Unknown |
| MA62-40 | Rumford River | Unknown |
| MA62-47 | Wading River | Unknown |
| MA62-49 | Wading River | Unknown |
| MA62-56 | Threemile River | Unknown |
| MA62-57 | Threemile River | MS4s |
| **Assonet River Subwatershed** | | |
| MA62-20 | Assonet River | MS4s, septic systems, marina/boating pumpout releases |
| **Mainstem Taunton River** | | |
| MA62-02 | Taunton River | MS4s, CSOs, septic systems |
| MA62-03 | Taunton River | MS4s, CSOs, septic systems, marina/boating releases |
| MA62-04 | Taunton River | MS4s, CSOs, septic systems, marina/boating releases |

MS4 = Municipal Separate Storm Water Sewer System – community storm water drainage system
Sources were identified in the MADEP WQA.

**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 $10^4$ to $10^6$ 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. The EPA, MADEP and many communities have been active in the identification and mitigation of these sources. It is probable that numerous illicit sewer connections exist in storm drainage systems serving the older developed portions of the Taunton River watershed.

Monitoring of storm drain outfalls during dry weather is needed to document the presence or absence of sewage in the drainage systems. Approximately 51.6 percent of the Taunton River 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. See Section 7.0 of this TMDL for information regarding illicit discharge detection guidance.

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 Taunton River 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 3 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.

**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 (1999). 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. Using the population estimate (700,000) provided on the Executive Office of Environmental Affairs website for this watershed, 35,000 pounds of feces are produced per day in the Taunton River watershed. 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, 5-2 and 5-3) 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 5-2 and 5-3. 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 5-2. 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 5-3. Storm Water Event Mean Fecal Coliform Concentrations (as reported in MADEP 2002b; original data provided in Metcalf & Eddy, 1992) and Necessary Reductions to Meet Class B WQS.**

| Land Use Category | 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 Pathogen TMDL Development

Section 303 (d) of the Federal Clean Water Act (CWA) requires states to place water bodies that do not meet the water quality standards on a list of impaired waterbodies. The most recent impairment list, *2002 List* and the MADEP WQA, identifies 15 segments within the Taunton River 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. 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 pollutant each point source can release to the waterbody. Non-point sources of pollution (all sources of pollution other than point) receive a load allocation (LA) specifying the amount of a pollutant that can be released to the waterbody by this source. 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:

$$TMDL = WLAs + LAs + Margin\ of\ Safety$$

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 source 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.

This TMDL 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 bacterial pollution is regulated (i.e., according to concentration standards) and achieves essentially the same result as if the equation were to be used.

## 6.1. Indicator Bacteria TMDL

*Loading Capacity*

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). Typically, TMDLs are expressed as total maximum daily loads. Expressing the TMDL 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 are allowable if the volume of water that transports indicator bacteria is also high. Conversely, a relatively low load of indicator bacteria may exceed water quality standard if flow rates are low. Therefore, the MADEP believes it is appropriate to express indicator bacteria TMDLs in

terms of a concentration because the water quality standard is also expressed in terms of the concentration of organisms per 100 mL. Since source concentrations may not be directly added due to varying flow conditions, the TMDL equation is modified and reflects a margin of safety in the case of this pathogen concentration based TMDL. To ensure attainment with Massachusetts' WQS for indicator bacteria, all sources (at their point of discharge to the receiving water) must be equal to or less than the WQS for indicator organisms. For all the above reasons the TMDL is simply set equal to the concentration-based standard and may be expressed as follows:

$$TMDL = State\ Standard = WLA_{(p1)} = LA_{(n1)} = WLA_{(p2)} = etc.$$

Where:

$WLA_{(p1)}$ = allowable concentration for point source category (1)
$LA_{(n1)}$ = allowable concentration for nonpoint source category (1)
$WLA_{(p2)}$ = allowable concentration for point source category (2) etc.

For Class A surface waters (1) *the arithmetic mean of a representative set of fecal coliform samples shall not exceed 20 organisms per 100 mL*; and (2) *no more than 10% of the samples shall exceed 100 organisms per 100 mL.*

For Class B and Class SB and SA areas not designated for shellfishing (1) *the geometric mean of a representative set of fecal coliform samples shall not exceed 200 organisms per 100 mL*; and (2) *no more than 10% of the samples shall exceed 400 organisms per 100 mL*.

For Class SA open shellfish area surface waters (1) *the geometric mean of a representative set of fecal coliform samples shall not exceed 14 organisms per 100 mL*; and (2) *no more than 10% of the samples shall exceed 43 organisms per 100 mL.*

For Class SB open shellfish surface waters (1) *the geometric mean of a representative set of fecal coliform samples shall not exceed 88 organisms per 100 mL*; and (2) *no more than 10% of the samples shall exceed 260 organisms per 100 mL.*

For marine bathing beaches (BEACH Act standard) (1) *the geometric mean of a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period) shall not exceed 35 colonies per 100 mL* and (2) *no single enterococci sample shall exceed 104 colonies per 100 mL*.

For freshwater bathing beaches (MADPH standard, not yet adopted by the MADEP) (1) *the geometric mean of the most recent five enterococci levels within the same bathing season shall not exceed 33 colonies per 100 mL* and (2) *no single enterococci sample shall exceed 61 colonies per 100 mL*. – OR – (1) *the geometric mean of the most recent five E. coli levels within the same bathing season shall not exceed 126 colonies per 100 mL* and (2) *no single E. coli sample shall exceed 235 colonies per 100 mL.*

*Waste Load Allocations (WLAs) and Load Allocations (LAs)*

There are several WWTPs and other NPDES-permitted wastewater discharges within the Taunton River 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 SB, Class SA, Class A, and Class B segments within the Taunton River 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 WQS exceedances. 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), sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs). Wet weather non-point sources primarily include diffuse storm water runoff.

Table 6-1 presents the indicator bacteria WLAs and LAs for the various source categories. WLAs and LAs will change to reflect the revised indicator organisms (*E. coli* and enterococci) when the updated WQS have been finalized (See Section 3.0 of this report). Source categories representing discharges of untreated sanitary sewage to receiving waters are prohibited, and therefore, assigned WLAs and LAs equal to zero. There are several sets of WLAs and LAs, one for Class SA shellfish open waters, one for Class SB shellfish open waters, one for Class A waters, one for Class B and shellfish restricted Class SA and SB waters, one for no discharge areas, one for freshwater beaches, and one for marine beaches.

The TMDL should provide a discussion of the magnitudes of the pollutant reductions needed to attain the goals of the TMDL. Since accurate estimates of existing sources are generally unavailable, it is difficult to estimate the pollutant reductions for specific sources. For the illicit sources including failing septic systems, the goal is complete elimination (100% reduction). However, overall wet weather indicator bacteria load reductions can be estimated using typical storm water bacteria concentrations, as presented in the *Taunton River Watershed 2001 Water Quality Assessment Report*. These data indicate that up to two to three orders of magnitude (i.e., greater than 90%) reductions in storm water fecal coliform loadings generally will be necessary, especially in developed areas. This goal is expected to be accomplished through implementation of the best management practices (BMPs) associated with the Phase II control program in designated Urban Areas. The specific goal for controlling discharges from combined sewer overflows (CSOs) will be based on the site specific studies embodied in the Long Term Control Plan being developed by each community with combined sewers.

**Table 6-1. Indicator Bacteria Waste Load Allocations (WLAs) and Load Allocations (LAs) for the Taunton River 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 | Illicit discharges to storm drains | 0 | N/A |
| A, B, SA, SB | Leaking sanitary sewer lines | 0 | N/A |
| A, B, SA, SB | Failing septic systems | N/A | 0 |
| A | NPDES – WWTP | Not to exceed an arithmetic mean of 20 organisms in any set of representative samples, nor shall 10% of the samples exceed 100 organisms[2] | N/A |
| A | Storm water runoff Phase I and II | Not to exceed an arithmetic mean of 20 organisms in any set of representative samples, nor shall 10% of the samples exceed 100 organisms[3] | N/A |
| A | Direct storm water runoff not regulated by NPDES and livestock, wildlife & pets | N/A | Not to exceed an arithmetic mean of 20 organisms in any set of representative samples, nor shall 10% of the samples exceed 100 organisms[3] |
| B & Not Designated for Shellfishing SA & SB | CSOs | Shall not exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms[4] | N/A |
| B & Not Designated for Shellfishing SA & SB | NPDES – WWTP | Shall not exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms[2] | N/A |
| B & Not Designated for Shellfishing SA & SB | Storm water runoff Phase I and II | Not to exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms[3] | N/A |
| B & Not Designated for Shellfishing SA & SB | Direct storm water runoff not regulated by NPDES and livestock, wildlife & pets | N/A | Not to exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms[3] |

| Surface Water Classification | Pathogen Source | Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1] | Load Allocation Indicator Bacteria (CFU/100 mL)[1] |
|---|---|---|---|
| SA Designated Shellfishing Areas | NPDES – WWTP | Not to exceed a geometric mean of 14 organisms in any set of representative samples, nor shall 10% of the samples exceed 43 organisms[2] | N/A |
| SA Designated Shellfishing Areas | Storm water Runoff Phase I and II | Not to exceed a geometric mean of 14 organisms in any set of representative samples, nor shall 10% of the samples exceed 43 organisms[3] | N/A |
| SA Designated Shellfishing Areas | Direct storm water runoff not regulated by NPDES and livestock, wildlife & pets | N/A | Not to exceed a geometric mean of 14 organisms in any set of representative samples, nor shall 10% of the samples exceed 43 organisms[3] |
| SB Designated Shellfishing Areas | CSOs | Not to exceed a geometric mean of 88 organisms in any set of representative samples, nor shall 10% of the samples exceed 260 organisms[4] | N/A |
| SB Designated Shellfishing Areas | NPDES – WWTP | Not to exceed a geometric mean of 88 organisms in any set of representative samples, nor shall 10% of the samples exceed 260 organisms[2] | N/A |
| SB Designated Shellfishing Areas | Storm water runoff Phase I and II | Not to exceed a geometric mean of 88 organisms in any set of representative samples, nor shall 10% of the samples exceed 260 organisms[3] | N/A |
| SB Designated Shellfishing Areas | Direct storm water runoff not regulated by NPDES and livestock, wildlife & pets | N/A | Not to exceed a geometric mean of 88 organisms in any set of representative samples, nor shall 10% of the samples exceed 260 organisms[3] |
| No Discharge Areas | Vessels – raw or treated sanitary waste | 0 | N/A |
| Marine Beaches[5] | All Sources | Enterococci not to exceed a geometric mean of 35 colonies in a statistically significant number of samples, nor shall any single sample exceed 104 colonies | Enterococci not to exceed a geometric mean of 35 colonies in a statistically significant number of samples, nor shall any single sample exceed 104 colonies |

| Surface Water Classification | Pathogen Source | Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1] | Load Allocation Indicator Bacteria (CFU/100 mL)[1] |
|---|---|---|---|
| Fresh Water Beaches[6] | All Sources | Enterococci not to exceed a geometric mean of 33 colonies of the five most recent samples within the same bathing season, nor shall any single sample exceed 61 colonies<br>OR<br>*E. coli* not to exceed a geometric mean of 126 colonies of the five most recent samples within the same bathing season, nor shall any single sample exceed 235 colonies | Enterococci not to exceed a geometric mean of 33 colonies of the five most recent samples within the same bathing season, nor shall any single sample exceed 61 colonies<br>OR<br>*E. coli* not to exceed a geometric mean of 126 colonies of the five most recent samples within the same bathing season, nor shall any single sample exceed 235 colonies |

N/A means not applicable

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

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

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

[4] Or shall be consistent with an approved Long Term Control Plan (LTCP) for Combined Sewer Overflow (CSO) abatement. If the level of control specified in the LTCP is less than what is necessary to attain Class B water quality standards, then the above criteria apply unless MADEP has proposed and EPA has approved water quality standards revisions for the receiving water.

[5] Federal Beaches Environmental Assessment and Coastal Health Act of 2000 (BEACH Act) Water Quality Criteria

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

Note: this table represents waste load and load reductions based on water quality standards current as of the publication date of these TMDLs, any future changes made to the Massachusetts water quality standards will become the governing water quality standards for these TMDLs.

The expectation 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 individuals responsible for monitoring activities.

This TMDL applies to the 15 pathogen impaired segments of the Taunton River watershed that are currently listed on the CWA § 303(d) list of impaired waters and in the MADEP WQA. MADEP 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-1 and Table 6-1).

This Taunton River 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.

## 6.2. 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.

## 6.3. Seasonal Variability

In addition to a Margin of Safety, TMDLs must also account for seasonal variability. Pathogen sources to Taunton River 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.

# 7.0 Implementation Plan

Setting and achieving TMDLs should be an iterative process, with realistic goals over a reasonable timeframe and adjusted 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 Taunton River watershed.

Controls on several types of pathogen sources will be required as part of the comprehensive control strategy. Many of the sources in the Taunton River watershed including sewer connections to drainage systems, leaking sewer pipes, combined sewer overflows, 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. The MADEP, ESS Inc., and the Taunton River Watershed Alliance (TRWA) have been successful in carrying out such monitoring, identifying sources, and, in some cases, mobilizing the responsible municipality and other entities to begin to take corrective actions.

Storm water runoff represents another major source of pathogens in the Taunton River watershed, and the current level of control is inadequate for standards to be attained. Improving storm water runoff quality is essential for restoring water quality and recreational uses. At a minimum, intensive application of non-structural BMPs is needed throughout the watershed to reduce pathogen loadings as well as loadings of other storm water pollutants (e.g., nutrients and sediments) contributing to use impairment in the Taunton River watershed. Depending on the degree of success of the non-structural storm water BMP program, structural controls may become necessary.

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 7-1. The MADEP working with EPA 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 7-1. Tasks.**

| Task | Organization |
|---|---|
| Writing TMDL | MADEP |
| TMDL public meeting | MADEP |
| Response to public comment | MADEP |
| Organization, contacts with volunteer groups | MADEP/TRWA |
| Development of comprehensive storm water management programs including identification and implementation of BMPs | Taunton River Basin Communities |
| Illicit discharge detection and elimination | Taunton River Basin Communities |
| Leaking sewer pipes and sanitary sewer overflows | Taunton River Basin Communities |
| CSO management | Taunton River Basin Communities |
| Inspection and upgrade of on-site sewage disposal systems as needed | Homeowners and Taunton River Basin Communities (Boards of Health) |
| Organize implementation; work with stakeholders and local officials to identify remedial measures and potential funding sources | MADEP and Taunton River Basin Communities, TRWA |
| Organize and implement education and outreach program | MADEP and Taunton River Basin Communities, TRWA |
| Write grant and loan funding proposals | Taunton River Basin Communities and Planning Agencies with guidance from MADEP, TRWA |
| Inclusion of TMDL recommendations in Executive Office of Environmental Affairs (EOEA) Watershed Action Plan | EOEA |
| Surface Water Monitoring | MADEP, TRWA |
| Provide periodic status reports on implementation of remedial activities | TRWA and Taunton River Basin Communities |

## 7.1. Summary of Activities within the Taunton River Watershed

There are two not-for-profit active stewards of the Taunton River, the Taunton River Watershed Alliance and the Taunton River Stewardship Program. "The Taunton River Watershed Alliance (TRWA) is a non-profit alliance of concerned individuals, businesses, and organizations dedicated to protecting and restoring the Taunton River Watershed – its tributaries, wetlands, floodplains, river corridors and wildlife. TRWA conducts water quality monitoring at sites along the Taunton River and its tributaries with volunteers playing a critical role in water quality sampling" (MADEP 2005). TRWA is also involved in community education, land acquisition, and shoreline surveys efforts to restore and protect the Taunton River's resources (TRWA 2004). The Taunton River Stewardship Program is dedicated to promoting the preservation of the upper Taunton River corridor. The efforts of the Stewardship Program and their partners have protected 695 acres in the watershed (MADEP 2005).

Data supporting this TMDL indicate that indicator bacteria enter the Taunton River 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 include and 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 below as well as additional measures not provided herein, such as by-law, ordinances and public outreach and education.

## 7.2. Illicit Sewer Connections, Failing Infrastructure and CSOs

Elimination of illicit sewer connections, repairing failing infrastructure, and controlling impacts associated with CSOs are of extreme importance. A number of municipalities within the Taunton River watershed have implemented measures to address sewage discharges and CSO events. The City of Taunton made upgrades to their wastewater treatment plant (WWTP) in 2001 and 2002. As a result, the number of CSO events has dropped from 24 events in 2000 to only one event in 2004. The City of Fall River has been addressing CSOs since 1984. The city's three phase CSO program includes upgrades to the WWTP, a CSO tunnel to enlarge the storage capacity of the system, and partial sewer and catchbasin separation. The WWTP upgrades and much of the tunnel project have been completed. The City of Brockton received funding from the State Revolving Fund program to reduce sewer system overflows and discharge violations. In 2004, the WWTP began a three phase facility-wide upgrade to improve effluent quality. The Town of Dighton has received funds from the Clean Water SRF to identify areas where the existing onsite sewage disposal systems are inadequate and to develop wastewater management recommendations (MADEP 2005).

Guidance for illicit discharge detection and elimination has been developed by EPA New England (USEPA 2004c) for the Lower Charles River. The guidance document provides a plan, available to all Commonwealth communities, 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 is applicable to all watersheds throughout the Commonwealth. Implementation of the protocol outlined in the guidance document satisfies the Illicit Discharge Detection and Elimination requirement of the NPDES program. A copy of the guidance document is provided in Appendix B.

## 7.3. 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.

## 7.4. Failing Septic Systems

Septic system bacteria contributions to the Taunton River 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 may be transferred, building expansions, or changes in use of properties, 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 MADEP on the worldwide web at http://www.mass.gov/dep/brp/wwm/t5pubs.htm.

## 7.5. 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.

## 7.6. 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:

- petitioning the State for the designation of 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.

Sewage from boats has been identified as a potential source of bacteria in some segments of the Taunton River watershed. However, this watershed does not have any areas designated as no discharge areas (NDAs) for vessel sewage. This designation by the Commonwealth of Massachusetts and approved by the EPA would provide 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 MACZM 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 2004b).

## 7.7. 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 (MADEP 2000b) available on line at http://www.mass.gov/dep/brp/wm/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.

## 7.8. 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*" accompanying this document.

## 8.0 Monitoring Plan

The long term monitoring plan for the Taunton River watershed includes several components:

1. continue with the current monitoring of the Taunton River watershed (TRWA, and other stakeholders),
2. continue with MADEP 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.

## 9.0 Reasonable Assurances

Reasonable assurances that the TMDL will be implemented include both 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 will address discharges from municipal owned storm water drainage systems. Enforcement of regulations controlling non-point discharges includes local enforcement of the states 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 604 and 104b programs, which are provided as part of the Performance Partnership Agreement between MADEP 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.

## 10.0 Public Participation

To be added later….

## 11.0 References


Ashan, M 2005. Personal Communication. Avon Custon Mixing Inc. facility information. Massachusetts Department of Environmental Protection, Northeast Regional Office, Boston, MA.

Ayres Associates 1993. Onsite Sewage Disposal Systems Research in Florida. The Capacity of Fine Sandy Soil for Septic Tank Effluent Treatment: A Field Investigation at an In-Situ Lysimeter Facility in Florida.

Center for Watershed Protection, 1999. Watershed Protection Techniques. Vol. 3, No. 1.

DMF 2002. Massachusetts Division of Marine Fisheries. Programs and Projects. Shellfish Sanitation and Management. Information from website, downloaded March 2005. http://www.mass.gov/dfwele/dmf/programsandprojects/shelsani.htm

ESS 2003. Matfield and Salisbury Plain River Watersheds Nonpoint Source Pollution Assessment Report and Management Plan. Prepared for DEP/DWM. Wellesley, MA.

MADEP 2000a. 314 CMR 4.00: Massachusetts Surface Water Quality Standards. Massachusetts Department of Environmental Protection Bureau of Waste Prevention. Available for download at http://www.mass.gov/dep/bwp/iww/files/314cmr4.htm

MADEP 2000b. Nonpoint Source Management Plan Volume I Strategic Summary. Massachusetts Department of Environmental Protection Bureau of Waste Prevention. Available for download at http://www.mass.gov/dep/brp/wm/nonpoint.htm

MADEP 2002a. Cape Cod Watershed Water Quality Assessment Report. Massachusetts Department of Environmental Protection, Division of Water Management. Worcester, Massachusetts. Available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm

MADEP 2002b. Final Total Maximum Daily Loads of Bacteria for Neponset River Basin. Massachusetts Department of Environmental Protection, Bureau of Resource Protection, Division of Watershed Management. Report MA73-01-2002 CN 121.0. Boston, Massachusetts. Available for download at http://www.mass.gov/dep/brp/wm/tmdls.htm

MADEP 2003. Massachusetts Year 2002 Integrated List of Waters. Part 2 – Final Listing of Individual Categories of Waters. Massachusetts Department of Environmental Protection, Bureau of Resource Protection, Division of Watershed Management. Boston, Massachusetts. Available for download at http://www.mass.gov/dep/brp/wm/tmdls.htm

MADEP 2005. DRAFT Taunton River Watershed 2001 Water Quality Assessment Report. Massachusetts Department of Environmental Protection, Division of Water Management. Worcester, Massachusetts.

MassGIS 2005. Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs. MADEP 2002 Integrated List of Waters (305(b)/303(d)) as of 2005; Land Use as of 1999; Town Boundaries as of 2002. Census TIGER Roads as of 2003. Major Drainage Boundaries as of 2003. Designated Shellfish Growing Areas as of July 2000. Downloaded January 2005. http://www.mass.gov/mgis/laylist.htm

MDC-CDM. 1997. Wachusett Stormwater Study. Massachusetts District Commission and Camp, Dresser, and McKee, Inc.

Metcalf and Eddy 1991. Wastewater Engineering: Treatment, Disposal, Reuse. Third Edition.

Metcalf and Eddy 1992. Casco Bay Storm Water Management Project.

TRWA 2004. Taunton River Watershed Alliance: Mission Statement. Taunton River Watershed Alliance. Information from website, downloaded March 2005. http://www.trwaonline.org/mission.html

USEPA 1983. Results of the Nationwide Urban Runoff Program. Volume I. Final Report. Water Planning Division. Washington, D.C. 159 pp.

USEPA 1986. Ambient Water Quality Criteria for Bacteria – 1986. EPA 440/5-84-002.

USEPA. 1997. Urbanization of Streams: Studies of Hydrologic Impacts. EPA 841-R-97-009

USEPA 1999. Regional Guidance on Submittal Requirements for Lake and Reservoir Nutrient TMDLs. USEPA, New England Region. November 1999.

USEPA 2001. Protocol for Developing Pathogen TMDLs. EPA 841-R-00-002

USEPA 2004a. Monitoring and Assessing Water Quality. Information from website, downloaded December 2004. http://www.epa.gov/OWOW/monitoring/volunteer/stream/vms511.html

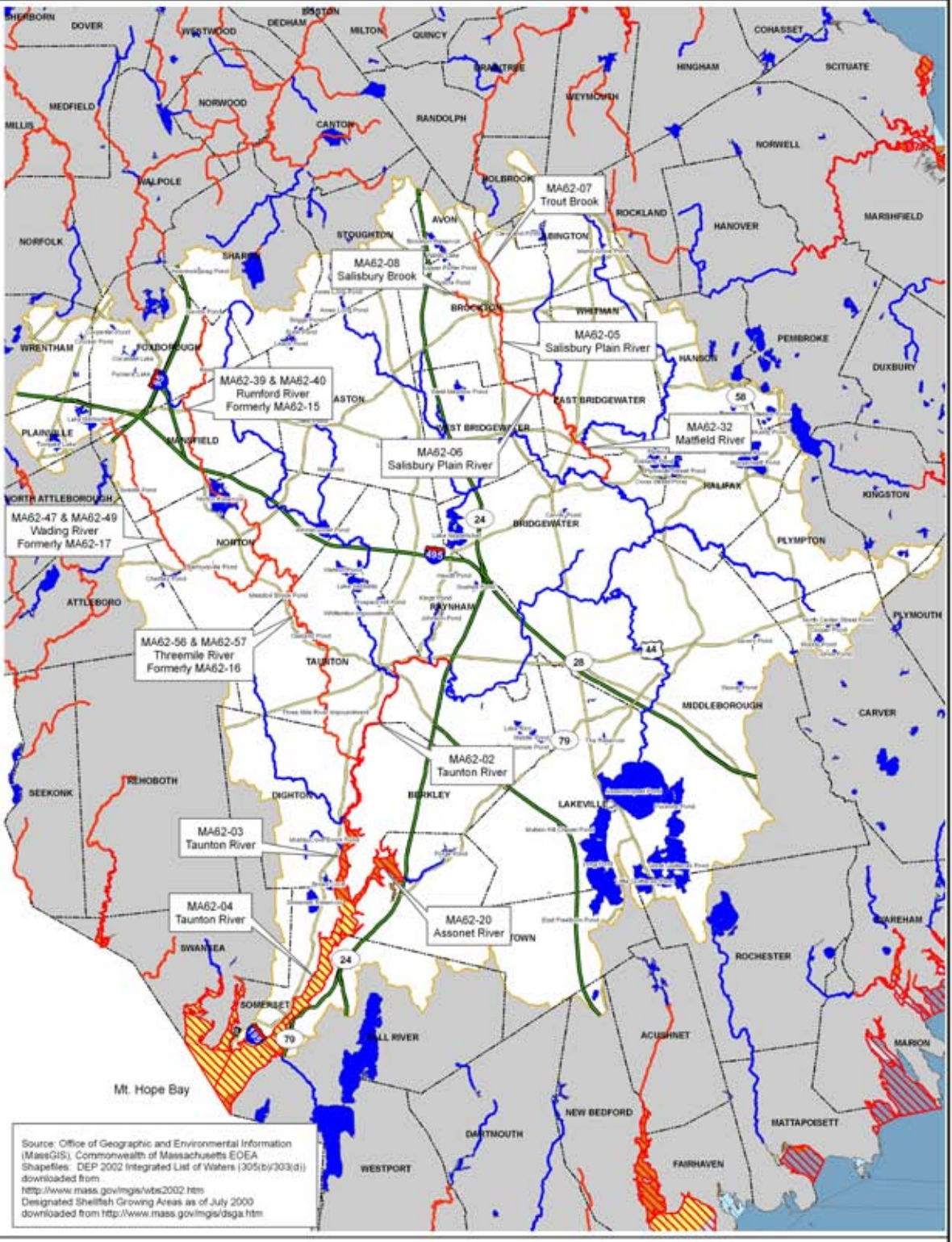
USEPA 2004b. No Discharge Areas in Massachusetts. Information from website, downloaded March 2005. http://www.epa.gov/region01/eco/nodiscrg/ma.html

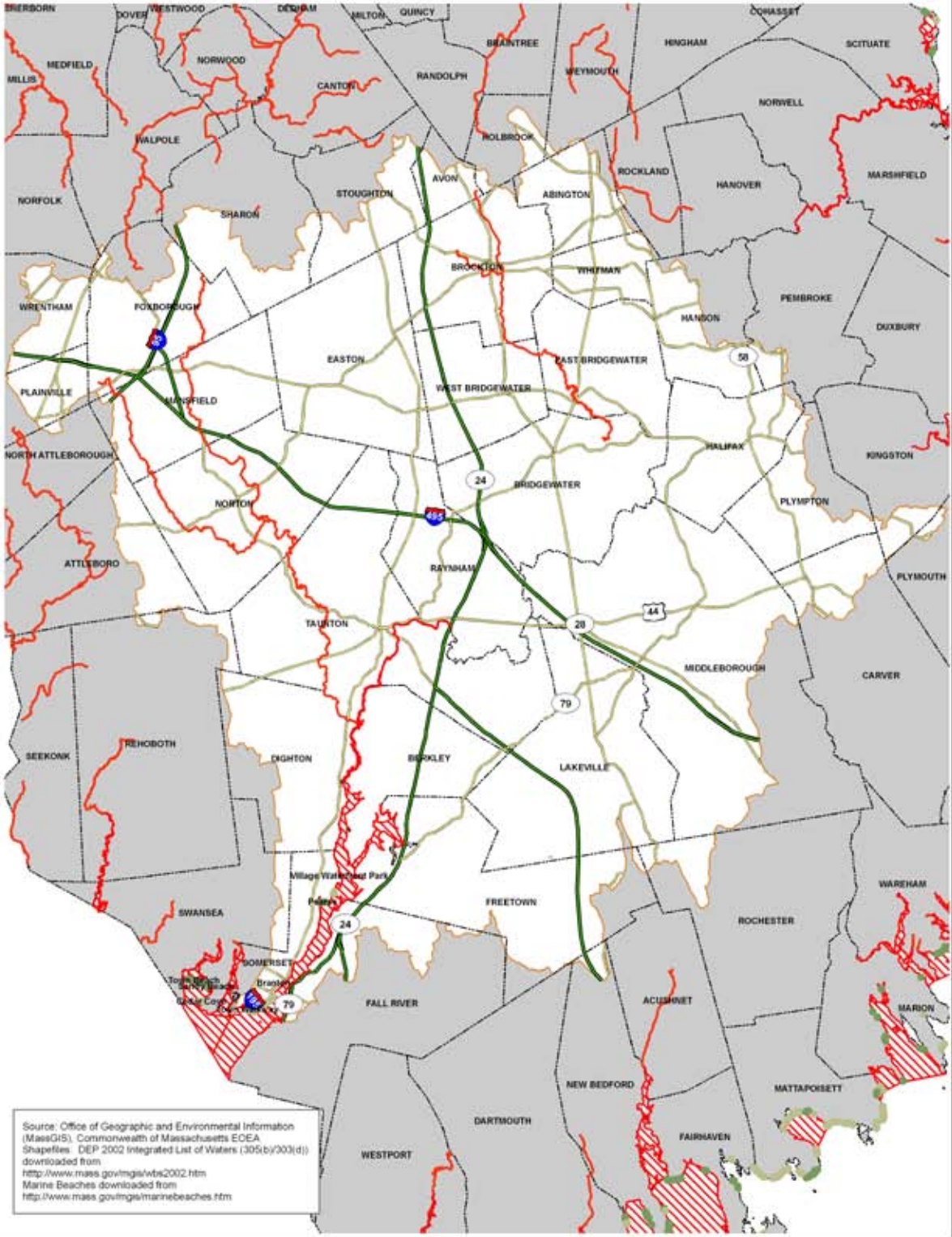
USEPA 2004c. Lower Charles River Illicit Discharge Detection & Elimination (IDDE) Protocol Guidance for Consideration - November 2004 United States Environmental Protection Agency Region I New England

USGS 2002. Measured and Simulated Runoff to the Lower Charles River, Massachusetts, October 199-September 2000. 02-4129. United States Geological Survey. Northborough, Massachusetts.

# Appendix A

Lower Charles River Illicit Discharge Detection & Elimination (IDDE)
Protocol Guidance for Consideration - November 2004


MA62-07
Trout Brook
MA62-08
Salisbury Brook
MA62-05
Salisbury Plain River
MA62-39 & MA62-40
Rumford River
Formerly MA62-15
MA62-32
Matfield River
MA62-06
Salisbury Plain River
MA62-47 & MA62-49
Wading River
Formerly MA62-17
MA62-56 & MA62-57
Threemile River
Formerly MA62-16
MA62-02
Taunton River
MA62-03
Taunton River
MA62-04
Taunton River
MA62-20
Assonet River
Mt. Hope Bay
Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts EOEA
Shapefiles: DEP 2002 Integrated List of Waters (305(b)/303(d))
downloaded from
http://www.mass.gov/mgis/wbs2002.htm
Designated Shellfish Growing Areas as of July 2000
downloaded from http://www.mass.gov/mgis/dsga.htm
0 2.5 5 10 15 20 Miles
Legend
MADEP Assessed Impairment Status
Pathogen Non-Impaired Segment
Pathogen Impaired Segment
Pathogen Non-Impaired Estuary
Pathogen Impaired Estuary
City/Town Boundary
Highway
Major Road
BasinOutline
DMF Designated Shellfish Growing Areas Status
APPROVED
CONDITIONALLY APPROVED
CONDITIONALLY RESTRICTED
RESTRICTED
MANAGEMENT CLOSURE
PROHIBITED
Note: All locations are approximate. Not all waterbodies have been assessed. Not all waterbodies are labeled with segment numbers. Some segments have been changed and/or renumbered since the 2002 List was published.
Taunton River Watershed
Pathogen Impaired Segments
and Designated Shellfish
Growing Areas
Project No. 10598-001
January 2005
ENSR INTERNATIONAL
N
Figure 1-1




Taunton River Watershed
Marine Beach Locations and
Pathogen Impaired Segments

Project No. 10598-001

January 2005

ENSR INTERNATIONAL

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Figure 2-2