MASSACHUSETTS watershed·based plans

WATERSHED-BASED PLAN

Westport River

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Prepared For:

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

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Executive Summary

Introduction: The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds and present the information in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows the United States Environmental Protection Agency's (USEPA's) recommended format for "nine-element" watershed plans. This WBP was developed by Geosyntec Consultants, Inc. (Geosyntec) under the direction of the Massachusetts Association of Conservation Districts (MACD) with funding, input, and collaboration from the Massachusetts Department of Environmental Protection (MassDEP).

This WBP was prepared for the Westport River watershed, which is approximately 84 square miles in area and located in southeastern Massachusetts and a portion of Rhode Island. The communities of Westport, Dartmouth, Fall River, and Freetown in Massachusetts and the towns of Little Compton and Tiverton in Rhode Island are located within the watershed (MEP, 2013; NRCS, 2021). Westport River watershed is a tidal embayment with marine waters entering from Buzzard's Bay and freshwater entering through several stream inflows and direct groundwater discharge (MEP, 2013; NRCS, 2021). Major streams in the watershed include Westport River (MA95-54), East Branch Westport River (MA95-40 and MA95-41), Snell Creek (MA95-44 and MA94-45), and West Branch Westport River (MA95-37).

Impairments and Pollution Sources: Water quality problems in the Westport River watershed have been linked primarily to agricultural activities and septic systems and, to a lesser extent, stormwater runoff, lawn fertilizers, and landfills. Total Nitrogen (TN) and bacteria (e.g., Escherichia coli *(E. coli)*, enterococci, fecal coliform (FC)) linked to fecal waste from human, livestock, and other animal sources are considered the primary pollutants of concern within the watershed (NRCS, 2021) . Both the East Branch Westport River and West Branch Westport River are listed on the MassDEP 2018/2020 Massachusetts Integrated List of Waters (303(d) List) as impaired for TN, nutrient/eutrophication biological indicators, and estuarine bioassessments due to agriculture, runoff from impervious services, and septic systems. Numerous segments in the Westport River watershed are also identified on the 303(d) List as impaired for enterococcus, FC, and *E. coli* due to animal feeding operations, dairy farms, MS4 discharges, grazing in riparian zones, and unknown sources (MassDEP, 2021).

Goals, Management Measures, and Funding: The long-term goal of this WBP is to reduce TN and bacteria loading in the Westport River watershed, eventually leading to delisting of impaired waterbodies in the study area from the 303(d) list. It is expected that these pollutant load reductions will result in improvements to other water quality parameters throughout the watershed as well.

It is expected that these goals will be accomplished primarily through installation of agricultural Best Management Practices (BMPs) to capture runoff and reduce TN and bacteria loading as well as implementation of watershed education and outreach to achieve additional pollutant load reductions. Agricultural BMP planning and implementation will initially be performed at various farms in the watershed, with funding from the Fiscal Year 2019 Section 319 grant program (MACD, 2018). MACD was awarded this funding to conduct outreach and education to farmers in the Westport River watershed; develop conservation plans outlining BMPs to reduce pollutant runoff; assist landowners in obtaining access to financial resources; implement BMPs and ensure farmers follow operation and maintenance practices (MACD, 2018).

It is expected that future funding for management measures will be obtained from a variety of sources including Section 319 Grant Funding, Massachusetts Environmental Trust (MET) grants, the Agricultural Environmental Enhancement Program (AEEP), the Agricultural Produce Safety Improvement Program (APSIP), Town capital funds, volunteer efforts, and United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) grants including the Environmental Quality Incentives Program (EQIP) and the Agricultural Management Assistance (AMA) program.

Public Education and Outreach: Goals of public education and outreach are to: engage with residents and landowners in the watershed to share information as efforts by NRCS, the Massachusetts Department of Agricultural Resources (MDAR) and others within the agricultural community to preserve and protect water quality; provide information and incentives to farmers on funding resources for BMP implementation; provide information about farm conservation plans and agricultural BMPs and their anticipated water quality benefits; and provide information to promote watershed stewardship.

MACD will engage in outreach and dialogue with farmers in the Westport River watershed and share information about the availability of funds from MassDEP, MDAR and NRCS to implement BMPs to reduce contaminated runoff from agricultural operations.

The Westport River Watershed Association (WRWA) also provides information about the Westport River watershed on the WRWA website (Westport River Watershed Alliance - WRWA Westport, MA (westportwatershed.org) and host events and education programs (such as home school, summer, and scouts programs).

Implementation Schedule and Evaluation Criteria: The implementation schedule includes milestones for outreach and education; monitoring; development and implementation of farm conservation plans; assisting farmers in obtaining access to financial resources; BMP implementation. and operation and maintenance plans.

This WBP recommends continuing and possibly expanding the current water quality monitoring program that is managed by WRWA, to include sampling at key locations in the Westport River watershed. This would help continued understanding of water quality trends in Westport River including determining sources of pollution, evaluating the effectiveness of implemented BMPs, and tracking compliance with the water quality goals identified in this WBP.

This WBP is meant to be a living document and reevaluated at least once every three years and adjusted as needed based on ongoing efforts (e.g., based on monitoring results, 319 funding, etc.). It is recommended that a working group including additional stakeholders be established to meet at least biannually, implement, and update this WBP, and track progress.

Introduction

What is a Watershed-Based Plan?

Purpose & Need

The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds and present the information in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows the United States Environmental Protection Agency's (USEPA's) recommended format for "nine-element" watershed plans, as described below.

All states are required to develop WBPs, but not all states have taken the same approach. Most states develop WBPs only for selected watersheds. Massachusetts Department of Environmental Protection's (MassDEP's) approach has been to develop a tool to support statewide development of WBPs, so **that good projects in all areas of the state may be eligible for federal watershed implementation grant funds** under Section 319 of the Clean Water Act.

USEPA guidelines promote the use of Section 319 funding for developing and implementing WBPs. WBPs are required for all projects implemented with Section 319 funds, and are recommended for all watershed projects, whether they are designed to protect unimpaired waters, restore impaired waters, or both.

Watershed-Based Plan Outline

This WBP for the Westport River watershed includes nine elements (a through i) in accordance with USEPA Guidelines:

a) An **identification of the causes and sources** or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this WBP (and to achieve any other watershed goals identified in the WBP), as discussed in item (b) immediately below.

b) An **estimate of the load reductions** expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time).

c) A **description of the nonpoint source management measures** needed to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this WBP), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

d) An **estimate of the amounts of technical and financial assistance needed**, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, United States Department of Agriculture's (USDA's) Environmental Quality Incentives Program (EQIP) and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

e) An **information/education component** that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.

f) A **schedule for implementing the nonpoint source management measures** identified in this plan that is reasonably expeditious.

g) A description of **interim, measurable milestones** for determining whether nonpoint source management measures or other control actions are being implemented.

h) A set of **criteria to determine if loading reductions are being achieved** over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this WBP needs to be revised or, if a nonpoint source total maximum daily load (TMDL) has been established, whether the TMDL needs to be revised.

i) A **monitoring component** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Project Partners and Stakeholder Input

This WBP was developed by Geosyntec under the direction of the Massachusetts Association of Conservation Districts (MACD) with funding, input, and collaboration from MassDEP. This WBP was developed using funds from the Section 319 program to assist grantees in developing technically robust WBPs using MassDEP's Watershed-Based Planning Tool (WBP Tool). The MACD was a recipient of Section 319 funding in Fiscal Year 2019 to complete as many farm conservation plans as possible within the watershed and to fully implement as many of the completed plans featuring the adoption and installation of structural and non-structural best management practices (BMPs) to reduce pollutant runoff from agricultural operations (MACD, 2018).

The following are core project stakeholders:

- Michael Leff – MACD
- Meghan Selby – MassDEP
- Judith Rondeau – MassDEP
- Padmini Das – MassDEP

This WBP is meant to be a living document and reevaluated at least once every three years and adjusted as needed based on ongoing efforts (e.g., based on monitoring results, 319 funding, etc.). It is recommended that a working group including additional stakeholders be established to meet at least biannually, implement, and update this WBP, and track progress.

Data Sources

This WBP was developed using the framework and data sources provided by MassDEP's WBP Tool and supplemented by information provided in the Section 319 grant application for "Westport River Agricultural Nonpoint Source Program (MACD, 2018) and the draft report written by the USDA Natural Resources Conservation Service (NRCS) for the NRCS National Water Quality Initiative (NWQI), entitled "Westport River Watershed Assessment" (NRCS, 2021). The purpose of the NRCS report was to provide a characterization and analysis of the Westport River drainage area, and the main objective was to assess agricultural impacts and opportunities for water quality improvements (NRCS, 2021). Table 1 includes a compilation of available reports used to characterize hydrology and water quality conditions in the Westport River watershed (NRCS, 2021). Table 2 includes a

compilation of available data used to characterize hydrology and water quality conditions in the watershed (NRCS, 2021). Once the Westport River Watershed Assessment is finalized it will be included as an appendix in a future revision of this WBP.

Table 1: Compilation of available reports used to characterize hydrology and water quality conditions in the watershed (Adapted from NRCS, 2021)

Title	Year published	Author(s)	Type of resource	Description
Relationships Between Suspended Sediment and the Movement of Bacteria in the East Branch of the Westport River	1986	Hydrogeology Research Group, Department of Geology, Boston University, Boston, MA	Technical report	Analyzes sedimentation and transport of bacteria and the contributions to contamination problems in the Westport River
Atlas of Stormwater Discharges in the Buzzards Bay Watershed	2003	Buzzards Bay Project National Estuary Program, MA Office of Coastal Zone Management, East Wareham, MA	Stormwater monitoring report	Documents all known stormwater discharges and contributing catchments along the shores of the eight municipalities within Buzzards Bay watershed
Buzzards Bay Watershed 2000 Water Quality Assessment Report	2003	O'Brien, K., and A. Langhauser, MassDEP, Division of Watershed Management, Worcester, MA	Water quality report	Summary of current water quality data and information used to assess the status of designated uses for waters in Buzzards Bay watershed
Massachusetts Year 2008 Integrated List of Waters	2008	MassDEP, Division of Watershed Management, Watershed Planning Program, Worcester, MA	Integrated list of waters report	Includes process where waters in Massachusetts are evaluated for designated uses, report on trophic status of lakes and ponds, and identifying water bodies that are not expected to meet surface water quality standards
Buzzards Bay Watershed 2005 Benthic Macroinvertebrate Bioassessment	2009	Fiorentino, J.F., MassDEP Watershed Planning Program, Worcester, MA	Biological monitoring report	A total of nine biomonitoring stations, in streams previously "not assessed" or "unassessed" by MassDEP, were sampled to investigate the effects of anthropogenic stressors on the aquatic communities of Buzzards Bay watershed
Final Pathogen TMDL for the Buzzards Bay Watershed	2009	MassDEP, EPA Region 1, and ENSR International	TMDL report	TMDLs for pathogens within the Buzzards Bay watershed
314 CMR: The Massachusetts Surface Water Quality Standards	2013	MassDEP, Worcester, MA	Surface water quality standards report	Includes surface water quality standards for water bodies in Massachusetts and the minimum water quality criteria required to sustain designated uses

Title	Year published	Author(s)	Type of resource	Description
Linked Watershed-Embayment Approach to Determine Critical Nitrogen Loading Thresholds for the Westport River Embayment System: Town of Westport, Massachusetts	2013	Massachusetts Estuaries Project: University of Massachusetts Dartmouth, MA, and MassDEP, Boston, MA	Nitrogen load modeling report	Includes current quantitative assessment of the nutrient related health of the Westport River embayment, identification of all nitrogen sources and N loads to embayment waters, N threshold levels for maintaining Massachusetts Water Quality Standards within embayment waters, and analysis of watershed nitrogen loading reductions needed to achieve the N threshold concentrations in embayment waters
Stream Flow and Water Quality Monitoring in Bread and Cheese Brook (2012–2014)	2014	Howes, B., R. Samimy, and M. Bartlett, University of Massachusetts, Dartmouth, MA	Water quality report	Report detailing a water quality and stream gage sampling study in the Bread and Cheese Brook/Upper Westport River system in 2012–2014
Westport River Estuarine System Total Maximum Daily Loads for Total Nitrogen (CN-375.1)	2017	MassDEP, Boston, MA	TMDL report	TMDLs for TN within the Westport River Estuarine System
Massachusetts Year 2016 Integrated List of Waters	2019	MassDEP, Division of Watershed Management, Watershed Planning Program, Worcester, MA	Integrated list of waters report	Includes process where waters in Massachusetts are evaluated for designated uses, report on trophic status of lakes and ponds, and identifying water bodies that are not expected to meet surface water quality standards
Targeted-Integrated Plan for Water Resources Management: Town of Westport, MA	2020	Town of Westport Planning Board, Westport, MA	Water resource management plan	Water resource management plan created with the goal of preserving the water quality in the town of Westport, MA; describes plan of implementing projects and programs to preserve water quality
Westport River Watershed Alliance: River Water Quality Monitoring Website	2020	Westport River Watershed Alliance	Website	A website that contains current and past water quality monitoring data (bacteria levels) and summaries from sampling conducted by Westport River Watershed Alliance

Table 2: Compilation of available data used to characterize hydrology and water quality conditions in the watershed (Adapted from NRCS, 2021)

Title	Year(s) of data included	Description	Available data parameters	Sampling frequency	URL
MassDEP Water Quality Data	2005–2006; 2012–2016	Water quality data collected from various water bodies within the Westport Watershed	Color; apparent color; ammonia-N; turbidity; TP; TN; FC; enterococci; *E. coli;* chloride; nitrate/nitrite-N; and dissolved forms of molybdenum, selenium, silver, manganese, zinc, nickel, thallium, magnesium, lead, copper, calcium, cobalt, aluminum, antimony, arsenic, barium, vanadium, beryllium, cadmium, chromium, and iron"	Monthly; May–Sept	https://www.mass.gov/guides/water-quality-monitoring-program-data
New Bedford COOP climate station data	1981–2010	Climate data collected from the New Bedford COOP climate section, located close to Westport Watershed	Monthly average maximum temperature (°F), monthly average minimum temperature (°F), monthly average precipitation (inches), monthly more or less than 30% chance of precipitation (inches), and monthly average snowfall (inches)	Daily	https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USC00195246/detail
PRISM Climate Group Bristol County, MA climate data	1981–2010	Precipitation and temperature data for Bristol County, MA collected by PRISM Climate Group	Annual/monthly average precipitation (inches), annual/monthly average minimum temperature (°F), annual/monthly mean temperature (°F), and annual/monthly average maximum temperature (°F)	Daily	https://prism.oregonstate.edu/explorer/
Westport River Watershed Alliance water quality monitoring data	2015–2019	Water quality data collected from various water bodies within Westport River watershed	Weather/climate data, water temperature, turbidity, salinity, pH, fecal coliform	Varies; 1–4 times a month June–Sept	https://www.savebuzzardsbay.org/bay-health/waterway/westport-river/
USGS Base-flow Index Grid Dataset for the Conterminous United States	2001	Baseflow Modeling Dataset	Baseflow index rates for Westport Watershed	N/A	https://www.sciencebase.gov/catalog/item/537f6a6fe4b021317a86e394
USGS gage sites within Westport River watershed					
USGS 01105945 East Branch Westport River, on Forge Rd. at Forge P	1991–1992	Streamflow measurements collected from USGS Massachusetts Water Science Center gage site	Streamflow, gage height, gage height change, measurement duration, measurement rated, and who measured	~Monthly; 6 total field samples	https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=01105945

Title	Year(s) of data included	Description	Available data parameters	Sampling frequency	URL
USGS 01105947 Bread and Cheese Brook at head of Westport, MA	1972–1996; 2003	Streamflow measurements collected from USGS Massachusetts Water Science Center gage site	Streamflow, gage height, gage height change, measurement duration, measurement rated, and who measured	~Annually; 27 total field samples	https://waterdata.usgs.gov/nwis/inventory/?site_no=01105947&agency_cd=USGS
USGS 01105950 Kirby Brook near head of Westport, MA	1963–1973 1965–1992; 2003	Peak streamflow and streamflow measurements collected from USGS Massachusetts Water Science Center gage site	Peak streamflow Streamflow, gage height, gage height change, measurement duration, measurement rated, and who measured	Annually ~Annually; 16 total field samples	https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=01105950
USGS 01106000 Adamsville Brook at Adamsville, RI	1940–1987	Streamflow discharge measurements collected from USGS Massachusetts Water Science Center gage site	Daily mean discharge	Daily	https://waterdata.usgs.gov/nwis/inventory/?site_no=01106000&agency_cd=USGS&amp
USGS 01106005 Angeline Brook near Westport Point, MA	1972–1992; 2003	Streamflow measurements collected from USGS Massachusetts Water Science Center gage site	Streamflow, gage height, gage height change, measurement duration, measurement rated, and who measured	~Annually; 16 total field samples	https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=01106005
USGS StreamStats Tool	2020	USGS web-based geographic information systems (GIS) application that provides access to additional flow statistics and previously published information for USGS gage stations, including the Adamsville Brook gage during the period of record as well as other discontinued gage sites	Various streamflow statistics	Daily, monthly	https://streamstats.usgs.gov/ss/

Note:
USGS = U.S. Geological Survey

Element A: Identify Causes of Impairment & Pollution Sources

Element A: Identify the causes and sources or groups of similar sources that need to be controlled to achieve the necessary pollutant load reductions estimated in the watershed based plan (WBP).

General Watershed Information

This WBP was prepared for the Westport River watershed. Westport River watershed is approximately 84 square miles in area and located in southeastern Massachusetts and a portion of Rhode Island. The communities of Westport, Dartmouth, Fall River, and Freetown in Massachusetts and the towns of Little Compton and Tiverton in Rhode Island are located within the watershed (MEP, 2013; NRCS, 2021). Westport River watershed is a tidal embayment with marine waters entering from Buzzard's Bay and freshwater entering through several stream inflows and direct groundwater discharge (MEP, 2013; NRCS, 2021). Major streams in the watershed include Westport River (MA95-54), East Branch Westport River (MA95-40 and MA95-41), Snell Creek (MA95-44 and MA94-45), and West Branch Westport River (MA95-37).

Table A-1 presents the general watershed information for the Westport River watershed and **Figure A-1** includes a map of the watershed boundary.

Table A-1: Westport River General Watershed Information

Watershed Name (Assessment Unit ID):	Westport River (MA95-54) East Branch Westport River (MA95-40) East Branch Westport River (MA95-41) Snell Creek (MA95-44) Snell Creek (MA94-45) West Branch Westport River (MA95-37) Angeline Brook (MA95-83) Bread and Cheese Brook (MA95-58) Copicut River (MA95-43) Dunhams Brook (MA95-73) Kirby Brook (MA95-82) Shingle Island River (MA95-12) Unnamed Tributary (MA95-57) Unnamed Tributary (MA95-75) Unnamed Tributary (MA95-84)
Major Basin:	Buzzards Bay
Watershed Area:	84.1 square miles (74.3 square miles within Massachusetts)

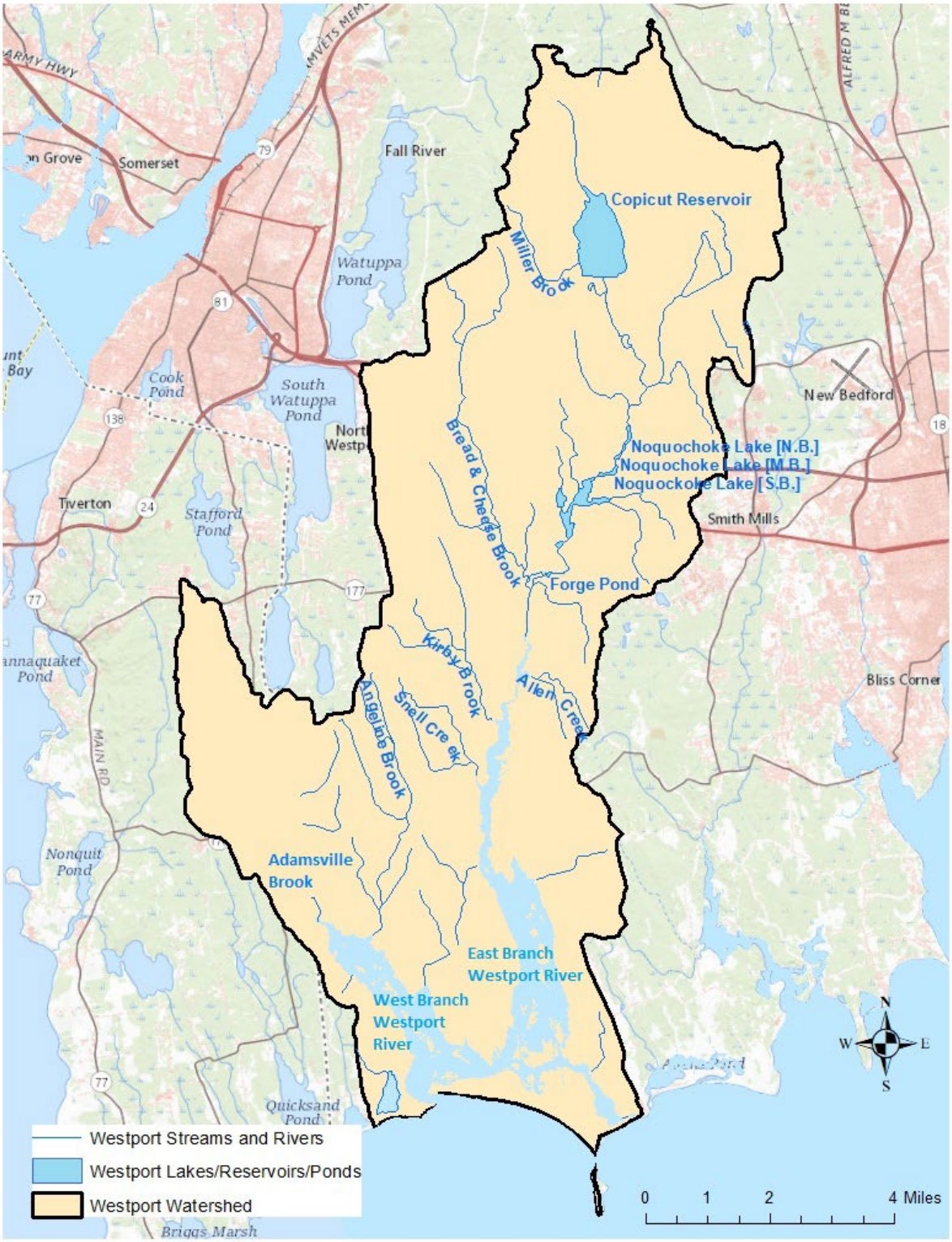


Figure A-1: Westport River Watershed Boundary Map (NRCS, 2021)

Water Quality Impairments and Pollution Sources

Water quality problems in the Westport River watershed have been linked primarily to agricultural activities and septic systems and, to a lesser extent, stormwater runoff, lawn fertilizers, and landfills. Total Nitrogen (TN) and bacteria linked to fecal waste from human, livestock, and other animal sources are considered the primary pollutants of concern within the watershed (NRCS, 2021).

Water quality problems affecting nutrient-enriched embayments generally include periodic decreases of dissolved oxygen, loss of eelgrass beds, decreased diversity and quantity of benthic animals, and periodic algae blooms. Continued degradation could significantly reduce the recreational and commercial value and use of these important environmental resources (NRCS, 2021).

Fecal bacteria impairments (e.g., *E. coli*, enterococci, fecal coliform (FC)), which indicate the potential presence of pathogenic organisms, have been documented in numerous locations throughout Westport River watershed. Fecal pathogens can present a risk of human exposure through recreational use, drinking water, and consumption of filter-feeding shellfish contamination (NRCS, 2021).

MassDEP Water Quality Assessment Report and TMDL Review

TMDL assessments for TN and fecal bacteria have been developed for segments of the Westport River watershed and are listed below:

- Final Pathogen TMDL for the Buzzards Bay Watershed (MassDEP, ENSR International, EPA, 2009)
- Westport River Estuarine System Total Maximum Daily Loads for Nitrogen (MassDEP, 2017)

A water quality assessment report was also developed and is listed below:

- Buzzards Bay Watershed 2000 Water Quality Assessment Report (MassDEP, 2003)

Select excerpts from the Pathogen TMDL (MassDEP, 2009) and the water quality assessment report (MassDEP, 2003) relating to the water quality in the Westport River watershed are included in **Appendix B** (note: relevant information is included directly from these documents for informational purposes and has not been modified).

303 (d) Water Quality Impairments

Impairment categories from the MassDEP 2018/2020 Massachusetts Integrated List of Waters (303(d) List) are listed in **Table A-2**. Known water quality impairments for river segments in the Westport River watershed, as documented in the 2018/2020 303(d) List, are listed in **Table A-3**. Both the East Branch Westport River and West Branch Westport River are identified impaired for TN, nutrient/eutrophication biological indicators, and estuarine bioassessments due to agriculture, runoff from impervious services, and septic systems. Numerous segments in the Westport River watershed are also identified as impaired for enterococcus, FC, and Escherichia coli (*E. coli*) due to animal feeding operations, dairy farms, MS4 discharges, grazing in riparian zones, and unknown sources (MassDEP, 2021).

Table A-2: 2018/2020 MA Integrated List of Waters Categories (MassDEP, 2021)

Integrated List Category	Description
1	Unimpaired and not threatened for all designated uses.
2	Unimpaired for some uses and not assessed for others.
3	Insufficient information to make assessments for any uses.
4	Impaired or threatened for one or more uses, but not requiring calculation of a Total Maximum Daily Load (TMDL), including: 4a: TMDL is completed 4b: Impairment controlled by alternative pollution control requirements 4c: Impairment not caused by a pollutant - TMDL not required
5	Impaired or threatened for one or more uses and requiring preparation of a TMDL.

Table A-3: Water Quality Impairments (MassDEP, 2021)

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA95-12	Shingle Island River	5	Primary Contact Recreation	Enterococcus	Source Unknown
MA95-40	East Branch Westport River	4A	Primary Contact Recreation	Enterococcus	Source Unknown
MA95-40	East Branch Westport River	4A	Primary Contact Recreation	Fecal Coliform	Source Unknown
MA95-41	East Branch Westport River	5	Fish, other Aquatic Life and Wildlife	Estuarine Bioassessments	Agriculture
MA95-41	East Branch Westport River	5	Fish, other Aquatic Life and Wildlife	Estuarine Bioassessments	Impervious Surface/Parking Lot Runoff
MA95-41	East Branch Westport River	5	Fish, other Aquatic Life and Wildlife	Estuarine Bioassessments	On-site treatment systems (septic systems and similar decentralized systems)
MA95-41	East Branch Westport River	5	Fish, other Aquatic Life and Wildlife	Nitrogen, Total	Agriculture
MA95-41	East Branch Westport River	5	Fish, other Aquatic Life and Wildlife	Nitrogen, Total	Impervious Surface/Parking Lot Runoff
MA95-41	East Branch Westport River	5	Fish, other Aquatic Life and Wildlife	Nitrogen, Total	On-site treatment systems (septic systems and similar decentralized systems)
MA95-41	East Branch Westport River	5	Fish, other Aquatic Life and Wildlife	Nutrient/Eutrophication Biological Indicators	Agriculture

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA95-41	**East Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Nutrient/Eutrophication Biological Indicators	Impervious Surface/Parking Lot Runoff
MA95-41	**East Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Nutrient/Eutrophication Biological Indicators	On-site treatment systems (septic systems and similar decentralized systems)
MA95-41	**East Branch Westport River**	**5**	Primary Contact Recreation	Fecal Coliform	Animal Feeding Operations (NPS)
MA95-41	**East Branch Westport River**	**5**	Primary Contact Recreation	Fecal Coliform	Dairies
MA95-41	**East Branch Westport River**	**5**	Primary Contact Recreation	Fecal Coliform	Discharges from Municipal Separate Storm Sewer Systems (MS4)
MA95-41	**East Branch Westport River**	**5**	Primary Contact Recreation	Fecal Coliform	Grazing in Riparian or Shoreline Zones
MA95-41	**East Branch Westport River**	**5**	Secondary Contact Recreation	Fecal Coliform	Animal Feeding Operations (NPS)
MA95-41	**East Branch Westport River**	**5**	Secondary Contact Recreation	Fecal Coliform	Dairies
MA95-41	**East Branch Westport River**	**5**	Secondary Contact Recreation	Fecal Coliform	Discharges from Municipal Separate Storm Sewer Systems (MS4)
MA95-41	**East Branch Westport River**	**5**	Secondary Contact Recreation	Fecal Coliform	Grazing in Riparian or Shoreline Zones
MA95-41	**East Branch Westport River**	**5**	Shellfish Harvesting	Fecal Coliform	Animal Feeding Operations (NPS)
MA95-41	**East Branch Westport River**	**5**	Shellfish Harvesting	Fecal Coliform	Dairies
MA95-41	**East Branch Westport River**	**5**	Shellfish Harvesting	Fecal Coliform	Discharges from Municipal Separate Storm Sewer Systems (MS4)
MA95-41	**East Branch Westport River**	**5**	Shellfish Harvesting	Fecal Coliform	Grazing in Riparian or Shoreline Zones
MA95-43	**Copicut River**	**5**	Fish Consumption	Mercury in Fish Tissue	Source Unknown
MA95-43	**Copicut River**	**5**	Fish Consumption	PCBs In Fish Tissue	CERCLA NPL (Superfund) Sites
MA95-43	**Copicut River**	**5**	Fish Consumption	PCBs In Fish Tissue	Contaminated Sediments
MA95-44	**Snell Creek**	**4A**	Primary Contact Recreation	Enterococcus	Source Unknown

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA95-44	**Snell Creek**	**4A**	Primary Contact Recreation	Escherichia Coli (E. Coli)	Source Unknown
MA95-44	**Snell Creek**	**4A**	Primary Contact Recreation	Fecal Coliform	Source Unknown
MA95-44	**Snell Creek**	**4A**	Secondary Contact Recreation	Enterococcus	Source Unknown
MA95-45	**Snell Creek**	**4A**	Primary Contact Recreation	Enterococcus	Source Unknown
MA95-45	**Snell Creek**	**4A**	Primary Contact Recreation	Escherichia Coli (E. coli)	Source Unknown
MA95-45	**Snell Creek**	**4A**	Primary Contact Recreation	Fecal Coliform	Animal Feeding Operations (NPS)
MA95-45	**Snell Creek**	**4A**	Primary Contact Recreation	Fecal Coliform	Dairies
MA95-45	**Snell Creek**	**4A**	Primary Contact Recreation	Fecal Coliform	Grazing in Riparian or Shoreline Zones
MA95-45	**Snell Creek**	**4A**	Primary Contact Recreation	Fecal Coliform	Source Unknown
MA95-45	**Snell Creek**	**4A**	Secondary Contact Recreation	Enterococcus	Source Unknown
MA95-45	**Snell Creek**	**4A**	Secondary Contact Recreation	Fecal Coliform	Animal Feeding Operations (NPS)
MA95-45	**Snell Creek**	**4A**	Secondary Contact Recreation	Fecal Coliform	Dairies
MA95-45	**Snell Creek**	**4A**	Secondary Contact Recreation	Fecal Coliform	Grazing in Riparian or Shoreline Zones
MA95-45	**Snell Creek**	**4A**	Secondary Contact Recreation	Fecal Coliform	Source Unknown
MA95-59	**Snell Creek**	4A	Primary Contact Recreation	Fecal Coliform	Animal Feeding Operation (NPS)
MA95-59	**Snell Creek**	4A	Primary Contact Recreation	Fecal Coliform	Dairies
MA95-59	**Snell Creek**	4A	Primary Contact Recreation	Fecal Coliform	Grazing in Riparian or Shoreline Zones
MA95-59	**Snell Creek**	4A	Secondary Contact Recreation	Fecal Coliform	Animal Feeding Operation (NPS)
MA95-59	**Snell Creek**	4A	Secondary Contact Recreation	Fecal Coliform	Dairies
MA95-59	**Snell Creek**	4A	Secondary Contact Recreation	Fecal Coliform	Grazing in Riparian or Shoreline Zones
MA95-59	**Snell Creek**	4A	Shellfish Harvesting	Fecal Coliform	Animal Feeding Operation (NPS)
MA95-59	**Snell Creek**	4A	Shellfish Harvesting	Fecal Coliform	Dairies
MA95-59	**Snell Creek**	4A	Shellfish Harvesting	Fecal Coliform	Grazing in Riparian or Shoreline Zones
MA95-58	**Bread and Cheese Brook**	**4A**	Primary Contact Recreation	Enterococcus	Source Unknown

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA95-58	**Bread and Cheese Brook**	**4A**	Primary Contact Recreation	Fecal Coliform	Source Unknown
MA95-82	**Kirby Brook**	**5**	Primary Contact Recreation	Enterococcus	Source Unknown
MA95-83	**Angeline Brook**	**5**	Primary Contact Recreation	Enterococcus	Source Unknown
MA95-37	**West Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Estuarine Bioassessments	Agriculture
MA95-37	**West Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Estuarine Bioassessments	Impervious Surface/Parking Lot Runoff
MA95-37	**West Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Estuarine Bioassessments	On-site treatment systems (septic systems and similar decentralized systems)
MA95-37	**West Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Nitrogen, Total	Agriculture
MA95-37	**West Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Nitrogen, Total	Impervious Surface/Parking Lot Runoff
MA95-37	**West Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Nitrogen, Total	On-site treatment systems (septic systems and similar decentralized systems)
MA95-37	**West Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Nutrient/Eutrophication Biological Indicators	Agriculture
MA95-37	**West Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Nutrient/Eutrophication Biological Indicators	Impervious Surface/Parking Lot Runoff
MA95-37	**West Branch Westport River**	**5**	Fish, other Aquatic Life and Wildlife	Nutrient/Eutrophication Biological Indicators	On-site treatment systems (septic systems and similar decentralized systems)
MA95-37	**West Branch Westport River**	**5**	Shellfish Harvesting	Fecal Coliform	Source Unknown
MA95-54	**Westport River**	**4A**	Shellfish Harvesting	Fecal Coliform	Source Unknown

Figure A-2 displays the classifications for designated shellfish growing areas in Westport River watershed. Upper parts of both the East Branch Westport River and the West Branch Westport River are currently designated as prohibited areas for shellfish growing. Shellfish classifications largely drive MassDEP impairment decisions (NRCS, 2021).

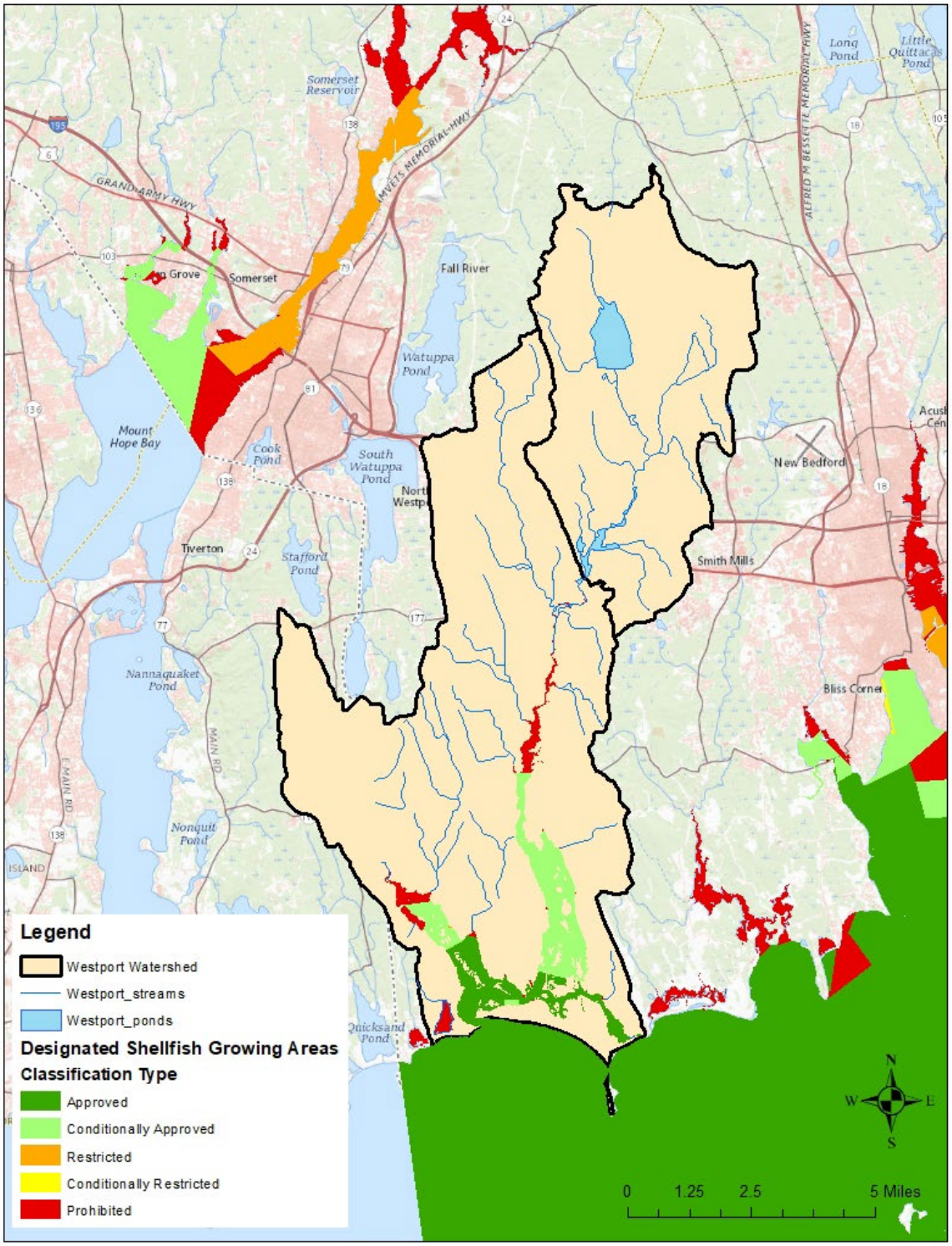


Figure A-2: Classification for designated shellfish growing areas in coastal waters of Westport River watershed (NRCS, 2021)

Water Quality Data

Total Nitrogen

Table A-4 presents average TN concentrations measured in Westport River watershed based on seven years (2003–2009) of data collection by Buzzards Bay Coalition (BBC) and the University of Massachusetts Dartmouth School for Marine Science & Technology (SMAST). The water quality sampling stations for this data collection are identified in **Figure A-3**. The upper section of the East Branch had higher TN concentrations of TN. These were attributed to the relatively low flow rates at the headwaters of this branch and to the higher loading rates from Bread and Cheese Brook subwatershed (NRCS, 2021; MassDEP, 2017).

Table A-4: Present TN concentrations and station target threshold TN concentrations for Westport River watershed (MassDEP 2017; Adapted from NRCS, 2021)

Westport River watershed sub-embayment	Observed nitrogen concentrations[1]	Target threshold nitrogen concentration[2]
Upper East Branch	0.874–1.102 mg/L	------
Middle East Branch	0.794–0.864 mg/L	------
Lower East Branch (E-33)	0.538–0.700 mg/L	0.49 mg/L
Lower West Branch (W-12)	0.449–0.649 mg/L	0.48 mg/L
Westport Harbor	0.534 mg/L	------

Notes:
mg/L = milligrams per liter
[1] Average total N concentration from present loading based on an average of the annual N means from 2003–2009. Ranges of means are provided if the area contained several monitoring stations.
[2] Target threshold N concentrations for the Lower East Branch sentinel station (E-33) and the Lower West Branch sentinel station (W-12).

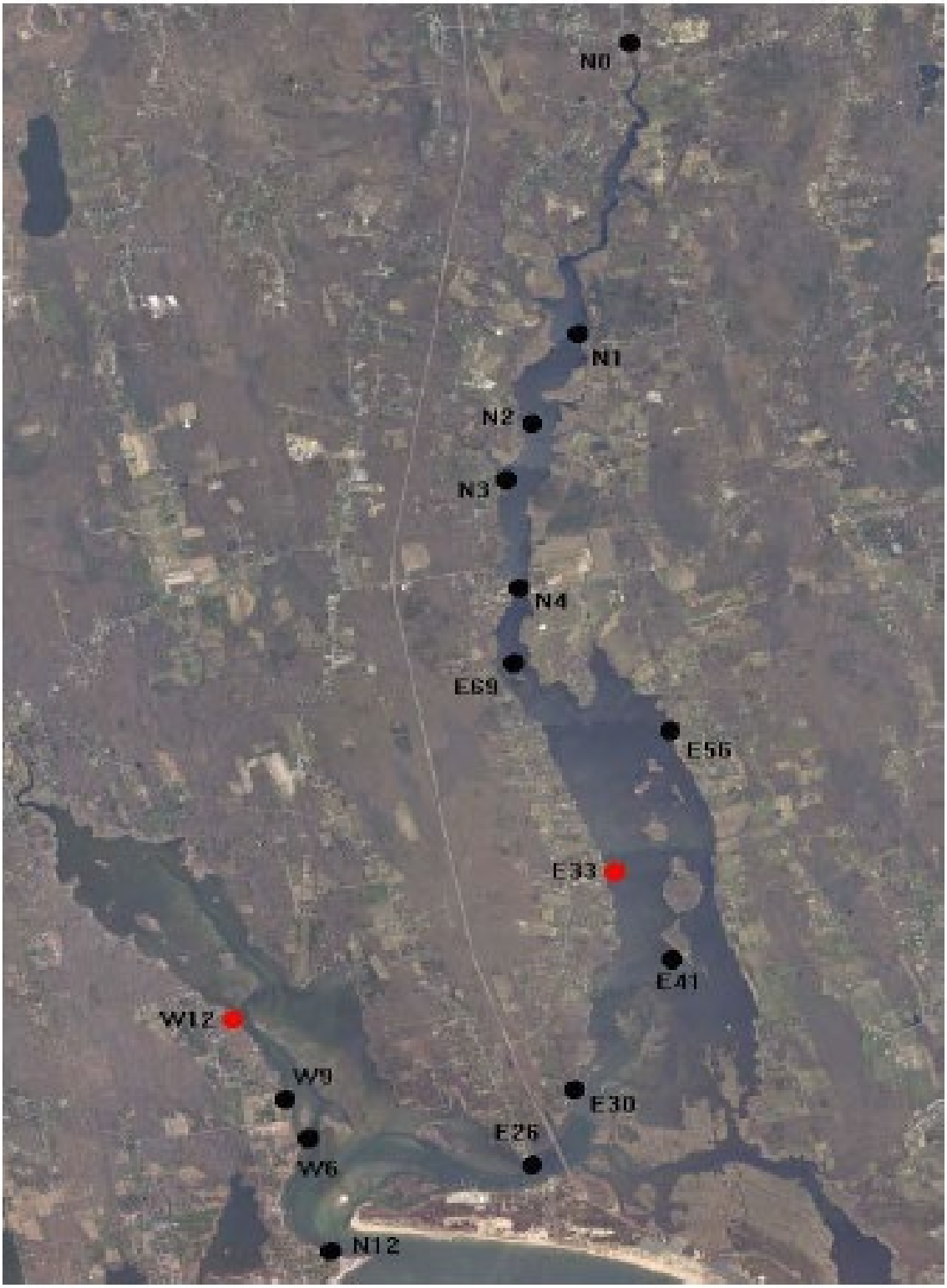


Figure A-3: Water Quality Sampling Stations in the Westport River Estuarine System (Sentinel Stations noted in red) (Adapted from MassDEP, 2017)

Additionally for the East Branch Westport River, annual TN concentration ranges (box and whisker plots) from 1992 to 2017 (approximately 960 samples taken by BBC) are displayed in **Figure A-4**. The average concentration of TN exceeded the TMDL target concentration for the watershed (0.49 milligrams per liter [mg/L]) each year, with 1993 being an exception. The mean observed concentration ranged between 0.81 mg/L and 1.04 mg/L, with the highest average concentration (1.25 mg/L) being observed in 2006 (NRCS, 2021). Recent data from a monitoring station in East Branch Westport River shows the mean TN concentration decreased to 0.51 mg/L between 2011 and 2017 (MACD 2021; Town of Westport 2020). This represents a 13% decrease in TN concentration when comparing means for the 2003–2009 period and the 2011–2017 period (MACD 2021; MEP 2013).

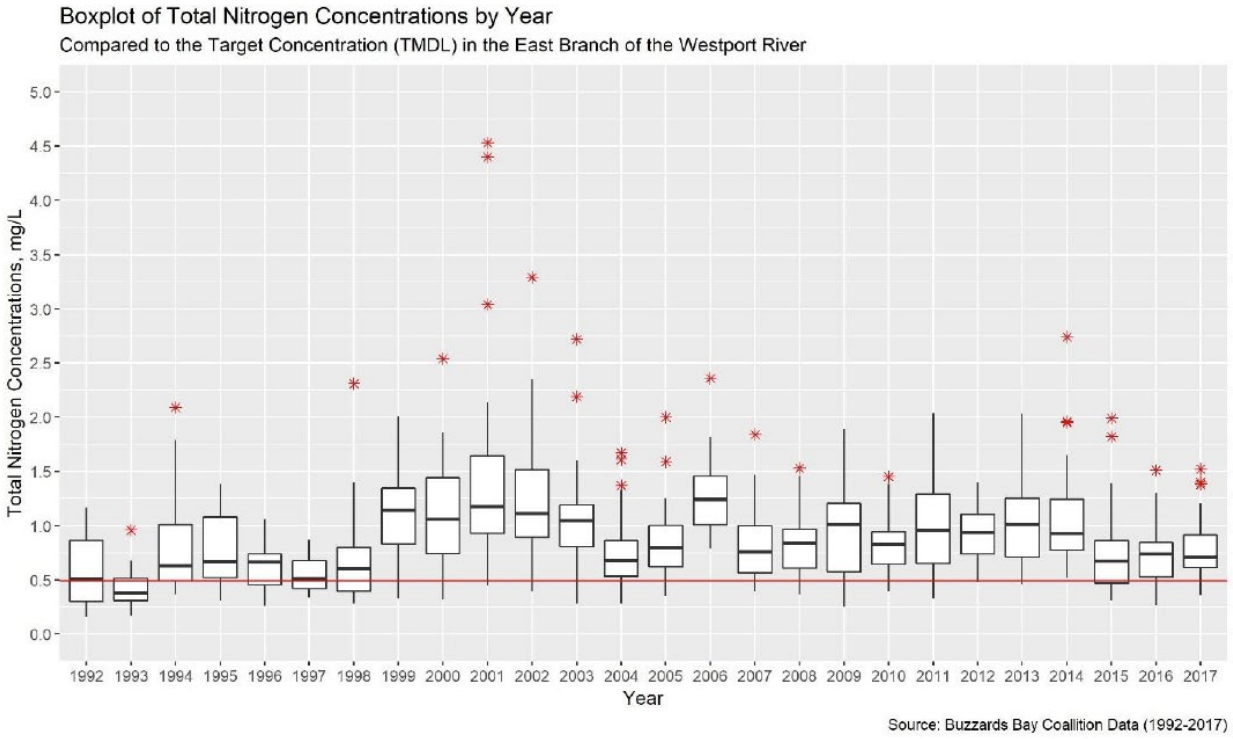


Figure A-4: TN concentrations from 1992–2017 compared to concentration (0.49 mg/L) set in the 2017 TMDL. Box and whisker plots show max and min (whiskers) and 25th, 50th, and 75th percentiles (box) (Adapted from NRCS, 2021)

Additional nutrient sampling data from BBC indicates a regional decrease in dissolved inorganic nitrogen (DIN) concentration since 2015 (see **Figure A-5**). Numerous factors including decreased use of inorganic fertilizers and reduced fossil fuel emissions have been suggested as potential reasons for the recent decline in DIN concentrations within the system. Some may be due to local actions ("controllable" sources such as improved land management practices, active stormwater management for water quality, and continuous septic system upgrades driven by standard Title V requirements) and other regional factors such as partial sewer installation upgradient in the town of Dartmouth or reduced atmospheric deposition based on air quality improvement (NRCS, 2021; Town of Westport 2020).

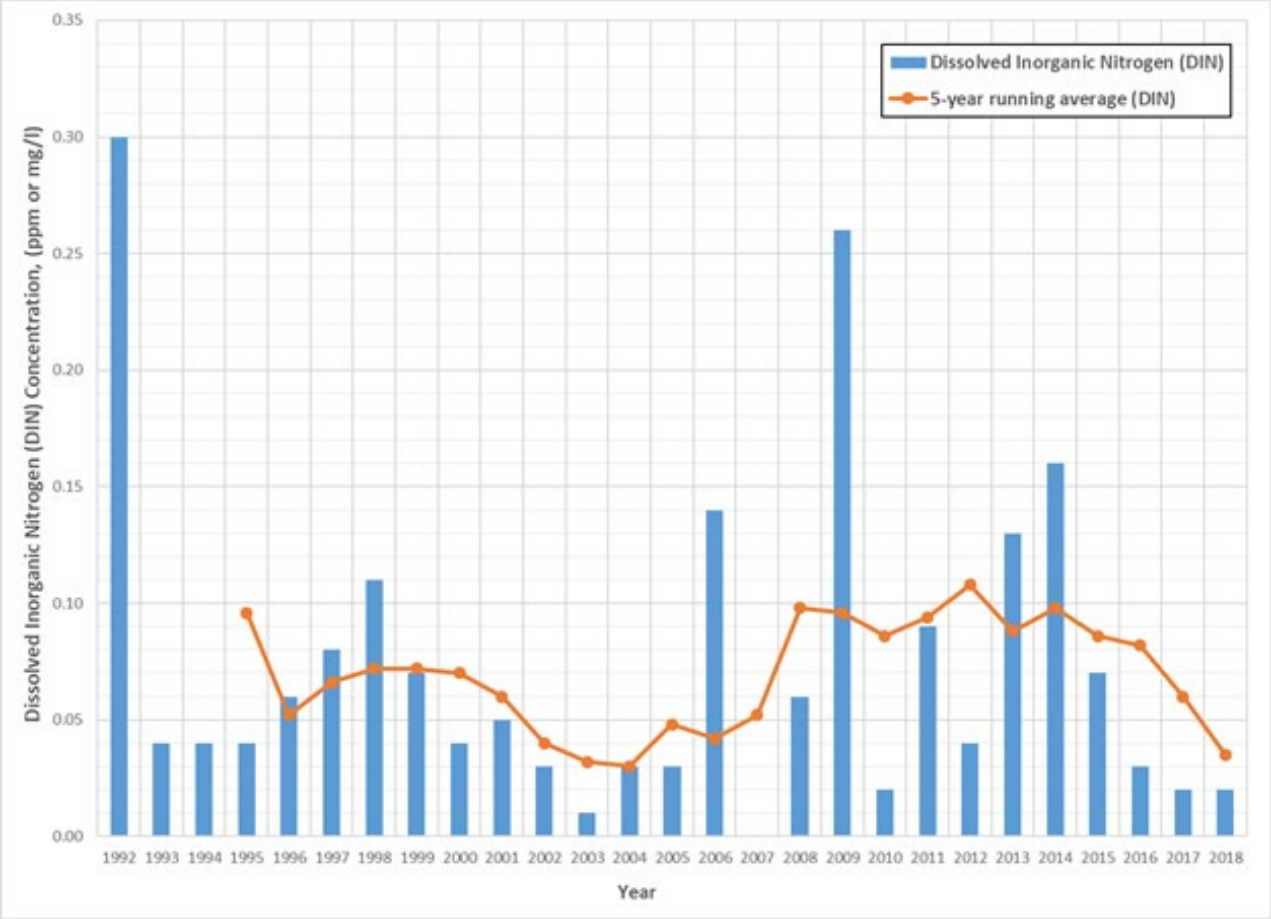


Figure A-5: Long-term DIN concentrations and the 5-year moving average on the East Branch (adapted from NRCS, 2021).

Bacteria

In its 2019 Water Quality Summary, the Westport River Watershed Alliance (WRWA) suggested that bacteria counts in the Westport River watershed has steadily improved over the past 10 years due to Title V septic improvements, better manure management and farming practices, and improved treatment and minimization of stormwater runoff (NRCS, 2021; WRWA, 2022). However, segments of the systems still fail to meet current recreational and shellfishing water quality criteria due to elevated levels of fecal indicator bacteria (NRCS, 2021; WRWA, 2022).

Figure A-6 displays FC monitoring data collected by WRWA during the summers of 2015–2019 as well as the shellfish FC criteria for coastal waters (see **Figure HI-2** in Element HI for monitoring locations). Generally, FC levels fall below (i.e., comply with) the criteria; however, there are some exceedances. This suggests the potential for episodic exceedances due to fecal waste loading from upland sources (NRCS, 2021; WRWA, 2022).

WRWA reports that bacteria levels are typically elevated during wet weather events in Westport River watershed. Conversely, bacteria levels are typically low during dry weather and the entire river is usually considered safe for swimming (NRCS, 2021; WRWA, 2022). This suggests that in-stream bacteria levels are mainly associated with precipitation-driven nonpoint sources of fecal bacteria from upland sources (NRCS, 2021).

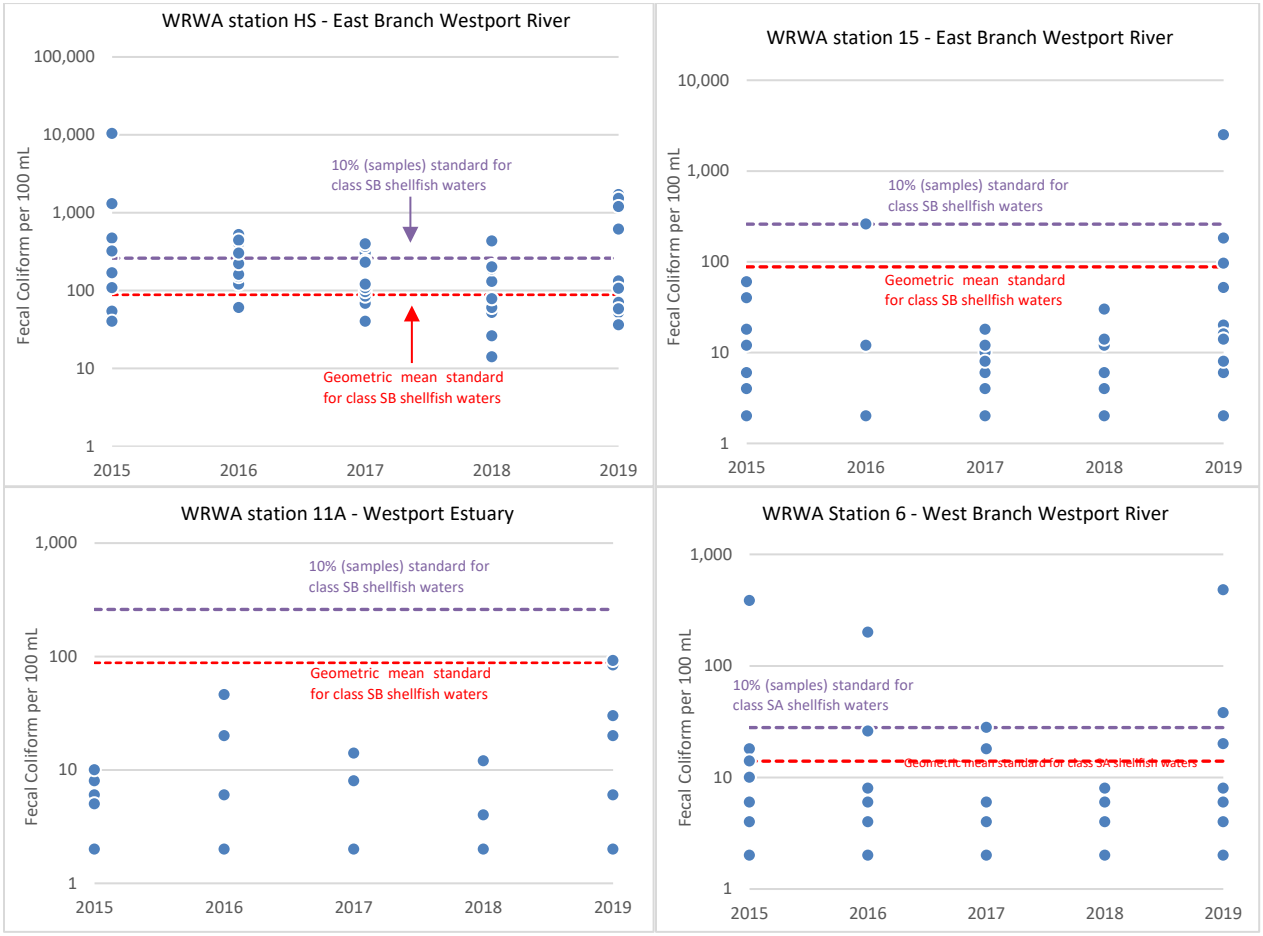


Figure A-6: Westport River Watershed Alliance FC monitoring data (summer 2015–2019) and associated shellfish waters criteria (classes SA and SB) for selected monitoring stations in Westport River watershed (Adapted from NRCS, 2021)

MassDEP Water Quality Monitoring Program Data

Historical and current Technical Memoranda (TM) produced by the MassDEP Watershed Planning Program are available here: Water Quality Technical Memoranda | Mass.gov and are organized my major watersheds in Massachusetts. Most of these TMs present the water chemistry and biological sampling results of WPP monitoring surveys. The TMs pertaining primarily to biological information (e.g., benthic macroinvertebrates, periphyton, fish populations) contain biological data and metrics that are currently not reported elsewhere. The data contained in the water quality TMs are also provided on the "Data" page (Water Quality Monitoring Program Data | Mass.gov). Many of these TMs have helped inform Clean Water Act 305(b) assessment and 303(d) listing decisions.

Water quality monitoring data for bacteria (*E. Coli*, Enterococci, and FC) is available for stream segments in the Westport River watershed mostly from the year 2005 and some data from 2006 as well as 2012 (MassDEP, 2022). TN data is available for stream segments in the watershed mostly from the year 2005 and TN data also available from 2013, 2014, 2015, and 2016 in Bread and Cheese Brook. **Figure HI-1** in Element HI of this WBP includes the locations of these monitoring stations. The data is presented **Appendix B** and indicates numerous exceedances of the Massachusetts Surface Water Quality Standards (MassDEP, 2013) for bacteria and exceedances of the TMDL target for TN (MassDEP, 2017) (presented in **Table A-6**).

Water Quality Goals

Based on the Westport River watershed impairments and water quality data identified above, water quality goals were identified for TN and bacteria and are listed in **Table A-6**. Element C of this WBP includes proposed management measures to address these water quality goals.

The water quality goals for bacteria are based on the Massachusetts Surface Water Quality Standards. The Massachusetts Surface Water Quality Standards (MassDEP, 2013) prescribe the minimum water quality criteria required to sustain a waterbody's designated uses. **Table A-5** includes the Massachusetts surface water classifications by assessment unit within the Westport River watershed (MassDEP, 2021).

The water quality goals for TN are based on the TN TMDL (MassDEP, 2017).

Table A-5: Surface Water Quality Classification by Assessment Unit (MassDEP, 2021)

Assessment Unit ID	Waterbody	Class
MA95-12	Shingle Island River	A
MA95-54	Westport River	SA
MA95-37	West Branch Westport River	SA
MA95-40	East Branch Westport River	B
MA95-41	East Branch Westport River	SB
MA95-43	Copicut River	A
MA95-44	Snell Creek	B
MA95-45	Snell Creek	B
MA95-59	Snell Creek	SA
MA95-57	Unnamed Tributary	B
MA95-58	Bread and Cheese Brook	B
MA95-73	Dunhams Brook	B
MA95-75	Unnamed Tributary	B
MA95-82	Kirby Brook	B
MA95-83	Angeline Brook	B
MA95-84	Unnamed Tributary	B

Table A-6: Water Quality Goals for Westport River Watershed

Pollutant	Goal	Source
Total Nitrogen (TN)	TN should not exceed: --0.49 mg/L for the East Branch Westport River and --0.48 mg/L for the West Branch Westport River	Westport River Estuarine System Total Maximum Daily Loads for Nitrogen (MassDEP, 2017)
Bacteria	**Class A Standards** • At water supply intakes in unfiltered public water supplies: either FC shall not exceed 20 FC organisms per 100 ml in all samples taken in any six-month period, or total coliform shall not exceed 100 organisms per 100 ml in 90% of the samples taken in any six-month period, If both FC and total coliform are measured, then only the FC criterion must be met. More stringent regulations may apply under the Massachusetts Drinking Water regulations, 310 CMR 22.00 (see 314 CMR 4.06(1)(d)1.); • At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml; • For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples, and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department **Class B Standards** • Public Bathing Beaches: For *E. coli*, geometric mean of 5 most recent samples shall not exceed 126 colonies/ 100 ml and no single sample during the bathing season shall exceed 235 colonies/100 ml. For enterococci, geometric mean of 5 most recent samples shall not exceed 33 colonies/100 ml and no single sample during bathing season shall exceed 61 colonies/100 ml; • Other Waters and Non-bathing Season at Bathing Beaches: For *E. coli*, geometric mean of samples from most recent 6 months shall not exceed 126 colonies/100 ml (typically based on min. 5 samples) and no single sample shall exceed 235 colonies/100 ml. For enterococci, geometric mean of samples from most recent 6 months shall not exceed 33 colonies/100 ml, and no single sample shall exceed 61 colonies/100 ml.	Massachusetts Surface Water Quality Standards (MassDEP, 2013)

Pollutant	Goal	Source
Bacteria (continued)	**Class SA Standards** • Waters designated for shellfishing: FC shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms/100 mL nor shall more than 10% of the samples exceed an MPN of 28 organisms/100 mL • Bathing beaches: no single enterococci sample taken during the bathing season shall exceed 104 colonies/100 mL, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 colonies/100 mL • Nonbathing beach waters and bathing beach waters during the nonbathing season: no single sample shall exceed 104 colonies/100 mL, and the geometric mean of all samples taken within the most recent 6 months typically based on five samples shall not exceed 35 colonies/100 mL **Class SB Standards** • Waters designated for shellfishing with depuration: FC "shall not exceed a median or geometric mean MPN of 88 organisms/100 mL nor shall more than 10% of the samples exceed an MPN of 260 organisms/100 mL • At bathing beaches and in nonbathing beach waters, the same criteria as Class SA apply. At bathing beach waters during the nonbathing season the same criteria as Class SA also apply	

Watershed Land Uses

Table A-7 provides a breakdown of the various land use classes within Westport River watershed. Agricultural areas make up approximately 8% of Westport River watershed and consist mainly of small cropland and pastureland parcels (NRCS, 2021 Griffith et al., 2009). Forested land (45%) covers the majority of the watershed. Upland forested land cover is mostly deciduous and mixed forest (e.g., central hardwoods, elm-ash-red maple, red and white pine). Coastal forests are made up of shrub layers and vines. Other land use types include developed land (13%), wetlands (22%), open water (7%), shrub/grassland (4%), and barren land (2%). **Figure A-7** shows land uses within the Westport River watershed drainage area (NRCS, 2021).

The 2017 USDA Agriculture Census indicates that there are 688 farms in Bristol County, Massachusetts, that operate on over 32,025 acres. Crops make up the majority of share of sales at 79%, with livestock, poultry, and products totaling the other 21%. Bristol County makes up 7% of Massachusetts's agriculture sales (NRCS, 2021; USDA NASS, 2017a). There are 196 farms (covering 9,713 acres) reported as operating in Newport County, Rhode Island. Crops make up the majority of share of sales at 63%. Livestock, poultry, and products total the other 37%. The county makes up 33% of Rhode Island's agriculture sales (NRCS, 2021; USDA NASS, 2017b).

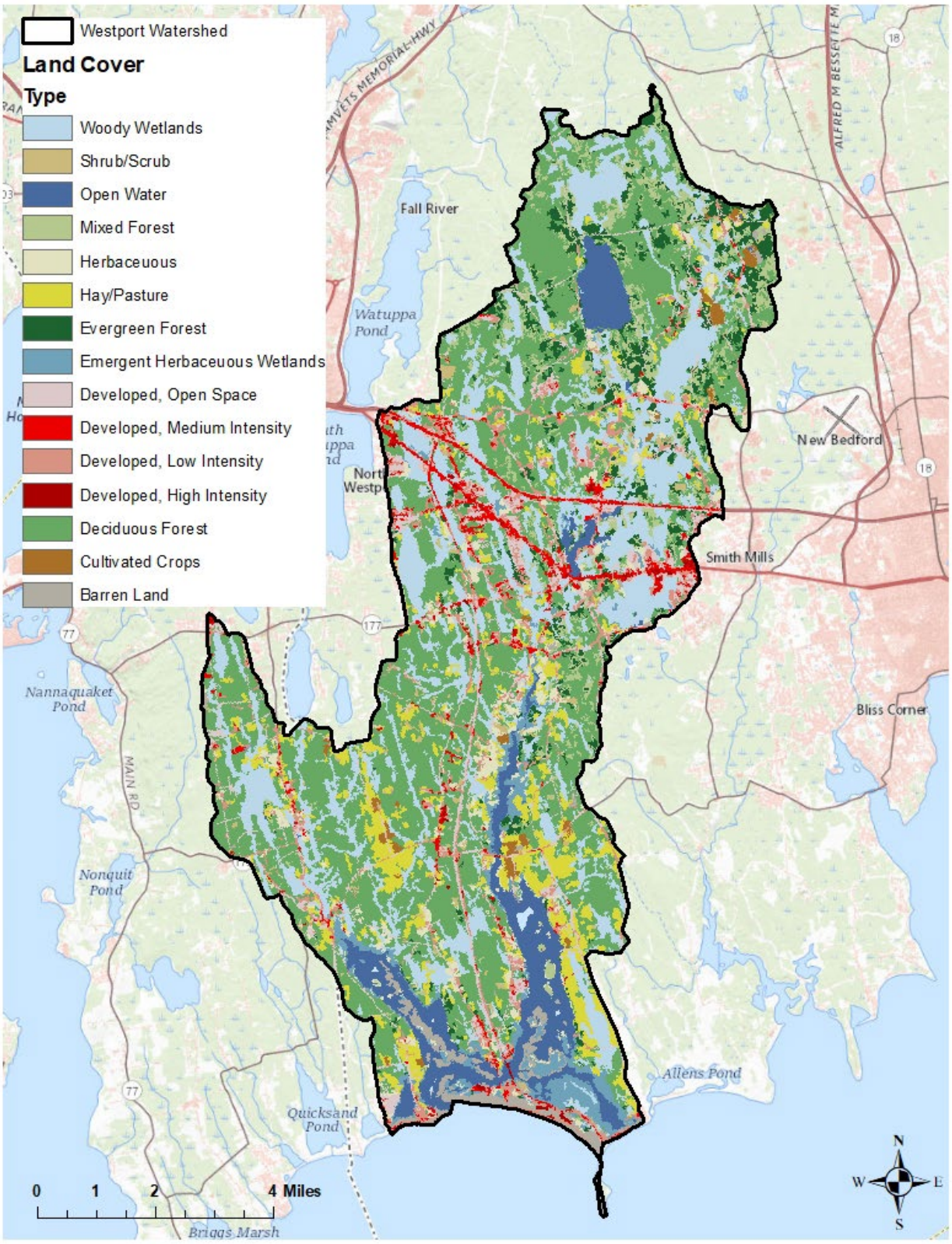


Figure A-7: Land use distribution across Westport River watershed (Adapted from NRCS, 2021; MRLC, 2011).

Table A-7: Area, coverage, and total active river area (in square miles) for each land use type in the Westport River watershed (Adapted from NRCS, 2021; MRLC, 2011)

Land use type	Area (mi^2)	Coverage (%)	Active river area (mi^2)
Deciduous forest	29.4	35	7.3
Woody wetlands	16.2	19.2	11.6
Pasture/hay	5.8	6.9	1.7
Open water	5.7	6.7	5.6
Developed, open space	4.6	5.5	1.3
Mixed forest	4.2	5.1	1.2
Evergreen forest	3.9	4.7	0.9
Developed, low intensity	3.8	4.5	1.0
Emergent herbaceous wetlands	2.5	3	2.4
Grassland/herbaceous	2.5	3	1.0
Developed, medium intensity	2.2	2.6	0.6
Barren land (rock/sand/clay)	1.4	1.7	1.0
Shrub/scrub	0.8	1	0.2
Cultivated crops	0.6	0.7	0.2
Developed, high intensity	0.3	0.4	0.1
Total	84.1	100	36.0

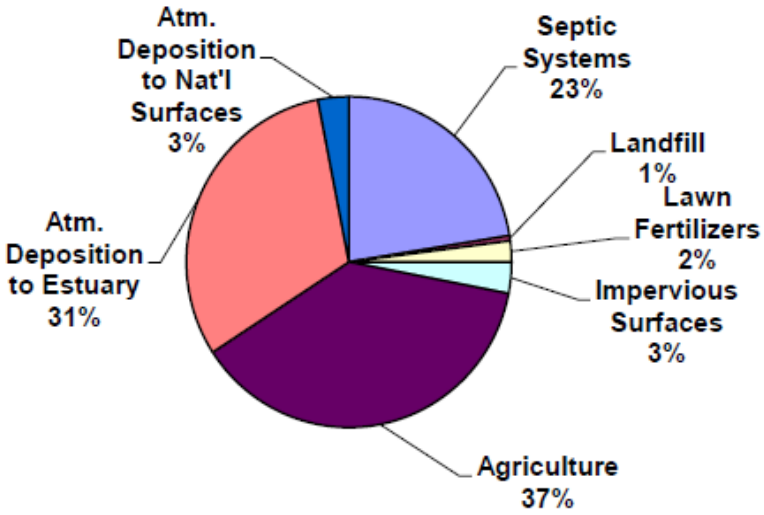
Notes:
mi^2 = square miles
[1] Active river area includes material contribution zones, meander belts, floodplains, terraces, and riparian wetlands

Pollutant Loading

Total Nitrogen

Figure A-8(a) displays the sources of TN to the Westport River watershed, and Figure A-3(b) shows only the controllable sources. The highest TN loading from controllable sources is from agricultural activities (57%, e.g., fertilizer and livestock manure) and septic systems (34%). Other sources include runoff from impervious surfaces (5%), lawn fertilizers (3%), and landfills (1%) (MEP, 2013; MassDEP, 2017; NRCS, 2021). The Massachusetts Estuaries Project (MEP) study (MEP, 2013) determined that sediments did not contribute a significant amount of TN to this system. Atmospheric TN deposition to the estuary and watershed surface area was found to be significant (34% of the total load); however, this source is considered uncontrollable (MEP, 2013; MassDEP, 2017; NRCS, 2021).

(a) All N sources



(b) Controllable N sources

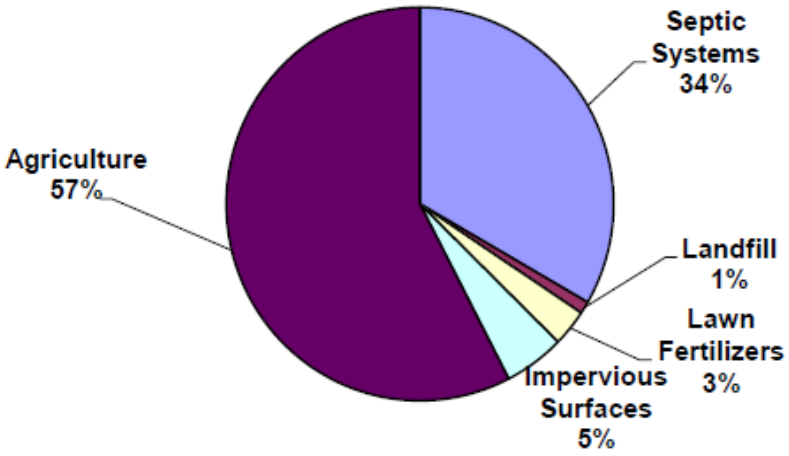


Figure A-8: Percent contributions of all N sources and controllable N sources to Westport River watershed (MEP, 2013; MassDEP, 2017; NRCS, 2021).

A subwatershed breakdown of TN loading, by source, is presented in **Table A-8** (NRCS, 2021; MassDEP, 2017). The total attenuated watershed load, which includes fertilizer, agriculture, runoff, landfills, atmospheric deposition, and wastewater is 488 kilograms per day (kg/day) or 392,687 pounds per year (lbs/year).

Table A-8: Nitrogen loadings (kilograms [kg] N/day) to Westport River watershed (adapted from MEP, 2013; MassDEP, 2017)

Sub-embayment	Septic system load	Agriculture load (unattenuated)	Total attenuated watershed load[1]	Atmospheric deposition[2]	Benthic flux[3]	TN load: all sources[4]
Old County Road	48.3	62.4	162.6	-	-	162.6
Kirby Brook	7.8	5.5	21.0	-	-	21.0
Snell Creek	4.6	1.0	8.1	-	-	8.1
North East Branch	9.3	84.5	103.1	4.4	-30.4	75.5
South East Branch	15.9	14.6	62.3	20.9	-16.7	63.4
The Let	1.5	1.5	5.8	2.0	11.8	19.5
Angeline Creek	3.1	24.0	34.3	-	-	34.3
Adamsville Brook	17.1	13.5	47.6	-	-	47.6
West Branch	6.5	21.9	32.9	11.2	-6.3	37.8
Westport Harbor	6.6	1.3	10.3	8.2	-30.5	-12.0
System total	120.5	230.1	488.0	46.6	-72.0	457.8

Notes:

[1] Includes fertilizer, agriculture, runoff, landfills, atmospheric deposition to lakes and natural surfaces, and wastewater from Table ES-1 in the MEP Technical Report (MEP, 2013). Note the total watershed load is based on yearly loads with the exception of Old County Road, which is based on measured summer loads (see Table IV- 3, Howes et al. 2014, pg. 63).

[2] Atmospheric deposition to the estuarine surface only.

[3] Nitrogen loading from sediments.

[4] Composed of fertilizer, agriculture, runoff, landfills, wastewater, atmospheric deposition, and benthic nitrogen input.

Bacteria

Table A-9 summarizes potential bacteria sources based on information from the 2009 pathogen TMDL (MassDEP et al., 2009). As also indicated in the 303(d) list (see **Table A-3**), bacteria associated with fecal waste are primarily linked to upland agricultural and human sources in the Westport River watershed. However, quantitative estimates of indicator bacteria contributions from the various sources in the watershed have not been calculated to date because many of the sources are diffuse and intermittent—this makes sources difficult to monitor or accurately model (NRCS, 2021; MassDEP et al., 2009).

Table A-9: Potential sources of bacteria in pathogen impaired segments of Westport River watershed (adapted from NRCS, 2021; MassDEP et al., 2009)

Segment	Segment name	Potential sources	Bacterial water quality criteria classes
MA95-54	Westport River	MS4	Class SA
MA95-40	East Branch Westport River	MS4, highway/road runoff, animal feeding operations	Class B
MA95-41	East Branch Westport River	Animal feeding operation, dairy outside milk parlor area, grazing in riparian zone, MS4, on-site septic systems, highway/road runoff	Class SB
MA95-44	Snell Creek	MS4, on-site septic systems, highway/road runoff	Class B
MA95-45	Snell Creek	MS4, on-site septic systems, highway/road runoff	Class B
MA95-59	Snell Creek	MS4, on-site septic systems, highway/road runoff	Class SA
MA95-37	West Branch Westport River	MS4	Class SA
MA95-58	Bread and Cheese Brook	MS4, livestock	Class B

Element B: Determine Pollutant Load Reductions Needed to Achieve Water Quality Goals

Element B of your WBP should:

Determine the pollutant load reductions needed to achieve the water quality goals established in Element A. The water quality goals should incorporate Total Maximum Daily Load (TMDL) goals, when applicable. For impaired water bodies, a TMDL establishes pollutant loading limits as needed to attain water quality standards.

Estimated Pollutant Loads

The estimated TN pollutant load (488 kg/day or 392,687 lbs/year) for the Westport River watershed was previously presented in **Table A-8** of this WBP. As stated in Element A, bacteria loading has not been estimated, because many of the sources are diffuse and intermittent making it difficult to monitor or accurately model (NRCS, 2021; MassDEP et al., 2009).

Water Quality Goals and Required Load Reduction

As discussed in Element A, water quality goals for this WBP are focused on reducing TN and bacteria loading in the Westport River watershed. TN water quality goals from this WBP are based on criteria from the TN TMDL (MassDEP, 2017) (see **Table B-1**). The TMDL established an overall 18.3 percent load reduction goal of approximately 89.1 kg/day (71,698 lbs/year) for the Westport River watershed. The MEP study (MEP, 2013) found agricultural activities the largest contributor of TN in the watershed (57% of the controllable load as compared to 34% from septic systems) (MassDEP, 2017). Bacteria water quality goals of this WBP are based on the Massachusetts Surface Water Quality Standards (MassDEP, 2013) and are concentration-based (see **Table B-2**).

Table B-1: Total Nitrogen (TN) Load Reductions Needed for Westport River Watershed (MassDEP, 2017)

Sub-embayment	Present Watershed Load (kg/day)	Target Watershed Load (kg/day)	Percent Watershed Load Reductions Needed to Achieve Target
Old County Road	162.6	111.8	-31.2%
Kirby Brook	21.0	13.2	-37.2%
Snell Creek	8.1	3.6	-56.0%
North East Branch	103.1	93.0	-9.8%
South East Branch	62.3	46.5	-25.4%
The Let	5.8	5.8	0.0
Angeline Creek	34.3	34.3	0.0
Adamsville Brook	47.6	47.6	0.0
West Branch	32.9	32.9	0.0
Westport Harbor	10.3	10.3	0.0
System total	488.0	398.9	-18.3%

Table B-2: Bacteria Water Quality Goals for Westport River Watershed (MassDEP, 2013; MassDEP, 2017; MassDEP, 2021)

Assessment	Waterbody	Class	Water Quality Goal (MassDEP, 2013)
MA95-12	Shingle Island River	A	**Class A Standards** • At water supply intakes in unfiltered public water supplies: either FC shall not exceed 20 FC organisms per 100 ml in all samples taken in any six-month period, or total coliform shall not exceed 100 organisms per 100 ml in 90% of the samples taken in any six month period, If both FC and total coliform are measured, then only the FC criterion must be met. More stringent regulations may apply under the Massachusetts Drinking Water regulations, 310 CMR 22.00 (see 314 CMR 4.06(1)(d)1.); • At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml; • For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples, and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department
MA95-43	Copicut River	A	
MA95-40	East Branch Westport River	B	**Class B Standards** • Public Bathing Beaches: For *E. coli*, geometric mean of 5 most recent samples shall not exceed 126 colonies/ 100 ml and no single sample during the bathing season shall exceed 235 colonies/100 ml. For enterococci, geometric mean of 5 most recent samples shall not exceed 33 colonies/100 ml and no single sample during bathing season shall exceed 61 colonies/100 ml; • Other Waters and Non-bathing Season at Bathing Beaches: For *E. coli*, geometric mean of samples from most recent 6 months shall not exceed 126 colonies/100 ml (typically based on min. 5 samples) and no single sample shall exceed 235 colonies/100 ml. For enterococci, geometric mean of samples from most recent 6 months shall not exceed 33 colonies/100 ml, and no single sample shall exceed 61 colonies/100 ml.
MA95-44	Snell Creek	B	
MA95-45	Snell Creek	B	
MA95-57	Unnamed Tributary	B	
MA95-58	Bread and Cheese Brook	B	
MA95-73	Dunhams Brook	B	
MA95-75	Unnamed Tributary	B	
MA95-82	Kirby Brook	B	
MA95-83	Angeline Brook	B	

Assessment	Waterbody	Class	Water Quality Goal (MassDEP, 2013)
MA95-84	Unnamed Tributary	B	
MA95-54	Westport River	SA	**Class SA Standards** • Waters designated for shellfishing: FC shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms/100 mL nor shall more than 10% of the samples exceed an MPN of 28 organisms/100 mL • Bathing beaches: no single enterococci sample taken during the bathing season shall exceed 104 colonies/100 mL, and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 colonies/100 mL • Nonbathing beach waters and bathing beach waters during the nonbathing season: no single sample shall exceed 104 colonies/100 mL, and the geometric mean of all samples taken within the most recent 6 months typically based on five samples shall not exceed 35 colonies/100 mL
MA95-37	West Branch Westport River	SA	
MA95-59	Snell Creek	SA	
MA95-41	East Branch Westport River	SB	**Class SB Standards** • Waters designated for shellfishing with depuration: FC "shall not exceed a median or geometric mean MPN of 88 organisms/100 mL nor shall more than 10% of the samples exceed an MPN of 260 organisms/100 mL • At bathing beaches and in nonbathing beach waters, the same criteria as Class SA apply. At bathing beach waters during the nonbathing season the same criteria as Class SA also apply

Element C: Describe management measures that will be implemented to achieve water quality goals

Element C: A description of the nonpoint source management measures needed to achieve the pollutant load reductions presented in Element B, and a description of the critical areas where those measures will be needed to implement this plan.

Ongoing Management Measures

Westport River Agricultural Nonpoint Source Program (MACD, 2018)

As presented in Element A and B, pollutant load modeling conducted by MEP (MEP, 2013) concluded that agricultural activities are the largest contributor of TN in the watershed (57% of the controllable load) (MassDEP, 2017). MACD was awarded Fiscal Year 2019 Section 319 grant funding for its "Westport River Agricultural Nonpoint Source Program", which includes implementing watershed-wide farm conservation practices and agricultural BMPs in the Westport River watershed to contribute to addressing this loading. As part of this project, MACD is working with NRCS, Massachusetts Department of Agricultural Resources (MDAR), EPA, and MassDEP, and the Westport Agricultural Commission to encourage agricultural operations within the watershed to take voluntary actions to minimize impacts on water quality through the development and implementation of NRCS designed and engineered BMPs such as manure management or construction of waste facilities. MACD's general strategy is to apply the following adaptive management framework as a cooperative effort with the stakeholders listed above as well as private organizations and the public:

- First, assess the problem;
- Next, design solutions;
- Next, implement BMPs;
- Next, monitor and evaluate results; and
- Finally, adjust to help achieve proposed outcomes.
-

To complete the Westport River Agricultural Nonpoint Source Program, the MACD team will:

- Conduct outreach and education with farmers in the Westport River watershed to solicit interest in the program;
- Develop NRCS approved conservation plans outlining BMPs to reduce pollutant runoff;
- Assist landowners to obtain access to financial resources; and
- Ensure farmers prepare operation and maintenance plans.

Agricultural lands in the Westport River watershed are identified in **Figure C-1**.

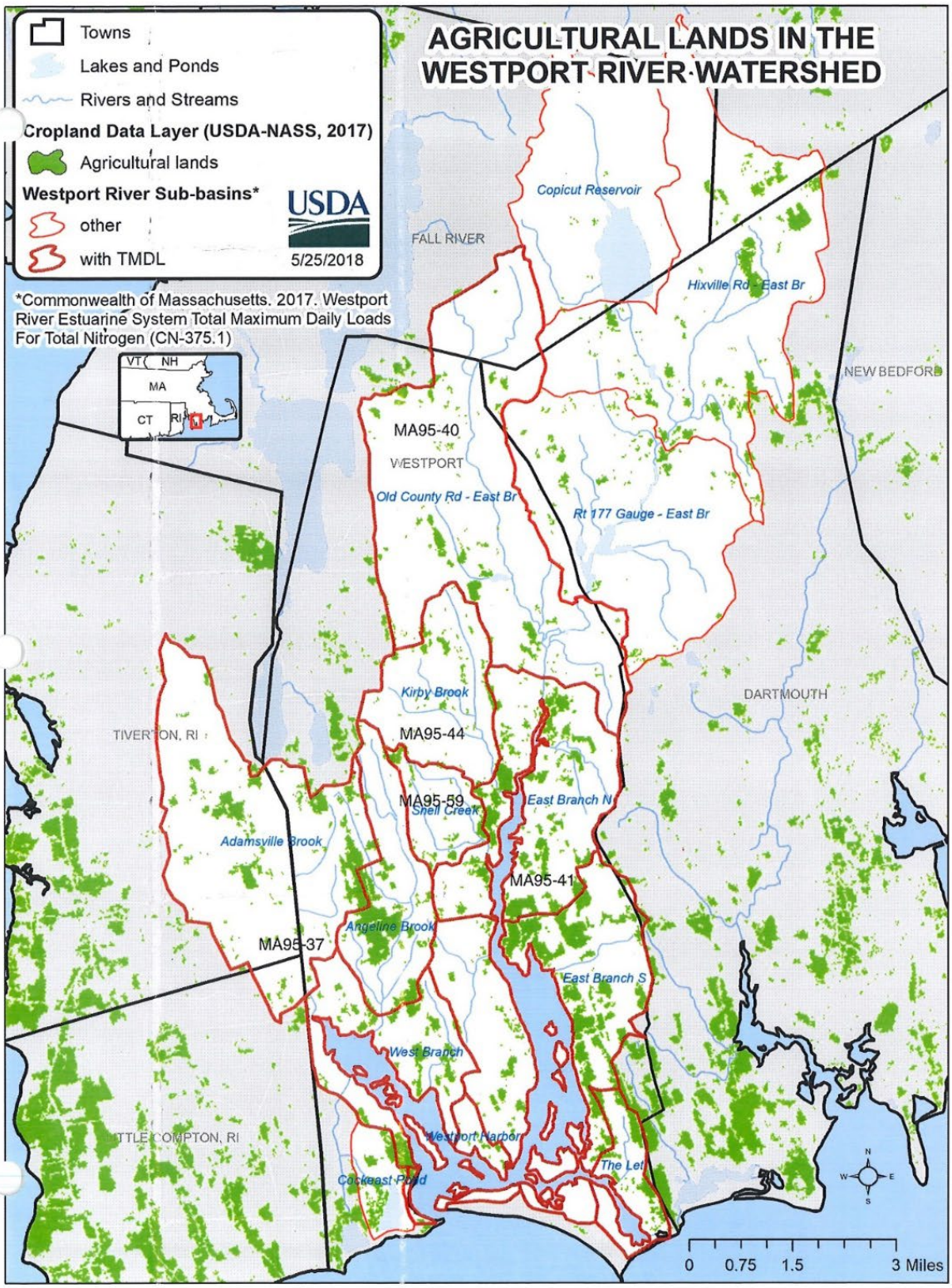


Figure C-1: Agricultural Lands in the Westport River Watershed (adapted from MACD, 2018)

Future Management Measures

Critical Source Areas Identified from Modeling

Catchment Classifications

As part of the NWQI assessment (NRCS, 2021), the Model My Watershed (MMW) application (MapShed) was used to estimate mass loadings by land use within the two Hydrologic Unit Code (HUC)-12 watersheds of the Westport River watershed as well as to identify catchments with higher nutrient loadings. Soil drainage classes based on the Soil Survey Geographic (SSURGO) database for agricultural land provided another level of focus to prioritize areas within the catchments that were more vulnerable to runoff or subsurface loss of pollutants. Critical source areas within Westport River watershed were assessed using pollutant loading rates from MMW, land use data, and soil drainage classes. Attenuated loading rates (lbs TN/acre) from MMW were used to identify areas to which management measures could be prioritized. Catchment loading rates for TN (estimated by MMW) were used to create a set of ranges to designate priorities. The catchment categorization based on TN loading rates was as follows (NRCS, 2021):

- High priority catchments: > 4 lbs TN/acre
- Medium priority catchments: 2.5–4 lbs TN/acre
- Low priority catchments: < 2.5 lbs TN/acre

Figure C-2 displays the priority level assigned of individual catchments in Westport River watershed. There were 40 “high priority catchments” catchments identified in the watershed. There were 40 catchments that were classified as medium priority. There were 57 catchments classified as low priority (NRCS, 2021).

Note, the catchment priority designations are based on best professional judgement and were developed using catchment loading rates simulated by MMW only. The priority designations are simply intended to help target and identify catchments where management measures may be needed most in the watershed. Specific sites for BMP installation in the priority catchments should be identified via site level surveys, which may include visual assessments, local knowledge, windshield surveys, or other more detailed approaches.

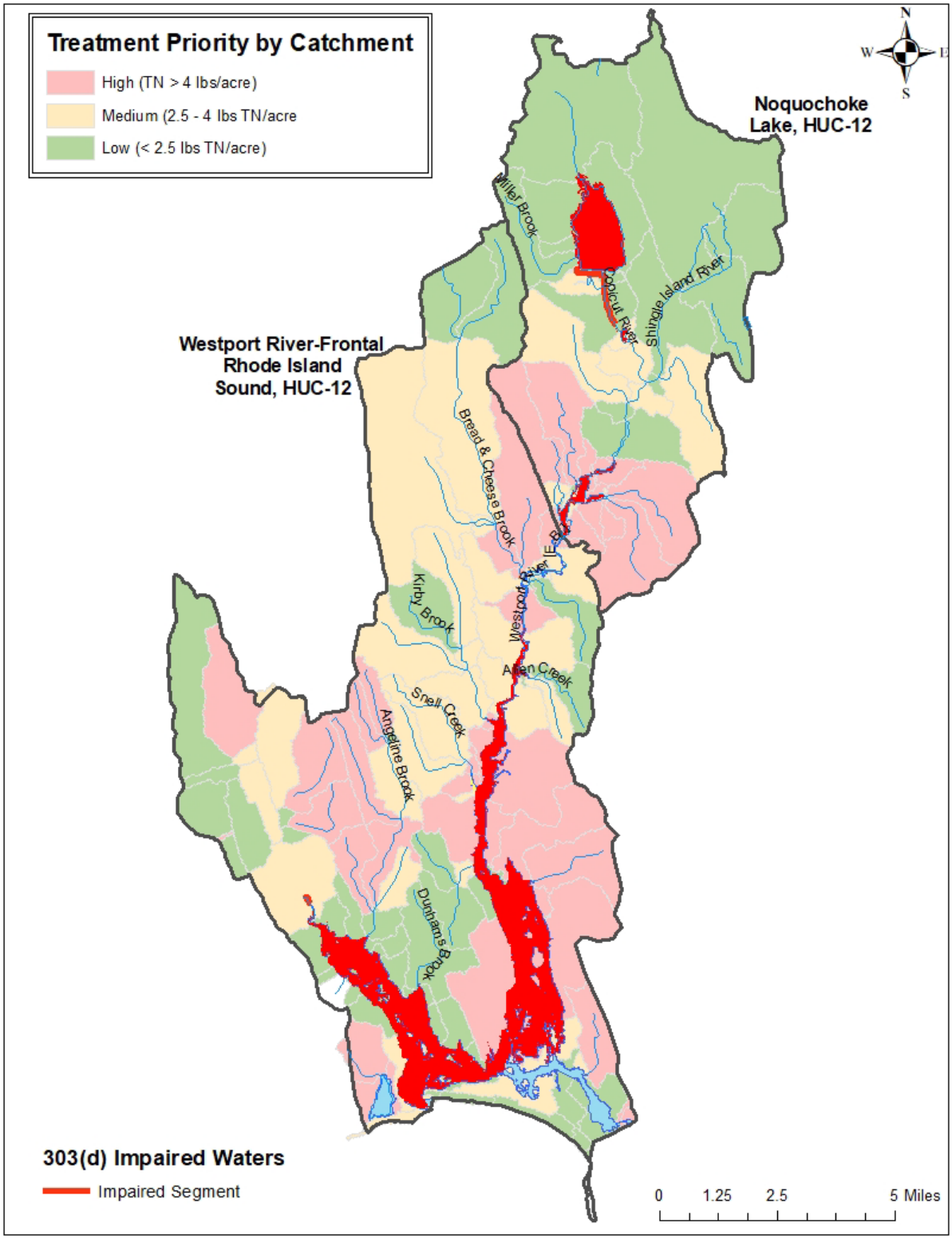


Figure C-2: Treatment priority categorization of Westport River watershed catchments based on TN loading rates. Note: Impairments in Copicut Reservoir and Copicut River are for mercury in fish tissue (adapted from NRCS, 2021)

Pollutant Loss Potential

As part of the NWQI assessment (NRCS, 2021) **Table C-1** summarizes the area of agricultural land and associated runoff/subsurface loss potential within different catchment priority categories (from **Figure C-2**). Most of the agricultural land in high priority catchments has moderate runoff potential. Thirteen percent of the agricultural land in medium priority catchments has high runoff potential.

Subsurface flow is a key source of TN losses based on the MMW results (27–60% of TN losses). The subsurface loss summary indicates that 700 acres of agricultural land (~18%) are susceptible to high subsurface losses. The MMW results show that an estimated 366 acres of this agricultural land are in high priority catchments.

Figure C-1: Agricultural land areas and loss potential for catchment priority categories (adapted from NRCS, 2021)

Catchment information	High priority (>4 lbs TN/ac)		Medium priority (2.5–4 lbs TN/ac)		Low priority (<2.5 lbs TN/ac)	
HUC-12	**NL**	**WR-FRIS**	**NL**	**WR-FRIS**	**NL**	**WR-FRIS**
Total area in acres	**3,730**	**12,661**	**2,504**	**13,326**	**11,304**	**10,392**
Agricultural area in acres						
Total	**94**	**2,283**	**170**	**852**	**407**	**346**
[1]High runoff potential	12	343	18	114	97	29
[2]Moderate runoff potential	73	1,529	56	567	121	272
[3]High subsurface loss potential	3	363	62	128	118	26
[4]No class assigned	5	49	34	41	72	20

Notes:

NL = Noquochoke Lake HUC-12 watershed; WR-FRIS = Westport River-Frontal Rhode Island Sound HUC-12 watershed

[1] High runoff potential: soils drainage classes "very poorly drained" and "poorly drained."

[2] Moderate runoff potential: other soil drainage classes (e.g., well drained, moderately well drained).

[3] High subsurface loss potential: soils drainage classes "excessively drained" and "somewhat excessively drained."

[4] No class assigned: no drainage class given.

Figure C-3 displays the spatial locations of these areas within "high priority" and "medium priority" catchments in both HUC-12s. This map helps to identify agricultural land areas where management measures could be focused in order to meet water quality objectives for nutrients, sediment, and bacteria. Overall, results suggest that management measures should be focused in the area of the "WR-FRIS" HUC-12 watershed, where agricultural operations are more widespread.

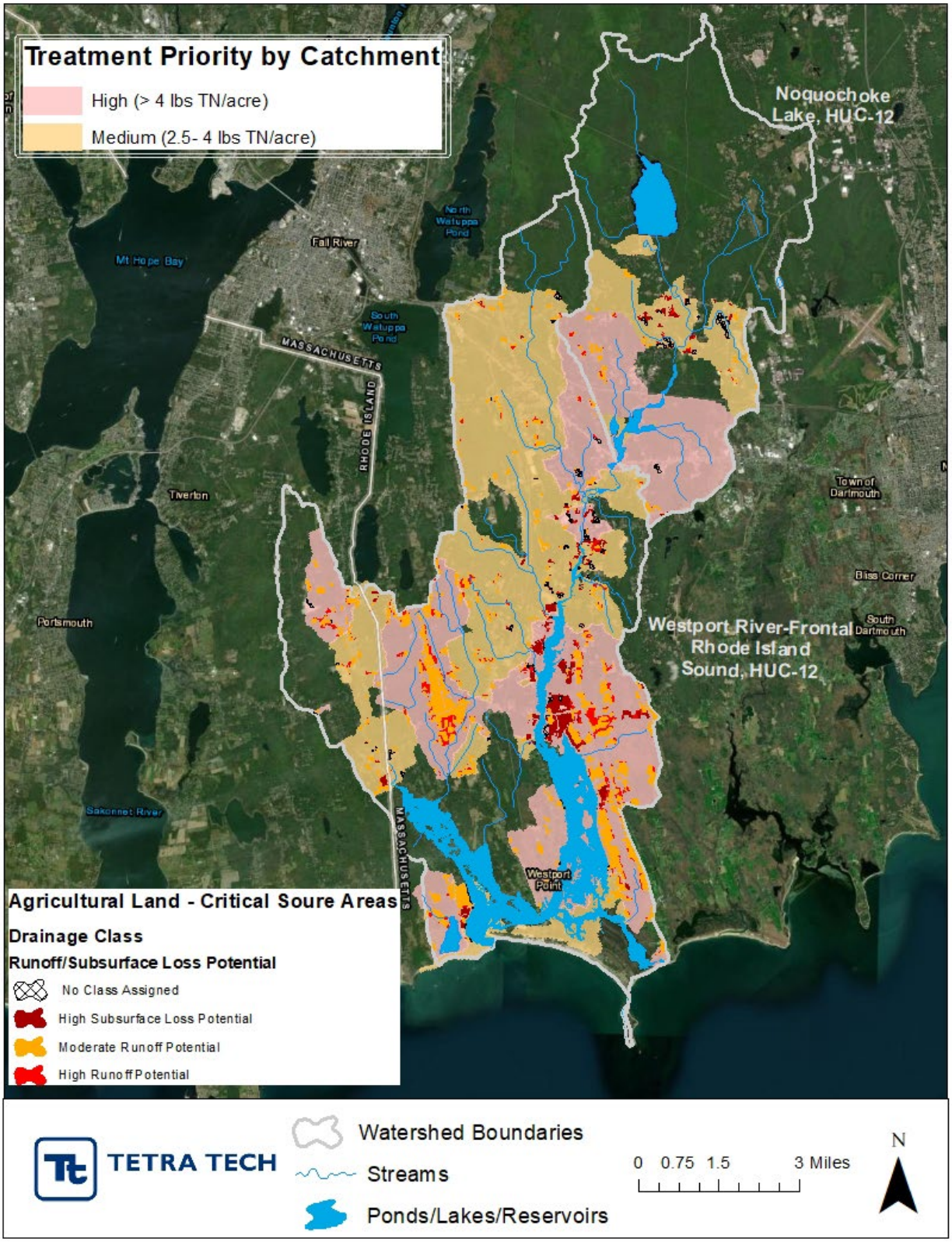


Figure C-3: Critical TN source areas within "high priority and "medium priority" catchments from Westport River watershed (adapted from NRCS, 2021)

Identification of Priority Locations for Structural BMPs.

Implementing agricultural BMPs, along with incorporating structural BMPs (e.g., low impact development practices) on new and existing development, and investigation and remediation of potential other sources such as failing septic systems will be necessary to achieve a measurable and sustainable improvement in water quality in the Westport River watershed. The following general sequence is recommended to identify and implement future structural BMPs. Note this approach applies largely to non-agricultural BMPs as MACD's project is to build relationships with the agricultural community, which would guide any future agricultural BMP implementation.

1. **Identify Potential Implementation Locations:** Perform a desktop analysis using aerial imagery and GIS data to develop a preliminary list of potentially feasible implementation locations based on land use; soil type (i.e., hydrologic soil groups A and B); available public open space (e.g., lawn area in front of a police station); potential redevelopment sites where additional public-private partnerships may be leveraged; and other factors such as proximity to receiving waters, known problem areas, or publicly owned right of ways or easements. See BMP Hotspot Map analysis below, which helps identify potential implementation locations.

2. **Visit Potential Implementation Locations:** Perform field reconnaissance, preferably during a period of active runoff-producing rainfall, to evaluate potential implementation locations, gauge feasibility, and identify potential BMP ideas. During field reconnaissance, assess identified locations for space constraints, potential accessibility issues, presence of mature vegetation that may cause conflicts (e.g., roots), potential utility conflicts, site-specific drainage patterns, and other factors that may cause issues during design, construction, or long-term maintenance.

3. **Develop BMP Concepts:** Once potential BMP locations are conceptualized, use the BMP-selector tool on the watershed-based planning tool to help develop concepts. Concepts can vary widely. One method is to develop 1-page fact sheets for each concept that includes a site description, including definition of the problem, a description of the proposed BMPs, annotated site photographs with conceptual BMP design details, and a discussion of potential conflicts such as property ownership, O&M requirements, and permitting constraints. The fact sheet can also include information obtained from the BMP-selector tool including cost estimates, load reduction estimates, and sizing information (i.e., BMP footprint, drainage area, etc.).

4. **Rank BMP Concepts:** Once BMP concepts are developed, perform a priority ranking based on site-specific factors to identify the implementation order. Ranking can include many factors including cost, expected pollutant load reductions, implementation complexity, potential outreach opportunities and visibility to public, accessibility, expected operation and maintenance effort, and others. Prioritized BMP concepts should focus on reducing TN and bacteria loading to Westport River watershed as summarized by **Element B.**

BMP Hotspot Map

An additional GIS-based analysis[1] was performed within the watershed[2] to help identify high priority parcels for BMP (also referred to as management measure) implementation:

- Each parcel within the watershed was evaluated based on ten different criteria accounting for the parcel ownership, social value, and implementation feasibility (See **Table C-2** for more detail below);

[1] GIS data used for the BMP Hotspot Map analysis included: MassGIS (2015a); MassGIS (2015b); MassGIS (2017a); MassGIS (2017b); MassGIS (2020); MA Department of Revenue Division of Local Services (2016); MassGIS (2005); ArcGIS (2020a); MassGIS (2009b); MassGIS (2012); MassGIS (2021); and ArcGIS (2020b).

[2] This analysis was conducted using the MassDEP's Watershed-Based Planning Tool (WBP Tool) and the watershed delineation boundary is slightly different than the delineation presented in the NWQI assessment.

- Each criterion was then given a score from 0 to 5 to represent the priority for BMP implementation based on a metric corresponding to the criterion (e.g., a score of 0 would represent lowest priority for BMP implementation whereas a score of 5 would represent highest priority for BMP implementation);
- A multiplier was also assigned to each criterion, which reflected the weighted importance of the criterion (e.g., a criterion with a multiplier of 3 had greater weight on the overall prioritization of the parcel than a criterion with a multiplier of 1); and
- The weighted scores for all the criteria were then summed for each parcel to calculate a total BMP priority score.

Table C-2 presents the criteria, indicator type, metrics, scores, and multipliers that were used for this analysis. Parcels with total scores above 60 are recommended for further investigation for BMP implementation suitability. **Figure C-4** presents the resulting BMP Hotspot Map for the Westport River watershed. The following link includes a Microsoft Excel file with information for all parcels that have a score above 60: hotspot spreadsheet.

This analysis solely evaluated individual parcels for BMP implementation suitability and likelihood for the measures to perform effectively within the parcel's features. This analysis does not quantify the pollutant loading to these parcels from the parcel's upstream catchment. When further evaluating a parcel's BMP implementation suitability and cost-effectiveness of BMP implementation, the existing pollutant loading from the parcel's upstream catchment and potential pollutant load reduction from BMP implementation should be evaluated.

Table C-2: Matrix for BMP Hotspot Map GIS-based Analysis

Criteria	Indicator Type	METRICS																										Multiplier	Maximum Potential Score
		Yes or No?		Hydrologic Soil Group				Land Use Type								Water Table Depth				Parcel Area			Parcel Average Slope						
		Yes	No	A or A/D	B or B/D	C or C/D	D	Low and Medium Density Residential	High Density Residential	Commercial	Industrial	Highway	Agriculture	Forest	Open Land	Water	101-200 cm	62-100 cm	31-61 cm	0-30 cm	Greater than 2 acres	Between 1-2 acres	Less than 1 acre	Less than 2%	Between 2% and 15%	Greater than 15%	Less than 50%	Between 51% and 100%		
Is the parcel a school, fire station, police station, town hall or library?	Ownership	5	0																									2	10
Is the parcel's use code in the 900 series (i.e., public property or university)?	Ownership	5	0																									2	10
Is parcel fully or partially in an Environmental Justice Area?	Social	5	0																									2	10
Most favorable Hydrologic Soil Group within Parcel	Implementation Feasibility			5	3	0	0																					2	10
Most favorable Land Use in Parcel	Implementation Feasibility							1	2	4	2	4	5	1	4	X[1]												3	15
Most favorable Water Table Depth (deepest in Parcel)	Implementation Feasibility																5	4	3	0								2	10
Parcel Area	Implementation Feasibility																				5	4	1					3	15
Parcel Average Slope	Implementation Feasibility																							3	5	1		1	5
Percent Impervious Area in Parcel	Implementation Feasibility																										5	2.5	1	5
Within 100 ft buffer of receiving water (stream or lake/pond)?	Implementation Feasibility	5	2																									2	10

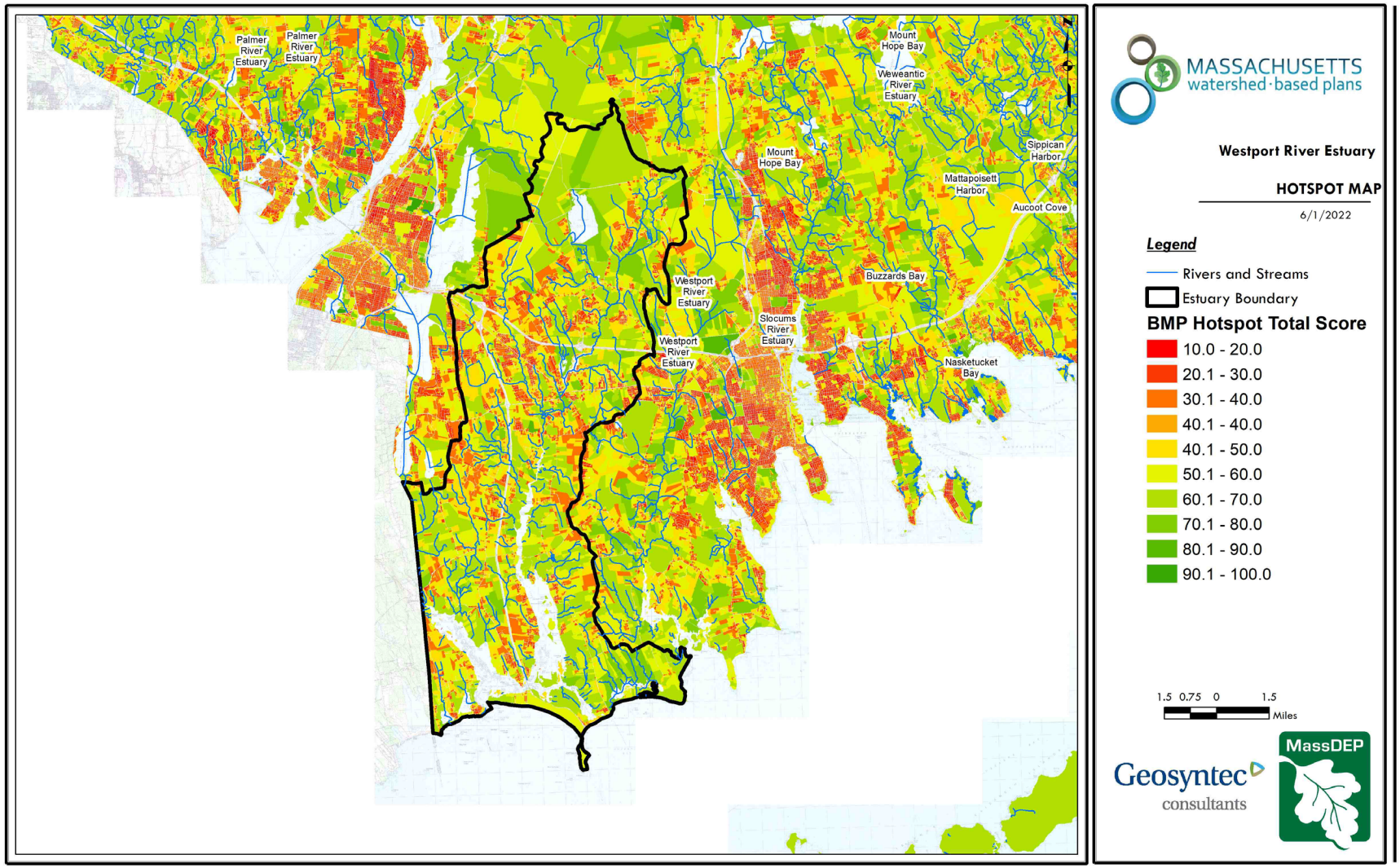


Figure C-4: BMP Hotspot Map (MassGIS (2015a), MassGIS (2015b), MassGIS (2017a), MassGIS (2017b), MassGIS (2020), MA Department of Revenue Division of Local Services (2016), MassGIS (2005), ArcGIS (2020a), MassGIS (2009b), MassGIS (2012), MassGIS (2021), ArcGIS (2020b))

(Ctrl + Click on the map to view a full-sized image in your web browser.)

Additional Non-structural BMPs

It is also recommended that nonstructural BMPs that the Towns of Westport, Dartmouth, Fall River, and Freetown in Massachusetts and the towns of Little Compton and Tiverton in Rhode Island currently implement, including street sweeping and catch basin cleaning, be evaluated, and potentially optimized for removal of TN and bacteria. First, it is recommended that potential pollutant load removals from ongoing activities be calculated in accordance with **Elements H and I** of this document. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions, such as increased frequency or improved technology.

Element D: Identify Technical and Financial Assistance Needed to Implement Plan

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.

Current Management Measures

Westport River Agricultural Nonpoint Source Program

The funding needed to implement the MACD Westport River Agricultural Nonpoint Source Program (described in **Element C**) is presented in **Table D-1** (MACD, 2018). The total cost for the program was estimated at $292,700.

Table D-1: Summary of Proposed BMPs Costs (Westport River Agricultural Nonpoint Source Program) (MACD, 2018)

Expense Item	s.319 Amount	Non-Federal Match and Source	Total Amount
Salary and Wages			
Conservation Farm Planners	$14,000	$50,000	$64,000
Project Coordinator	$8,000		$8,000
Sub-contractors	$141,700		$141,700
Supplies			
BMP Materials and Supplies	$10,500	$68,000	$78,500
Travel	$500	$0	$500
Totals	**$174,700**	**$118,000**	**$292,700**

Future Management Measures

Identification of Additional Management Measures

Funding for future BMP installations to further reduce loads within the watershed may be provided by a variety of sources including Section 319 funding, Massachusetts Environmental Trust (MET) grants, the Agricultural Environmental Enhancement Program (AEEP), the Agricultural Produce Safety Improvement Program (APSIP), Town and City capital funds, volunteer efforts, and NRCS grants including the Environmental Quality Incentives Program (EQIP) and the Agricultural Management Assistance (AMA) program. MACD has previously been successful with and will continue to pursue securing grant funding through various sources. Guidance is available to provide additional information on potential funding sources for nonpoint source pollution reduction efforts[3].

[3] Guidance on funding sources to address nonpoint source pollution: http://prj.geosyntec.com/prjMADEPWBP_Files/Guide/Element%20D%20-%20Funds%20and%20Resources%20Guide.pdf

Element E: Public Information and Education

Element E: Information and Education (I/E) component of the watershed plan used to:

1. Enhance public understanding of the project; and
2. Encourage early and continued public participation in selecting, designing, and implementing the NPS management measures that will be implemented.

A large component of the MACD Westport River Agricultural Nonpoint Source Program involves outreach to farmers (MACD, 2018). The components of the watershed public information and education program are described below. Additional outreach efforts will be determined when future management measures and activities are planned for implementation in the watershed. This section of the WBP will be updated when the plan is reevaluated in 2025 in accordance with elements F&G of this document.

Step 1: Goals and Objectives

The goals and objectives for the watershed information and education program.

1. Engage with residents/landowners in the watershed to share information as to efforts by NRCS, MDAR and others within the agricultural community to preserve and protect water quality
2. Provide information and incentives to farmers on funding resources for BMP implementation
3. Provide information about farm conservation plans and agricultural BMPs and their anticipated water quality benefits.
4. Provide information to promote watershed stewardship.

Step 2: Target Audience

Target audiences that need to be reached to meet the goals and objectives identified above.

1. Farm-owners in the watershed
2. Watershed organizations and other user groups, including the WRWA.
3. Businesses, schools, and local government within the watershed.
4. All watershed residents.

Step 3: Outreach Products and Distribution

The outreach product(s) and distribution form(s) that will be used for each.

1. MACD will conduct one-on-one outreach with farmers in the watershed.

2. WRWA provides information about the Westport River watershed on the WRWA website (Westport River Watershed Alliance - WRWA Westport, MA (westportwatershed.org) and host events and education programs (such as home school, summer, and scouts programs).

Step 4: Evaluate Information/Education Program

Information and education efforts and how they will be evaluated.

1. Track the number of materials and information, such as fact sheets and emails, and the size of the lists receiving these materials.
2. Track the farms who receive funding and from what sources.

Elements F & G: Implementation Schedule and Measurable Milestones

Element F: Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.

Element G: A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

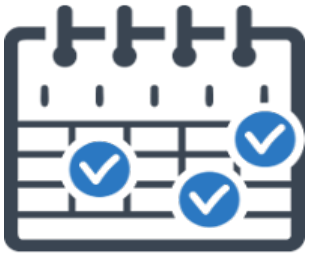


Table FG-1 provides a preliminary schedule for implementation of recommendations provided by this WBP. It is expected that the WBP will be re-evaluated and updated in 2025, or as needed, based on ongoing monitoring results and other ongoing efforts. New projects will be identified through future data analysis and stakeholder engagement and will be included in updates to the implementation schedule.

Table FG-1: Implementation Schedule and Interim Measurable Milestones

Category	Action	Cost Estimate	Year(s)
Monitoring	Perform water quality sampling at key locations along Westport River watershed segments as an expansion of the existing WRWA water quality monitoring program per Element H&I		2022 and annually
Westport River Agricultural Nonpoint Source Program	MACD team will: • conduct outreach and education with farmers in the Westport River watershed to solicit interest in the program; • develop NRCS approved conservation plans outlining BMPs to reduce pollutant runoff; • assist landowners to obtain access to financial resources; and • ensure farmers prepare operation and maintenance plans • conduct reporting and project oversight	$292,700	2022—2023
Nonstructural BMPs	Document potential pollutant removals from nonstructural BMPs (i.e., street sweeping, catch basin cleaning). The methodology is included in the 2016 Massachusetts Small MS4 Permit and in Elements H&I of this WBP.		2023
	Evaluate ongoing nonstructural BMPs and determine if modifications can be made to optimize pollutant removals (e.g., increase frequency).		2023
	Routinely implement optimized nonstructural BMPs.		Annual
Public Education and Outreach	MACD will conduct outreach and education activities, including one-on-one outreach to farmers		2022
	WRWA events and education programs		Annual
Adaptive Management and Plan Updates	Establish a working group that includes stakeholders and other interested parties to implement recommendations and track progress. Meet at least twice per year.		2022-2023
	Reevaluate WBP at least once every three years and adjust, as needed, based on ongoing efforts (e.g., based on monitoring results, 319 funding, etc.). – Next update, June 2025		2025
	Use monitoring results to reevaluate BMP effectiveness at reducing TN and bacteria and/or other indicator parameters in Westport River watershed and establish additional long-term reduction goal(s), if needed.		**2032**
	Delist Westport River watershed segments from the 303(d) list.		**2037**

Elements H & I: Progress Evaluation Criteria and Monitoring

Element H: A set of criteria used to determine (1) if loading reductions are being achieved over time and (2) if progress is being made toward attaining water quality goals. Element H asks "**how will you know if you are making progress towards water quality goals?**" The criteria established to track progress can be direct measurements (e.g., E. coli bacteria concentrations) or indirect indicators of load reduction (e.g., number of beach closings related to bacteria).

Element I: A monitoring component to evaluate the effectiveness of implementation efforts over time, as measured against the Element H criteria. Element I asks "**how, when, and where will you conduct monitoring?**"

The TN and bacteria water quality goals are presented in Element A and Element B of this WBP. Element C of this plan describes management measures that will be implemented to help achieve these targeted load reductions. The evaluation criteria and monitoring program described below will be used to establish a baseline and measure the effectiveness of the proposed management measures (described in Element C) in improving the water quality of the Westport River watershed and in making progress toward achieving the water quality goals.

Direct Measurements

The locations of MassDEP water quality monitoring stations in Westport River watershed are shown in **Figure HI-1**. Thirty-five locations have been monitored by MassDEP, and the sampling data (**see Appendix B**) have been used to inform several watershed assessments (NRCS, 2021).

The WRWA has been sampling water quality at 19 sites along Westport River since the 1990s. WRWA monitors the river for bacteria every week from the beginning of June to the end of August. WRWA has also coordinated with the BBC to collect water quality data throughout the watershed (see **Figure HI-2** for locations) (NRCS, 2021).

MEP also conducted long-term measurements of natural attenuation relating to the most significant surface water discharges to the estuary in addition to the natural attenuation measures by fresh kettle ponds. These site-specific studies were conducted in the five major surface water flow systems in Westport River watershed: (1) Westport River discharging from Lake Noquachoke to the head of the Westport River system, (2) Kirby Brook discharging from upland to the East Branch of Westport River, (3) Snell Creek discharging from upland to the East Branch of Westport River, (4) Adamsville Brook discharging from Adamsville Pond to the head of the West Branch, and (5) Angeline Brook discharging from upland to the West Branch (NRCS, 2021; MEP 2013).

Shellfish monitoring has also been extensively carried out in Westport River watershed and Buzzards Bay. **Figure HI-3** displays the locations of shellfish sampling stations in the region (NRCS, 2021).

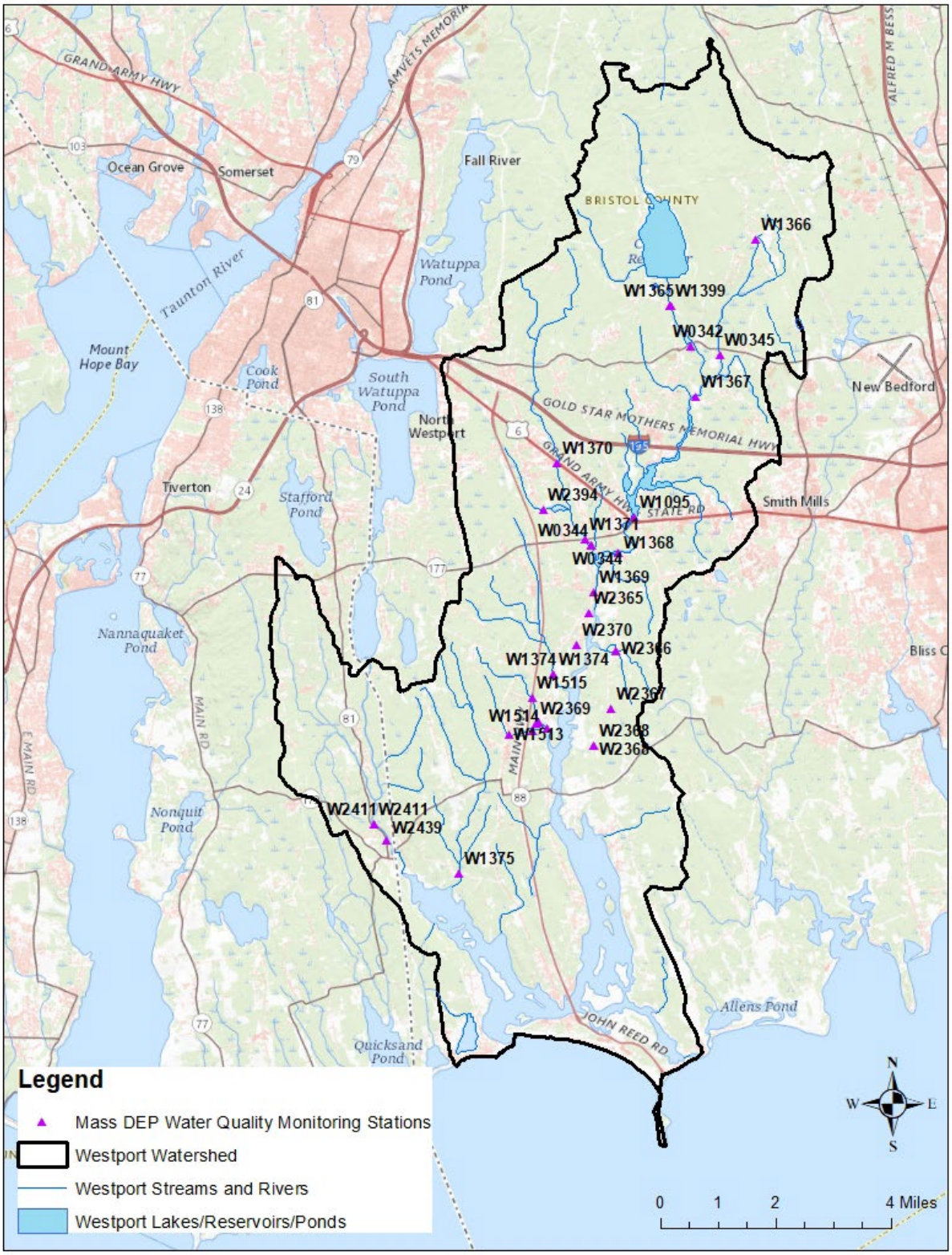


Figure HI-1. Locations of MassDEP water quality monitoring stations in Westport River watershed (adapted from NRCS, 2021)

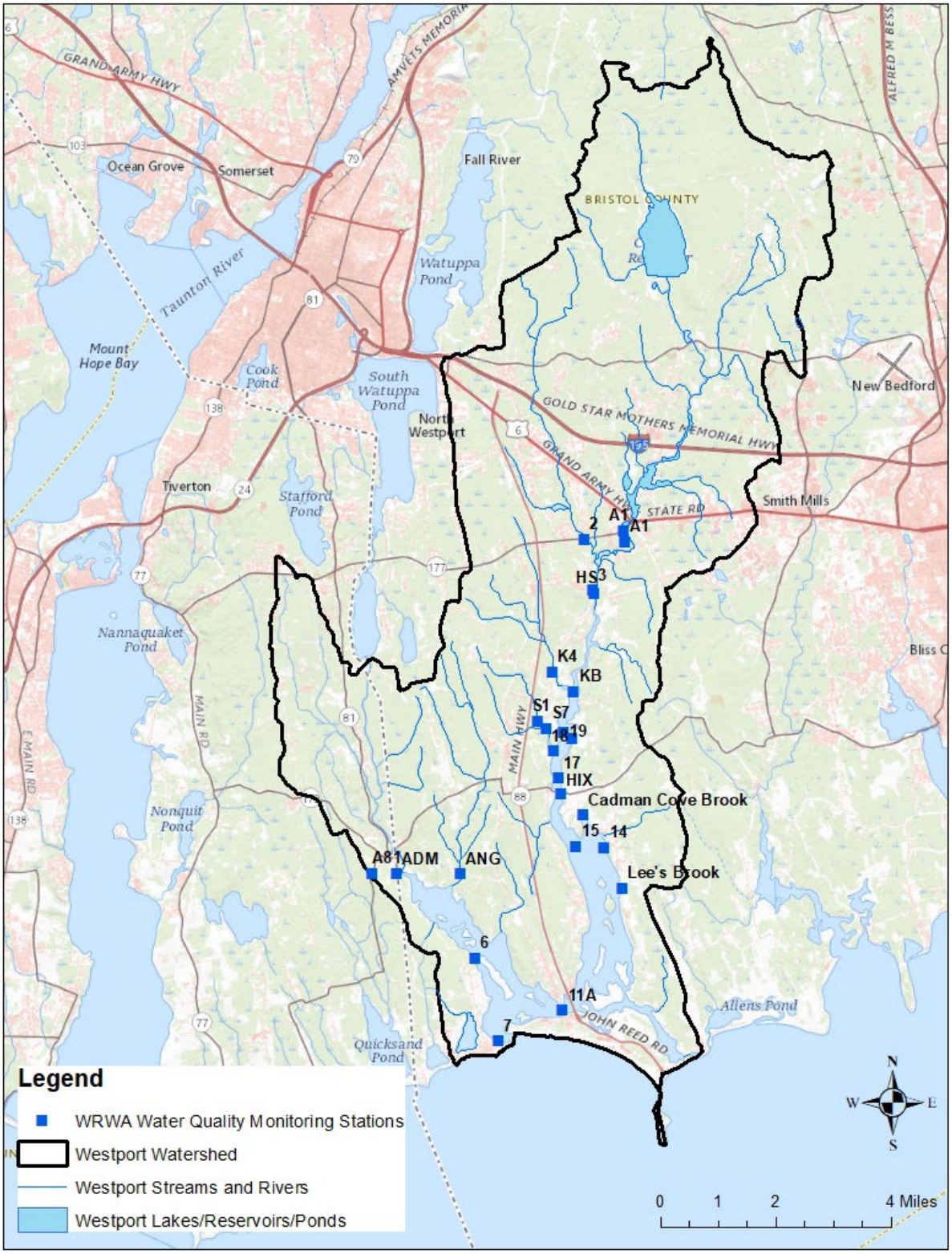


Figure HI-2. Locations of WRWA water quality monitoring stations and estuarine water quality monitoring stations sampled by WRWA (adapted from NRCS, 2021).

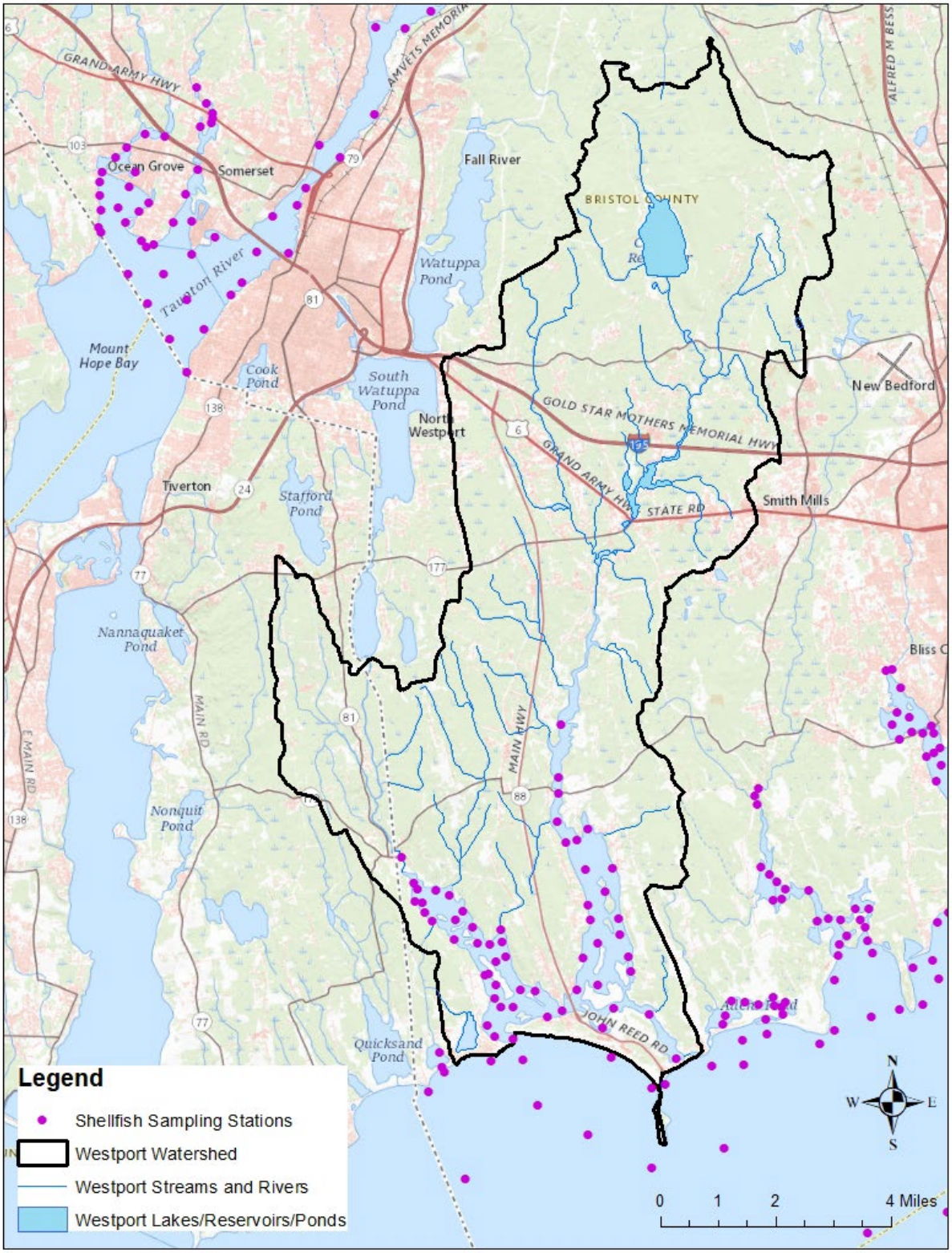


Figure HI-3. Locations of shellfish monitoring stations in Westport River watershed and Buzzards Bay (adapted from NRCS, 2021).

It is suggested that water quality monitoring in Westport River continue under these programs and expanded as deemed necessary and as funding allows. MassDEP also provides support for water quality monitoring efforts through its Water Quality Monitoring Grant Program.

Regular sampling will help to understand the water quality in Westport River watershed including determining sources of pollution and tracking achievements toward water quality goals. Key features of the water quality monitoring program should include:

- Analytes: The samples collected should at a minimum be analyzed for bacteria (FC, enterococci, *E. Coli*) and TN.
- Sampling Frequency: It is recommended that a minimum of five sampling events (alternate weeks from June to September) be conducted annually. Bacteria sampling conducted at this frequency aligns with the proposed surface water quality standard revisions and MassDEP assessment requirements and will provide the most value.
- Locations: The water quality monitoring program should be focused on Westport River watershed segments downstream of suspected TN or bacteria sources. If possible, samples should be collected within the stream directly downstream of implemented BMPs to determine the impact of BMPs within the watershed (samples at these locations prior to BMP implementation should also be collected to establish a baseline). Monitoring locations should ultimately be selected based on accessibility and representativeness and shall be appropriate to quantify water quality improvements in the watershed. BMP performance monitoring locations will be selected after BMPs have been identified for implementation.
- Planning: As noted above, it is suggested that the current WRWA monitoring program continue and expand and possibly seek support through the MassDEP Water Quality Monitoring Grant Program.

Indirect Indicators of Load Reduction

Non-Structural BMPs

Potential load reductions from non-structural BMPs (i.e., street sweeping and catch basin cleaning) can be estimated from indirect indicators, such as the number of miles swept, or the number of catch basins cleaned. As summarized by **Figure HI-4** and **Figure HI-5**, Appendix F of the 2016 Massachusetts Small MS4 General Permit (USEPA, 2020) provides specific guidance for calculating TP removal from these practices. As indicated by **Element C**, it is recommended that potential TP removal from these ongoing actives be estimated. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions such as increased frequency or improved technology.

$$Credit_{sweeping} = IA_{swept} \times PLE_{IC\text{-}land\ use} \times PRF_{sweeping} \times AF \qquad \textbf{(Equation 2-1)}$$

Where:

$Credit_{sweeping}$	=	Amount of phosphorus load removed by enhanced sweeping program (lb/year)
IA_{swept}	=	Area of impervious surface that is swept under the enhanced sweeping program (acres)
$PLE_{IC\text{-}land\ use}$	=	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr) (see Table 2-1)
$PRF_{sweeping}$	=	Phosphorus Reduction Factor for sweeping based on sweeper type and frequency (see Table 2-3).
AF	=	Annual Frequency of sweeping. For example, if sweeping does not occur in Dec/Jan/Feb, the AF would be 9 mo./12 mo. = 0.75. For year-round sweeping, AF=1.0[1]

As an alternative, the permittee may apply a credible sweeping model of the Watershed and perform continuous simulations reflecting build-up and wash-off of phosphorus using long-term local rainfall data.

Table 2-3: Phosphorus reduction efficiency factors ($PRF_{sweeping}$) for sweeping impervious areas

Frequency[1]	Sweeper Technology	$PRF_{sweeping}$
2/year (spring and fall)[2]	Mechanical Broom	0.01
2/year (spring and fall)[2]	Vacuum Assisted	0.02
2/year (spring and fall)[2]	High-Efficiency Regenerative Air-Vacuum	0.02
Monthly	Mechanical Broom	0.03
Monthly	Vacuum Assisted	0.04
Monthly	High Efficiency Regenerative Air-Vacuum	0.08
Weekly	Mechanical Broom	0.05
Weekly	Vacuum Assisted	0.08
Weekly	High Efficiency Regenerative Air-Vacuum	0.10

Figure HI-4. Street Sweeping Calculation Methodology

$$Credit_{CB} = IA_{CB} \times PLE_{IC\text{-}land\ use} \times PRF_{CB} \qquad \textbf{(Equation 2-2)}$$

Where:

$Credit_{CB}$	=	Amount of phosphorus load removed by catch basin cleaning (lb/year)
IA_{CB}	=	Impervious drainage area to catch basins (acres)
$PLE_{IC\text{-}and\ use}$	=	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr) (see Table 2-1)
PRF_{CB}	=	Phosphorus Reduction Factor for catch basin cleaning (see Table 2-4)

Table 2-4: Phosphorus reduction efficiency factor (PRF_{CB}) for semi-annual catch basin cleaning

Frequency	Practice	PRF_{CB}
Semi-annual	Catch Basin Cleaning	0.02

Figure HI-5. Catch Basin Cleaning Calculation Methodology (USEPA, 2020)

Project-Specific Indicators

Number of BMPs Installed and Pollutant Reduction Estimates:

Anticipated pollutant load reductions from future BMPs will be tracked as BMPs are installed.

Adaptive Management

The baseline monitoring program will be used to evaluate progress towards achieving the water quality goals outlined in Element A and Element B. Long-term goals will be re-evaluated at least **once every three years** and adaptively adjusted based on additional monitoring results and other indirect indicators. If monitoring results and indirect indicators do not show improvement to the bacteria and TN concentrations and other indicators measured within the watershed, the management measures and loading reduction analysis (Elements A through D) will be revisited and modified accordingly.

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Appendices

Appendix A – Select excerpts from the Buzzards Bay Watershed 2000 Water Quality Assessment Report (MassDEP, 2003) and the Final Pathogen TMDL for the Buzzards Bay Watershed (MassDEP, ENSR International, EPA, 2009) (note: relevant information is included directly from these documents for informational purposes and has not been modified).

Buzzards Bay Watershed 2000 Water Quality Assessment Report (MA95-58 - Bread and Cheese Brook)

AQUATIC LIFE
Biology
DWM conducted fish population sampling (8 October 1996) on Bread and Cheese Brook approximately 300 meters downstream from Route 177 (station NB04BAC) in Westport as part of the Biocriteria Development Project. Seven American eel (Anguilla rostrata), one swamp darter (Etheostoma fusiforme), one creek chubsucker (Erimyzon oblongus), two brook trout (Salvelinus fontinalis), and one chain pickerel (Esox niger) were collected (MA DEP 1996b).

Also as part of the Biocriteria Development Project DWM conducted benthic macroinvertebrate sampling on Bread and Cheese Brook along the same reach as fish population sampling using a modified RBP III approach (MA DEP 1996b and Nuzzo 1999). Metrics calculated for these samples were not consistent with those used for assessment purposes, therefore, details are not provided here. Please refer to The Massachusetts Pilot Study on Numeric Biocriteria for Streams and Small Rivers 1996 Data on Macroinvertebrates report prepared by Lotic Inc. (1998) for additional information.

Habitat and Flow
As part of the fish population and benthic macroinvertebrate sampling for the Biocriteria Project, DWM conducted a habitat assessment of Bread and Cheese Brook approximately 300 meters downstream from Route 177 (station NB04BAC). There were no dams or channelization present in this reach. Substrates were comprised of cobble, gravel, and sand. This stream was used as a reference station and received a habitat score of 166 out of 200 due to the lack of epifaunal substrate, moderate sediment deposition, limited riffle areas, and human activities impacting the riparian zone. Sparganium sp. (bur-reed) was present over 30% of the reach (MA DEP 1996b).

Chemistry - water
DWM sampled Bread and Cheese Brook approximately 300 meters downstream of Route 177 in Westport (station NB04BAC) as part of the Biocriteria Development Project on 8 October 1996.

Parameter Result
Measurement Depth (m) **i
Time 16:12
Temperature (°C) 10.3
pH (SU) 5.4
Conductivity (µS/cm) 166
Total Dissolved Solids (mg/L) 106
Dissolved Oxygen (mg/L) 10.8
Percent Saturation (%) 96
Turbidity (NTU) 6i
** = censored or missing data
i= inaccurate readings from Hydrolab likely

Too little current data are available; therefore, the Aquatic Life Use is currently not assessed.

PRIMARY AND SECONDARY CONTACT RECREATION
WRWA collected bacteria samples from Bread and Cheese Brook at Rte 177 between March and October 2001. FC bacteria counts ranged from 0 to 1,190 cfu/100mL (n=17). The geometric mean of the samples collected during the primary contact season was 55.9. Two of the 15 samples (13%) collected during the primary contact season had counts greater than 400 cfu/100mL. Both of the elevated counts were representative of wet weather conditions. Enterococci counts at Rte 177 ranged from 0 to 4940 cfu/100ml (n=16).

ESS also collected FC bacteria samples from the three stations along Bread and Cheese Brook as part of a NPS bacteriological assessment project (01-02/MWI); station WR13 was located at Bedford Road, WR12 was located at Route 6 and WR10 was located at Route 177. Samples were also collected from one unnamed tributary at Gifford Road (station WR11) and a storm drain on the downstream side of station WR13. Samples were collected on 7 June, 21 September, 20 November, and 17 December 2001, and 4 and 30 January 2002 during wet and dry weather. Results from the first two sampling rounds were censored due to lab error. None of the FC counts exceeded 100 cfu/100 mls (ESS 2003).

ESS noted that large impervious areas along Route 6 and Gifford Road convey storm water runoff directly into Bread and Cheese Brook. Livestock pastures were also noted within 200 feet of the brook.

Based on the elevated FC bacteria counts during wet weather conditions documented by WRWA, the Primary Contact Recreational use is assessed as impaired. The Secondary Contact Recreational Use, however, is assessed as support.
The drainage area of this segment is approximately 10.6 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):
Forest 67%
Residential 20%
Agriculture 5%
MassWildlife has proposed that Bread and Cheese Brook be reclassified in the SWQS as a cold water fishery (MassWildlife 2001).

Report Recommendations:
· Continue to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, the Phase II community storm water management programs, and implementation of BMPs to assess the recreational uses.

· Continue to work with the WRWA to promote education and outreach programs to protect surface water resources. Offer technical support and guidance to WRWA to continue/expand their water quality monitoring program. Review final reports to assess the Aquatic Life Use and the recreational uses.

· In 1996 DWM identified sediment deposition (most likely from road runoff) in Bread and Cheese Brook downstream of Route 177. As part of a shoreline survey, evaluate the extent of sedimentation problems in this subwatershed. Conduct biomonitoring in this subwatershed bracketing these nonpoint sources to determine if sedimentation and or other nutrient inputs negatively affect the aquatic life. Conduct bacteria monitoring to determine if road runoff is a source of bacteria to this segment and to assess the recreational uses. As a follow up to the survey(s), determine the need to implement erosion control measures and best management practices.

Buzzards Bay Watershed 2000 Water Quality Assessment Report (MA95-12 - Shingle Island River)

AQUATIC LIFE
Biology
DWM conducted fish population sampling (8 October 1996) on the Shingle Island River downstream of Old Fall River Road (Station NB14SHI) in Dartmouth as part of the Biocriteria Development Project. Only two fish were collected: tesselated darter (Etheostoma olmstedi) and an American eel (Anguilla rostrata). On replicate sampling, no fish were captured, however, a single American eel was sighted. Invertebrate collection was conducted just prior to fish sampling and electrofishing was difficult due to deep, very dark, 'tea stained" water (MA DEP 1999b).

As part of the Biocriteria Development Project DWM conducted benthic macroinvertebrate sampling on the Shingle Island River along the same reach as fish population sampling using a modified RBP III approach (MA DEP 1996b and Nuzzo 1999). Metrics calculated for these samples were not consistent with those used for assessment purposes, therefore, details are not provided here. Please refer to The Massachusetts Pilot Study on Numeric Biocriteria for Streams and Small Rivers 1996 Data on Macroinvertebrates report prepared by Lotic Inc. (1998) for additional information.

Habitat and Flow

As part of the fish population and benthic macroinvertebrate sampling for the Biocriteria Project, DWM conducted a habitat assessment of the Shingle Island River, downstream of Old Fall River Road. There were no dams or channelization present in this reach. Substrates were comprised of sand, silt, and clay. This reach was described by DWM biologists as " classic meandering, low gradient streamthrough an extensive flood plain". This stream was used as a reference station and received a habitat score of 141 out of 180 due to the lack of epifaunal substrate, sediment deposition, and lack of riffles. Sparganium sp. (bur-reed) was present over 40% of the reach (MA DEP 1996b).

Chemistry-water
DWM sampled the Shingle Island River at approximately 150 meters downstream of Old Fall River Road in Dartmouth (station NB14SHI) as part of the Biocriteria Development Project on 8 October 1996.

Parameter Result
Measurement Depth (m) 0.2
Time 14:23
Temperature (°C) 10.0
pH (SU) 5.0
Conductivity (µS/cm) 60
Total Dissolved Solids (mg/L) 38.6
Dissolved Oxygen (mg/L) 9.1
Percent Saturation (%) 80
Turbidity (NTU) 7i
i= inaccurate readings from Hydrolab likely

The Aquatic Life Use is currently not assessed, however, potential effects of water withdrawals (public water supply and cranberry bogs) are of concern and, therefore, the Aquatic Life Use is identified with an Alert Status. Sediment deposition and embeddedness were also noted.

FISH CONSUMPTION
Although fish were not collected from the Shingle Island River the presence of site-specific advisories in Cornell Pond and Noquochoke Lake (Maietta 1989a) suggest that this segment should be included.

At this time a site-specific advisory for the Shingle Island River has not been issued by MDPH, therefore the Fish Consumption Use is currently not assessed.

AESTHETICS
As part of the fish population and benthic macroinvertebrate sampling for the Biocriteria Project, DWM conducted a habitat assessment of the Shingle Island River, downstream of Old Fall River Road (Station NB14SHI). No aesthetic quality degradation (odors, turbidity, oil, grease, etc.) was identified (MA DEP 1996b).
The drainage area of this segment is approximately 20.1 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):
Forest 75 %
Residential 8 %
Open Land 5 %
The Greater New Bedford Compost Site, a landfill owned by the Greater New Bedford Refuse District, is partially located within this subwatershed near the Dartmouth/Freetown town line (MA DEP BWP 2000).

Report Recommendations:
· Develop a monitoring plan to evaluate the potential impacts of water withdrawals on streamflow/habitat in this segment/subwatershed to assess the Aquatic Life Use.

· In 1996 DWM identified sediment deposition (most likely from road runoff) in the Shingle Island River downstream of Old Fall River Road. As part of a shoreline survey, evaluate the extent of sedimentation problems in this subwatershed. Conduct biomonitoring in this subwatershed bracketing these nonpoint sources to determine if sedimentation and/or other nutrient inputs negatively affect the aquatic life. Conduct bacteria monitoring to determine if road runoff is a source of bacteria to this segment and to assess the recreational uses. As a follow up the survey(s), determine the need to implement erosion control measures and best management practices.

· MPDH is currently reevaluating their Fish Consumption Advisory for the Shingle Island River. Additional fish toxics monitoring should be considered for this segment if deemed necessary to refine the extent of the advisory.

Buzzards Bay Watershed 2000 Water Quality Assessment Report (MA95-45 - Snell Creek)

AQUATIC LIFE
Chemistry-water
WRWA conducted temperature, salinity, pH, and turbidity monitoring at one station S-7 Snell Creek at Marcus' Bridge, between March and October 2001. Samples were collected during ebb or flood tide between 0600 and 1300 (Carvalho-Souza 2002).

pH
pH in Snell Creek ranged from 6.13 to 7.16 S.U. (n=18).

Temperature
Temperature in Snell Creek ranged from 0 to 22.22 °C with three of the 17 measurements (18%) greater than 20°C.

Turbidity
Turbidity ranged from 0.47 to 4.69 NTU (n=18).

Too limited data (lack of biological and DO data) are available; therefore, the Aquatic Life Use is currently not assessed.

PRIMARY AND SECONDARY CONTACT RECREATION
WRWA collected FC and Enterococci bacteria samples at Station S-7 Snell Creek at Marcus' Bridge between March and October 2001. Samples were collected during both wet and dry weather. The majority of exceedances were recorded during wet weather conditions (Carvalho-Souza 2002).

[See table on page 64 of Water Quality Assessment Report]

Enterococci counts ranged from 12 to 94,000 cfu/100mL.

Based on the high FC bacteria counts, the Primary and Secondary Contact Recreational uses are assessed as impaired.
The drainage area of this segment is approximately 1.4 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):
Forest 65 %
Agriculture 16 %
Residential 16 %
MassWildlife has proposed that this segment, as well as an unnamed tributary (locally known as Snell Creek), be reclassified in the SWQS as a cold water fishery (MassWildlife 2001).

Report Recommendations:
· Continue to monitor farm operation (effectiveness of best management practices) and compliance with CAFO permit requirements that are aimed at reducing bacteria and nutrient inputs to Snell Creek.

· Develop a monitoring program to bracket nonpoint sources of bacteria to Snell Creek and to document the effectiveness of bacteria source reduction activities including treatment of storm water discharges, implementation of best management practices, implementation of vegetated buffer zone between the farm and Snell Creek, and the Phase II community storm water management programs. Data from the program could be used to assess the recreational uses.

· Continue to work with the WRWA to promote education and outreach programs to protect surface water resources. Offer technical support and guidance to WRWA to continue/expand their water quality monitoring program. Review final reports to assess the Aquatic Life Use and recreational uses.

Buzzards Bay Watershed 2000 Water Quality Assessment Report (MA95-44 - Snell Creek)

AQUATIC LIFE
Chemistry-water
WRWA conducted temperature, salinity, pH, and, turbidity monitoring at one station, S-1 Snell Creek at Drift Road, between March and October 2001. Samples were collected during ebb or flood tide between0600 and 1300 (Carvalho-Souza 2002).

pH
pH in Snell Creek ranged from 6.02 to 7.16 S.U. (n=18).

Temperature
Temperature in Snell Creek ranged from 0 to 21.39 °C with three of the 17 measurements (18%)greater than 20°C.

Turbidity
Turbidity ranged from 0.40 to 4.01 NTU (n=18).

Salinity
Salinity measurements in Snell Creek were all 0.1 ppt (n=18).

Too limited data (lack of biological and DO data) are available; therefore, the Aquatic Life Use is currently not assessed.

PRIMARY AND SECONDARY CONTACT RECREATION
WRWA collected FC and Enterococci bacteria samples at Station S-1, Snell Creek at Drift Road between March and October 2001. Samples were collected during both wet and dry weather. The majority of exceedances were recorded during wet weather conditions (Carvalho-Souza 2002).

[See table on page 62 of Water Quality Assessment Report]

Enterococci counts ranged from 2 to 37,000 cfu/100mL.

Based on the elevated FC bacteria counts, the Primary Contact Recreational Use is assessed as impaired and the Secondary Contact Recreational Use is assessed as support.
The drainage area of this segment is approximately 0.5 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):
Forest 72 %
Agriculture 16 %
Residential 9 %
MassWildlife has proposed that this segment, as well as an unnamed tributary (locally known as Snell Creek) be reclassified in the SWQS as a cold water fishery (MassWildlife 2001).

Report Recommendations:
· Continue to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges and the Phase II community storm water management programs to assess the recreational uses.

· Continue to work with the WRWA to promote education and outreach programs to protect surface water resources. Offer technical support and guidance to WRWA to continue/expand their water quality monitoring program. Review final reports to assess the status of the Aquatic Life Use and the recreational uses.

Buzzards Bay Watershed 2000 Water Quality Assessment Report (MA95-37 - West Branch Westport River)

AQUATIC LIFE
Eelgrass Bed Habitat
MA DEP identified the presence of eelgrass in the West Branch Westport River from historic 1951 black and white aerial photography. Eelgrass beds in the West Branch Westport River were mapped by MA DEP from field verified 1994 aerial

photography (Costello 2003). Loss of eelgrass beds occurred along the western shore between Sanford Flat and Canoe Rock. Decline of the beds along the eastern shore occurred between Judy Island and Sanford Flat.

Chemistry-water
WRWA conducted temperature, salinity, pH, and turbidity monitoring at one station in the river off of 448 River Road (station 6) between March and October 2001. Samples were collected during ebb or flood tide between 0600 and 1300 (Carvalho-Souza 2002 and WRWA 2001).

pH
pH ranged from 7.75 to 8.16 SU (n=18).

Temperature
Temperature ranged from 2.22 to 24.44 °C (n=18).

Turbidity
Turbidity ranged from 0.69 to 3.06 NTU (n=18).

Salinity
Salinity ranged from 19.4 to 32.3 ppt (n=18).

Due to the loss of eelgrass bed habitat the Aquatic Life Use is assessed as impaired for the West Branch Westport River. The eelgrass bed loss may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources or other anthropogenic activities that result in reduced water clarity. Suspected sources of nutrient enrichment include animal feeding operations, storm drains, and septic systems.

SHELLFISH HARVESTING
The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB3.0 is approved, BB3.11 and BB3.12 are conditionally approved, and BB3.3 and BB3.6 are prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status the Shellfish Harvesting Use is assessed as support for 0.50 mi2 and impaired for 0.78 mi2.

PRIMARY AND SECONDARY CONTACT RECREATION
WRWA collected FC and Enterococcus bacteria samples at one station in the river near 448 River Road (station 6), between March and October 2001(Carvalho-Souza 2002). FC bacteria counts from this location ranged from 0 to 2,500 cfu/100mL (n=19). Of the 17 samples collected during the primary contact recreational season the geometric mean was 8.6 (excluding zero values) and only one count (6%) was greater than 400 cfu/100mL. Samples were collected during both wet and dry weather and the two highest counts were recorded during wet weather conditions. Enterococci counts ranged from 0 to 3,200 cfu/100mL.

Based on the low FC bacteria counts in the river near 448 River Road and the stricter shellfish guidelines, the Primary and Secondary Contact Recreational uses are assessed as support for lower 0.5 mi2 but are not assessed for the upper 0.78 mi2.
The Massachusetts portion of the drainage area for this segment is approximately 9.1 square miles. Landuse estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):
Forest 67 %
Agriculture 19 %
Residential 10 %
MassWildlife has proposed that Dunghams and Angeline brooks, tributaries to this segment be reclassified in the SWQS as a cold water fishery (MassWildlife 2001).
The headwaters of the West Branch Westport River form an impoundment at Adamsville Pond, which is also known as Greys Mill Pond. Since 1675 the pond has been utilized to operate Grey's Grist Mill and has historically been the spawning grounds for river he

Report Recommendations:
· Continue to support the implementation of best management practices (BMPs) at farms within the region to reduce bacteria and nutrient inputs to the West Branch Westport River.

· Review and implement recommendations in the DMF anadromous fish assessment report (when available) to improve water

quality and increase habitat. If applicable review data to assess the Aquatic Life Use.

· Continue to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, the Phase II community storm water management programs, and on-site septic system improvements and to assess the recreational uses.

· Review and implement, as appropriate, recommendations from DMF shellfish survey program reports (sanitary surveys and triennial reports) to reduce bacteria and remediate sources causing the closure of the shellfish beds. Continue to review DMF shellfish status report to assess the Shellfish Harvesting Use.

· Work with the Coalition for Buzzards Bay to improve quality assurance procedures, data exchange, and if deemed necessary, increase spatial and temporal coverage of in-situ monitoring. Review final reports to continue to evaluate the status of the Aquatic Life Use.

· Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Review data to assess the Aquatic Life Use.

· Continue to work with the WRWA to promote education and outreach programs to protect surface water resources. Offer technical support and guidance to WRWA to continue/expand their water quality monitoring program. Review final reports to assess the Aquatic Life Use and the recreational uses.

· Implement the four salt marsh restoration projects identified in the 2002 Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts that have been evaluated and prioritized by the Town. Sites in this subwatershed are WP01, WP02, WP 15 and WP16. Develop a monitoring plan to determine the effectiveness of the restorations and to assess their impacts on the Aquatic Life Use.

Buzzards Bay Watershed 2000 Water Quality Assessment Report (MA95-54 - Westport River)

AQUATIC LIFE
Eelgrass Bed Habitat
MA DEP identified the presence of eelgrass in the Westport River from historic 1951 black and white aerial photography. Eelgrass beds in the Westport River were mapped by MA DEP from field verified 1994 aerial photography (Costello 2003). Decline of the beds occurred in the vicinity of Whites Flat, the Westport Yacht Club, Hudson Cove, Canoe Rock, and Baileys Flats and Cory's Island.

Chemistry-water
WRWA conducted temperature, salinity, pH, and turbidity monitoring at two stations: off of Westport Point Town Wharf (station 11A) and the Harbor entrance at Charlton Wharf (station 7) between March and October 2001. Samples were collected during ebb or flood tide between 0600 and 1300 (Carvalho-Souza 2002).

pH
pH ranged from 7.68 to 8.18SU (n=36).

Temperature
Temperature ranged from 2.2 to 23.6°C (n=36).

Turbidity
Turbidity ranged from 0.29 to 1.90 NTU (n=36).

Salinity
Salinity ranged from 22.4 to 32.4 ppt (n=36).

Due to the decline of eelgrass bed habitat the Aquatic Life Use is assessed as impaired for this segment of the Westport River. This loss may be attributed to nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources and recreational

uses or other anthropogenic activities that result in reduced water clarity Suspected sources of nutrient enrichment include animal feeding operations, storm drains, recreational activities (boating) and septic systems.

SHELLFISH HARVESTING
The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB3.0 is approved, BB3.5 is conditionally approved, and BB3.7 is prohibited (DFWELE 2000).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as support for 0.7 mi2 and impaired for 0.04 mi2.

PRIMARY AND SECONDARY CONTACT RECREATION
WRWA collected FC and Enterococcus bacteria samples at two stations: off of Westport Point Town Wharf (station 11A) and the Harbor entrance at Charlton Wharf (station 7) between March and October 2001(Carvalho-Souza 2002). Their data are summarized below:

[See table on page 78 of Water Quality Assessment Report]

Enterococci counts at station 11A ranged from 0 to 410 cfu/100mL (n=17). The counts at station 7 (n=17) ranged from 0 to 240 cfu/100mL (Carvalho-Souza 2002).

Based on the low FC bacteria counts and the DMF shellfish classification information, the Primary and Secondary Contact Recreational Uses are assessed as support.
The drainage area of this segment is approximately 71.7 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):
Forest 65%
Residential 14%
Agriculture 10%

ACOE is evaluating a proje

Report Recommendations:
· Review and implement recommendations in the DMF anadromous fish assessment report (when available) to improve water quality and increase habitat. If applicable, review data to assess the Aquatic Life Use.

· Continue to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges and the Phase II community storm water management programs and to assess the recreational uses.

· Review and implement, as appropriate, recommendations from DMF shellfish sanitary survey and triennial reports to reduce pollutants causing the closure of the shellfish beds. Continue to review the DMF Shellfish Status Reports to assess the Shellfish Harvesting Use.

· Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality and to assess the Aquatic Life Use.

· Continue to work with the WRWA to promote education and outreach programs to protect surface water resources. Offer technical support and guidance to WRWA to continue/expand their water quality monitoring program. Review final reports to assess the Aquatic Life Use and the recreational uses.

· Implement the five salt marsh restoration projects identified in the 2002 Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts that have been evaluated and prioritized by the Town. Sites in this subwatershed are WP03, WP17 through WP20. Develop a monitoring plan to determine their effectiveness and to assess the improvements to water quality and the aquatic life.

AQUATIC LIFE

Habitat and Flow

A habitat assessment was conducted on this unnamed tributary as part of the Biocriteria Development Project (NB03COP) on 27 September 1996. The sampling reach received a habitat score of 145 out of 200 due to a lack of epifaunal substrate, moderate embeddedness (50-75% of the substrate surrounded by fine sediment), and moderate sediment deposition while instream flows were optimal (MA DEP 1996b).

The large water withdrawal from Copicut Reservoir (see details in Copicut River) combined with the small size of the drainage area is of concern due to the potential negative effects on instream habitat.

Biology

DWM conducted fish population sampling on this unnamed tributary downstream of Old Fall River Road, Dartmouth (Station NB03COP). Seven American eel (Anguilla rostrata), one yellow perch (Perca flavescens), four redfin pickerel (Esox americanus americanus), two brown bullhead (Ameiurus nebulosus), one largemouth bass (Micropterus salmoides), and one bluegill (Lepomis macrochirus) were collected (MA DEP 1996b).

As part of the Biocriteria Development Project DWM conducted benthic macroinvertebrate sampling on this unnamed tributary along the same reach as fish population sampling using a modified RBP III approach (MA DEP 1996b and Nuzzo 1999). Metrics calculated for these samples were not consistent with those used for assessment purposes, therefore, details are not provided here. Please refer to The Massachusetts Pilot Study on Numeric Biocriteria for Streams and Small Rivers 1996 Data on Macroinvertebrates report prepared by Lotic Inc. (1998) for additional information.

Chemistry-water

Additionally, this unnamed tributary was sampled approximately 50 meters downstream of Old Fall River Road, Dartmouth as part of the Biocriteria Project on 8 October 1996. The results from Station NB03COP are:

Parameter	Result
Measurement Depth (m)	0.1i
Time	12:18
Temperature (°C)	11.4
pH (SU)	6.4
Conductivity (µS/cm)	79
Total Dissolved Solids (mg/L)	50.5
Dissolved Oxygen (mg/L)	9.8
Percent Saturation (%)	89
Turbidity (NTU)	14i

i= inaccurate readings from Hydrolab likely

The Aquatic Life Use is currently not assessed, however, potential effects of water withdrawals are ofvconcern and, therefore, the Aquatic Life Use is identified with an Alert Status. Sediment deposition andvembeddedness were also noted.

FISH CONSUMPTION

In 1988 DWM conducted fish toxics monitoring in three lakes in the vicinity of the ReSolve Superfund Site: Copicut Reservoir, Cornell Pond, and Noquochoke Lake. Based on data from this survey MDPH issued a fish consumption advisory for the Copicut River and Cornell Pond, Dartmouth due to elevated levels of mercury and PCBs in fish tissue (Maietta 1989a).

At this time a site-specific advisory for this unnamed tributary has not been issued by MDPH, therefore the Fish Consumption Use is currently not assessed.

AESTHETICS

During the habitat assessment survey conducted on this unnamed tributary sulfur odors, road runoff, iron deposits, foam, turbidity, abundant trash, and very soft, “mucky” substrates were noted (MA DEP 1996b).

The Aesthetics Use is not assessed, however, it is identified with an Alert Status because of the trash, foam, turbidity and odors noted during the survey conducted in the fall of 1996.

The drainage area of this segment is approximately 34.3 square miles. Landuse estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):

Forest 91%

Open Land 3%

Wetlands 1%

Report Recommendations:
· Continue to review the status of the Re-Solve Inc. Superfund site cleanup and review any environmental monitoring data and/or need for additional monitoring to assess the status of the Aquatic Life Use.

· In 1996 DWM identified sediment deposition (most likely from road runoff) in this unnamed tributary south of Old Fall River Road. As part of a shoreline survey, evaluate the extent of sedimentation problems in this subwatershed. Conduct biomonitoring in this subwatershed bracketing these nonpoint sources to determine if sedimentation and/or other nutrient inputs negatively effect the aquatic life. Conduct bacteria monitoring to determine if road runoff is a source of bacteria to this segment and to assess the recreational uses. As a follow up to the survey(s), determine the need to implement erosion control measures and best management practices.

· MDPH is currently reevaluating the fish consumption advisory for Copicut River/ Cornell Pond to determine if this unnamed tributary should be included. Additional fish toxics monitoring should be considered if deemed necessary.

· Work with Riverways, the Coalition for Buzzards Bay, Westport River Watershed Alliance and other concerned parties to form stream teams for the Westport River drainage area. Determine the current need to conduct a stream cleanup in this subwatershed. Review final stream team report(s) for information to assess the Aesthetic Use.

Buzzards Bay Watershed 2000 Water Quality Assessment Report (MA95-43 - Copicut River)

AQUATIC LIFE
Habitat and Flow
Although no habitat quality and/or flow data are currently available for the Copicut River, the large water withdrawal combined with the small size of the drainage area are of concern.

The Aquatic Life Use is currently not assessed, however, potential effects of water withdrawals are of concern and, therefore, the Aquatic Life Use is identified with an Alert Status.

FISH CONSUMPTION
In 1988, DWM conducted fish toxics monitoring in Copciut Reservoir, Cornell Pond, and Noquochoke Lake to bracket the ReSolve Superfund site (Maietta 1989a). Based on elevated concentrations of PCBs and mercury in fish tissue MDPH issued a fish consumption advisory for the Copicut River and Cornell Pond, Dartmouth. The MDPH advisory recommends the following:
1. Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from the Copicut River or Cornell Pond.
2. The general public should not consume any American eel (Anguilla rostrata) from Copicut River or Cornell Pond.
3. The general public should limit consumption of largemouth bass (Micropterus salmoides) to two meals per month.

Based on the MDPH site-specific fish consumption advisory this segment is assessed as impaired for the Fish Consumption Use. The drainage area of this segment is approximately 7.4 square miles. Landuse estimates (top three, excluding water) for the subwatershed (map inset,
gray shaded area):
Forest 76%
Wetlands 5%
Open Land 3%
The Re-Solve, Inc. Superfund Site is a former waste chemical reclamation facility situated on 6 acres of land in Dartmouth. Between 1956 and 1980, Re-Solve handled a variety of hazardous materials, including solvents, waste oils, organic liquids and solids, acids, alkalies, inorganic liquids and solids, and polychlorinated biphenyls (PCBs). Residues from the distillation tower, liquid sludge waste, impure solvents, and burned tires were disposed of in four on-site unlined lagoons. The lagoon contents were burned periodically to reduce the volatile organic compounds (VOCs) content. An oil waste that accumulated at the bottom of the degreaser distillation still was disposed of on one portion of the site through landfarming. This oil waste also was spread throughout the site to control dust. Cooling water from the distillation tower was discharged to a shallow on-site lagoon. The groundwater is contaminated with VOCs and PCBs. Sediments are contaminated with PCBs and VOCs and the soil contains

PCBs, lead, and VOCs including, trichloroethylene (TCE), vinyl chloride, methylene chloride, and toluene. Surface water is contaminated with PCBs and VOCs. Fish from the adjacent Copicut River and Cornell Pond contain elevated levels of PCBs and mercury; mercury is not related to the site (EPA 13 December 2002b).

Report Recommendations:
Continue to review the status of the Re-Solve Inc. Superfund site cleanup and review any environmental monitoring data and/or need for additional monitoring to assess the Aquatic Life Use and/or Fish Consumption Use.

Buzzards Bay Watershed 2000 Water Quality Assessment Report (MA95-40 - East Branch Westport River)

AQUATIC LIFE
The Westport River Watershed Alliance (WRWA) conducted temperature, salinity, pH, and turbidity monitoring at two stations, 3--Head of Westport River at Old Colony Road and A-1-- Westport River at Rte 177, between March and October 2001. Samples were collected during ebb or flood tide between 0600hours and 1300 hours (Carvalho-Souza 2002 and WRWA 2001). As part of this project, ESS was commissioned to design a BMP (pocket wetland) for the stormdrain on the south side of Old Colony Road, east bank of the river.

With funding from the Massachusetts Watershed Initiative's Buzzards Bay Team, ESS conducted a bacteriological NPS assessment of the East Branch Westport River near the Head of Westport between 7 June 2001 and 30 January 2002. Sampling included storm drain sampling and instream sampling at three stations for turbidity, pH, conductivity, and flow: (upstream to downstream) WR8—East Branch, upstream of Forge Pond at 251 Reed Road; WR6—East Branch behind Primrose Lane, opposite Ferry Farm; WR3—East Branch at Head Bridge at Old Colony Road (ESS 2003). The information collected was used as support for a successful s. 319 grant awarded to the Town of Westport to address two of the major storm water discharges into the upper reaches of the river (Pierce 2003).

Habitat and Flow
As part of the bacteriological NPS assessment of the East Branch Westport River, ESS noted that the bank of the river is "coincident with a stone wall" (ESS 2003), which implies the stream has been straightened. Flow readings taken between 7 June 2001 and 30 January 2002 during the ESS assessment ranged from 11.94 to 737.64 cfs (n=18).

Chemistry-water
pH
pH reported by WRWA ranged from 4.93 to 8.18 SU with 21 of the 38 less than 6.5 SU (55%), while pH values reported by ESS ranged from 5.6 SU to 7.5 SU (n=18) with six values less than 6.5 SU.

Temperature
WRWA temperatures ranged from 1.11 to 26.67 °C. Temperatures reported by ESS ranged from 2.0°C to 23.0°C (n=18).

Turbidity
Turbidity ranged from 0.74 to 6.14 NTU (n=37). Turbidity readings reported by ESS ranged between 0.9 and 52.6 NTU (n=15), but only one measurement exceeded 25 NTU.

Salinity
Salinity ranged from 0.0 to 3.2 ppt (n=38).

Too limited data (lack of biological and DO data) are available to assess the status of the Aquatic Life Use; therefore, it is currently not assessed.

FISH CONSUMPTION
Although there are currently three site-specific advisories in waterbodies upstream of this segment, due to a lack of data the Fish Consumption Use is currently not assessed.

PRIMARY AND SECONDARY CONTACT RECREATION
WRWA collected FC and Enterococci bacteria samples at Station A-1 (Westport River at Rte 177), and Station 3 (Head of

Westport River at Old Colony Road) between March and October 2001. Samples were collected during both wet and dry weather. The majority of high counts were recorded during wet weather conditions.

[See table on page 55 of Water Quality Assessment Report]

Enterococci counts ranged between 2 and 201,000 cfu/200mL (n=35). Twenty-six of the 35 samples (74%) had counts greaterthan 61 cfu/100mL and six counts were greater than 1,000 cfu/100mL, primarily collected during wet weather conditions (Carvalho-Souza 2002).

ESS collected FC bacteria samples from their three water quality stations on this segment of the East Branch Westport River as part of a NPS bacteriological assessment project (01-02/MWI). Samples were collected on 7 June, 21 September, 20 November, and 17 December 2001, and 4 and 30 January 2002 during wet and dry weather. Results from the first two sampling rounds were censored due to lab error. None of the samples exceeded 46 cfu/100 mls (ESS 2003). Additionally, three storm drains were also sampled. Sampling from the storm drains suggested that station WR5 at Gifford Road, between Rte 177 and Old Colony Road, may be a significant source of FC bacteria during wet weather (counts were 580,000 and 2,100,000 cfu/100mL; n=2). Station WR5 is immediately downstream from the Ferry Farm. The area has three small detention/infiltration basins, however, they do not appear to be designed properly. ESS recommended that the downgradient side of the system be constructed or reinforced with a water impermeable material, as well as implement vigorous behavioral BMPs at the farm.

The Town of Westport was awarded a s. 319 grant for a storm water mitigation project in 2002. The project will install two BMPs at storm water drains (one near a farm on Gifford Road and one near Head of Westport) in order to treat the first flush using sediment collection and effluent infiltration. Pre- and post implementation water quality monitoring will be conducted. The project is expected to take 2½ years to complete. QAPP development began in January 2003 (Peirce 2003).

Based on the elevated FC bacteria counts during wet weather conditions documented by WRWA, the Primary Contact Recreational Use is assessed as impaired. The Secondary Contact Recreational Use is assessed as support in the upper 2.53 miles and impaired downstream from the Gifford Road storm drain (lower 0.32 miles).
The drainage area of this segment is approximately 40.2 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):
Forest 70 %
Residential 14 %
Agriculture 4 %

Report Recommendations:
· Continue to monitor bacteria levels to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, the Phase II community storm water management programs, and implementation of BMPs to assess the recreational uses.

· Continue to work with the WRWA to promote education and outreach programs to protect surface water resources. Offer technical support and guidance to WRWA to continue/expand their water quality monitoring program. Review final reports to assess the Aquatic Life Use and the recreational uses.

· Additional fish toxics monitoring should be conducted downstream of Noquochoke Lake in the East Branch Westport River and Forge Pond to help assess the Fish Consumption Use.

Buzzards Bay Watershed 2000 Water Quality Assessment Report (MA95-41 - East Branch Westport River)

AQUATIC LIFE
WRWA conducted temperature, salinity, pH, and turbidity monitoring between March and October 2001 at six stations on this segment and one tributary station. Samples were collected during ebb or flood tide between 0600 and 1300 at the following stations (Carvalho-Souza 2002):
14-River off Cummings Lane
15-River off of Cadaman's Neck
17-River at Doctor's Point

18-River at the Mouth of Snell Creek
19-River off of Farm North Wall
KB-River at the Mouth of Kirby Brook
K4-Kirby Brook at Drift Road

As part of the Coastal 2000 Project, CZM, in partnership with EPA, UMass Boston, and UMass Dartmouth, sampled two stations on the East Branch Westport River-- 39A (near Lower Spectacle Island) and 35B (near Little Ram Island). Sediment toxicity; sediment chemistry; in situ DO, temperature, salinity, pH; TSS; chlorophyll a; and ammonia samples were collected on 13 September 2000. Sediments were analyzed for 78 analytes and TOC. Benthic community structure and habitat assessments were also conducted, however, final metrics have not yet been calculated. Additional monitoring was conducted in 2001 and results are not yet available (Krahforst 2003).

Habitat and Flow
The Hix Bridge on Bridge Road causes a tidal restriction due to build up of sediments under the bridge (BBP Tidal Atlas Site WP06). Additionally, large granite blocks, which toppled into the river during the Hurricane of 1938, also impede flows. The ACOE conducted a tidal flushing study to determine the benefits of increased tidal flushing (BBP 2002b). The Massachusetts Highway Department reconstruction of the Hix Bridge during the spring of 2003 will improve the storm water drainage facilities on both sides of the river. The drainage from this bridge, at a low point in the road, will now be collected in basins and diverted into a vegetated swale (Janik 2003).

Eelgrass Bed Habitat
MA DEP identified the presence of eelgrass in the East Branch Westport River from historic 1951 black and white aerial photography. Eelgrass beds in the East Branch Westport River were mapped by MA DEP from field verified 1994 aerial photography (Costello 2003). Decline of eelgrass beds occurred in the areas to the northwest of Upper and Lower Spectacle Island, to the northeast of Big Pine Island, south of Big Pine Island and west of Great Island, east of Great Island and Cunning Island, and east of Wood Point.

Toxicity-sediment
As part of the Coastal 2000 Project (Krahforst 2003) sediment toxicity tests were conducted on sediments from Station 39A and 35B in the East Branch Westport River using the small shrimp-like amphipod Ampelisca abdita. (Ampelisca construct tubes of fine sand grains and feed on detritus and are especially sensitive to oil pollution). Amphipods were exposed to sediments for 10 days under static conditions following the EPA Environmental Monitoring and Assessment Program (EMAP) procedures (EPA 1995 and ASTM 1991). Twenty juvenile amphipods were added to each test chamber for a ten-day exposure. The surviving amphipods were counted, and the results reported as the average number of amphipods surviving in the sample tests divided by the number of amphipods surviving in the control sediment, expressed as a percent. Lower values of this result indicate higher toxicity. The result was considered to be statistically significant if sample and control values were distinct with a p-value # 0.05 in a one way analysis of variance (ANOVA) F test. The assay was taken to indicate toxicity if the survival rate was less than 80% of the control and the test was statistically significant. Sediments from Station 39A were not toxic (survival >80%). Sediments at 35B, however, were acutely toxic (74.74% mean survival when compared to control survival).

Chemistry-water
DO
The dissolved oxygen concentration measured by Coastal 2000 on 13 September 2000 at Station 35B was 7.32 mg/L (surface) and 6.06 mg/L (bottom). The DO concentration at Station 39A was 5.52 mg/L (surface) and 5.56 mg/L (bottom).

pH
WRWA reported pH ranging from 6.02 to 8.15 SU. Six of the 103 readings from throughout their sampling area were less than 6.5 SU (6%). pH at the tributary station ranged from 5.68 to 7.09 SU (n=22). pH taken as part of the Coastal 2000 Project was 8.04 SU at station 39A, near Lower Spectacle Island, and 8.11SU at station 35B, near Little Ram Island.

Temperature
WRWA reported temperatures ranging from 8.33 to 28.06°C (n=107). Temperatures in the tributary did not exceed surface water quality standards. The surface water temperature at CZM Station 35B was 21.74°C and the bottom temperature was 21.78°C. At CZM Station 39A, the surface temperature was 22.67°C and in the bottom waters the temperature was 21.85°C.

Turbidity
Turbidity at the WRWA stations ranged from 1.62 to 6.93 NTU (n=104). Turbidity in the tributary ranged from 0.53 to 3.53 NTU

(n=22).

Salinity
Salinities at the WRWA stations ranged from 0.1 to 30.2 ppt (n=104). Salinity in the tributary ranged from 0.0 to 0.2 ppt (n=19). Salinity at CZM Station 35B was 31.03 at the surface and 30.96 in the bottom water. At Station 39A, salinity was 28.99 (surface) and 30.75 (bottom).

Total Suspended Solids
TSS measured as part of the Coastal 2000 Project at Station 39A was 3.53 mg/L. At Station 35B TSS in the surface waters was 4.03 mg/L and 3.74 mg/L in the bottom waters.

Ammonia- Nitrogen (as N)
The ammonia concentration at station 39A was 0.032 mg/L and at Station 35B, the ammonia concentration was 0.03 mg/L (n=2). Neither of these values exceeded the criteria continuous concentration (chronic criteria) for ammonia-nitrogen.

Chlorophyll a
The chlorophyll a concentration at Station 39A was 1.41 µg/L and at Station 35B the concentration was 1.75 µg/L.

Because of the loss of eelgrass bed habitat, the Aquatic Life Use is assessed as impaired for this segment of the East Branch Westport River. The eelgrass bed loss may be associated with nutrient enrichment (i.e., elevated nitrogen loadings) from nonpoint sources (animal feeding operation and storm drains) or other anthropogenic activities that result in reduced water clarity. Suspected sources of nutrient enrichment include septic systems. Habitat alteration (tidal restriction) in the form of sedimentation at the Hix bridge is also a concern.

SHELLFISH HARVESTING
The DMF Shellfish Status Report of July 2000 indicates that shellfish growing areas BB3.0, BB3.13, BB4.0, BB4.24 are approved; BB4.13 and BB4.20, BB4.7, BB4.8, BB4.9 are conditionally approved; BB4.1, BB4.5, BB4.6, and BB4.11 are prohibited; and BB4.2 is restricted (DFWELE 2000).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as support for 2.01 mi2 and impaired for 0.64mi2.

PRIMARY AND SECONDARY CONTACT RECREATION
WRWA collected FC and Enterococcus bacteria samples at their water quality stations between March and October 2001(Carvalho-Souza 2002).

[See table on page 70 of Water Quality Assessment Report]

Enterococci counts ranged from 0 to 49,400 cfu/100mL (n=83). Enterococci counts at the tributary station ranged from 3 to 13,500 cfu/100mL (n=17)(Carvalho-Souza 2002).

ESS conducted a bacteriological NPS assessment project (01-02/MWI) of the East Branch Westport River. In-stream sampling occurred in the upstream segment of the river. One wet weather storm drain sample was collected from station WR4 on 17 December 2001; the FC bacteria count was 60 cfu/100mL. There are three additional storm drains that discharge untreated storm water to the East Branch Westport River downstream of Head Bridge/Old Colony Road (ESS 2003). FC bacteria at station WR1 (storm drain along west side of Head Bridge at Old Colony Road) ranged from 1 to 700 (n=3). At station WR2 (storm drain along east side of Head Bridge at Old colony Road) FC bacteria counts were 610 and 1,600 cfu/100mL (n=2). Sampling from the storm drains indicated that station WR5 at Gifford Road, between Old Colony Road and Rte 177 (upstream of this segment), was a significant source of FC bacteria during wet weather (counts were 580,000 and 2,100,000 cfu/100mL; n=2). FC bacteria at station WR1 ranged from 1 to 700 (n=3) and at station WR2 FC bacteria counts were 610 and 1,600 cfu/100mL. Station WR5 is immediately downstream from the Ferry Farm. The area has three small detention/infiltration basins, however, it does not appear to be designed properly. ESS recommended that the downgradient side of the system be reconstructed or reinforced with a water impermeable material and that vigorous behavioral BMPs be implemented at the farm.

The Town of Westport was awarded a s. 319 grant for a storm water mitigation project in 2002. The project will install two BMPs; one a pocket wetland at station WR2 and the other at the farm on Gifford Road to treat the first flush using sediment collection and effluent infiltration. Pre- and post water quality monitoring will be conducted to determine the inefficiency. The

project is expected to take 2½ years to complete. QAPP development began in January 2003 (Peirce 2003).

Based on the high FC bacteria counts, the Primary and Secondary Contact Recreational Uses are assessed as impaired for the upper 2.43 square miles. The lower 0.22 square miles are assessed as support based on the DMF shellfish classification (approved).
The drainage area of this segment is approximately 58.4 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):
Forest 66 %
Residential 14 %
Agriculture 9 %
MassWildlife has proposed that Kirby Brook, a tributary to this segment, be reclassified in the SWQS as a cold water fishery (MassWildlife 2001). There is public access to the Westport River via one asphalt boat launch maintained by the Department of Environmental Management Forest and Parks Division. There are 35 parking spaces at this location (DFWELE 2002). There are two vessel sewage pump-out boats at the Westport Point-Town Dock (BBP undated and DMF 29 January 2003).
The Coalition for Buzzards Bay conducted weekly water quality monitoring for dissolved oxygen, temperature, salinity, and water clarity (Secchi depth) at seven stations on this segment of the East Branch Westport River between May and September from 1992

Report Recommendations:
· Review the results of the ACOE flushing study and implement recommendations as appropriate. Data from the report could be used to assess the Aquatic Life Use.

· Review the sediment chemistry and biomonitoring results of the CZM Coastal 2000 Project to assess the status of the Aquatic Life Use and investigate the potential source of sediment toxicity at Station 35A near Little Ram Island.

· Continue to support the implementation of best management practices (BMPs) at dairy farms within the region to reduce bacteria/nutrient inputs to the subwatershed.

· Review and implement recommendations in the DMF anadromous fish assessment report, when available, to improve water quality and spawning habitat. If applicable, review for data to assess the Aquatic Life Use.

· Develop a monitoring program for bacteria to document the effectiveness of bacteria source reduction activities including treatment of storm water discharges, compliance with CAFO permit, and the Phase II community storm water management programs and to continue to assess the recreational uses.

· Review and implement, as appropriate, recommendations from DMF shellfish survey program reports (sanitary surveys and triennial reports) to reduce bacteria and remediate sources causing the closure of the shellfish beds. Continue to review DMF shellfish status report to assess the Shellfish Harvesting Use.

· Continue to work with the WRWA to promote education and outreach programs to protect surface water resources. Offer technical support and guidance to WRWA to continue/expand their water quality monitoring program. Review final reports to assess the Aquatic Life Use and recreational uses.

· Work with the Buzzards Bay Coalition to improve quality assurance procedures, data exchange, and if deemed necessary, increase spatial and temporal coverage of in-situ monitoring. Review final reports to continue to assess the Aquatic Life Use.

· Implement those 11 salt marsh restoration projects identified in the 2002 Atlas of Tidally Restricted Salt Marshes – Buzzards Bay Watershed, Massachusetts that have been evaluated and prioritized by the Town. Sites in this subwatershed are WP04 through WP14. Site WP06 is at the Hix Bridge where the Massachusetts Highway Department has a reconstruction project scheduled for 2003. Develop a monitoring plan to assess the effectiveness of the projects and to assess the Aquatic Life Use.

· Continue to support efforts to map the distribution of eelgrass beds throughout the Buzzards Bay Watershed and continue to examine the health and biovolume of the plants as indicators of water quality. Review data to assess the Aquatic Life Use.

Buzzards Bay Watershed 2000 Water Quality Assessment Report (MA95-59 - Snell Creek)

SHELLFISH HARVESTING
The DMF Shellfish Status Report of July 2000 indicates that growing area BB4.2, which includes this entire segment, is restricted (DFWELE 2000).

Based on the DMF shellfish growing area status, the Shellfish Harvesting Use is assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION
As a result of elevated FC bacteria counts documented by WRWA at Marcus' Bridge and the known problems at the Pimental Farm (see segment MA95-45) both the recreational uses are assessed as impaired.
The drainage area of this segment is approximately 1.7 square miles. Land-use estimates (top three, excluding water) for the subwatershed (map inset, gray shaded area):
Forest 63 %
Agriculture 18 %
Residential 14 %

Report Recommendations:
· Develop a monitoring program for bacteria to document effectiveness of bacteria source reduction activities including treatment of storm water discharges, compliance with CAFO permit, and the Phase II community storm water management programs and to continue to assess the recreational uses.

· Review and implement, as appropriate, recommendations from DMF shellfish survey program reports (sanitary surveys and triennial reports) to reduce bacteria and remediate sources causing the closure of the shellfish beds. Continue to review DMF shellfish status report to assess the Shellfish Harvesting Use.

· Continue to work with the WRWA to promote education and outreach programs to protect surface water resources. Offer technical support and guidance to WRWA to continue/expand their water quality monitoring program. Review final reports to assess the Aquatic Life Use and the recreational uses.

Final Pathogen TMDL for the Buzzards Bay Watershed
(MA95-58 - Bread and Cheese Brook)

Problem Assessment
Available bacteria data are summarized in the following section. The primary sources of data include, but are not limited to, DMF, CZM, MassDEP, and the Westport River Watershed Alliance (WRWA).
Additional discussion can be found at:
• MassDEP WQA 2003 – Buzzards Bay Watershed 2000 Water Quality Assessment Report available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm.
• MACZM 2003 – Atlas of Stormwater Discharges in the Buzzards Bay Watershed available for download at http://www.buzzardsbay.org/stormatlas.htm
The summary tables for each segment contain data sources and calendar years for which data were collected. The "Station" column displays the sampling location identifier issued by sampling organization and a short narrative description if available. The next three columns provide statistics relating to sampling conducted. These columns provide the number of samples collected as well as the number of those samples that were collected during the primary contact season. The next column provides the range of FC values for the samples collected at that station. The "geometric mean" column provides the geometric mean of all the samples collected for a particular station if sufficient data exists. The number and percentage of samples exceeding a threshold value is also reported in this column. The threshold values provided in this TMDL are those established by the MassDEP in the WQA and are: 100 cfu/100mL (Class A WQS- average shall not exceed 20 cfu/100mL, and 10% of the samples shall not exceed 100 cfu/100mL); (Class SA Shellfishing Approved- average shall not exceed 14cfu/ 100mL, and 10% of the samples shall not exceed 28 cfu/100 mL); (Class SB Shellfishing Approved (but not necessarily open)- average shall not exceed 88cfu/100 mL, and 10% of samples shall not exceed 260 cfu/100mL); (Class B WQS: geometric average (E coli) shall not exceed 126cfu/100mL, and a single sample shall not exceed 235 cfu/100mL (it should be noted that in January 2007, MA WQS for bacteria were revised to E coli). The percentage value indicates the percent of the samples exceeding the noted threshold. For example "7 samples >126 (44%)" indicates that 7 samples contained FC densities greater

than 126 cfu/100mL, equating to 44% of the samples analyzed. It should be noted that some of these percentages are calculated based on the number of samples analyzed during the primary contact season, while others may be calculated based on total number of samples. Note that while many of the data included here are for FC, which remain the indicator of sanitary quality for shellfish areas, E. coli and enterococcus in fresh water and enterococcus in salt water are now the standards for swimming. Nevertheless, FC remain a qualitative indicator of water quality.

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.

Individual maps showing catch basins and storm drain discharges are available in the "Atlas of Stormwater Discharges in the Buzzards Bay Watershed" (MACZM 2003).

The Buzzards Bay Project National Estuary Program, through the Mass CZM office in East Wareham, has granted permission to include maps and other relevant information in this final TMDL report. These maps provide locations and prioritization of catch basins, storm drains and road cuts inventoried by the MACZM. This entire report is also available for download: http://www.buzzardsbay.org/stormatlas.htm.

The following section of this report is intended to briefly summarize the impaired waterbody segments and available data in the Buzzards Bay watershed. For more information on any of these segments, see the "Buzzards Bay Watershed 2000 Water Quality Assessment Report" on the MassDEP website: http://www.mass.gov/dep/brp/wm/wqassess.htm.

Between 1997 and 2001, DMF collected over 37,000 FC samples from tributaries of Buzzards Bay.

Bread and Cheese Brook Segment MA95-58

This is a 4.9 mile long Class B river segment, running from the headwaters, north of Old Bedford Road, Westport to confluence with East Branch Westport River, Westport. WRWA collected bacteria samples from Bread and Cheese Brook at Rte 177 between March and October 2001 (Table 4-25 below). Two elevated counts were representative of wet weather conditions. ESS also collected FC bacteria samples from the three stations along Bread and Cheese Brook as part of a Nonpoint Source bacteriological assessment project (01-02/MWI). ESS noted that large impervious areas along Route 6 and Gifford Road convey storm water runoff directly into Bread and Cheese Brook. Livestock pastures were also noted within 200 feet of the brook.

Bread and Cheese Brook was previously listed for pathogen impairments. Data collected by the Westport River Watershed Alliance and ESS are provided in the following table (originally Table 4-25 "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009) and identify periodic exceedances of the State Water Quality Standards.

Table MA95-58 Bread and Cheese Brook; WRWA Fecal Coliform Data

Station(s)	Total Number of Samples (Number of Samples during Primary Contact Season)	Fecal Coliform Bacteria Range (cfu/100mL)
Route 177, Westport (WRWA)	17	0 – 1,190*
WR-13, Bedford Rd; WR-12, Route 6; WR-10, Route 177 (ESS)	12	< 100

* Enterococci counts at Rte 177 ranged from 0 to 4940 cfu/100ml (n=16).

b>Watershed Description

Buzzards Bay watershed is bordered to the east by Cape Cod and to the northeast by southeastern Massachusetts. The bay is 28 miles long and 8 miles wide (MACZM 2003). The Buzzards Bay watershed drains 432 square miles and includes 17 cities and towns within Massachusetts and Rhode Island. Land use within the watershed is primarily undeveloped forest.

Development in the watershed is concentrated in a half mile area landward of the coastline. MassDEP estimated a population of 373,690 people living in the watershed in 2000 (MassDEP 2003b). Two-fifths of these people reside in the Greater New Bedford area.

The 280 mile coastline includes 11 miles of public beaches. 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).

The drainage basin includes several rivers, which flow into Buzzards Bay. The rivers tend to increase in velocity and width as they near the bay. In comparison to other rivers in the state, the rivers in the Buzzards Bay watershed tend to be shorter and have smaller drainage areas. Water also enters the Bay through groundwater seepage.

Significant natural and cultural resources exist in the Buzzards Bay Watershed that warrants special protection. The Back River and the Pocasset River 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. The entire Buzzards Bay is considered a "No Discharge Area" (NDA). NDAs are waterbodies in which a state, with EPA approval, has determined to be important ecological or recreational areas worthy of special protection against the release of raw or treated sewage in navigable waters. Vessels are banned from discharging both raw and treated sewage in a NDA (USEPA 2004a).

The Buzzards Bay 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, public water supply, and beachfront.

MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm

MassDEP 2003b. Buzzards Bay Watershed 2000 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

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

Potential Bacteria Sources

The Buzzards Bay watershed has 52 segments, located throughout the watershed, that are listed as pathogen impaired requiring a TMDL. These segments represent 100% of the estuary area and 21.3% of the river miles that have been assessed. Sources of indicator bacteria in the Buzzards Bay watershed are many and varied. A number of organizations and local governments have conducted work over the last decade in an effort to identify and address local sources of bacteria. Even with these efforts much more needs to be done.

Largely through the efforts organizations such as the Westport River Watershed Association (WRWA), the Division of Marine Fisheries (DMF), the MA Office of Coastal Zone Management (MACZM), and MassDEP field staff, numerous point and non-point sources of pathogens have been identified. The following two tables (originally from Table 5-1 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009) summarizes a number of impaired segments and some of the suspected and known sources identified in the state Watershed Assessment Report (WAR) or by other organizations (e.g., MACZM, WRWA, etc.).

Table . Potential Sources of Bacteria in Pathogen Impaired Segments in the Buzzards Bay Watershed.

Segment	Segment Name	Potential Sources
MA95-40	East Branch Westport River	MS4, highway/road runoff, animal feeding operations
MA95-45	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-59	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-41	East Branch Westport River	Animal feeding operation, dairy outside milk parlor area, grazing in riparian zone, MS4, on-site septic systems, highway/road runoff
MA95-37	West Branch Westport River	MS4
MA95-54	Westport River	MS4
MA95-34	Slocums River	On-site treatment systems (septic systems), urbanized high density area, MS4
MA95-44	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-31	Acushnet River	Unknown
MA95-32	Acushnet River	Unknown
MA95-33	Acushnet River	CSO, urbanized high density area
MA95-42	New Bedford Inner Harbor	CSO, urbanized high density area, waterfowl
MA95-63	Outer New Bedford Harbor	MS4
MA95-38	Clarks Cove	CSO, urbanized high density area, MS4
MA95-13	Buttonwood Brook	Unknown
MA95-39	Apponagansett Bay	On-site treatment systems, urbanized high density area, MS4
MA95-35	Mattapoisett Harbor	MS4
MA95-39	Mattapoisett River	MS4
MA95-65	Nasketucket Bay	MS4
MA95-56	Hammett Cove	MS4
MA95-08	Sippican Harbor	MS4
MA95-09	Aucoot Cove	MS4
MA95-10	Hiller Cove	MS4
MA95-64	Little Bay	Unknown
MA95-07	Sippican River	MS4
MA95-53	Beaverdam Creek	MS4
MA95-58	Bread and Cheese Brook	MS4, Livestock
MA95-05	Weweantic River	MS4, on-site treatment systems (septic systems)
MA95-29	Agawam River	MS4, municipal point source discharge
MA95-50	Wankinco River	MS4
MA95-49	Broad Marsh River	MS4
MA95-51	Crooked River	MS4
MA95-52	Cedar Island Creek	MS4
MA95-03	Wareham River	MS4

Segment	Segment Name	Potential Sources
MA95-02	Onset Bay	MS4
MA95-01	Buttermilk Bay	MS4
MA95-62	Buzzards Bay	MS4
MA95-14	Cape Cod Canal	MS4, Boats
MA95-48	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-51	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-47	Back River	MS4, on-site treatment systems (septic systems)
MA95-15	Phinneys Harbor	On-site treatment systems (septic systems), highway/road runoff
MA95-16	Pocasset River	On-site treatment systems (septic systems), road runoff, MS4
MA95-17	Pocasset Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-18	Red Brook Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-21	Herring Brook	On-site treatment systems (septic systems)
MA95-46	Harbor Head	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-20	Wild Harbor Estuary	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-22	West Falmouth Harbor	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-23	Great Sippewisset Creek	On-site treatment systems (septic systems), highway/road runoff
MA95-24	Little Sippewisset Marsh	On-site treatment systems (septic systems), highway/road runoff
MA95-25	Quissett Harbor	On-site treatment systems (septic systems), road runoff

Specific sources for the remaining impaired segments are unknown

MS4 = Municipal Separate Storm Water Sewer System – community storm water drainage system

Most sources were identified in the MassDEP WQA, although some sources have been identified by other organizations such as WRWA and MACZM.

Suspected dry weather sources include:
1. animal feeding operations,
2. animal grazing in riparian zones,
3. leaking sewer pipes,
4. storm water drainage systems (illicit connections of sanitary sewers to storm drains),
5. failing septic systems,
6. recreational activities,
7. wildlife, including birds, and
8. illicit boat discharges.

Suspected and known wet weather sources include:
1. wildlife and domesticated animals (including pets),
2. storm water runoff including municipal separate storm sewer systems (MS4),
3. combined sewer overflows (CSOs), and
4. sanitary sewer overflows (SSOs).

It is difficult to provide accurate quantitative estimates of indicator bacteria contributions from the various sources in the Buzzards Bay watershed because many of the sources are diffuse and intermittent, and extremely difficult to monitor or accurately model. Many of

the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they could result in a potential health risk and, therefore, must be eliminated. Estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) can perhaps be achieved for wet and dry conditions using ambient data available that define baseline conditions (MassDEP 2003).

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.
MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm
MassDEP 2003. Buzzards Bay Watershed 2000 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

Final Pathogen TMDL for the Buzzards Bay Watershed (MA95-44 - Snell Creek)

Problem Assessment

Available bacteria data are summarized in the following section. The primary sources of data include, but are not limited to, DMF, CZM, MassDEP, and the Westport River Watershed Alliance (WRWA).

Additional discussion can be found at:

• MassDEP WQA 2003 – Buzzards Bay Watershed 2000 Water Quality Assessment Report available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm.

• MACZM 2003 – Atlas of Stormwater Discharges in the Buzzards Bay Watershed available for download at http://www.buzzardsbay.org/stormatlas.htm

The summary tables for each segment contain data sources and calendar years for which data were collected. The “Station” column displays the sampling location identifier issued by sampling organization and a short narrative description if available. The next three columns provide statistics relating to sampling conducted. These columns provide the number of samples collected as well as the number of those samples that were collected during the primary contact season. The next column provides the range of FC values for the samples collected at that station. The “geometric mean” column provides the geometric mean of all the samples collected for a particular station if sufficient data exists. The number and percentage of samples exceeding a threshold value is also reported in this column. The threshold values provided in this TMDL are those established by the MassDEP in the WQA and are: 100 cfu/100mL (Class A WQS- average shall not exceed 20 cfu/100mL, and 10% of the samples shall not exceed 100 cfu/100mL); (Class SA Shellfishing Approved- average shall not exceed 14cfu/ 100mL, and 10% of the samples shall not exceed 28 cfu/100 mL); (Class SB Shellfishing Approved (but not necessarily open)- average shall not exceed 88cfu/100 mL, and 10% of samples shall not exceed 260 cfu/100mL); (Class B WQS: geometric average (E coli) shall not exceed 126cfu/100mL, and a single sample shall not exceed 235 cfu/100mL (it should be noted that in January 2007, MA WQS for bacteria were revised to E coli). The percentage value indicates the percent of the samples exceeding the noted threshold. For example “7 samples >126 (44%)” indicates that 7 samples contained FC densities greater than 126 cfu/100mL, equating to 44% of the samples analyzed. It should be noted that some of these percentages are calculated based on the number of samples analyzed during the primary contact season, while others may be calculated based on total number of samples. Note that while many of the data included here are for FC, which remain the indicator of sanitary quality for shellfish areas, E. coli and enterococcus in fresh water and enterococcus in salt water are now the standards for swimming.

Nevertheless, FC remain a qualitative indicator of water quality. 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. Individual maps showing catch basins and storm drain discharges are available in the “Atlas of Stormwater Discharges in the Buzzards Bay Watershed” (MACZM 2003).

The Buzzards Bay Project National Estuary Program, through the Mass CZM office in East Wareham, has granted permission to include maps and other relevant information in this final TMDL report. These maps provide locations and prioritization of catch basins, storm drains and road cuts inventoried by the MACZM. This entire report is also available for download: http://www.buzzardsbay.org/stormatlas.htm.

The following section of this report is intended to briefly summarize the impaired waterbody segments and available data in the

Buzzards Bay watershed. For more information on any of these segments, see the "Buzzards Bay Watershed 2000 Water Quality Assessment Report" on the MassDEP website: http://www.mass.gov/dep/brp/wm/wqassess.htm.
Between 1997 and 2001, DMF collected over 37,000 FC samples from tributaries of Buzzards Bay.

Snell Creek Segment MA95-44

This 1.5 mile long Class B warm water fishery flows from the headwaters area west of Main Street, Westport, to Drift Road, Westport. WRWA collected FC and Enterococci bacteria samples at Station S-1, Snell Creek at Drift Road between March and October 2001. Samples were collected during both wet and dry weather. The majority of exceedances were recorded during wet weather conditions (Carvalho-Souza 2002).

Table MA95-44 Snell Creek; WRWA Fecal Coliform Data Summary.

Station	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mea
S-1 (n=20, 17 during primary contact season)	6 – 3,100	92 6 samples > 400 (3 2 samples > 2,000 (

Enterococci counts ranged from 2 to 37,000 cfu/100mL.

b>Watershed Description

Buzzards Bay watershed is bordered to the east by Cape Cod and to the northeast by southeastern Massachusetts. The bay is 28 miles long and 8 miles wide (MACZM 2003). The Buzzards Bay watershed drains 432 square miles and includes 17 cities and towns within Massachusetts and Rhode Island. Land use within the watershed is primarily undeveloped forest.

Development in the watershed is concentrated in a half mile area landward of the coastline. MassDEP estimated a population of 373,690 people living in the watershed in 2000 (MassDEP 2003b). Two-fifths of these people reside in the Greater New Bedford area. The 280 mile coastline includes 11 miles of public beaches. 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).

The drainage basin includes several rivers, which flow into Buzzards Bay. The rivers tend to increase in velocity and width as they near the bay. In comparison to other rivers in the state, the rivers in the Buzzards Bay watershed tend to be shorter and have smaller drainage areas. Water also enters the Bay through groundwater seepage.

Significant natural and cultural resources exist in the Buzzards Bay Watershed that warrants special protection. The Back River and the Pocasset River 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. The entire Buzzards Bay is considered a "No Discharge Area" (NDA). NDAs are waterbodies in which a state, with EPA approval, has determined to be important ecological or recreational areas worthy of special protection against the release of raw or treated sewage in navigable waters. Vessels are banned from discharging both raw and treated sewage in a NDA (USEPA 2004a).

The Buzzards Bay 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, public water supply, and beachfront.

MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm

MassDEP 2003b. Buzzards Bay Watershed 2000 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

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

Potential Bacteria Sources

The Buzzards Bay watershed has 52 segments, located throughout the watershed, that are listed as pathogen impaired requiring a TMDL. These segments represent 100% of the estuary area and 21.3% of the river miles that have been assessed. Sources of indicator bacteria in the Buzzards Bay watershed are many and varied. A number of organizations and local governments have conducted work

over the last decade in an effort to identify and address local sources of bacteria. Even with these efforts much more needs to be done.

Largely through the efforts organizations such as the Westport River Watershed Association (WRWA), the Division of Marine Fisheries (DMF), the MA Office of Coastal Zone Management (MACZM), and MassDEP field staff, numerous point and non-point sources of pathogens have been identified. The following two tables (originally from Table 5-1 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009) summarizes a number of impaired segments and some of the suspected and known sources identified in the state Watershed Assessment Report (WAR) or by other organizations (e.g., MACZM, WRWA, etc.).

Table . Potential Sources of Bacteria in Pathogen Impaired Segments in the Buzzards Bay Watershed.

Segment	Segment Name	Potential Sources
MA95-40	East Branch Westport River	MS4, highway/road runoff, animal feeding operations
MA95-45	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-59	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-41	East Branch Westport River	Animal feeding operation, dairy outside milk parlor area, grazing in riparian zone, MS4, on-site septic systems, highway/road runoff
MA95-37	West Branch Westport River	MS4
MA95-54	Westport River	MS4
MA95-34	Slocums River	On-site treatment systems (septic systems), urbanized high density area, MS4
MA95-44	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-31	Acushnet River	Unknown
MA95-32	Acushnet River	Unknown
MA95-33	Acushnet River	CSO, urbanized high density area
MA95-42	New Bedford Inner Harbor	CSO, urbanized high density area, waterfowl
MA95-63	Outer New Bedford Harbor	MS4
MA95-38	Clarks Cove	CSO, urbanized high density area, MS4
MA95-13	Buttonwood Brook	Unknown
MA95-39	Apponagansett Bay	On-site treatment systems, urbanized high density area, MS4
MA95-35	Mattapoisett Harbor	MS4
MA95-39	Mattapoisett River	MS4
MA95-65	Nasketucket Bay	MS4
MA95-56	Hammett Cove	MS4
MA95-08	Sippican Harbor	MS4
MA95-09	Aucoot Cove	MS4
MA95-10	Hiller Cove	MS4
MA95-64	Little Bay	Unknown
MA95-07	Sippican River	MS4
MA95-53	Beaverdam Creek	MS4
MA95-58	Bread and Cheese Brook	MS4, Livestock
MA95-05	Weweantic River	MS4, on-site treatment systems (septic systems)
MA95-29	Agawam River	MS4, municipal point source discharge
MA95-50	Wankinco River	MS4
MA95-49	Broad Marsh River	MS4
MA95-51	Crooked River	MS4
MA95-52	Cedar Island Creek	MS4
MA95-03	Wareham River	MS4

Segment	Segment Name	Potential Sources
MA95-02	Onset Bay	MS4
MA95-01	Buttermilk Bay	MS4
MA95-62	Buzzards Bay	MS4
MA95-14	Cape Cod Canal	MS4, Boats
MA95-48	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-51	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-47	Back River	MS4, on-site treatment systems (septic systems)
MA95-15	Phinneys Harbor	On-site treatment systems (septic systems), highway/road runoff
MA95-16	Pocasset River	On-site treatment systems (septic systems), road runoff, MS4
MA95-17	Pocasset Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-18	Red Brook Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-21	Herring Brook	On-site treatment systems (septic systems)
MA95-46	Harbor Head	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-20	Wild Harbor Estuary	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-22	West Falmouth Harbor	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-23	Great Sippewisset Creek	On-site treatment systems (septic systems), highway/road runoff
MA95-24	Little Sippewisset Marsh	On-site treatment systems (septic systems), highway/road runoff
MA95-25	Quissett Harbor	On-site treatment systems (septic systems), road runoff

Specific sources for the remaining impaired segments are unknown

MS4 = Municipal Separate Storm Water Sewer System – community storm water drainage system

Most sources were identified in the MassDEP WQA, although some sources have been identified by other organizations such as WRWA and MACZM.

Suspected dry weather sources include:
1. animal feeding operations,
2. animal grazing in riparian zones,
3. leaking sewer pipes,
4. storm water drainage systems (illicit connections of sanitary sewers to storm drains),
5. failing septic systems,
6. recreational activities,
7. wildlife, including birds, and
8. illicit boat discharges.

Suspected and known wet weather sources include:
1. wildlife and domesticated animals (including pets),
2. storm water runoff including municipal separate storm sewer systems (MS4),
3. combined sewer overflows (CSOs), and
4. sanitary sewer overflows (SSOs).

It is difficult to provide accurate quantitative estimates of indicator bacteria contributions from the various sources in the Buzzards Bay

watershed because many of the sources are diffuse and intermittent, and extremely difficult to monitor or accurately model. Many of the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they could result in a potential health risk and, therefore, must be eliminated. Estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) can perhaps be achieved for wet and dry conditions using ambient data available that define baseline conditions (MassDEP 2003).

Carvalho- Souza, R. 2002. WRWA 2001 Data. Westport River Watershed Alliance. Email to Katie O'Brien, MassDEP, Division of Watershed Management, July 25, 2002

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.

MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm

MassDEP 2003. Buzzards Bay Watershed 2000 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

Final Pathogen TMDL for the Buzzards Bay Watershed (MA95-54 - Westport River)

Problem Assessment

Available bacteria data are summarized in the following section. The primary sources of data include, but are not limited to, DMF, CZM, MassDEP, and the Westport River Watershed Alliance (WRWA).

Additional discussion can be found at:

• MassDEP WQA 2003 – Buzzards Bay Watershed 2000 Water Quality Assessment Report available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm.

• MACZM 2003 – Atlas of Stormwater Discharges in the Buzzards Bay Watershed available for download at http://www.buzzardsbay.org/stormatlas.htm

The summary tables for each segment contain data sources and calendar years for which data were collected. The "Station" column displays the sampling location identifier issued by sampling organization and a short narrative description if available. The next three columns provide statistics relating to sampling conducted. These columns provide the number of samples collected as well as the number of those samples that were collected during the primary contact season. The next column provides the range of FC values for the samples collected at that station. The "geometric mean" column provides the geometric mean of all the samples collected for a particular station if sufficient data exists. The number and percentage of samples exceeding a threshold value is also reported in this column. The threshold values provided in this TMDL are those established by the MassDEP in the WQA and are: 100 cfu/100mL (Class A WQS- average shall not exceed 20 cfu/100mL, and 10% of the samples shall not exceed 100 cfu/100mL); (Class SA Shellfishing Approved- average shall not exceed 14cfu/ 100mL, and 10% of the samples shall not exceed 28 cfu/100 mL); (Class SB Shellfishing Approved (but not necessarily open)- average shall not exceed 88cfu/100 mL, and 10% of samples shall not exceed 260 cfu/100mL); (Class B WQS: geometric average (E coli) shall not exceed 126cfu/100mL, and a single sample shall not exceed 235 cfu/100mL (it should be noted that in January 2007, MA WQS for bacteria were revised to E coli). The percentage value indicates the percent of the samples exceeding the noted threshold. For example "7 samples >126 (44%)" indicates that 7 samples contained FC densities greater than 126 cfu/100mL, equating to 44% of the samples analyzed. It should be noted that some of these percentages are calculated based on the number of samples analyzed during the primary contact season, while others may be calculated based on total number of samples. Note that while many of the data included here are for FC, which remain the indicator of sanitary quality for shellfish areas, E. coli and enterococcus in fresh water and enterococcus in salt water are now the standards for swimming.

Nevertheless, FC remain a qualitative indicator of water quality. 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. Individual maps showing catch basins and storm drain discharges are available in the "Atlas of Stormwater Discharges in the Buzzards Bay Watershed" (MACZM 2003).

The Buzzards Bay Project National Estuary Program, through the Mass CZM office in East Wareham, has granted permission to include maps and other relevant information in this final TMDL report. These maps provide locations and prioritization of catch basins, storm

drains and road cuts inventoried by the MACZM. This entire report is also available for download: http://www.buzzardsbay.org/stormatlas.htm.
The following section of this report is intended to briefly summarize the impaired waterbody segments and available data in the Buzzards Bay watershed. For more information on any of these segments, see the "Buzzards Bay Watershed 2000 Water Quality Assessment Report" on the MassDEP website: http://www.mass.gov/dep/brp/wm/wqassess.htm.
Between 1997 and 2001, DMF collected over 37,000 FC samples from tributaries of Buzzards Bay.

Westport River MA95-54

This 0.74 square mile segment is a Class SA waterbody. The segment extends from the confluences of the East and West Branches of the Westport River to Rhode Island Sound. The Town of Westport has submitted a NOI requesting permit coverage under the NPDES program for their MS4. According to the "Atlas of Stormwater Discharges in the Buzzards Bay Watershed", within the town of Westport (which includes part of this segment) there are 29 low priority, 109 medium priority, and 17 high priority discharges. A total of 17 of these discharges have been remediated. Separate maps, outlining stormwater drainage systems with outfalls (Westport Maps #8,9) of this segment and surrounding areas are available for download at http://www.buzzardsbay.org/stormatlas.htm.
Shellfish harvesting is supported in 0.5 square miles of this segment and impaired in 0.78 square miles due to elevated FC concentrations.
DMF 5 year (1997-2001) FC geometric mean data (taken in both dry and wet weather periods) for stations in this segment indicate relatively low levels for the SA Classification at most stations (0- 4.4cfu/100mL) Summaries of FC data are available for download at http://www.buzzardsbay.org/stormatlas.htm.
A summary of FC data collected by WRWA between March and October 2001 (MassDEP 2003b) is provided in the following table (originally Table 4-9 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009).

Table MA95-54 Westport River; WRWA Fecal Coliform Data Summary.

Station	Total Number of Samples (Number of Samples during Primary Contact Season)	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Me (cfu/100mL
11A: Off of Westport Town Wharf	19 (17)	<1 – 1040	5.0 1 sample > 400
7: Harbor entrance at Charlton Wharf	9* (9)	1 – 157	5.9

* value reported as zero was not used in the reported range or calculation
Enterococci counts for 11A ranged from 0-410 cfu/100mL (17 samples); counts at station 7 ranged from samples)

b>Watershed Description

Buzzards Bay watershed is bordered to the east by Cape Cod and to the northeast by southeastern Massachusetts. The bay is 28 miles long and 8 miles wide (MACZM 2003). The Buzzards Bay watershed drains 432 square miles and includes 17 cities and towns within Massachusetts and Rhode Island. Land use within the watershed is primarily undeveloped forest.
Development in the watershed is concentrated in a half mile area landward of the coastline. MassDEP estimated a population of 373,690 people living in the watershed in 2000 (MassDEP 2003b). Two-fifths of these people reside in the Greater New Bedford area. The 280 mile coastline includes 11 miles of public beaches. 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).
The drainage basin includes several rivers, which flow into Buzzards Bay. The rivers tend to increase in velocity and width as they near the bay. In comparison to other rivers in the state, the rivers in the Buzzards Bay watershed tend to be shorter and have smaller drainage areas. Water also enters the Bay through groundwater seepage.
Significant natural and cultural resources exist in the Buzzards Bay Watershed that warrants special protection. The Back River and the Pocasset River 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. The entire Buzzards Bay is considered a "No Discharge Area" (NDA). NDAs are waterbodies in which a state, with EPA approval, has determined to be important ecological or recreational areas worthy of special protection against the release of raw or treated sewage in navigable waters. Vessels are banned from discharging both raw and treated sewage in a NDA (USEPA 2004a).

The Buzzards Bay 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, public water supply, and beachfront.

MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm

MassDEP 2003b. Buzzards Bay Watershed 2000 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

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

Potential Bacteria Sources

The Buzzards Bay watershed has 52 segments, located throughout the watershed, that are listed as pathogen impaired requiring a TMDL. These segments represent 100% of the estuary area and 21.3% of the river miles that have been assessed. Sources of indicator bacteria in the Buzzards Bay watershed are many and varied. A number of organizations and local governments have conducted work over the last decade in an effort to identify and address local sources of bacteria. Even with these efforts much more needs to be done.

Largely through the efforts organizations such as the Westport River Watershed Association (WRWA), the Division of Marine Fisheries (DMF), the MA Office of Coastal Zone Management (MACZM), and MassDEP field staff, numerous point and non-point sources of pathogens have been identified. The following two tables (originally from Table 5-1 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009) summarizes a number of impaired segments and some of the suspected and known sources identified in the state Watershed Assessment Report (WAR) or by other organizations (e.g., MACZM, WRWA, etc.).

Table . Potential Sources of Bacteria in Pathogen Impaired Segments in the Buzzards Bay Watershed.

Segment	Segment Name	Potential Sources
MA95-40	East Branch Westport River	MS4, highway/road runoff, animal feeding operations
MA95-45	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-59	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-41	East Branch Westport River	Animal feeding operation, dairy outside milk parlor area, grazing in riparian zone, MS4, on-site septic systems, highway/road runoff
MA95-37	West Branch Westport River	MS4
MA95-54	Westport River	MS4
MA95-34	Slocums River	On-site treatment systems (septic systems), urbanized high density area, MS4
MA95-44	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-31	Acushnet River	Unknown
MA95-32	Acushnet River	Unknown
MA95-33	Acushnet River	CSO, urbanized high density area
MA95-42	New Bedford Inner Harbor	CSO, urbanized high density area, waterfowl
MA95-63	Outer New Bedford Harbor	MS4
MA95-38	Clarks Cove	CSO, urbanized high density area, MS4
MA95-13	Buttonwood Brook	Unknown
MA95-39	Apponagansett Bay	On-site treatment systems, urbanized high density area, MS4
MA95-35	Mattapoisett Harbor	MS4
MA95-39	Mattapoisett River	MS4
MA95-65	Nasketucket Bay	MS4
MA95-56	Hammett Cove	MS4
MA95-08	Sippican Harbor	MS4
MA95-09	Aucoot Cove	MS4
MA95-10	Hiller Cove	MS4
MA95-64	Little Bay	Unknown
MA95-07	Sippican River	MS4
MA95-53	Beaverdam Creek	MS4
MA95-58	Bread and Cheese Brook	MS4, Livestock
MA95-05	Weweantic River	MS4, on-site treatment systems (septic systems)
MA95-29	Agawam River	MS4, municipal point source discharge
MA95-50	Wankinco River	MS4
MA95-49	Broad Marsh River	MS4
MA95-51	Crooked River	MS4
MA95-52	Cedar Island Creek	MS4
MA95-03	Wareham River	MS4

Segment	Segment Name	Potential Sources
MA95-02	Onset Bay	MS4
MA95-01	Buttermilk Bay	MS4
MA95-62	Buzzards Bay	MS4
MA95-14	Cape Cod Canal	MS4, Boats
MA95-48	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-51	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-47	Back River	MS4, on-site treatment systems (septic systems)
MA95-15	Phinneys Harbor	On-site treatment systems (septic systems), highway/road runoff
MA95-16	Pocasset River	On-site treatment systems (septic systems), road runoff, MS4
MA95-17	Pocasset Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-18	Red Brook Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-21	Herring Brook	On-site treatment systems (septic systems)
MA95-46	Harbor Head	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-20	Wild Harbor Estuary	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-22	West Falmouth Harbor	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-23	Great Sippewisset Creek	On-site treatment systems (septic systems), highway/road runoff
MA95-24	Little Sippewisset Marsh	On-site treatment systems (septic systems), highway/road runoff
MA95-25	Quissett Harbor	On-site treatment systems (septic systems), road runoff

Specific sources for the remaining impaired segments are unknown

MS4 = Municipal Separate Storm Water Sewer System – community storm water drainage system

Most sources were identified in the MassDEP WQA, although some sources have been identified by other organizations such as WRWA and MACZM.

Suspected dry weather sources include:
1. animal feeding operations,
2. animal grazing in riparian zones,
3. leaking sewer pipes,
4. storm water drainage systems (illicit connections of sanitary sewers to storm drains),
5. failing septic systems,
6. recreational activities,
7. wildlife, including birds, and
8. illicit boat discharges.

Suspected and known wet weather sources include:
1. wildlife and domesticated animals (including pets),
2. storm water runoff including municipal separate storm sewer systems (MS4),
3. combined sewer overflows (CSOs), and
4. sanitary sewer overflows (SSOs).

It is difficult to provide accurate quantitative estimates of indicator bacteria contributions from the various sources in the Buzzards Bay

watershed because many of the sources are diffuse and intermittent, and extremely difficult to monitor or accurately model. Many of the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they could result in a potential health risk and, therefore, must be eliminated. Estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) can perhaps be achieved for wet and dry conditions using ambient data available that define baseline conditions (MassDEP 2003).

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.
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Final Pathogen TMDL for the Buzzards Bay Watershed (MA95-40 - East Branch Westport River)

Problem Assessment

Available bacteria data are summarized in the following section. The primary sources of data include, but are not limited to, DMF, CZM, MassDEP, and the Westport River Watershed Alliance (WRWA).

Additional discussion can be found at:

• MassDEP WQA 2003 – Buzzards Bay Watershed 2000 Water Quality Assessment Report available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm.

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The summary tables for each segment contain data sources and calendar years for which data were collected. The “Station” column displays the sampling location identifier issued by sampling organization and a short narrative description if available. The next three columns provide statistics relating to sampling conducted. These columns provide the number of samples collected as well as the number of those samples that were collected during the primary contact season. The next column provides the range of FC values for the samples collected at that station. The “geometric mean” column provides the geometric mean of all the samples collected for a particular station if sufficient data exists. The number and percentage of samples exceeding a threshold value is also reported in this column. The threshold values provided in this TMDL are those established by the MassDEP in the WQA and are: 100 cfu/100mL (Class A WQS- average shall not exceed 20 cfu/100mL, and 10% of the samples shall not exceed 100 cfu/100mL); (Class SA Shellfishing Approved- average shall not exceed 14cfu/ 100mL, and 10% of the samples shall not exceed 28 cfu/100 mL); (Class SB Shellfishing Approved (but not necessarily open)- average shall not exceed 88cfu/100 mL, and 10% of samples shall not exceed 260 cfu/100mL); (Class B WQS: geometric average (E coli) shall not exceed 126cfu/100mL, and a single sample shall not exceed 235 cfu/100mL (it should be noted that in January 2007, MA WQS for bacteria were revised to E coli). The percentage value indicates the percent of the samples exceeding the noted threshold. For example “7 samples >126 (44%)” indicates that 7 samples contained FC densities greater than 126 cfu/100mL, equating to 44% of the samples analyzed. It should be noted that some of these percentages are calculated based on the number of samples analyzed during the primary contact season, while others may be calculated based on total number of samples. Note that while many of the data included here are for FC, which remain the indicator of sanitary quality for shellfish areas, E. coli and enterococcus in fresh water and enterococcus in salt water are now the standards for swimming.

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The Buzzards Bay Project National Estuary Program, through the Mass CZM office in East Wareham, has granted permission to include maps and other relevant information in this final TMDL report. These maps provide locations and prioritization of catch basins, storm drains and road cuts inventoried by the MACZM. This entire report is also available for download: http://www.buzzardsbay.org/stormatlas.htm.

The following section of this report is intended to briefly summarize the impaired waterbody segments and available data in the Buzzards Bay watershed. For more information on any of these segments, see the "Buzzards Bay Watershed 2000 Water Quality Assessment Report" on the MassDEP website: http://www.mass.gov/dep/brp/wm/wqassess.htm.
Between 1997 and 2001, DMF collected over 37,000 FC samples from tributaries of Buzzards Bay.

East Branch Westport River Segment MA95-40

This 2.85 mile long segment is a Class B warm water fishery in Westport. The segment begins at the outlet of Lake Noquochoke and extends to Old County Road bridge. The East Branch Westport River watershed contains 169.4 acres of cranberry bog open space. Mid City Scrap Iron & Salvage has a general storm water permit for this segment. The Town of Westport has submitted a Notice of Intent (NOI) requesting permit coverage under the NPDES program for their municipal separate storm sewer system (MS4). According to the "Atlas of Stormwater Discharges in the Buzzards Bay Watershed", within the two combined MA segments, East Branch Westport River, MA 95-40, and 95-41, there are 584 catch basins, of which 103 are treated, and there are a total of 332 pipe or road cut discharges, of which 126 are ranked medium or high priority for remediation, 17 of which have been remediated. A map showing stormwater discharge priorities (Priority Map #1) for this particular segment and a separate map, outlining stormwater drainage systems with outfalls (Westport Map #2) of this segment and surrounding areas are available for download at http://www.buzzardsbay.org/stormatlas.htm.
A summary of FC data collected by the Westport River Watershed Alliance (WRWA), and Environmental Sciences Services, Inc. (ESS), in 2001 and 2002 (MassDEP 2003b) is provided in the following table (originally Table 4-4 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009).
The Alliance conducted their monitoring program under an approved QAPP (Costa 2008). Samples were collected during both wet and dry weather. The majority of the high FC counts were collected during wet weather conditions.

Table MA95-40 East Branch Westport River WRWA Fecal Coliform Data Summary

Station	Total Number of Samples (Number of Samples during Primary Contact Season)	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric (cfu/100
A-1: Westport River at Rte 177 (WRWA)	18 (16)	2 – 2,470	83 3 samples > 4 1 sample > 2,
3: Head of Westport River at Old Colony Rd (WRWA)	18 (16)	25 – 84,000	375 7 samples > 4 4 samples > 2,
Storm drain at Gifford Road between Route 177 and Old Colony Rd.(ESS)	2	580,000-2,100,000	Insufficien

Enterococci counts, collected by WRWA, ranged from 2-201,000 cfu/100mL (35 samples); 74% > 61 cfu/100

Watershed Description

Buzzards Bay watershed is bordered to the east by Cape Cod and to the northeast by southeastern Massachusetts. The bay is 28 miles long and 8 miles wide (MACZM 2003). The Buzzards Bay watershed drains 432 square miles and includes 17 cities and towns within Massachusetts and Rhode Island. Land use within the watershed is primarily undeveloped forest.
Development in the watershed is concentrated in a half mile area landward of the coastline. MassDEP estimated a population of 373,690 people living in the watershed in 2000 (MassDEP 2003b). Two-fifths of these people reside in the Greater New Bedford area. The 280 mile coastline includes 11 miles of public beaches. 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).
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Pocasset River 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. The entire Buzzards Bay is considered a "No Discharge Area" (NDA). NDAs are waterbodies in which a state, with EPA approval, has determined to be important ecological or recreational areas worthy of special protection against the release of raw or treated sewage in navigable waters. Vessels are banned from discharging both raw and treated sewage in a NDA (USEPA 2004a).
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Potential Bacteria Sources

The Buzzards Bay watershed has 52 segments, located throughout the watershed, that are listed as pathogen impaired requiring a TMDL. These segments represent 100% of the estuary area and 21.3% of the river miles that have been assessed. Sources of indicator bacteria in the Buzzards Bay watershed are many and varied. A number of organizations and local governments have conducted work over the last decade in an effort to identify and address local sources of bacteria. Even with these efforts much more needs to be done.

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MA95-45	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-59	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-41	East Branch Westport River	Animal feeding operation, dairy outside milk parlor area, grazing in riparian zone, MS4, on-site septic systems, highway/road runoff
MA95-37	West Branch Westport River	MS4
MA95-54	Westport River	MS4
MA95-34	Slocums River	On-site treatment systems (septic systems), urbanized high density area, MS4
MA95-44	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-31	Acushnet River	Unknown
MA95-32	Acushnet River	Unknown
MA95-33	Acushnet River	CSO, urbanized high density area
MA95-42	New Bedford Inner Harbor	CSO, urbanized high density area, waterfowl
MA95-63	Outer New Bedford Harbor	MS4
MA95-38	Clarks Cove	CSO, urbanized high density area, MS4
MA95-13	Buttonwood Brook	Unknown
MA95-39	Apponagansett Bay	On-site treatment systems, urbanized high density area, MS4
MA95-35	Mattapoisett Harbor	MS4
MA95-39	Mattapoisett River	MS4
MA95-65	Nasketucket Bay	MS4
MA95-56	Hammett Cove	MS4
MA95-08	Sippican Harbor	MS4
MA95-09	Aucoot Cove	MS4
MA95-10	Hiller Cove	MS4
MA95-64	Little Bay	Unknown
MA95-07	Sippican River	MS4
MA95-53	Beaverdam Creek	MS4
MA95-58	Bread and Cheese Brook	MS4, Livestock
MA95-05	Weweantic River	MS4, on-site treatment systems (septic systems)
MA95-29	Agawam River	MS4, municipal point source discharge
MA95-50	Wankinco River	MS4
MA95-49	Broad Marsh River	MS4
MA95-51	Crooked River	MS4
MA95-52	Cedar Island Creek	MS4
MA95-03	Wareham River	MS4

Segment	Segment Name	Potential Sources
MA95-02	Onset Bay	MS4
MA95-01	Buttermilk Bay	MS4
MA95-62	Buzzards Bay	MS4
MA95-14	Cape Cod Canal	MS4, Boats
MA95-48	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-51	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-47	Back River	MS4, on-site treatment systems (septic systems)
MA95-15	Phinneys Harbor	On-site treatment systems (septic systems), highway/road runoff
MA95-16	Pocasset River	On-site treatment systems (septic systems), road runoff, MS4
MA95-17	Pocasset Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-18	Red Brook Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-21	Herring Brook	On-site treatment systems (septic systems)
MA95-46	Harbor Head	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-20	Wild Harbor Estuary	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-22	West Falmouth Harbor	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-23	Great Sippewisset Creek	On-site treatment systems (septic systems), highway/road runoff
MA95-24	Little Sippewisset Marsh	On-site treatment systems (septic systems), highway/road runoff
MA95-25	Quissett Harbor	On-site treatment systems (septic systems), road runoff

Specific sources for the remaining impaired segments are unknown

MS4 = Municipal Separate Storm Water Sewer System – community storm water drainage system

Most sources were identified in the MassDEP WQA, although some sources have been identified by other organizations such as WRWA and MACZM.

Suspected dry weather sources include:
1. animal feeding operations,
2. animal grazing in riparian zones,
3. leaking sewer pipes,
4. storm water drainage systems (illicit connections of sanitary sewers to storm drains),
5. failing septic systems,
6. recreational activities,
7. wildlife, including birds, and
8. illicit boat discharges.

Suspected and known wet weather sources include:
1. wildlife and domesticated animals (including pets),
2. storm water runoff including municipal separate storm sewer systems (MS4),
3. combined sewer overflows (CSOs), and
4. sanitary sewer overflows (SSOs).

It is difficult to provide accurate quantitative estimates of indicator bacteria contributions from the various sources in the Buzzards Bay

watershed because many of the sources are diffuse and intermittent, and extremely difficult to monitor or accurately model. Many of the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they could result in a potential health risk and, therefore, must be eliminated. Estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) can perhaps be achieved for wet and dry conditions using ambient data available that define baseline conditions (MassDEP 2003).

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MassDEP 2003. Buzzards Bay Watershed 2000 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

Final Pathogen TMDL for the Buzzards Bay Watershed
(MA95-41 - East Branch Westport River)

Problem Assessment
Available bacteria data are summarized in the following section. The primary sources of data include, but are not limited to, DMF, CZM, MassDEP, and the Westport River Watershed Alliance (WRWA).
Additional discussion can be found at:
• MassDEP WQA 2003 – Buzzards Bay Watershed 2000 Water Quality Assessment Report available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm.
• MACZM 2003 – Atlas of Stormwater Discharges in the Buzzards Bay Watershed available for download at http://www.buzzardsbay.org/stormatlas.htm
The summary tables for each segment contain data sources and calendar years for which data were collected. The "Station" column displays the sampling location identifier issued by sampling organization and a short narrative description if available. The next three columns provide statistics relating to sampling conducted. These columns provide the number of samples collected as well as the number of those samples that were collected during the primary contact season. The next column provides the range of FC values for the samples collected at that station. The "geometric mean" column provides the geometric mean of all the samples collected for a particular station if sufficient data exists. The number and percentage of samples exceeding a threshold value is also reported in this column. The threshold values provided in this TMDL are those established by the MassDEP in the WQA and are: 100 cfu/100mL (Class A WQS- average shall not exceed 20 cfu/100mL, and 10% of the samples shall not exceed 100 cfu/100mL); (Class SA Shellfishing Approved- average shall not exceed 14cfu/ 100mL, and 10% of the samples shall not exceed 28 cfu/100 mL); (Class SB Shellfishing Approved (but not necessarily open)- average shall not exceed 88cfu/100 mL, and 10% of samples shall not exceed 260 cfu/100mL); (Class B WQS: geometric average (E coli) shall not exceed 126cfu/100mL, and a single sample shall not exceed 235 cfu/100mL (it should be noted that in January 2007, MA WQS for bacteria were revised to E coli). The percentage value indicates the percent of the samples exceeding the noted threshold. For example "7 samples >126 (44%)" indicates that 7 samples contained FC densities greater than 126 cfu/100mL, equating to 44% of the samples analyzed. It should be noted that some of these percentages are calculated based on the number of samples analyzed during the primary contact season, while others may be calculated based on total number of samples. Note that while many of the data included here are for FC, which remain the indicator of sanitary quality for shellfish areas, E. coli and enterococcus in fresh water and enterococcus in salt water are now the standards for swimming.
Nevertheless, FC remain a qualitative indicator of water quality. 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. Individual maps showing catch basins and storm drain discharges are available in the "Atlas of Stormwater Discharges in the Buzzards Bay Watershed" (MACZM 2003).
The Buzzards Bay Project National Estuary Program, through the Mass CZM office in East Wareham, has granted permission to

include maps and other relevant information in this final TMDL report. These maps provide locations and prioritization of catch basins, storm drains and road cuts inventoried by the MACZM. This entire report is also available for download: http://www.buzzardsbay.org/stormatlas.htm.

The following section of this report is intended to briefly summarize the impaired waterbody segments and available data in the Buzzards Bay watershed. For more information on any of these segments, see the "Buzzards Bay Watershed 2000 Water Quality Assessment Report" on the MassDEP website: http://www.mass.gov/dep/brp/wm/wqassess.htm.

Between 1997 and 2001, DMF collected over 37,000 FC samples from tributaries of Buzzards Bay.

East Branch Westport River Segment MA95-41

This Class SB Shellfishing (restricted) segment covers 2.65 square miles beginning at Old County Road bridge. In the East Branch Westport River subwatershed, cranberry bogs make up 169.4 acres of open space.. F L Tripp & Sons Inc. has a general storm water permit to discharge in this watershed. This river segment is adjacent to a farm on Drift Road, which was issued the CAFO permit as discussed under Snell Creek MA95-45. Town of Westport has submitted a NOI requesting permit coverage under the NPDES program for their MS4. According to the "Atlas of Stormwater Discharges in the Buzzards Bay Watershed", within the two combined MA segments, East Branch Westport River, MA 95-40, and 95-41, there are 584 catch basins, of which 103 are treated, and there are a total of 332 pipe or road cut discharges, of which 126 are ranked medium or high priority for remediation, of which 17 have actually been remediated. A map showing stormwater discharge priorities (Priority Map #1) for this particular segment and separate maps, outlining stormwater drainage systems with outfalls (Westport Maps #2-4;6,7,9) of this segment and surrounding areas are available for download at http://www.buzzardsbay.org/stormatlas.htm.

Shellfish harvesting is impaired because of elevated levels of FC in 0.64 square miles of this segment. WRWA, ESS, and DMF data (taken in both dry and wet weather periods) are summarized in the following table (originally Table 4-7 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009).

Table MA95-41 East Branch Westport River; WRWA; ESS; DMF Fecal Coliform Data.

Station	Total Number of Samples (Number of Samples during Primary Contact Season)	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean (cfu/100mL)
14 (WRWA)	23 (20)	2 - 2,900	31 3 samples > 400 (14%) 1 sample > 2,000 (4%)
15(WRWA)	20 (18)	1 - 9,200	31 4 samples > 400 (22%) 3 samples > 2,000 (15%)
17(WRWA)	15 (14)	6 - 25,000	90 4 samples > 400 (29%) 2 samples > 2,000 (13%)
18(WRWA)	15 (13)	6 - 30,600	322 4 samples > 2000 (27%)
19(WRWA)	15 (15)	10 - 29,900	292 4 samples > 2,000 (27%)
KB(WRWA)	11 (10)	56 - 31,800	423 2 samples > 2,000 (18%)
K4(WRWA)	20 (18)	14 - 2,500	87 2 samples > 400 (11%) 1 sample > 2,000 (5%)
WR1(ESS)	3	1-700	Insufficient data
WR2(ESS)	2	610-1,600	Insufficient data
WR5(ESS)	2	580,000- 2,100,000	Insufficient data
DMF stations	2127	1- 492	8.3

Enterococci counts (data collected by WRWA) ranged from 0-49,400 cfu/100mL (83 samples)

Watershed Description

Buzzards Bay watershed is bordered to the east by Cape Cod and to the northeast by southeastern Massachusetts. The bay is 28 miles long and 8 miles wide (MACZM 2003). The Buzzards Bay watershed drains 432 square miles and includes 17 cities and towns within Massachusetts and Rhode Island. Land use within the watershed is primarily undeveloped forest. Development in the watershed is concentrated in a half mile area landward of the coastline. MassDEP estimated a population of 373,690 people living in the watershed in 2000 (MassDEP 2003b). Two-fifths of these people reside in the Greater New Bedford area. The 280 mile coastline includes 11 miles of public beaches. 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).
The drainage basin includes several rivers, which flow into Buzzards Bay. The rivers tend to increase in velocity and width as they near the bay. In comparison to other rivers in the state, the rivers in the Buzzards Bay watershed tend to be shorter and have smaller drainage areas. Water also enters the Bay through groundwater seepage.
Significant natural and cultural resources exist in the Buzzards Bay Watershed that warrants special protection. The Back River and the Pocasset River 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. The entire Buzzards Bay is considered a "No Discharge Area" (NDA). NDAs are waterbodies in which a state, with EPA approval, has determined to be important ecological or recreational areas worthy of special protection against the release of raw or treated sewage in navigable waters. Vessels are banned from discharging both raw and treated sewage in a NDA (USEPA 2004a).
The Buzzards Bay 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, public water supply, and beachfront.
MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm
MassDEP 2003b. Buzzards Bay Watershed 2000 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
USEPA 2004a. No Discharge Areas in Massachusetts. Information from website, downloaded March 2005. http://www.epa.gov/region01/eco/nodiscrg/ma.html

Potential Bacteria Sources

The Buzzards Bay watershed has 52 segments, located throughout the watershed, that are listed as pathogen impaired requiring a TMDL. These segments represent 100% of the estuary area and 21.3% of the river miles that have been assessed. Sources of indicator bacteria in the Buzzards Bay watershed are many and varied. A number of organizations and local governments have conducted work over the last decade in an effort to identify and address local sources of bacteria. Even with these efforts much more needs to be done.

Largely through the efforts organizations such as the Westport River Watershed Association (WRWA), the Division of Marine Fisheries (DMF), the MA Office of Coastal Zone Management (MACZM), and MassDEP field staff, numerous point and non-point sources of pathogens have been identified. The following two tables (originally from Table 5-1 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009) summarizes a number of impaired segments and some of the suspected and known sources identified in the state Watershed Assessment Report (WAR) or by other organizations (e.g., MACZM, WRWA, etc.).

Table . Potential Sources of Bacteria in Pathogen Impaired Segments in the Buzzards Bay Watershed.

Segment	Segment Name	Potential Sources
MA95-40	East Branch Westport River	MS4, highway/road runoff, animal feeding operations
MA95-45	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-59	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-41	East Branch Westport River	Animal feeding operation, dairy outside milk parlor area, grazing in riparian zone, MS4, on-site septic systems, highway/road runoff
MA95-37	West Branch Westport River	MS4
MA95-54	Westport River	MS4
MA95-34	Slocums River	On-site treatment systems (septic systems), urbanized high density area, MS4
MA95-44	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-31	Acushnet River	Unknown
MA95-32	Acushnet River	Unknown
MA95-33	Acushnet River	CSO, urbanized high density area
MA95-42	New Bedford Inner Harbor	CSO, urbanized high density area, waterfowl
MA95-63	Outer New Bedford Harbor	MS4
MA95-38	Clarks Cove	CSO, urbanized high density area, MS4
MA95-13	Buttonwood Brook	Unknown
MA95-39	Apponagansett Bay	On-site treatment systems, urbanized high density area, MS4
MA95-35	Mattapoisett Harbor	MS4
MA95-39	Mattapoisett River	MS4
MA95-65	Nasketucket Bay	MS4
MA95-56	Hammett Cove	MS4
MA95-08	Sippican Harbor	MS4
MA95-09	Aucoot Cove	MS4
MA95-10	Hiller Cove	MS4
MA95-64	Little Bay	Unknown
MA95-07	Sippican River	MS4
MA95-53	Beaverdam Creek	MS4
MA95-58	Bread and Cheese Brook	MS4, Livestock
MA95-05	Weweantic River	MS4, on-site treatment systems (septic systems)
MA95-29	Agawam River	MS4, municipal point source discharge
MA95-50	Wankinco River	MS4
MA95-49	Broad Marsh River	MS4
MA95-51	Crooked River	MS4
MA95-52	Cedar Island Creek	MS4
MA95-03	Wareham River	MS4

Segment	Segment Name	Potential Sources
MA95-02	Onset Bay	MS4
MA95-01	Buttermilk Bay	MS4
MA95-62	Buzzards Bay	MS4
MA95-14	Cape Cod Canal	MS4, Boats
MA95-48	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-51	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-47	Back River	MS4, on-site treatment systems (septic systems)
MA95-15	Phinneys Harbor	On-site treatment systems (septic systems), highway/road runoff
MA95-16	Pocasset River	On-site treatment systems (septic systems), road runoff, MS4
MA95-17	Pocasset Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-18	Red Brook Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-21	Herring Brook	On-site treatment systems (septic systems)
MA95-46	Harbor Head	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-20	Wild Harbor Estuary	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-22	West Falmouth Harbor	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-23	Great Sippewisset Creek	On-site treatment systems (septic systems), highway/road runoff
MA95-24	Little Sippewisset Marsh	On-site treatment systems (septic systems), highway/road runoff
MA95-25	Quissett Harbor	On-site treatment systems (septic systems), road runoff

Specific sources for the remaining impaired segments are unknown

MS4 = Municipal Separate Storm Water Sewer System – community storm water drainage system

Most sources were identified in the MassDEP WQA, although some sources have been identified by other organizations such as WRWA and MACZM.

Suspected dry weather sources include:
1. animal feeding operations,
2. animal grazing in riparian zones,
3. leaking sewer pipes,
4. storm water drainage systems (illicit connections of sanitary sewers to storm drains),
5. failing septic systems,
6. recreational activities,
7. wildlife, including birds, and
8. illicit boat discharges.

Suspected and known wet weather sources include:
1. wildlife and domesticated animals (including pets),
2. storm water runoff including municipal separate storm sewer systems (MS4),
3. combined sewer overflows (CSOs), and
4. sanitary sewer overflows (SSOs).

It is difficult to provide accurate quantitative estimates of indicator bacteria contributions from the various sources in the

Buzzards Bay watershed because many of the sources are diffuse and intermittent, and extremely difficult to monitor or accurately model. Many of the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they could result in a potential health risk and, therefore, must be eliminated. Estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) can perhaps be achieved for wet and dry conditions using ambient data available that define baseline conditions (MassDEP 2003).

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.
MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm
MassDEP 2003. Buzzards Bay Watershed 2000 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

Final Pathogen TMDL for the Buzzards Bay Watershed
(MA95-45 - Snell Creek)

Problem Assessment

Available bacteria data are summarized in the following section. The primary sources of data include, but are not limited to, DMF, CZM, MassDEP, and the Westport River Watershed Alliance (WRWA).
Additional discussion can be found at:
• MassDEP WQA 2003 – Buzzards Bay Watershed 2000 Water Quality Assessment Report available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm.
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The summary tables for each segment contain data sources and calendar years for which data were collected. The "Station" column displays the sampling location identifier issued by sampling organization and a short narrative description if available. The next three columns provide statistics relating to sampling conducted. These columns provide the number of samples collected as well as the number of those samples that were collected during the primary contact season. The next column provides the range of FC values for the samples collected at that station. The "geometric mean" column provides the geometric mean of all the samples collected for a particular station if sufficient data exists. The number and percentage of samples exceeding a threshold value is also reported in this column. The threshold values provided in this TMDL are those established by the MassDEP in the WQA and are: 100 cfu/100mL (Class A WQS- average shall not exceed 20 cfu/100mL, and 10% of the samples shall not exceed 100 cfu/100mL); (Class SA Shellfishing Approved- average shall not exceed 14cfu/ 100mL, and 10% of the samples shall not exceed 28 cfu/100 mL); (Class SB Shellfishing Approved (but not necessarily open)- average shall not exceed 88cfu/100 mL, and 10% of samples shall not exceed 260 cfu/100mL); (Class B WQS: geometric average (E coli) shall not exceed 126cfu/100mL, and a single sample shall not exceed 235 cfu/100mL (it should be noted that in January 2007, MA WQS for bacteria were revised to E coli). The percentage value indicates the percent of the samples exceeding the noted threshold. For example "7 samples >126 (44%)" indicates that 7 samples contained FC densities greater than 126 cfu/100mL, equating to 44% of the samples analyzed. It should be noted that some of these percentages are calculated based on the number of samples analyzed during the primary contact season, while others may be calculated based on total number of samples. Note that while many of the data included here are for FC, which remain the indicator of sanitary quality for shellfish areas, E. coli and enterococcus in fresh water and enterococcus in salt water are now the standards for swimming.
Nevertheless, FC remain a qualitative indicator of water quality. 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. Individual maps showing catch basins and storm drain discharges are available in the "Atlas of Stormwater Discharges in the Buzzards Bay Watershed" (MACZM 2003).
The Buzzards Bay Project National Estuary Program, through the Mass CZM office in East Wareham, has granted permission to include maps and other relevant information in this final TMDL report. These maps provide locations and prioritization of catch basins, storm drains and road cuts inventoried by the MACZM. This entire report is also available for download:

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The following section of this report is intended to briefly summarize the impaired waterbody segments and available data in the Buzzards Bay watershed. For more information on any of these segments, see the "Buzzards Bay Watershed 2000 Water Quality Assessment Report" on the MassDEP website: http://www.mass.gov/dep/brp/wm/wqassess.htm.
Between 1997 and 2001, DMF collected over 37,000 FC samples from tributaries of Buzzards Bay.

Snell Creek Segment (MA95-45)

This segment 0.67 mile long Class B creek extends from Drift Road to Marcus' Bridge in Westport. The first Concentrated Animal Feeding Operations (CAFO) permit was issued to a farm bordering the waterbody on Drift Road, but this farm no longer operates. The town of Westport has submitted a NOI requesting permit coverage under the NPDES program for their MS4. Within the Town of Westport, The "Atlas of Stormwater Discharges in the Buzzards Bay Watershed" has identified a total of 173 pipe or road cut outfall discharges. Out of this total, 126 are ranked either high or medium priority for remediation, and 18 have already been remediated. A map showing stormwater discharge priorities (Priority Map #1) for this particular segment and a separate map, outlining stormwater drainage systems with outfalls (Westport Map #3) of this segment and surrounding areas is available for download at http://www.buzzardsbay.org/stormatlas.htm.
A summary of FC data collected by the WRWA between March and October of 2001 (MassDEP 2003b) is provided in the following table (originally Table 4-5 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009). The WRWA program operated under an approved QAPP (Costa 2008). Samples were collected during both wet and dry weather. The majority of the high FC counts were collected during wet weather conditions.

Table A95-45 Snell Creek WRWA Fecal Coliform Data Summary.

Station	Total Number of Samples (Number of Samples during Primary Contact Season)	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric M (cfu/100ml
S-7: Snell Creek at Marcus' Bridge	17 (16)	17 – 6,000*	307* 7 samples > 400 4 samples > 2,00

* value reported as zero was not used in the number of samples analyzed, reported range or calculation.
Enterococci counts ranged from 12-94,000 cfu/100mL

b>Watershed Description

Buzzards Bay watershed is bordered to the east by Cape Cod and to the northeast by southeastern Massachusetts. The bay is 28 miles long and 8 miles wide (MACZM 2003). The Buzzards Bay watershed drains 432 square miles and includes 17 cities and towns within Massachusetts and Rhode Island. Land use within the watershed is primarily undeveloped forest.
Development in the watershed is concentrated in a half mile area landward of the coastline. MassDEP estimated a population of 373,690 people living in the watershed in 2000 (MassDEP 2003b). Two-fifths of these people reside in the Greater New Bedford area. The 280 mile coastline includes 11 miles of public beaches. 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).
The drainage basin includes several rivers, which flow into Buzzards Bay. The rivers tend to increase in velocity and width as they near the bay. In comparison to other rivers in the state, the rivers in the Buzzards Bay watershed tend to be shorter and have smaller drainage areas. Water also enters the Bay through groundwater seepage.
Significant natural and cultural resources exist in the Buzzards Bay Watershed that warrants special protection. The Back River and the Pocasset River 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. The entire Buzzards Bay is considered a "No Discharge Area" (NDA). NDAs are waterbodies in which a state, with EPA approval, has determined to be important ecological or recreational areas worthy of special protection against the release of raw or treated sewage in navigable waters. Vessels are banned from discharging both raw and treated sewage in a NDA (USEPA 2004a).
The Buzzards Bay 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, public water supply, and beachfront.
MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm

MassDEP 2003b. Buzzards Bay Watershed 2000 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
USEPA 2004a. No Discharge Areas in Massachusetts. Information from website, downloaded March 2005. http://www.epa.gov/region01/eco/nodiscrg/ma.html

Potential Bacteria Sources

The Buzzards Bay watershed has 52 segments, located throughout the watershed, that are listed as pathogen impaired requiring a TMDL. These segments represent 100% of the estuary area and 21.3% of the river miles that have been assessed. Sources of indicator bacteria in the Buzzards Bay watershed are many and varied. A number of organizations and local governments have conducted work over the last decade in an effort to identify and address local sources of bacteria. Even with these efforts much more needs to be done.

Largely through the efforts organizations such as the Westport River Watershed Association (WRWA), the Division of Marine Fisheries (DMF), the MA Office of Coastal Zone Management (MACZM), and MassDEP field staff, numerous point and non-point sources of pathogens have been identified. The following two tables (originally from Table 5-1 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009) summarizes a number of impaired segments and some of the suspected and known sources identified in the state Watershed Assessment Report (WAR) or by other organizations (e.g., MACZM, WRWA, etc.).

Table . Potential Sources of Bacteria in Pathogen Impaired Segments in the Buzzards Bay Watershed.

Segment	Segment Name	Potential Sources
MA95-40	East Branch Westport River	MS4, highway/road runoff, animal feeding operations
MA95-45	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-59	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-41	East Branch Westport River	Animal feeding operation, dairy outside milk parlor area, grazing in riparian zone, MS4, on-site septic systems, highway/road runoff
MA95-37	West Branch Westport River	MS4
MA95-54	Westport River	MS4
MA95-34	Slocums River	On-site treatment systems (septic systems), urbanized high density area, MS4
MA95-44	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-31	Acushnet River	Unknown
MA95-32	Acushnet River	Unknown
MA95-33	Acushnet River	CSO, urbanized high density area
MA95-42	New Bedford Inner Harbor	CSO, urbanized high density area, waterfowl
MA95-63	Outer New Bedford Harbor	MS4
MA95-38	Clarks Cove	CSO, urbanized high density area, MS4
MA95-13	Buttonwood Brook	Unknown
MA95-39	Apponagansett Bay	On-site treatment systems, urbanized high density area, MS4
MA95-35	Mattapoisett Harbor	MS4
MA95-39	Mattapoisett River	MS4
MA95-65	Nasketucket Bay	MS4
MA95-56	Hammett Cove	MS4
MA95-08	Sippican Harbor	MS4
MA95-09	Aucoot Cove	MS4
MA95-10	Hiller Cove	MS4
MA95-64	Little Bay	Unknown
MA95-07	Sippican River	MS4
MA95-53	Beaverdam Creek	MS4
MA95-58	Bread and Cheese Brook	MS4, Livestock
MA95-05	Weweantic River	MS4, on-site treatment systems (septic systems)
MA95-29	Agawam River	MS4, municipal point source discharge
MA95-50	Wankinco River	MS4
MA95-49	Broad Marsh River	MS4
MA95-51	Crooked River	MS4
MA95-52	Cedar Island Creek	MS4
MA95-03	Wareham River	MS4

Segment	Segment Name	Potential Sources
MA95-02	Onset Bay	MS4
MA95-01	Buttermilk Bay	MS4
MA95-62	Buzzards Bay	MS4
MA95-14	Cape Cod Canal	MS4, Boats
MA95-48	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-51	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-47	Back River	MS4, on-site treatment systems (septic systems)
MA95-15	Phinneys Harbor	On-site treatment systems (septic systems), highway/road runoff
MA95-16	Pocasset River	On-site treatment systems (septic systems), road runoff, MS4
MA95-17	Pocasset Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-18	Red Brook Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-21	Herring Brook	On-site treatment systems (septic systems)
MA95-46	Harbor Head	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-20	Wild Harbor Estuary	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-22	West Falmouth Harbor	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-23	Great Sippewisset Creek	On-site treatment systems (septic systems), highway/road runoff
MA95-24	Little Sippewisset Marsh	On-site treatment systems (septic systems), highway/road runoff
MA95-25	Quissett Harbor	On-site treatment systems (septic systems), road runoff

Specific sources for the remaining impaired segments are unknown

MS4 = Municipal Separate Storm Water Sewer System – community storm water drainage system

Most sources were identified in the MassDEP WQA, although some sources have been identified by other organizations such as WRWA and MACZM.

Suspected dry weather sources include:
1. animal feeding operations,
2. animal grazing in riparian zones,
3. leaking sewer pipes,
4. storm water drainage systems (illicit connections of sanitary sewers to storm drains),
5. failing septic systems,
6. recreational activities,
7. wildlife, including birds, and
8. illicit boat discharges.

Suspected and known wet weather sources include:
1. wildlife and domesticated animals (including pets),
2. storm water runoff including municipal separate storm sewer systems (MS4),
3. combined sewer overflows (CSOs), and
4. sanitary sewer overflows (SSOs).

It is difficult to provide accurate quantitative estimates of indicator bacteria contributions from the various sources in the Buzzards Bay

watershed because many of the sources are diffuse and intermittent, and extremely difficult to monitor or accurately model. Many of the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they could result in a potential health risk and, therefore, must be eliminated. Estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) can perhaps be achieved for wet and dry conditions using ambient data available that define baseline conditions (MassDEP 2003).

Costa, Joseph E. Executive Director Buzzards Bay Project National Estuary Program, Massachusetts Office of Coastal Management. East Wareham MA. Personal Communication.

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.

MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm

MassDEP 2003. Buzzards Bay Watershed 2000 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

Final Pathogen TMDL for the Buzzards Bay Watershed (MA95-59 - Snell Creek)

Problem Assessment

Available bacteria data are summarized in the following section. The primary sources of data include, but are not limited to, DMF, CZM, MassDEP, and the Westport River Watershed Alliance (WRWA).

Additional discussion can be found at:

• MassDEP WQA 2003 – Buzzards Bay Watershed 2000 Water Quality Assessment Report available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm.

• MACZM 2003 – Atlas of Stormwater Discharges in the Buzzards Bay Watershed available for download at http://www.buzzardsbay.org/stormatlas.htm

The summary tables for each segment contain data sources and calendar years for which data were collected. The “Station” column displays the sampling location identifier issued by sampling organization and a short narrative description if available. The next three columns provide statistics relating to sampling conducted. These columns provide the number of samples collected as well as the number of those samples that were collected during the primary contact season. The next column provides the range of FC values for the samples collected at that station. The “geometric mean” column provides the geometric mean of all the samples collected for a particular station if sufficient data exists. The number and percentage of samples exceeding a threshold value is also reported in this column. The threshold values provided in this TMDL are those established by the MassDEP in the WQA and are: 100 cfu/100mL (Class A WQS- average shall not exceed 20 cfu/100mL, and 10% of the samples shall not exceed 100 cfu/100mL); (Class SA Shellfishing Approved- average shall not exceed 14cfu/ 100mL, and 10% of the samples shall not exceed 28 cfu/100 mL); (Class SB Shellfishing Approved (but not necessarily open)- average shall not exceed 88cfu/100 mL, and 10% of samples shall not exceed 260 cfu/100mL); (Class B WQS: geometric average (E coli) shall not exceed 126cfu/100mL, and a single sample shall not exceed 235 cfu/100mL (it should be noted that in January 2007, MA WQS for bacteria were revised to E coli). The percentage value indicates the percent of the samples exceeding the noted threshold. For example “7 samples >126 (44%)” indicates that 7 samples contained FC densities greater than 126 cfu/100mL, equating to 44% of the samples analyzed. It should be noted that some of these percentages are calculated based on the number of samples analyzed during the primary contact season, while others may be calculated based on total number of samples. Note that while many of the data included here are for FC, which remain the indicator of sanitary quality for shellfish areas, E. coli and enterococcus in fresh water and enterococcus in salt water are now the standards for swimming.

Nevertheless, FC remain a qualitative indicator of water quality. 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. Individual maps showing catch basins and storm drain discharges are available in the “Atlas of Stormwater Discharges in the Buzzards Bay Watershed” (MACZM 2003).

The Buzzards Bay Project National Estuary Program, through the Mass CZM office in East Wareham, has granted permission to include

maps and other relevant information in this final TMDL report. These maps provide locations and prioritization of catch basins, storm drains and road cuts inventoried by the MACZM. This entire report is also available for download: http://www.buzzardsbay.org/stormatlas.htm.

The following section of this report is intended to briefly summarize the impaired waterbody segments and available data in the Buzzards Bay watershed. For more information on any of these segments, see the "Buzzards Bay Watershed 2000 Water Quality Assessment Report" on the MassDEP website: http://www.mass.gov/dep/brp/wm/wqassess.htm.

Between 1997 and 2001, DMF collected over 37,000 FC samples from tributaries of Buzzards Bay.

Snell Creek Segment (MA95-59)

This Class A shellfishing, impaired segment covers 0.01 square miles beginning at the 'Marcus Bridge', Westport, and running to the confluence with East Branch Westport River, Westport. As a result of elevated FC bacteria counts documented by WRWA at Marcus' Bridge and the known problems at the Pimental Farm (see segment MA95-45) both recreational uses (primary contact and shellfishing) are assessed as impaired.

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Snell Creek Segment MA 95-59 are summarized in the table below (originally Table 4-6 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009). These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table MA95-59 Snell Creek DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Me 2001 data (cfu/100
202	1-247	24

b>Watershed Description

Buzzards Bay watershed is bordered to the east by Cape Cod and to the northeast by southeastern Massachusetts. The bay is 28 miles long and 8 miles wide (MACZM 2003). The Buzzards Bay watershed drains 432 square miles and includes 17 cities and towns within Massachusetts and Rhode Island. Land use within the watershed is primarily undeveloped forest.

Development in the watershed is concentrated in a half mile area landward of the coastline. MassDEP estimated a population of 373,690 people living in the watershed in 2000 (MassDEP 2003b). Two-fifths of these people reside in the Greater New Bedford area. The 280 mile coastline includes 11 miles of public beaches. 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).

The drainage basin includes several rivers, which flow into Buzzards Bay. The rivers tend to increase in velocity and width as they near the bay. In comparison to other rivers in the state, the rivers in the Buzzards Bay watershed tend to be shorter and have smaller drainage areas. Water also enters the Bay through groundwater seepage.

Significant natural and cultural resources exist in the Buzzards Bay Watershed that warrants special protection. The Back River and the Pocasset River 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. The entire Buzzards Bay is considered a "No Discharge Area" (NDA). NDAs are waterbodies in which a state, with EPA approval, has determined to be important ecological or recreational areas worthy of special protection against the release of raw or treated sewage in navigable waters. Vessels are banned from discharging both raw and treated sewage in a NDA (USEPA 2004a).

The Buzzards Bay 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, public water supply, and beachfront.

MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm

MassDEP 2003b. Buzzards Bay Watershed 2000 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

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

Potential Bacteria Sources

The Buzzards Bay watershed has 52 segments, located throughout the watershed, that are listed as pathogen impaired requiring a TMDL. These segments represent 100% of the estuary area and 21.3% of the river miles that have been assessed. Sources of indicator bacteria in the Buzzards Bay watershed are many and varied. A number of organizations and local governments have conducted work over the last decade in an effort to identify and address local sources of bacteria. Even with these efforts much more needs to be done.

Largely through the efforts organizations such as the Westport River Watershed Association (WRWA), the Division of Marine Fisheries (DMF), the MA Office of Coastal Zone Management (MACZM), and MassDEP field staff, numerous point and non-point sources of pathogens have been identified. The following two tables (originally from Table 5-1 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009) summarizes a number of impaired segments and some of the suspected and known sources identified in the state Watershed Assessment Report (WAR) or by other organizations (e.g., MACZM, WRWA, etc.).

Table . Potential Sources of Bacteria in Pathogen Impaired Segments in the Buzzards Bay Watershed.

Segment	Segment Name	Potential Sources
MA95-40	East Branch Westport River	MS4, highway/road runoff, animal feeding operations
MA95-45	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-59	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-41	East Branch Westport River	Animal feeding operation, dairy outside milk parlor area, grazing in riparian zone, MS4, on-site septic systems, highway/road runoff
MA95-37	West Branch Westport River	MS4
MA95-54	Westport River	MS4
MA95-34	Slocums River	On-site treatment systems (septic systems), urbanized high density area, MS4
MA95-44	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-31	Acushnet River	Unknown
MA95-32	Acushnet River	Unknown
MA95-33	Acushnet River	CSO, urbanized high density area
MA95-42	New Bedford Inner Harbor	CSO, urbanized high density area, waterfowl
MA95-63	Outer New Bedford Harbor	MS4
MA95-38	Clarks Cove	CSO, urbanized high density area, MS4
MA95-13	Buttonwood Brook	Unknown
MA95-39	Apponagansett Bay	On-site treatment systems, urbanized high density area, MS4
MA95-35	Mattapoisett Harbor	MS4
MA95-39	Mattapoisett River	MS4
MA95-65	Nasketucket Bay	MS4
MA95-56	Hammett Cove	MS4
MA95-08	Sippican Harbor	MS4
MA95-09	Aucoot Cove	MS4
MA95-10	Hiller Cove	MS4
MA95-64	Little Bay	Unknown
MA95-07	Sippican River	MS4
MA95-53	Beaverdam Creek	MS4
MA95-58	Bread and Cheese Brook	MS4, Livestock
MA95-05	Weweantic River	MS4, on-site treatment systems (septic systems)
MA95-29	Agawam River	MS4, municipal point source discharge
MA95-50	Wankinco River	MS4
MA95-49	Broad Marsh River	MS4
MA95-51	Crooked River	MS4
MA95-52	Cedar Island Creek	MS4
MA95-03	Wareham River	MS4

Segment	Segment Name	Potential Sources
MA95-02	Onset Bay	MS4
MA95-01	Buttermilk Bay	MS4
MA95-62	Buzzards Bay	MS4
MA95-14	Cape Cod Canal	MS4, Boats
MA95-48	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-51	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-47	Back River	MS4, on-site treatment systems (septic systems)
MA95-15	Phinneys Harbor	On-site treatment systems (septic systems), highway/road runoff
MA95-16	Pocasset River	On-site treatment systems (septic systems), road runoff, MS4
MA95-17	Pocasset Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-18	Red Brook Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-21	Herring Brook	On-site treatment systems (septic systems)
MA95-46	Harbor Head	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-20	Wild Harbor Estuary	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-22	West Falmouth Harbor	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-23	Great Sippewisset Creek	On-site treatment systems (septic systems), highway/road runoff
MA95-24	Little Sippewisset Marsh	On-site treatment systems (septic systems), highway/road runoff
MA95-25	Quissett Harbor	On-site treatment systems (septic systems), road runoff

Specific sources for the remaining impaired segments are unknown

MS4 = Municipal Separate Storm Water Sewer System – community storm water drainage system

Most sources were identified in the MassDEP WQA, although some sources have been identified by other organizations such as WRWA and MACZM.

Suspected dry weather sources include:
1. animal feeding operations,
2. animal grazing in riparian zones,
3. leaking sewer pipes,
4. storm water drainage systems (illicit connections of sanitary sewers to storm drains),
5. failing septic systems,
6. recreational activities,
7. wildlife, including birds, and
8. illicit boat discharges.

Suspected and known wet weather sources include:
1. wildlife and domesticated animals (including pets),
2. storm water runoff including municipal separate storm sewer systems (MS4),
3. combined sewer overflows (CSOs), and
4. sanitary sewer overflows (SSOs).

It is difficult to provide accurate quantitative estimates of indicator bacteria contributions from the various sources in the Buzzards Bay

watershed because many of the sources are diffuse and intermittent, and extremely difficult to monitor or accurately model. Many of the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they could result in a potential health risk and, therefore, must be eliminated. Estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) can perhaps be achieved for wet and dry conditions using ambient data available that define baseline conditions (MassDEP 2003).

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.
MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm
MassDEP 2003. Buzzards Bay Watershed 2000 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

Final Pathogen TMDL for the Buzzards Bay Watershed (MA95-37 - West Branch Westport River)

Problem Assessment

Available bacteria data are summarized in the following section. The primary sources of data include, but are not limited to, DMF, CZM, MassDEP, and the Westport River Watershed Alliance (WRWA).

Additional discussion can be found at:

• MassDEP WQA 2003 – Buzzards Bay Watershed 2000 Water Quality Assessment Report available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm.

• MACZM 2003 – Atlas of Stormwater Discharges in the Buzzards Bay Watershed available for download at http://www.buzzardsbay.org/stormatlas.htm

The summary tables for each segment contain data sources and calendar years for which data were collected. The “Station” column displays the sampling location identifier issued by sampling organization and a short narrative description if available. The next three columns provide statistics relating to sampling conducted. These columns provide the number of samples collected as well as the number of those samples that were collected during the primary contact season. The next column provides the range of FC values for the samples collected at that station. The “geometric mean” column provides the geometric mean of all the samples collected for a particular station if sufficient data exists. The number and percentage of samples exceeding a threshold value is also reported in this column. The threshold values provided in this TMDL are those established by the MassDEP in the WQA and are: 100 cfu/100mL (Class A WQS- average shall not exceed 20 cfu/100mL, and 10% of the samples shall not exceed 100 cfu/100mL); (Class SA Shellfishing Approved- average shall not exceed 14cfu/ 100mL, and 10% of the samples shall not exceed 28 cfu/100 mL); (Class SB Shellfishing Approved (but not necessarily open)- average shall not exceed 88cfu/100 mL, and 10% of samples shall not exceed 260 cfu/100mL); (Class B WQS: geometric average (E coli) shall not exceed 126cfu/100mL, and a single sample shall not exceed 235 cfu/100mL (it should be noted that in January 2007, MA WQS for bacteria were revised to E coli). The percentage value indicates the percent of the samples exceeding the noted threshold. For example “7 samples >126 (44%)” indicates that 7 samples contained FC densities greater than 126 cfu/100mL, equating to 44% of the samples analyzed. It should be noted that some of these percentages are calculated based on the number of samples analyzed during the primary contact season, while others may be calculated based on total number of samples. Note that while many of the data included here are for FC, which remain the indicator of sanitary quality for shellfish areas, E. coli and enterococcus in fresh water and enterococcus in salt water are now the standards for swimming.

Nevertheless, FC remain a qualitative indicator of water quality. 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. Individual maps showing catch basins and storm drain discharges are available in the “Atlas of Stormwater Discharges in the Buzzards Bay Watershed” (MACZM 2003).

The Buzzards Bay Project National Estuary Program, through the Mass CZM office in East Wareham, has granted permission to include maps and other relevant information in this final TMDL report. These maps provide locations and prioritization of catch basins, storm drains and road cuts inventoried by the MACZM. This entire report is also available for download:

http://www.buzzardsbay.org/stormatlas.htm.
The following section of this report is intended to briefly summarize the impaired waterbody segments and available data in the Buzzards Bay watershed. For more information on any of these segments, see the "Buzzards Bay Watershed 2000 Water Quality Assessment Report" on the MassDEP website: http://www.mass.gov/dep/brp/wm/wqassess.htm.
Between 1997 and 2001, DMF collected over 37,000 FC samples from tributaries of Buzzards Bay.

West Branch Westport River Segment MA95-37

This 1.28 square mile segment begins at the outlet of Gray's Mill Pond (also known as Adamsville Pond) in Adamsville, Rhode Island to the mouth at Westport Harbor in Westport. This segment is a Class SA, shellfishing (open) waterbody. The Gray's Mill Pond, which is created by a dam and is used by Gray's Grist Mill forms the headwaters of this segment. There are no permitted NPDES dischargers in this segment. Town of Westport has submitted a NOI requesting permit coverage under the NPDES program for their MS4. According to the "Atlas of Stormwater Discharges in the Buzzards Bay Watershed", within this segment sub watershed there are 158 catch basins, of which 12 are treated, and there are a total of 43 pipe or road cut discharges, of which 13 are ranked medium or high priority for remediation. One of these has been remediated.
Shellfish harvesting is impaired in 0.78 square miles of this segment. The suspected source of FC is the MS4.
DMF and WRWA data (taken in both dry and wet weather periods) are summarized in the following table (originally Table 4-8 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009).

Table MA95-37 West Branch Westport River ; DMF/WRWA Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
2197 (DMF)	1- 2400	5.2
19 at 1 station (WRWA)	0-2,500	8.6

* zero value reported in the range was not used in the calculation
Enterococci counts ranged from 0-3,200 cfu/100mL

b>Watershed Description
Buzzards Bay watershed is bordered to the east by Cape Cod and to the northeast by southeastern Massachusetts. The bay is 28 miles long and 8 miles wide (MACZM 2003). The Buzzards Bay watershed drains 432 square miles and includes 17 cities and towns within Massachusetts and Rhode Island. Land use within the watershed is primarily undeveloped forest.
Development in the watershed is concentrated in a half mile area landward of the coastline. MassDEP estimated a population of 373,690 people living in the watershed in 2000 (MassDEP 2003b). Two-fifths of these people reside in the Greater New Bedford area. The 280 mile coastline includes 11 miles of public beaches. 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).
The drainage basin includes several rivers, which flow into Buzzards Bay. The rivers tend to increase in velocity and width as they near the bay. In comparison to other rivers in the state, the rivers in the Buzzards Bay watershed tend to be shorter and have smaller drainage areas. Water also enters the Bay through groundwater seepage.
Significant natural and cultural resources exist in the Buzzards Bay Watershed that warrants special protection. The Back River and the Pocasset River 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. The entire Buzzards Bay is considered a "No Discharge Area" (NDA). NDAs are waterbodies in which a state, with EPA approval, has determined to be important ecological or recreational areas worthy of special protection against the release of raw or treated sewage in navigable waters. Vessels are banned from discharging both raw and treated sewage in a NDA (USEPA 2004a).
The Buzzards Bay 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, public water supply, and beachfront.

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MassDEP 2003b. Buzzards Bay Watershed 2000 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
USEPA 2004a. No Discharge Areas in Massachusetts. Information from website, downloaded March 2005.

http://www.epa.gov/region01/eco/nodiscrg/ma.html

Potential Bacteria Sources

The Buzzards Bay watershed has 52 segments, located throughout the watershed, that are listed as pathogen impaired requiring a TMDL. These segments represent 100% of the estuary area and 21.3% of the river miles that have been assessed. Sources of indicator bacteria in the Buzzards Bay watershed are many and varied. A number of organizations and local governments have conducted work over the last decade in an effort to identify and address local sources of bacteria. Even with these efforts much more needs to be done.

Largely through the efforts organizations such as the Westport River Watershed Association (WRWA), the Division of Marine Fisheries (DMF), the MA Office of Coastal Zone Management (MACZM), and MassDEP field staff, numerous point and non-point sources of pathogens have been identified. The following two tables (originally from Table 5-1 of "Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed" report, 2009) summarizes a number of impaired segments and some of the suspected and known sources identified in the state Watershed Assessment Report (WAR) or by other organizations (e.g., MACZM, WRWA, etc.).

Table . Potential Sources of Bacteria in Pathogen Impaired Segments in the Buzzards Bay Watershed.

Segment	Segment Name	Potential Sources
MA95-40	East Branch Westport River	MS4, highway/road runoff, animal feeding operations
MA95-45	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-59	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-41	East Branch Westport River	Animal feeding operation, dairy outside milk parlor area, grazing in riparian zone, MS4, on-site septic systems, highway/road runoff
MA95-37	West Branch Westport River	MS4
MA95-54	Westport River	MS4
MA95-34	Slocums River	On-site treatment systems (septic systems), urbanized high density area, MS4
MA95-44	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-31	Acushnet River	Unknown
MA95-32	Acushnet River	Unknown
MA95-33	Acushnet River	CSO, urbanized high density area
MA95-42	New Bedford Inner Harbor	CSO, urbanized high density area, waterfowl
MA95-63	Outer New Bedford Harbor	MS4
MA95-38	Clarks Cove	CSO, urbanized high density area, MS4
MA95-13	Buttonwood Brook	Unknown
MA95-39	Apponagansett Bay	On-site treatment systems, urbanized high density area, MS4
MA95-35	Mattapoisett Harbor	MS4
MA95-39	Mattapoisett River	MS4
MA95-65	Nasketucket Bay	MS4
MA95-56	Hammett Cove	MS4
MA95-08	Sippican Harbor	MS4
MA95-09	Aucoot Cove	MS4
MA95-10	Hiller Cove	MS4
MA95-64	Little Bay	Unknown
MA95-07	Sippican River	MS4
MA95-53	Beaverdam Creek	MS4
MA95-58	Bread and Cheese Brook	MS4, Livestock
MA95-05	Weweantic River	MS4, on-site treatment systems (septic systems)
MA95-29	Agawam River	MS4, municipal point source discharge
MA95-50	Wankinco River	MS4
MA95-49	Broad Marsh River	MS4
MA95-51	Crooked River	MS4
MA95-52	Cedar Island Creek	MS4
MA95-03	Wareham River	MS4

Segment	Segment Name	Potential Sources
MA95-02	Onset Bay	MS4
MA95-01	Buttermilk Bay	MS4
MA95-62	Buzzards Bay	MS4
MA95-14	Cape Cod Canal	MS4, Boats
MA95-48	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-51	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-47	Back River	MS4, on-site treatment systems (septic systems)
MA95-15	Phinneys Harbor	On-site treatment systems (septic systems), highway/road runoff
MA95-16	Pocasset River	On-site treatment systems (septic systems), road runoff, MS4
MA95-17	Pocasset Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-18	Red Brook Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-21	Herring Brook	On-site treatment systems (septic systems)
MA95-46	Harbor Head	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-20	Wild Harbor Estuary	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-22	West Falmouth Harbor	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-23	Great Sippewisset Creek	On-site treatment systems (septic systems), highway/road runoff
MA95-24	Little Sippewisset Marsh	On-site treatment systems (septic systems), highway/road runoff
MA95-25	Quissett Harbor	On-site treatment systems (septic systems), road runoff

Specific sources for the remaining impaired segments are unknown

MS4 = Municipal Separate Storm Water Sewer System – community storm water drainage system

Most sources were identified in the MassDEP WQA, although some sources have been identified by other organizations such as WRWA and MACZM.

Suspected dry weather sources include:
1. animal feeding operations,
2. animal grazing in riparian zones,
3. leaking sewer pipes,
4. storm water drainage systems (illicit connections of sanitary sewers to storm drains),
5. failing septic systems,
6. recreational activities,
7. wildlife, including birds, and
8. illicit boat discharges.

Suspected and known wet weather sources include:
1. wildlife and domesticated animals (including pets),
2. storm water runoff including municipal separate storm sewer systems (MS4),
3. combined sewer overflows (CSOs), and
4. sanitary sewer overflows (SSOs).

It is difficult to provide accurate quantitative estimates of indicator bacteria contributions from the various sources in the Buzzards Bay

watershed because many of the sources are diffuse and intermittent, and extremely difficult to monitor or accurately model. Many of the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they could result in a potential health risk and, therefore, must be eliminated. Estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) can perhaps be achieved for wet and dry conditions using ambient data available that define baseline conditions (MassDEP 2003).

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MACZM. 2003. Atlas of Stormwater Discharges in the Buzzards Bay Watershed, August 2003. Massachusetts Office of Coastal Zone Management (MACZM), Buzzards Bay Project National Estuaries Program. East Wareham, Massachusetts. Available for download at http://www.buzzardsbay.org/stormatlas.htm

MassDEP 2003. Buzzards Bay Watershed 2000 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

Appendix B – MassDEP Water Quality Monitoring Program Bacteria and TN Data for Westport River Watershed (MassDEP, 2022)

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
Angeline Brook	W1375	[Cornell Road, Westport]	5/3/2005	E. coli	115	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	6/9/2005	E. coli	25	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	6/28/2005	E. coli	>1600	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	8/2/2005	E. coli	<5	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	8/30/2005	E. coli	##	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	9/12/2005	E. coli	45	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	5/3/2005	E. coli	55	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	5/3/2005	E. coli	<5	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	6/9/2005	E. coli	40	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	6/9/2005	E. coli	60	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	6/28/2005	E. coli	1400	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	6/28/2005	E. coli	520	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	8/2/2005	E. coli	5	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	8/2/2005	E. coli	20	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	8/30/2005	E. coli	##	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	8/30/2005	E. coli	##	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	9/12/2005	E. coli	35	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	9/12/2005	E. coli	110	CFU/100mL
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	5/3/2005	E. coli	5	CFU/100mL
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	6/9/2005	E. coli	<5	CFU/100mL
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	6/28/2005	E. coli	170	CFU/100mL
Copicut River	W1399	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	8/30/2005	E. coli	##	CFU/100mL
Copicut River	W1399	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	9/12/2005	E. coli	5	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	5/3/2005	E. coli	55	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	5/3/2005	E. coli	95	CFU/100mL

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	6/9/2005	E. coli	35	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	6/9/2005	E. coli	15	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	6/28/2005	E. coli	920	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	6/28/2005	E. coli	620	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	8/2/2005	E. coli	150	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	8/2/2005	E. coli	30	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	8/30/2005	E. coli	##	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	8/30/2005	E. coli	##	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	9/12/2005	E. coli	35	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	9/12/2005	E. coli	75	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	5/3/2005	E. coli	5	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	6/9/2005	E. coli	65	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	6/28/2005	E. coli	1500	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	8/2/2005	E. coli	100	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	8/30/2005	E. coli	##	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	9/12/2005	E. coli	50	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	6/20/2012	E. coli	25	MPN/100mL
Kirby Brook	W1374	[Drift Road, Westport]	9/11/2012	E. coli	219	MPN/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	5/3/2005	E. coli	20	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	5/3/2005	E. coli	5	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	6/9/2005	E. coli	45	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	6/9/2005	E. coli	30	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	6/28/2005	E. coli	440	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	6/28/2005	E. coli	45	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	8/2/2005	E. coli	125	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	8/2/2005	E. coli	10	CFU/100mL

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
Shingle Island River	W1367	[Hixville Road, Dartmouth]	8/30/2005	E. coli	##	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	8/30/2005	E. coli	##	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	9/12/2005	E. coli	200	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	9/12/2005	E. coli	35	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	5/3/2005	E. coli	5	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	5/3/2005	E. coli	50	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	6/9/2005	E. coli	35	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	6/9/2005	E. coli	80	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	6/28/2005	E. coli	>1600	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	6/28/2005	E. coli	>1600	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	8/2/2005	E. coli	265	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	8/2/2005	E. coli	1200	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	8/30/2005	E. coli	##	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	8/30/2005	E. coli	##	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	9/12/2005	E. coli	840	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	9/12/2005	E. coli	270	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	5/11/2006	E. coli	6	MPN/100mL
Snell Creek	W1372	[Drift Road, Westport]	5/11/2006	E. coli	91	MPN/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	6/8/2006	E. coli	613	MPN/100mL
Snell Creek	W1372	[Drift Road, Westport]	6/8/2006	E. coli	816	MPN/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	7/18/2006	E. coli	365	MPN/100mL
Snell Creek	W1372	[Drift Road, Westport]	7/18/2006	E. coli	326	MPN/100mL
Snell Creek	W1515	[Route 88 crossing, Westport]	7/18/2006	E. coli	387	MPN/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	8/21/2006	E. coli	548	MPN/100mL
Snell Creek	W1372	[Drift Road, Westport]	8/21/2006	E. coli	435	MPN/100mL
Snell Creek	W1515	[Route 88 crossing, Westport]	8/21/2006	E. coli	1050	MPN/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	9/25/2006	E. coli	55	MPN/100mL
Snell Creek	W1372	[Drift Road, Westport]	9/25/2006	E. coli	173	MPN/100mL
Snell Creek	W1515	[Route 88 crossing, Westport]	9/25/2006	E. coli	63	MPN/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	5/3/2005	Enterococci	45	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	6/9/2005	Enterococci	<5	CFU/100mL

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
Angeline Brook	W1375	[Cornell Road, Westport]	6/28/2005	Enterococci	>1600	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	8/2/2005	Enterococci	40	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	8/30/2005	Enterococci	##	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	5/3/2005	Enterococci	25	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	5/3/2005	Enterococci	15	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	6/9/2005	Enterococci	40	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	6/9/2005	Enterococci	90	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	6/28/2005	Enterococci	860	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	6/28/2005	Enterococci	270	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	8/2/2005	Enterococci	30	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	8/2/2005	Enterococci	130	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	8/30/2005	Enterococci	##	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	8/30/2005	Enterococci	##	CFU/100mL
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	5/3/2005	Enterococci	<5	CFU/100mL
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	6/9/2005	Enterococci	<5	CFU/100mL
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	6/28/2005	Enterococci	270	CFU/100mL
Copicut River	W1399	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	8/30/2005	Enterococci	##	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	5/3/2005	Enterococci	140	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	5/3/2005	Enterococci	170	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	6/9/2005	Enterococci	35	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	6/9/2005	Enterococci	10	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	6/28/2005	Enterococci	620	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	6/28/2005	Enterococci	1100	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	8/2/2005	Enterococci	165	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	8/2/2005	Enterococci	175	CFU/100mL

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	8/30/2005	Enterococci	##	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	8/30/2005	Enterococci	##	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	5/3/2005	Enterococci	10	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	6/9/2005	Enterococci	35	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	6/28/2005	Enterococci	>1600	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	8/2/2005	Enterococci	460	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	8/30/2005	Enterococci	##	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	5/3/2005	Enterococci	20	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	5/3/2005	Enterococci	<5	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	6/9/2005	Enterococci	25	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	6/9/2005	Enterococci	<5	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	6/28/2005	Enterococci	105	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	6/28/2005	Enterococci	20	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	8/2/2005	Enterococci	180	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	8/2/2005	Enterococci	150	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	8/30/2005	Enterococci	##	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	8/30/2005	Enterococci	##	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	5/3/2005	Enterococci	<5	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	5/3/2005	Enterococci	40	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	6/9/2005	Enterococci	10	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	6/9/2005	Enterococci	35	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	6/28/2005	Enterococci	>1600	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	6/28/2005	Enterococci	>1600	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	8/2/2005	Enterococci	1300	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	8/2/2005	Enterococci	1500	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	8/30/2005	Enterococci	##	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	8/30/2005	Enterococci	##	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	5/3/2005	Fecal Coliforms	145	CFU/100mL

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
Angeline Brook	W1375	[Cornell Road, Westport]	6/9/2005	Fecal Coliforms	<5	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	6/28/2005	Fecal Coliforms	>1600	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	8/2/2005	Fecal Coliforms	5	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	8/30/2005	Fecal Coliforms	##	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	9/12/2005	Fecal Coliforms	100	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	5/3/2005	Fecal Coliforms	75	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	5/3/2005	Fecal Coliforms	10	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	6/9/2005	Fecal Coliforms	35	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	6/9/2005	Fecal Coliforms	50	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	6/28/2005	Fecal Coliforms	1100	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	6/28/2005	Fecal Coliforms	440	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	8/2/2005	Fecal Coliforms	15	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	8/2/2005	Fecal Coliforms	20	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	8/30/2005	Fecal Coliforms	##	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	8/30/2005	Fecal Coliforms	##	CFU/100mL
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	9/12/2005	Fecal Coliforms	70	CFU/100mL
Bread And Cheese Brook	W1370	[Route 6, Westport]	9/12/2005	Fecal Coliforms	270	CFU/100mL
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	5/3/2005	Fecal Coliforms	<5	CFU/100mL
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	6/9/2005	Fecal Coliforms	5	CFU/100mL
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	6/28/2005	Fecal Coliforms	370	CFU/100mL
Copicut River	W1399	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	8/30/2005	Fecal Coliforms	##	CFU/100mL
Copicut River	W1399	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	9/12/2005	Fecal Coliforms	10	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	5/3/2005	Fecal Coliforms	295	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	5/3/2005	Fecal Coliforms	420	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	6/9/2005	Fecal Coliforms	45	CFU/100mL

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	6/9/2005	Fecal Coliforms	10	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	6/28/2005	Fecal Coliforms	960	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	6/28/2005	Fecal Coliforms	1100	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	8/2/2005	Fecal Coliforms	170	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	8/2/2005	Fecal Coliforms	65	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	8/30/2005	Fecal Coliforms	##	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	8/30/2005	Fecal Coliforms	##	CFU/100mL
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	9/12/2005	Fecal Coliforms	145	CFU/100mL
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	9/12/2005	Fecal Coliforms	75	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	5/3/2005	Fecal Coliforms	50	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	6/9/2005	Fecal Coliforms	25	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	6/28/2005	Fecal Coliforms	1600	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	8/2/2005	Fecal Coliforms	60	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	8/30/2005	Fecal Coliforms	##	CFU/100mL
Kirby Brook	W1374	[Drift Road, Westport]	9/12/2005	Fecal Coliforms	85	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	5/3/2005	Fecal Coliforms	35	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	5/3/2005	Fecal Coliforms	5	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	6/9/2005	Fecal Coliforms	40	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	6/9/2005	Fecal Coliforms	15	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	6/28/2005	Fecal Coliforms	500	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	6/28/2005	Fecal Coliforms	40	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	8/2/2005	Fecal Coliforms	130	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	8/2/2005	Fecal Coliforms	30	CFU/100mL

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
Shingle Island River	W1367	[Hixville Road, Dartmouth]	8/30/2005	Fecal Coliforms	##	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	8/30/2005	Fecal Coliforms	##	CFU/100mL
Shingle Island River	W1367	[Hixville Road, Dartmouth]	9/12/2005	Fecal Coliforms	205	CFU/100mL
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	9/12/2005	Fecal Coliforms	130	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	5/3/2005	Fecal Coliforms	10	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	5/3/2005	Fecal Coliforms	30	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	6/9/2005	Fecal Coliforms	35	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	6/9/2005	Fecal Coliforms	110	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	6/28/2005	Fecal Coliforms	>1600	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	6/28/2005	Fecal Coliforms	>1600	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	8/2/2005	Fecal Coliforms	280	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	8/2/2005	Fecal Coliforms	1300	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	8/30/2005	Fecal Coliforms	##	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	8/30/2005	Fecal Coliforms	##	CFU/100mL
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	9/12/2005	Fecal Coliforms	1220	CFU/100mL
Snell Creek	W1372	[Drift Road, Westport]	9/12/2005	Fecal Coliforms	270	CFU/100mL
Angeline Brook	W1375	[Cornell Road, Westport]	5/3/2005	Total Nitrogen	1.3	mg/L
Angeline Brook	W1375	[Cornell Road, Westport]	6/9/2005	Total Nitrogen	3.8	mg/L
Angeline Brook	W1375	[Cornell Road, Westport]	6/28/2005	Total Nitrogen	4.8	mg/L
Angeline Brook	W1375	[Cornell Road, Westport]	8/2/2005	Total Nitrogen	5.7	mg/L
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	5/3/2005	Total Nitrogen	0.83	mg/L
Bread And Cheese Brook	W1370	[Route 6, Westport]	5/3/2005	Total Nitrogen	0.69	mg/L
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	6/9/2005	Total Nitrogen	1.6	mg/L
Bread And Cheese Brook	W1370	[Route 6, Westport]	6/9/2005	Total Nitrogen	1.4	mg/L
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	6/28/2005	Total Nitrogen	1.8	mg/L

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
Bread And Cheese Brook	W1370	[Route 6, Westport]	6/28/2005	Total Nitrogen	1.7	mg/L
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	8/2/2005	Total Nitrogen	1.4	mg/L
Bread And Cheese Brook	W1370	[Route 6, Westport]	8/2/2005	Total Nitrogen	1.3	mg/L
Bread And Cheese Brook	W1371	[American Legion Highway (Route 177), Westport]	8/30/2005	Total Nitrogen	1.6	mg/L
Bread And Cheese Brook	W1370	[Route 6, Westport]	8/30/2005	Total Nitrogen	1.2	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	5/28/2013	Total Nitrogen	1.3	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	6/26/2013	Total Nitrogen	2.0	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	7/31/2013	Total Nitrogen	1.9	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	8/28/2013	Total Nitrogen	##	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	9/30/2013	Total Nitrogen	2.1	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	5/29/2014	Total Nitrogen	1.6	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	6/19/2014	Total Nitrogen	2.0	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	7/24/2014	Total Nitrogen	1.8	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	8/20/2014	Total Nitrogen	2.4	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	5/28/2015	Total Nitrogen	1.6	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	6/24/2015	Total Nitrogen	1.3	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	7/29/2015	Total Nitrogen	0.79	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	8/26/2015	Total Nitrogen	1.5	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	5/18/2016	Total Nitrogen	0.75	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	6/15/2016	Total Nitrogen	1.6	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	7/27/2016	Total Nitrogen	1.1	mg/L
Bread And Cheese Brook	W0344	[approximately 980 feet downstream of Route 177, Westport]	8/31/2016	Total Nitrogen	1.2	mg/L
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	5/3/2005	Total Nitrogen	0.41	mg/L
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	6/9/2005	Total Nitrogen	0.45	mg/L
Copicut River	W1365	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	6/28/2005	Total Nitrogen	0.58	mg/L

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
Copicut River	W1399	[just downstream of the driveway to the Rod and Gun Club of New Bedford]	8/30/2005	Total Nitrogen	1.2	mg/L
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	5/3/2005	Total Nitrogen	0.62	mg/L
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	5/3/2005	Total Nitrogen	0.49	mg/L
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	6/9/2005	Total Nitrogen	0.79	mg/L
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	6/9/2005	Total Nitrogen	0.64	mg/L
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	6/28/2005	Total Nitrogen	1.1	mg/L
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	6/28/2005	Total Nitrogen	0.74	mg/L
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	8/2/2005	Total Nitrogen	##	mg/L
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	8/2/2005	Total Nitrogen	0.77	mg/L
East Branch Westport River	W1369	[just upstream at Old County Road, Westport]	8/30/2005	Total Nitrogen	1.5	mg/L
East Branch Westport River	W1368	[upstream from Forge Pond, approximately 700 feet from Forge Road, Westport]	8/30/2005	Total Nitrogen	0.68	mg/L
Kirby Brook	W1374	[Drift Road, Westport]	5/3/2005	Total Nitrogen	0.69	mg/L
Kirby Brook	W1374	[Drift Road, Westport]	6/9/2005	Total Nitrogen	1.4	mg/L
Kirby Brook	W1374	[Drift Road, Westport]	6/28/2005	Total Nitrogen	1.6	mg/L
Kirby Brook	W1374	[Drift Road, Westport]	8/2/2005	Total Nitrogen	1.8	mg/L
Shingle Island River	W1367	[Hixville Road, Dartmouth]	5/3/2005	Total Nitrogen	0.45	mg/L
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	5/3/2005	Total Nitrogen	0.42	mg/L
Shingle Island River	W1367	[Hixville Road, Dartmouth]	6/9/2005	Total Nitrogen	0.61	mg/L
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	6/9/2005	Total Nitrogen	0.59	mg/L
Shingle Island River	W1367	[Hixville Road, Dartmouth]	6/28/2005	Total Nitrogen	0.76	mg/L
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	6/28/2005	Total Nitrogen	0.92	mg/L
Shingle Island River	W1367	[Hixville Road, Dartmouth]	8/2/2005	Total Nitrogen	0.63	mg/L
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	8/2/2005	Total Nitrogen	0.87	mg/L

Waterbody	Sampling Station Unique ID	Description	Date	Analyte	Value	Units
Shingle Island River	W1367	[Hixville Road, Dartmouth]	8/30/2005	Total Nitrogen	1.1	mg/L
Shingle Island River	W1366	[Flag Swamp Road, Dartmouth]	8/30/2005	Total Nitrogen	1.2	mg/L
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	5/3/2005	Total Nitrogen	0.87	mg/L
Snell Creek	W1372	[Drift Road, Westport]	5/3/2005	Total Nitrogen	0.95	mg/L
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	6/9/2005	Total Nitrogen	1.7	mg/L
Snell Creek	W1372	[Drift Road, Westport]	6/9/2005	Total Nitrogen	1.4	mg/L
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	6/28/2005	Total Nitrogen	1.8	mg/L
Snell Creek	W1372	[Drift Road, Westport]	6/28/2005	Total Nitrogen	1.5	mg/L
Snell Creek	W1373	[Marcus' Bridge (near Snell Corner), Westport]	8/2/2005	Total Nitrogen	4.0	mg/L
Snell Creek	W1372	[Drift Road, Westport]	8/2/2005	Total Nitrogen	2.2	mg/L

Sources: MassDEP, 2022

"MPN/100 mL" = most probable number per 100 milliliters

"CFU/100 mL"= colony forming units per 100 milliliters

"mg/L" = milligrams per liter