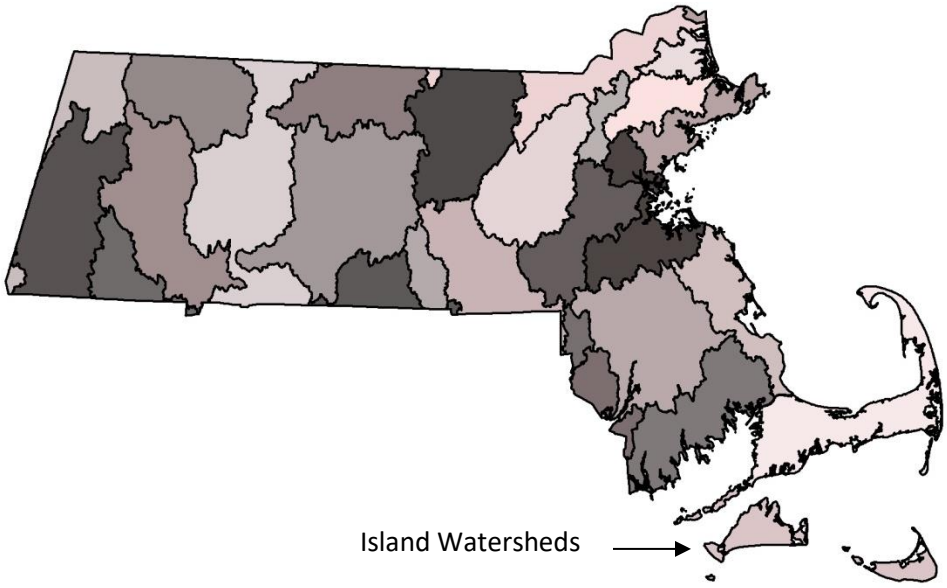
Final Pathogen TMDL for the Islands Watershed April 2020 (Control Number: CN 254.1)



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NOTICE OF AVAILABILITY

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

Massachusetts Department of Environmental Protection (MassDEP)
Division of Watershed Management
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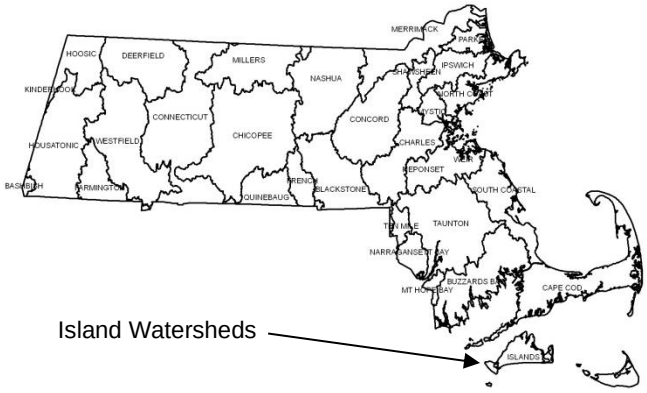
This report is also available on MassDEP's web page https://www.mass.gov/total-maximum-daily-loads-tmdls.

DISCLAIMER

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

Acknowledgement
This report was developed by ENSR (now AECOM) through a partnership with the Resource Triangle Institute (RTI) contracting with the United States Environmental Protection Agency (EPA) and MassDEP under the National Watershed Protection Program. The report follows the same format and methodology for previously approved bacteria TMDLs (Boston Harbor, Weymouth, Weir and Mystic Rivers, Buzzards Bay, Cape Cod, Charles, North Coastal, and South Coastal Watersheds).

Total Maximum Daily Loads for Pathogens within the Islands Watershed



Key Features: Pathogen TMDL for the Islands Watershed

Location: EPA Region 1

Land Type: New England Coastal

303(d) Listings: Pathogens

Nantucket[1]:

- Nantucket Harbor (MA97-01)
- Polpis Harbor (MA97-26)
- Sesachacha Pond (MA97-02)

Martha's Vineyard[1,2]:

- Chilmark Pond (MA97-05)
- Edgartown Harbor (MA97-15)
- Oak Bluffs Harbor (MA97-07)
- Sengekontacket Pond MA97-10,
- Tisbury Great Pond (MA97-18)
- Vineyard Haven Harbor (MA97-09)

Elizabeth Islands:

- Cuttyhunk Pond (MA97-21)

1- Pathogen Impaired segments identified after the public comment period for this TMDL will be included in a future TMDL as an Addendum to this report. The following segments are listed as impaired for pathogens in the 2016 Integrated report and will be included in a future TMDL: Long Pond (MA97-29) and Katama Bay (MA97-16).

2- Islands segments delisted for pathogens after the draft TMDL public notice: Edgartown Great Pond (MA97-17), Menemsha Pond (MA97-06), Oyster Pond (MA97-13), and Westend Pond (MA97-20).

Data Sources: MassDEP 2003. Islands Watershed 2000 Water Quality Assessment Report; and unpublished data. Division of Marine Fisheries Office, SE Region, Fall River, MA.

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

Monitoring Plan: Division of Marine Fisheries, Local Volunteer Groups

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

ACRONYM LIST

§	Section
7Q10	Seven Day Ten Year Low Flow
ACEC	Area of Critical Environmental Concern
BEACH Act	Beaches Environmental Assessment and Coastal Health Act of 2000
BMP	Best Management Practice
BOH	Board(s) of Health
BST	Bacteria source tracking
CALM	Consolidated Assessment and Listing Methodology
CCC	Cape Cod Commission
CFR	Code of Federal Regulations
CFU	colony forming units
CIHA	Cape and Islands Harbormasters Association
CMR	Code of Massachusetts Regulations
CSO	Combined Sewer Overflow
CWA	Clean Water Act, Federal
CWA § 303(d)	The CWA and implementing regulations at 40 CFR 130.7 require states to identify those waterbodies that are not expected to meet surface water quality standards after the implementation of technology-based controls and to prioritize and schedule them for the development of a total maximum daily load (TMDL).
CZM	Massachusetts Coastal Zone Management
DCR	Massachusetts Department of Conservation and Recreation
DFG or MA DFG	Massachusetts Division of Fish and Game
DMF or MA DMF	Massachusetts Division of Marine Fisheries
DWM	Massachusetts Division of Watershed Management
E. coli	*Escherichia coli*
EEA	Massachusetts Executive Office of Energy and Environmental Affairs
EMC	Event Mean Concentration
EPA or US EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
FOS	Friends of Sengekontacket, Inc.
GIS	Geographic Information System
gpd	gallons per day
GPF	Great Pond Foundation
IDDE	Illicit Discharge Detection and Elimination System
ILOW	Integrated List of Waters
LA	Load Allocation

LID	Low Impact Development
LPA	Lagoon Pond Association, Inc.
LTCP	Long Term Control Plan
MassBays	Massachusetts Bays Estuary Program
MADPH or DPH	Massachusetts Department of Public Health
MassDEP	Massachusetts Department of Environmental Protection
MEP	Maximum Extent Practicable
MEPA	Massachusetts Environmental Policy Act
MG	Million Gallons
mg/L	Milligrams per liter
MHD	Massachusetts Highway Department
mi^2	Square mile
ml	milliliter
MOS	Margin of Safety
MPN	Most Probable Number
MSD	Marine Sanitation Device
MS4	Municipal Separate Storm Sewer Systems
MVC	Martha's Vineyard Commission
MVDC	Martha's Vineyard Donors Collaborative
NDZ	No Discharge Zone
NEAR	Northeast Aquatic Research
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
ORW	Outstanding Resource Water
POTW	Publicly Owned Treatment Works
RTI	Research Triangle Institute
SRF	State Revolving Fund
SSO	Sanitary Sewer Overflows
SWMP	Stormwater Management Plan
SWPP	Stormwater Program Plan
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
TN	Total Nitrogen
TWI	Tisbury Waterways, Inc.
USACOE	United States Army Corps of Engineers
VCS	Vineyard Conservation Society
WHOI	Woods Hole Oceanographic Institute
WLA	Waste Load Allocation

WPP	Watershed Planning Program
WQA	Water Quality Assessment
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant

Executive Summary

Purpose and Intended Audience

This document provides a framework to address bacterial pathogens and other fecal-related pollution in the surface waters of Massachusetts. The term "Pathogens" refers to the set of indicator bacterial organisms that includes fecal coliform, *Escherichia coli* (*E. coli*) and enterococci, which represent a threat to human health and the environment. Although not all bacteria are pathogenic, the words "pathogens" and "bacteria" are used interchangeably in this TMDL. Pathogen contamination of our surface waters is most often a direct result of the improper management of human wastes, excrement from barnyard animals, pet feces and agricultural applications of manure. It can also result from large congregations of birds such as geese and gulls. Discharges of inadequately treated boat waste are of particular concern in urban coastal areas. Inappropriate disposal of human and animal wastes can degrade aquatic ecosystems and negatively affect public health. Pathogen contamination can also result in closures of shellfish beds, bathing beaches, swimming areas and drinking water supplies. The closure of such important public resources can erode quality of life and diminish property values.

Coastal communities rely on clean, productive, aesthetically pleasing marine and estuarine waters for swimming, boating, fishing and tourism. Failure to reduce and control bacterial contamination results in illness in humans, closures of shellfishing areas and bathing beaches, fish kills, unpleasant odors and visible scum. Total Maximum Daily Loads (TMDLs) for pathogens have been established for waterbody segments within the Islands Watershed. This TMDL will be used to provide stakeholders with the means to identify bacterial sources and the actions to take to reduce their effects.

Who should read this document?

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

a) Although town and municipalities in the TMDL study area are not covered under the 2018 Municipal Separate Stormwater Systems (MS4) permit (US EPA 2018g), towns and municipalities will find information to help manage their natural resources, particularly water resources.;

b) Watershed groups that wish to pursue funding to identify and/or mitigate sources of pathogens in their watersheds;

c) Harbormasters, public health officials and/or municipalities that are responsible for monitoring, enforcing or otherwise mitigating contamination that results in beach and/or shellfish closures or results in the failure of other surface waters to meet Massachusetts standards for pathogens;

d) Citizens who wish to become more aware of pollution issues and who may be interested in helping build local support for implementation of remediation measures; and

e) Government agencies that provide groups with planning, technical assistance, and funding to remediate pollution, including pathogens.

Islands Watershed

The Islands Watershed (or coastal drainage area) includes Nantucket, Martha's Vineyard and the Elizabeth Islands. Nantucket is a 49 square mile (mi^2) island surrounded by the Atlantic Ocean. The Town of Nantucket, which is a county as well, encompasses the entire island. It is a combination of moraines and outwash plain resulting primarily from the last episode of glaciation that affected the Northeastern United States about 15,000 years ago, with elevations up to approximately 100 feet above sea level and 94 miles of shoreline.

Martha's Vineyard is a 96 mi^2 island consisting of six towns: Chilmark, Edgartown, Gay Head, Oak Bluffs, Tisbury and West Tisbury. The maximum elevation on Martha's Vineyard is roughly 300 feet. There are approximately 125 miles of shoreline, ranging from nine miles in West Tisbury to 49 miles in Edgartown.

The Elizabeth Islands are a chain of fifteen islands encompassing 13.6 mi^2 with approximately 54 miles of tidal shoreline in the town of Gosnold, Dukes County. One family owns and manages all but two of the islands (Cuttyhunk and Penikese). Most of the Elizabeth Islands are grassy with areas of low woods or shrub growth.

Progress in Discovering and Reducing Bacteria Sources in the Watershed

Measurable improvement has been made in the last 15 years to address bacterial contamination within the Islands watershed as shown in the data in Chapter 4. Bacterial pollution in the Islands segments covered by this report persists due to non-point sources of pollution. Non-point sources may include runoff from failing septic systems, illicit connections, wildlife and pet wastes, boat and marina wastes and direct overland stormwater runoff. Note that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing wild birds or animals to congregate.

The document discusses a total of 10 waterbodies requiring a TMDL for bacteria impairment. These waterbodies were identified and publicly noticed in the Draft TMDL in accordance with what was reported in the 2002 Integrated List of Waters (§303(d) list). Subsequent to the Draft TMDL, four waterbodies [Edgartown Great Pond, (MA97-17), Menemsha Pond (MA97-06), Oyster Pond (MA97-13), and Westend Pond (MA97-20)] are no longer listed as impaired for pathogens and are therefore not discussed in this document. Additionally, since the publication of the draft TMDL, an additional two waterbodies [Katama Bay (MA97-16), and Long Pond (MA97-29)] in the TMDL study area have been added as pathogen impaired segments that are listed in the 2016 Integrated List of Impaired Waters. Only the 10 remaining segments originally listed in the 2002 Integrated List of Waters (§303(d) list) for Pathogen impairment (based on fecal coliform data), that are currently identified as Category 5 waters (MassDEP 2020), are discussed in this document. Each are within estuary areas that are classified as SA, designated for shellfishing.

In order for estuary areas in all upstream Islands segments to meet SA standards, substantial effort is needed to detect and eliminate sources of bacterial pollution. The major goal for waters to meet the stringent Class SA standards is to reopen closed shellfishing areas or maintain existing shellfishing areas. To meet these standards existing stormwater and other pollution issues must be resolved in the contributing watershed. Bacterial problems generally increase during, and just following, wet weather periods (e.g., precipitation, snow melt). Overland stormwater runoff in the Islands watershed collects pollutants from such sources of bacteria as pet and/or wildlife wastes, failing septic systems, boat sewage discharges, illicit connections to storm drains, and agricultural or animal husbandry activities.

In August 2006, the Executive Office of Environmental Affairs (now known as the Executive Office of Energy and Environment) formally announced that coastal areas, encompassing the Islands, became a No Discharge Area (NDA), which prohibits any discharge of boat sewage (Figure 2-3). This was enacted to better protect the waters from receiving nutrient and bacterial waters from marine vessels operating within these waters (CZM 2014).

On Nantucket, nitrogen and pathogen overloading occurs as the result of faulty septic systems leaching into groundwater, and enriched fertilizers and other agricultural additives that collect in stormwater runoff; both groundwater and runoff eventually reach the coast. Additional pathogen pollution can enter estuaries from failing septic and wastewater systems, boat sewage, and animal wastes. Residents and visitors to Nantucket need to be made aware of the steps they can take to reduce the amount of nitrogen and pathogens that end up in the Island's harbors. Nantucket has significant amounts of glacially deposited coarse, sandy soils that are subject to rapid water infiltration, percolation, and leaching of both nutrients and pathogens. Excess nutrients applied to lawns and gardens, or nutrients and pathogens that remain in groundwater after passing through cesspools, septic systems and package wastewater treatment plant leaching fields, eventually reach groundwater and inland water bodies, coastal estuaries, and harbors.

On Martha's Vineyard, the majority of residents dispose of wastewater via on-site septic systems. Only those residents and businesses in downtown Oak Bluffs, Edgartown, and Tisbury are served by wastewater collection systems with central sewage treatment. Wastewater contains significant amounts of nitrogen and pathogens that are very water-soluble neither of which are easily broken down in the aquifer. Nitrogen in the form of nitrate, as well as pathogens, travel with groundwater to springs and seeps along the shore and shallow tidal areas in the ponds, with nitrates generating the growth of microscopic plants and algae. When these are stimulated to excess levels of growth, the capability of the system to support eelgrass, shellfish and finfish is harmed. Pathogens in shellfish can be harmful for human consumption. In more intensively developed areas where there are many septic systems and private wells, the groundwater may be affected to the point where the drinking water standard for nitrate is exceeded. Much of the nitrogen in wastewater can be removed by denitrifying systems, either as an individual component for a single residence, or as a treatment unit for a cluster of residences. Septic and package treatment systems will remove a very high percentage of the pathogens if they are functioning properly.

Bacterial Water Quality Indicators

The terms "pathogens" and "bacteria" are used in this report to refer to bacteriological data collected and analyzed for Fecal coliform, *E. coli* or Enterococci. The Massachusetts Surface (WQS), 314 CMR 4.0 were revised in 2007, replacing Fecal coliform as the water quality indicator for pathogens in both fresh and marine waters with ***E. coli* for fresh water** and **Enterococci for marine waters** (MassDEP 2007). **Fecal coliform** is the water quality indicator used by the Massachusetts Division of Marine Fisheries (DMF) for shellfish harvesting in coastal-estuarine segments. Readily available data for the impaired (Category 5) segments in the Islands Watershed are listed in tables in Section 4 of this report.

Bacterial Implementation Priorities

ES Table-1 below provides guidance for setting bacterial implementation priorities within the Islands Watershed in the form of a prioritized list of pathogen-impaired segments that may require additional bacterial source tracking work and stepwise implementation of structural (e.g., the repair of failing infrastructure) and non-structural (e.g., administrative controls) Best Management Practices (BMPs). Since limited source information and data are available in each impaired segment, a simple scheme was used to prioritize segments based on bacteria concentrations and designated uses. Depending on the particular bacteria indicator sampled and analyzed by the particular organization, the data listed are either Fecal coliform, *E. coli*, or Enterococci.

ES Table-1 Prioritized List of Pathogen-Impaired Segments for The Islands Watershed

Segment ID	Segment Name	Class/ Qualifier	Size (mi^2)	Segment Description	Priority	Indicators
	Nantucket Island					
MA97-01	Nantucket Harbor	SA/ Shellfishing	7.16	Waters south and east of an imaginary line drawn from Jetties Beach to Coatue Point (excluding Polpis Harbor and Coskata Pond), Nantucket	*Medium	Fecal Coliform
MA97-26	Polpis Harbor	SA/ Shellfishing	0.302	Polpis Harbor and all adjacent coves, to an imaginary line drawn from Quaise Point to the opposite shore, Nantucket	*Medium	Fecal Coliform
MA97-02	Sesachacha Pond	SA/ Shellfishing	0.423	South of Quidnet Road and North of Polpis Road, Nantucket	(Insufficient Data)	Fecal Coliform
	Martha's Vineyard					
MA97-05	Chilmark Pond	SA/ Shellfishing	0.3134	South of South Road including Wades Cove and Gilberts Cove, Chilmark, Martha's Vineyard	*Medium Shellfishing	Fecal Coliform, Enterococci

Segment ID	Segment Name	Class/ Qualifier	Size (mi^2)	Segment Description	Priority	Indicators
MA97-15	Edgartown Harbor	SA/ Shellfishing	3.086	Waters west of Cape Poge Gut bounded by an imaginary line drawn from Chappaquiddick Point to Dock Street and northeasterly from the end of Plantingfield Way to Cape Poge Elbow (excluding Eel Pond), Edgartown, Martha's Vineyard	**Low (all shellfishing areas are unrestricted)	Fecal Coliform
MA97-07	Oak Bluffs Harbor	SA/ Shellfishing	0.047	North of Lake Avenue to confluence with Nantucket Sound, Oak Bluffs, Martha's Vineyard	*Medium	Fecal Coliform
MA97-10	Sengekontacket Pond	SA/ Shellfishing	1.10	Between Edgartown-Vineyard Haven Road and Oak Bluffs Road, including Majors Cove, Edgartown/Oak Bluffs, Martha's Vineyard.	*Medium	Fecal Coliform
MA97-18	Tisbury Great Pond	SA/ Shellfishing	1.10	Including Town Cove, Muddy Cove, Pear Tree Cove, Short Cove, Tiah Cove, Tississa Pond, Deep Bottom Cove, and Thumb Cove, Chilmark/West Tisbury, Martha's Vineyard	*Medium	Fecal Coliform
MA97-09	Vineyard Haven Harbor	SA/ Shellfishing	1.545	The waters south and west of an imaginary line drawn from the tip of West Chop, Tisbury and the tip of East Chop, Oak Bluffs to the confluence of Lagoon Pond at Beach Road, Tisbury/Oak Bluffs, Martha's Vineyard	*Medium	Fecal Coliform
	Elizabeth Islands					
MA97-21	Cuttyhunk Pond	SA/ Shellfishing/ ORW	0.154	Waters west of the channel connecting Cuttyhunk Pond to Cuttyhunk Harbor, Gosnold, Elizabeth Islands. (Changed from MA95-26 to MA97-21 on 10/7/97)	*Medium	Fecal Coliform

* A segment adjacent to or immediately upstream of a sensitive use such as an ORW is elevated one level of priority.

** Latest DMF Classifications indicate that all shellfishing waters are fully 'approved'.

High priority would be assigned to segments where dry and/or wet weather concentrations (end of pipe or ambient) were equal to or greater than 10,000 colony forming unit per 100 milliliters (CFU/100ml);

medium priority was assigned to segments where concentrations ranged from 1,000 to 9,999 CFU/100ml, and low priority was assigned to segments where observed concentrations were less than 1,000 CFU/100 ml. Prioritization was also adjusted upward based on proximity of waters within the segment to sensitive areas such as Outstanding Resource Waters (ORWs), or designated uses that require higher water quality standards than Class B, such as public water supply intakes, public swimming areas, or shellfish areas.

Stormwater runoff collects and accumulates pollutants from sources such as pets and wildlife, failing septic systems, illicit connections to storm drains, catch basins, poor agricultural and animal husbandry practices, and boating sewage discharges, all of which appear to be potential sources of pathogen pollution in the Islands. Therefore, the control and/or elimination of these sources is the highest priority in improving bacterial water quality. Repair of failing septic systems will result in reduced bacteria levels and improved water quality.

On the Islands, there is a potential for contamination from illicit connections (e.g., wastewater pipes connected to stormwater drainage). A key to finding illicit connections, failing infrastructure, et cetera is to conduct dry weather bacteria source tracking in those segments where data show elevated levels of bacteria. Identification and remediation of dry weather bacteria sources is usually more straightforward and successful than tracking and eliminating wet weather sources. If anthropogenic bacteria sources are found and eliminated, it should result in a dramatic reduction of pathogen levels in impacted segments under both dry and wet-weather conditions.

Finding and repairing the failed areas of infrastructure, which are mostly buried, poses logistical and financial challenges. Stormwater runoff greatly exacerbates the pollution from failed infrastructure. Segments that are only impaired during wet weather should be evaluated for stormwater BMP implementation opportunities starting with less costly non-structural practices (such as street sweeping, catch basin cleaning, and/or managerial approaches using local regulatory controls), and lastly, more expensive structural measures. Unfortunately, many failed infrastructure problems require costly structural repairs; additional study may be needed to identify the most cost efficient and effective technology. For more details on Prioritization see section 6.0.

TMDL Overview

The Massachusetts Department of Environmental Protection (MassDEP) is responsible for monitoring the waters of the Commonwealth, identifying those waters that are impaired, and developing a plan to bring them back into compliance with the Massachusetts WQS. The Massachusetts Year 2016 Integrated List of Waters (ILOW) contains a list of impaired waters that require a TMDL (Category 5 Waters, formerly known as the "303(d) List"). This list identifies impaired segments of rivers and streams, coastal waters and lakes, and the justification for the impairment decision(s). It should be noted that all of these waterbodies are influenced by seasonal variations in flow and temperature and the tidal cycles in the estuaries, and these variations will directly impact the extent to which these waterbodies are impaired.

Once a water body is identified as impaired, MassDEP is required by the CWA to design a "pollution budget" to restore the health of the impaired segment. The process of developing this budget, generally referred to as a Total Maximum Daily Load (TMDL), includes: identifying the source(s) of the pollutant

causing the impairment, from both direct (point sources) and indirect discharges (non-point sources); determining the maximum amount of the pollutant that can be discharged to a specific water body without causing it to fail to meet water quality standards; and assigning pollutant load allocations to the identified sources. A plan to implement the necessary pollutant reductions is essential in order to reach the ultimate goal of restoring uses and meeting water quality standards instream.

Pathogen TMDL: This report presents a TMDL for pathogen indicators (i.e., fecal coliform, *E. coli*, and enterococcus bacteria) in the Islands Watershed (e.g., Nantucket, Martha's Vineyard, and Elizabeth Islands). Certain bacteria, such as those named above, are indicators of contamination from sewage (human) and/or the feces of warm-blooded wildlife (other mammals and birds). Such contamination may pose a risk to human health. Therefore, in order to prevent further degradation in water quality and to ensure that waterbodies within the watershed meet state water quality standards, the TMDL establishes indicator bacteria limits and outlines corrective actions to achieve that goal.

Sources of indicator bacteria in the Islands Watershed were found to be many and varied, although most are believed to be stormwater related. In Section 5, Table 5-1 provides a general compilation of likely bacteria sources in the Islands Watershed including failing septic systems, certain recreational activities, wildlife including birds as well as domestic pets and animals, and overland stormwater runoff. Note that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing wild birds or animals to congregate. A discussion of pathogen-related control measures and best management practices are provided in the companion document: "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" (ENSR 2005[1]) and on the interactive web site, Massachusetts Clean Water Toolkit, http://prj.geosyntec.com/npsmanual/default.aspx.

This TMDL applies to the 10 bacteria-impaired estuary segments of the Islands Watershed that were publicly noticed in 2005 that are currently identified as Category 5 waters (MassDEP 2020). MassDEP recommends, however, that the information contained in this TMDL will guide management activities for all other waters throughout the watershed to help maintain and protect existing water quality. Water quality has improved subsequent to the publication of the draft TMDL and continued sampling to assess progress towards reducing bacterial pollution is recommended.

The analyses conducted for the bacteria impaired segments in this TMDL would apply to the non-impaired segments, since the sources and their characteristics are equivalent. The concentration waste load and/or load allocation for each source and designated use would be the same as specified in this TMDL. This TMDL may be used as a pollution prevention TMDL as it would have identical waste load and load allocations (WLA, LA) based on the sources present and the designated use of the water body segment

[1] This document was created at the initiation of the project in 2005 to be used as a companion guide by communities for addressing bacteria pollution impairments and should be used judiciously since the content does not represent the current status of regulations, permits, and grant programs.

(see ES Table 1 and Table 6-1). This Islands Watershed TMDL may also be applied to segments with similar pathogen impairments in (future) Massachusetts Integrated Lists of Waters. For such segments, this TMDL may apply if, after listing the waters for bacteria impairment and taking into account all relevant comments submitted on the particular future Integrated List of Waters in effect, the Commonwealth determines with EPA approval that this TMDL should apply to newly listed bacteria impaired segments. Similarly, two waterbodies described in this document identified as impaired after public notice of the Draft TMDL (2005), will be released for public comment and included in an addendum to this document.

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

TMDL goals for each type of bacteria source are provided in ES Table-2. Municipalities are the primary responsible parties for achieving water quality standards through elimination of these sources. TMDL implementation to achieve these goals should be an iterative process, with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows, and best management practices to mitigate stormwater runoff volume. None of the towns in the watershed are classified as Urbanized Areas by the United States Census Bureau and therefore are not subject to the Stormwater Phase II Final Rule, which requires the development and implementation of an illicit discharge detection and elimination plan.

In most cases, the authority to regulate non-point source pollution and thus successful implementation of this TMDL is limited to local government entities, and will require cooperative support from volunteers, watershed associations, and local officials in municipal government. Those activities can take the form of expanded education and outreach, funding appropriation and possibly local enforcement. In some cases, such as subsurface disposal of wastewater from homes, the Commonwealth provides the regulatory framework, but administration occurs on the local level. Towns in the Islands watersheds are eligible to compete for §319 Nonpoint Source grant funds (provided by the EPA and administered by MassDEP) to address non-point sources of contamination. Additional sources of grant funding include Water Quality Management Planning Grants (CWA § 604(b), also provided by the EPA administered by MassDEP) and Coastal Pollution Remediation grants (administered by the Massachusetts Office of Coastal Zone Management, or CZM). State Revolving (Loan) Fund Program (SRF) funds can provide low-interest loans for pollution mitigation.

ES Table-2 Sources and Expectations for Limiting Bacterial Contamination in the Islands Watershed

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1]	Load Allocation Indicator Bacteria (CFU/100 mL)[1]
A, B, SA, SB (prohibited)	Illicit discharges to storm drains	0	Not applicable
	Leaking sanitary sewer lines	0	Not Applicable
	Failing septic systems	Not Applicable	0
A (Includes filtered water supply) & B	Any regulated discharge- including stormwater runoff[2] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges [4,6]	Either; *a) E. coli* <=geometric mean[3] 126 colonies per 100 mL; single sample <=235 colonies per 100 mL[7] or b) Enterococci geometric mean[3] <= 33 colonies per 100 mL and single sample <= 61 colonies per 100 mL[7]	Not Applicable
	Nonpoint source stormwater runoff[2]	Not Applicable	Either *E. coli* <=geometric mean[3] 126 colonies per 100 mL; single sample <=235 colonies per 100 mL; or Enterococci geometric mean[3]<= 33 colonies per 100 mL and single sample <= 61 colonies per 100 mL
SA (approved for shellfishing)	Any regulated discharge - including stormwater runoff[2] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[4,6]	Fecal Coliform <= geometric mean, MPN, of 14 organisms per 100 mL nor shall 10% of the samples be >=28 organisms per 100 mL	Not Applicable
	Nonpoint Source Stormwater Runoff[2]	Not Applicable	Fecal Coliform <= geometric mean, MPN, of 14 organisms per 100 mL nor shall 10% of the samples be >=28 organisms per 100 mL
SA & SB (Beaches[7] and non-designated shellfish areas)	Any regulated discharge - including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[4,6]	Enterococci - geometric mean[5] <= 35 colonies per 100 mL and single sample <= 104 colonies per 100 mL[7]	Not Applicable

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1]	Load Allocation Indicator Bacteria (CFU/100 mL)[1]
	Nonpoint Source Stormwater Runoff[2]	Not Applicable	Enterococci -geometric mean[3] <= 35 colonies per 100 mL and single sample <= 104 colonies per 100 mL
SB (approved for shellfishing w/depuration)	Any regulated discharge - including stormwater runoff[2] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[2,4]	Fecal Coliform <= median or geometric mean, MPN, of 88 organisms per 100 mL nor shall 10% of the samples be >=260 organisms per 100 mL[7]	Not Applicable
	Nonpoint Source Stormwater Runoff[2]	Not Applicable	Fecal Coliform <= median or geometric mean, MPN, of 88 organisms per 100 mL nor shall 10% of the samples be >=260 organisms per 100 mL
	Nonpoint Source Stormwater Runoff[2]	Not Applicable	Enterococci -geometric mean[3] <= 35 colonies per 100 mL and single sample <= 104 colonies per 100 mL

[1] Waste Load Allocation (WLA) and Load Allocation (LA) refer to fecal coliform densities unless specified in table.
[2] The expectation for WLAs and LAs for stormwater discharges is that they will be achieved through the implementation of BMPs and other controls.
[3] The geometric mean of the 5 most recent samples is used at bathing beaches. For all other waters and during the non-bathing season the geometric mean of all samples taken within the most recent six months, typically based on a minimum of five samples.
[4] Or shall be consistent with the Waste Water Treatment Plant (WWTP) National Pollutant Discharge Elimination System (NPDES) permit.
[5] Massachusetts Department of Public Health regulations (105 CMR Section 445)
[6] Seasonal disinfection may be allowed by the Department on a case-by-case basis.
[7] Threshold for beach closure. Beaches Environmental Assessment and Coastal Health (BEACH) Act.

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

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1.0 Introduction

Section (§) 303(d) of the Federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 Code of Federal Regulations, or CFR, Part 130) require states to place waterbodies that do not meet established water quality standards on a list of impaired waterbodies (formerly known as the "303(d) List") and to develop Total Maximum Daily Loads (TMDLs) to identify the pollutant(s) contributing to the impairment and to restore listed waters. Subsequent to the draft TMDL four waterbodies (Edgartown Great Pond MA97-17, Menemsha Pond MA97-06, Oyster Pond MA97-13, and Westend Pond MA97-20) are no longer listed as impaired for pathogens. Additionally, since the publication of the draft TMDL an additional two waterbodies impaired for pathogens in this Final TMDL (Katama MA97-16, and Long Pond MA97-29) are included in Category 5 of the "*Massachusetts Year 2016 Integrated List of Waters: Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d)* of the Clean Water Act" (MassDEP 2020). Figure 1-1 provides a map of the Islands Watershed indicating bacteria-impaired segments. As shown in Figure 1-1 below, 10 of the Islands Watershed waterbodies are listed as Category 5, "impaired or threatened for one or more uses and requiring a TMDL" based upon excessive indicator bacteria concentrations.

The Final Report has been greatly expanded from the original Draft TMDL. Section 4, Problem Assessment, has been substantially updated with current MassDEP, DMR and CZM data. Sections 5 and 6 have been reworked to give more information on both possible and actual sources of pathogen pollution. Section 7 has been modified to include giving WLA and LA loadings calculations for each segment. Section 8 is a detailed update on activities and progress of each community in the watershed. Section 10, Reasonable Assurances has been expanded to give details on various tools and resources that are potentially available to communities and organizations for pathogen pollution controls.

TMDLs are to be developed for water bodies that are not meeting designated uses under technology-based controls only, such as wastewater treatment plant (WWTP) upgrades. TMDLs determine the amount of a pollutant that a waterbody can safely assimilate without violating water quality standards. The TMDL process establishes the maximum allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollutant sources and in-stream conditions. The TMDL process is designed to assist states and watershed stakeholders in the implementation of water quality-based controls specifically targeted to identify sources of pollution in order to restore and maintain the quality of their water resources (EPA 2001). TMDLs allow watershed stewards to establish measurable water quality goals based on the difference between site-specific in-stream conditions and state water quality standards.

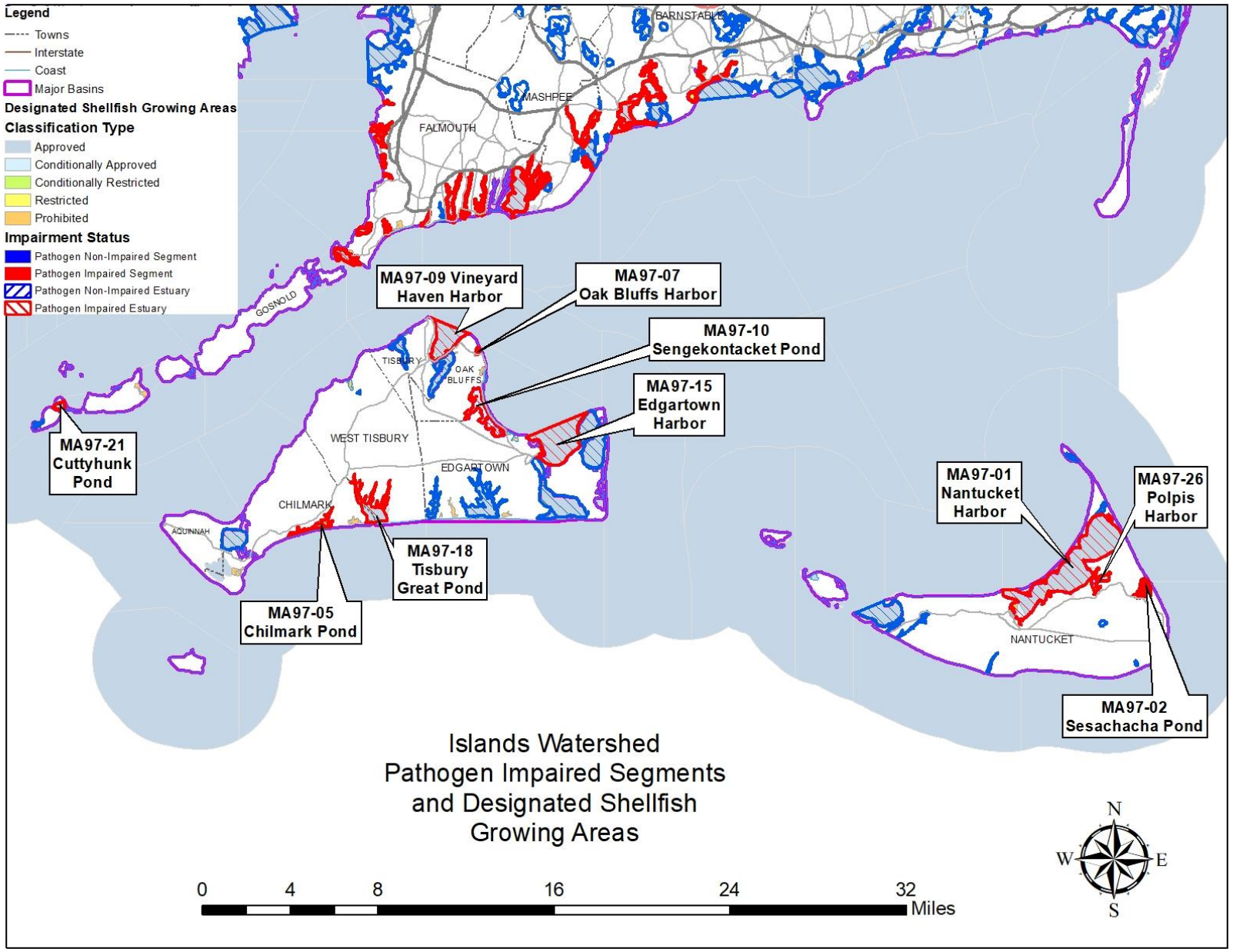
A major goal of this TMDL is to achieve meaningful environmental results with regard to the designated uses of the Islands Watershed waterbodies. These include: water supply, shellfish harvesting, fishing, boating, and swimming. This TMDL establishes the appropriate pollutant load to achieve designated uses and water quality standards. The companion document entitled: "*Mitigation Measures to Address*

Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts" (ENSR 2005)[1] which provides guidance for the implementation of this TMDL. https://www.mass.gov/files/documents/2016/08/pu/impguide.pdf?_ga=2.91336601.286719323.1577985992-1994365120.1577803653 and on the interactive web site, *Massachusetts Clean Water Toolkit*, http://prj.geosyntec.com/npsmanual/default.aspx.

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

[1] This document was created at the initiation of the project in 2005 to be used as a companion guide by communities for addressing bacteria pollution impairments and should be used judiciously since content of does not represent the current status of regulations, permits, and grant programs.

Figure 1-1 Islands Watershed and Pathogen Impaired Segment



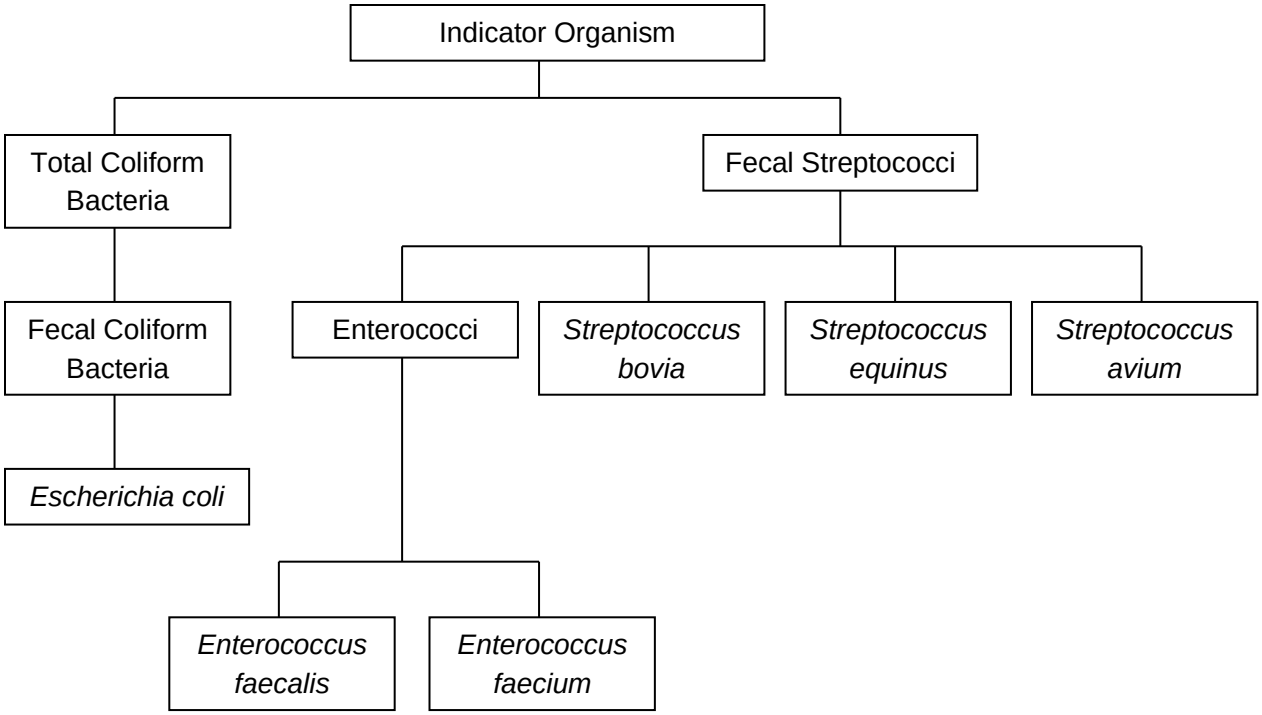
1.1. Pathogens and Indicator Bacteria

The Islands Watershed pathogen TMDL is designed to support the reduction of waterborne disease-causing organisms, known as pathogens, to reduce public health risks. Waterborne pathogens enter surface waters from a variety of sources including sewage and the feces of warm-blooded wildlife. These pathogens can pose a risk to human health (e.g., as a cause of gastrointestinal illness) through ingestion from contact with recreational and drinking waters, and via the consumption of filter-feeding shellfish.

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

The selection of indicator bacteria is difficult as new technologies challenge current methods of detection and the strength of the correlation between indicator bacteria and human illness. Currently, coliform and fecal streptococcal bacteria are commonly used as indicators of potential pathogens (i.e., as indicators). Coliform bacteria used as indicator organisms include total coliform, fecal coliform and *Escherichia coli* (*E. coli*). Fecal coliform (a subset of total coliform) and *E. coli* (a subset of fecal coliform) bacteria are present in the intestinal tracts of warm-blooded animals, thus the presence of coliform bacteria in water indicates the likelihood of fecal contamination. Fecal streptococcal bacteria are also used as indicator bacteria, specifically enterococci, a subgroup of fecal streptococci. These bacteria also live in the intestinal tracts of animals, but their presence is a better predictor of human gastrointestinal illness than fecal coliform since the die-off rate of enterococci is much lower (i.e., enterococci bacteria remain in the environment longer) (EPA 2001). The relationships among indicator organisms are shown in Figure 1-2. The EPA, in the "*Ambient Water Quality Criteria for Bacteria – 1986"* (EPA 1986) and *"2012 Recreational Water Quality Criteria for Bacteria*" (EPA 2012a), recommends the use of *E. coli* or Enterococci as indicators of potential pathogen presence in fresh water and enterococci in salt water.

Figure 1-2 Relationships among Indicator Organisms (EPA 2001)



The Islands Watershed pathogen TMDLs have been developed using fecal coliform as an indicator bacterium for shellfish areas and enterococci for bathing in marine waters. Any future changes in the Massachusetts pathogen water quality standard(s) will apply to this TMDL at the time of promulgation of the revised standard. MassDEP believes that the magnitude of indicator bacteria loading reductions outlined in this TMDL will be both necessary and sufficient for the listed impaired waters to attain present water quality standards (WQS) and any future modifications to the WQS for pathogens.

MassDEP believes a comprehensive management approach must be adapted and implemented by all watershed communities to address the ubiquitous nature of pathogen sources present in the Islands watershed. Watershed-wide implementation is needed to meet WQS and restore designated uses in impaired segments while providing protection of desirable water quality in waters that are not currently impaired or not assessed.

1.2. Comprehensive Watershed-based Approach to TMDL Development

As discussed below, this TMDL applies to the 10 pathogen impaired segments of the Islands Watershed that were publicly noticed that are currently listed as Category 5 (impaired, requiring a TMDL) in the 2016 Integrated List of Waters (ILOW) (MassDEP 2019). MassDEP recommends however, that the information contained in this TMDL guide management activities for all other waters in the watershed to help maintain and protect existing water quality. For these non-impaired waters, Massachusetts is proposing "pollution prevention TMDLs" consistent with CWA § 303(d)(3).

The analyses conducted for the pathogen-impaired segments in this TMDL also apply to the non-impaired segments, since the sources and their characteristics are equivalent. The waste load and/or load allocation (WLA, LA) for each source and designated use would be the same as specified herein. Therefore, the pollution prevention TMDLs would have identical WLAs and LAs based on the sources present and the designated use(s) of the water body segments (see ES Table-2 or Table 7-1).

This Islands Watershed TMDL may, in appropriate circumstances, also apply to segments that are listed for pathogen impairment in subsequent Massachusetts ILOW. For such segments, this TMDL may apply if, after listing the waters for pathogen impairment, addressing all relevant comments submitted on the draft ILOW in effect at that time, and receiving EPA approval, the Commonwealth determines that this TMDL should apply to future pathogen impaired segments.

As of 2005, there were 32 waterbody segments that considered part of the Islands Watershed by MassDEP. Four of these segments were freshwater lakes or ponds, and four were rivers/streams, none of which are covered in this report. Twelve of a total 24 estuaries/coastal embayments/salt water ponds assessed as of 2005 are currently meeting standards for bacteria or have not been assessed. Two of the 24 are pathogen impaired but have not been publicly noticed as subject to this TMDL. The remaining ten are pathogen impaired, have been publicly noticed, and are addressed in this TMDL. As shown in Figure 1-1, none of the four river/stream segments considered for this report are pathogen-impaired (MassDEP 2020. Pathogen contamination has been documented by MassDEP in previous reports, such as water quality assessments (WQA), resulting in the impairment determinations. In this TMDL document, an overview of pathogen impairment is provided in Chapter 4 to illustrate the nature and extent of the pathogen impairment problem. Additional data used to determine impairment status, which were not collected by MassDEP, are also provided in this TMDL to illustrate the pathogen problem. Since pathogen impairment has been previously established, only a summary is provided herein.

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

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

1.3. TMDL Report Format

This document contains the following sections:

- Watershed Description (Section 2) – provides watershed specific information
- Water Quality Standards (Section 3) – provides a summary of current Massachusetts WQS as they relate to indicator bacteria
- Problem Assessment (Section 4) – provides an overview of indicator bacteria measurements collected in the Islands Watershed
- Identification of Sources (Section 5) – identifies and discusses potential sources of waterborne pathogens within the Islands Watershed.
- Prioritization and Known Sources (Section 6) – identifies and discusses specific sources of waterborne pathogens and assigns pollution priorities to specific segments.
- TMDL Development (Section 7) – specifies required TMDL development components including:
    - Definitions and Equation
    - Loading Capacity
    - Load and Waste Load Allocations
    - Margin of Safety
    - Seasonal Variability
- Implementation Plan (Section 8) – describes specific implementation activities designed to remove pathogen impairment. This section, the companion document "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*", ENSR 2005, and the interactive web site, Massachusetts Clean Water Toolkit, http://prj.geosyntec.com/npsmanual/default.aspx. should be used together to support implementing management actions
- Monitoring Plan (Section 9) – describes recommended monitoring activities
- Reasonable Assurances (Section 10) – describes reasonable assurances the TMDL will be implemented
- Public Participation (Section 11) – describes the public participation process, and
- References (Section 12).

2.0 Watershed Description

The Islands watershed includes the Elizabeth (Gosnold), Martha's Vineyard and Nantucket Islands. Roughly 82% of the land use on the islands is devoted to open space and natural (i.e., undeveloped) areas. Residential and commercial/industrial areas make up the remaining 18% of land use (Table 2-1). Dukes (the Elizabeth Islands and Martha's Vineyard) and Nantucket counties encompass the entire watershed. It is important to note that the populations of both counties have experienced significant population increases when compared to other Massachusetts counties between 2000 and 2010, namely, 10.3% and 6.8% increases respectively (Smith- Johnson 2017). And historically, tourism swells island populations during the summer months. On Martha's Vineyard, the winter (resident) population of 16,535 swells to over 115,000 during the tourism season (State House News Service 2015), and from 10,172 to 60,000 on Nantucket (Smith Johnson 2017).

Nantucket spans approximately 49 square miles (mi^2) and has roughly 94 miles of shoreline. Its geology is characterized by moraines and outwash plains. The maximum elevation of the island is approximately 100 feet above sea level. Open space on Nantucket is dominated by undeveloped land, pasture and cropland (Figure 2-1).

Martha's Vineyard is a 96 mi^2 island with roughly 125 miles of shoreline. The island is divided into six towns: Chilmark, Edgartown, Gay Head, Oak Bluffs, Tisbury, and West Tisbury. Maximum elevation on the Island is approximately 300 feet (MassDEP 2003). Martha's Vineyard includes extensive areas of woody perennial forest and residential developments (Figure 2-1).

The Elizabeth Islands is a chain of fifteen islands encompassing 13.6 mi^2 with approximately 54 miles of tidal shoreline in the town of Gosnold, Dukes County (MassDEP 2003). The Elizabeth Islands contain extensive areas of open space and isolated areas of residential land use (Figure 2-1).

Many of the extensive marine and brackish waters of the Islands watershed waters are commonly used for primary and secondary contact recreation (swimming and boating), fishing, wildlife viewing, habitat for aquatic life, shellfish harvesting, irrigation, agricultural uses, public water supply, and beachfront. Figure 2-2 shows the locations of marine beaches on the Islands. Information regarding swimming beaches can be obtained from the beach quality annual reports published by the Massachusetts Department of Public Health (DPH 2018); these are available for download at the MA DPH website: https://ma.healthinspections.us/public_21/beaches.cfm?showsearch=1 (DPH 2018).

Estuary waters within and surrounding all the Islands in the watershed have been declared "No Discharge Zones", or NDZs, where vessels are banned from discharging either raw or treated wastes. NDZs are established in waterbodies determined to be important ecological or recreational areas, worthy of special protection from the release of raw or treated sewage in navigable waters. NDZs in Massachusetts are shown in Figure 2-3 (EPA 2015).

Groundwater is the source of drinking water on all of these islands. Under the Safe Drinking Water Act, Martha's Vineyard and Nantucket have been declared sole source aquifers by the EPA. The designation protects an area's ground water resource by requiring U.S Environmental Protection Agency (EPA) review of any proposed projects within the designated area that are receiving federal financial assistance. All proposed projects receiving federal funds are subject to review to ensure they do not endanger the water source (EPA 2005).

In addition to federal protection, groundwater used for public drinking water is afforded additional protection measures through MassDEP's Drinking Water Regulations 310 CMR 22.21. These regulations require public water suppliers to delineate the recharge area (Zone II) of a public well, and to maintain drinking water quality through testing, monitoring, treatment, emergency response planning, and maintenance. MassDEP regulations also require that Zone IIs are protected at the local level through municipal controls that prohibit the land uses cited in the MA Wellhead Protection Regulations, 310 CMR 22.21(2). The Zone II, as well as interim Wellhead Protection Areas (recharge for wells less than 100k gal/day), are further protected through MassDEP's permitted programs. These programs, such as Solid Waste, Groundwater Discharge, Hazardous Waste and others, directly prohibit land uses and activities from locating in drinking water supply areas (Sarafinas-Hamilton, 2018).

Table 2-1 Islands Watershed Land Use In 2005

Landuse Type	Area in Acres	Percent
Agriculture - Cranberry Bog, Cropland, Nursery, Orchard & Pasture	3828.6	3.5
Undeveloped Lands Brushland Succesional, Forest, Forested Wetland, Open Land, & WaterSaltwater Sandy Beach, Saltwater Wetland,	90012.2	82.2
Urban Public - Cemeteries, Commercial, Urban Public/Institutional	983.4	0.9
Recreation - Golf Courses, Participation Recreation, Water Based Recreation, Spectator Recreation	1163.5	1.1
Industrial - Junkyard, Industrial, Marina, Mining, Powerline/Utility , Transitional, Transportation and Waste Disposal	1634.3	1.5
Low and Medium Density Residential	10529.0	9.6
High and Multi-Family Residential	1352.8	1.2
Total Acreage:	109503.0	100.0

Figure 2-1 Islands Watershed Land Use in 2005

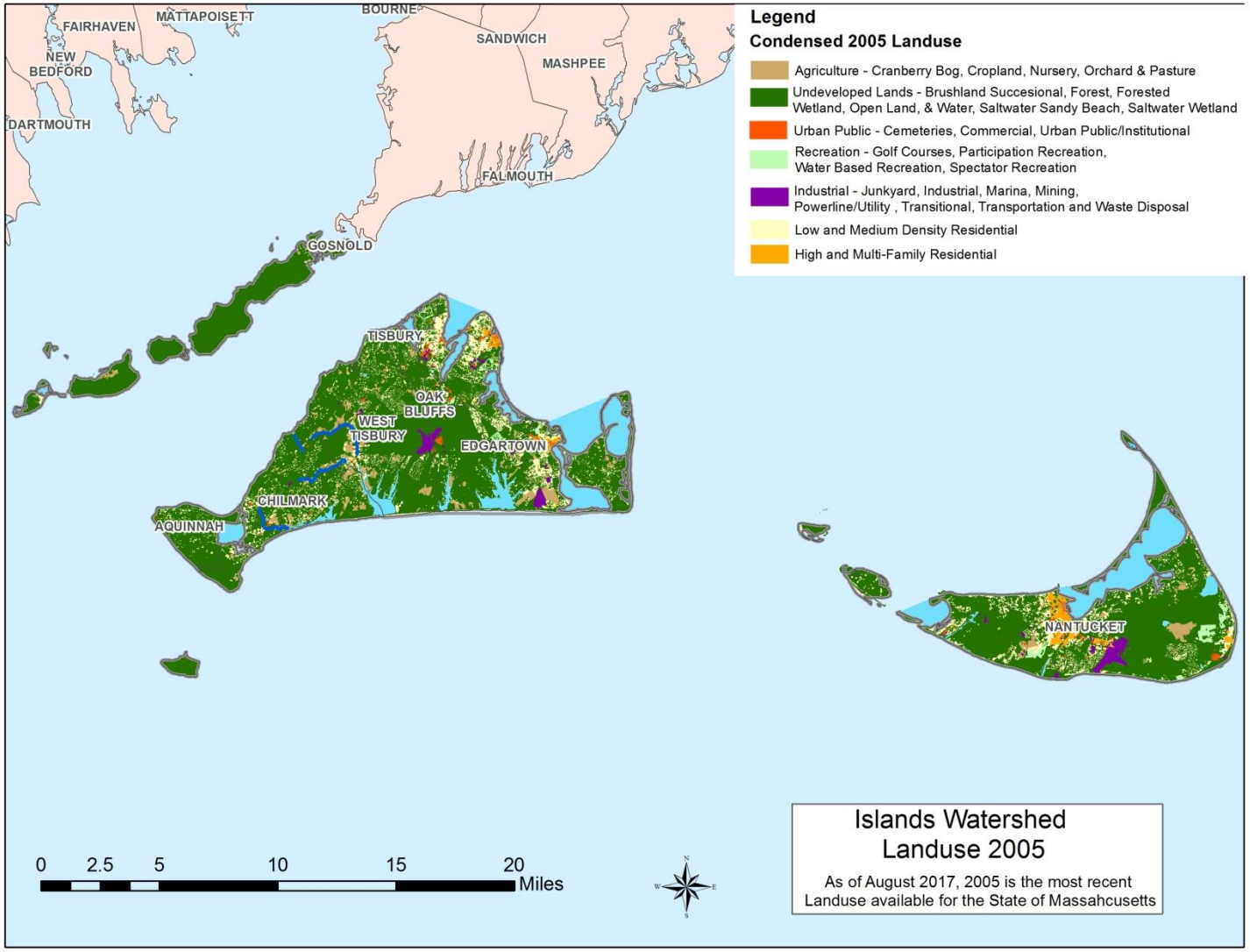


Figure 2-2 Islands Marine Beach Locations and Pathogen Impaired Segments

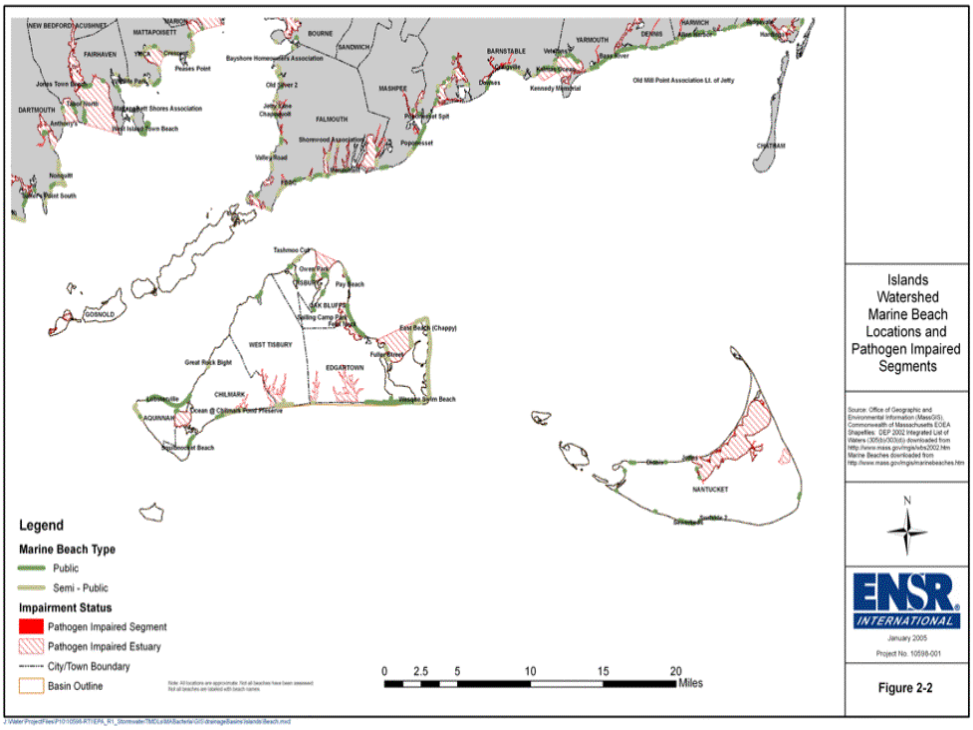
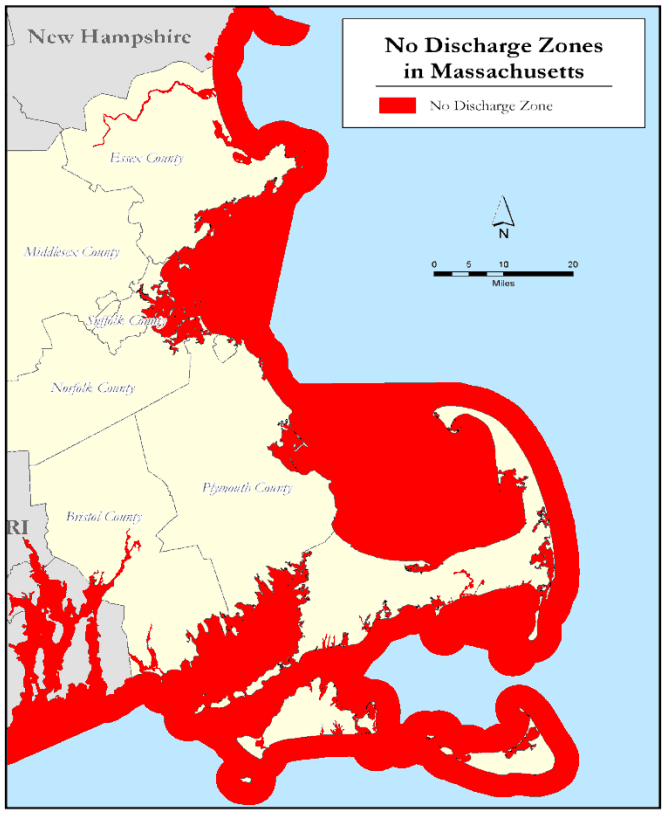


Figure 2-3 No Discharge Zones in Massachusetts



3.0 Water Quality Standards

The Surface Water Quality Standards (WQS) for the Commonwealth of Massachusetts establish chemical, physical, and biological standards for the restoration and maintenance of the most sensitive uses (MassDEP 2007). The WQS limit the discharge of pollutants to surface waters for the protection of existing uses and attainment of designated uses in downstream and adjacent segments.

The Islands Watershed contains waterbodies designated as Class B, SA and SB. According to the Massachusetts WQS, these waters should be suitable for the following uses: (1) habitat for fish, other aquatic life, wildlife, (2) primary and secondary contact recreation, (3) shellfish harvesting in approved areas, and (4) should have consistently good aesthetic value (Class A and SA waters should have excellent aesthetic value). The pathogen impairments (exceedances of fecal coliform, enterococci, and *E. coli* bacteria criteria) associated with the waterbodies in this report affect primary contact recreation and shellfishing uses. Because the WQS were in transition during the development of statewide pathogen TMDLs, and were formally changed after the draft reports were produced, the new bacteria indicator standards are presented in Table ES-2 and 7-1, and can be found at: https://www.mass.gov/regulations/314-CMR-4-the-massachusetts-surface-water-quality-standards (MassDEP 2013).

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

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

- Water Quality Criteria: Microbial (Pathogen) https://www.epa.gov/wqc/microbial-pathogenrecreational-water-quality-criteria (EPA 2018c)
- Advisories and Technical Resources for Fish and Shellfish Consumption http://www.epa.gov/waterscience/fish/ (EPA 2018d)
- Swimming Advisories: http://www.epa.gov/waterscience/beaches/seasons/ (EPA 2018e)

Massachusetts revised its freshwater WQS in 2007 by replacing fecal coliform with *E. coli* and enterococci as the regulated indicator bacteria in freshwater systems, as recommended by the EPA in the "Ambient Water Quality Criteria for Bacteria – 1986" and "2012 Recreational Water Quality Criteria" documents (EPA 1986 and EPA 2012a). Until January 2007, Massachusetts used fecal coliform as the indicator organism for all waters except marine bathing beaches, where the Federal Beaches Environmental Assessment and Coastal Health Act (BEACH Act) has required the use of Enterococci as the indicator organism since 2000. In January 2007, Massachusetts changed the indicator organisms to *E. coli* and enterococci for all fresh waters and enterococci for all marine waters, including non-bathing marine beaches. Fecal coliform remains the indicator organism for shellfishing areas.

Some of the threshold values provided in this TMDL are those established by MassDEP in the WQS:

- **Class A** -Unfiltered water supply intakes – either fecal coliform shall not exceed 20 colony forming units, or CFU per 100 ml in all samples taken in any six month, or total coliform shall not exceed 100 CFU/100 ml in 90% of the samples in any six-month period.
- **Class SA** -Shellfishing Approved- geometric mean for fecal coliform shall not exceed 14 CFU/100 mL, and 10% of the samples shall not exceed 28 CFU/100 mL;
- **Class SB** -Shellfishing Approved (but not necessarily open) - geometric mean for fecal coliform shall not exceed 88 CFU/100 mL, and 10% of samples shall not exceed 260 CFU/100 mL;
- **Class SA and SB Beaches** and non- designated shellfish areas- geometric mean for Enterococci shall not exceed 35 CFU/100 mL, and a single sample shall not exceed 104 CFU/ 100 mL for the purposes of beach closure.
- **Class B –Beaches**- geometric average for *E. coli* shall not exceed 126 CFU/100 mL, and a single sample shall not exceed 235 CFU/100 mL.

Shellfish growing areas are classified by the Massachusetts Division of Marine Fisheries (DMF 2015). The classification system provided below is a summary of the DMF classification system included in the MassDEP Consolidated Assessment and Listing Methodology, or CALM (MassDEP 2018a. Figure 2-2 provides designated shellfish growing areas status as of July 2015.

Approved "...open for harvest of shellfish for direct human consumption subject to local rules and regulations..." An approved area is open all the time and closes only due to hurricanes or other major coastwide events."

Conditionally Approved "...subject to intermittent microbiological pollution..." During the time the area is open, it is "...for harvest of shellfish for direct human consumption subject to local rules and regulations…" A conditionally approved area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, shellfish harvested are treated as from an approved area."

Restricted "…area contains a "limited degree of pollution." It is open for "harvest of shellfish with depuration subject to local rules and state regulations" or for the relay of shellfish. A restricted area is used by DMF for the relay of shellfish to a less contaminated area."

Conditionally Restricted "...subject to intermittent microbiological pollution..." During the time that the area is restricted, it is only open for "the harvest of shellfish with depuration subject to local rules and state regulations." A conditionally restricted area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, only soft shell clams may be harvested by specially licensed diggers (Master/Subordinate Diggers) and transported to the DMF Shellfish Purification Plant for depuration (purification)."

Prohibited – "Closed for harvest of shellfish."

In general, the shellfish harvesting use is assessed as supported (i.e., non-impaired) when shellfish harvested from approved (open) shellfish areas are suitable for consumption without depuration and shellfish harvested from restricted shellfish areas are suitable for consumption with depuration. For an expanded discussion on the relationship between the DMF shellfish growing areas classification and the MassDEP designated use support status, please see any of the completed MassDEP Water Quality Assessment Reports available on-line (for example the "Islands Watershed 2000 Water Quality Assessment Report", MassDEP 2003).

In addition to the WQS, the Massachusetts Department of Public Health (MA DPH) has established minimum standards for bathing beaches (105 Code of Massachusetts Regulations, or CMR, 445.000) under the State Sanitary Code, Chapter VII: http://www.falmouthmass.us/DocumentCenter/View/2376/105-CMR-445000-Minimum-Standards-for-Bathing-Beaches-State-Sanitary-Code-Chapter-VII (DPH 2010). These standards have been adopted by the MassDEP as the state surface WQS for fresh water and will apply to this TMDL. The MA DPH bathing beach standards are generally the same as those recommended in the EPA's "Ambient Water Quality Criteria for Bacteria – 1986" (EPA 1986) and the 2012 Recreational Water Quality Criteria (EPA 2012a). These specify Enterococci as the indicator bacteria for marine recreational waters and Enterococci or *E. coli* for fresh waters. As such, the following MA DPH standards have been established for bathing beaches in Massachusetts:

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

The BEACH Act of 2000 established a federal standard for marine beaches, which is essentially the same as the MA DPH marine beach standard; these can be accessed at:

https://www.epa.gov/beach-tech/about-beach-act (EPA 2000).

Figure 2-3 provides the location of marine bathing beaches, where the MADPH Marine Waters and the Federal BEACH Act standards would apply. A list of beaches, both freshwater and marine, by community with indicator bacteria data can be found in the annual reports on the testing of public and semi-public beaches provided by the MA DPH. These reports are available for download from the MADPH website at: https://ma.healthinspections.us/public_21/beaches.cfm?showsearch=1 (DPH 2018).

4.0 Problem Assessment

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

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

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

- Increase flow volume,
- Increase peak flow,
- Increase peak flow duration,
- Increase stream temperature,
- Decrease base flow, and
- Change sediment loading rates (EPA 1997).

Many of the impacts associated with increased impervious surface area also result in changes in pathogen loading (e.g., greater sediment loads can result in larger pathogen loads). In addition to increased impervious surface impacts, higher human and pet densities in developed areas increase the potential for

fecal contamination of surface waters. Furthermore, stormwater drainage systems and associated stormwater culverts and outfall pipes often result in the channelization of streams which reduces the attenuation of pathogen pollution.

Table 4-1 Wachusett Reservoir Storm Water Sampling[1]

Land Use Category	Fecal Coliform Bacteria[2] Organisms / 100 mL
Agriculture, Storm 1	110 - 21,200
Agriculture, Storm 2	200 - 56,400
"Pristine" (not developed, forest), Storm 1	0 - 51
"Pristine" (not developed, forest), Storm 2	8 - 766
High Density Residential (not sewered, on septic systems), Storm 1	30 - 29,600
High Density Residential (not sewered, on septic systems), Storm 2	430 - 122,000

[1]As reported in MassDEP 2002 (original data provided in MDC Wachusett Storm Water Study June 1997)
[2] Grab samples collected for four storms between September 15, 1999 and June 7, 2000

Table 4-2 Lower Charles River Basin Storm Water Event Mean Bacteria Concentrations[1]

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

[1]Data summarized from USGS 2002.
[2]An Event Mean Concentration (EMC) is the concentration of a pollutant in a flow-proportioned sample throughout a storm event. These samples are commonly collected using an automated sampler which can proportion sample aliquots based on streamflow.

In the Islands Watershed, there are 10 estuary segments as defined by the MassDEP on the *2016 Integrated List of Impaired Waters* (MassDEP 2020) that were publicly noticed in 2005. Table 4-3 provides summary statistics of assessed and impaired waters within the Islands Watershed. These segments, each requiring a TMDL, contain indicator bacteria concentrations in excess of the Massachusetts WQS for SA waterbodies (314 CMR 4.05), the MADPH standard for bathing beaches, and/or the BEACH Act. Pathogen impaired estuary segments represent 60% (15.23 mi^2) of the total estuary area assessed (25.3 mi^2). None of the total freshwater river/stream segments assessed were determined to be pathogen-impaired (of the 9.5 total river miles).

The basis for impairment listings is provided in the *2016 Integrated List* (MassDEP 2020). Massachusetts has included all waters known to fail to meet water quality standards for pathogens in the Islands

Watershed on its 2016 ILOW in Category 5 (Section 303(d) list). The listings that occurred in prior listing cycles have been documented in water quality assessment reports (MassDEP 2003). The methods used to develop listing decisions are described in the Comprehensive Assessment and Listing Methodology (MassDEP 2018a) found at https://www.mass.gov/files/documents/2018/05/07/2018calm.pdf.

A list of pathogen impaired segments requiring TMDLs (that are publicly noticed) is provided in Table 4-4. An overview of the Islands Watershed pathogen impairment, describing the nature and extent thereof, is provided in this section. Since pathogen impairment has been previously established and documented in the ILOW, it is not necessary to provide detailed documentation of pathogen impairment herein. Data from the MassDEP, Division of Marine Fisheries (DMF), Coastal Zone Management (CZM), Nantucket and Madaket Harbors Plan Review Committee, and Martha's Vineyard Commission were reviewed and are summarized in the segments below for illustrative purposes (see Figures 4-4 to 4-12 below). Additional details regarding each impaired segment including water withdrawals, discharges, use assessments and recommendations to meet use criteria are provided in the MassDEP WQA reports.

This TMDL was based on the current WQS using fecal coliform as an indicator for shellfish areas, and *E. coli* for freshwater and enterococci for either salt or fresh water bathing, respectively. MassDEP has incorporated *E. coli* and enterococci as indicator organisms for all waters other than shellfishing and potable water intake areas. Not all data presented herein were used to determine impairment listing due to a variety of reasons (including data quality assurance and quality control).

Table 4-3 Assessed and Pathogen Impaired Segment Statistics for the Islands Watershed[1]

Segment and Impairment	Islands %
ESTUARY (COUNT)	24
total pathogen impaired segments by basin (COUNT)	12
% impaired (COUNT)	50
ESTUARY (mi^2)	25.6
total pathogen impaired segments by basin (mi^2)	17.4
% impaired (mi^2)	68
RIVER (COUNT)	4
total pathogen impaired segments by basin (COUNT)	0
% impaired (COUNT)	0.0
RIVER (mi)	9.5
total pathogen impaired segments by basin (mi)	0.0
% impaired (mi)	0.0
Source: EPA 2015	

[1] Includes Katama Bay and Long Pond to be included in a future addendum to this TMDL.

Table 4-4 Islands Watershed Pathogen Impaired Segments Requiring TMDLs

Segment ID	Segment Name	Segment Type	Segment Size (mi^2)	Segment Description
Nantucket				
MA97-01	Nantucket Harbor	Estuary	7.16	Waters south and east of an imaginary line drawn from Jetties Beach to Coatue Point (excluding Polpis Harbor and Coskata Pond), Nantucket
MA97-26	Polpis Harbor	Estuary	0.302	Polpis Harbor and all adjacent coves, to an imaginary line drawn from Quaise Point to the opposite shore, Nantucket.
MA97-02	Sesachacha Pond	Estuary	0.423	South of Quidnet Road and North of Polpis Road, Nantucket
Martha's Vineyard				
MA97-05	Chilmark Pond	Estuary	0.3134	South of South Road including Wades Cove and Gilberts Cove, Chilmark, Martha's Vineyard
MA97-15	Edgartown Harbor	Estuary	3.086	Waters west of Cape Poge Gut bounded by an imaginary line drawn from Chappaquiddick Point to Dock Street and northeasterly from the end of Plantingfield Way to Cape Poge Elbow (excluding Eel Pond), Edgartown, Martha's Vineyard.
MA97-07	Oak Bluffs Harbor	Estuary	0.047	North of Lake Avenue to confluence with Nantucket Sound, Oak Bluffs, Martha's Vineyard.
MA97-10	Sengekontacket Pond	Estuary	1.1	Between Edgartown-Vineyard Haven Road and Oak Bluffs Road, including Majors Cove, Edgartown/Oak Bluffs, Martha's Vineyard.
MA97-18	Tisbury Great Pond	Estuary	1.103	Including Town Cove, Muddy Cove, Pear Tree Cove, Short Cove, Tiah Cove, Tississa Pond, Deep Bottom Cove, and Thumb Cove, Chilmark/West Tisbury, Martha's Vineyard
MA97-09	Vineyard Haven Harbor	Estuary	1.545	The waters south and west of an imaginary line drawn from the tip of West Chop, Tisbury and the tip of East Chop, Oak Bluffs to the confluence of Lagoon Pond at Beach Road, Tisbury/Oak Bluffs, Martha's Vineyard.
Elizabeth (Gosnold) Islands				
MA97-21	Cuttyhunk Pond	Estuary	0.154	Waters west of the channel connecting Cuttyhunk Pond to Cuttyhunk Harbor, Gosnold, Elizabeth Islands. (Changed from MA95-26 to MA97-21 on 10/7/97)

Data from the Massachusetts Division of Marine Fisheries (DMF) were used, in part, as the basis for pathogen impairment for many of the estuarine areas (Figure 1-1)(DMF 2016b). Numerous samples have been collected in estuary areas in the Islands Watershed by the DMF. DMF has a well-established and effective shellfish monitoring program, consistent with the National Shellfish Sanitation Program that provides quality assured data for each shellfish growing area. Each growing area must have a complete sanitary survey every 12 years, a triennial evaluation every three years, and an annual review in order to maintain a shellfish harvesting classification with the exception of those areas already classified as Prohibited. Annual fecal coliform water quality monitoring includes identification of specific sources and assessment of effectiveness of controls and attainment of standards. DMF reports that "Each year water samples are collected by the DMF at 2,320 stations in 294 growing areas in Massachusetts's coastal waters at a minimum frequency of five times while open to harvesting" (DMF 2016b). Designated Shellfish Growing Areas Status as of July 1, 2015 is shown on Figure 1-1 above.

Available bacteria data are summarized in the following section. The primary sources of data include but are not limited to DMF. Note that while many of the data included here are for fecal coliform, (the indicator of sanitary quality for shellfish areas), *E. coli* and enterococci in fresh water and enterococci in salt water are now the standards for swimming. Nevertheless, fecal coliform remains a qualitative indicator of water quality.

The MA DPH publishes annual reports on the testing of public and semi-public beaches for both marine and fresh waters which note exceedances of water quality criteria that result in beach closures. These reports are available for download from the MA DPH website at https://ma.healthinspections.us/public_21/beaches.cfm?showsearch=1 (DPH 2018).

Islands Watershed

4.1. Nantucket Island

Three pathogen impaired segments are located on Nantucket Island. Each of these impaired segments is a tidal estuary. The waters around Nantucket Island are located within "No Discharge Zones"; discharge of all boat sewage is prohibited within these waters. There are no NPDES permitted discharges on Nantucket Island.

Nantucket Harbor Segment MA97-01

This segment is a 7.16 mi^2 Class SA tidal estuary located on the northwestern coast of Nantucket. The segment extends from waters south and east of an imaginary line drawn from Jetties Beach to Coatue Point (excluding Polpis Harbor and Coskata Pond), Nantucket. The land use estimates for 12.1 mi^2 groundwater recharge area of Nantucket Harbor are 55% Open space, 19% Residential and 15% Forest (MassDEP 2003).

The impairment status for this segment was based on DMF data. DMF shellfish growing area status as of July 2000 was: Conditionally Approved for 7.0 mi^2; Prohibited for 0.15 mi^2. DMF shellfish growing area status as of July 2016: Approved for 6.75 mi^2; Conditionally Approved for 0.21 mi^2; Prohibited for 0.15 mi^2 (Figure 1-1). There has been overall improvement in shellfishing classifications since the year 2000.

Bacteria problems existed as far back as the 1970's, and possibly earlier. Up until 2006-07, the main contributions to pathogens in the harbor were illicit connections and other sewerage problems during rain events in downtown Nantucket. Bacteria counts from storm drain pipes were as high as 99,000 CFU/100mL before the town made efforts to detect and eliminate illicit connections. The Harbor area experiences intensive boating activities, including ferries to and from the mainland. It has moorings for up to 1,800 vessels, with an active pump-out program (exceeding 125,000 gallons of waste pumped from vessels each summer). Docking areas are near the commercial areas. Areas closed to shellfish harvesting are nearest to docking areas. Open areas are furthest from dockings and moorings and conditionally approved areas are located in intermediate areas. Bacteria monitoring by DMF during 2004-05 (see Table 4-5 below) demonstrated geometric average levels of 3.8- 4.8 CFU/100mL (numerous readings >28) in the closed areas; 2.6- 3.8 CFU/100mL (one reading >28) in the conditionally approved areas; 2.0- 3.5 CFU/100mL (no readings >28) in the approved areas. Overall, water quality has improved slightly since the 1990's. More recent DMF monitoring 2014-15 at sixteen classification stations (121 data points) is also reviewed in Table 4-5 below. Recent monitoring shows continued improvements in pathogen water quality conditions in the non-prohibited shellfishing areas.

Table 4-5 MA97-01 Nantucket Harbor DMF Fecal Coliform Data, 2004-2015

Total Number of Data Points 2004- 2005	Fecal Coliform Bacteria Range (CFU/100mL)	Geometric Mean (CFU/100mL)
Numerous	0 to >28	Closed areas 3.8-4.8 with numerous readings >28; Conditionally Approved Areas 2.6-3.8 with one reading >28; Approved Areas 2.0-3.5 with no reading >28
Total Number of Data Points 2014- 2015	**Fecal Coliform Bacteria Range (CFU/100mL)**	**Geometric Mean (CFU/100mL)**
121 (total of 16 stations in areas NT2.0, NT2.2, NT2.3, NT3.0, NT5.0)	Approved Areas NT2.0 0.9 to 25; NT3.0: 0.9 to 4.0; NT5.0: 0.9 to 3.0; Condit. Approved Area NT2.3: 0.9 to 21; Prohibited Area NT2.2: 0.9 to 16.	Approved Areas NT2.0: 1.47; NT3.0: 1.05; NT5.0: 0.98 Conditionally Approved Area NT2.3: 2.11 Prohibited Area NT 2.2: 1.97 no areas had readings > 28 (2014-2015)

The Town of Nantucket Health Department monitors water quality weekly in the summer at two public beaches (Brant Point and Children's Beach) in Nantucket Harbor. No beach closures or postings occurred in 2001 or 2002. Between 2005 and 2013, Brant Point and Children's Beach had postings greater than

10% of the swimming season one year each (MA DPH, 2014, Appendix C). Wauwinet Bayside Beach was sampled between 2008 and 2013; postings never exceeded 10% of during any swimming season.

Based on the public beach information (both beaches are located in prohibited shellfish harvesting areas) and the more stringent bacteria guidelines for shellfish harvesting than for recreational uses, the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this entire segment (MassDEP 2003, MassDEP 2020). The *Shellfish Use* was categorized as not supporting (impaired) in the most recent Integrated List (MassDEP 2020).

Polpis Harbor Segment MA97-26

This segment is a 0.302 mi^2 Class SA tidal estuary located on the southeastern edge of Nantucket Harbor. The Polpis Harbor segment includes Polpis Harbor and all adjacent coves, to an imaginary line drawn from Quaise Point to the opposite shore, Nantucket. The MassDEP WQA lists no discharges for this segment.

Impairment status for this segment was based on DMF data. The DMF shellfish growing area status of Polpis Harbor as of July 2000 was as follows: Approved for 0.26 mi^2; Prohibited for 0.04 mi^2. The DMF shellfish growing area status as of July 2016 was: Approved for NT4.0 (0.25 mi^2); Prohibited for NT4.1 (0.045 mi^2) (Figure 1-1).

In 1995, the DMF shoreline surveys revealed approximately 20 houses on septic systems that needed checking by the town BOH. Stormwater pipe discharges revealed fecal coliform levels up to 220 CFU/100mL (see Table 4-6 below). A 2005 DMF update report indicated several new houses on septic systems in the area. There are moorings for up to 150 boats, but there are no overnight stays allowed. Surveys conducted in 2004-05 (see Table 4-6 below) at three stations had geometric averages ranging from 2.9- 4.6 CFU/100mL, with one reading >28. The 2005 report indicates that this segment was conditionally opened for shellfishing, from September 1- May 3, beginning in 2004. More recent DMF monitoring conducted from 2014-15 at three classification stations (27 data points) is also reviewed in Table 4-6 below.

Table 4-6 MA97-26 Polpis Harbor DMF Fecal Coliform Data, 2004-2015

Total Number of Data Points 2004- 2005	Fecal Coliform Bacteria Range (CFU/100mL)	Geometric Mean (CFU/100mL)
Numerous	0 to 220	2.9- 4.6 with 1 reading >28
Total Number of Data Points 2014- 2015	**Fecal Coliform Bacteria Range (CFU/100mL)**	**Geometric Mean (CFU/100mL)**
3 stations, and 27 total data points	Approved Area NT4.0: 0.9 to 81	NT4.0: 1.96 (2014-2015) with 1 reading > 28

Based on the more stringent bacteria guidelines for shellfish harvesting than for recreational uses, the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for 0.26 mi^2 of this segment and not assessed for 0.04 mi^2 of this segment (MassDEP 2003, MassDEP 2018a. The *Shellfish Use* was categorized as not supporting (impaired) in the most recent Integrated List (MassDEP 2015).

Sesachacha Pond Segment MA 97-02

This segment is a 0.423 mi^2 Class SA tidal estuary water area located south of Quidnet Road and north of Polpis Road, Nantucket.

The DMF Shellfish Status Report of July 2000 indicated that shellfish harvesting in areas NT9.0, NT 9.1, and NT9.2 (which includes this entire segment) was prohibited. The DMF Shellfish Status Report of July 2016 indicated that shellfish harvesting in areas NT9.0, NT 9.1, and NT9.2 (0.43 mi^2) were still prohibited (DMF 2016a). The DMF has not conducted routine monitoring in this area for quite some time; no other recent pathogen data are currently available.

The Town of Nantucket monitors bacteria weekly in the summer at the public beach on Sesachacha Pond. No beach closures occurred in 2001 or 2002 (MassDEP 2003). Based on the public beach closure information, the *Primary* and *Secondary Contact Recreation Uses* are assessed as supported (MassDEP 2003, 2015). Based on the DMF shellfish growing area status, the *Shellfish Harvesting Use* is assessed as impaired (MassDEP 2003, 2015).

4.2. Martha's Vineyard

Six impaired segments are located on Martha's Vineyard. All impaired segments are tidal estuaries, as described below. There is only one NPDES permitted discharge (MA0090590) on Martha's Vineyard and it is not located within any of the bacteria impaired waters listed in the TMDL. This permit was issued to the US Coast Guard for a treated wastewater discharge to Menemsha Bight and Menemsha Creek. There have been no discharges since 1994 and the permit will likely be terminated (EPA 2012b).

Chilmark Pond Segment MA97-05

This segment is a 0.3134 mi^2 Class SA tidal estuary located on the southern coast of Martha's Vineyard, south of South Road (includes Wades and Gilberts Coves), Chilmark, Martha's Vineyard.

DMF indicated that, as of January 2017, this segment was closed to shellfish harvesting and had been for many years; also, DMF has not sampled Chilmark Pond in recent years. The Lucy Vincent Beach was sampled between 2008 and 2013 and was posted for a period exceeding 10% of the swimming season for the years 2010 through 2013 (MA DPH 2014). No other pathogen data are currently available.

The impairment status for this segment was based on DMF data. The DMF shellfish growing area status for Chilmark Pond as of July 2000 was: Prohibited (Figure 1-1). DMF sampled Chilmark Pond 15 times a year from 2002-2005 at 8 classification stations (see Table 4-7 below). Fecal coliform geometric means were all high, with ranges between 8.6- 93.8 CFU/100mL, with many values >28. Sanitary surveys did not identify possible sources for the elevated levels. Without substantial improvement in water quality, these shellfish harvesting areas will remain closed. Between 2005 and 2013, Lucy Vincent Beach had postings greater than 10% of the swimming season for four years (2010-2013), (MA DPH, 2014, Appendix C). The *Shellfish Use* was categorized as not supporting (impaired) in the most recent Integrated List. The *Primary*

and *Secondary Contact Recreation Uses* are listed as having insufficient information and being not assessed respectively (MassDEP 2020).

Table 4-7 MA97-05 Chilmark Pond DMF Fecal Coliform Data, 2002-2005

Total Number of Data Points 2002-2005	Fecal Coliform Bacteria Range (CFU/100mL)	Geometric Mean (CFU/100mL)
8 stations, 15 times per/yr	0 to >93.8, with many exceedances >28	8.6- 93.8

Edgartown Harbor Segment MA97-15

This segment is a 3.086 mi^2 Class SA tidal estuary located on the eastern end of Martha's Vineyard. The segment includes waters west of Cape Poge Gut bounded by an imaginary line drawn from Chappaquiddick Point to Dock Street and northeasterly from the end of Plantingfield Way to Cape Poge Elbow (excluding Eel Pond), Edgartown, Martha's Vineyard. The Town of Edgartown operates a free boat pump-out area, funded by the Clean Vessel Act.

Geographically, the water body has partially limited tidal flushing capability, since its connection with the open ocean is underneath a small bridge on the northeast corner.

The impairment status for this segment was based on DMF data. The DMF shellfish growing area status as of July 2000 was: Approved for 3.0 mi^2; Conditionally Approved for 0.1 mi^2 (Figure 1-1). Since 2003, the entire shellfishing area has improved, and the shellfish harvesting classification was upgraded to Approved with no restrictions. In 2000, DMF sampled 10 stations, fifteen times (see Table 4-8 below); the geometric averages of fecal coliform data ranged from 2.1 to 5.6 CFU/100mL. DMF sampling conducted in 2002, 2005 and 2006 measured levels between 1.9- 2.6 CFU/100mL, with no values greater than 28 CFU/100ml. A sanitary survey of five discharge pipes in November 2005 reported fecal coliform levels below 10 CFU/100mL. Recent DMF monitoring in 2014 and 2015 at four classification stations (20 data points) is also shown in Table 4-8 below, which shows an overall improvement in shellfishing classifications since the year 2000.

Table 4-8 MA97-15 Edgartown Harbor DMF Fecal Coliform Data, 2002-2015

Total Number of Data Points 2002- 5	Fecal Coliform Bacteria Range (CFU/100mL)	Geometric Mean (CFU/100mL)
10 stations, 15 times each of 4 years; 5 discharge pipes	0 to <28; 5 discharge pipes <10	1.9- 2.6
Total Number of Data Points 2014-2015	**Fecal Coliform Bacteria Range (CFU/100mL)**	**Geometric Mean (CFU/100mL)**
4 stations, for a total of 20 data points	Approved: V18.0: 0.9 to 1.0; V13 (part of the MA segment): 0.9 to 1.0	Approved: V18.0 and V13(part of the MA segment): 0.939; no readings > 28

The Edgartown Land Bank collects bacteria samples from Chappy Point Beach in Edgartown Harbor. No beach closures or postings occurred in 2001 or 2002 (Dicks 2003). Between 2005 and 2013 the Fuller Street Beach, Chappy Point Beach and Chappy Beach Club were never posted for bacterial contamination (MA DPH 2014).

Based on the public beach information, Chappy Point Beach is located in the Approved shellfish harvesting area, and because of the more stringent bacteria guidelines for shellfish harvesting than for recreational uses, the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for this entire segment.

Since the entire shellfishing area is now approved for shellfishing, it is recommended that this segment be removed from Category 5 for pathogen impairment in a future Integrated List of Waters.

Oak Bluffs Harbor Segment MA97-07

This segment is a 0.047 mi^2 Class SA tidal estuary located on the northern coast of Martha's Vineyard. Oak Bluffs Harbor extends from north of Lake Avenue and east of East Chop Drive to the confluence with Nantucket Sound, Oak Bluffs, Martha's Vineyard. The Oak Bluffs Harbor Marina operates a free boat pump-out area, funded by the Clean Vessel Act.

The *Shellfish Use* was categorized as not supporting (impaired) in the most recent ILOW (MassDEP 2020). The impairment status for this segment was based on DMF data. The DMF shellfish growing area status as of July 2000 was Conditionally Approved (Figure 1-1). But, as reported in the January 2007 DMF sanitary survey report, shellfish harvesting was classified as Prohibited in Sunset Lake, a small waterbody separated from the main harbor by a directly connected pipe under Lake Ave. DMF field notes identified a resident bird population as a possible source of bacterial contamination. DMF sampling at 2 stations in Sunset Lake indicate high numbers: geometric averages of 5.2- 14.6 CFU/100mL. As of July 2016, shellfishing harvesting in area V14.1 (0.05 mi^2) was classified as Conditionally Approved and Prohibited in area V14.2 (0.007 mi^2).

There are considerable summertime boating activities within the main harbor area, plus a ferry terminal (whose service connects with the Cape and Islands). Additionally, studies have indicated that tidal flushing within Oak Bluffs Harbor is limited by the small opening to Nantucket Sound. The Town of Oak Bluffs has operated a small wastewater treatment plant serving over 700 users in the downtown area since April 2002; it has a groundwater discharge located approximately 0.25 miles SE of Oak Bluffs Harbor, and some storm drains previously suspected to be sources of bacterial contamination to the harbor were connected to it. DMF sampling from 2002 to 2005 at 4 to 5 classification stations measured fecal coliform with geometric averages from 2.8- 4.2 CFU/100m; several per year exceeded 28 CFU/100ml (see Table 4-9 below). The results of DMF monitoring conducted in 2014 and 2015 at six classification stations (83 data points) are also reported in Table 4-9.

Table 4-9 MA97-07 Oak Bluffs Harbor DMF Fecal Coliform Data, 2002-2015

Total Number of Data Points 2002-2005	Fecal Coliform Bacteria Range (CFU/100mL)	Geometric Mean (CFU/100mL)
4- 5 classification stations, many times	0 to >28 with several values each yr>28	2.8- 4.2
Total Number of Data Points 2014-2015	**Fecal Coliform Bacteria Range (CFU/100mL)**	**Geometric Mean (CFU/100mL)**
Area V14.1, 5 stations; Area 14.2, 1 station; total of 83 data points	Conditionally Approved Area V14.1 0.9 to 80; Prohibited Area V14.2: 0.9 to 10	Conditionally Approved Area V14.1: 1.38; Prohibited Area V14.2: 1.57; V14.1: 3 readings > 28; V14.2 no readings > 28

Sengekontacket Pond Segment MA97-10

This segment is a 1.1 mi^2 Class SA tidal estuary located on the northeastern coast of Martha's Vineyard. It is located: between East Vineyard Haven Road and Beach Road, including Major's Cove, Edgartown/Oak Bluffs, Marthas Vineyard. There are two groundwater withdrawals on this segment: Edgartown Water Department and Farm Neck Golf Club (MassDEP 2003). The Town of Edgartown operates a free boat pump-out area, funded by the Clean Vessel Act.

Impairment status for this segment is based on DMF data. DMF shellfish growing area status as of July 2000: Approved. Subsequent DMF data in 2001-2 showed elevated levels, as the MA 2002 ILOW had the segment listed as impaired for bacteria, but this was lifted in subsequent 2004-14 Integrated Reports, and placed back on the impaired bacteria list in 2016. (Fig 1-1).

Bacteria counts tracked in 2007 by the Division of Marine Fisheries showed high levels of fecal coliform bacteria, an indicator of the presence of fecal matter in the pond, sufficient to trigger conditional approval status for the pond. Small islands in the pond are important nesting sites for shorebirds such as terns. Of the six contaminated samples obtained, two contained fecal matter from cormorants, three from geese, one from unknown birds, and one from septage (from septic tanks) (Vineyard Gazette, 2009).

Recent DMF data collected during 2009-2018 are summarized by the following:

(1) For 'Seasonal data' collected in all-weather conditions within shellfishing beds that were officially open. Sampling occurred at 5 to 6 stations each year (2009-2018) out of a total 17 total water quality stations. Geometric means over these years for the stations sampled ranged between 1.1-1.8 CFU/100ml, with 0.0% of the readings > 31 CFU/100ml.

(2) For 'Seasonal data' collected in dry weather conditions, only within shellfishing beds that were officially open. Geometric means over these years for the stations sampled ranged between 1.7-4.1 CFU/100ml, with 9 stations having 0.0% of these readings > 31 CFU/100ml, and 3 stations having a range of 6.6%- 10.0% of these readings > 31 CFU/100ml (Churchill, 2019).

The total (8) of all shellfish growing area classifications (MA DFG, 2014) within this segment is 1.0866 sq mi (99%). As of November 2015, Shellfishing areas V16.0, V16.3, V16.30, V16.31, and V16.32 were classified as 'Conditionally Open', and V16.33, V16.34, and V16.7 were prohibited. The approved shellfish growing area represents 0 sq mi (0%). Therefore, the shellfish harvesting use is assessed as not supporting because the growing area (normalized to the segment area) is < 100% approved.

Tisbury Great Pond Segment MA97-18

This segment is a 1.103 mi^2 Class SA tidal estuary located on the southern coast of Martha's Vineyard in Chilmark/West Tisbury. Tisbury Great Pond includes Town Cove, Muddy Cove, Pear Tree Cove, Short Cove, Tiah Cove, Tissisa Pond, Deep Bottom Cove, and Thumb Cove, Chilmark/West Tisbury, Martha's Vineyard.

The *Shellfish Use* was categorized as not supporting (impaired) in the most recent Integrated List (MassDEP 2020). The impairment status for this segment was based on DMF data. The DMF shellfish growing area status as of July 2000 was: Approved for 0.8 mi^2; Conditionally Approved for 0.2 mi^2; and Prohibited for 0.1 mi^2. As of July 2016, the DMF shellfish growing area status was: Approved for area V31.1 (0.96 mi^2) and Prohibited for areas V31.3 and V31.4 (0.30 mi^2) (DMF 2016a) (Figure 1-1).

Potential sources of bacterial contamination to Tisbury Great Pond are fairly limited. There are few boats moored in this embayment. Both migratory and resident waterfowl have been observed in the pond. There are relatively few houses, all of which utilize on-site septic systems for waste disposal. Creeks and marshes flowing into the pond do not represent significant sources of bacterial contamination. A single horse farm on the eastern side of the pond does not appear to be a source of pathogens. DMF sampling in the two Prohibited areas from 1997 to 2000 reported numerous fecal coliform results greater than 28 CFU/100mL. DMF sampled 7 sites in the approved shellfishing areas in 2005 (see Table 4-10 below); the geometric averages of fecal coliform ranged from 2.8 to 3.9 CFU/100mL with 4 readings over 28 CFU/100ml; at 5 sites in the seasonally approved areas, levels ranged from 2.6 to 4.2 CFU/100mL with 5 readings greater than 28 CFU/100ml; and in the Prohibited areas levels ranged from 4.7 to 5.3 CFU/100ml, with many results exceeding 28 CFU/100ml. The results of DMF monitoring conducted in 2014 and 2015 at eighteen classification stations (144 data points) are also reported in Table 4-10 below.

Table 4-10 MA97-18 Tisbury Great Pond DMF Fecal Coliform Data, 2005-2015

Total Number of Data Points 2005	Fecal Coliform Bacteria Range (CFU/100mL)	Geometric Mean (CFU/100mL)
At least 10 sites, many times	0 to >28 with 4 readings in approved areas >28; seasonally approved areas 5 >28; closed areas many >28	2.8- 3.9 in approved areas; 2.6- 4.2 in seasonally approved areas; 4.7- 5.3 in closed areas
Total Number of Data Points 2014-2015	**Fecal Coliform Bacteria Range (CFU/100mL)**	**Geometric Mean (CFU/100mL)**
Area V31.0 10 stations; Area 31.3 8 stations; total of 144 data points	Approved Area V31.0: 0.9 to 34; Prohibited Area V31.3: 0.9 to 81	Approved Area V31.0: 1.44; Prohibited Area 31.3: 4.89; V31.0, no readings > 28; V31.3 9 readings > 28

The Edgartown Land Bank and The Trustees of Reservations monitor bacteria at two beaches on Tisbury Great Pond, Sepiessa Point Beach and South Beach (Long Point Wildlife Refuge). No beach closures or postings occurred at Sepiessa Point Beach in 2001 or 2002. Long Point (Great Pond) beach was sampled

between 2005 and 2011 and was only posted for greater than 10% of the swimming season during one year (MA DPH 2014).

Based on the more stringent guidelines for shellfish harvesting than for recreational uses (both beaches are located in approved shellfish harvesting areas), the *Primary* and *Secondary Contact Recreation Uses* are assessed as support for 0.80 mi^2 of this segment and not assessed for 0.30 mi^2 of this segment (MassDEP 2003, 2020).

Vineyard Haven Harbor Segment MA97-09

This segment is a 1.545 mi^2 Class SA tidal estuary located in the waters south and west of an imaginary line drawn from the tip of West Chop, Tisbury to the tip of East Chop, Oak Bluffs, and southwest to the confluence with Lagoon Pond at Beach Road, Tisbury/Oak Bluffs, Martha's Vineyard. A free boat pump-out area is located in the Harbor, funded by the Clean Vessel Act.

The Town of Tisbury monitors water quality at two public beaches (Owen Park Beach and Tisbury Town Beach) in Vineyard Haven Harbor. No beach closures occurred in 2000 or 2001 and each beach was closed for only one day in 2002 (Tisbury BOH, 2003). The Town of Oak Bluffs monitored water quality at one beach (Eastville Point Beach) in Vineyard Haven Harbor. No beach closures or postings occurred in 2000, 2001 or 2002 (Oak Bluffs BOH 2003). The Eastville Point Beach is no longer sampled. Between 2005 and 2013 Eastville Town beach and Owen Park beach were sampled and posted rarely, if ever, with postings never exceeding 10% of any swimming season (MA DPH 2014). Based on the public beach closure information, the *Primary* and *Secondary Contact Recreation Uses* are assessed as support (MassDEP 2003, 2020).

The *Shellfish Use* was categorized as not supporting (impaired) in the most recent 2016 Integrated List (MassDEP 2020). The impairment status for this segment was based on DMF data. The DMF shellfish growing area status as of July 2000 was Conditionally Approved. As of July 2016, the DMF shellfish growing area status was: for area V10.0, Approved (1.44 mi^2); and for area V10.1, Conditionally Approved (0.09 mi^2) (Figure 1-1). As shown by significant increases in the extent of fully Approved shellfish harvesting areas, the overall water quality in Vineyard Haven Harbor has improved.

Vineyard Haven Harbor is heavily used for boating and related businesses; it hosts 3 shipyards and 2 marinas with several mooring areas, including those where overnight anchorage is allowed. In addition, the Steamship Authority Vineyard Haven Terminal is located at the southwestern end of the harbor, with ferries connecting Martha's Vineyard with Cape Cod and New Bedford. The harbor has a pump-out facility and strict regulations.

Shellfishing areas with seasonal closures encompass 176 acres. From 2004-2005, DMF sampled 10 ambient stations, 15 times each (see Table 4-11 below). Fecal coliform geometric means averaged 2.0-3.3 CFU/100mL, with no values greater than 28 CFU/100ml. From 1998-1999, DMF sampling revealed higher numbers (geometric averages of 2.1- 9.0 with more exceedances). A sanitary survey conducted at

3 sites in November 2005 reported fecal coliform levels below 10 CFU/100mL. DMF monitoring in 2014 and 2015 at ten classification stations (78 data points) is also reported in Table 4-11.

Table 4-11 MA97-09 Vineyard Haven Harbor DMF Fecal Coliform Data, 1998-2015

Total Number of Data Points 1998-1999	Fecal Coliform Bacteria Range (CFU/100mL)	Geometric Mean (CFU/100mL)
150	0 to >28 with many exceedances	2.1- 9.0
Total Number of Data Points 2004-2005	**Fecal Coliform Bacteria Range (CFU/100mL)**	**Geometric Mean (CFU/100mL)**
150	0 to <10 with no readings >28	2.0- 3.3
Total Number of Data Points 2014-2015	**Fecal Coliform Bacteria Range (CFU/100mL)**	**Geometric Mean (CFU/100mL)**
Area V10.0 7 stations; Area V10.1 3 stations; total of 78 data points	Approved Area V10.0: 0.9 to 14; Conditionally Approved Areas V10.1: 0.9 to 81	Approved Area V10.0: 1.39; Conditionally Approved Areas V10.1: 1.81; V10.0: no reading > 28; V10.1:, 1 reading > 28

As the most recent bacteria data show little evidence of ongoing pathogen contamination, this segment could be considered for removal from Category 5 of the ILOW.

4.3. The Elizabeth (Gosnold) Islands

The only impaired segment in the Elizabeth Islands is on Cuttyhunk Island (see Figure 1-1). There are no permitted NPDES discharges in the Elizabeth Islands.

Cuttyhunk Pond Segment MA97-21

This segment is a 0.154 mi^2 Class SA tidal estuary located on the northeastern shore of Cuttyhunk Island. The segment consists of the waters west of the channel connecting Cuttyhunk Pond to Cuttyhunk Harbor, Gosnold, Elizabeth Islands (changed from MA95-26 to MA97-21 on 10/7/97). A minor NPDES permit on Cuttyhunk Island was terminated in 2016 (MA0100081). It was located in Vineyard Sound, outside the drainage area of Cuttyhunk Pond.

The *Shellfish Use* was categorized as not supporting (impaired) in the most recent Integrated List (MassDEP 2015). The impairment status for this segment was based on DMF data. The DMF shellfish growing area status as of July 2000 was: Conditionally Approved for 0.14 mi^2; and Prohibited for 0.01 mi^2 (MassDEP 2003). As of July 2016, the status was: Conditionally Approved (0.15 mi^2) for area; and Prohibited in area E9.2 (0.013 mi^2) (DMF 2016a).

Cuttyhunk Pond has limited tidal flushing due to the narrow channel to Cuttyhunk Harbor. In addition, the pond is heavily used for boating and related activities during the summer, with 60 moorings, 85 slips, and

42 mooring pilings; 95% of the moored vessels stay overnight. In the mid-1990's, DMF field surveys noted pollution issues associated with boats. Since then, dockside restrooms were constructed (1996), along with boat pump-out facilities. There is a prohibited (shellfishing) zone surrounding Slate's Island; potential sources of pathogens include waterfowl populations, as well as stormwater from adjacent dock areas and shorefront properties. From 2003 to 2005, DMF sampled 5 stations 15 times/yr; fecal coliform geometric averages ranged from 1.9 to 3.0 CFU/100mL, with one result greater than 28 CFU/100ml (see Table 4-12). DMF also sampled one station in the closed area; data ranged from 2.2 to 2.9 CFU/100mL, with multiple results above 28 CFU/100ml. DMF monitored 6 stations in 2014 and 2015 (51 data points); these data are also reported in Table 4-12 below. The conditionally approved area is open for shellfishing between October 1 and the Friday before Memorial Day each year.

Table 4-12 MA97-21 Cuttyhunk Pond DMF Fecal Coliform Data, 2002-2015

Total Number of Data Points 2002-2005	Fecal Coliform Bacteria Range (CFU/100mL)	Geometric Mean (CFU/100mL)
6 classification stations, sampled 15 times/ year	0 to >28 with one reading >28 in seasonally approved area; several readings in closed area >28	1.9- 3.0 in seasonally approved area; 2.2- 2.9 in closed area
Total Number of Data Points 2014- 2015	**Fecal Coliform Bacteria Range (CFU/100mL)**	**Geometric Mean (CFU/100mL)**
Area E9.2: 5 stations; Area E9.1: 1 stations; total of 51 data points	Conditionally Approved Area E9.2: 0.9 to 4; Prohibited Area E9.1: 0.9 to 3	Conditionally Approved Area E9.2: 1.02; Prohibited Area E9.1: 1.25; E9.2 and E9.1: no readings > 28;

5.0 Potential Sources

The Islands watershed has 10 estuary segments located throughout the watershed that are listed as publicly noticed pathogen impaired and requiring a TMDL (out of 24 total assessed estuaries). These segments represent 68% of the 25.6 mi^2 estuarine area assessed in the Islands watershed. Table 5-1 summarizes the bacteria-impaired estuaries and identifies some of the known and potential sources (MassDEP 2003).

Table 5-1 Known and Potential Sources of Bacteria in Pathogen Impaired Segments in the Islands Watershed

Segment ID	Segment	Potential Sources
	Nantucket	
MA97-01	Nantucket Harbor	Boating
MA97-26	Polpis Harbor	Boating, onsite treatment systems (septic systems), wildlife
MA97-02	Sesachacha Pond	Onsite treatment systems (large-scale and small)
	Martha's Vineyard	
MA97-09	Vineyard Haven Harbor	Boating
MA97-07	Oak Bluffs Harbor	Stormwater (storm drains)
MA97-15	Edgartown Harbor	Septic, stormwater
MA97-10	Sengekontacket Pond	Wildlife, Septic systems
MA97-18	Tisbury Great Pond	Septic
MA97-05	Chilmark Pond	Septic, stormwater
	Gosnold Islands	
MA97-21	Cuttyhunk Pond	Boating

Dry weather sources may include:

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

Wet weather sources may include:

- wildlife and domesticated animals (including pets), and
- storm water runoff.

It is difficult to determine quantitative estimates of bacteria contributions in the Islands watershed, as many of the sources are diffuse and intermittent, and difficult to monitor or model accurately. Therefore, a general level of quantification according to source category is provided; for examples from the Charles Watershed, see Tables 5-2 and 5-3. This approach is suitable for the TMDL analysis, because it indicates the magnitude of the sources and illustrates the need for controlling them. Additionally, many of the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they indicate a potential health risk and, therefore, must be eliminated. However, estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) is achieved for wet and dry conditions using the ambient data available from baseline conditions defined in segment summary tables (Section 4.0) and MassDEP 2003.

Table 5-2 Lower Charles River Basin Stormwater Event Mean Bacteria Concentrations and Reductions Necessary to Meet Class B WQS

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

[1] This table was developed under the previous Class B Standard (revised in 2007): Shall not exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms. Used 400 to illustrate required reductions in the "Reduction to Meet WQS (%)" Column. The current standards are discussed in the Executive Summary and Section 1.

Table 5-3 Stormwater Event Mean Fecal Coliform Concentrations and Reductions Necessary to Meet Class B WQS[1]

Land Use Category	Fecal Coliform[2] Organisms / 100 mL	Class B WQS[3]	Reduction to Meet WQS (%)
Single Family Residential	37,000	10% of the samples shall not exceed 400 organisms/ 100 mL	36,600 (98.9)
Multifamily Residential	17,000		16,600 (97.6)
Commercial	16,000		15,600 (97.5)
Industrial	14,000		13,600 (97.1)

[1] As reported in MassDEP 2002b; original data provided in Metcalf & Eddy, 1992
[2] Derived from NURP study event mean concentrations and nationwide pollutant buildup data (EPA 1983)
[3] This table was developed under the previous Class B Standard (revised in 2007): Shall not exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms. Used 400 to illustrate required reductions in the "Reduction to Meet WQS (%)" Column. The current standards are discussed in the Executive Summary and Section 1.

Agriculture

Land used primarily for agriculture is likely to be impacted by a number of activities that can contribute to indicator bacteria impairments of surface waters. Examples of these include:

- field application of manure,
- runoff from grazing areas,
- direct deposition livestock waste into streams,
- animal feeding operations,
- leaking manure storage facilities, and
- runoff from barnyards.

Indicator bacteria numbers are generally associated with sediment loading i.e., reducing sediment loading often results in a reduction of indicator bacteria loading as well.

Sanitary Waste

Leaking sewerage pipes, illicit sewer connections, sanitary sewer overflows (SSOs) and failing septic systems discharge partially treated or untreated human wastes to the surrounding environment, and thus represent a direct threat to public health. Typical values of fecal coliform in untreated domestic wastewater range from 10^4 to 10^6 MPN/100mL (Metcalf and Eddy 1991). Quantifying sources of untreated wastes is extremely speculative without knowledge of the volume of the source(s) and the proximity to the surface water.

The existence of illicit sewer connections to storm drains, which directly discharge sewage into surface waters, is well documented in many urban drainage systems, particularly older systems that may have once been combined with wastewater conveyances. The US EPA, MassDEP, many environmental organizations, and many communities throughout the Commonwealth have actively pursued identifying and mitigating these sources. The US EPA Region I has estimated that over one million gallons per day (gpd) of illicit discharges were removed in the last decade in the Boston Harbor Watershed, for example. It is probable that illicit sewer connections exist in storm drainage systems serving the older, developed portions of the Islands watershed.

Monitoring storm drain outfalls during dry weather is needed to document the presence or absence of sewage in the drainage systems. According to the MassDEP WQA, no towns in the Islands watershed are Phase II stormwater communities (MassDEP 2003). Therefore, communities in the Islands watershed are not subject to the Stormwater Phase II Final Rule that requires the development and implementation of an illicit discharge detection and elimination (IDDE) plan. However, finding and eliminating such discharges is a recommended action for Island communities. See Section 7.0 of this TMDL for information regarding IDDE guidance.

Septic systems designed, installed, operated and maintained in accordance with 310 CMR 15.000: Title 5, are not significant sources of fecal coliform bacteria. Studies demonstrate that wastewater located four feet below properly functioning septic systems contain on average less than one fecal coliform bacteria organism per 100 mL (Ayres Associates 1993). Failed or non-conforming septic systems, however, can be a major source of fecal coliform. Wastes from failing septic systems enter surface waters either as overland flow (stormwater runoff) or via groundwater. Wet weather events typically increase the rate of transport of pollutant loadings from failing septic systems to surface waters because of the wash-off effect from runoff and the increased rate of groundwater recharge. Local Boards of Health (BOH) enforce the Title 5 regulations, which require systems inspections at the time of property transfer and convey broad authority to the local BOH to ensure that septic systems are in compliance.

The recreational use of waterbodies can be a source of pathogens. Swimmers may contribute to bacterial pollution at swimming areas; when swimmers enter the water (especially small children in diapers),

residual fecal matter may be washed from the body to contaminate the water with pathogens. These sources are likely to be particularly important when the number of swimmers is high and the flushing action of waves or tides is low.

Another potential source of pathogens is the discharge of sewage from vessels with onboard toilets. These vessels are required to have a marine sanitation device (MSD) to either store or treat sewage. When MSDs are operated or maintained incorrectly, they have the potential to discharge untreated or inadequately treated sewage. For example, some MSDs are simply tanks designed to hold sewage until it can be pumped out at a pump-out facility or discharged into the water more than 3 miles from shore; however, uneducated boaters may discharge waste from these devices into near-shore waters. When MSDs designed to treat sewage are improperly maintained or operated, they may malfunction and discharge inadequately treated sewage. Finally, even properly operating MSDs may discharge sewage into ambient water in concentrations higher than allowed for fishing or shellfishing. Vessels are most likely to contribute to bacterial impairment in situations where large numbers of vessels congregate in enclosed environments with low tidal flushing; many marinas and popular anchorages are located in such environments.

In 2014, the EPA approved Massachusetts designation of all of Massachusetts water as a "No Discharge Zone" (NDZ; see Figure 2-3). In an NDZ, any discharge of boat sewage is prohibited, and this was applied to Massachusetts waters to better protect them from receiving nutrient and bacterial wastes from any marine vessel operating within these waters.

Wildlife and Pet Waste

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

Household pets such as cats and dogs can be a substantial source of bacteria, generating as much as 23,000,000 colonies/gram, according to the Center for Watershed Protection (1999). A rule-of-thumb estimate is approximately 1 dog per 10 people, producing an estimated 0.5 pound of feces per dog per day. In 2010, the Islands watershed had a combined year- round population of 26,707 Smith-Johnson, 2017); based on the rule-of-thumb, this means approximately 2,670 dogs producing 1,225 pounds of feces each day. Uncollected pet waste is then flushed from the parks, beaches and yards where pets are walked and transported into nearby waterways during wet weather.

Stormwater

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

Extensive data have been collected and compiled both locally and nationally (e.g. Tables 5-2 and 5-3) in an attempt to characterize stormwater quality. Bacteria vary the most of all stormwater pollutants, as concentrations can fluctuate by factors of 10 to 100 during a single storm. Considering this variability, stormwater bacteria concentrations are difficult to predict accurately. Caution must be exercised when using data from single wet weather grab samples to estimate the magnitude of bacteria loading, as it is difficult to know if the sample is representative of the "true" mean. To gain an understanding of the magnitude of bacterial loading from stormwater and to avoid over- or underestimating bacteria loading, event mean concentrations (EMC) are often used. An EMC is the concentration of bacteria in a flow-proportioned sample collected through the entirety of a storm event. These samples are commonly collected using an automated sampler, which can proportion sample aliquots based on flow. Typical stormwater EMCs for various indicator bacteria in Massachusetts watersheds and nationwide are provided in Tables 5-2 and 5-3. These EMCs illustrate that stormwater indicator bacteria concentrations from certain land uses (i.e., residential) are typically at levels sufficient to cause water quality problems.

6.0 Prioritization and Known Sources

Roughly 85% of the buildings in the Islands watershed (including residences and businesses) utilize on-site septic systems for human waste disposal. Only two towns (Nantucket and Edgartown) have municipal wastewater treatment plants, and only a small percentage of the towns are sewered (Cape Cod Commission 2003). Septic system failures, or poorly performing systems, definitely contribute to the bacterial contamination issue throughout the Cape and Islands. Stormwater runoff from wet weather events can carry this contamination into surface and ground water aquifers, particularly in and around densely populated areas.

Year-round island populations have increased dramatically over the past few decades, more than tripling since 1975. Summer season visitor populations and attendant restaurant and hotel facilities have quadrupled over the same time period, and boating activities have also risen. Therefore, disposal of all wastes including sewage have become problematic, resulting in a steady rise of background bacteria levels in freshwater, as well as salt waters. As discussed in previous sections, Massachusetts approved the designation of No Discharge Zones throughout all estuarine waters surrounding the Commonwealth, including all waters surrounding and between the Cape and the Islands, in 2015.

DMF water quality ambient surveys, as well as frequent sanitary surveys have been conducted throughout the Islands watershed over recent decades. Another bacteria pollution contributor that is clearly evident from these surveys (also true throughout the Cape) is the great increase of both migratory and resident bird populations throughout the Islands. In addition to septic systems contributing to bacteria problems in the region, bird populations can also be significant contributors in areas where they frequent. Although bird populations are largely natural, efforts to properly manage food sources associated with humans like refuse and bird feed can be beneficial.

Although in general, bacterial contamination has not been high enough to limit swimming, bacterial levels have been sufficiently elevated to increase shellfishing restrictions and some periodic closures of shellfishing beds. The water quality standards (WQS) for these shellfishing waters (<14 CFU/100mL fecal coliform) are far more stringent than the primary contact recreation standard for Class B (fresh) waters (formerly <200 CFU/100mL, now <126 CFU *E. coli*). All of the drainage areas, including rivers and streams from inland areas, must have very low background bacteria levels in order for shellfishing beds to remain open. Table 6-1 provides a listing of the segments covered by this TMDL with prioritization for implementation strategies based on principal bacteria sources.

Prioritization of Future Activities

In an effort to provide guidance for addressing bacterial contamination within the Islands Watershed, Table 6-1 provides a prioritized list of pathogen-impaired segments that will require additional bacterial source tracking work (BST) and stepwise implementation of structural and non-structural Best Management Practices (BMPs). Priority should be given to monitoring segments where there is insufficient information on current conditions. Since limited source information and data are available in each impaired segment, a simple scheme was used to prioritize segments based on bacteria concentrations. Data for the Category 5 segments in the Islands Watershed are listed in Tables 4-5 to 4-18 in Section 4 of this report.

Table 6-1 Prioritized List of Pathogen-Impaired Segments in the Islands Watershed

Segment ID	Segment Name	Class/ Qualifier	Size	Segment Description	Priority	Indicators
	Nantucket Island					
MA97-01	Nantucket Harbor	SA/ Shellfishing	7.16 m^2	Waters south and east of an imaginary line drawn from Jetties Beach to Coatue Point (excluding Polpis Harbor and Coskata Pond), Nantucket	*Medium	Fecal Coliform
MA97-26	Polpis Harbor	SA/ Shellfishing	0.302 m^2	Polpis Harbor and all adjacent coves, to an imaginary line drawn from Quaise Point to the opposite shore, Nantucket	*Medium	Fecal Coliform
MA97-02	Sesacha-cha Pond	SA/ Shellfishing	0.423 m^2	South of Quidnet Road and North of Polpis Road, Nantucket	(Insufficient Data)	Fecal Coliform
	Martha's Vineyard					
MA97-05	Chilmark Pond	SA/ Shellfishing	0.3134 m^2	South of South Road including Wades Cove and Gilberts Cove, Chilmark, Martha's Vineyard	*Medium Shellfishing	Fecal Coliform, Enterococci

Segment ID	Segment Name	Class/ Qualifier	Size	Segment Description	Priority	Indicators
MA97-15	Edgartown Harbor	SA/ Shellfishing	3.086 m^2	Waters west of Cape Poge Gut bounded by an imaginary line drawn from Chappaquiddick Point to Dock Street and northeasterly from the end of Plantingfield Way to Cape Poge Elbow (excluding Eel Pond), Edgartown, Martha's Vineyard	**Low (all shellfishing areas are unrestricted)	Fecal Coliform
MA97-07	Oak Bluffs Harbor	SA/ Shellfishing	0.047 m^2	North of Lake Avenue to confluence with Nantucket Sound, Oak Bluffs, Martha's Vineyard	*Medium	Fecal Coliform
MA97-10	Sengekon-tacket Pond	SA/ Shellfishing	1.10	Between Edgartown-Vineyard Haven Road and Oak Bluffs Road, including Majors Cove, Edgartown/Oak Bluffs, Martha's Vineyard.	*Medium	Fecal Coliform
MA97-18	Tisbury Great Pond	SA/ Shellfishing	1.103 m^2	Including Town Cove, Muddy Cove, Pear Tree Cove, Short Cove, Tiah Cove, Tississa Pond, Deep Bottom Cove, and Thumb Cove, Chilmark/West Tisbury, Martha's Vineyard	*Medium	Fecal Coliform
MA97-09	Vineyard Haven Harbor	SA/ Shellfishing	1.545 m^2	The waters south and west of an imaginary line drawn from the tip of West Chop, Tisbury and the tip of East Chop, Oak Bluffs to the confluence of Lagoon Pond at Beach Road, Tisbury/Oak Bluffs, Martha's Vineyard	*Medium	Fecal Coliform
	Elizabeth Islands					
MA97-21	Cuttyhunk Pond	SA/ Shellfishing/ ORW	0.154 m^2	Waters west of the channel connecting Cuttyhunk Pond to Cuttyhunk Harbor, Gosnold (Changed from MA95-26 to MA97-21 on 10/7/97)	*Medium	Fecal Coliform

* A segment adjacent to or immediately upstream of a sensitive use such as an ORW is elevated one level of priority.

**Latest DMF Classifications indicate that all shellfishing waters are fully 'approved'.

High priority would be assigned to segments where dry or wet weather concentrations were equal to or greater than 10,000 CFU/100 ml since such high levels may indicate a direct sanitary source; no high priority segments were identified in the Islands watershed. Medium priority was assigned to segments where concentrations ranged from 1,000 to 9,999 CFU/100ml as this generally indicates a direct sewage source that may get diluted in the conveyance system. Low priority was assigned to segments where observed concentrations were less than 1,000 CFU/100 ml. The highest fecal coliform, *E. coli* or enterococci data (as shown in Tables 4-5 to 4-12) were used. It should be noted that waters identified in Table 6-1 exceed water quality standards for bacteria and are therefore considered to be impaired.

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

Failing septic systems and stormwater runoff are the highest overall contributors to bacterial pollution in the watershed. Therefore, control and elimination of these is the highest priority in reducing bacterial contamination and improving water quality. The next highest contributors of bacteria are illicit sewer connections and failing sewer infrastructure in the limited areas where sewer systems are present. Fixing these will also reduce bacterial contamination and improve water quality.

A top priority for finding illicit connections should be bacteria source tracking in segments where data show elevated bacteria levels during dry weather. Identification and remediation of dry weather bacteria sources is usually more straightforward and successful than tracking and eliminating wet weather sources. If illicit bacteria sources are found and eliminated it should result in a dramatic reduction of bacteria concentration in the watershed in both dry and wet weather.

Finding and fixing illicit connections and failed infrastructure pose real challenges. Stormwater runoff exacerbates efforts to locate failed infrastructure pollution sources. Segments that remain impaired during wet weather should be evaluated for stormwater BMP opportunities, and MassDEP recommends starting with less-costly non-structural practices (e.g., street sweeping, catch basin cleaning, and/or managerial approaches using local regulatory controls), then the more expensive structural measures. Unfortunately, many failed infrastructure problems require expensive structural repair measures, requiring additional study to identify the most cost efficient and effective options.

7.0 Pathogen TMDL Development

Section 303(d) of the Federal Clean Water Act (CWA) requires states to identify and list waters that do not meet water quality standards and thus their designated uses ("fishable, swimmable", etc). The 2016 ILOW (MassDEP 2020) identifies 10 publicly noticed estuary segments within the Islands Watershed that suffer use impairment caused by excessive indicator bacteria concentrations, and these are considered to be Category 5 waters. Two additional Category 5 pathogen impaired segments currently listed will be included in the Addendum: Final Total Maximum Daily Loads of Bacteria for the Islands Watershed CN 254.2.

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

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

Where:

WLA = Waste Load Allocation; the portion of the receiving water's loading capacity allocated to each existing and future point source(s) of pollution.

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

MOS = Margin of safety, either explicitly or implicitly.

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

7.1. General Approach: Development of TMDL Targets

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

For embayments on the Islands, maximum daily loads were calculated as a function of the observed long-term precipitation on Cape Cod (which is similar in volume), the estimated average runoff from the land within 200 feet of each embayment, or the entire contributing watershed area for each segment, and the most stringent water quality criteria based on segment classification. Each methodology is described in greater detail in the following sections, however both assure loading capacities are equal to or less than the Water Quality Standards.

It is important to note that MassDEP realizes, given the vast potential number of bacteria sources and the difficulty of identifying and removing them from sources such as stormwater, the required iterative process which will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge, it is also MassDEP's expectation that for stormwater, an approach is needed that includes prioritization of outfalls and the application of BMPs to achieve water quality standards. MassDEP believes this approach is consistent with current EPA guidance and regulations as stated in a November 22, 2002 EPA memo from Robert Wayland with an addendum from Andrew Sawyers and Benita Best-Wong provided November 26, 2014 (see Appendix B, Wayland and Hanlon 2002, Sawyers and Best-Wong 2014).

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

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

As previously noted, there are many different potential sources of indicator bacteria on the Islands. Most of the bacteria sources are believed to be related to marinas and boating activities, wildlife (particularly birds) and failing septic systems. Some of this pollution is potentially exacerbated by stormwater. Table 7-1 presents the TMDL indicator bacteria WLAs and LAs for the various source categories as daily concentration targets for the Islands.

Most discharges on the Islands that involve potential pathogen pollutants are groundwater discharges and are not treated as point sources regulated by surface water quality standards. These discharges are regulated under a revised (March 2009) Groundwater Program 314 CMR 5.00, related to groundwater discharge permits. The groundwater regulations are established to coincide with Drinking Water Standards in order to promote maximum protection of groundwater as a drinking water source.

In terms of point sources, the Islands have several small, package treatment plants that discharge to groundwater, and thus do not require a NPDES surface water discharge permit. All piped discharges are, by definition, point sources regardless of whether they are currently subject to the requirements of a NPDES permit. Despite that lack of regulated stormwater areas in the Islands Watershed, to be conservative, a WLA set equal to the WQS criteria will be assigned to the portion of the stormwater that discharges to surface waters via storm drains. It should be noted that the load allocation (LA) for each segment throughout the Islands watershed is zero since the runoff from pervious areas is assumed to be negligible on an annual basis. For any illicit sources, including illicit discharges to stormwater systems and sewer system overflows (SSOs), the goal is complete elimination (100% reduction). It is recommended that these concentration targets be used to guide implementation. The goal to attain WQS at the point of discharge is environmentally protective and offers a practical means to identify and evaluate the effectiveness of control measures. In addition, this approach establishes clear objectives that can be easily understood by the public and others responsible for monitoring activities. Success of the control efforts and subsequent conformance with the TMDL will be determined by documenting that a sufficient number of bacteria samples from the receiving water meet the appropriate indicator criteria (WQS) for the water body.

Table 7-1 presents the TMDL indicator bacteria WLAs (to address point sources of pollution) and LAs (to address non-point sources of pollution) as daily concentration targets for the Islands Watershed. The full version of the current WQS can be accessed at the MassDEP website: https://www.mass.gov/regulations/314-CMR-4-the-massachusetts-surface-water-quality-standards.

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

Table 7-1 Sources and Expectations for Limiting Bacterial Contamination in the Islands Watershed

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1]	Load Allocation Indicator Bacteria (CFU/100 mL)[1]
A, B, SA, SB (prohibited)	Illicit discharges to storm drains	0	Not applicable
	Leaking sanitary sewer lines	0	Not Applicable
	Failing septic systems	Not Applicable	0
A (Includes filtered water supply) & B	Any regulated discharge- including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges [4,6]	Either a) *E. coli* <=geometric mean[3] 126 cfu/100 mL; single sample <=235 cfu/100 mL[7]; or b) Enterococci geometric mean[3] <= 33 cfu/100 mL and single sample <= 61 cfu/100 mL	Not Applicable
	Nonpoint source stormwater runoff[4]	Not Applicable	Either *E. coli* <=geometric mean[3] 126 cfu/100 mL; single sample <=235 cfu/100 mL; or Enterococci geometric mean[3]<= 33 cfu/100 mL and single sample <= 61 cfu/100 mL
SA (approved for shellfishing)	Any regulated discharge - including stormwater runoff[2] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[4,6]	Fecal Coliform <= geometric mean, MPN, of 14 cfu/100 mL nor shall 10% of the samples be >=28 cfu/100 mL	Not Applicable
	Nonpoint Source Stormwater Runoff[2]	Not Applicable	Fecal Coliform <= geometric mean, MPN, of 14 cfu/100 mL nor shall 10% of the samples be >=28 cfu/100 mL
SA & SB (Beaches[5] and non-designated	Any regulated discharge - including stormwater runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[4,6]	Enterococci - geometric mean[3] <= 35 cfu/100 mL and single sample <= 104 cfu/100 mL	Not Applicable

Table 7-1 Sources and Expectations for Limiting Bacterial Contamination in the Islands Watershed

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1]	Load Allocation Indicator Bacteria (CFU/100 mL)[1]
shellfish areas)	Nonpoint Source Stormwater Runoff[2]	Not Applicable	Enterococci -geometric mean[3] <= 35 cfu/100 mL and single sample <= 104 cfu/100 mL
SB (approved for shellfishing w/depuration)	Any regulated discharge - including stormwater runoff[2] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[4,6]	Fecal Coliform <= median or geometric mean, MPN, of 88 cfu/100 mL nor shall 10% of the samples be >=260 cfu/100 mL[7]	Not Applicable
	Nonpoint Source Stormwater Runoff[2]	Not Applicable	Fecal Coliform <= median or geometric mean, MPN, of 88 cfu/100 mL nor shall 10% of the samples be >=260 cfu/100 mL
	Nonpoint Source Stormwater Runoff[2]	Not Applicable	Enterococci -geometric mean[3] <= 35 cfu/100 mL and single sample <= 104 cfu/100 mL

[1] Waste Load Allocation (WLA) and Load Allocation (LA) refer to fecal coliform densities unless specified in table.
[2]The expectation for WLAs and LAs for stormwater discharges is that they will be achieved through the implementation of BMPs and other controls.
[3]The geometric mean of the 5 most recent samples is used at bathing beaches. For all other waters and during the non-bathing season the geometric mean of all samples taken within the most recent six months, typically based on a minimum of five samples.
[4] Or shall be consistent with the Waste Water Treatment Plant (WWTP) National Pollutant Discharge Elimination System (NPDES) permit.
[5] Massachusetts Department of Public Health regulations (105 CMR Section 445)
[6]Seasonal disinfection may be allowed by the Department on a case-by-case basis.
[7] Threshold for beach closure. Beaches Environmental Assessment and Coastal Health (BEACH) Act.

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

Potential Sources of Bacterial Contamination

Some insight on potential sources of bacteria is gained using dry or wet weather bacteria concentrations as a benchmark for reductions. In the case of the Islands, where a segment is identified as having elevated levels during dry weather, sources such as permitted discharges, failing septic systems, bird wastes and illicit connections to storm drains may be the primary contributors. For elevated levels in wet weather, potential sources may include flooded septic systems and/or stormwater runoff. In more populated areas, sources of elevated bacteria concentrations can include runoff in areas with high populations of domestic animals or pets. Other potential sources (though relatively uncommon in the Islands) include sanitary sewers connected to storm drains; and in the absence of precipitation, when flow in storm conveyances is minimal until wet weather flushes the line. Sections 4, 5 and 6 discuss the types of sources identified, as well as their prioritization for implementation, in greater detail.

7.3. TMDL Expressed as Daily Load (CFU/Day)

The following section describes the approach this particular TMDL utilized to derive allowable daily bacteria loads for the Islands Watershed.

7.3.1. Embayments

An approach for estimating daily loads of pathogenic bacteria to embayments was developed by approximating the buffer zone runoff. The estimate of daily bacteria load for the Islands was based on USGS hydrology data for Cape Cod, since the geography and geology of both areas are very similar. Walter and Whealan (2005) studied precipitation data recorded at the Hatchville weather station in Falmouth, MA from 1941-1995. These data indicate that an annual average precipitation of 45 inches/year (3.75 feet/year) typically falls on Cape Cod and the Islands, varying from approximately 25 (1965) to 73 inches (1972). Rates of natural surface runoff on Cape Cod are generally very low to zero, because the medium-to-coarse sandy soils allow rapid percolation. Precipitation on the sandy soils of Cape Cod progresses to: (1) ground-water recharge, or (2) evapotranspiration. The annual average ground water recharge rate for Cape Cod was reported to be 27 inches/year (Walter and Whealan 2005) and Desimone (2003) estimated that approximately 24 inches of precipitation on Cape Cod is utilized in evapotranspiration processes.

In the Islands Watershed TMDL, it was assumed that no runoff occurs from pervious areas and therefore a load allocation was not applicable. A buffer area of 200 feet was chosen as a reasonable estimate of the area likely to contribute stormwater discharges directly to each embayment. Within this 200 ft area it was assumed that all precipitation (45 inches per year, approximate) runs directly off impervious areas into the water body, while runoff from pervious surfaces is negligible (e.g., 0 inches/yr) because of the medium-to-coarse sandy soils. A conservative assumption was made that all runoff from impervious surfaces is collected and piped directly to the embayment through storm drain infrastructure. Hence, the allowable total number of bacteria per day is the water quality standard times the estimated daily runoff associated with impervious areas within the 200-foot buffer zone (once conversions for the various units are applied).

The resulting TMDL for embayments on the Islands is reflected in the following equation:

$$TMDL = WLA + LA + MOS$$

Where:

WLA = allowable load for point source categories (including piped stormwater) within 200 ft buffer zone

LA = allowable load for nonpoint source categories associated with pervious areas within 200 ft buffer zone = 0

MOS = margin of safety

Hence, the allowable total bacteria load on an annualized basis was calculated as the water quality standard (14 CFU/100 ml of fecal coliform for Class SA shellfishing) times the estimated annual runoff associated with impervious areas within the 200-foot buffer zone (once conversions for the various units are applied). The daily load of pathogens in CFU/day is then calculated by dividing the allowable annual load by 365 days. The formula and calculations are provided below in Section 7.3.3, 'Calculating the TMDL as Daily Loads'.

7.3.2. Water Quality Criteria

The water quality criteria used to develop the TMDL were based on the most stringent designated use identified in the Massachusetts Water Quality Standards. In the case of the Islands Watershed the principal and most sensitive use is shellfishing. Shellfishing criteria are also applied to segments where shellfishing is prohibited but where there may be an approved area in an abutting or downstream segment. A summary of the relevant water quality criteria that apply to the Islands Watershed is provided in Table 7-2.

Table 7-2 Water Quality Targets for the Islands Watershed

Waterbody Use	Shellfishing Criterion (apply in DMF approved areas)		Primary Contact Recreation Criterion	
	Fecal coliform (CFU/100LmL)		*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)
Waterbody Class	Geometric Mean	10% of samples not to exceed	Geometric Mean	Geometric Mean
SA	14[a]	28[a]	None	35[b]

[a] Fecal coliform is the indicator.
[b]Enterococci is the indicator, the MA Surface Water Quality Standards can be found at: https://www.mass.gov/regulations/314-CMR-4-the-massachusetts-surface-water-quality-standards.

7.3.3. Calculating the TMDL as Daily Loads

MassDEP believes it is appropriate to express indicator bacteria TMDLs proportional to flow. Because the Water Quality Standard is also expressed in terms of the concentration of colony-forming organisms per

100 mL, the acceptable daily load or TMDL for each estuary is the product of the contributing watershed runoff and the water quality standard criterion, which is the same approach used for any pollutant with a numerical criterion.

The TMDL is based on volume and the concentration of the applicable Massachusetts water quality standard criterion for bacteria. Once the volume is estimated, the total maximum daily load of bacteria in colony-forming units per day is derived by multiplying the estimated runoff volume by the water quality standard criterion for the indicator bacteria.

Example calculations for determining the TMDL are provided as follows:

For Estuary Embayments: For all 15 of the estuary-embayment segments covered in this particular TMDL, it was important to account for the size of the watershed contributing flow to the impaired water body. The following equation illustrates the calculation that applies to the estuarine segments.

Class SA - Fecal Coliform Annual Waste Load Allocation (WLA) for Impaired Segment (CFU/Year) =

(200 ft buffer area in acres) x (43,560 ft^2/acre) x (fraction impervious area in 200-foot buffer area) x (3.75 ft/year annual precipitation) x (1.4 CFU/ml) x (1000 ml/l) x (28.32 l/ft^3) = CFU/year

(note the Fecal Coliform Standard is 14 CFU/100 ml or 1.4 CFU/mL)

Class SA- Fecal Coliform Daily WLA for Impaired Segment (CFU/Day) =

(CFU/year) x (year/365 days) = CFU/day

Class SA - Enterococci Annual Waste Load Allocation (WLA) for Impaired Segment (CFU/Year) =

(200 ft buffer area in acres) x (43,560 ft^2/acre) x (fraction impervious area in 200-foot buffer area) x (3.75 ft/year annual precipitation) x (3.5 CFU/1 ml) x (1000 ml/l) x (28.32 l/ft^3) = CFU/year

(note the Enterococci standard is 35 CFU/100 ml or 3.5 CFU/mL)

Class SA- Enterococci Daily WLA for Impaired Segment (CFU/Day) =

(CFU/year) x (year/365 days) = CFU/day

In conformance with the requirement that maximum daily loads be explicit, MassDEP has calculated the daily bacteria loads associated with each impaired segment. The TMDL in CFU/day for each impaired segment contributing to runoff to estuaries on the Islands is summarized in Table 7-3 and Table 7-4.

Table 7-3 Fecal Coliform Waste Load Allocation and Total Maximum Daily Load by Segment-

Segment ID	Waterbody Name	Class	Applicable Water Quality Standard- Fecal Coliform (CFU/100ml)	200 ft Buffer Area (Acres)	Impervious Area in 200 ft Buffer Area (Acres)[1]	WLA		TMDL
						Impervious Buffer Area		(WLA + LA[2])
						Percent of Impervious Area within 200 ft buffer (%)	Daily Load (CFU/day)	Daily Load (CFU/day)
MA97-01	Nantucket Harbor	SA	14	552.1	50.0	9.1	3.09E+08	3.09E+08
MA97-26	Polpis Harbor	SA	14	144.8	0.7	0.5	4.02E+06	4.02E+06
MA97-02	Sesachacha Pond	SA	14	72.7	3.0	4.2	1.86E+07	1.86E+07
MA97-05	Chilmark Pond	SA	14	185.1	6.4	3.4	3.92E+07	3.92E+07
MA97-15	Edgartown Harbor	SA	14	232.9	11.3	4.8	6.95E+07	6.95E+07
MA97-07	Oak Bluffs Harbor	SA	14	27.1	12.6	46.3	7.75E+07	7.75E+07
MA97-10	Sengekontacket Pond	SA	14	235.3	7.3	0.8	3.34E+06	3.34E+06
MA97-18	Tisbury Great Pond	SA	14	376.8	11.0	2.9	6.79E+07	6.79E+07
MA97-09	Vineyard Haven Harbor	SA	14	165.2	27.6	16.7	1.70E+08	1.70E+08
MA97-21	Cuttyhunk Pond	SA	14	49.9	7.0	13.9	4.29E+07	4.29E+07
1= Where Impervious Area in 200ft Buffer Area overlapped among nearby waterbodies, impervious area was assigned to the more seaward segment								
2 = Load Allocation (LA) equals zero since runoff from the pervious area is assumed to be negligible.								

Table 7-4 Enterococci Waste Load Allocation and Total Maximum Daily Load by Segment-

Segment ID	Waterbody Name	Class	Applicable Water Quality Standard- *Enterococci* (CFU/100ml)	200 ft Buffer Area (Acres)	Impervious Area in 200 ft Buffer Area (Acres)[1]	WLA		TMDL
						Impervious Buffer Area		(WLA + LA[2])
						Percent of Impervious Area within 200 ft buffer (%)	Daily Load (CFU/day)	Daily Load (CFU/day)
MA97-01	Nantucket Harbor	SA	35	552.1	50.0	9.1	2.22E+08	2.22E+08
MA97-26	Polpis Harbor	SA	35	144.8	0.7	0.5	2.89E+06	2.89E+06
MA97-02	Sesachacha Pond	SA	35	72.7	3.0	4.2	1.34E+07	1.34E+07
MA97-05	Chilmark Pond	SA	35	185.1	6.4	3.4	2.82E+07	2.82E+07
MA97-15	Edgartown Harbor	SA	35	232.9	11.3	4.8	5.00E+07	5.00E+07
MA97-07	Oak Bluffs Harbor	SA	35	27.1	12.6	46.3	5.57E+07	5.57E+07
MA97-10	Sengekontacket Pond	SA	35	235.3	7.3	0.8	8.35E+06	8.35E+06
MA97-18	Tisbury Great Pond	SA	35	376.8	11.0	2.9	4.89E+07	4.89E+07
MA97-09	Vineyard Haven Harbor	SA	35	165.2	27.6	16.7	1.22E+08	1.22E+08
MA97-21	Cuttyhunk Pond	SA	35	49.9	7.0	13.9	3.09E+07	3.09E+07
1= Where Impervious Area in 200ft Buffer Area overlapped among nearby waterbodies, impervious area was assigned to the more seaward segment								
2 = Load Allocation (LA) equals zero since runoff from the pervious area is assumed to be negligible.								

7.3.4. Wasteload Allocations (WLAs) and Load Allocations (LAs)

For point sources, the Islands have several small-scale, package wastewater treatment plants (WWTPs) and no active NPDES-permit related wastewater discharges. NPDES wastewater discharge WLAs are set at the water quality standards. All piped discharges are, by definition, point sources regardless of whether they are currently subject to the requirements of NPDES permits, and bacterial contamination from all piped discharges are set at the applicable WQS. There are numerous stormwater discharges from drainage systems in the watershed, particularly in populated areas. Therefore, a WLA set equal to the WQS will be assigned to that portion of stormwater flows that discharge to surface waters via storm drains.

WLAs and LAs are identified for all known source categories including both dry and wet weather sources for Class SA segments within the Islands Watershed. Establishing WLAs and LAs that only address dry weather bacteria sources would not ensure attainment of standards because of the significant contribution of wet weather sources to WQS exceedances. Illicit sewer connections and deteriorating sewerage infrastructure leaking to storm drainage systems are likely to be scattered sources in this watershed. Failing septic systems, animal, bird and pet wastes represent the principal non-point sources. Wet weather point sources include discharges from stormwater drainage systems. Wet weather non-point sources primarily include stormwater runoff from impervious surfaces.

7.3.5. Stormwater Contribution

Part of the stormwater-driven bacterial pollution is contributed by point sources and is included in the waste load allocation element of the TMDL; the remaining portion comes from non-point sources and is included in the load allocation. The fraction of the runoff load attributed to the waste load allocation is estimated from the fraction of the watershed that has impervious cover, because stormwater from impervious cover is more likely to be diverted, collected and conveyed to the receiving water by stormwater collection systems than in non-impervious areas. The fraction of the TMDL associated with the waste load allocation was based on data available in MassGIS and the algorithm within it to estimate the extent of impervious surface within a 200-foot buffer area around the impaired water body; it was assumed that no runoff occurs from pervious areas and therefore no-load allocation was developed. For the Islands Watershed, a buffer area of 200 feet was chosen as a reasonable estimate of the area likely to contribute stormwater discharges directly to each embayment. Within this 200-foot area, it was assumed that the entire annual precipitation (approximately 45 inches) runs directly off impervious surfaces, while runoff is negligible from pervious surfaces (i.e., 0 inches/yr) because of the percolation capacity of the medium-to-coarse sandy soils prevalent on the Islands. The waste load allocation was then defined by multiplying the TMDL for each segment by the percent of imperviousness within the 200’ buffer zone within each sub-watershed segment. The load allocation was estimated as zero, based on the absence of runoff assumed to originate from pervious areas. MassDEP believes this approach is conservative because it assumes that all runoff from impervious areas within the 200’ buffer zone actually enters the waterbody segment, which may or may not always be the case.

7.4. Application of the TMDL to Unimpaired or Currently Unassessed Segments

This TMDL applies to the 10 publicly noticed pathogen impaired estuary segments in the Islands Watershed that are currently listed as Category 5 waters in the 2016 ILOW (MassDEP 2020). MassDEP recommends however, that the information contained in this TMDL guide management activities for all other waters throughout the watershed to help maintain and protect existing water quality.

The analyses conducted for the pathogen-impaired segments in this TMDL would apply to the non-impaired segments, since the sources and their characteristics are equivalent. The concentration waste load and/or load allocation for each source and designated use would be the same as specified herein. Therefore, the pollution prevention TMDLs would have identical waste load and load allocations based on the sources present and the designated use of the water body segment (see Table 7.1). Any discharge would need to be consistent with the applicable waste load allocations, as well as the anti-degradation provision of the Massachusetts Water Quality Standards. Any new construction that complies with state stormwater standards and permits is presumed to comply with anti-degradation requirements of the state water quality standards.

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

7.5. Margin of Safety

This section addresses the incorporation of a Margin of Safety (MOS) in the TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can either be implicit (i.e., incorporated into the TMDL analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS, through inclusion of three conservative assumptions. First, the TMDL does not account for mixing in the receiving waters and assumes that zero dilution is available. Realistically, influent water will mix with the receiving water and become diluted below the water quality standard, provided that the receiving water concentration does not exceed the TMDL concentration. Second, the goal of attaining standards at the point of discharge does not account for losses due to die-off and the settling of indicator bacteria that are known to occur. Third, the TMDL assumes that all of the runoff from impervious areas throughout the contributing watershed actually enters the impaired segment, which is generally not the case, especially in large watersheds where impervious surfaces are not continually connected.

While the general vulnerabilities of coastal areas to climate change can be identified, specific impacts and effects of changing estuarine conditions are not well known at this time https://www.mass.gov/files/documents/2016/08/qz/eea-climate-adaptation-report.pdf; (EEA 2011).

Because the science is not yet available, MassDEP is unable to analyze climate change impacts on streamflow, precipitation and loading with any degree of certainty for TMDL development. In light of these uncertainties and information gaps, MassDEP has opted to address all sources of uncertainty through an implicit MOS. MassDEP does not believe that an explicit MOS approach is appropriate under the circumstances or will provide a more protective or accurate MOS than the implicit MOS approach, as the available data simply does not lend itself to characterizing and estimating loadings to derive numeric allocations within confidence limits. Although the implicit MOS approach does not expressly set aside a specific portion of the load to account for potential impacts of climate change, MassDEP has no basis to conclude that the conservative assumptions that were used to develop the loadings in this TMDL are insufficient to account for the lack of knowledge regarding climate change.

7.6. Seasonal Variability

In addition to a Margin of Safety, TMDLs must also account for seasonal variability. Pathogen sources to waterbodies in the Islands Watershed include continuous and wet-weather driven sources, and there may be no single critical condition that is protective for all other conditions. This TMDL has set WLAs and LAs for all known and suspected source categories equal to the Massachusetts WQS independent of seasonal and climatic conditions. This will ensure the attainment of water quality standards regardless of seasonal and climatic conditions. Controls that are necessary to protect the applicable uses will be in place throughout the year, maximizing protection of water quality.

8.0 Implementation Plan

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

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

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

For these reasons, a basin-wide implementation strategy is recommended. The strategy includes a mandatory program for implementing storm water BMPs and eliminating illicit sources. The "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" was developed to support implementation of pathogen TMDLs (ENSR 2005) and the interactive web site, Massachusetts Clean Water Toolkit, http://prj.geosyntec.com/npsmanual/default.aspx.

TMDL implementation-related tasks are shown in Table 8-1. MassDEP, working with EPA and other team partners, shall make every reasonable effort to assure implementation of this TMDL. These stakeholders can provide valuable assistance in defining hot spots and sources of pathogen contamination as well as in implementing mitigation or preventative measures.

Table 8-1 TMDL Development and Implementation Tasks

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

8.1. Summary of Activities within the Islands Watershed

There are numerous organizations on Nantucket and Martha's Vineyard concerned with improving water quality and conserving the islands' natural resources. Many of these organizations have already made strides towards monitoring and/or reducing fecal coliform levels in their waterbodies.

The Nantucket Land Council focuses on preserving land, protecting water resources and working with the town to conduct ecologically sound planning. The Council is focused on protecting groundwater resources from pollution and has conducted water studies on pollutants. The Council works with the town to incorporate study findings into their planning efforts (NLC 2000).

The Nantucket Harbormaster duties include water quality monitoring of all Nantucket waters, including Tuckernuck and Muskeget Islands. Monitoring sites focus on both point- and nonpoint sources of pollution. The Harbormaster also provides outreach and enforcement of the No Discharge Zone (for a detailed description of the No Discharge Zones, see section 2) (CIHA 2005, EPA 2015).

The Friends of Sengekontacket, Inc. (FOS) organization aims to preserve the resources of Sengekontacket Pond. FOS's goals are to protect the water quality and wildlife habitat and to promote sound management. FOS focuses on research, outreach and education programs and the establishment of alliances with residents and agencies to protect the pond (FOS 2004).

The Martha's Vineyard Commission is the regional planning agency of Dukes County, including the 6 towns on the Vineyard (Aquinnah, Chilmark, Edgartown, Oak Bluffs, Tisbury and West Tisbury) and the town of Gosnold (encompassing the entire Elizabeth Islands chain). In 1974, the Legislature adopted the Martha's Vineyard Commission (MVC) Act, which created regional planning/regulation to protect the unique natural, historical, ecological, and cultural qualities of the Vineyard. The MVC's mission is to manage growth so the Vineyard's unique environment, character, social fabric and sustainable economy are maintained (MVC 2016).

The Tisbury Waterways, Inc. (TWI) organization is concerned with water issues relating to the waterways in their town, which includes Vineyard Haven Harbor. The organization helps people seeking grant money for water research, conducts conservation projects, and works with other organizations to conduct long-term environmental planning (TWI 2004).

The Lagoon Pond Association, Inc. (LPA) strives to preserve Lagoon Pond and adjacent areas and waters. LPA attempts to preserve the waterbody's resources and to cooperate with governmental agencies to solve environmental issues. The LPA also funds water quality monitoring for Lagoon Pond (LPA 2018).

The Great Pond Foundation (GPF) seeks to promote the health of Edgartown Great Pond. GPF's mission is twofold: to educate people on the pond's value and water quality status; and to work with the Town of Edgartown to preserve the pond's ability to support recreation and remain ecologically sound. GPF is also dedicated to providing grants for research relevant to their mission (GPF 2003).

In 1995, the Wampanoag Tribe of Gay Head (Aquinnah) conducted a water quality investigation of the tribe's ecosystem (including coastal ponds and tidal waters), with parameters including pathogens (Wampanoag Tribe of Gay Head 2018a). The tribe constructed an accredited air and water quality laboratory in Menemsha, the Wampanoag Environmental Laboratory; analyses offered include microbiology and chemistry, e.g., total coliform and *E. coli* (Wampanoag Tribe of Gay Head 2018b).
Several other organizations on Martha's Vineyard are concerned with water quality, including Protect Our Water, Squibnocket Pond District Advisory Committee, the Riparian Owners of Tisbury Great Pond, the

Senior Environmental Corps, the Vineyard Conservation Society (VCS) and the Vineyard Research Institute (VCS 2005).

The Woods Hole Oceanographic Institution (WHOI) has conducted studies on Martha's Vineyard waters. The Edgartown Harbor Association provided $750,000 to fund a water quality study conducted by WHOI. FOS has also funded WHOI studies totaling more than $90,000 (Karney 2000).

There have been a number of State and Federally sponsored environmental studies on Martha's Vineyard and Nantucket in recent years. Many of these have focused on nutrient assessment and control, although an ancillary and very important offshoot of these efforts is a better understanding of how to control bacterial contaminants in these waters. Included in these works were numerous nutrient studies and TMDLs within the Massachusetts Estuaries Project (MEP). The following is a brief listing and review of these State and Federal studies/projects:

(1) Section 319 NPS grant project #94-08- 'Lake Tashmoo Stormwater Remediation Project', a $95,872 project which consisted of capturing and treating road runoff contributing to the contamination of Lake Tashmoo in Tisbury on Martha's Vineyard, through the construction of a system of 12 'first flush leaching basins'. The EPA considered this to be a highly successful project, with removal rates for pathogens well over 90%. Chromium, lead, and other heavy metals were below detection after the basins were constructed. Many shellfish beds that had been closed throughout the Lake were reopened in subsequent years.
(2) Section 319 NPS grant project #01-18- 'Lagoon Pond Runoff Renovation Project', a $122,745 project which consisted of the construction of runoff interception, infiltration, and treatment systems in three subwatersheds of Lagoon Pond in Oak Bluffs (Vineyard Ave; Lagoon Rd; Hudson Ave). The purpose of these was to remove bacteria, BOD, and phosphorous particularly during the first flush in storm events;
(3) Mass. Watershed Initiative Project #01-05- 'Martha's Vineyard Lake Tashmoo and Lake Anthony/Sunset Lake Nutrient Loading Studies', a $45,000 EOEA grant focused on monitoring, land use analysis, tidal flushing analysis and installation of tidal control gates in these waterbodies in the town of Tisbury;
(4) Mass. Watershed Initiative Project #01-11- 'Madaket Harbor Circulation Study', a $49,983 EOEA grant which developed and applied hydrodynamic and tidal flushing models to the Madaket Harbor/ Long Pond System on Nantucket, including support monitoring of hydrologic and water quality parameters;
(5) Mass. Watershed Initiative Project #02-10- 'Martha's Vineyard Source Water Protection Project'- a $43,900 EOEA grant which identified and assessed potential water quality impacts within Zone II areas associated with well fields in the towns of Edgartown, Oak Bluffs and Tisbury. This included consideration of nitrate-loading effects within those water aquifers;
(6) Mass. Watershed Initiative Project #03-18- Martha's Vineyard Great Ponds Water Quality Monitoring' –a $20,000 EOEA grant which conducted water quality monitoring on eight

pond/estuary ponds across the Vineyard (Edgartown Great Pond, Tisbury Great Pond, Lagoon Pond, Squibnocket Pond, Chilmark Pond, Menemsha Pond, Lake Tashmoo, Sunset Lake/Lake Anthony complex);

(7) Mass. Watershed Initiative Project #03-19- 'Madaket Harbor Water Quality Monitoring'- a $47,000 EOEA grant which conducted a comprehensive harbor monitoring program, including nutrients;

(8) Section 604(b) EPA project #98-04, 'Assessment of Current Quality and Projected Nutrient Loading for Menemsha Pond and Chilmark Great Pond'- a $45,415 EPA grant that assessed water quality and determined the nutrient loading limits for these two ponds;

(9) Section 604(b) EPA project #99-02, 'Nutrient (N) Loading to Two Great Ponds: Tisbury Great Pond and Lagoon Pond'- a $52,000 EPA grant that developed N-loading models to establish nutrient loading limits for these two ponds;

(10) Section 604(b) EPA project #03-01- 'Martha's Vineyard: Water Quality Assessment of Nine Coastal Ponds'- a $45,424 EPA grant that obtained additional water quality data from nine coastal saltwater ponds in support of the MEP: Sengekontacket, Cape Pogue, Poucha, Tashmoo, Oak Bluffs Harbor, Farm, Menemsha, Chilmark, and Squibnocket. GIS maps were prepared in clickable format with station locations and water quality data.

(11) Section 604(b) EPA project #04-01- 'Martha's Vineyard: Water Quality Assessment of Four Coastal Ponds'- a $18,012 EPA grant that continued to obtain additional water quality data from four coastal saltwater ponds (Chilmark, Farm, Sengekontacket and Lake Tashmoo) in support of the MEP, and to enhance the existing dataset for two other saltwater ponds (Cape Pogue and Poucha). GIS maps were produced with station locations, and water quality data were obtained.

(12) Section 604(b) EPA project #05-02 Martha's Vineyard Coastal Pond Water Quality Assessment – Phase III. This focus of this project was to obtain water quality data to prepare six coastal salt ponds for inclusion in the MEP. First year data was collected for Katama Bay and James Ponds; second year data was collected for Oyster Pond; and data needed to complete the dataset was collected for Cape Pogue, Farm and Poucha Ponds. The MVC collected additional water quality data for Sengekontacket Pond and Lake Tashmoo.

(13) Section 604(b) EPA project # 06-02 Martha's Vineyard Coastal Pond Water Quality Assessment – Phase IV. This project continued the collection of water quality data to prepare six coastal salt ponds for entry into the MEP. Second year data was collected for Katama Bay and James Ponds; and third year data was collected for Oyster Pond.

(14) Section 604(b) EPA project # 07-01 Martha's Vineyard Coastal Pond Water Quality Assessment – Phase V. This project continued the collection of water quality data to prepare six coastal salt ponds for entry into the MEP. Third year data was collected for Katama Bay and James Ponds. Additional data was collected from both Oyster and Tisbury Great Ponds.

(15) Section 604(b) EPA project # 08-03 Martha's Vineyard Coastal Pond Water Quality Assessment – Phase VI. This project continued the collection of water quality and land use data to prepare Martha's Vineyard coastal salt ponds for entry into the MEP. Additional data was collected from

both Oyster and Tisbury Great Ponds at regular intervals before, during, and after openings to the ocean were cut through the barrier beaches.

(16) Section 604(b) EPA project # 15-04 Phosphorus Sources for Hummock & Miacomet Ponds. Both Hummock and Miacomet Ponds are major public recreational resources on Nantucket, but both experience algae blooms in summer, including cyanobacteria at potentially hazardous levels. Extensive work evaluated nitrogen loading in conjunction with the MEP. The Town of Nantucket conducted additional work to assess blooms and oxygen levels (critical to release of phosphorus from sediments).

For the past 12 years, the Massachusetts Estuaries Project (MEP) has been addressing nitrogen enrichment in coastal waters of estuaries on the Cape, the Islands and in Buzzards Bay. There have been at least six studies on Martha's Vineyard, and four other studies on Nantucket that have determined a threshold Total Nitrogen (TN) level range, which represents the average ambient level of TN that will support adequate habitat quality in an estuarine system. Many of these studies found existing N levels greater than 1.00 mg/L, with suggested threshold levels at a much lower range of 0.35 to 0.45 mg/L.

The 2013 MEP study, "*Linked Watershed Embayment Model to Determine Critical Nitrogen Loading Threshold for the Oak Bluffs System*" (UMD and MassDEP 2013), found that generally 79% of the controllable land-related N load to these embayment waters came from (on-site septic) wastewaters, 9% from overland impervious surfaces runoff, and 7% from wastewater treatment plants. In the 2009 TMDL study, "*Nantucket Harbor Embayment System Total Maximum Daily Loads for Total Nitrogen*", septic system N loads were found to represent 28% to 53% of the controllable watershed load to the Nantucket Harbor embayment system (MassDEP 2009). These studies all indicate that failing septic systems are likely to provide the highest percentages of the TN and pathogen loadings to the Islands' ground and surface waters. These Cape and Islands MEP studies indicate that controlling nitrogen/nutrient pollution from human activities, such as proper operation and disposal of septic system and boat wastes, and use of manure for fertilizers and agriculture, will also tie-in with controlling bacteria pollution, since nutrients and bacteria often occur together in waste from these activities, and controls for nutrients most often will help to control bacteria as well.

The Martha's Vineyard Commission initiated and coordinated the *Island Plan: Charting the Future of the Vineyard* (2009). The Island Plan Steering Committee responsible for developing the plan received considerable input from state and local governments and citizens. It provides guidance on protecting and maintaining the Vineyard's rural character and open space, and addressing environmental issues such as wastewater pollution of coastal ponds, and habitat alteration and destruction (MVC 2009).
A key goal of the Plan is to "restore the ecological vibrancy of salt ponds and bays with healthy expanses of eelgrass, sustainable shellfish populations, and varied recreational opportunities."

Data supporting this TMDL indicate that bacteria enter the Islands waters from a number of contributing sources, under a variety of conditions. Activities that are currently ongoing and/or planned to ensure that

the TMDL can be implemented include and are summarized in the sections 8.2 through 8.9. The "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" (ENSR 2005) provides additional details on the implementation of pathogen control measures summarized below as well as additional measures not provided herein, such as by-law, ordinances and public outreach and education.

8.2. Illicit Sewer Connections and Failing Infrastructure

Elimination of illicit sewer connections and repairing failing infrastructure are of extreme importance. According to the United States Census Bureau there are no "Urban Areas" in the Islands watershed and therefore, no Phase II communities regulated under the NPDES program requiring an Illicit Detection and Elimination plan. However, the Oaks Bluffs Board of Health has adopted "Stormwater Management Regulations" with the goal of stormwater pollution prevention and illicit connection elimination (MassDEP 2003). Implementing these regulations will thus help communities achieve bacteria TMDLs.

Guidance for developing and implementing an illicit discharge detection and elimination (IDDE) program is available from several documents. EPA New England developed an IDDE plan for the Lower Charles River to separate storm sewer systems (under both dry and wet weather conditions) (EPA 2004). Although originally prepared for the Charles River watershed, it may be applicable to other watersheds throughout the Commonwealth. However, it represents just one of the approved methodologies available. More generic guidance is provided in a document prepared for the EPA by the Center for Watershed Protection and the University of Alabama entitled *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments* which can be downloaded from https://www3.epa.gov/npdes/pubs/idde_manualwithappendices.pdf (CWP and Robert Pitt 2004).

In addition, practical guidance for municipalities is provided in a New England Interstate Water Pollution Control Commission publication entitled *Illicit Discharge Detection and Elimination Manual, A Handbook for Municipalities* available at http://neiwpcc.org/neiwpcc_docs/iddmanual.pdf (NEIWPCC 2003). Implementation of the protocol outlined in these guidance documents satisfies the IDDE requirement of the NPDES program.

8.3. Storm Water Runoff

Stormwater runoff can be categorized as: 1) point source discharges, and 2) non-point source discharges (including sheet flow and direct runoff). Many point source stormwater discharges are regulated under the Municipal Separate Storm Sewer Systems (MS4) NPDES Phase I and Phase II permitting programs, when discharged to a water of the United States. It should be pointed out that none of the communities on the Islands are required to be covered under these NPDES stormwater permitting programs. However, the communities in the Islands Watershed can choose to follow any of the program guidelines to reduce pollutants in stormwater discharges.

Municipalities that operate regulated MS4s must develop and implement a stormwater management plan (SWMP), which must set quantifiable goals for the following six minimum control measures:

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

The NPDES program does not, however, establish numeric limitations for pollutants in stormwater discharges. The maximum extent practicable is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. This standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.

Non-point source discharges are generally characterized as sheet flow runoff and are not categorically regulated under the NPDES program, and these can be difficult to manage. However, some of the same principles for mitigating point source impacts may be applicable. Individual municipalities not regulated under the Phase I or II can, and should, elect to implement the exact same six minimum control measures described above to minimize stormwater contamination. For example, as described above, the Oaks Bluffs Board of Health has adopted "Stormwater Management Regulations" with the goal of stormwater pollution prevention and illicit connection elimination. Implementation of these regulations will thus help this Oak Bluffs and other communities on the Islands to move towards achieving bacteria TMDLs. For example, the Town of Tisbury has already instituted control measures for stormwater entering Lake Tashmoo to address shellfish bed closures. Tisbury Waterways, Inc. and the town installed a series of 12 "first flush" leaching basins along road drains. The basins receive the first ¼" of rainfall (which contains most of the contaminants in stormwater runoff) and provide sufficient residence time for fecal coliform populations to decay. Results of water quality samples collected in Lake Tashmoo after the installation of the leaching basins showed a 91% reduction in fecal coliform and a 98% reduction in total coliform (EPA 2002).

Also, the Towns of Tisbury and Oak Bluffs and the Martha's Vineyard Commission mapped storm drains in these two towns. The mapping will be used to direct engineering projects to fix stormwater problems (MVC 2004a).

A list of the municipalities in Massachusetts regulated by the Phase II Rule, as well as the Notices of Intent for each municipality can be viewed at https://www.epa.gov/npdes-permits/2003-small-ms4-general-permit-archives-massachusetts-new-hampshire (EPA 2018f). As previously stated, none of the Islands communities are included in the NPDES Phase II Stormwater Rule. Other than the progress made by the towns of Oak Bluffs and Tisbury in addressing stormwater pollution, little information is available relative to assessing or implementing stormwater management by other Islands communities. Most stormwater-related progress has been under the guise of the MEP through various assessment and implementation studies funded by state and federal grants (described in section 8.1 above).

8.4. Failing Septic Systems

Septic system bacterial contributions to the Islands Watershed may be reduced in the future through improved septic system maintenance and/or replacement. Additionally, the implementation of Title 5 (310 CMR 15.00), which requires inspection of private sewage disposal systems before transfer of property ownership, building expansions, or changes in use of properties, will aid in the discovery of poorly operating or failing systems.

Bacteria contributions to surface waters from septic systems could be significant, as 80% of the roughly 1,500 dwellings on Martha's Vineyard are serviced by on-site wastewater disposal systems (MVC 2004b); a similar proportion of buildings with on-site wastewater disposal systems is found on Nantucket. Therefore, heightened efforts to maintain and/or replace septic systems throughout the Islands watershed is expected to result in reduced bacterial contamination to Islands waters. Additionally, the implementation of Title 5 inspection requirements will aid in the discovery of poorly operating or failing systems. Because systems which are found to fail Title 5 inspections must be repaired or upgraded, it is expected that the bacteria load from on-site septic systems will be significantly reduced in the future. Regulatory and educational materials for septic system installation, maintenance, and alternative technologies are provided by the MassDEP on the web at https://www.mass.gov/septic-systems-title-5 (MassDEP 2018b). Locally, the Martha's Vineyard Commission has developed an informational guide on the importance of properly operated septic systems, available online at http://mvcommission.org/sites/default/files/docs/Martha_s_Vineyard_Wastewater_Management_Study_May_2010.pdf (MVC, 2010)

8.5. Treatment Plants

There are five wastewater treatment plants (WWTP) in the Islands watershed with groundwater discharges: Nantucket-Surfside; Nantucket-Siasconset; Edgartown; Oak Bluffs; and Tisbury. The NPDES permitting program regulates WWTP discharges when treated effluent is discharged to surface water. The town of Gosnold has the only NPDES surface water permit in the Islands Watershed for an ocean discharge (from the south side of Cuttyhunk Island); another NPDES (minor) permit is for the US Coast Guard facility in Chilmark, which discharges to Menemsha Creek. No active discharges are occurring at either location and both permits are likely to be terminated. Each WWTP has an effluent limit included in its NPDES or groundwater discharge permit. Some NPDES permits are listed on the following website: https://www.epa.gov/npdes-permits/massachusetts-final-individual-npdes-permits (EPA 2018a). Details on the Massachusetts groundwater discharge permit program are available at https://www.mass.gov/regulations/314-CMR-5-ground-water-discharge-permit-program (MassDEP 2018c).

8.6. Recreational Waters Use Management

Recreational waters receive pathogen inputs from swimmers and boats. To reduce pathogen pollution from swimmers, shower facilities can be made available, and bathers should be encouraged to shower prior to swimming. In addition, parents should change children's diapers as soon as they are soiled.

Options for controlling pathogen contamination from boats include:

- supporting installation of pump-out facilities for boat sewage;
- educating boat owners on the proper operation and maintenance of marine sanitation devices (MSDs); and
- encouraging marina owners to provide clean and safe onshore restrooms and pump-out facilities.

The waters surrounding the Islands Watershed has been designated a "No Discharge Zone" (NDZ). This designation by the Commonwealth of Massachusetts and approved by the EPA prohibits the release of raw or treated sewage from vessels into navigable waters of the U.S. In Massachusetts, all coastal waters are designated NDZ, and the law is enforced by the Massachusetts Environmental Police. In 2009 legislation was passed that defined the role of harbormasters and other coastal police officers in enforcing NDZs and would allow them to collect up to $2000 for violations in NDZs (Commonwealth of Massachusetts, 2018).

8.7. Funding/Community Resources

A complete list of funding sources for implementing non-point source pollution abatement programs is provided in Section VII of the Massachusetts Nonpoint Source Management Plan Volume I , available on line at https://www.mass.gov/info-details/final-2020-2024-massachusetts-nonpoint-source-management-program-plan (MassDEP 2019). This list includes specific programs available for non-point source management and resources available for communities to manage local growth and development. The State Revolving Fund (SRF) provides low interest loans to communities for certain capital costs associated with building or improving wastewater treatment facilities. In addition, many communities in Massachusetts sponsor low cost loans through the SRF program for homeowners to repair or upgrade failing septic systems.

State monies are also available through the Massachusetts Office of Coastal Zone Management (CZM): Coastal Pollution Remediation, Coastal Nonpoint Source Pollution Control, and Coastal Monitoring programs.

8.8. Mitigation Measures to Address Pathogen Pollution in Surface Water:

For additional discussion on ways to mitigate pathogen water pollution, see *Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts* (ENSR 2005). Also refer to information on the interactive web site, *Massachusetts Clean Water Toolkit*, http://prj.geosyntec.com/npsmanual/default.aspx.

8.9. Climate Change

MassDEP recognizes that long-term (25+ years) climate change impacts to Massachusetts (including the geographic area included in this TMDL) are possible, based on known science. The *Massachusetts Climate Change Adaptation Report* (EEA 2011) predicted that, by the year 2100, sea level could be 1 to 6 feet higher than currently, and precipitation rates in the Northeast could increase by as much as 20 percent. However, the details of how climate change will affect sea level rise, precipitation, streamflow, sediment and nutrient loading in specific locations are generally unknown. The ongoing debate is not about whether climate change is affecting the state; the questions are on the rate and extent to which it will occur and the adjustments needed to address impacts. EPA's 2012 Climate Change Strategy http://water.epa.gov/scitech/climatechange/upload/epa_2012_climate_water_strategy_full_report_final.pdf states: "Despite increasing understanding of climate change, there still remain questions about the scope and timing of climate change impacts, especially at the local scale where most water-related decisions are made" (EPA 2018b). For estuarine TMDLs in Massachusetts, MassDEP recognizes that this is particularly true, where water quality management decisions and implementation actions are generally made and conducted at the municipal level on a sub-watershed scale.

EPA's Climate Change Strategy identifies the types of research needed to support the goals and strategic actions to respond to climate change. EPA acknowledges that data are missing or not available for making water resource management decisions under changing climate conditions. In addition, EPA recognizes the limitation of current modeling in predicting the pace and magnitude of localized climate change impacts and recommends further exploration of the use of tools, such as atmospheric, precipitation and climate change models, to help states evaluate pollutant load impacts under a range of projected climatic shifts.

In 2013, EPA published the results of a study, "*Watershed Modeling to Assess the Sensitivity of Streamflow, Nutrient, and Sediment Loads to Potential Climate Change and Urban Development in 20 U.S. Watersheds*." (EPA 2013). The watersheds included in the study are not in the Massachusetts Estuary Project (MEP) region, and they have different watershed characteristics, including soils, geography, hydrology, and land use – key components used in a modeling analysis. The initial "first order" conclusion of this study is that, in many locations, future conditions, including water quality, are likely to be different from past experience. However, most significantly, this study did not demonstrate that changes to TMDLs (the water quality restoration targets) would be necessary for the region. EPA's 2012 Climate Change Strategy also acknowledges that the Northeast, including New England, needs to develop standardized regional assumptions regarding future climate change impacts. EPA's 2013 modeling study does not provide the scientific methods and robust datasets needed to predict specific long-term climate change impacts in the MEP region to inform TMDL development.

MassDEP believes that climate change impacts should be addressed through TMDL implementation by employing an adaptive management approach. Adjustments can be made as environmental conditions, pollutant sources or other factors change over time. Massachusetts Coastal Zone Management (CZM) has

developed a StormSmart Coasts Program (2008) to help coastal communities address impacts and effects of erosion, storm surge and flooding which are increasing due to climate change. The program, available at http://www.mass.gov/czm/stormsmart, offers technical information, planning strategies, legal and regulatory tools to communities to adapt to climate change impacts.

As more information and tools become available, there may be opportunities to adjust existing TMDLs to address predictable climate change impacts.

9.0 Monitoring Plan

The long-term monitoring plan for the Islands Watershed includes several components:

1. Continue current monitoring activities in the Islands Watershed,
2. Focus on water bodies where data are insufficient to determine if use criteria are supported,
3. Monitor areas where BMPs and other control strategies have been implemented or discharges have been removed to assess the effectiveness of the action,
4. Assemble data collected by all monitoring entities into a comprehensive report, and
5. Add/remove/modify BMPs as justified based on monitoring results.

A monitoring plan requires flexibility to add, change or delete sampling locations, sampling frequency, methods and analysis, based on results. At the minimum, all monitoring should focus on:

- capturing water quality conditions under varied weather conditions,
- establishing sampling locations to locate potential sources,
- researching new and proven technologies for separating human from animal bacteria sources, and
- assessing efficacy of BMPs.

10.0 Reasonable Assurances

Reasonable assurances that the TMDL will be implemented in the Islands Watershed include application and enforcement of current regulations, availability of financial incentives including low or no-interest loans to communities for wastewater treatment facilities through the State Revolving Fund (SRF), and oversight by the various local, state and federal programs for pollution control. Stormwater NPDES permit coverage is designed to address discharges from municipal-owned stormwater drainage systems. Enforcement of regulations controlling non-point discharges includes local enforcement of the state Wetlands and Rivers Protection Acts, Title 5 regulations for septic systems and various local regulations including zoning regulations. Financial incentives may include federal monies available under the CWA Section 319 NPS program and the CWA Section 604(b) and 104(b)(3) programs. However, 319 Nonpoint Source funds cannot be used for point source remediation, and therefore cannot be used to address the requirements of NPDES stormwater permits. Additional financial incentives include state income tax

credits for Title 5 upgrades, and low interest loans for Title 5 septic system upgrades through municipalities participating in this portion of the state revolving fund program. State monies are also available through the Massachusetts Office of Coastal Zone Management's Coastal Pollutant Remediation, Coastal Nonpoint Source Pollution Control, and Coastal Monitoring grant programs. The primary goal of all three programs is to improve coastal water quality by reducing or eliminating nonpoint sources of pollution.

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

10.1. Overarching Tools

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

Surface Water Quality Standards (314 CMR 4.00): The MA Water Quality Standards (WQS) assign designated uses and establish water quality criteria to meet those uses. Water body classifications (Class A, B, and C, for freshwater and SA, SB, and SC for marine waters) are established to protect each class of designated uses. In addition, bacteria criteria are established for each individual classification.

Ground Water Discharge Permit Program (314 CMR 5.00): This program regulates the discharge of pollutants to the groundwaters of the Commonwealth to assure that groundwaters are protected for their actual and potential uses as sources of potable water, and surface waters are protected for their existing and designated uses and to assure the attainment and maintenance of the MA WQS.

Rivers Protection Act: In 1996 MA passed the Massachusetts Rivers Protection Act (MGL c 258 Acts of 1996; MassDEP 1996). The purposes of the Act were: to protect the private or public water supply; to protect the ground water; to provide flood control; to prevent storm damage; to prevent pollution; to protect land containing shellfish; to protect wildlife habitat; and to protect the fisheries. The provisions of the Act are implemented through the Wetlands Protection Regulations (MassDEP 2014b), which establish up to a 200-foot setback from rivers in the Commonwealth to control construction activities and protect the items listed above. Although this Act does not directly reduce pathogen discharges, it indirectly controls many sources of pathogens close to water bodies. More information on the Rivers Protection Act can be found on MassDEP's web site.

Regulation of Plant Nutrients: In 2012, the Massachusetts Department of Agricultural Resources (MDAR) developed regulations (330 CMR 31.00) to ensure that plant nutrients are applied in an effective manner to provide sufficient nutrients for maintaining healthy agricultural lands, turf and lawns, while minimizing

the impacts of the nutrients on surface and groundwater resources. The regulations include seasonal application restrictions, as well as setbacks from surface waters, public drinking water supplies, and wetlands.

10.2 Additional Tools to Address Failed Septic Systems

Septic System Regulations (Title 5) (310 CMR 15.00): MassDEP has promulgated regulations that require minimum standards for the design of individual septic systems. Those regulations ensure, in part, protection for nearby surface and ground waters from bacterial contamination. The regulations also provide minimum standards for replacing failed and inadequate systems and include a requirement that all septic systems must be inspected and upgraded to meet Title 5 requirements at the time of sale or transfer of the property.

10.3 Additional Tools to Address Stormwater

Stormwater is regulated through both federal and state programs. Those programs include, but are not limited to, the federal and state Phase I and Phase II NPDES stormwater programs, and, at the state level, the Wetlands Protection Act (MGL Chapter 130, Section 40; MassDEP 2014a), the state water quality standards, and the various permitting programs previously identified.

NPDES Phase I & 2 Stormwater Regulations: Existing stormwater discharges are regulated under the NPDES Stormwater Permitting program, Phases I and II. In MA, the two Phase I communities, Boston and Worcester, have been issued individual permits to address stormwater discharges. Phase II is intended to reduce adverse impacts to water quality and aquatic habitat by instituting use controls on the unregulated sources of stormwater discharges that have the greatest likelihood of causing continued environmental degradation, including those from municipal separate storm sewer systems (MS4s) and discharges from construction activity. Any new construction that complies with state stormwater standards and permits is presumed to comply with the anti-degradation requirements of the state water quality standards. The EPA, as part of continued Phase II efforts, has recently issued a new MS4 stormwater permit for towns in Massachusetts which contain areas considered urbanized areas by the 2010 Census. This new MS4 permit became effective in July 2018 (EPA 2018g). None of the communities in the Island Watershed have urbanized areas as defined by the 2010 census and therefore are not subject to the requirements of the recent MS4 permit. Future updates to the MS4 program as appropriate may include the Islands communities.

Stormwater Management Policy: The MassDEP Wetlands regulations (310 CMR 10.0) direct issuing authorities to enforce the MassDEP Stormwater Management Policy, place conditions on the quantity and quality of point source discharges, and to control erosion and sedimentation. The Stormwater Management Policy was issued under the authority of the 310 CMR 10.0. The policy and its accompanying Stormwater Performance Standards apply to new and redevelopment projects where there may be an alteration to a wetland resource area or within 100 feet of a wetland resource (buffer zone). The policy requires the application of structural and/or non-structural BMPs to control suspended solids, which have associated co-benefits for bacteria removal. The Massachusetts

Stormwater Handbook was developed to promote consistent interpretation of the Stormwater Management Policy and Performance Standards: Volumes 1 through 3, can be found at: https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards (MassDEP 2008), and stormwater policies and guidance can be found at http://www.mass.gov/eea/agencies/massdep/water/regulations/water-resources-policies-and-guidance-documents.html#11 (MassDEP 2018e).

10.4 Financial Tools

Nonpoint Source Control Program: The Department has developed the Nonpoint Source Management Program Plan that sets forth an integrated strategy and identifies important programs to prevent, control, and reduce pollution from nonpoint sources and, more importantly, to protect and restore the quality of waters in the Commonwealth; it includes a grant component (MassDEP 2019). Section 319 of the CWA specifies the contents of the management plan, which is an implementation strategy for BMPs, including funding sources and schedules. Statewide implementation of the Management Plan is being accomplished through a wide variety of federal, state, local and non-profit programs and partnerships. It includes partnering with the Massachusetts Coastal Zone Management (CZM) on the implementation of the Section 6217 program under the Coastal Zone Act Reauthorization Amendments of 1990. That program outlines both short and long term strategies to address urban areas and stormwater, marinas and recreational boating, agriculture, forestry, hydromodification, and wetland restoration and assessment. The CZM 6217 program also addresses TMDLs and nitrogen sensitive embayments and was crafted to reduce water quality impairments and restore segments not meeting state standards.

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

Section 319 Program: MassDEP, in conjunction with EPA, administers a grant program to implement nonpoint source BMPs to address water quality goals. The Section 319 grant program funds implementation measures and prioritizes projects that are designed to restore impaired waters (Category 5, ILOW) and to implement TMDLs. MassDEP has funded numerous 319 projects (approximately 75% of all projects funded since 2002) designed to address stormwater and bacteria-related impairments. Under EPA guidance issued in 2003, Section 319 funds cannot be used to address the requirements of NPDES permits, including MS4, Residual Designation, Phase I and Phase II permits. This eliminated funding for most urban water quality restoration projects comparable to some that had previously been funded with Section 319 grants.

The 319 program also funded the development of *The Massachusetts Clean Water Toolkit*, available online at http://prj.geosyntec.com/npsmanual/ (Geosyntec 2016). The Toolkit contains detailed guidance in the form of BMPs by landuse to address various water quality impairments and associated pollutants.

State Revolving Fund: The State Revolving Fund (SRF) Program provides low interest loans to eligible applicants for the abatement of water pollution problems across the Commonwealth. MassDEP has issued millions of dollars in loans for the planning and construction of CSO facilities and to address stormwater pollution.

Loans have been distributed to municipal governments statewide to upgrade and replace failed Title 5 systems. These programs demonstrate the State's commitment to assist local governments in implementing TMDL recommendations. Additional information about the SRF Program may be found on the MassDEP website at: https://www.mass.gov/state-revolving-fund-srf-loan-program (MassDEP 2018f).

In summary, MassDEP's approach and existing programs include a wide variety of tools both MassDEP and communities can use to address bacterial pollution, based on land use and the commonality of pathogen sources (e.g., CSOs, failing septic systems, stormwater and illicit connections, pet waste, etc.) Since there are only a few types of pathogen sources in the Islands Watershed, the necessary remedial actions to address these sources are well established. MassDEP's authority, combined with the programs identified above, provide sufficient reasonable assurance that implementation of remedial actions will take place.

11.0 Public Participation

Two public meetings were held at 3 p.m. and 7 p.m. at the Cape Cod Commission office (CCC), Barnstable on 7/23/2005 to present the Bacteria TMDL and to collect public comments. The public comment period began on July 23, 2005 and ended on August 26, 2005. The attendance list, public comments and the MassDEP responses are attached as Appendix A. The final TMDL will be sent to U.S. EPA Region 1 in Boston for final approval.

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Appendix A Public Participation

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

Public Meeting Announcement Published in the Monitor	7/23/2005
Date of Public Meeting	8/1/2005
Location of Public Meeting	CCC, Barnstable
Times of Public Meeting	3 P.M. and 7 P.M.

ISLANDS WATERSHED DRAFT PATHOGEN TMDL PUBLIC MEETING ATTENDEES

Date 8/1/2005 Time 3 PM

Name	Organization
1. Ed Baker	Mashpee Environmental Coalition
2. Tom Cambareri	Cape Cod Commission
3. Scott Michaud	Cape Cod Commission
4. Mike Hill	EPA
5. Richard Ray	Nantucket Health Department
6. Susan Rohrbach	Senator Robert O'Leary

Date 8/1/2005 Time 7 P.M

Name	Organization
1. Peggy Funtozzi	Nantucket Conservation Commission
2. Mike Hill	EPA
3. Robert Duncansen	Chatham

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

General Comments:

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

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

2. Question: What is the Septic System Program?

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

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

Response: The Massachusetts Surface Water Quality Standards, 314 CMR 4.00 (WQS), do not have any waters designated for "non-contact recreation." All Massachusetts surface waters currently are designated in the WQS for both primary and secondary contact recreation, among other uses. The bacteria criteria protect waters for their most sensitive uses, accordingly, the recreation based bacteria criteria for all Class A, SA, B and SB waters are protective of primary contact recreation. While the WQS do contain C and SC water classifications, with associated criteria, which are described to include waters designated for secondary contact recreation, there are no waters assigned to these classes. The bacteria criteria for Class C fresh waters are: "The geometric mean of all E. coli samples taken within the most recent six months shall not exceed 630 colonies forming units (CFU) per 100 ml, typically based on a minimum of five samples, and 10% of such samples shall not exceed 126 CFU per 100 ml. This criterion may be applied on a seasonal basis at the discretion of the Department."

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

secondary contact recreation is defined to include water contact that is "incidental" so that contact incidental to such activities as boating and fishing would be anticipated.

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

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

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

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

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

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

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

Response: The National Pollutant discharge Elimination System (NPDES) Stormwater Phase II General Permit Program became effective in Massachusetts in March 2003. The municipal separate storm sewer systems (MS4) general permit, was reissued April 2016 and became effective July 1, 2018. The permit requires the regulated entities to develop, implement and enforce a stormwater management program (SWMP) that effectively reduces or prevents the discharge of pollutants into receiving waters to the Maximum Extent Practicable (MEP). Stormwater discharges must also comply with meeting state water quality standards. The Phase II permit uses a best management practice framework and measurable goals to meet MEP and water quality standards. If there is a discharge from the MS4 to a waterbody that is subject to an approved TMDL identified in part 2.2.1 of the re-issued permit, the permittee shall comply with all applicable schedules and requirements for that TMDL listed in Appendix F. If there is a discharge from the MS4 to a waterbody that is water quality limited identified in part 2.2.2 of the re-issued permit, the permittee shall comply with all applicable schedules and requirements for that water quality limited waters listed in Appendix H. A permittees' compliance with its requirements in Appendix F and/or H shall constitute compliance with its requirement to ensure that its discharges do not cause or contribute to an exceedance of water quality standard. As TMDLs are developed and approved, permittees' stormwater management programs and annual reports must include a description of the BMPs that will be used to control the pollutant(s) of concern, to the maximum extent practicable. Annual reports filed by the permittee should highlight the status or progress of control measures currently being implemented or plans for implementation in the future. Records should be kept concerning assessments or inspections of the appropriate control measures and how the pollutant reductions will be met.

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

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

This approach is consistent with current EPA guidance and regulations. As stated in the November 22, 2002 Wayland/Hanlon memorandum, revised November 26, 2014 Sawyer/Best-Wong (TMDL Appendix B), "WQBELs for NPDES-regulated stormwater discharges that implement WLAs in TMDLs may be expressed in the form of best management practices (BMPs) under specified circumstances. See 33 U.S.C. 1342(p)(3)(B)(iii); 40 C.F.R. 122.44(k)(2)&(3)" (TMDL Appendix B). This memorandum goes on to state:

"...because stormwater discharges are due to storm events that are highly variable in frequency and duration and are not easily characterized, only in rare cases will it be feasible or appropriate to establish numeric limits for municipal and small construction stormwater discharges. The variability in the system and minimal data generally available make it difficult to determine with precision or certainty actual or

projected loadings for individual dischargers or groups of dischargers. Therefore, EPA believes that in these situations, permit limits typically can be expressed as BMPs, and that numeric limits will be used only in rare instances" (TMDL Appendix B).

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

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

A more detailed discussion / explanation of this response can be found in TMDL Appendix B, a memorandum titled Revisions to the November 22, 2002 Memorandum "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs" by Andrew Sawyers and Benita Best-Wong (11/26/14).

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

Response: In general, the MassDEP is pursuing a cooperative approach in addressing non-point sources of contamination by bacteria. A total of 247 cities and towns in Massachusetts do have legal requirements to implement best management practices under their general NPDES storm-water permits. In addition, failing septic systems are required to be corrected once the local Board of Health becomes aware of them and at the time of property transfer should required inspections reveal a problem. Other activities, such as farming involving livestock, are the subject of cooperative control efforts through such organizations as the Natural Resources Conservation Service (NRCS) which has a long history of providing both technical advice and matching funds for instituting best management practices on farms. While MassDEP has broad legal authority to address non-point source pollution and enforcement tools available for use for cases of egregious neglect, it intends to fully pursue cooperative efforts which it feels offer the most promise for improving water quality.

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

Response: Part of the Statewide TMDL project was to produce an accompanying TMDL implementation guidance document for all the TMDL reports, "Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Document for MA". There is an entire section in that document (Section D.4) that discusses LID principles and TMDL implementation in detail. There is additional information on LID on the interactive web site for non-point source pollution, *Massachusetts Clean Water Toolkit*, http://prj.geosyntec.com/npsmanual/default.aspx.

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

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

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

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

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

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

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

Response: Proper design and implementation of stormwater systems during construction will address both pre and post-construction runoff issues and thus eliminate future problems. Post-construction runoff is also one of the six minimum control measures that Phase II communities are required to include in their stormwater management program in order to meet the conditions of their National Pollutant Discharge Elimination System (NPDES) permit. In short, Phase II communities are required to:

- Develop and implement strategies which include structural and/or nonstructural best management practices (BMPs);
- Have an ordinance or other regulatory mechanism requiring the implementation of post-construction runoff controls to the extent allowable under State or local law;
- Ensure adequate long-term operation and maintenance controls; and
- Determine the appropriate best management practices (BMPs) and measurable goals for their minimum control measure.

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

It should be noted that there are a number of other permitting programs that regulate pre/post construction run-off including the construction general permit, wetlands requirements and the Mass DEP General Stormwater permit. EPA and MassDEP reissued the MS4 permit in April 2016 with an effective date of July 1, 2018. A full list of MS4 Phase II communities in MA can be found at on the EPA website. This TMDL forms the basis for the implementation plans to meet the Pathogen loading capacity. Although EPA's Phase II MS4 regulations only require a small MS4 to implement its program in the urbanized area subject to permitting, EPA and MassDEP nonetheless encourage permittees, to update and implement their respective SWMPs jurisdiction-wide to further water quality improvements.

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

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

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

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

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

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

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

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

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

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

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

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

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

Response: Because Table 7-1 and 8-1 serve significantly different purposes it was not intended that the tasks needed to align with and exactly address the eight sources of impairment. With regard to pollution sources, it might be more pertinent to compare Table 7-1 with Table 5-1, where it would be appropriate according to geographic location of known potential sources in Table 5-1. Table 8-1 is more of a suggested possible planning tool, matching tasks with potential organizations for action.

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

Response: Failing infrastructure is a very broad term, and is addressed, in part in such discussions as those on leaking sewer pipes, sanitary sewer overflows, and failed septic systems. It should be mentioned that in the Final TMDL reports, information on infrastructure rehabilitation efforts and progress has been expanded in Section 8. It is outside of the scope of the TMDL documents to detail every possible type of infrastructure failure. Nonetheless, additional information is provided in the TMDL companion document titled: "Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Document for Massachusetts."

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

Response: MassDEP and the EPA recognize that the municipalities have done, and are continuing to do, a tremendous amount of work to control bacterial contamination of surface waters. The TMDL has been expanded to provide additional examples of that overall effort. However, the additional discussion is not designed nor intended to include an exhaustive listing of all the work required by each municipality to finalize this effort and provide as status of that work. Programs, such as Phase II Stormwater, require such status reports, and those will be very valuable in assessing priorities and future work. Phase II reports for each community are available on EPAs website: https://www.epa.gov/npdes-permits/2003-small-ms4-general-permit-archives-massachusetts-new-hampshire

20. Comment: There are no milestones to which individual communities should aim (e.g., all stormwater lines upstream of known contamination inspected for illegal connections in five years). As another example, Sections 7 and 8 of each TMDL state that "The strategy includes a mandatory program for implementing stormwater BMPs and eliminating illicit sources" but it is not clear over what timeframe a community should be acting.

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

For example, the Phase II stormwater program, revised permit effective July 1, 2018, establishes a 10-year timeline for each regulated community with specific goals related to the identification and control of illicit pollution sources.

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

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

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

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

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

Response: Please see response to comment #22.

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

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

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

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

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

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

Response: The Mass Highway Department, now officially known as the Massachusetts Department of Transportation (MassDOT), has not been included in the new MS4 permit which became effective 7/1/2018. They are currently covered under the 2003 MS4 permit, and have requested that EPA issue an individual MS4 permit to DOT. EPA plans to include MassDOT under the umbrella of individually issued permittees for facilities such as transportation depots, airports, military facilities and other such enterprise operations. Each of these facility permittees has separate requirements depending on the particular operations that occur at that facility. EPA anticipates a draft permit will go out for public review later this year.

27. Comment: What is the current 303d list of impaired waters?

Response: This TMDL was written to reflect the 2016 303d list, however, the analyses conducted for the bacteria impaired segments in this TMDL would apply to the non-impaired segments, since the sources and their characteristics are equivalent. The concentration waste load and/or load allocation for each source and designated use would be the same as specified in this TMDL. Therefore, the pollution prevention TMDLs would have identical waste load and load allocations based on the sources present and the designated use of the water body segment (see ES-4 and Table 7.1). This Boston Harbor watershed TMDL may, in appropriate circumstances, also apply to segments that are listed for bacteria impairment in future Massachusetts CWA § 303(d) Integrated List of Waters. For such segments, this TMDL may apply if, after listing the waters for bacteria impairment and taking into account all relevant comments

submitted on the CWA § 303(d) list, the Commonwealth determines with EPA approval of the future CWA § 303(d) Integrated List of Waters that this TMDL should apply to newly listed bacteria impaired segments.

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

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

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

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

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

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

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

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

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

Response: Each pathogen TMDL report has a section on implementation which includes a table that generally lists the various tasks and the responsible entity. Most of the implementation tasks will fall on the authority of the municipalities. Probably two of the larger tasks in urban areas include implementing stormwater BMPs and eliminating illicit sources. The MassDEP working with EPA and other team partners shall make every reasonable effort to assure implementation of the TMDLs.

33. Comment: Several watershed groups believe that active and effective implementation and enforcement is essential to carry out the objectives in the pathogen TMDLs. They define effective implementation as the MassDEP partnering with them and municipalities to identify funding

opportunities to develop stormwater management plans, implement Title 5 upgrades, and repair failing sewer infrastructure. The groups define effective enforcement as active MassDEP application of Title 5 regulations and implementation of Stormwater Phase II permitting requirements for Phase II municipalities.

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

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

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

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

Response: In accordance with the EPA regulations governing TMDL requirements, only segments that are included on the state's 303(d) list of impaired waterbodies need to be included in any TMDL. An addendum TMDL will be issued at a later date that will include segments that have been listed as impaired for pathogens after the public notification period.

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

Response: Section 10.0, Reasonable Assurances, should provide these assurances. This section has been drastically expanded in the Final version of the Draft Pathogen TMDL reports. The revised section 10.0 describes all of the appropriate state programs and their enabling statutes and relevant regulations which actively address nonpoint source pollution impacting waters of the Commonwealth. Many of these programs involve municipality first line defense mechanisms such as the Wetlands Protection Act (and the Rivers Protection Act; MassDEP 1996). This expanded section also covers grant programs available to municipalities to control and abate nonpoint source pollution such as 319 grants, 604b grants, 104b(3)

funds, 6,217 coastal nonpoint source grants, low interest loans for septic system upgrades, state revolving fund grants, and many others.

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

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

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

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

Watershed Specific Comments / Responses

There were no written watershed specific comments received by DEP on the Islands watershed pathogen TMDL.

1. Comment:

   Several comments noted that many towns continue strong efforts to control bacteria contamination and other pollution problems within the resources available. Among the comments to this effect were:

Richard Ray, Certified Health Officer, Town of Nantucket, (508) 228-7226:
Nantucket has created two “protection districts” with regard to sewage/septic issues. The first is in the Nantucket Harbor area, the second in the Madaket Harbor area. In the Nantucket Harbor area they have mandated that all septic systems be inspected and be brought up to code. They plan to do the same for Madaket Harbor area. After these two zones are done, the town officials plan to do the same for all other septic systems on the island.

Appendix B EPA Memoranda

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NOV 2 6 2014

OFFICE OF WATER

MEMORANDUM
SUBJECT: Revisions to the November 22, 2002 Memorandum "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Stormwater Sources and NPDES Permit Requirements Based on LAs"
FROM: Andrew D. Sawyers, Director, Office of Wastewater Management
Benita Best-Wong, Director, Office of Wetlands, Oceans and Water
TO: Water Division Directors
Regions 1 - 10

This memorandum updates aspects of EPA's November 22, 2002 memorandum from Robert H. Wayland, III, Director of the Office of Wetlands, Oceans and Watersheds, and James A. Hanlon, Director of the Office of Wastewater Management, on the subject of "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs" (hereafter "2002 memorandum' '). Today's memorandum replaces the November 12, 2010, memorandum on the same subject; the Water Division Directors should no longer refer to that memorandum for guidance.

This memorandum is guidance. It is not a regulation and does not impose legally binding requirements on EPA or States. EPA and state regulatory authorities should continue to make permitting and TMDL decisions on a case-by-case basis considering the particular facts and circumstances and consistent with applicable statutes, regulations, and case law. The recommendations in this guidance may not be applicable to a particular situation. EPA may change or revoke this guidance at any time.

Background
Stormwater discharges are a significant contributor to water quality impairment in this country, and the challenges from these discharges are growing as more land is developed and more impervious surface is created. Stormwater discharges cause beach closures and contaminate shellfish and surface drinking water supplies. The increased volume and velocity of stormwater discharges causes streambank erosion, flooding, sewer overflows, and basement backups. The decreased natural infiltration of rainwater reduces

groundwater recharge, depleting our underground sources of drinking water.[1] There are stormwater management solutions, such as green infrastructure, that can protect our waterbodies from stormwater discharges and, at the same time, offer many other benefits to communities.

Section III of the 2002 memorandum recommended that for NPDES-regulated municipal and small construction stormwater discharges, effluent limits be expressed as best management practices (BMPs) or other similar requirements, rather than as numeric effluent limits. The 2002 memorandum went on to provide guidance on using "an iterative, adaptive management BMP approach" for improving stormwater management over time as permitting agencies, the regulated community, and other involved stakeholders gain more experience and knowledge. EPA continues to support use of an iterative approach, but with greater emphasis on clear, specific, and measurable permit requirements and, where feasible, numeric NPDES permit provisions, as discussed below.

Since 2002, States and EPA have obtained considerable experience in developing TMDLs and WLAs that address stormwater sources (see Box 1 in the attachment for specific examples). Monitoring of the impacts of stormwater discharges on water quality has become more sophisticated and widespread.[2] The experience gained during this time has provided better information on the effectiveness of stormwater controls to reduce pollutant loadings and address water quality impairments. In many parts of the country, permitting agencies have issued several rounds of stormwater permits. Notwithstanding these developments, stormwater discharges remain a significant cause of water quality impairment in many places, highlighting a continuing need for more meaningful WLAs and more clear, specific, and measurable NPDES permit provisions to help restore impaired waters to their beneficial uses.

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[1] See generally Urban Stormwater Management in the United States (National Research Council, 2009), particularly the discussion in Chapter 3, Hydrologic, Geomorphic, and Biological Effects of Urbanization on Watersheds.

[2] Stormwater discharge monitoring programs have expanded the types pollutants and other indices (e.g., biologic integrity) being evaluated. This information is being used to help target priority areas for cleanup and to assess the effectiveness of stormwater BMPs. There are a number of noteworthy monitoring programs that are ongoing, including for example those being carried out by Duluth, MN, Capitol Region Watershed District, MN, Honolulu, HI, Baltimore or Montgomery County, MD, Puget Sound, WA, Los Angeles County, CA, and the Alabama Dept. of Transportation, among many others. See also Section 4.2 (Monitoring/Modeling Requirements) of EPA's Municipal Separate Storm Sewer System Permits: Post-Construction Performance Standards & Water Quality-Based Requirements – A Compendium of Permitting Approaches (EPA, June 2014), or "MS4 Compendium" available at http://water.epa.gov/polwaste/npdes/stormwater/upload/sw_ms4_compendium.pdf, for other examples of note.

With this additional experience in mind, on November 12, 2010, EPA issued a memorandum updating and revising elements of the 2002 memorandum to better reflect current practices and trends in permits and WLAs for stormwater discharges. On March 17, 2011, EPA sought public comment on the November 2010 memorandum and, earlier this year, completed a nationwide review of current practices used in MS4 permits[1] and industrial and construction stormwater discharge permits. As a result of comments received and informed by the reviews of EPA and state-issued stormwater permits, EPA is in this memorandum replacing the November 2010 memorandum, updating aspects of the 2002 memorandum and providing additional information in the following areas:

- Including clear, specific, and measurable permit requirements and, where feasible, numeric effluent limitations in NPDES permits for stormwater discharges;
- Disaggregating stormwater sources in a WLA; and
- Designating additional stormwater sources to regulate and developing permit limits for such sources.

Including Clear, Specific, and Measurable Permit Requirements and, Where Feasible, Numeric Effluent Limitations in NPDES Permits for Stormwater Discharges

At the outset of both the Phase I and Phase II stormwater permit programs, EPA provided guidance on the type of water quality-based effluent limits (WQBELs) that were considered most appropriate for stormwater permits. See Interim Permitting Policy for Water Quality-Based Limitations in Stormwater Permits [61 FR 43761 (August 26, 1996) and 61 FR 57425 (November 6, 1996)] and the Phase II rulemaking preamble 64 FR 68753 (December 8, 1999). Under the approach discussed in these documents, EPA envisioned that in the first two to three rounds of permit issuance, stormwater permits typically would require implementation of increasingly more effective best management practices (BMPs). In subsequent stormwater permit terms, if the BMPs used during prior years were shown to be inadequate to meet the requirements of the Clean Water Act (CWA), including attainment of applicable water quality standards, the permit would need to contain more specific conditions or limitations.

There are many ways to include more effective WQBELs in permits. In the spring of 2014, EPA published the results of a nationwide review of current practices used in MS4 permits *in Municipal Separate Storm Sewer Systems Permits: Post-Construction Performance Standards & Water Quality-Based Requirements – A Compendium of Permitting Approaches* (June 2014). This MS4 Compendium demonstrates how NPDES authorities have been able to effectively establish permit requirements that are more specifically tied to a measurable water quality target, and includes examples of permit requirements expressed in both numeric and non-numeric form.

[1] See EPA's MS4 Permit Compendium, referenced in the above footnote.

These approaches, while appropriately permit-specific, each share the attribute of being expressed in a clear, specific, and measurable way. For example, EPA found a number of permits that employ numeric, retention-based performance standards for post-construction discharges, as well as instances where permits have effectively incorporated numeric effluent limits or other quantifiable measures to address water quality impairment (see the attachment to this memorandum).

EPA has also found examples where the applicable WLAs have been translated into BMPs, which are required to be implemented during the permit term to reflect reasonable further progress towards meeting the applicable water quality standard (WQS). Incorporating greater specificity and clarity echoes the approach first advanced by EPA in the 1996 Interim Permitting Policy, which anticipated that where necessary to address water quality concerns, permits would be modified in subsequent terms to include "more specific conditions or limitations [which] may include an integrated suite of BMPs, performance objectives, narrative standards, monitoring triggers, numeric WQBELs, action levels, etc."

EPA also recently completed a review of state-issued NPDES industrial and construction permits, which also revealed a number of examples where WQBELs are expressed using clear, specific, and measurable terms. Permits are exhibiting a number of different approaches, not unlike the types of provisions shown in the MS4 Compendium. For example, some permits are requiring as an effluent limitation compliance with a numeric or narrative WQS, while others require the implementation of specific BMPs that reduce the discharge of the pollutant of concern as necessary to meet applicable WQS or to implement a WLA and/or are requiring their permittees to conduct stormwater monitoring to ensure the effectiveness of those BMPs. EPA intends to publish a compendium of permitting approaches in state-issued industrial and construction stormwater permits in early 2015.

Permits for MS4 Discharges

The CWA provides that stormwater permits for MS4 discharges "shall require controls to reduce the discharge of pollutants to the maximum extent practicable … and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants." CWA section 402(p)(3)(B)(iii). Under this provision, the NPDES permitting authority has the discretion to include requirements for reducing pollutants in stormwater discharges as necessary for compliance with water quality standards. Defenders of Wildlife v. Browner, 191 F.3d 1159, 1166 (9th Cir. 1999).

The 2002 memorandum stated "EPA expects that most WQBELs for NPDES-regulated municipal and small construction stormwater discharges will be in the form of BMPs, and that numeric limitations will be used only in rare instances." As demonstrated in the MS4 Compendium, NPDES permitting authorities are using various forms of clear, specific, and measurable requirements, and, where feasible, numeric effluent limitations in order to establish a more objective and accountable means for reducing pollutant discharges

that contribute to water quality problems.[1] Where the NPDES authority determines that MS4 discharges have the reasonable potential to cause or contribute to a water quality standard excursion, EPA recommends that the NPDES permitting authority exercise its discretion to include clear, specific, and measurable permit requirements and, where feasible, numeric effluent limitations[2] as necessary to meet water quality standards.

NPDES authorities have significant flexibility in how they express WQBELs in MS4 permits (see examples in Box 1 of the attachment). WQBELs in MS4 permits can be expressed as system-wide requirements rather than as individual discharge location requirements such as effluent limitations on discharges from individual outfalls. Moreover, the inclusion of numeric limitations in an MS4 permit does not, by itself, mandate the type of controls that a permittee will use to meet the limitation.

EPA recommends that NPDES permitting authorities establish clear, specific, and measurable permit requirements to implement the minimum control measures in MS4 permits. With respect to requirements for post-construction stormwater management, consistent with guidance in the 1999 Phase II Rule, EPA recommends, where feasible and appropriate, numeric requirements that attempt to maintain pre-development runoff conditions (40 CFR § 122.34(b)(5)) be incorporated into MS4 permits. EPA's MS4 Compendium features examples from 17 states and the District of Columbia that have already implemented retention performance standards for newly developed and redeveloped sites. See Box 2 of the attachment for examples.

Permits for Industrial Stormwater Discharges

The CWA requires that permits for stormwater discharges associated with industrial activity comply with section 301 of the Act, including the requirement under section 301(b)(1)(C) to contain WQBELs to achieve

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[1] The MS4 Compendium presents examples of different permitting approaches that EPA has found during a nationwide review of state MS4 permits. Examples of different WQBEL approaches in the MS4 Compendium include permits that have (1) a list of applicable TMDLs, WLAs, and the affected MS4s; (2) numeric limits and other quantifiable approaches for specific pollutants of concern; (3) requirements to implement specific stormwater controls or management measures to meet the applicable WLA; (4) permitting authority review and approval of TMDL plans; (5) specific impaired waters monitoring and modeling requirements; and (6) requirements for discharges to impaired waters prior to TMDL approval.

[2] For the purpose of this memorandum, and in the context of NPDES permits for stormwater discharges, "numeric" effluent limitations refer to limitations with a quantifiable or measurable parameter related to a pollutant (or pollutants). Numeric WQBELs may include other types of numeric limits in addition to end-of-pipe limits. Numeric WQBELs may include, among others, limits on pollutant discharges by specifying parameters such as on-site stormwater retention volume or percentage or amount of effective impervious cover, as well as the more traditional pollutant concentration limits and pollutant loads in the discharge.

water quality standards for any discharge that the permitting authority determines has the reasonable potential to cause or contribute to a water quality standard excursion. CWA section 402(p)(3)(A), 40 CFR § 122.44(d)(1)(iii). When the permitting authority determines, using the procedures specified at 40 CFR § 122.44(d)(1)(ii), that the discharge causes or has the reasonable potential to cause or contribute to an in-stream excursion of the water quality standards, the permit must contain WQBELs as stringent as necessary to meet any applicable water quality standard for that pollutant. EPA recommends that NPDES permitting authorities use the experience gained in developing WQBELs to design effective permit conditions to create objective and accountable means for controlling stormwater discharges. See box 3 in the attachment for examples.

Permits should contain clear, specific, and measurable elements associated with BMP implementation (e.g., schedule for BMP installation, frequency of a practice, or level of BMP performance), as appropriate, and should be supported by documentation that implementation of selected BMPs will result in achievement of water quality standards. Permitting authorities should also consider including numeric benchmarks for BMPs and associated monitoring protocols for estimating BMP effectiveness in stormwater permits. Benchmarks can support an adaptive approach to meeting applicable water quality standards. While exceeding the benchmark is not generally a permit violation, exceeding the benchmark would typically require the permittee to take additional action, such as evaluating the effectiveness of the BMPs, implementing and/or modifying BMPs, or providing additional measures to protect water quality.[1] Permitting authorities should consider structuring the permit to clarify that failure to implement required corrective action, including a corrective action for exceeding a benchmark, is a permit violation. EPA notes that, as many stormwater discharges are authorized under a general permit, NPDES authorities may find it more appropriate where resources allow to issue individual permits that are better tailored to meeting water quality standards for large industrial stormwater discharges with more complex stormwater management features, such as multiple outfalls and multiple entities responsible for permit compliance.

<u>All Permitted Stormwater Discharges</u>

As stated in the 2002 memorandum, where a State or EPA has established a TMDL, NPDES permits must contain effluent limits and conditions consistent with the assumptions and requirements of the WLAs in the TMDL. See 40 CFR § 122.44(d)(1)(vii)(B). Where the TMDL includes WLAs for stormwater sources that provide numeric pollutant loads, the WLA should, where feasible, be translated into effective, measurable

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[1] For example, Part 6.2.1 of EPA's 2008 MSGP provides: "This permit stipulates pollutant benchmark concentrations that may be applicable to your discharge. The benchmark concentrations are not effluent limitations; a benchmark exceedance, therefore, is not a permit violation. Benchmark monitoring data are primarily for your use to determine the overall effectiveness of your control measures and to assist you in knowing when additional corrective action(s) may be necessary to comply with the effluent limitations …"

WQBELs that will achieve this objective. This could take the form of a numeric limit, or of a measurable, objective BMP-based limit that is projected to achieve the WLA. For MS4 discharges, CWA section 402(p)(3)(B)(iii) provides flexibility for NPDES authorities to set appropriate deadlines for meeting WQBELs consistent with the requirements for compliance schedules in NPDES permits set forth in 40 CFR § 122.47.

The permitting authority's decision as to how to express the WQBEL(s), either as numeric effluent limitations or as BMPs, with clear, specific, and measurable elements, should be based on an analysis of the specific facts and circumstances surrounding the permit, and/or the underlying WLA, including the nature of the stormwater discharge, available data, modeling results, and other relevant information. As discussed in the 2002 memorandum, the permit's administrative record needs to provide an adequate demonstration that, where a BMP-based approach to permit limitations is selected, the BMPs required by the permit will be sufficient to implement applicable WLAs. Permits should also include milestones or other mechanisms where needed to ensure that the progress of implementing BMPs can be tracked. Improved knowledge of BMP effectiveness gained since 2002[1] should be reflected in the demonstration and supporting rationale that implementation of the BMPs will attain water quality standards and be consistent with WLAs.

EPA's regulations at 40 CFR § 122.47 govern the use of compliance schedules in NPDES permits. Central among the requirements is that the effluent limitation(s) must be met "as soon as possible." 40 CFR § 122.47(a)(1). As previously discussed, by providing discretion to include "such other provisions" as deemed appropriate, CWA section 402(p)(3)(B)(iii) provides flexibility for NPDES authorities to set appropriate deadlines towards meeting WQBELs in MS4 permits consistent with the requirements for compliance schedules in NPDES permits set forth in 40 CFR § 122.47. See Defenders of Wildlife v Browner, 191 F.3d at 1166. EPA expects the permitting authority to document in the permit record the basis for determining that the compliance schedule is "appropriate" and consistent with the CWA and 40 CFR § 122.47. Where a TMDL has been established and there is an accompanying implementation plan that provides a schedule for an MS4 to implement the TMDL, or where a comprehensive, integrated plan addressing a municipal government's wastewater and stormwater obligations under the NPDES program has been developed, the permitting authority should consider such schedules as it decides whether and how to establish enforceable interim requirements and interim dates in the permit.

EPA notes that many permitted stormwater discharges are covered by general permits. Permitting authorities should consider and build into general permits requirements to ensure that permittees take actions necessary to meet the WLAs in approved TMDLs and address impaired waters. A general permit

[1] See compilation of current BMP databases and summary reports available at http://water.epa.gov/infrastructure/greeninfrastructure/gi_performance.cfm, which has compiled current BMP databases and summary reports.

can, for example, identify permittees subject to applicable TMDLs in an appendix, and prescribe the activities that are required to meet an applicable WLA.

Lastly, NPDES permits must specify monitoring requirements necessary to determine compliance with effluent limitations. See CWA section 402(a)(2); 40 CFR 122.44(i). The permit could specify actions that the permittee must take if the BMPs are not performing properly or meeting expected load reductions. When developing monitoring requirements, the NPDES authority should consider the variable nature of stormwater as well as the availability of reliable and applicable field data describing the treatment efficiencies of the BMPs required and supporting modeling analysis.

Disaggregating Stormwater Sources in a WLA

In the 2002 memorandum, EPA said it "may be reasonable to express allocations for NPDES-regulated stormwater discharges from multiple point sources as a single categorical wasteload allocation when data and information are insufficient to assign each source or outfall individual WLAs." EPA also said that, "[i]n cases where wasteload allocations are developed for categories of discharges, these categories should be defined as narrowly as available information allows." Furthermore, EPA said it "recognizes that the available data and information usually are not detailed enough to determine waste load allocations for NPDES-regulated stormwater discharges on an outfall-specific basis."

EPA still recognizes that "[d]ecisions about allocations of pollutant loads within a TMDL are driven by the quantity and quality of existing and readily available water quality data," but has noted the difficulty of establishing clear, specific, and measurable NPDES permit limitations for sources covered by WLAs that are expressed as single categorical or aggregated wasteload allocations. Today, TMDL writers may have more information—such as more ambient monitoring data, better spatial and temporal representation of stormwater sources, and/or more permit-generated data—than they did in 2002 to develop more disaggregated TMDL WLAs.

Accordingly, for all these reasons, EPA is again recommending that, "when information allows," WLAs for NPDES-regulated stormwater discharges be expressed "as different WLAs for different identifiable categories" (e.g., separate WLAs for MS4 and industrial stormwater discharges). In addition, as EPA said in 2002, "[t]hese categories should be defined as narrowly as available information allows (e.g., for municipalities, separate WLAs for each municipality and for industrial sources, separate WLAs for different types of industrial stormwater sources or dischargers)." EPA does not expect states to assign WLAs to individual MS4 outfalls; however, some states may choose to do so to support their implementation efforts. These recommendations are consistent with the decision in Anacostia Riverkeeper, Inc. v. Jackson, 2011 U.S. Dist. Lexis 80316 (July 25, 2011).

In general, states are encouraged to disaggregate the WLA when circumstances allow to facilitate implementation. TMDL writers may want to consult with permit writers and local authorities to collect additional information such as sewer locations, MS4 jurisdictional boundaries, land use and growth

projections, and locations of stormwater controls and infrastructure, to facilitate disaggregation. TMDLs have used different approaches to disaggregate stormwater to facilitate MS4 permit development that is consistent with the assumptions and requirements of the WLA. For example, some TMDLs have used a geographic approach and developed individual WLAs by subwatershed[1] or MS4 boundary (i.e., the WLA is subdivided by the relative estimated load contribution to the subwatershed or the area served by the MS4). TMDLs have also assigned percent reductions[2] of the loading based on the estimated wasteload contribution from each MS4 permit holder. Where appropriate, EPA encourages permit writers to identify specific shares of an applicable wasteload allocation for specific permittees during the permitting process, as permit writers may have more detailed information than TMDL writers to effectively identify reductions for specific sources.

Designating Additional Stormwater Sources to Regulate and Developing Permit Limits for Such Sources

The 2002 memorandum states that "stormwater discharges from sources that are not currently subject to NPDES regulation may be addressed by the load allocation component of a TMDL." Section 402(p)(2) of the Clean Water Act (CWA) requires industrial stormwater sources, certain municipal separate storm sewer systems, and other designated sources to be subject to NPDES permits. Section 402(p)(6) provides EPA with authority to identify additional stormwater discharges as needing a permit.

In addition to the stormwater discharges specifically identified as needing an NPDES permit, the CWA and the NPDES regulations allow for EPA and NPDES authorized States to designate additional stormwater discharges for regulation. See: 40 CFR §§122.26 (a)(9)(i)(C), (a)(9)(i)(D), (b)(4)(iii), (b)(7)(iii), (b)(15)(ii) and 122.32(a)(2). Accordingly, EPA encourages permitting authorities to consider designation of stormwater sources in situations where coverage under NPDES permits would, in the reasonable judgment of the permitting authority and, considering the facts and circumstances in the waterbody, provide the most appropriate mechanism for implementing the pollution controls needed within a watershed to attain and maintain applicable water quality standards.

If a TMDL had previously included a newly permitted source as part of a single aggregated or gross load allocation for all unregulated stormwater sources, or all unregulated sources in a specific category, the NPDES permit authority could identify an appropriate allocation share and include a corresponding

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[1] Wissahickon Creek Siltation TMDL (Pennsylvania) www.epa.gov/reg3wapd/tmdl/pa_tmdl/wissahickon/index.htm.

[2] Liberty Bay Watershed Fecal Coliform Bacteria TMDL (Washington). https://fortress.wa.gov/ecy/publications/SummaryPages/1310014.html and Upper Minnehaha Creek Watershed Nutrients and Bacteria TMDL (Minnesota) http://www.pca.state.mn.us/index.php/view-document.html?gid=20792

limitation specific to the newly permitted stormwater source. EPA recommends that any additional analysis used to identify that share and develop the corresponding limit be included in the administrative record for the permit. The permit writer's additional analysis would not change the TMDL, including its overall loading cap.

In situations where a stormwater source addressed in a TMDL's load allocation is not currently regulated by an NPDES permit but may be required to obtain an NPDES permit in the future, the TMDL writer should consider including language in the TMDL explaining that the allocation for the stormwater source is expressed in the TMDL as a "load allocation" contingent on the source remaining unpermitted, but that the "load allocation" would later be deemed a "wasteload allocation" if the stormwater discharge from the source were required to obtain NPDES permit coverage. Such language would help ensure that the allocation is properly characterized by the permit writer should the source's regulatory status change. This will help the permit writer develop limitations for the NPDES permit applicable to the newly permitted source that are consistent with the assumptions and requirements of the TMDL's allocation to that source.

If you have any questions please feel free to contact us or Deborah Nagle, Director of the Water Permits Division, or Tom Wall, Director of the Assessment and Watershed Protection Division.

cc: Association of Clean Water Administrators
TMDL Program Branch Chiefs, Regions 1 – 10
NPDES Permits Branch Chiefs, Regions 1 – 10

ATTACHMENT: MS4 and Industrial Stormwater Permit Examples

BOX 1. Examples of WQBELs in MS4 Permits:

1. Numeric expression of the WQBEL: The MS4 Permit includes a specific, quantifiable performance requirement that must be achieved within a set timeframe. For example: -
    - Reduce fine sediment particles, total phosphorus, and total nitrogen loads by 10 percent, 7 percent, and 8 percent, respectively, by September 30, 2016 (2011 Lake Tahoe, CA MS4 permit).
    - Restore within the 5-year permit term 20 percent of the previously developed impervious land (2014 Prince George's County, MD MS4 permit).
    - Achieve a minimum net annual planting rate of 4,150 planting annually within the MS4 area, with the objective of an MS4-wide urban tree canopy of 40 percent by 2035 (2011 Washington, DC MS4 permit).
    - Discharges from the MS4 must not cause or contribute to exceedances of receiving water limits for Diazinon of 0.08µg/L for acute exposure (1 hr averaging period) or 0.05µg/L for chronic exposure (4-day averaging period), OR must not exceed Diazinon discharge limits of 0.072 µg/L for acute exposure or 0.045µg/L for chronic exposure (2013 San Diego, CA Regional MS4 permit).

2. Non-numeric expressions of the WQBEL: The MS4 Permit establishes individualized, watershed-based requirements that require each affected MS4 to implement specific BMPs within the permit term, which will ensure reasonable further progress towards meeting applicable water quality standards.

- To implement the corrective action recommendations of the Issaquah Creek Basin Water Cleanup Plan for Fecal Coliform Bacteria (part of the approved Fecal Coliform Bacteria TMDL for the Issaquah Creek Basin), King County is required during the permit term to install and maintain animal waste education and/or collection stations at municipal parks and other permittee owned and operated lands reasonably expected to have substantial domestic animal use and the potential for stormwater pollution. The County is also required to complete IDDE screening for bacteria sources in 50 percent of the MS4 subbasins, including rural MS4 subbasins, by February 2, 2017 and implement the activities identified in the Phase I permit for responding to any illicit discharges found (2013 Western Washington Small MS4 General Permit)

For discharges to Segment 14 of the Upper South Platte River Basin associated with WLAs from the approved *E. coli* TMDL, the MS4 must identify outfalls with dry weather flows; monitor priority outfalls for flow rates and *E. coli* densities; implement a system maintenance program for listed priority basins (which includes storm sewer cleaning and sanitary sewer investigations); install markers on at least 90% of storm drain inlets in areas with public access; and conduct a public outreach program focused on sources that contribute *E. coli* loads to the MS4. By November 30, 2018, dry weather discharges from MS4 outfalls of concern must not contribute to an exceedance of the *E. coli* standard (126 CFU per 100 ml for

a geometric mean of all samples collected at a specific outfall in a 30-day period) (2009 Denver, CO MS4 Permit).

3. Hybrid approach with both numeric and non-numeric expressions of the WQBEL: - Discharges of trash from the MS4 to the LA River must be reduced to zero by Sept. 2016. Permittees also have the option of complying via the installation of defined "full capture systems" to prevent trash from entering the MS4 (2012 Los Angeles County, CA MS4 Permit). - To attain the shared, load allocation of 27,000 metric tons/year of sediment in the Napa River sediment TMDL, municipalities shall determine opportunities to retrofit and/or reconstruction of road crossings to minimize road-related sediment delivery (≤ 500 cubic yards/mile per 20-year period) to stream channels (2013 CA Small MS4 General Permit).

Box 2. Examples of Retention Post Construction Standards for New and Redevelopment in MS4 Permits

- 2009 WV small MS4 permit: Keep and manage on site the first one inch of rainfall from a 24-hour storm preceded by 48 hours of no measurable precipitation.
- 2011 DC Phase I MS4 permit: Achieve on-site retention of 1.2" of stormwater from a 24-hour storm with a 72-hour antecedent dry period through evapotranspiration, infiltration and/or stormwater harvesting.
- 2012 Albuquerque, NM Phase I MS4 permit: Capture the 90th percentile storm event runoff to mimic the predevelopment hydrology of the previously undeveloped site.
- 2010 Anchorage, AK Phase I MS4 permit: Keep and manage the runoff generated from the first 0.52 inches of rainfall from a 24 hour event preceded by 48 hours of no measureable precipitation. - 2013 Western WA small MS4 permit: Implement low impact development performance standards to match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 8% of the 2-year flow to 50% of the 2-year flow.

BOX 3. Examples of WQBELs in Industrial (including Construction) Stormwater Permits:

1. Numeric expression of the WQBEL: The permit includes a specific, quantifiable performance requirement that must be achieved:

- Pollutant concentrations shall not exceed the stormwater discharge limits specified in the permit (based on state WQS), including (for example): Cadmium-0.003 mg/l; Mercury-0.0024 mg/l; Selenium-0.02 mg/l (2013 Hawaii MSGP)
- Beginning July 1, 2010, permittees discharging to impaired waters without an EPA-approved TMDL shall comply with the following effluent limits (based on state WQS), including (for example):

Turbidity-25 NTU; TSS-30 mg/l; Mercury-0.0021 mg/l; Phosphorus, Ammonia, Lead, Copper, Zinc-site-specific limits to be determined at time of permit coverage (2010 Washington MSGP) - If discharging to waters on the 303(d) list (Category 5) impaired for turbidity, fine sediment, or phosphorus, the discharge must comply with the following effluent limit for turbidity: 25 NTU (at the point of discharge from the site), or no more than 5 NTU above background turbidity when the background turbidity is 50 NTU or less, or no more than a 10% increase in turbidity when background turbidity is more than 50 NTU. Discharges to waterbodies on the 303(d) list (Category 5) for high pH must comply with the numeric effluent limit of pH 6.5 to 8.5 su (2010 Washington CGP) (2010 Washington CGP)

2. Narrative expression of the WQBEL: The permit includes narrative effluent limits based on applicable WQS:

- New discharges or new dischargers to an impaired water are not eligible for permit coverage, unless documentation or data exists to show that (1) all exposure of the pollutant(s) of concern to stormwater is prevented; or (2) the pollutant(s) of concern are not present at the facility; or (3) the discharge of the pollutant(s) of concern will meet instream water quality criteria at the point of discharge (for waters without an EPA-approved TMDL), or there is sufficient remaining WLAs in an EPA-approved TMDL to allow the discharge and that existing dischargers are subject to compliance schedules to bring the waterbody into attainment with WQS (2011 Vermont MSGP; similar requirements in RI, NY, MD, VA, WV, SC, AR, TX, KS, NE, AZ, CA, AK, OR, and WA permits)

- In addition to other applicable WQBELs, there shall be no discharge that causes visible oil sheen, and no discharge of floating solids or persistent foam in other than trace amounts. Persistent foam is foam that does not dissipate within one half hour of point of discharge (2014 Maryland MSGP)

3. Requirement to implement additional practices or procedures for discharges to impaired waters:

- For sediment-impaired waters (without an approved TMDL), the permittee is required to maintain a minimum 50-foot buffer zone between any disturbance and all edges of the receiving water (2009 Kentucky CGP)

- For discharges to impaired waters, implement the following: (1) stabilization of all exposed soil areas immediately, but in no case later than 7 days after the construction activity in that portion of the site has temporarily or permanently ceased (as compared to 14 days for no-impaired waters); (2) temporary sediment basins must meet specified design standards if they will serve an area of 5 or more acres (as compared to 10 or more acres for other sites); (3) retain a water quality volume of 1 inch of runoff from the new impervious surfaces created by the project (though this volume reduction requirement is for discharges to all waters, not just impaired waters) (2013 Minnesota CGP).

- If the site discharges to a water impaired for sediment or turbidity, or to a water subject to an EPA-approved TMDL, the permittee must implement one or more of the following practices: (1) compost berms, compost blankets, or compost socks; (2) erosion control mats; (3) tackifiers used with a perimeter control BMP; (4) a natural buffer of 50 feet (horizontally) plus 25 feet (horizontally) for 5 degrees of slope; (5) water treatment by electro-coagulation, flocculation, or filtration; and/or (6) other substantially equivalent sediment or turbidity BMP approved by the state (2010 Oregon CGP)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460
OFFICE OF WATER
MEMORANDUM
SUBJECT: Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs
FROM: Robert H. Wayland, III, Director
Office of Wetlands, Oceans and Watersheds
James A. Hanlon, Director
Office of Wastewater Management
TO: Water Division Directors
Regions 1 - 10

This memorandum clarifies existing EPA regulatory requirements for, and provides guidance on, establishing wasteload allocations (WLAs) for stormwater discharges in total maximum daily loads (TMDLs) approved or established by EPA. It also addresses the establishment of water quality-based effluent limits (WQBELs) and conditions in National Pollutant Discharge Elimination System (NPDES) permits based on the WLAs for stormwater discharges in TMDLs. The key points presented in this memorandum are as follows:

NPDES-regulated stormwater discharges must be addressed by the wasteload allocation component of a TMDL. See 40 C.F.R. § 130.2(h).
NPDES-regulated stormwater discharges may not be addressed by the load allocation (LA) component of a TMDL. See 40 C.F.R. § 130.2 (g) & (h).
Stormwater discharges from sources that are not currently subject to NPDES regulation may be addressed by the load allocation component of a TMDL. See 40 C.F.R. § 130.2(g).
It may be reasonable to express allocations for NPDES-regulated stormwater discharges from multiple point sources as a single categorical wasteload allocation when data and information are insufficient to assign each source or outfall individual WLAs. See 40 C.F.R. § 130.2(i). In cases where wasteload allocations are developed for categories of discharges, these categories should be defined as narrowly as available information allows.
The WLAs and LAs are to be expressed in numeric form in the TMDL. See 40 C.F.R. § 130.2(h) & (i). EPA expects TMDL authorities to make separate allocations to NPDES- regulated stormwater discharges (in the form of WLAs) and unregulated stormwater (in the form of LAs). EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability in the system.
NPDES permit conditions must be consistent with the assumptions and requirements of available WLAs. See 40 C.F.R. § 122.44(d)(1)(vii)(B).
WQBELs for NPDES-regulated stormwater discharges that implement WLAs in TMDLs may be expressed in the form of best management practices (BMPs) under specified circumstances. See 33 U.S.C.

§1342(p)(3)(B)(iii); 40 C.F.R. §122.44(k)(2)&(3). If BMPs alone adequately implement the WLAs, then additional controls are not necessary.

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

The NPDES permit must also specify the monitoring necessary to determine compliance with effluent limitations. See 40 C.F.R. § 122.44(i). Where effluent limits are specified as BMPs, the permit should also specify the monitoring necessary to assess if the expected load reductions attributed to BMP implementation are achieved (e.g., BMP performance data). The permit should also provide a mechanism to make adjustments to the required BMPs as necessary to ensure their adequate performance.
This memorandum is organized as follows:
(I). Regulatory basis for including NPDES-regulated stormwater discharges in WLAs in TMDLs;
(II). Options for addressing stormwater in TMDLs; and
(III). Determining effluent limits in NPDES permits for stormwater discharges consistent with the WLA
I). Regulatory Basis for Including NPDES-regulated Stormwater Discharges in WLAs in TMDLs
As part of the 1987 amendments to the CWA, Congress added Section 402(p) to the Act to cover discharges composed entirely of stormwater. Section 402(p)(2) of the Act requires permit coverage for discharges associated with industrial activity and discharges from large and medium municipal separate storm sewer systems (MS4), i.e., systems serving a population over 250,000 or systems serving a population between 100,000 and 250,000, respectively. These discharges are referred to as Phase I MS4 discharges.

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

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

Administrator or the State determines appropriate for the control of such pollutants." See 33 U.S.C. §1342(p)(3)(B)(iii).

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

(II). Options for Addressing Stormwater in TMDLs

Decisions about allocations of pollutant loads within a TMDL are driven by the quantity and quality of existing and readily available water quality data. The amount of stormwater data available for a TMDL varies from location to location. Nevertheless, EPA expects TMDL authorities will make separate aggregate allocations to NPDES-regulated stormwater discharges (in the form of WLAs) and unregulated stormwater (in the form of LAs). It may be reasonable to quantify the allocations through estimates or extrapolations, based either on knowledge of land use patterns and associated literature values for pollutant loadings or on actual, albeit limited, loading information. EPA recognizes that these allocations might be fairly rudimentary because of data limitations.

EPA also recognizes that the available data and information usually are not detailed enough to determine waste load allocations for NPDES-regulated stormwater discharges on an outfall-specific basis. In this situation, EPA recommends expressing the wasteload allocation in the TMDL as either a single number for all NPDES-regulated stormwater discharges, or when information allows, as different WLAs for different identifiable categories, e.g., municipal stormwater as distinguished from stormwater discharges from construction sites or municipal stormwater discharges from City A as distinguished from City B. These categories should be defined as narrowly as available information allows (e.g., for municipalities, separate WLAs for each municipality and for industrial sources, separate WLAs for different types of industrial stormwater sources or dischargers).

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

Where a TMDL has been approved, NPDES permits must contain effluent limits and conditions consistent with the requirements and assumptions of the wasteload allocations in the TMDL. See 40 CFR § 122.44(d)(1)(vii)(B). Effluent limitations to control the discharge of pollutants generally are expressed in numerical form. However, in light of 33 U.S.C. §1342(p)(3)(B)(iii), EPA recommends that for NPDES-regulated municipal and small construction stormwater discharges effluent limits should be expressed as best management practices (BMPs) or other similar requirements, rather than as numeric effluent limits. See Interim Permitting Approach for Water Quality-Based Effluent Limitations in Stormwater Permits, 61 FR 43761 (Aug. 26, 1996). The Interim Permitting Approach Policy recognizes the need for an iterative approach to control pollutants in stormwater discharges. Specifically, the policy anticipates that a suite of

BMPs will be used in the initial rounds of permits and that these BMPs will be tailored in subsequent rounds.

EPA's policy recognizes that because stormwater discharges are due to storm events that are highly variable in frequency and duration and are not easily characterized, only in rare cases will it be feasible or appropriate to establish numeric limits for municipal and small construction stormwater discharges. The variability in the system and minimal data generally available make it difficult to determine with precision or certainty actual and projected loadings for individual dischargers or groups of dischargers. Therefore, EPA believes that in these situations, permit limits typically can be expressed as BMPs, and that numeric limits will be used only in rare instances.

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

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

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

The policy outlined in this memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and non-structural BMPs) that address stormwater discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as

necessary to protect water quality. This approach is further supported by the recent report from the National Research Council (NRC), Assessing the TMDL Approach to Water Quality Management (National Academy Press, 2001). The NRC report recommends an approach that includes "adaptive implementation," i.e., "a cyclical process in which TMDL plans are periodically assessed for their achievement of water quality standards" ... and adjustments made as necessary. NRC Report at ES-5.

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

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

cc:
Water Quality Branch Chiefs
Regions 1 - 10
Permit Branch Chiefs
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Appendix C: MA DPH Beach Posting Data (2005-2013) for Islands Watershed Segments

(MA DPH 2014, years highlighted in bold had greater than 10% of sampling season with beach closure, obsolete in beach name indicates sampling has been discontinued)

Table C1: Summary of MA DPH Posting Data (2005-2013) for Islands TMDL Study Area

Segment	Segment Name	Beach Name	Id	Town	2005	2006	2007	2008	2009	2010	2011	2012	2013
MA97-01	Nantucket Harbor	Children's	2998	Nantucket	0%	3%	0%	0%	0%	4%	0%	***20%***	1%
MA97-01	Nantucket Harbor	Washington Street	3010	Nantucket	1%	3%	0%	1%	***23%***	4%	0%	3%	3%
MA97-01	Nantucket Harbor	Wauwinet Bayside	5446	Nantucket				7%	0%	3%	0%	0%	0%
MA97-05	Chilmark Pond	Pond @ Lucy Vincent Beach	2719	Chilmark	0%	0%	0%	5%	0%	***40%***	***31%***	***41%***	***86%***
MA97-06	Menemsha Pond	Red Beach	3246	Aquinnah	0%	0%	0%	0%	1%	0%	0%	0%	0%
MA97-09	Vineyard Haven Harbor	Eastville Town Beach - Lagoon side	3038	Oak Bluffs	0%	0%	0%	0%	0%	5%	7%	1%	7%
MA97-09	Vineyard Haven Harbor	[obsolete]Eastville Road	3040	Oak Bluffs									
MA97-09	Vineyard Haven Harbor	Owen Park	3144	Tisbury	0%	0%	0%	0%	0%	0%	0%	0%	0%
MA97-09	Vineyard Haven Harbor	Owen Little Way	3145	Tisbury	0%	0%	0%	9%	0%	6%	0%	0%	3%
MA97-09	Vineyard Haven Harbor	Vineyard Harbor Motel	3148	Tisbury		0%	3%	0%	6%	4%	1%	0%	0%
MA97-09	Vineyard Haven Harbor	[uses surrogate] Vineyard Haven Yacht Club	3149	Tisbury									
MA97-10	Sengekontacket Pond	[obsolete] Felix Neck	2807	Edgartown	0%	0%							
MA97-10	Sengekontacket Pond	[obsolete] Pecoy Point Preserve Beach	5453	Oak Bluffs				0%	0%	***18%***			
MA97-11	Lagoon Pond	Medeiros Cove (Sailing Camp)	3033	Oak Bluffs	0%	0%	0%	0%	0%	2%	9%	***11%***	7%
MA97-11	Lagoon Pond	[obsolete] Lagoon Pond Herring Run	3034	Oak Bluffs	0%	0%	0%						

Segment	Segment Name	Beach Name	Id	Town	2005	2006	2007	2008	2009	2010	2011	2012	2013
MA97-11	Lagoon Pond	Eastville Town Beach - Harbor side	3037	Oak Bluffs	0%	0%	0%	0%	0%	0%	0%	0%	0%
MA97-11	Lagoon Pond	[obsolete] Ramble Trail Preserve Beach	5452	Tisbury				0%	0%	***25%***			
MA97-12	Lake Tashmoo	Tashmoo Cut	3141	Tisbury	0%	0%	0%	0%	1%	2%	0%	0%	0%
MA97-12	Lake Tashmoo	Hilman's Point	3142	Tisbury		0%	0%	0%	0%	0%	0%	0%	0%
MA97-12	Lake Tashmoo	[obsolete] Lake Street	3143	Tisbury	0%	1%	0%						
MA97-14	Mattakeset Bay	[obsolete] Norton Point Beach - west bay (boat launch)	2803	Edgartown									
MA97-14	Mattakeset Bay	[obsolete] Norton Point Beach - east katama bay	2804	Edgartown									
MA97-15	Edgartown Harbor	Fuller Street	2806	Edgartown	0%	0%	0%	0%	0%	0%	0%	0%	0%
MA97-15	Edgartown Harbor	Chappy Point Beach	2809	Edgartown	0%	0%	0%	0%	0%	0%	0%	0%	0%
MA97-15	Edgartown Harbor	Chappy Beach Club	2810	Edgartown			0%	0%	0%	0%	0%	0%	0%
MA97-16	Katama Bay	Norton Point East	2797	Edgartown	0%	0%	0%	0%	0%	0%	0%	0%	0%
MA97-16	Katama Bay	[obsolete] Katama Point	5473	Edgartown					0%	***16%***			
MA97-18	Tisbury Great Pond	[obsolete] Long Point (Great Pond)	3194	West Tisbury	0%	6%	***11%***	0%	0%	***17%***	4%		
MA97-18	Tisbury Great Pond	Tisbury Great Pond Beach	4963	West Tisbury	0%	0%	0%	0%	0%	0%	1%	0%	0%
MA97-27	Madaket Harbor	Warren's Landing	3008	Nantucket	0%	0%	0%	0%	4%	0%	***26%***	9%	0%

Appendix D: Summary of TMDLs Developed

Table D1: Summary of TMDLs Developed - Final Pathogen TMDL for the Islands Watershed

Segment ID	Name	Impaired Use	Cause	TMDL Type (Cause)
MA97-01	Nantucket Harbor	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)
MA97-02	Sesachacha Pond	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)
MA97-05	Chilmark Pond	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), (Enterococci)
MA97-07	Oak Bluffs Harbor	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)
MA97-10	Sengekontacket Pond	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)
MA97-09	Vineyard Haven Harbor	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)
MA97-15	Edgartown Harbor	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)
MA97-18	Tisbury Great Pond	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)
MA97-21	Cuttyhunk Pond	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)
MA97-26	Polpis Harbor	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)

Pathogen Impaired Segments that were identified in the 2016 Integrated List of Waters (MassDEP 2020) are listed below. These segments were impaired after the public comment period for this TMDL and will be included in an addendum report.

Segment ID	Name	Impaired Use	Cause	TMDL Type
MA97-16	Katama Bay	Shellfish Harvesting	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)
MA97-29	Long Pond	Primary Contact Recreation	Fecal Coliform	Restoration (Fecal Coliform), Preventative (Enterococci)