

Rhode Island Statewide Total Maximum Daily Load (TMDL) for Bacteria Impaired Waters



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Rhode Island Statewide Total Maximum Daily Load (TMDL) for Bacteria Impaired Waters

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1.0 Introduction

This *Statewide Total Maximum Daily Load (TMDL)* report provides a framework to address bacterial pollution in the surface waters of Rhode Island, including rivers and streams, impoundments, lakes, ponds, estuaries, and the Atlantic Ocean. Bacterial contamination of surface waters may result from a variety of sources including waste from humans via failing onsite wastewater treatment systems or malfunctioning sewer infrastructure, farm animals, waterfowl, wildlife, and domestic pets. In coastal systems, illicit discharges from boat waste can also be a concern. Bacterial contamination can degrade aquatic ecosystems and negatively affect public health, and may ultimately result in closures of shellfish beds, beaches, and drinking water supplies (MADEP, 2007).

This bacteria TMDL report establishes the allowable bacterial contributions for Rhode Island's surface waters, provides documentation of impairment, and specifies the pollutant reductions needed to meet water quality standards. The goal of these TMDLs is attainment of water quality standards. Though not an enforceable document itself, these TMDLs establish both the regulatory requirements and recommendations for local communities and other stakeholders to address pollutant sources contributing to the impairment. To support this goal, this report provides information to help communities, watershed groups, and other stakeholders to achieve phased implementation of TMDLs using a community-based approach that will ultimately result in attainment of water quality standards.

1.1. Background

Section 303(d) of the Federal Clean Water Act and Federal Water Quality Planning and Management Regulations (40 CFR Part 130) require states to place waterbodies that do not meet established water quality standards on a list of impaired waterbodies, commonly referred to as the "303(d) List." In Rhode Island, the Department of Environmental Management (RIDEM) is responsible for the 303(d) listing process. The 303(d) List is updated and issued for public comment every two years with the final list submitted to the United States Environmental Protection Agency (USEPA) for final approval. The final 2010 303(d) List was submitted to the USEPA on May 25, 2011 for final approval; RIDEM will post the final 2010 303(d) List once it has been approved by USEPA.

Surface waters placed on the 303(d) List have one or more designated uses impaired by one or more pollutants and require a TMDL study for each pollutant causing an impairment (RIDEM,

2009b). A TMDL establishes the allowable contributions for specific pollutants that a waterbody can receive without exceeding water quality standards (USEPA, 2001a). Water quality standards include numeric and narrative criteria that must be met to protect the designated uses of the surface water, described in greater detail below. The TMDL process maps a course for states, municipalities, private landowners, and other stakeholders to follow an iterative process leading to the ultimate restoration of the impaired water and its uses. In Rhode Island, components of the TMDL process typically include the following (RIDEM, 2008b):

1. Identify the impaired waterbodies and pollutant(s) not meeting water quality standards;
2. Assemble and review available data and information on the waterbody and its watershed;
3. Identify municipalities, private landowners, and other stakeholders with an interest in the waterbody and/or watershed;
4. Identify data gaps that need to be addressed to characterize water quality conditions and pollution sources causing the identified impairment;
5. If needed, develop and implement a monitoring plan to collect additional data to further characterize water quality and pollution sources;
6. Estimate the current amount of point and non-point source pollution entering the waterbody;
7. Establish the TMDL water quality target and estimate the allowable amount of the pollutant that the waterbody can receive and still meet water quality standards;
8. Allocate allowable loads between point and non-point sources, and a margin of safety;
9. Develop a detailed implementation plan identifying the specific actions necessary to achieve the TMDL water quality target(s);
10. Conduct public meetings and formally solicit and respond to public comments; and
11. Submit the draft TMDL to the USEPA for formal approval.

In Rhode Island, the 303(d) List of Impaired Waterbodies is included in Category 5 of the “Integrated Water Quality Monitoring and Assessment Report”. The methodology for assessing surface waters in Rhode Island is described in the State’s Consolidated Assessment and Listing Methodology (CALM) (RIDEM, 2009b). As described in the CALM, water quality data are compared to the State’s surface water quality standards to determine which designated uses are supported, which are not, and which uses cannot be assessed due to insufficient data. Designated uses for Rhode Island surface waters include (RIDEM, 2009b):

- Public drinking water supply;
- Primary contact recreation;
- Secondary contact recreation;
- Fish and wildlife habitat;
- Shellfish consumption;
- Fish consumption; and
- Shellfish harvesting for controlled relay and depuration.

To facilitate tracking and assessing surface water quality, all surface waters in Rhode Island have been assigned to an assessment unit (AU), which refers to a waterbody or waterbody segment. Each assessment unit has been assigned an identifying number, referred to as a waterbody identification number. For the 2010 TMDL cycle, Rhode Island assessed 881 AUs. The ultimate goal is to have all surface waters assessed and supporting their designated uses (RIDEM, 2009b).

1.2. Purpose of Report

This *Rhode Island Statewide Bacteria TMDL Report* is designed to set reductions for bacterial pollution to restore water quality. The report recommends applying a watershed approach and is organized by watershed planning area (WPA) with site-specific data presented for each impaired waterbody. RIDEM has established 24 WPAs that include all of the Rhode Island and some hydrologically-connected parts of Massachusetts and Connecticut. Figure 1-1 provides a map of Rhode Island with WPAs indicated by number and outlined with green boundaries. The figure also illustrates the locations of bacteria impaired segments addressed by this TMDL, shown as

blue lines. A list of Rhode Island's WPAs is provided in Table 1-1, along with a compilation of bacteria impaired segments in each WPA. As shown in Table 1-1, impaired segments are spread among 12 of the 24 planning areas in Rhode Island, with most of the bacteria impaired segments situated in three WPAs. The three WPAs with the most impaired segments are the Wood-Pawcatuck (18 impaired segments), the Pawtuxet (12), and the Branch-Blackstone (11).

This initial statewide TMDL for bacteria impaired waters includes 57 impaired segments from Rhode Island's 2010 303(d) List. A complete list is provided in Table 1-2. Table 1-2 provides the impaired waterbody name, waterbody identification number (WBID#), water use classification, town(s), and specific indicator bacteria used for each impaired segment. All of the impaired segments in this initial submission are fresh water bodies.

The 303(d) List contains bacteria impaired segments that were not included in this Statewide Bacteria TMDL. They were not included because there were not sufficient data, there were combined sewer overflow (CSO) discharges to the waterbody segment, and/or additional site-specific investigation is warranted.

This Statewide Bacteria TMDL allows the implementation and restoration process to begin sooner than developing TMDLs individually. This TMDL approach also provides a useful format for guiding both remediation and protection efforts in impaired WPAs. Using the watershed approach provides a coordinating framework for environmental management that supports efforts to systematically identify, evaluate, and prioritize point and non-point sources of pollution using watershed or hydrologic boundaries to define the problem areas.

The purpose of a TMDL is to calculate the amount of a pollutant that receiving waters can assimilate without exceeding water quality standards or compromising their designated use. Acceptable pollution contributions are then allocated to specific sources. This statewide TMDL report is designed to ensure that impaired streams achieve their designated uses by meeting bacteria water quality criteria. The purpose of this report is to:

1. Provide documentation of impairment;
2. Determine the percent reduction in bacteria required to achieve water quality standards; and

3. Provide tools to help municipalities, watershed groups, and other stakeholders to implement the TMDL in a phased approach that will ultimately result in attainment of water quality standards.

In the future, RIDEM may propose that additional bacteria-impaired waters be included in this Statewide Bacteria TMDL. The future submittals will provide detailed information on the impaired waterbodies, similar to the information that is provided in Appendices A through L. At that time, RIDEM will provide public notice to review of these additional bacteria TMDLs either alone or as part of the public notice process associated with the biennial review of the State's Section 303(d) list in its Integrated Water Quality Report. If previously unlisted waterbodies are involved, RIDEM will clearly state its intent to list the newly assessed waterbodies as impaired, and to apply the appropriate waterbody-specific bacteria TMDLs. Once the USEPA approves the TMDL modification as part of the 303(d) list approval, these additional waterbodies would be added to the waterbody impairments addressed by this Statewide Bacteria TMDL.

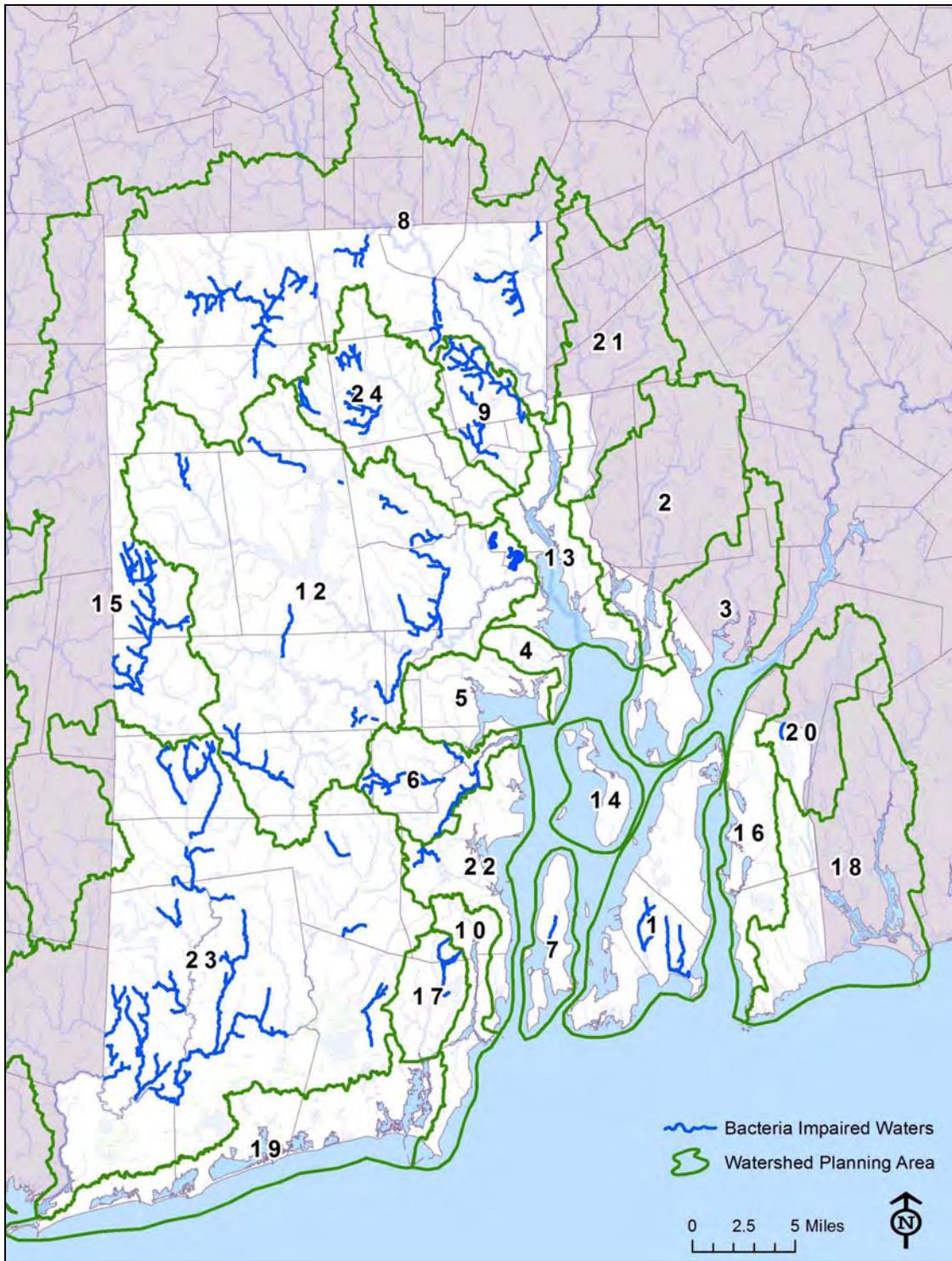


Figure 1-1: Rhode Island Watershed Planning Areas (WPA) with Bacteria Impaired Waters

Table 1-1: Watershed Planning Areas (WPA) with Number of Impaired Segments included in the Statewide Bacteria TMDL

WPA ID	WPA Name	Number of Impaired Segments
1	Aquidneck Island	4
2	Barrington-Palmer-Warren Rivers	0
3	Bristol-Kickemuit River	0
4	Buckeye Brook	0
5	Greenwich Bay	0
6	Hunt River	3
7	Jamestown	1
8	Branch-Blackstone	11
9	Moshassuck	3
10	Narrow River	0
11	New Shoreham-Block Island	0
12	Pawtuxet	12
13	Providence-Seekonk River	0
14	Prudence Island	0
15	Quinebaug	1
16	Sakonnet-East	0
17	Saugatucket	1
18	Southeast Coastal	0
19	Southwest Coastal	0
20	Stafford Pond	1
21	Ten Mile	0
22	West Passage	1
23	Wood-Pawcatuck	16
24	Woonasquatucket	3

Table 1-2: Bacteria Impaired Segments Included in the Statewide Bacteria TMDL

Waterbody Name	Waterbody ID	Class	Towns	Impairment
WPA 1: Aquidneck Island				
Bailey's Brook	RI0007035R-01	AA	Middletown	Enterococci
Maidford River	RI0007035R-02A	AA	Middletown	Fecal Coliform
Maidford River	RI0007035R-02B	AA	Middletown	Fecal Coliform
Paradise Brook	RI0007035R-03	AA	Middletown	Fecal Coliform
WPA 6: Hunt River				
Frenchtown Brook	RI0007028R-01	A	East Greenwich, West Greenwich	Enterococci
Hunt River	RI0007028R-03D	B	North Kingstown, Warwick	Enterococci
Sandhill Brook	RI0007028R-05	B	North Kingstown	Fecal Coliform
WPA 7: Jamestown				
Jamestown Brook	RI0007036R-01	AA	Jamestown	Fecal Coliform
WPA 8: Branch - Blackstone				
Branch River	RI0001002R-01A	B	Burrillville	Enterococci
Branch River	RI0001002R-01B	B	North Smithfield	Enterococci
Chepachet River	RI0001002R-03	B	Burrillville, Glocester	Enterococci
Clear River	RI0001002R-05C	B	Burrillville	Enterococci
Clear River	RI0001002R-05D	B1	Burrillville	Enterococci
Pascoag River	RI0001002R-09	B	Burrillville	Enterococci
Tarkiln Brook	RI0001002R-13B	B	Burrillville, North Smithfield	Enterococci
Crookfall Brook	RI0001004R-01	AA	Lincoln, North Smithfield, Smithfield	Enterococci
Long Brook	RI0001006R-02	AA	Cumberland	Enterococci
East Sneece Brook	RI0001006R-03	AA	Cumberland	Enterococci
Burnt Swamp Brook	RI0001006R-06	AA	Cumberland	Enterococci
WPA 9: Moshassuck				
Moshassuck River	RI0003008R-01A	B	Lincoln	Enterococci
Moshassuck River	RI0003008R-01B	B	Lincoln, Pawtucket, Central Falls	Enterococci
West River	RI0003008R-03B	B	Lincoln, North Providence, Providence, Smithfield	Enterococci
WPA 12: Pawtuxet				
Nooseneck River	RI0006012R-05	A	Coventry, West Greenwich	Enterococci
Boyd Brook	RI0006013R-01	B	Scituate, Coventry	Enterococci
South Branch Pawtuxet River	RI0006014R-04B	B1	Coventry, West Warwick	Enterococci
Tiogue Tribs	RI0006014R-05	B	Coventry	Enterococci
Huntinghouse Brook	RI0006015R-11	AA	Glocester, Scituate	Enterococci
Moswansicut Stream	RI0006015R-16	AA	Scituate	<i>E.coli</i>
Winsor Brook	RI0006015R-30	AA	Foster	Enterococci
Meshanticut Brook	RI0006017R-02	B	Cranston, West Warwick, Warwick	Enterococci
Dry Brook	RI0006018R-02A	B	Johnston	Enterococci
Simmons Brook	RI0006018R-04	B	Johnston, Cranston	Enterococci
Roger Williams Park Ponds	RI0006017L-05	B	Providence	Fecal Coliform
Mashapaug Pond	RI0006017L-06	B	Providence	Fecal Coliform

Table 1-2: Bacteria Impaired Segments Included in the Statewide Bacteria TMDL
(continued)

Waterbody Name	Waterbody ID	Class	Towns	Impairment
WPA 15: Quinebaug				
Moosup River	RI0005011R-03	A	Foster, Coventry	Enterococci
WPA 17: Saugatucket				
Fresh Meadow Brook	RI0010045R-01	B	North Kingstown, South Kingstown	Enterococci
WPA 20: Stafford Pond				
Sucker Brook	RI0007037R-01	A	Tiverton	Enterococci
WPA 22: West Passage				
Belleville Upper Pond Inlet	RI0007027R-02	B	North Kingstown	Enterococci
WPA 23: Wood - Pawcatuck				
Ashaway River	RI0008039R-02A	A	Hopkinton	Enterococci
Chickasheen Brook	RI0008039R-05A	A	Exeter	Enterococci
Meadow Brook	RI0008039R-13	A	Richmond	Enterococci
Mile Brook	RI0008039R-14	B	Hopkinton	Enterococci
Pawcatuck River	RI0008039R-18B	B1	Charlestown, Richmond	Enterococci
Pawcatuck River	RI0008039R-18C	B	Charlestown, Richmond, Hopkinton, Westerly	Enterococci
Taney Brook	RI0008039R-23	B	Richmond	Enterococci
Tomaquag Brook	RI0008039R-24	A	Hopkinton	Enterococci
White Horn Brook	RI0008039R-27B	B	South Kingstown	Enterococci
Dutemple Brook	RI0008039R-30	A	Exeter	Enterococci
Parmenter Brook	RI0008039R-37	A	Hopkinton	Enterococci
Breakheart Brook	RI0008040R-02	A	West Greenwich, Exeter	Enterococci
Brushy Brook	RI0008040R-03B	B	Hopkinton	Fecal Coliform
Canonchet Brook	RI0008040R-04B	B	Hopkinton	Enterococci
Phillips Brook	RI0008040R-14	A	West Greenwich	Enterococci
Wood River	RI0008040R-16A	A	Exeter, Richmond, Hopkinton	Enterococci
WPA 24: Woonasquatucket				
Cutler Brook	RI0002007R-02	B	Glocester	Enterococci
Latham Brook	RI0002007R-05	B	Smithfield	Enterococci
Stillwater River	RI0002007R-09	B	Smithfield	Enterococci

1.3. Report Format

This document contains the following sections:

- ***Water Quality Standards for Bacteria (Section 2)*** – This section provides an overview of pathogenic impacts of bacteria and the selection of indicator bacteria to assess pathogen impairment in waterbodies, as well as a summary of Rhode Island water quality standards.
- ***Types of Bacteria Pollution Sources (Section 3)*** – This section defines point and non-point sources of bacteria pollution and provides examples of bacteria sources that may affect Rhode Island’s waterbodies.
- ***Bacteria Impaired Waters (Section 4)*** – This section includes an overview of the 303(d) listing process, a summary of Rhode Island’s surface water monitoring programs, and provides a brief introduction to all bacteria impaired waters in Rhode Island (based on the draft 2010 303(d) list).
- ***TMDL Development (Section 5)*** – This section provides a description of the TMDL allocation process based on designated use and waterbody class.
- ***Implementation Plans (Section 6)*** – This section provides a description of the implementation process, including coordination with local stakeholders and development of watershed management plans, and a menu of mitigative actions (organized by source) to reduce bacteria contributions.
- ***Funding and Community Resources (Section 7)*** – This section provides a description of funding sources available to address impaired waters in Rhode Island.
- ***Watershed-Specific Bacteria Summaries and Reductions (Section 8)*** – This section summarizes Rhode Island’s 2010 bacteria impaired waterbodies that are included this initial statewide TMDL submission and provides reductions necessary for each impaired segment. This section also introduces Appendices A through L, organized by WPA which contain available bacteria data and information, reduction needed for each impaired segment, and GIS-based maps of the WPAs.

2.0 Water Quality Standards for Bacteria

This section provides a description of potential impacts associated with bacteria in surface waters and the State of Rhode Island's water quality standards for bacteria. Bacteria water quality standards are designed to be protective of human health and associated designated uses (i.e., drinking water, recreational activities, and shellfish consumption).

2.1. Overview of Pathogens and Indicator Bacteria

Bacteria TMDLs are designed to support reduction of waterborne disease-causing organisms, known as pathogens, to reduce public health risk. Pathogens may be transported to surface waterbodies by stormwater runoff or persistent sources, such as failing onsite wastewater treatment systems (OWTS)¹ and illicit discharges. Once in a stream, lake, or estuary, they can infect humans through consumption of contaminated fish and shellfish, skin contact, or ingestion of water. Of the designated uses listed in Section 303(d) of the Clean Water Act, protection from pathogenic contamination is most important for waters designated for recreation (primary and secondary contact); public water supplies; aquifer protection; and protection and propagation of fish, shellfish, and wildlife (USEPA, 2001a).

Infections due to pathogen-contaminated recreational waters include gastrointestinal, respiratory, eye, ear, nose, throat, and skin diseases (USEPA, 1986). Filter-feeding shellfish, such as quahogs, clams, oysters, and mussels, concentrate microbial contaminants in their tissues and may be harmful to humans when consumed raw or undercooked.

Wastes from warm-blooded animals are a source for many types of bacteria found in waterbodies, including the coliform group and *Streptococcus*, *Lactobacillus*, *Staphylococcus*, and *Clostridia*. Each gram of human feces contains approximately 12 billion bacteria that may include pathogenic bacteria, such as *Salmonella*, associated with gastroenteritis. In addition, feces may contain pathogenic viruses, protozoa, and parasites (MADEP, 2007).

¹An onsite wastewater treatment system or OWTS refers to any system of piping, tanks, dispersal areas, alternative toilets, or other facilities designed to function as a unit to convey, store, treat or disperse wastewater by means other than discharge into a public wastewater system. A septic system is a type of OWTS.

The numbers of pathogenic organisms present in waters are generally difficult to identify and isolate, and are often highly varied in their characteristic or type. Therefore, scientists and public health officials usually monitor nonpathogenic bacteria that are typically associated with harmful pathogens in fecal contamination and are most easily sampled and measured. These associated bacteria are called indicator organisms. Indicator bacteria are not themselves a health risk, but are used to indicate the presence of pathogenic organisms. High densities of indicator bacteria increase the likelihood of the presence of pathogenic organisms (USEPA, 2001a).

Some commonly used indicators include coliform bacteria and fecal streptococci. The relationship of indicator organisms is illustrated in Figure 2-1, with indicators used in Rhode Island highlighted in yellow. Indicator criteria specific to Rhode Island are provided in Section 2.2 of this report. Fecal coliform (a subset of total coliform) and *Escherichia coli* (*E.coli*) are present in the intestinal tracts of warm-blooded animals. Presence of coliform bacteria in water indicates fecal contamination and the possible presence of pathogens. Fecal streptococci bacteria are also used as indicator bacteria, specifically the subgroup enterococci. These bacteria also live in the intestinal tracts of animals. However, as enterococci have a lower die-off rate, their presence is a better predictor of human gastrointestinal illness than fecal coliform (USEPA, 2001a). In 1986, USEPA established enterococci and *E. coli* as the indicator organisms for states to use in establishing primary contact recreational criteria. Fecal coliform are still utilized as the indicator for shellfish consumption in accordance with the National Shellfish Sanitation Program.

The State of Rhode Island uses fecal coliform and enterococci as indicator organisms of potential pathogen contamination. Fecal coliform is used to determine risk for shellfish consumption, while enterococci is used to determine risk associated with primary and secondary contact recreation activities in the state's fresh and salt waters. Enterococci recently replaced fecal coliform as the indicator bacteria for contact recreation uses in the Rhode Island water quality standards. In accordance with the Rhode Island water quality standards, during the transition, fecal coliform may be utilized to evaluate water quality if sufficient enterococci data are not available. As a result, this report will present fecal coliform data to document impairment of some waterbodies designated for contact recreation. These criteria are set forth in the State's Water Quality Regulations promulgated by RIDEM's Office of Water Resources (RIDEM, 2009b).

Escherichia coli (*E.coli*) is another species of fecal coliform bacteria that is specific to fecal material from humans and warm-blooded animals and may also be used as an indicator of pathogenic bacteria in freshwaters. Although Rhode Island has not adopted water quality criteria

for *E. coli* in the Water Quality Regulations, the USEPA’s *E.coli* criteria can be used to assess *E.coli* data in cases where there are no fecal coliform or enterococci data available. The State may use the USEPA’s recommended criteria for *E.coli* bacteria to list the waterbody, and to calculate a TMDL for it.

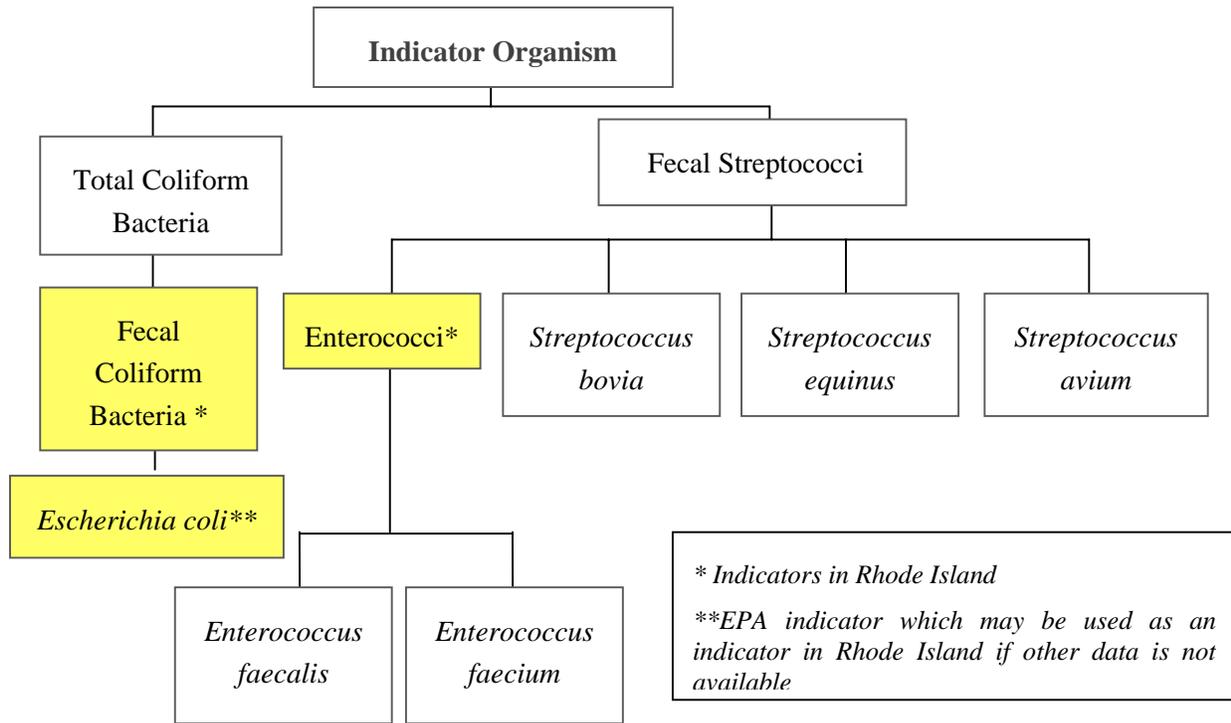


Figure 2-1: Relationship among Indicator Organisms (USEPA, 2001a)

2.2. Water Quality Standards for Bacteria in Rhode Island Waters

Water quality standards define the baseline water quality that all surface waters of Rhode Island must meet in order to protect their intended uses. They are the “yardstick” for identifying where water quality violations exist and for determining the effectiveness of regulatory pollution control and prevention programs. Rhode Island’s water quality standards are intended to restore, preserve and enhance the physical, chemical and biological integrity of the waters of the State, to maintain existing water uses and to serve the purposes of the Clean Water Act and Rhode Island General Laws Chapter 46-12 (RIDEM, 2009a). Water quality standards define the goals for a waterbody by designating its uses; setting criteria to protect those uses; and establishing antidegradation provisions. Each of these parts is described below.

2.2.1. Designated Uses and Water Use Classifications

Rhode Island's designated uses consist of Public Drinking Water Supply, Primary and Secondary Contact Recreation, Fish and Wildlife Habitat (Aquatic Life Use), Shellfish Consumption, Fish Consumption, and Shellfish Harvesting for controlled relay and depuration. All surface waters of the State have been categorized according to the water use classifications of Rule 8.B of the Rhode Island Water Quality Regulations which assigns all surface waters to one of four Freshwater (Class AA, A, B, B1), or one of three saltwater (Class SA, SB, SB1), classifications. Each classification is defined by the designated uses that are the most sensitive, and therefore governing, water uses to be protected. Surface waters may be suitable for other beneficial uses, but are regulated to protect and enhance the specified designated uses (RIDEM, 2009a). In addition, the State has incorporated partial use classifications into the Water Quality Regulations. Partial use denotes specific restrictions of use assigned to a waterbody or waterbody segment that may affect the application of criteria. Partial use designations have been adopted in the Water Quality Regulations for waters, which will likely be impacted by activities such as combined sewer overflows (CSOs) and concentrations of vessels (marinas and/or mooring fields). Partial use designation for waters impacted by CSOs are denoted by "{a}" following the classification. Partial use designation for waters with concentration of vessels are denoted by "{b}" following the classification.

Water quality classifications denote the water quality *goals* for the waterbody, which may not be the present condition of the waterbody. Assessments of the present water quality conditions are determined for each waterbody through water quality data and information compiled in preparation of the most recent Integrated Water Quality Monitoring and Assessment Report (Integrated Report). The Integrated Report is developed biennially and reports both water quality assessment information in accordance with Section 305(b) of the Clean Water Act and lists impaired waterbodies in accordance with Section 303(d) of the Clean Water Act.

The Rhode Island Water Quality Classifications are shown below with differences between classifications underlined. The complete list of designated uses for Rhode Island's surface waters is provided in Table 2-1 (RIDEM, 2009b).

Freshwater Classifications

Class AA

- Designated as a source of public drinking water supply or as tributary waters within a public drinking water supply watershed;
- Designated for primary and secondary contact recreational activities;
- Designated for fish and wildlife habitat; and
- Shall have excellent aesthetic value.

Class A

- Designated for primary and secondary contact recreational activities;
- Designated for fish and wildlife habitat;
- Suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses; and
- Shall have excellent aesthetic value.

Class B

- Designated for primary and secondary contact recreational activities;
- Designated for fish and wildlife habitat;
- Suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses; and
- Shall have good aesthetic value.

Class B1

- Designated for primary and secondary contact recreational activities²;
- Designated for fish and wildlife habitat;
- Suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses; and
- Shall have good aesthetic value.

Seawater Classifications**Class SA**

- Designated for shellfish harvesting for direct human consumption;
- Designated for primary and secondary contact recreational activities;
- Designated for fish and wildlife habitat;
- Shall be suitable for aquacultural uses, navigation and industrial cooling; and
- Shall have good aesthetic value.

Class SB

- Designated for primary and secondary contact recreational activities;
- Designated for shellfish harvesting for controlled relay and depuration;
- Designated for fish and wildlife habitat;
- Shall be suitable for aquacultural uses, navigation, and industrial cooling; and
- Shall have good aesthetic value.

²Note that primary contact recreational activities may be impacted due to pathogens from approved wastewater discharges. However, all Class B criteria must be met.

Class SB1

- Designated for primary and secondary contact recreational activities³;
- Designated For fish and wildlife habitat;
- They shall be suitable for aquacultural uses, navigation, and industrial cooling; and
- These waters shall have good aesthetic value.

³Note that primary contact recreational activities may be impacted due to pathogens from approved wastewater discharges. However, all Class SB criteria must be met.

Table 2-1: Designated Uses for Rhode Island Surface Waters

Designated Use	Definition	Applicability
Public Drinking Water Supply (PDWS)	The source of surface water for a public drinking water supplier.	AA
Primary Contact Recreation	Swimming, water skiing, surfing or other recreational activities in which there is prolonged and intimate contact by the human body with the water, involving considerable risk of ingesting water.	All surface waters
Secondary Contact Recreation	Boating, canoeing, fishing, kayaking or other recreational activities in which there is minimal contact by the human body with the water and the probability of ingestion of the water is minimal.	All surface waters
Fish and Wildlife Habitat	The area which provides direct support for fish and wildlife. It includes all environmental features that comprise an area such as air, water, vegetation, soil, substrate and hydrologic characteristics.	All surface waters
Shellfish harvesting for direct human consumption	Waters support a population of shellfish free from pathogens that could pose a human health risk to consumers.	SA, SA{b}
Shellfish harvesting for controlled relay and depuration	Waters support a population of shellfish that are suitable for transplant to Class SA waters for ambient depuration and controlled harvest.	SB, SB{a}
Fish Consumption, implicit in "Fish and Wildlife Habitat"	The waterbody supports fish free from contamination that could pose a human health risk to consumers.	All surface waters

2.2.2. Water Quality Criteria

Rhode Island's water quality criteria consist of both narrative and numeric components included in Rule 8.D of the State Water Quality Regulations. In general, narrative criteria describe acceptable conditions necessary for a waterbody to attain its designated uses. Numeric criteria are typically concentrations of pollutants representing maximum acceptable levels of pollutants. Concentrations of pollutants above the numeric criteria represent potentially harmful levels and violate the water quality standards.

A waterbody that meets the criteria for its designated uses is considered to be meeting its water quality standards. Ambient numeric criteria for bacteria in surface waters are presented in Table 2-2. Enterococci have recently been adopted into Rhode Island's water quality standards as the bacteria indicator for assessing waters for primary and secondary contact recreation uses. During the transition to this new indicator, the water quality standards have maintained fecal coliform criteria for use in evaluating water for primary and secondary contact activities when adequate enterococci data are not available.

To protect shellfish consumers, fecal coliform is used as an indicator of pathogenic bacteria in designated shellfishing areas. Bacteria criteria for fecal coliform are expressed as a **geometric mean concentration** and **90th percentile concentration**. Criteria for enterococci are expressed as a geometric mean and a single sample maximum. The single sample maximum value only applies to beach closure notification (utilized by the Rhode Island Department of Health (HEALTH)) and not to Clean Water Act purposes such as impairment assessment or removal from the impaired waters list (RIDEM, 2009b).

A *geometric mean* is a way to average a set of values, and is commonly used with bacterial water assessments, which often show a great deal of variability. Unlike the arithmetic mean, a geometric mean reduces the effect of an occasional high or low value on the average. A *90th percentile concentration* indicates that 90 percent of the values in a dataset are less than or equal to this value.

As noted in Section 2.1, *E.coli* may be used to assess water quality in cases where there are no fecal coliform or enterococci data available. In these cases, it is appropriate to use the USEPA standard for *E.coli* for freshwater (Geometric Mean = 126 MPN/100mL), as Rhode Island does not currently have a water quality standard for *E.coli* (USEPA, 1986).

Table 2-2: Numeric Criteria for Indicator Bacteria by Waterbody Class in Rhode Island

Waterbody Class Designated Use	Fecal Coliform (MPN/100 mL)		Enterococci (colonies/100 mL)	
	<i>Geometric Mean</i> ¹	<i>90th Percentile</i> ¹	<i>Geometric Mean</i> ¹	<i>Single Sample Maximum</i> ²
Class AA <i>Public Drinking Water Supply</i>	20 ³	200 ³	NA	NA
Classes AA, A, B, B1, B{a}, B1{a} <i>Primary/Secondary Contact Recreation</i>	200 ⁴	400 ⁴	NDB: 54 DB: 33	61 ²
Classes SA, SA{b} <i>Shellfish Consumption</i>	14 ⁵	49 ⁵	NA	NA
Classes SA, SA{b}, SB, SB1, SB{a}, SB1{a} <i>Primary/Secondary Contact Recreation</i>	50 ⁴	400 ⁴	35	104 ²
¹ Geometric mean and 90 th percentile metrics are statistically based ² Used by HEALTH to determine swimming beach advisories at designated beaches ³ Only at Terminal Reservoir of the system ⁴ Only if adequate enterococci data are not available ⁵ For a three-tube decimal dilution NDB denotes Non-Designated Beach DB denotes Designated Beach				

2.2.3. Antidegradation Provisions

Rhode Island's antidegradation policy requires that, at a minimum, the water quality necessary to support existing uses be maintained (see Rule 18, Tier 1 in the State of Rhode Island's Water Quality Regulations). If water quality for a particular parameter is of a higher level than necessary to support an existing use (i.e., bacterial levels are below Class SA or SB standards), that improved level of quality should be maintained and protected (see Rule 18, Tier 2 in the State of Rhode Island's Water Quality Regulations). Because water quality violates standards in several locations, Tier 2 does not apply.

2.3. Numeric Water Quality Target

The numeric water quality targets are set at the applicable water quality criteria or standard for each impaired segment. Numeric targets must ensure that water quality criteria are met in all adjacent waters, including waters that belong to an adjacent state. In some areas, a waterbody segment with higher allowable bacteria limits discharges to a waterbody with more stringent criteria. In these places, the numeric water quality target must be set to the more strict criteria of the two standards at the point of discharge.

The numeric water quality targets are set to the applicable fecal coliform or enterococci concentrations necessary to restore the designed uses to the waterbodies. For example, in SA waters, targets are set to what is necessary to reopen the shellfish waters during all weather conditions, in accordance with Rhode Island's Shellfish Program approved by the United States Food and Drug Administration.

2.4. Other Applicable Standards

The closure of shellfish areas to harvesting is not solely based on the ambient water quality data. In accordance with the National Shellfish Sanitation Program (NSSP), a shellfish growing area shall be classified as Prohibited if no current sanitary survey has been performed or if a sanitary survey or other monitoring program data indicate that fecal coliform material may reach the area in excessive concentrations. If it has been determined that there is a good potential for harvested shellfish to be contaminated due to the nature of an upland source, then the affected growing area is closed (NSSP, 1997, 2007).

3.0 Types of Bacteria Pollution Sources

Potentially harmful bacteria can enter Rhode Island surface waters from a variety of sources. Types of bacteria pollution sources, including wastewater treatment facilities, stormwater runoff, failing onsite wastewater systems, and animal waste are introduced below. Section 6 provides detailed descriptions of each type of pollutant source including the regulatory context and potential mitigation activities.

Wastewater Treatment Plants

In Rhode Island, in addition to the 19 major⁴ and two minor municipal wastewater treatment plants (WWTP), there are three major and three minor Industrial WWTPs that have the potential to discharge bacteria pollution. WWTPs receive and treat wastewater from a variety of sources including institutions, hospitals, commercial, industrial, and residential users. This wastewater, which contains a variety of organic and inorganic pollutants, is treated by WWTPs in order to remove harmful waste products down to permitted levels. Untreated or partially treated wastewater may enter the State's surface waters as a result of malfunctioning WWTPs or sanitary sewer overflows. Sanitary sewer overflows are described below.

Developed Area Stormwater Runoff

Stormwater runoff is the water from rain or snowmelt that flows over the land surface that is not absorbed into the ground, and instead flows into surface waters. As the runoff moves, it picks up and carries away natural and anthropogenic pollutants, such as soil and animal waste, and eventually deposits them into surface waters. In developed areas, stormwater is typically channelized in storm drains, discharging via outfalls to wetlands and surface waters. Stormwater runoff is one of the leading sources of impairment of our nation's waters (USEPA, 2011) and often contains high concentrations of various pollutants including bacteria. Urbanization and associated impervious surfaces have a significant impact on the hydrology within a watershed by increasing stormwater runoff volume to receiving surface waters.

⁴ WWTPs are classified as major discharges if they discharge more than 1.0 million gallons per day.

Sanitary Sewer Overflows

Sanitary sewer overflows are discharges of untreated wastewater from sewer systems. These overflows can be caused by clogged or cracked sewer pipes, by excess infiltration and inflow, by undersized sewer systems (piping and/or pumps), or by equipment failure. Such untreated wastewater can find its way to surface waters and cause bacteria violations.

Illicit Discharges (to Stormwater Systems)

Illicit discharge refers to any discharge to a storm drain that is neither an allowable non-stormwater discharge (e.g. uncontaminated groundwater, dechlorinated pool discharges, etc.) nor composed entirely of stormwater. Examples of illicit discharges commonly seen include direct discharges such as sanitary wastewater pipes connected from a home to a storm drain and indirect illicit discharges such as a damaged sanitary sewer line that is leaking wastewater into a cracked storm sewer line (NEIWPC, 2003).

Boats

Boats have the potential to discharge harmful bacteria in sewage from installed toilets and greywater (drainage from sinks, showers, and laundry). Sewage and greywater discharged from boats can contain pathogens (including bacteria, viruses, and protozoans), nutrients, and chemical products that can lead to water quality violations. On August 18, 1998, the USEPA designated all of Rhode Island's marine waters as a *Federal No Discharge Area* (USEPA, 2003). While RI statute prohibits the discharge of untreated sewage from any vessel in both fresh and marine waters, the *No Discharge* designation also prohibits the discharge of treated sewage in Rhode Island marine waters. In *No Discharge Areas*, boats with installed toilets must have an operable Coast Guard approved marine sanitation device designed to hold sewage for pump-out or for discharge in the ocean beyond the three-mile limit. RIDEM oversees the operation and maintenance of the pump-out infrastructure by participating in the Clean Vessel Act program, which provides money for the construction, repair, and replacement of pump-out facilities and, by coordinating outreach and education programs.

Onsite Wastewater Treatment Systems

When properly installed, operated, and maintained, onsite wastewater treatment systems (OWTS) (i.e., septic systems) effectively reduce bacteria concentrations in sewage. However,

poor maintenance, overloading, improper design or construction, or age can result in OWTS failure and the release of bacteria and other pollutants into surface waters (USEPA, 2006). Bacteria from malfunctioning OWTS can enter surface waters through groundwater, stormwater runoff, or overland flow.

Waterfowl, Wildlife, and Domestic Animals

Fecal matter from wildlife may be a significant source of bacteria in some watersheds. This is particularly true when human activities, including the feeding of wildlife and habitat modification, result in the congregation of wildlife (CWP, 1999). Concentrations of geese, gulls, and ducks are of particular concern because they often deposit their waste directly into surface waters. Wildlife waste deposited on land can also be washed off and transported to surface waters by stormwater runoff. Roads and drainage structures that expedite the transport of natural sources of bacteria to surface waters may exacerbate the impact of these sources on water quality.

In residential areas, pet waste can be a significant contributor of bacteria to surface waters. For example, each dog is estimated to produce 200 grams of feces per day and pet feces can contain up to 23,000,000 fecal coliform colonies per gram (CWP, 1999). If pet waste is not properly disposed, these bacteria can be washed off the land and transported to surface waters by stormwater runoff. Pet waste can also enter surface waters by direct deposition of fecal matter from pets standing or swimming in surface water (USEPA, 2001b).

Agriculture

Agricultural land includes dairy farming, raising livestock and poultry, growing crops, and keeping horses and other animals for pleasure or profit. Activities and facilities associated with agricultural land use can be sources of bacteria impairment to surface waters. Direct deposition of fecal matter from farm animals standing or swimming in surface waters, and the runoff of farm animal waste from land surfaces, are considered the primary mechanisms for agricultural bacteria pollution in surface waters.

Contact Recreation (Swimming or Wading)

Bacteria from people swimming or wading in surface waters can contribute bacteria via direct deposition. When people enter the water, residual fecal matter may be washed from the body

and contaminate the water with pathogens. In addition, small children with diapers may contribute to bacterial contamination of surface waters.

Summary

Typically, a combination of several of types of bacteria sources result in failure of surface waterbodies to achieve the bacteria water quality standards. As part of TMDL implementation, described in Section 6, specific bacteria sources are identified and mitigation activities are identified utilizing readily available bacteria source information. With subsequent development of watershed plans and/or TMDL Implementation Plans, municipalities and other stakeholders are encouraged to further investigate and/or utilize all available information to further refine bacteria sources and appropriate mitigation activities.

It is acknowledged that in some circumstances, it may be determined that even after implementation of point source and non-point source controls that water quality improvements are not sufficient to meet applicable bacteria criteria at all times. In these cases, removal/partial removal of a designated use, such as primary contact recreation or shellfish harvesting use from specific water bodies through the Use Attainability Assessment process (see 40 CFR 131.10(g)), could be considered. In that case, it would first be necessary to confirm that the use in question is not an existing use (which would preclude use removal under federal regulations) and then to define the highest attainable use (and associated criteria) that is closest to the use being removed. The evaluation of the highest attainable use should reflect the factors and constraints on the attainability of a use that were evaluated as part of the UAA process. The highest attainable use (and associated criteria) needs to be determined taking into account the capability of the natural system as well as the technical and economic limitations of human sources throughout the basin that affect the site. While DEM agrees that a UAA is a potential tool to address water quality standards violations, given the applicable federal Clean Water Act requirements it is not expected to substantially change the actions required to address impairments. For more information on the UAA process, RIDEM recommends EPA's resources at: <http://water.epa.gov/scitech/swguidance/standards/uses/uaa/>.

4.0 Bacteria Impaired Waters

This section provides a description of the 303(d) listing process, an outline of the ambient monitoring programs for bacteria in Rhode Island, and a discussion on the benefits of using a watershed-based approach to develop a TMDL. Information specific to Rhode Island's 2010 (303d) List is provided at the end of this section.

4.1. The 303(d) Listing Process

All states are required to report to the USEPA every two years on the quality of its surface and groundwater resources (Section 305(b)) and to provide a list of those waters where their designated uses are deemed "impaired" (Section 303(d)), in accordance with sections (as indicated) of the Federal Clean Water Act. Prior to 2002, many states submitted separate 305(b) Reports and 303(d) Lists. In an effort to simplify the reporting process, USEPA developed guidance and a computer database (known as the Assessment Database) to facilitate integration of the 305(b) water quality assessments and the 303(d) Lists. In 2008, following USEPA guidance, RIDEM integrated the 305(b) assessment information and 303(d) impaired waters list into a single document called the Integrated Water Quality Monitoring and Assessment Report (Integrated Report). RIDEM's 2010 Integrated Report continues to follow the integrated format to provide an effective tool for assessing and reporting on the quality of the State's waters (RIDEM, 2009b).

The "*Rhode Island Consolidated Assessment and Listing Methodology*" (or CALM; RIDEM, 2009b) documents the decision-making process for assessing and reporting on the quality of the State's surface waters following the Integrated Report format. This process provides the basis for a majority of water pollution abatement actions undertaken in Rhode Island, and is fundamental to watershed-based environmental protection. The CALM is a dynamic process that will evolve as Rhode Island's Water Monitoring Strategy (RIDEM, 2005) is implemented. The Methodology will be modified as appropriate to accompany subsequent Integrated Reports (RIDEM, 2009b).

4.1.1. Integrated Reporting Categories

Rhode Island's surface waters are divided into 881 segments, or Assessment Units (AUs). AUs are the basic unit of record for conducting and reporting water quality assessments. During the

integrated reporting process, each AU is assigned to one of the following five categories of assessment determination (RIDEM, 2009b):

- **Category 1:** Attaining all designated uses and no use is threatened (waters are considered to be “fully supporting” all uses);
- **Category 2:** Attaining some of the designated uses; no use is threatened; and insufficient or no data and information are available to determine if the remaining uses are attained or threatened (i.e., some uses are “fully supporting” however more data are needed to assess other uses);
- **Category 3:** Insufficient or no data and information are available to determine if any designated use is attained, threatened, or impaired (i.e., more monitoring is needed to assess any use; associated waters are considered to have insufficient data or to be not assessed);
- **Category 4:** Impaired or threatened for one or more designated uses but does not require development of a TMDL because;
 - A. TMDL has been completed (and when implemented is expected to result in attainment of the water quality standard), or
 - B. Other pollution control requirements are reasonably expected to result in attainment of the water quality standard in the near future, or
 - C. Impairment is not caused by a pollutant;
- **Category 5:** Impaired or threatened for one or more designated uses by a pollutant(s), and requires a TMDL (this is the 303(d) Impaired Waters List).

4.1.2. Priority Ranking and TMDL Schedules

Section 303(d) of the Clean Water Act requires that waters on the 303(d) List be ranked in order of priority that the TMDLs will be developed. The Rhode Island 303(d) List identifies impaired waterbodies and provides a scheduled time frame for development of TMDLs. As such, the 303(d) List is used to help prioritize the State’s water quality monitoring and restoration planning activities. Scheduling is not necessarily representative of the severity of water quality impacts,

but rather reflects the priority given for TMDL development with consideration to shellfishing waters, drinking water supplies and other areas identified by the public as high priority areas. TMDL schedules are dynamic and subject to revisions due to resource, public interest and support, and technical factors (RIDEM, 2009b).

4.2. Surface Water Monitoring Programs for Bacteria

Section 106(e)(1) of the Clean Water Act requires States to develop a comprehensive monitoring and assessment strategy that provides a description of the sampling approach, a list of parameters to be tested, and a schedule for collecting data and information. RIDEM, in cooperation with the RI Environmental Monitoring Collaborative, accomplished this by preparing the RI Water Monitoring Strategy (RIDEM, 2005). The monitoring framework reflects the partnerships and collaborations that occur among state, local and federal agencies, universities, other organizations and volunteers regarding monitoring activities. When fully implemented, the strategy will yield data to support a statewide assessment of water quality conditions, allow measurements of key environmental indicators and provide important information to support management decision-making at both the state and local level. Monitoring programs outlined in the RI Water Monitoring Strategy that assess bacteria concentrations in coastal and freshwaters include the following (RIDEM, 2009b; RIDEM, 2005):

- ***Rhode Island Rotating Basin Assessments of Rivers and Streams Program*** – This statewide freshwater sampling program run by the RIDEM Office of Water Resources monitors rivers and streams. Sampling is conducted throughout Rhode Island in a rotating basin cycle using a geometric sampling design with some targeted sampling where specific data are needed. Monitoring data from this program are used to assess water quality for the biannual Integrated Water Quality Monitoring and Assessment Report. Waters of the state must support the applicable designated uses by compliance with applicable water quality criteria as stated in the RI Water Quality Regulations;
- ***Rhode Island DEM Shellfish Growing Area Monitoring Program*** – The Shellfish Growing Area Monitoring Program is part of the State of Rhode Island's agreement with the U.S. Food and Drug Administration's National Shellfish Sanitation Program (NSSP). The purpose of this program is to maintain national health standards by regulating the interstate shellfish industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain an industry standard. As part of this agreement, the State of

Rhode Island is required to conduct continuous bacteriological monitoring of the shellfish harboring waters of the State to maintain a certification of these waters for shellfish harvesting for direct human consumption. Shoreline surveys are an additional requirement of the NSSP. This sampling program monitors approximately 300 stations in coastal waters annually;

- ***Rhode Island HEALTH Bathing Beach Monitoring Program*** – This sampling program run by the RI Department of Health monitors approximately 70 coastal stations and numerous freshwater stations annually. The data are primarily used to open/close bathing beaches and to assess recreational use. **Online:** <http://www.ribeaches.org>;
- ***Narragansett Bay Commission (NBC) Monitoring Programs*** – The NBC Fecal Coliform and Enterococci sampling program monitors 19 stations along the Providence River and the NBC Regional Pathogen Monitoring in Rivers sampling program monitors 18 fixed stations on tributaries to the Providence River. Data from these programs are used to assess water quality conditions and bacterial contamination in waterbodies affected by the NBC wastewater system. **Online:** <http://www.narrabay.com/RegulatoryCompliance/Environmental%20Monitoring%20and%20Data%20Analysis%20Program.aspx>;
- ***University of Rhode Island Watershed Watch Program*** – This volunteer-based freshwater and coastal sampling program provides supplemental data to Rhode Island State programs. **Online:** <http://www.uri.edu/ce/wq/ww/index.htm>; and
- ***USGS Monitoring on Non-wadeable Rivers*** – Monitoring of water chemistry in large rivers is conducted by the USGS via an agreement with RIDEM. The monitoring involves water column testing for nutrients, common constituents, bacteria, trace elements, and various field determinations. Current agreements with USGS provide for sampling of six locations on the Branch, Blackstone, Pawcatuck, and Pawtuxet Rivers. Data from this program are used to assess water quality.

Though the primary sources of data generated for water quality assessments are listed above, RIDEM also uses data from other sources such as special projects, research, volunteer efforts, and the federal government. Data must be submitted to RIDEM with the required data quality assurance and data quality objective documentation, as outlined in the CALM. If the data collection and analysis do not include appropriate data quality assurance and objectives, the data

may still be considered for the water quality assessments following a qualitative approach as discussed in the CALM. However, RIDEM only uses data that meet the data quality assurance and objectives in developing the 303(d) List (RIDEM, 2009b).

The quality of the data used to determine an assessment of a waterbody must be documented to define the basis of the final assessment determination. Data are categorized in one of four data quality groups, ranging from low to excellent quality. Rankings are based on the age of data, whether an acceptable Quality Assurance/Quality Control plan was utilized in the field and/or lab, and the level of training of the data collectors. All data used to develop the 303(d) List are considered good to excellent (RIDEM, 2009b).

4.3. Watershed-Specific Bacteria TMDL Development Approach

The watershed approach is a coordinating framework for environmental management that focuses public and private sector efforts to address the highest priority problems within hydrologically-defined geographic areas, taking into consideration both ground and surface water flow.

Using a watershed approach for TMDLs serves several purposes. As described earlier in the document, this statewide TMDL allows the implementation and restoration process to begin sooner than developing TMDLs individually. More importantly, using a recommended watershed approach to restore waterbodies allows stakeholders to systematically identify, evaluate, and prioritize point and non-point sources of pollution using watershed or hydrologic boundaries to define the problem area. A watershed approach is based on the premise that water quality restoration and protection are best addressed through integrated efforts within a defined geographic area.

Participation by local governments and citizens in the TMDL process ensures that individuals most likely to be knowledgeable of watershed conditions will help identify problems and develop solutions. Community-based environmental protection is an iterative approach in which diverse stakeholders strive to achieve environmental objectives. One goal of this *Statewide Total Maximum Daily Load (TMDL)* report is to provide the necessary tools and information to help communities, watershed groups, and other stakeholders to implement the TMDL using a phased, community-based approach that will ultimately result in attainment of water quality standards.

4.4. Rhode Island's 2010 303(d) List

This *Statewide Bacteria Total Maximum Daily Load (TMDL)* report serves as TMDL documentation of 57 of the bacteria impaired waters on Rhode Island's 2010 303(d) List (Table 1-2). The scheduled date for TMDL development for these impaired waterbodies is 2011. Section 8 of this report provides a list of all 57 impaired segments and reductions required to meet the TMDL allocation. Appendices A through L contain brief summaries of each impaired segment including a bacteria data summary and GIS-based maps showing sampling locations and surrounding watershed areas. Figure 1-1 shows the Rhode Island bacteria impaired waters with the Watershed Planning Areas indicated.

5.0 TMDL Development

This section provides a description of a total maximum daily load (TMDL) and the components of the TMDL calculation. The method applied to determine TMDL allocations for bacteria in Rhode Island is also described along with specific allocations for each type of waterbody in the state. Lastly, this section provides descriptions of other components of the TMDL allocation process, such as a margin of safety factor, calculations of bacteria statistics and percent reductions, seasonal considerations, and public participation.

5.1. Definition of a TMDL

According to the Federal Code of Regulations that govern water quality and management, a TMDL identifies the pollutant loading a waterbody can assimilate per unit time without violating water quality standards (40 CFR Part 130.2). The TMDL for a waterbody is equal to the sum of the individual loads from point sources (i.e. waste load allocations or WLAs), and load allocations (LAs) from non-point sources (including background conditions). Section 303(d) of the Clean Water Act also states that the TMDL must be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety (MOS) which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

In equation form, a TMDL is expressed as follows:

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS}$$

where, WLA = waste load allocation, LA = load allocation, and MOS = margin of safety.

TMDLs can be expressed in terms of mass per time (i.e. daily load), concentration, or other appropriate measure (40 CFR Part 130.2 (i)). The MOS can be either implicit or explicit. If the MOS is implicit, a specific value is not assigned to the MOS. Use of an implicit MOS is appropriate when assumptions used to develop the TMDL are believed to be so conservative that they are sufficient to account for the MOS. If an explicit MOS is used, a portion of the total allowable loading is actually allocated to the MOS.

5.2. TMDL Allocations

Rhode Island bacteria TMDLs are expressed as concentrations and are set equal to state's water quality criteria for bacteria. TMDLs can also be expressed as daily loads in terms of numbers of organisms/day, and are included in Appendix M. The Rhode Island water quality criteria are expressed as statistical metrics based on sets of bacteria concentration measurements. Specifically, Rhode Island uses the geometric mean concentration for enterococci, and the geometric mean and 90th percentile bacteria concentrations for fecal coliform, based on analyses of sets of ambient water samples. Each of these statistical metrics is defined in Section 2.2. The concentration-based TMDL is considered to apply daily because daily values are used to calculate the geometric means and percent variability.

For the purposes of implementation and the reasons expressed below, it is recommended that the concentration be used to set percent reductions.

- Expressing bacteria TMDL reductions in terms of concentration provides a direct link between existing water quality and numeric water quality criteria;
- Using concentration to set TMDL reductions is more relevant and consistent with water quality standards, which apply for a range of flow and environmental conditions;
- Expressing bacteria TMDL reductions as daily loads (e.g., as number of organisms per day) can be more confusing to the public and can be difficult to interpret since they are dependent on flow conditions.

Concentration-based bacteria TMDLs set the WLA and LA equal to the ambient water quality criterion and compliance is measured at ambient stations representative of conditions throughout the water body. Consequently, the Rhode Island bacteria TMDLs represent very conservative TMDL target-setting. There is a high level of confidence that the TMDLs established are consistent with water quality standards, and the entire loading capacity can be allocated among sources.

These concentration-based bacteria TMDLs allocate the load among sources, identifying WLAs for point sources and LAs for non-point sources and natural background. Tables 5-1 through 5-3 present concentration-based WLAs and LAs by designated use, waterbody class, and potential bacteria source, based on current water quality standards for drinking water, primary/secondary contact recreation and shellfish consumption (as described in Section 2.2). These tables are

lengthy and detailed, containing numerous concentration-based limits, because there are many combinations of the several types of waterbodies and several types of bacteria sources in the state. The tables are intended to enable stakeholders to efficiently look up the applicable bacteria water quality criterion for a specific type of waterbody and source. As noted above, the TMDLs are also expressed as daily loads. See Appendix M for graphs, tables, and equations that express the TMDLs as daily loads.

The numeric value of the WLA and LA depend on whether the source of bacteria is prohibited or allowable, and on the appropriate water quality criterion for the receiving water, as follows:

- If the source of the bacteria load is prohibited, then the WLA and LA are set to zero. For example, discharges of wastewater to Class A waters and discharges of untreated wastewater to any surface water from sources such as illicit discharges to stormwater systems, sanitary sewer overflows, boats, and failed OWTS are prohibited and would receive bacteria load allocations of zero.
- If the source of the bacteria load is allowable, the WLA is set equal to the applicable water quality criterion for bacteria and compliance is measured at ambient stations representing conditions throughout the waterbody.

Table 5-1: Waste Load Allocations (WLA) and Load Allocation (LA) for Freshwater^o

Class	Source	Enterococci Geometric Mean Colonies/100 mL		Fecal Coliform Geometric Mean MPN/100 mL		Fecal Coliform 90 th Percentile MPN/100 mL	
		WLA ¹	LA ¹	WLA ¹	LA ¹	WLA ¹	LA ¹
AA*	RIPDES Wastewater Sources ²	0	NA	0	NA	0	NA
	RIPDES Stormwater ^{1,3}	--	NA	--	NA	--	NA
	Non-RIPDES Stormwater or Groundwater ^{1,5}	NA	--	NA	--	NA	--
	Illicit Wastewater Discharges ⁶	0	0	0	0	0	0
	Other Non-Point Source ⁷	NA	54	NA	20	NA	200
AA** A ⁸	RIPDES Wastewater Sources ²	0	NA	0	NA	0	NA
	RIPDES Stormwater ^{1,3}	--	NA	--	NA	--	NA
	Non-RIPDES Stormwater or Groundwater ^{1,5}	NA	--	NA	--	NA	--
	Illicit Wastewater Discharges ⁶	0	0	0	0	0	0
	Other Non-Point Source ⁷	NA	54 / 33 ⁸	NA	200	NA	400
B ⁸	RIPDES Wastewater Sources ²	0	NA	0	NA	0	NA
	RIPDES Stormwater ^{1,3}	--	NA	--	NA	--	NA
	Non-RIPDES Stormwater or Groundwater ^{1,5}	NA	--	NA	--	NA	--
	Illicit Wastewater Discharges ⁶	0	0	0	0	0	0
	Other Non-Point Source ⁷	NA	54 / 33 ⁸	NA	200	NA	400
B1 ⁸	RIPDES Wastewater Sources ²	54 / 33 ⁸	NA	200	NA	400	NA
	RIPDES Stormwater ^{1,3}	--	NA	--	NA	--	NA
	Non-RIPDES Stormwater or Groundwater ^{1,5}	NA	--	NA	--	NA	--
	Illicit Wastewater Discharges ⁶	0	0	0	0	0	0
	Other Non-Point Source ⁷	NA	54 / 33 ⁸	NA	200	NA	400

^oFootnotes are located in Table 5-3.

*Applied only at the terminal reservoir.

**Applies to waters within a public drinking water supply when the water is not the terminal reservoir.

Table 5-2: Waste Load Allocations (WLA) and Load Allocations (LA) for Saltwater^o

Class	Source	Enterococci Geometric Mean Colonies/100 mL		Fecal Coliform Geometric Mean MPN/100 mL		Fecal Coliform 90 th Percentile MPN/100 mL	
		WLA ¹	LA ¹	WLA ¹	LA ¹	WLA ¹	LA ¹
SA SA{b} ⁹	RIPDES Wastewater Sources ²	0	NA	0	NA	0	NA
	RIPDES Stormwater ^{1,3}	--	NA	--	NA	--	NA
	Non-RIPDES Stormwater or Groundwater ^{1,5}	NA	--	NA	--	NA	--
	Illicit Wastewater Discharges ⁶	0	0	0	0	0	0
	Other Non-Point Source ⁷	NA	35	NA	14	NA	49
SB ⁸	RIPDES Wastewater Sources ²	0	NA	0	NA	0	NA
	RIPDES Stormwater ^{1,3}	--	NA	--	NA	--	NA
	Non-RIPDES Stormwater or Groundwater ^{1,5}	NA	--	NA	--	NA	--
	Illicit Wastewater Discharges ⁶	0	0	0	0	0	0
	Other Non-Point Source ⁷	NA	35	NA	50	NA	400
SB1 ⁸	RIPDES Wastewater Sources ²	35	NA	50	NA	400	NA
	RIPDES Stormwater ^{1,3}	--	NA	--	NA	--	NA
	Non-RIPDES Stormwater or Groundwater ^{1,5}	NA	--	NA	--	NA	--
	Illicit Wastewater Discharges ⁶	0	0	0	0	0	0
	Other Non-Point Source ⁷	NA	35	NA	50	NA	400

^oFootnotes are located in Table 5-3.

Table 5-3: Notes for Tables 5-1 and 5-2

1. Unless otherwise stated by statute or regulation, compliance with this TMDL will be based on ambient concentrations.
2. RIPDES Wastewater Sources include all point source discharges regulated under the RIPDES permit program excluding stormwater covered under the RIPDES stormwater permit program. An example includes municipal WWTPs; ambient bacteria criteria shall be applied at the end of the discharge pipe.
3. RIPDES Stormwater includes all stormwater regulated under the RIPDES stormwater permit program, such as stormwater under the Municipal Separate Storm Sewer Systems (MS4) General Permit, the Construction General Permit (CGP), and the Multi-Sector General Permit (MSGP).
4. Per Rule 8.1.d of the Rhode Island Water Quality Regulations, primary contact recreation in Class B1 and Class SB1 waters may be impacted due to pathogens from approved wastewater discharges. However, all Class B or Class SB1 criteria must be met.
5. Non-RIPDES Stormwater or Groundwater includes stormwater not regulated under the RIDPES stormwater program, agricultural runoff, and groundwater discharges to surface waters.
6. Discharges of untreated wastewater are prohibited. Examples of point source discharges of untreated wastewater include sanitary sewer overflows, illicit connections to storm drains, and discharges of sewage from boats. An example of a non-point source discharge is a failed OWTS that conveys untreated or partially treated wastewater to surface water by groundwater or Non-RIPDES stormwater.
7. Other Non-Point Source Pollution into surface waters includes bacteria from agricultural runoff, from humans contacting surface water by swimming or wading (i.e. bathing load), and from domestic and wild animals and birds.
8. Class A, B, B1, SA, SA{b}, SB, and SB1 waters are designated as non-designated beaches (NDB) or designated beaches (DB). Freshwater designated beaches have stricter water quality standards.
9. Class SA and SA{b} waters are assessed for both shellfish consumption and primary/secondary contact recreation. The fecal coliform allocations are for shellfishing use. Since these standards are stricter than those for primary/secondary contact recreation; they are protective of this use. The enterococci allocations are for primary/secondary contact recreation only.

5.3. Margin of Safety

The margin of safety (MOS) is a required TMDL component designed to account for assumptions or lack of knowledge about linking loading allocations with water quality impairment. The MOS can be either explicit or implicit. An explicit margin of safety equal to an additional five percent of the calculated percent reduction was assumed to conservatively

account for possible uncertainties in the analysis. In cases where the percent reductions is calculated to be more than 95%, the MOS may be less than 5% to ensure that the percent reduction is not more than 100%. Appendix M explains the MOS for TMDLs expressed as daily loads.

5.4. Wet/Dry Weather Analysis Methodology

Wet or dry weather status (i.e., whether or not it has rained recently) concurrent with sampling events has been found to be a useful data characteristic. This analysis enables investigators to evaluate whether or not bacteria violations occur during wet or dry weather conditions, supporting the identification and prioritization of bacteria pollutant sources for mitigation. Since most of the bacteria data presented in the watershed-specific appendices were collected without noting the weather conditions, the RIDEM TMDL section characterized the rainfall status for the 57 waterbody segments covered by this TMDL using the method described below.

RIDEM used daily rainfall data from NOAA and Weather Underground. Rainfall amounts were gathered from the five locations listed below. A rainfall station was assigned to each sampling location based on geography, knowledge of Rhode Island rainfall patterns, and watershed. A map of the approximate sampling sites, as well as the rainfall stations can be found here: <http://goo.gl/maps/dqho>. The rainfall location used for each waterbody segment is included in its appendix.

- Warwick (TF Green Airport) was used for was stations in central Rhode Island, including stations in the Pawtuxet River watersheds. Information was given to RIDEM from NOAA.
- Kingston (URI) was used for stations in southern Rhode Island, including all stations in the Wood-Pawcatuck watershed and stations in North Kingstown. Information was given to RIDEM from NOAA.
- Newport was used for stations on Aquidneck Island and in Tiverton, RI. Kingston was used when Newport rain information was not available. Information was gathered from <http://WeatherUnderground.com>.
- Lincoln was used for stations in northern Rhode Island, including stations in the Blackstone River watershed. Information was gathered from <http://WeatherUnderground.com>.

- Willimantic was used for two stations in Foster. Information was gathered from <http://WeatherUnderground.com>.

The available precipitation data used for this analysis does not include hourly rainfall information. Since weather classification is being used to target implementation measures, not set percent reductions, an assumption was made that any rainfall that fell on the sampling day occurred before collecting the sample. If the rain actually fell after sample collection, the sample may be misclassified as wet weather.

The following rule was used to indicate wet weather: >0.1” in the past 24 hours; or >0.25” in the past 48 hours; or >2.0” in the past 96 hours. Using Excel, this rule was applied to all data. If the wet weather criteria were met, a “wet” designation was placed in a cell. A “dry” designation was given when the wet weather criteria was not met.

5.5. Estimated Bacteria Reduction Calculation Methodologies

Required TMDL reductions were calculated using sets of bacteria data. These methods are consistent with RIDEM water quality standards and USEPA guidelines for statistical analysis of bacteria data. Specifically, Rhode Island uses the geometric mean from populations of fecal coliform, enterococci, and *E.coli* (when necessary) bacteria data to determine compliance with water quality standards (as described in Section 2). For fecal coliform, 90th percentile statistics are also used to determine compliance.

Geometric means of bacteria data sets were calculated for all sampling stations in all impaired segments. Geometric means are often used to evaluate data spanning several orders of magnitude to remove the influence of any one particularly high or low data point. By definition, the geometric mean is the average of the logarithmic values, converted back to a base 10 number. Geometric means are calculated using the following equation:

$$\text{Geometric Mean} = n^{\text{th}} \text{ root of } (x_1)(x_2)\dots(x_n)$$

where, x_1 , x_2 , etc. represent individual data points and n is the total number of data points used in the calculation (Costa, 2011).

For segments impaired for fecal coliform, the 90th percentile values were also calculated for each sampling station. A 90th percentile concentration indicates that 90 percent of the values in a

dataset are less than or equal to this value. The 90th percentile concentrations are calculated by arranging the data in ascending order and applying the following equation:

$$K = [(n+ 1) * 90]/100$$

where K equals the location of the 90th percentile in the ordered values, and n equals the number of data points (USFDA, 2009).

For this TMDL, the geometric mean values were calculated using the GEOMEAN function in Microsoft Excel, while 90th percentile values were calculated using the PERCENTILE function.

In each impaired segment, the sampling station with the highest geometric mean and/or 90th percentile statistical value in relation to the applicable criterion was then used to calculate a percent reduction for bacteria for each segment. These TMDL reductions provide a rough estimation of the pollution abatement action needed for each segment to meet water quality standards. The percent reduction needed is calculated based on the difference between measured ambient bacteria data and the applicable water quality criterion for bacteria.

For example, if the highest geometric mean from a specific Class A segment impaired for fecal coliform is 500 MPN/100mL and the geometric mean water quality standard is 200 MPN/100ml, the percent reduction needed to meet the geometric mean criteria is calculated as follows:

$$\text{Initial percent reduction} = [(500 - 200)/500] \times 100 = 60\% \text{ reduction}$$

In addition, a 5% margin of safety was applied to the initial percent reduction:

$$\text{Final percent reduction} = 60\% + 5\% (\text{MOS}) = 65\% \text{ reduction}$$

In waterbodies where the 5% margin of safety would result in more than a 100% reduction, the percent reduction is set to 100%.

The results of this analysis for each sampling station and each impaired segment are provided in the appendices. The sampling stations with the highest geometric mean or 90th percentile values and the associated required reductions are provided in Table 8-2 by impaired segment.

The reductions necessary to achieve the TMDLs are based on estimates of current bacteria concentrations. Future development activities and land use changes have the potential to increase levels of bacteria or stormwater runoff associated with bacterial pollutants. These future activities will need to meet the TMDLs and be addressed in applicable watershed management plans and by state or local requirements.

5.6. Seasonal Considerations

Rhode Island's bacteria water quality criteria are applicable at all times. Since the TMDLs are set equal to the bacteria criteria, they are also applicable at all times and are therefore protective of water quality under all conditions and seasons.

5.7. Public Participation

USEPA regulations require that calculations to establish TMDLs be subject to public review (40 CFR 130.7 (c) (ii)). In June 2011, RIDEM hosted two public meetings to present the draft Rhode Island Statewide TMDL for Bacteria Impaired Waters for public review and comment. Presentations included information about the development of the core document and appendices, data sources and calculations, and the implementation requirements of the TMDL. The first meeting was held on June 28, 2011 at the RIDEM offices in Providence, RI, and the second meeting was held on June 29, 2011 at the Exeter Public Library in Exeter, RI. Thirty-five people representing the general public and the following organizations attended the meetings:

Breakwater Preservation

City of Cranston

ecoRI

EJ Prescott

Friends of the Mosshasuck

Narragansett Bay Commission

Narragansett Bay Estuaries Partnership

Rhode Island Audubon Society

Rhode Island Department of Environmental Management

Rhode Island Department of Transportation

Save the Bay
Town of Charlestown
Town of Jamestown
Town of Johnston
Town of Middletown
Town of North Kingstown
Town of North Providence
Town of South Kingstown
Town of West Greenwich
U.S. Environmental Protection Agency
Urban Pond Procession
Woodard and Curran
Wood-Pawcatuck Watershed Association
Woonasquatucket River Watershed Council

The public meetings began the public comment period, which ended on Monday, August 1, 2011. Letters were sent by email to key stakeholders in advance of this meeting. In addition, the meeting was publicized in a press release and public notices, which were posted at the RIDEM offices and at the Exeter Public Library. RIDEM posted the draft TMDL on its website more than two weeks before the public meeting. RIDEM received comments from Save the Bay, the Town of South Kingstown, the Town of Jamestown, and Rhode Island Department of Transportation during the public comment period. **The RIDEM response to these comments is found in Appendix N.** Where appropriate; the document was revised in response to comments received.

5.8. Monitoring Plans

Pending availability of resources, the long-term monitoring plan for Rhode Island's bacteria impaired waters includes several components, as listed below.

1. Continue monitoring of rivers and streams through the RIDEM Rotating Basin Assessments of Rivers and Streams Program;

2. Continue the Rhode Island HEALTH Bathing Beach Monitoring Program;
3. Continue the RIDEM Shellfish Growing Area Monitoring Program;
4. Continue using data from the Narragansett Bay Commission Monitoring Program;
5. Continue relying upon bacteria data collected by the volunteer-based URI Watershed Watch program; and
6. Continue to investigate complaints and inspect potential sources of bacteria.

5.9. Reasonable Assurance

USEPA guidance requires that in waters “impaired by both point and non-point sources, where a point source is given a less stringent wasteload allocation based on an assumption that non-point source load reductions will occur, reasonable assurance must be provided for the TMDL to be approvable” (USEPA, 2001a). This TMDL does not include less stringent WLAs for point sources based on anticipation of LA reductions from non-point sources, and therefore, a reasonable assurance demonstration is not required. Successful reduction in non-point sources depends on the willingness and motivation of stakeholders to get involved and the availability of private, federal, state, and local funds.

A set of regulations and ongoing programs designed to assure that bacteria wasteloads comply with water quality standards are provided in Section 6 - Implementation Plan below. These include state and federal programs to address stormwater, OWTS, pet waste, and other sources of bacteria pollution.

6.0 Implementation Plans

The Rhode Island Bacteria TMDLs quantify the reductions in ambient bacteria concentrations required to achieve water quality standards. An implementation plan is needed to achieve the reductions specified in the TMDL. The success of TMDL implementation efforts rests largely with watershed stakeholders. Implementation plans provide guidance to stakeholders by specifying mitigative actions designed to restore the waterbody and meet water quality criteria. This implementation plan section provides general guidance for developing more detailed watershed plans to address water pollution caused by potentially harmful bacteria in Rhode Island's surface waters.

Implementation activities focus on stormwater, wastewater, and animal management. The large amount of impervious area within the immediate watershed increases the amount of runoff and bacteria that enter the waterways during and immediately after wet weather events. As the amount of impervious area in a watershed increases, the peak runoff rates and runoff volumes generated by a storm increase because developed lands have lost much or all of their natural capacity to delay, store, and infiltrate water. As a result, bacteria from streets, lawns, wildlife, and domestic pets quickly wash off during storm events and discharge into the nearby waterbodies. Achieving standards requires that both the quantity of stormwater and the bacteria concentrations in that stormwater reaching impaired streams be reduced. Mitigation activities for stormwater should focus on urbanized stormwater runoff. Wastewater management activities include adopting wastewater management ordinances in areas without sewers to ensure that OWTS are properly maintained and operated, maintaining sewage collection and treatment systems to avoid sewage overflows, and ensuring that boaters fully utilize pump-out facilities. Other recommendations include minimizing fecal contamination from domestic animals, farm animals, waterfowl, and wildlife. Mitigative activities for each type of bacteria sources are described below.

It is acknowledged that in some circumstances, it may be determined that even after implementation of point source and non-point source controls that water quality improvements are not sufficient to meet applicable bacteria criteria. In these cases, removal/partial removal of a designated use, such as primary contact recreation or shellfish harvesting use from specific water bodies through the Use Attainability Assessment process (see 40 CFR 131.10(g)), could be considered. In that case, it would first be necessary to confirm that the use in question is not an existing use (which would preclude use removal under federal regulations) and then to define the highest attainable use (and associated criteria) that is closest to the use being removed. The evaluation of the highest attainable use should reflect the factors and constraints on the

attainability of a use that were evaluated as part of the UAA process. The highest attainable use (and associated criteria) needs to be determined taking into account the capability of the natural system as well as the technical and economic limitations of human sources throughout the basin that affect the site. While DEM agrees that a UAA is a potential tool to address water quality standards violations, given the applicable federal Clean Water Act requirements it is not expected to substantially change the actions required to address impairments.

6.1. Types of Implementation Measures to Restore Impaired Waters

Sections 6.3 through 6.10 contain information on **Best Management Practices (BMPs)** to reduce the amount of bacteria entering Rhode Island's surface waters. BMPs are either structural or non-structural.

Structural BMPs are engineered constructed systems that can be designed to provide water quality and/or water quantity control benefits. Structural BMPs are used to address both existing watershed impairments and the impacts of new development. Common structural BMPs include the following:

- *Infiltration systems*: designed to capture stormwater runoff, retain it, and encourage infiltration into the ground;
- *Detention systems*: designed to temporarily store runoff and release it at a gradual and controlled rate (considered acceptable for flood control only);
- *Retention systems*: designed to capture a volume of runoff and retain that volume until it is displaced in part or whole by the next runoff event (considered acceptable for flood control only);
- *Wet vegetated treatment systems*: designed to provide both water quality and water quantity control; and
- *Filtration systems*: designed to remove particulate pollutants found in stormwater runoff through the use of media such as sand, gravel or peat.

Best Management Practices (BMPs) are effective, practical, structural, or non-structural methods which prevent or reduce the movement of pollutants from the land to surface or ground water. BMPs are designed to protect water quality and to prevent new pollution.

The Rhode Island Stormwater Design and Installation Standards Manual (December 2010) contains detailed specifications for the design of these BMPs that can be used to meet water quality objectives. Non-structural BMPs are a broad group of practices designed to prevent pollution through maintenance and management measures. They are typically related to the improvement of operational techniques or the performance of necessary stewardship tasks that are of an ongoing nature. These include institutional and pollution-prevention practices designed to control pollutants at their source and to prevent pollutants from entering stormwater runoff. Non-structural measures can be very effective at controlling pollution generation at the source, thereby reducing the need for costly “end-of-pipe” treatment by structural BMPs. Examples of non-structural BMPs include maintenance practices to help reduce pollutant contributions from various land uses and human operations, such as street sweeping, road and ditch maintenance, or specifications regarding how and when to spread manure or sludge.

Structural and non-structural BMPs are often used together. Effective pollution management is best achieved from a management systems approach, as opposed to an approach that focuses on individual practices. Some individual practices may not be very effective alone, but in combination with others, may be more successful in preventing water pollution.

Effective BMP implementation should focus on reducing existing pollutant sources and preventing new pollutant sources. Once pollutants are present in a waterbody, it is much more difficult and expensive to restore to an unimpaired condition. Therefore, developing management systems that rely on preventing degradation of receiving waters is recommended.

Rhode Island’s programs to support reduction of ambient bacteria are described below and are organized by type of bacteria source. The sections below provide descriptions of various mitigation measures, relevant state and federal regulations, and useful web links to information resources for stormwater, onsite wastewater management, boats and marine pump out facilities, waterfowl, wildlife, and domestic pets, and agriculture.

6.2. Rhode Island Pollutant Discharge Elimination System (RIPDES) Phase II Stormwater Program

Stormwater runoff is most often carried to waterways by publicly owned drainage networks. Historically, these storm drain networks were designed to carry stormwater away from developed land as quickly as possible to prevent flooding with little to no treatment of pollutants. In 1999, the USEPA finalized its Stormwater Phase II rule, which required the operators of small

municipal separate storm sewer systems (MS4s) to obtain permits and to implement a stormwater management program as a means to control polluted discharges. In Rhode Island, the RIDEM RIPDES Program administers the Phase II program using a General Permit that was established in 2003 (RIDEM, 2003a). Rhode Island municipalities, the Rhode Island Department of Transportation (RIDOT), and Federal, State, and Quasi-State agencies serving more 1000 people per day (e.g. University of Rhode Island) are regulated under the Phase II program.

Stormwater Management Programs – SWMPPs and Six Minimum Measures

The Phase II Program requires MS4 operators to develop a stormwater management program that is based on six minimum measures. Operators develop Stormwater Management Program Plans (SWMPPs) that detail how their stormwater management programs comply with the Phase II regulations. SWMPPs describe BMPs for the six minimum measures, including measurable goals and schedules. The implementation schedules include interim milestones, frequency of activities, and result reporting. Plans also include any additional requirements that are mandated for stormwater that discharges to impaired waters.

The six minimum measures are listed below.

- A public education and outreach program to inform the public about the impacts of stormwater on surface water bodies;
- A public involvement/participation program;
- An illicit discharge detection and elimination program;
- A construction site stormwater runoff control program for sites disturbing 1 or more acres;
- A post construction stormwater runoff control program for new development and redevelopment sites disturbing 1 or more acres; and
- A municipal pollution prevention/good housekeeping operation and maintenance program.

In general, municipalities and RIDOT were automatically designated as part of the Phase II program if they were located either completely or partially within census-designated urbanized

or densely populated areas. Densely populated areas have a population density greater than 1000 people per square mile and a total population greater than 10,000 people. Figure 6-1 provides the location of urban and densely populated areas in Rhode Island. Table 6-1 provides Rhode Island municipalities requiring Phase II permits. Figure 6-1 also includes RIDOT divided highways outside the urbanized or densely populated areas that were also designated as part of the Phase II program. In addition to RIDOT, non-municipal MS4 operators include federal, state, and quasi-state facilities serving an average daily population equal to or greater than 1,000 people, regardless of location. Facilities included in this category include the University of Rhode Island in Kingston, Naval Station Newport, and the Pastore Complex in Cranston.

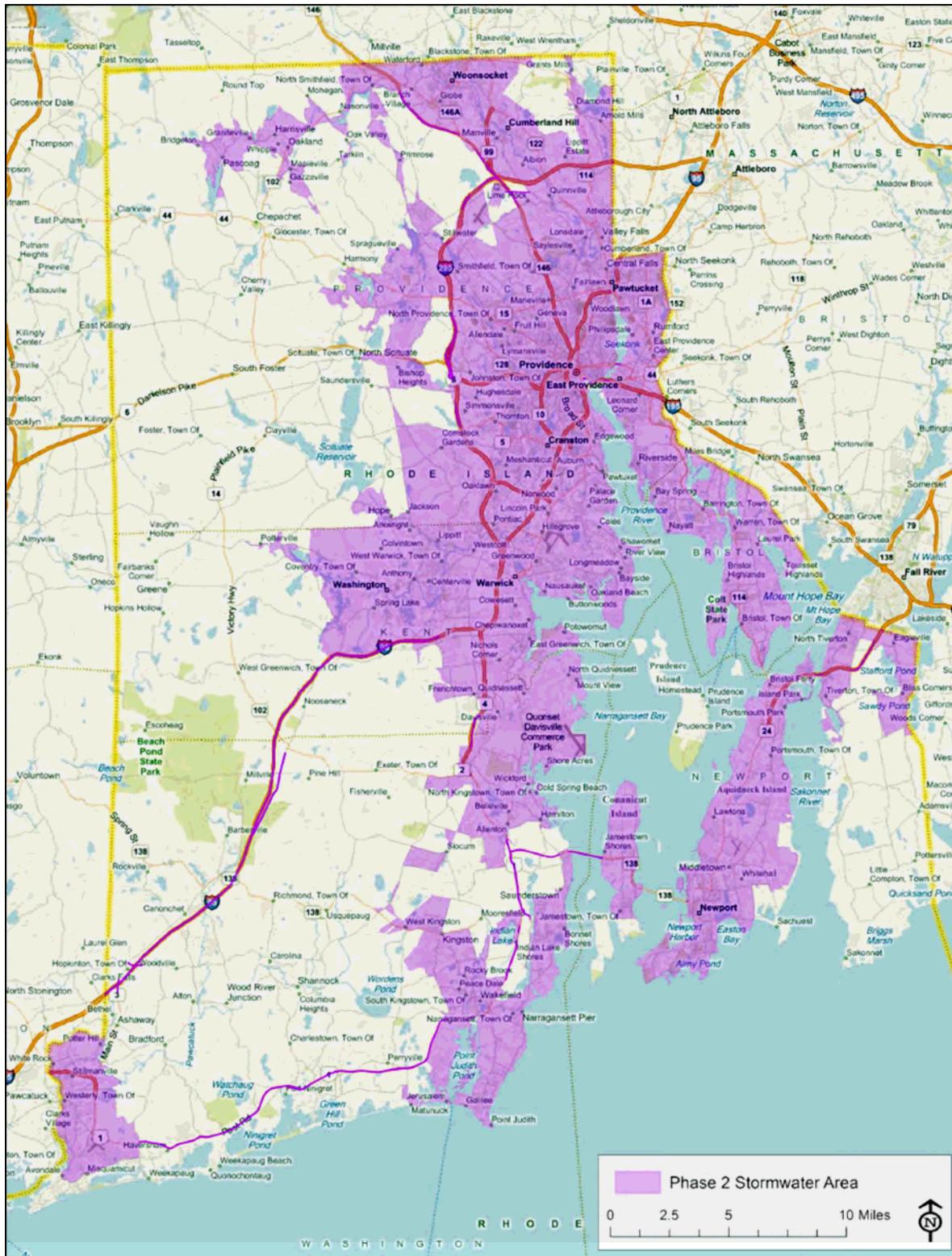


Figure 6-1: Municipalities in Rhode Island requiring a Phase II Permit

Table 6-1: Municipalities in Rhode Island Requiring Phase II Permits for Small MS4s

Population	Municipalities
> 10,000 in Urbanized Area (UA)	Barrington (C), Bristol (C), Central Falls (C), Coventry (P), Cranston (C), Cumberland (P), East Greenwich (P), East Providence (C), Johnston (P), Lincoln (P), Middletown (P), Narragansett (C), Newport (C), North Kingstown (P), North Providence (P), Pawtucket (C), Portsmouth (P), Providence (C), Smithfield (C), South Kingstown (P), Tiverton (P), Warren (P), Warwick (C), West Warwick (C), Woonsocket (C)
>10,000 in Densely Populated Area (DPA)*	South Kingstown (P), Westerly (P)
1,000 – 10,000 in Urbanized Area (UA)*	Burrillville (P), Glocester (P), Jamestown (P), North Smithfield (P), Scituate (P), Exeter (P)
< 1,000 in Urbanized Area (UA)*	West Greenwich (P)
<p>*denotes that entity may be eligible for a waiver (C) – Located completely within an urbanized area. (P) – Located partially within an urbanized or densely populated area.</p>	

Required SWMPP Amendments to TMDL Provisions

In Rhode Island, Part IV.D of the Phase II General Permit requires MS4 operators to address TMDL provisions in their SWMPP if the approved TMDL determines that urban stormwater is contributing to the impairment. Operators must comply with Phase II TMDL requirements if they contribute stormwater to priority outfalls, even if they do not own the outfall. Operators are legally responsible for pollutants transported via their drainage systems including bacteria sources from wildlife that enter MS4 drainage systems. Operators must identify amendments needed to their current SWMPP to comply with TMDL requirements. Operators must also address any previously non-regulated areas that are brought into the Phase II program as part of a TMDL, and are encouraged to apply their requirements town-wide. To avoid confusion and to better track progress, the SWMPP amendments should be addressed in a separate TMDL Implementation Plan (TMDL IP). Upon approval of a TMDL, towns and RIDOT should make revisions in their TMDL IP. The 2003 RIPDES General Permit requires that the revisions (i.e. TMDL IP) be submitted within one hundred and eighty (180) days of the date of written notice from RIDEM as described in more detail below (RIDEM, 2003a).

TMDL Implementation Plan Requirements

The TMDL IP must address all parts of the watershed that discharge to the impaired water and all impacts identified in the TMDL, including those areas that are brought into the Phase II program as part of a TMDL. MS4 operators must provide measurable goals for the development and/or implementation of the amendments to the six minimum measures and as relevant, for additional structural and non-structural BMPs that will be necessary to address the stormwater impacts identified in this TMDL.

TMDL IP requirements include an implementation schedule, which must contain all major milestone deadlines, including start and finish calendar dates, estimated costs, proposed or actual funding sources, and anticipated improvement(s) to water quality. As mentioned previously, these requirements apply to any operators of MS4s contributing stormwater to specifically identified outfalls, regardless of outfall ownership.

The TMDL IP must specifically address the following requirements that are described in Part IV.D of the RIPDES Stormwater General Permit (RIDEM, 2003b).

1. Determine the land areas contributing to the discharges identified in the TMDL using sub-watershed boundaries, as determined from USGS topographic maps or other appropriate means;
2. Address all contributing areas and the impacts identified by the Department;
3. Assess the six minimum control measure BMPs and additional controls currently being implemented or that will be implemented to address the TMDL provisions and pollutants of concern and describe the rationale for the selection of controls including the location of the discharge(s);
4. Identify and provide tabular description of the discharges identified in the TMDL including:
 - a. Location of discharge (latitude/longitude and street or other landmark);
 - b. Size and type of conveyance (e.g. 15" diameter concrete pipe);
 - c. Existing discharge data (flow data and water quality monitoring data);
 - d. Impairment of concern and any suspected sources(s);

- e. Interconnections with other MS4s within the system;
 - f. TMDL provisions specific to the discharge; and
 - g. Any additional outfall/drainage specific BMP(s) that have or will be implemented to address TMDL provisions.
5. If the TMDL does not recommend structural BMPs, the TMDL IP must evaluate whether the six minimum measures alone (including any revisions to ordinances) are sufficient to meet the TMDL plans specified pollutant reduction targets. The TMDL IP should describe the rationale used to select BMPs;
 6. If the TMDL determines structural BMPs are necessary, the TMDL IP must describe the tasks necessary to design and construct BMPs that reduce the pollutant of concern and stormwater volumes to the maximum extent feasible. The TMDL IP must describe the process and the rationale that will be used to select structural BMPs (or low impact development (LID) retrofits) and measurable goals to ensure that the TMDL provisions will be met. In a phased approach, operators must identify any additional outfalls not identified in the TMDL that contribute the greatest pollutant load and prioritize these for BMP construction. Referred to as a Scope of Work in the current permit, this structural BMP component of the TMDL IP must also include a schedule and cost estimates for the completion of the following tasks:
 - a. Prioritization of outfalls/drainage systems where BMPs are necessary. If not specified in TMDL, priority can be assessed using relative contribution of the pollutant of concern, percent effective impervious area, or pollutant loads as drainage area, pipe size, land use, etc. A targeted approach to constructing stormwater retrofit BMPs at state and locally owned stormwater outfalls is recommended;
 - b. Delineation of the drainage or catchment area;
 - c. Determination of interconnections within the system and the approximate percentage of contributing area served by each operator's drainage system, as well as a description of efforts to cooperate with owners of the interconnected system;
 - d. Completion of catchment area feasibility analyses to determine drainage flow patterns (surface runoff and pipe connectivity), groundwater recharge potentials(s), upland and end-of pipe locations suitable for siting BMPs

throughout the catchment area, appropriate structural BMPs that address bacteria, any environmental (severe slopes, soils, infiltration rates, depth to groundwater, wetlands or other sensitive resources, bedrock) and other siting (e.g. utilities, water supply wells, etc.) constraints, permitting requirements or restrictions, potential costs, preliminary and final engineering requirements;

- e. Design and construction of structural BMPs; and
 - f. Identification and assessment of all remaining discharges not identified in the TMDL owned by the operator contributing to the impaired waters addressed by the TMDL taking into consideration the factors addressed in paragraph iv above.
7. If the TMDL determines structural BMPs are necessary, but has not identified or prioritized outfalls/drainage systems for BMP construction, the TMDL IP must first identify and assess outfalls owned by the operator discharging directly to the impaired water or indirectly within 1 mile of the impaired water. The operator must then complete all tasks described in section f above.

6.3. MS4-Specific Requirements to Comply with RIPDES Phase II

The General Permit and Section 6.2 of this document contain the MS4 operator requirements needed to comply with the Phase II requirements for waters with a TMDL. The following sections contain the steps that towns and RIDOT would need to take to comply with RIPDES Phase II requirements if it is determined that urban stormwater is contributing to an impairment.

Past studies have shown a link between the amount of impervious area in a watershed and water quality conditions (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin et. al., 2000). In general, for implementation of this TMDL, bacteria impaired waters having watersheds with less than 10% impervious cover are assumed to be caused by sources other than urbanized stormwater runoff and MS4 operators will have no changes to their current Phase II permit requirements.

For impaired waterbodies having watersheds with impervious cover between 10% and 15%, MS4 operators must revise their post construction stormwater ordinances as described in detail below and continue to comply with the remaining minimum measures in developed areas. For the most part, these areas are currently regulated, but if they are not currently regulated, the MS4 regulated area may be expanded as described later in this section. Unless otherwise noted in the

waterbody summary, the only information that MS4 operators will be required to report in their TMDL IP regards the ordinance revisions and, if applicable, the regulated area expansion.

For waterbodies having watersheds with more than 15% impervious cover, MS4 operators will be required to revise their post construction ordinances as described in detail below and evaluate the sufficiency of the remaining minimum measures in achieving the TMDL provisions. In these cases, MS4s must comply with the relevant TMDL IP requirements described in the section above in numbers 1 through 5. For the most part, these areas are currently regulated, but if they are not currently regulated, the MS4 regulated area may be expanded as described later in this section.

Lastly, this TMDL determines in certain areas, the six minimum measures alone are insufficient to restore water quality and that structural BMPs are needed. In these cases, MS4s must comply with the relevant TMDL IP requirements described in the section (Numbers 1 through 7).

As stated above, these watershed percentage impervious cover thresholds will generally guide implementation of stormwater requirements. However, additional watershed specific information may result in different requirements for specific waterbodies regardless of the watershed percent impervious cover. The individual watershed-specific bacteria data and information summaries presented in the appendices describe the applicable stormwater requirements for each waterbody.

It is common for state-owned and municipal-owned storm drains to interconnect. RIDEM encourages cooperation between MS4 operators when developing and implementing the six minimum measures and in conducting feasibility analyses and determining suitable locations for the construction of BMPs. Communities affected by the Phase II program are encouraged to cooperate on any portion of, or an entire minimum measure when developing and implementing their stormwater programs.

Expansion of the MS4-Regulated Areas

Bacteria TMDLs may result in expansion of existing MS4-Regulated areas. The RIDES Regulations (Rule 31(a)(1)(vii)) allow RIDEM to designate discharges within a geographic area that contribute to a water quality violation (RIDEM, 2003b). When stormwater contributes to the impairment of receiving waters, MS4-Regulated areas may be expanded. Specifically, MS4 operators would be required to document that the six minimum measures apply to these

previously unregulated areas in town. As detailed in Part IV.D of the General Permit (RIDEM, 2003a), towns and RIDOT must evaluate whether the six minimum measures (including any revisions to ordinances) are sufficient to meet the TMDL plan's bacteria reduction targets in the expanded areas. In other words, MS4 operators will be required to comply with the relevant TMDL IP requirements described in the section (Numbers 1 through 5).

Evaluation of Sufficiency of Six Minimum Measures

In areas where stormwater has been found to contribute to the impairment, but that structural BMPs are not specifically recommended, evaluation shall be conducted to determine whether the six minimum measures alone are sufficient to meet the bacteria reduction targets. Consideration shall be given to the percent effective impervious area of the catchment area and pollutant loads as indicated by drainage area, pipe size, land use, known hot spots, and/or any sampling data. If these evaluations and measures determine that six minimum measures are insufficient, the MS4 will be required to describe modifications to their six minimum measures and/or the need for structural BMPs. The modifications and/or structural BMPs must be specified along with a schedule for implementation, as part of the TMDL Implementation Plan. Alternatively if the evaluation determines that no structural BMPs are needed, then the requirements would be considered satisfied at that time.

Modifications to Six Minimum Measures

As described previously, certain MS4 operators must assess the six minimum control measure BMPs included in their SWMPPs for compliance with this TMDL plan's provisions and provide measurable goals in the TMDL IP for any needed amendments. The operator must also describe the rationale for the selection of controls including the location of the discharge(s), receiving waters, water quality classification, shellfish growing waters, and other relevant information (General Permit Part IV.D.3.c). The following sections outline activities that towns and RIDOT should or must implement and/or consider when modifying their six minimum measures.

Public Education/Public Involvement

The public education program must focus on both water quality and water quantity concerns associated with stormwater discharges within the watershed. Public education material should target the particular audience being addressed, while public involvement programs should actively involve the community in addressing stormwater concerns.

An educational campaign targeted to residential land uses should include activities that residents can take to minimize water quality and water quantity impacts. Measures that can reduce bacteria contamination include proper OWTS maintenance, eliminating any wastewater connections to the storm drain network, proper disposal of pet waste, proper storage and disposal of garbage, and eliminating waterfowl feeding. Measures that can reduce the quantity of water that runs off during a wet weather event include decreasing effective impervious area and by providing on-site attenuation of runoff. Roof runoff can be infiltrated using green roofs, dry wells, or by redirecting roof drains to lawns and forested areas. Reducing land runoff can be accomplished by grading the site to minimize runoff and to promote stormwater attenuation and infiltration, creating rain gardens, and reducing paved areas such as driveways. Driveways can be made of porous materials such as crushed shells, stone, or porous pavement. Buffer strips and swales that add filtering capacity through vegetation can also slow runoff. Waterfront properties as well as those adjacent to hydrologically connected streams and wetland areas should establish and maintain natural buffers, planted with native plants, shrubs and/or trees to minimize impacts of development and restore valuable habitat.

Other audiences include commercial, industrial, and institutional property owners, land developers, and landscapers. In addition to the activities discussed above for residential land use, educational programs for these audiences could discuss BMPs that should be used when redeveloping or re-paving a site to minimize runoff and promote infiltration. Measures such as minimizing road widths, installing porous pavement, infiltrating catch basins, breaking up large tracts/areas of impervious surfaces, sloping surfaces towards vegetated areas, and incorporating buffer strips and swales should be used where possible. Section 6.4 discusses changes to the RI Stormwater Design and Installation Standards Manual (RIDEM and CRMC, 2010) that promote these measures using LID techniques.

The University of Rhode Island Cooperative Extension's Stormwater Phase II Public Outreach and Education Project provides participating MS4s with education and outreach programs that can be used to address TMDL public education recommendations. This project is funded by RIDOT and has many partners, including RIDEM. More information may be found on the URI website (<http://www.ristormwatersolutions.org/>).

Illicit Discharge Detection and Elimination

Illicit discharges are any discharge to a MS4 that is not composed entirely of stormwater with some exceptions. OWTS or sewer line wastewater connections to a storm drain result in the

discharge of untreated sewage to a waterbody. Sampling storm drains in dry weather can reveal illicit discharges.

Construction/Post Construction

MS4 operators are required to establish post construction stormwater runoff control programs for new land development and redevelopment at sites disturbing one or more acres (RIDEM, 2008a). Untreated stormwater runoff contains high bacteria loads, which may contribute significantly to the water quality problems. Land development and re-development projects must utilize best management practices if impaired surface waters are to be successfully restored. Consistent with the revised RI Stormwater Design and Installation Manual (RIDEM and CRMC, 2010), local ordinances meant to comply with the post construction minimum measures (General Permit Part IV.B.5.a.2.) must require that applicable development and re-development projects use LID techniques as the primary method of stormwater control to the maximum extent practicable and maintain groundwater recharge to pre-development levels.

As mentioned previously, examples of acceptable reduction measures include reducing impervious surfaces, sloping impervious surfaces to drain towards vegetated areas, using porous pavement, and installing infiltration catch basins where feasible. Other reduction measures to consider are the establishment of buffer zones, vegetated drainage ways, cluster zoning or low impact development, transfer of development rights, and overlay districts for sensitive areas. Section 6.4 discusses changes to the RI Stormwater Design and Installation Standards Manual (RIDEM and CRMC, 2010) that promote these measures using LID techniques.

To ensure consistency with the goals and recommendations of the TMDL, the TMDL IP must also address any revisions to local ordinances that are needed to ensure that:

- New land development projects employ stormwater controls to prevent any net increase in bacteria pollution to the impaired waterbodies; and
- Redevelopment projects employ stormwater controls to reduce bacteria pollution to the impaired waterbodies to the maximum extent feasible.

These runoff control programs also apply to MS4-owned facilities and infrastructure (General Permit Part IV.B.6.a.2 and Part IV.B.6.b.1). At a minimum, the TMDL IP must assess the impacts of imposing these requirements on lower threshold developments. The TMDL IP should

also assess and evaluate various enforceable mechanisms that ensure long-term maintenance of BMPs.

Good Housekeeping/Pollution Prevention

MS4 operators must identify the potential sources of pollution, including specifically the TMDL pollutant of concern (bacteria), which may reasonably be expected to affect the quality of stormwater discharges from their facilities; and describe and ensure implementation of practices, which the permittee will use to reduce bacteria in stormwater discharges from the facility. The SWPPP must address all areas of the facility and describe existing and/or proposed BMPs that will be used and at minimum must include the following:

- Frequent sweeping of roads, parking lots and other impervious areas;
- Effective management (storage and disposal) of solid waste and trash;
- Regular inspection and cleaning of catch basins and other stormwater BMPs; and
- Other pollution prevention and stormwater BMPs as appropriate.

Structural BMP Requirements

As described previously, this TMDL finds that in certain areas, the six minimum measures alone are insufficient to restore water quality and that structural BMPs are needed. The watershed-specific bacteria data and information summaries presented in the appendices identify those areas where structural BMPs are necessary. A BMP study must be completed that details the tasks necessary to design and construct BMPs that reduce the pollutant of concern and stormwater volumes to the maximum extent feasible. As noted previously, TMDL provisions apply to any MS4 operators contributing stormwater to the identified outfall regardless of outfall ownership. The BMP study should include all the components of Part IV.D.4 (RIDEM, 2003b) that were previously described in Number 6 in the TMDL IP section. It must evaluate the feasibility of distributing infiltration or equivalent BMPs throughout the drainage area of the priority outfalls as an alternative to end of pipe technologies since the amount of land available for BMP construction is limited.

6.4. LID and Future Development and Redevelopment

When possible, efforts by municipalities, land trusts and others to preserve open space should continue. As land is developed, it is critical that significant natural features be protected to maintain the area's unique characteristics and to prevent further degradation of water quality – as can be achieved through use of conservation development and LID techniques. Redevelopment projects represent opportunities to reduce the water quality impacts from the watershed's urbanized land uses by reducing impervious cover and/or attenuating runoff on-site. As described previously, municipal ordinances must be reviewed and revised to make sure that future development projects do not add to water quality problems and that redevelopment projects reduce contributions to the water quality problems in bacteria impaired water bodies.

In 2007, Rhode Island adopted the Smart Development for a Cleaner Bay Act (General Laws Chapter 45-61.2), requiring RIDEM and the Coastal Resources Management Council (CRMC) to update the Rhode Island Stormwater Design and Installations Manual. The manual was designed:

- To maintain groundwater recharge at pre-development levels;
- To maintain post-development peak discharge rates to not exceed pre-development rates; and
- To use low impact development techniques as the primary method of stormwater control to the maximum extent practicable.

The manual provides twelve minimum standards addressing LID Site Planning and Design Strategies, Groundwater Recharge, Water Quality, Redevelopment Projects, Pollution Prevention, Illicit Discharges, and Stormwater Management System Operation and Maintenance, among other concerns. This revised manual provides appropriate guidance for stormwater management on new development and redevelopment projects and, most importantly, incorporates LID as the “industry standard” for all sites, representing a fundamental shift in how development projects are planned and designed. Rhode Island joins a growing number of states and localities including the Puget Sound area (<http://www.psat.wa.gov/Programs/LID.htm>) that rely heavily on LID techniques to protect and restore their waters.

The revised Rhode Island Stormwater Manual was finalized in December 2010 and became effective January 1, 2011. A companion Rhode Island LID Site Planning and Design Guidance for Communities document is also available.

6.5. Stormwater from Industrial Activities

Facilities that discharge “stormwater associated with industrial activity” are regulated under the statewide general RIPDES permit prescribed in Chapter 46-12, 42-17.1 and 42-35 of the General Laws of the State of Rhode Island. As mentioned previously, stormwater is a major source contributing to the bacteria and bacteria-related impairments in Rhode Island surface waters. Stormwater from industrial activities may be discharged to these waters directly or via MS4s and may contain bacteria concentrations that contribute to the impairments.

In accordance with Part I.B.3.j of the RIPDES Multi-Sector General Permit (MSGP), permittees are required to demonstrate that the stormwater discharges are consistent with the TMDL once the TMDL has been approved. Permittees will have 90 days from written notification by RIDEM to submit this documentation, including revised Stormwater Pollution Prevention Plans (SWPPPs) to RIDEM.

The SWPPP must identify the potential sources of pollution, including specifically the TMDL pollutant of concern (bacteria), which may reasonably be expected to affect the quality of stormwater discharges from the facility; and describe and ensure implementation of practices, which the permittee will use to reduce bacteria in stormwater discharges from the facility. The SWPPP must address all areas of the facility and describe existing and/or proposed BMPs that will be used and at minimum must include the following:

- Frequent sweeping of roads, parking lots and other impervious areas;
- Effective management (storage and disposal) of solid waste and trash;
- Regular inspection and cleaning of catch basins and other stormwater BMPs; and
- Other pollution prevention and stormwater BMPs as appropriate.

Where structural BMPs are necessary, as stated in Part IV.F.7 of the permit, selection of BMPs should take into consideration:

- The quantity and nature of the pollutants, and their potential to impact the water quality of receiving waters;
- Opportunities to combine the dual purposes of water quality protection and local flood control benefits (including physical impacts of high flows on streams - e.g., bank erosion, impairment of aquatic habitat, etc.); and
- Opportunities to offset the impact of impervious areas of the facility on ground water recharge and base flows in local streams.

For existing facilities, the SWPPP must include a schedule specifying when each control will be implemented. Facilities that are not currently authorized will be required to demonstrate compliance with these requirements prior to authorization.

6.6. Stormwater - Best Management Practices Overview

In developed areas, such as small MS4 areas, large areas of natural landscape cover have been replaced with non-porous, or impervious, surfaces (e.g. homes, businesses, streets, and parking areas). Impervious surfaces change the character of runoff dramatically by causing water to remain on the land surface. Without slow percolation into the soil, water accumulates and runs off in larger quantities. This faster moving water washes soil from earth surfaces that are not securely held in place by structural means or healthy vegetation. Structural BMPs generally function by reducing and disconnecting these impervious surfaces, and minimizing the adverse impacts to receiving waters. Structural stormwater BMPs also collect and treat stormwater runoff before it is discharged.

Although structural BMPs are generally more costly than non-structural BMPs, an effective maintenance program will extend the life of stormwater controls and BMPs and avert expensive repair costs. Examples of structural stormwater BMPs include buffers, wet vegetated treatment system, sand filters, infiltration trenches, porous pavements, and rain gardens and other bioretention systems. Dense vegetative buffers facilitate bacteria removal through detention, filtration by vegetation, and infiltration into the soil. While the pollutant removal efficiency of BMPs will vary depending on local site characteristics and specific BMP design, construction, and maintenance considerations, the Center for Watershed Protection (CWP) has reported that bioretention, sand filters, and wet vegetated treatment system all typically perform well with respect to bacteria removal (CWP, 2007). Although few studies have yet formally assessed the effectiveness of infiltration practices on bacteria removal, these practices are widely considered

an effective option for bacteria because they are designed to reduce stormwater runoff volume and make use of the filtering capacity of the soil.

Stormwater – Available Resources

Rhode Island Stormwater Manual 2010 – This manual provides assistance to property owners, developers, engineers, consultants, contractors, municipal staff and others in planning, designing and implementing effective stormwater best management practices for the development and redevelopment of properties in Rhode Island. The primary purpose of the Stormwater Manual is to implement the “Smart Development for a Cleaner Bay Act of 2007” (the Act) (RIGL §23-45-61.2-1, et seq.). This Act requires that RIDEM and CRMC amend the 1993 version of the Stormwater Manual. As stated in the Act, “The changes shall include, but not be limited to, incorporation into existing regulatory programs that already include the review of stormwater impacts the following requirements:

- (a) Maintain pre-development groundwater recharge and infiltration on site to the maximum extent practicable;
- (b) Demonstrate that post-construction stormwater runoff is controlled, and that post-development peak discharge rates do not exceed pre-development peak discharge rates; and
- (c) Use low impact-design techniques as the primary method of stormwater control to the maximum extent practicable.”

To effectively avoid, minimize and manage the impacts of stormwater on stream channels, water quality, groundwater, wetland habitat, and flooding, extensive updates to the 1993 Stormwater Manual have been made – reflecting the state of the art in science and engineering practice concerning stormwater management. The revised Stormwater Manual specifies standards and design requirements for stormwater management on new development, redevelopment, and infill projects and, most importantly, requires LID as the “industry standard” for handling and treating stormwater, representing a fundamental shift in how development projects are planned and designed. Of particular relevance to achieving the pollutant reductions necessary to restore RI’s bacteria impaired waterbodies, is the manual’s requirement that redevelopment projects meeting certain threshold conditions incorporate water quality and groundwater recharge improvements for the existing developed site.

Online:

<http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/t4guide/desman.htm>

Rhode Island LID Site Planning and Design Guidance for Communities - This document provides guidance to communities regarding the site planning, design, and development strategies that communities should adopt to encourage low impact development.

Online: <http://www.dem.ri.gov/programs/bpoladm/suswshed/pdfs/lidplan.pdf>

RIDEM RIPDES Stormwater Page – This webpage provides information about Stormwater Phase I and Phase II programs as well as useful links to factsheets for Phase II permits, information on BMPs, and RIPDES regulations.

Online: <http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/index.htm>

NPDES Phase II Fact Sheets – The USEPA publishes a series of fact sheets regarding NPDES Stormwater Phase II final rules.

Online: <http://cfpub.epa.gov/npdes/stormwater/swfinal.cfm>

National Menu of Stormwater BMPs – The National Menu of BMPs for Stormwater Phase II was first released in October 2000. An updated version of this original webpage, including the addition of new fact sheets and the revision of existing fact sheets, is available through the USEPA website.

Online: <http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm>

University of New Hampshire Stormwater Center – The UNH Stormwater Center runs a facility that provides controlled testing of stormwater management designs and devices. Currently the Center is acting as a unique technical resource for stormwater practitioners by studying a range of issues for specific stormwater management strategies including design, water quality and quantity, cost, maintenance, and operations. The field research facility serves as a site for testing stormwater treatment processes, for technology demonstrations, and for conducting workshops. The testing results and technology demonstrations are meant to assist resource managers in planning, designing, and implementing effective stormwater management strategies. Detailed descriptions of multiple stormwater BMPs are available through their website and their annual reports.

Online: <http://www.unh.edu/erg/cstev/>

6.7. Onsite Wastewater Management

A properly designed and operating onsite wastewater treatment system (OWTS) prevents bacterial pollution from impacting the surrounding surface and ground waters. However, inadequately treated wastewater from substandard and failed OWTS adds bacteria to waterbodies, contributing to water quality impairments. These sources can be mitigated through proper OWTS maintenance and the repair or replacement of failed and/or substandard systems. In some cases bacteria sources may be best mitigated through off-site wastewater treatment, including connection to cluster treatment systems or sewer extensions where site constraints such as poor soil or shallow groundwater are too severe for effective onsite wastewater treatment.

RIDEM recommends that communities adopt ordinances to establish enforceable mechanisms to ensure that existing OWTSs are properly operated and maintained. As part of the wastewater management planning efforts, communities should create an inventory of onsite systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of substandard OWTSs and cesspools within a reasonable time frame should be adopted.

Several policies have already been put in place to begin addressing the risks posed by cesspools. Failed cesspools anywhere in the State are required to be replaced under current onsite wastewater treatment regulations. In addition, the OWTS rules require the replacement of cesspools that serve commercial facilities or multifamily dwellings. The Rhode Island Cesspool Act of 2007 requires the replacement of cesspools located within 200 feet of all shoreline features bordering tidal areas, within 200 feet of all public wells, and within 200 feet of a water body with an intake for a drinking water supply by January 1, 2013. Cesspools located in communities with comparable or more stringent replacement requirements are exempt from the law.

Onsite Wastewater Treatment Systems – Available Resources

RIDEM Onsite Wastewater Treatment Systems Website – This website offers links to OWTS Rules and Regulations, permitting information, licensed OWTS installers and inspectors, and other information about maintenance of an OWTS.

Online: <http://www.dem.ri.gov/programs/benviron/water/permits/isds/index.htm>

Maintaining Your OWTS Website – This website provides state-recommended standards for evaluating and maintaining OWTS that serve residences in Rhode Island. It includes instructions for gathering OWTS records, locating components, diagnosing minor in-home plumbing problems, conducting flow trials, dye tracing, and maintenance scheduling as well as other septic maintenance information.

Online: <http://www.dem.ri.gov/programs/benviron/water/permits/isds/fixowts.htm>

Rhode Island Wastewater Information System (RIWIS) – RIWIS is a statewide, web-accessed database available for use by local wastewater management programs to organize information about onsite systems and cesspools, including their location and condition, inspection results, and maintenance. It is easy to use and virtually free for Rhode Island municipalities. RIWIS is a valuable tool, adaptable to any level of wastewater management.

Online: <http://www.uri.edu/ce/wq/RESOURCES/wastewater/Resources/RIWIS.htm>

USEPA Septic Website – This site offers valuable information and resources to manage onsite wastewater systems in a manner that is protective of public health and the environment and allows communities to grow and prosper.

Online: <http://cfpub.epa.gov/owm/septic/home.cfm>

6.8. Boats and Marine Pump-out Facilities

In 1998, USEPA designated Rhode Island marine waters as *No Discharge Areas*. Boats with installed toilets must have an operable Coast Guard approved Marine Sanitation Device (MSD) designed to hold sewage for pump-out or for discharge in the ocean beyond the three-mile limit. (RI General Law 46-12-39). The Rhode Island waters include territorial seas within three miles of shore, including all of Narragansett Bay. Pump-out facilities should be operated and maintained throughout the state to maximize boat usage.

RIDEM oversees the operation and maintenance of the Rhode Island pump-out infrastructure by participating in the Clean Vessel Act program, which provides money for the construction, repair and replacement of pump-out facilities. RIDEM also coordinates outreach and education programs. RIDEM encourages all marinas with boats having MSDs to have pump-out facilities available. RIDEM also recommends the construction of shore-side restroom facilities at all marinas and boat ramps if none are currently available (RIDEM, 2009c).

CRMC should make marine pump-out facilities a mandatory maintenance item as a condition of minimum standard for operation of a marine facility.

Enforcing Rhode Island's No Discharge designation is required by the Clean Water Act. State laws §46-12-39, §46-12-40, and §46-12-41 give authority to local harbor masters, local police, Coast Guard, and RIDEM conservation officers and employees to enforce No Discharge laws. Boarding boats and inspecting MSDs by all empowered agencies may be conducted as follow-up to the last ten years of outreach and education. All agencies should develop a policy regarding the boarding of boats to inspect compliance with No Discharge requirements.

Education and enforcement programs should be implemented to ensure the maximum usage of the pump-out boats and importance of limiting greywater discharges. Additionally, efforts that increase shore-based facilities, such as bathrooms and showers, may also help water quality by decreasing the amount of greywater that is generated.

Boats and Marinas – Available Resources

RIDEM No Discharge Program Website – This website provides information about the Rhode Island No Discharge Area Program as well as useful links to fact sheets.

Online: <http://www.dem.ri.gov/programs/benviron/water/shellfish/pump/index.htm>

USEPA Compliance Assistance and Pollution Prevention in New England (Marina Topics) – This website provides links to information about marinas and pump-outs in Rhode Island.

Online: <http://www.epa.gov/ne/marinas/index.html>

6.9. Waterfowl, Wildlife, and Domestic Animals

Past TMDL studies have shown that waterfowl, wildlife, and domestic pets may contribute significantly to elevated bacteria concentrations in surface water. Pet waste left to decay on the sidewalk, or on grass near the street, may be washed into storm sewers by rain or melting snow and cause water quality impairments (USEPA, 2001b).

Stormwater Phase II requirements include an educational program to inform the public about the impact of stormwater. Education and outreach programs should highlight the importance of picking up after pets and not feeding waterfowl. Pet wastes should be disposed of away from any waterway or stormwater system. Towns should work with volunteers to map locations where pet waste is a significant and a chronic problem. This work should be incorporated into the municipalities' Phase II plans and should result in an evaluation of strategies to reduce the impact of pet waste on water quality. This may include installing signage, providing pet waste

receptacles or pet waste digester systems in high-use areas, enacting ordinances requiring clean-up of pet waste, and targeting educational and outreach programs in problem areas.

Towns and residents can take several measures to minimize waterfowl-related impacts. They can allow tall, coarse vegetation to grow in areas along the shores of impacted streams that are frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to the water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. With few exceptions, Part XIV, Section 14.13 of Rhode Island's Hunting Regulations prohibits feeding wild waterfowl at any time in the state of Rhode Island. Educational programs should emphasize that feeding waterfowl, such as ducks, geese, and swans, may contribute to water quality impairments and can harm human health and the environment. Towns should ensure that mention of this regulation is included in their SWMPs.

In response to the dramatic rise in the population of non-native swans in the northeast, as of 2006, swans are no longer protected under federal wildlife regulations. The RIDEM Division of Fish and Wildlife has developed a management plan to control the state's swan population, which includes the routine monitoring of swan populations (a summer aerial survey to identify swan nests and a fall productivity survey) as well as working to actively reduce the state's swan population from the currently estimated population of 1,400 to 300. While this program has been successful in reducing population to less than 1000, it is not currently funded.

Laws and practices in Rhode Island establish roles for Federal, state and local government in managing waterfowl and wildlife populations. In areas where nuisance waterfowl populations are particularly problematic, the involvement of cities and towns working with property owners, the RI Division of Fish and Wildlife and USDA Wildlife Services is necessary to develop a more comprehensive and publicly acceptable strategy.

Waterfowl, Wildlife, and Domestic Pets – Available Resources

RIDEM Mute Swan Fact Sheet - An example of the management of the mute swan population in Rhode Island.

Online: www.dem.ri.gov/programs/bnatres/fishwild/pdf/muteswan.pdf

RIDEM Animal Waste Fact Sheet – This fact sheet provides background information on the effects of pet waste to a waterbody and the difficulties and effectiveness of developing a pet waste pollution program.

Online:

<http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/t4guide/fact1.htm>

URI NEMO Pet Waste Fact Sheet – This fact sheet provides information on the effects of pet waste on water quality and provides links to useful resources available from URI NEMO.

Online: <http://www.uri.edu/ce/wq/has/PDFs/WQP.Pet%20Waste.pdf>

Rhode Island Dog-Friendly City Guide – This website provides a list of local dog parks.

Online:

<http://www.dogfriendly.com/server/travel/uscities/guides/us/cities/usonlinecityRIProvidence.shtml>

USEPA Source Water Protection Practices Bulletin – Managing wildlife and domestic animal waste to prevent contamination of drinking water.

Online: http://www.epa.gov/safewater/sourcewater/pubs/fs_swpp_petwaste.pdf

6.10. Agriculture

Agricultural activities such as dairy farming, the raising of livestock (including cattle, hogs, fowl, horses, llamas, alpacas, and other animals), and crop farming can contribute to bacterial impairment of surface waters. Agricultural land uses with the potential to contribute to bacteria pollution include manure storage and application, livestock grazing, and barnyards.

When appropriately applied to soil, animal manure can fertilize crops and restore nutrients to the land. However, when improperly managed, animal wastes can pose a threat to human health and the environment. Pollutants in animal waste and manure can enter surface waters through a number of pathways, including surface runoff and erosion, direct discharges to surface water, spills and other dry-weather discharges, and leaching into soil and groundwater. These discharges of manure pollutants can originate directly from animals accessing surface waters, or indirectly from manure stockpiles and cropland where manure is spread (USEPA, 2003).

In Rhode Island, the Farmland Ecology Unit within the Division of Agriculture work with, and regulate, farmers to ensure agricultural activities do not negatively impact Rhode Island's valuable wetland and groundwater resources. This unit works with the USDA Natural Resource Conservation Services to implement Best Management Practices for farmers and conservation projects. Permits are issued through this program for improvements to farms for activities which

may impact wetlands or nearby waterbodies. This unit works closely with RIDEM Freshwater Wetlands staff in the permitting process for activities such as constructing farm ponds, roads and agriculture waste runoff facilities (RIDEM, 2009d).

Agriculture - Best Management Practices Overview

Livestock Waste Management Plan - A livestock waste management plan specifies how, when and where animal waste will be handled and provides a documented method of operation that will prevent land-applied manure from impacting water quality. It is used for systems that store, stabilize, transport or apply animal waste to land. This plan also may be part of an installation permit, if a permit is needed for new or expanded animal waste treatment, storage or disposal facilities. This type of plan describes such information as systems to store, treat, and transport manure, characteristics of the manure, the amount and topography of the land available for application, and methods and times of land application (RIDEM, 2009d).

Manure Management BMPs – Manure management includes installing manure storage facilities and implementing BMPs, such as vegetative filter strips to prevent the loss of excess manure to surface waters (RIDEM, 2009d).

Agriculture - Available Resources

RIDEM Division of Agriculture Farmland Ecology Unit Fact Sheets – These fact sheets provide information on BMPs to reduce the impacts from manure and livestock to water quality.

Online: <http://www.dem.ri.gov/programs/bnatres/agricult/ecology.htm>

USEPA National Management Measures to Control Non-Point Source Pollution from Agriculture - **Online:** http://water.epa.gov/polwaste/nps/agriculture/agmm_index.cfm

USEPA Livestock Manure Storage – Software designed to assess the threat to ground and surface water from manure storage facilities. **Online:** <http://www.epa.gov/seahome/manure-store.html>

NRCS Animal Waste Management Software – A tool for estimating waste production and storage requirements.

Online: http://www.wsi.nrcs.usda.gov/products/w2q/awm/awm_home.html

7.0 Funding and Community Resources

Funding assistance for bacterial mitigation and other watershed management projects is available from various government and private sources. This section provides an overview and contact information for financial assistance programs offered by the State of Rhode Island. Information here is subject to change, so please contact the appropriate agency to learn more about the programs. Grant funding information for water quality, infrastructure, and agricultural improvements is provided below.

Water Quality Improvement Grants

Section 319 Non-Point Source Implementation Grants

Section 319 Grants are available to assist in the implementation of projects to promote restoration of water quality by reducing and managing non-point source pollution in Rhode Island waters. These grants are made possible by federal funds provided to RIDEM by the USEPA under Section 319 of the Clean Water Act.

Eligible applicants: Statewide, including municipal, state, or regional governments, quasi-state agencies, public schools and universities, and non-profit watershed, environmental, or conservation organizations.

Online at: <http://www.dem.ri.gov/programs/benviron/water/finance/non/index.htm>

Contact: RIDEM's Office of Water Resources, 235 Promenade St., Providence, RI 02908. (401) 222-6800

Infrastructure Improvement Grants

Clean Water State Revolving Fund Loans

The Clean Water State Revolving Fund is a federal/state partnership designed to finance the cost of infrastructure needed to achieve compliance with the Clean Water Act. The program is available to fund a wide variety of water quality projects including: 1) Traditional municipal wastewater treatment projects; 2) contaminated runoff from urban and agricultural areas; 3) wetlands restoration; 4) groundwater protection; 5) brownfields remediation; and 6) estuary management. Project types 2 through 5 must pertain to non-point source and estuary water quality protection and/or restoration projects. Through this program, Rhode Island maintains

revolving loan funds to provide low-cost financing for a wide range of water quality infrastructure projects. Funds to establish or capitalize these programs are provided through federal government grants and state matching funds (equal to 20% of federal government grants). The interest rate charged to the Clean Water State Revolving Fund is one-third off the borrower's market rate.

Eligible applicants: Statewide, including municipal, state, or regional governments, quasi-state agencies. Assistance will be offered and awarded to projects based on ranking of environmental benefits of the project, readiness to proceed, and availability of funds.

Online at: <http://www.dem.ri.gov/programs/benviron/water/finance/srf/index.htm>

Contact: RIDEM's Office of Water Resources, 235 Promenade St., Providence, RI 02908. (401) 222-4700

Rhode Island Clean Water Finance Agency, 235 Promenade St., Suite 119, Providence, RI 02908. (401) 222-4430

Community Septic System Loan Program/State Revolving Fund

The Community Septic System Loan Program (CSSLP) allows homeowners in participating communities low interest loans to repair or replace failed, failing, or sub-standard onsite wastewater treatment systems. These individual loans are funded from a Clean Water State Revolving Fund loan to a community and are administered locally by Rhode Island Housing. CSSLP loans to homeowners are offered at 2% interest rate with a 10-year term.

Eligible applicants: Statewide. Application requires RIDEM approval of an onsite wastewater management plan. Assistance will be offered and awarded to projects based on ranking of environmental benefits of the project, readiness to proceed, and availability of funds.

Online at: <http://www.dem.ri.gov/programs/benviron/water/finance/srf/index.htm>

Contact: RIDEM's Office of Water Resources, 235 Promenade St., Providence, RI 02908. (401) 222-6800

Rhode Island Clean Water Finance Agency, 235 Promenade St., Suite 119, Providence, RI 02908. (401) 222-4430

Pump-out Station Grants

This program awards grants to promote the development and maintenance of boater waste disposal facilities in Rhode Island marine waters in conformance with the mandatory Federal

“No Discharge” designation. To maintain this designation for the state’s marine waters, RIDEM must assure pump-out facility infrastructure is in sound operating condition. Through this ongoing grant program, RIDEM and participating marinas have successfully reduced a significant source of bacterial contamination to Rhode Island’s coastal waters, including waters in close proximity to shellfish harvesting and swimming areas.

Eligible applicants: Owners of any Rhode Island marina may apply for grants for projects located at the owner’s marina. A non-owner operator may apply for such a grant, but only if the owner co-signs the application and grant award. City and Towns may apply through their Harbor Departments.

Online at: <http://www.dem.ri.gov/programs/benviron/water/shellfish/pump/index.htm>

Contact: RIDEM’s Office of Water Resources, 235 Promenade St., Providence, RI 02908. (401) 222-6800

Community Development Block Grants (CDBG)

Title 1 of the Housing and Community Development Act of 1974 authorized the Community Development Block Grant (CDBG) program. The program is sponsored by the US Department of Housing and Urban Development (HUD) and the Rhode Island program is administered through the State of Rhode Island Office of Housing and Community Development. These grants include water and sewer system improvements.

Eligible applicants: Municipalities.

Online at: <http://www.hrc.ri.gov/CDBG-R.php>

Contact: Division of Planning, Office of Housing and Community Development, 1 Capitol Hill, 3rd Floor, Providence, RI 02908, (401) 222-7901

Rhode Island Statewide Planning Challenge Grant Program

This grant program, funded by the Rhode Island Statewide Planning Program, provides money for innovative solutions to address land use and transportation issues faced by Rhode Island communities. Past projects have included improving bike paths to promote sustainable transportation and increasing access to public transportation.

Eligible applicants: Statewide.

Online at: <http://www.planning.ri.gov/misc/pcgrants.htm>

Contact: Rhode Island Division of Planning, Rhode Island Statewide Planning Program, 1 Capitol Hill, Providence, RI 02908, (401) 222-7901

Agricultural Grants

Department of Agriculture Natural Resources Conservation Service Environmental Quality Incentives Program (EQIP)

This program is a voluntary conservation grant program designed to promote and stimulate innovative approaches to environmental enhancement and protection, while improving agricultural production. Through EQIP, farmers and forestland managers may receive financial and technical help to install or implement structural and management conservation practices on eligible agricultural and forest land. EQIP provides for additional funding specifically to promote ground and surface water conservation activities to improve irrigation systems; to convert to the production of less water intensive agricultural commodities; to improve water storage through measures such as water banking and groundwater recharge; or to institute other measures that improve groundwater and surface water conservation. EQIP payment rates may cover up to 75 percent of the costs of installing certain conservation practices.

Eligible applicants: Any person engaged in livestock, agricultural production, aquaculture, or forestry on eligible land.

Online at: <http://www.ri.nrcs.usda.gov/programs/eqip/EQIP.html>

Contact: USDA NRCS – RI State Office/Service Center, 60 Quaker Lane, Suite 46, Warwick, RI 02886, (401) 828-1300.

Additional Resources and Other Programs

Stormwater Utilities

Stormwater utilities operate on the principle that polluters must contribute to the cost of fixing the problems they cause by controlling the environmental impacts of land development. The utilities collect fees from those that use the municipal storm sewer system. The new funding source that is created by the stormwater utility can provide programmatic stability, allow for long-term planning and facilitate NPDES permit compliance. Nationwide, stormwater utility funding is used for a variety of projects, including projects that correct flooding, erosion, or other water quality problems. Funding is also used for ongoing maintenance. While stormwater utilities are most common in the Pacific Northwest and the Southeast, they are located in all regions through the country with about a half dozen utilities in New England.

In Rhode Island, the Rhode Island Stormwater Management and Utility District Act of 2002 authorizes municipalities to create stormwater management districts, empowering them to charge fees, providing that the “fee system shall be reasonable and equitable so that each contributor of runoff to the system shall pay to the extent to which runoff is contributed.” The Rhode Island law exempts the state from the fee system (RI General Law 45-61).

USEPA Funding Website

The USEPA recognizes that committed watershed organizations and state and local governments need adequate resources to achieve the goals of the Clean Water Act and improve our nation’s water quality. To this end, the USEPA has created the following website to provide tools, databases, and information about sources of funding to practitioners and funders that serve to protect watersheds:

Online at: <http://www.epa.gov/owow/funding.html>

8.0 Watershed-Specific Bacteria Data Summaries and Reduction Estimates

This section provides an overview of Rhode Island's Watershed Planning Areas (WPAs) and its bacteria impaired segments. The specific reductions required for each of the 57 impaired segments are presented. An introduction to the watershed-specific bacteria data and information summaries in Appendices A through L is also provided herein.

8.1. Bacteria Impaired Segments

A complete list of all 57 bacteria impaired segments included in this statewide TMDL is provided in Table 8-1. Table 8-1 provides the waterbody type, ID, town(s), and specific indicator bacteria for each impaired segment. The additional information in Table 8-1, related to percent reduction to meet the TMDL, was described previously in Section 5.5. Of the 57 impaired segments, nearly all (55 of 57) are river segments, while the remaining two are ponds located in the Pawtuxet WPA (WPA 12). In most segments, the indicator bacteria used to establish impairment status was enterococci (48 of 57), while 8 segments used fecal coliform, and one used *E.coli* bacteria. All of the impaired segments in this initial report are fresh water bodies.

Table 8-1: Summary of Estimate Percent Reductions for Bacteria Impaired Segments

Waterbody Name	Waterbody ID	Class	Impairment*	TMDL Endpoint†		% Reduction to meet TMDL^	
				Geometric Mean*	90th percentile*	Geometric Mean	90th percentile
WPA 1: Aquidneck Island							
Bailey's Brook	RI0007035R-01	AA	Enterococci	54	--	97%	--
Maidford River	RI0007035R-02A	AA	Fecal Coliform	--	400	--	100%
Maidford River	RI0007035R-02B	AA	Fecal Coliform	200	--	100%	--
Paradise Brook	RI0007035R-03	AA	Fecal Coliform	--	400	--	100%
WPA 6: Hunt River							
Frenchtown Brook	RI0007028R-01	A	Enterococci	54	--	58%	--
Hunt River	RI0007028R-03D	B	Enterococci	54	--	66%	--
Sandhill Brook	RI0007028R-05	B	Fecal Coliform	--	400	--	100%
WPA 7: Jamestown							
Jamestown Brook	RI0007036R-01	AA	Fecal Coliform	--	400	--	23%
WPA 8: Branch - Blackstone							
Branch River	RI0001002R-01A	B	Enterococci	54	--	17%	--
Branch River	RI0001002R-01B	B	Enterococci	54	--	68%	--
Chepachet River	RI0001002R-03	B	Enterococci	54	--	15%	--
Clear River	RI0001002R-05C	B	Enterococci	54	--	61%	--
Clear River	RI0001002R-05D	B1	Enterococci	54	--	34%	--
Pascoag River	RI0001002R-09	B	Enterococci	54	--	82%	--
Tarkiln Brook	RI0001002R-13B	B	Enterococci	54	--	50%	--
Crookfall Brook	RI0001004R-01	AA	Enterococci	54	--	41%	--
Long Brook	RI0001006R-02	AA	Enterococci	54	--	82%	--
East Sneece Brook	RI0001006R-03	AA	Enterococci	54	--	60%	--
Burnt Swamp Brook	RI0001006R-06	AA	Enterococci	54	--	84%	--
WPA 9: Moshassuck							
Moshassuck River	RI0003008R-01A	B	Enterococci	54	--	83%	--
Moshassuck River	RI0003008R-01B	B	Enterococci	54	--	16%	--
West River	RI0003008R-03B	B	Enterococci	54	--	91%	--

Table 8-1: Summary of Estimate Percent Reductions for Bacteria Impaired Segments (continued)

Waterbody Name	Waterbody ID	Class	Impairment*	TMDL Endpoint†		% Reduction to meet TMDL^	
				Geometric Mean*	90th percentile*	Geometric Mean	90th percentile
WPA 12: Pawtuxet							
Nooseneck River	RI0006012R-05	A	Enterococci	54	--	81%	--
Boyd Brook	RI0006013R-01	B	Enterococci	54	--	48%	--
South Branch Pawtuxet River	RI0006014R-04B	B1	Enterococci	54	--	85%	--
Tiogue Tribs	RI0006014R-05	B	Enterococci	54	--	50%	--
Huntinghouse Brook	RI0006015R-11	AA	Enterococci	54	--	10%	--
Moswansicut Stream	RI0006015R-16	AA	<i>E.coli</i>	126	--	42%	--
Winsor Brook	RI0006015R-30	AA	Enterococci	54	--	29%	--
Meshanticut Brook	RI0006017R-02	B	Enterococci	54	--	73%	--
Dry Brook	RI0006018R-02A	B	Enterococci	54	--	54%	--
Simmons Brook	RI0006018R-04	B	Enterococci	54	--	91%	--
Roger Williams Park Ponds	RI00006017L-05	B	Fecal Coliform	--	400	--	100%
Mashapaug Pond	RI00006017L-06	B	Fecal Coliform	--	--	--	--
WPA 15: Quinebaug							
Moosup River	RI0005011R-03	A	Enterococci	54	--	83%	--
WPA 17: Saugatucket							
Fresh Meadow Brook	RI0010045R-01	B	Enterococci	54	--	64%	--
WPA 20: Stafford Pond							
Sucker Brook	RI0007037R-01	A	Enterococci	54	--	70%	--
WPA 22: West Passage							
Belleville Upper Pond Inlet	RI0007027R-02	B	Enterococci	54	--	53%	--

Table 8-1: Summary of Estimate Percent Reductions for Bacteria Impaired Segments (continued)

Waterbody Name	Waterbody ID	Class	Impairment*	TMDL Endpoint†		% Reduction to meet TMDL^	
				Geometric Mean*	90th percentile*	Geometric Mean	90th percentile
WPA 23: Wood - Pawcatuck							
Ashaway River	RI0008039R-02A	A	Enterococci	54	--	78%	--
Chickasheen Brook	RI0008039R-05A	A	Enterococci	54	--	100%	--
Meadow Brook	RI0008039R-13	A	Enterococci	54	--	71%	--
Mile Brook	RI0008039R-14	B	Enterococci	54	--	12%	--
Pawcatuck River	RI0008039R-18B	B1	Enterococci	54	--	75%	--
Pawcatuck River	RI0008039R-18C	B	Enterococci	54	--	66%	--
Taney Brook	RI0008039R-23	B	Enterococci	54	--	35%	--
Tomaquag Brook	RI0008039R-24	A	Enterococci	54	--	80%	--
White Horn Brook	RI0008039R-27B	B	Enterococci	54	--	52%	--
Dutemple Brook	RI0008039R-30	A	Enterococci	54	--	13%	--
Parmenter Brook	RI0008039R-37	A	Enterococci	54	--	10%	--
Breakheart Brook	RI0008040R-02	A	Enterococci	54	--	74%	--
Brushy Brook	RI0008040R-03B	B	Fecal Coliform	--	400	--	21%
Canonchet Brook	RI0008040R-04B	B	Enterococci	54	--	50%	--
Phillips Brook	RI0008040R-14	A	Enterococci	54	--	29%	--
Wood River	RI0008040R-16A	A	Enterococci	54	--	35%	--
WPA 24: Woonasquatucket							
Cutler Brook	RI0002007R-02	B	Enterococci	54	--	34%	--
Latham Brook	RI0002007R-05	B	Enterococci	54	--	63%	--
Stillwater River	RI0002007R-09	B	Enterococci	54	--	63%	--
* Fecal coliform (MPN/100 mL); Enterococci/ <i>E.coli</i> (colonies/100 mL)							
† TMDL endpoint is set to the water quality standard							
^ Includes Margin of Safety							

8.2 Watershed-Specific Bacteria Data Summaries

Appendices A through L provide bacteria data and information for each of the 57 impaired segments. The appendices are organized by WPA, as follows:

- Appendix A - WPA 1: Aquidneck Island
- Appendix B - WPA 6: Hunt River
- Appendix C - WPA 7: Jamestown
- Appendix D - WPA 8: Branch – Blackstone
- Appendix E – WPA 9: Moshassuck
- Appendix F – WPA 12: Pawtuxet
- Appendix G – WPA 15: Quinebaug
- Appendix H – WPA 17: Saugatucket
- Appendix I – WPA 20: Stafford Pond
- Appendix J – WPA 22: West Passage
- Appendix K – WPA 23: Wood – Pawcatuck
- Appendix L – WPA 24: Woonasquatucket

Each appendix contains segment-specific summaries for all of the bacteria impaired segments in that WPA. For example, the Branch-Blackstone WPA appendix (D) contains 11 segment-specific summaries and the Quinebaug WPA appendix (G) contains one summary (Table 1-1).

Each segment-specific summary provides the following information:

- A description of the watershed for each impaired segment (size, location, and major features) and an overview of available information related to bacteria;
- A watershed map showing the locations of impaired segments and the land area draining to the impaired segment (i.e., the watershed);

- A land cover map showing land cover types within the watershed; and

Data tables with recent (within 10 years) bacteria data for each impaired segment, with geometric mean and 90th percentile calculations (as appropriate) and reductions needed to meet water quality standards. The data used to calculate the percent reductions were downloaded from the WQUAL database maintained by RIDEM. Actual data sources for the 57 segments included in the initial Statewide Bacteria TMDL waterbodies include the Rhode Island Rotating Basin Assessments of Rivers and Streams Program, the University of Rhode Island Watershed Watch Program, the USGS Monitoring on Non-wadeable Rivers, and the Providence Water Supply Board. More information about these data sources can be found in Section 4.2 of this document.

9.0 References

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Appendices A – L

Waterbody Summaries

Appendix A - WPA 1: Aquidneck Island

Appendix B – WPA 6: Hunt River

Appendix C – WPA 7: Jamestown

Appendix D – WPA 8: Branch – Blackstone Rivers

Appendix E – WPA 9: Moshassuck River

Appendix F – WPA 12: Pawtuxet River

Appendix G – WPA 15: Quinebaug River

Appendix H – WPA 17: Saugatucket River

Appendix I – WPA 20: Stafford Pond

Appendix J – WPA 22: West Passage

Appendix K – WPA 23: Wood – Pawcatuck Rivers

Appendix L – WPA 24: Woonasquatucket River

GIS Mapping Data Sources

Land use/Land cover – RIGIS 2003/2004

<http://www.edc.uri.edu/rigis/data/download/rilu0304.html>

Land use / land cover from 2003 & 2004 orthophotography. The minimum mapping unit for this dataset is .5 acre. The land use classification scheme used for these data was based on the Anderson Level III modified coding schema used in previous land use datasets in Rhode Island (1988 & 1995) with some modifications for the 2003 classification.

Land use – MASSGIS 2005

<http://www.mass.gov/mgis/lus2005.htm>

The Land Use (2005) datalayer is a Massachusetts statewide, seamless digital dataset of land cover / land use, created using semi-automated methods, and based on 0.5 meter resolution [digital ortho imagery](#) captured in April 2005. The classification scheme is based on the coding schema used for previous [Massachusetts land use datasets](#), with modifications. The categorization is represented by two fields: LU05_DESC (land use description) and LUCODE (land use code).

Land Cover – CT Center for Land Use Education & Research 2002

<http://clear.uconn.edu/projects/landscape/index.htm>

LANDSAT Thematic Mapper (TM) satellite imagery based land cover classification, circa 2002, for the state of Connecticut including local watersheds that intersect the state boundary, and towns in south central Massachusetts that are part of the Quinebaug and Shetucket Rivers Valley National Heritage Corridor. The classification depicts 12 land cover categories. These are: 1. Developed, 2. Turf & Grass, 3. Other Grasses 4. Agriculture 5. Deciduous Forest, 6. Coniferous Forest, 7. Water, 8. Non-forested Wetland, 9. Forested Wetland, 10. Tidal Wetland, 11. Barren Land, 12. Utility Corridors. Source Landsat TM image data were from September 8, 2002 and July 31, 2002. The classification was compiled using ERDAS Imagine 9.2 by the Center for Land use Education And Research (CLEAR) in the College of Agriculture and Natural Resources at the University of Connecticut.

Impervious Surface – RIGIS 2003/2004

<http://www.edc.uri.edu/rigis/spfdata/environment/impervious07.zip>

This is a statewide, seamless digital dataset of the impervious surfaces for the State of Rhode Island derived using semi-automated methods and based on imagery captured in 2003-2004. (2ft pixel)

Impervious Surface – MASSGIS 2005

http://www.mass.gov/mgis/impervious_surface.htm

The Impervious Surface raster layer represents impervious surfaces covering the Commonwealth of Massachusetts. The surfaces were extracted using semi-automated techniques by [Sanborn Map Company](#) from 50-cm [Vexcel UltraCam](#) near infrared orthoimagery that was acquired in April 2005 as part of the [Color Ortho Imagery](#) project. The pixel size for the impervious surface data is 1-meter.

Waste Water Treatment Facilities – RIDEM Office of Water Resources

RIGIS 1999 <http://www.edc.uri.edu/rigis/spfdata/environment/ripdes.zip>

BTMDL Impaired Waters – RIDEM/RIGIS 2008

http://www.edc.uri.edu/rigis/spfdata/inlandWaters/streams_IWQMA_08.zip

Vector line data representing Rhode Island Rivers and Streams included in the State's Integrated Water Quality and Assessment Report required under provisions of the US Clean Water Act.

http://www.edc.uri.edu/rigis/spfdata/inlandWaters/ponds_IWQMA_08.zip

Vector polygon data representing Rhode Island Lakes, Ponds and Reservoirs included in the State's Integrated Water Quality and Assessment Report required under provisions of the US Clean Water Act.

BTMDL Watersheds – RIDEM Geographic Information System/Office of Water Resources – Unpublished geospatial data

WQ Sampling Locations – RIDEM Office of Water Resources – Unpublished geospatial data

Stormwater Outfalls – RIDOT/RIDEM – Unpublished geospatial data

Septic NOI.NOV – RIDEM Office of Compliance & Inspection – Unpublished geospatial data

Sewer Service Area - RIDEM Office of Water Resources - Unpublished geospatial data

Aerial Photography – RIGIS 2008

<http://www.edc.uri.edu/rigis/data/2008RIE911.html>

Pictometry International collected statewide aerial photographs of Rhode Island in Spring 2008. These data are licensed by Pictometry for use by the Rhode Island Enhanced 911 Uniform Emergency Telephone System (RI E911) and RI E911 sublicensees.

Appendix M TMDLs Expressed as Daily Load

As explained in Section 5.2, Rhode Island prefers to express bacteria Total Maximum Daily Loads (TMDLs) as concentrations (counts of bacteria/100mL). However, in accordance with federal guidance, bacteria TMDLs are also expressed as daily loads in terms of mass per unit time (i.e., number of bacteria per day). The examples below contain graphs, tables, and formulas for enterococci and fecal coliform geometric means. Loads for fecal coliform 90th percentile values and *Escherichia coli* (*E. coli*) geometric means would be similarly derived.

Similar to the concentration-based bacteria TMDLs, the margin of safety in mass per unit time TMDLs is explicit when a discrete portion of the loading capacity is reserved to ensure that water quality standards will be attained. In the example mass per unit time bacteria TMDLs shown below, 5% of the loading capacity is allocated to the margin of safety with 95% of the loading capacity being allocated to existing and future point (wasteload) and non-point (load) sources.

Mass per unit time TMDLs for rivers and streams are calculated by multiplying river or stream flow at a given point in time by the allowable bacteria concentration. If stream-flow data are not available, a range of flows can be assumed based on drainage area. Flows within the assumed range are multiplied by the water quality standard (geometric mean and/or 90th percentile concentrations, where applicable) to obtain the loading capacity or TMDL for the stream segment or watershed. For lakes, ponds, or estuarine waters, the loading capacity is derived by multiplying the average daily water outflow by the allowable bacteria concentration. Average daily water outflow is obtained by dividing the basin volume by the flushing time of that basin⁵. Flushing time is the mean time that a parcel of water will spend in a particular lake or pond before it is replaced by waters from outside the system.

The following figures, tables, and formulas contain TMDL calculations for bacteria-impaired rivers and streams, lakes and ponds, and coastal embayments. These are intended to provide the necessary formulas, tables, and graphs required for calculating bacteria TMDLs for any bacteria-impaired waterbody, and for any flow and/or volume. Example daily load (mass per unit time) bacteria TMDLs are presented for freshwater rivers and streams, freshwater ponds and lakes, and estuarine waters.

⁵ Kalfs, Jacob (2002). *Limnology: Inland Water Systems*. Prentice Hall. Upper Saddle River, New Jersey: 124.

Freshwater Rivers and Streams - Figure 1, Table 1, and Formula 1 show the allowable loads for freshwater rivers and streams. The example below is based on the freshwater enterococci primary contact geometric mean criterion of 54 colonies per 100 mL (milliliters) at non-designated bathing beach waters. This is a flow-based daily load calculation. The daily load calculation would be similar if calculating loads for any concentration-based bacteria water quality criteria, including when calculating the allowable loads for the fecal coliform geometric mean and 90th percentile criteria. Daily loads at designated beaches would be calculated using an enterococci criterion of 33 colonies per 100mL.

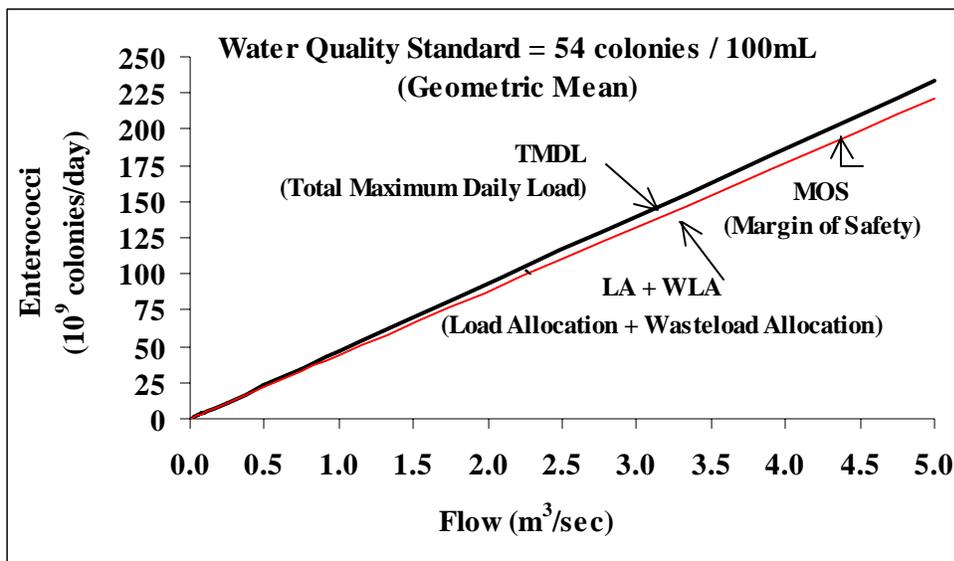


Figure 1: Enterococci Freshwater Rivers and Streams Daily Loads

Table 1: Enterococci Freshwater Rivers and Streams Daily Loads

Q Flow m ³ / sec	WQS ¹ Water Quality Standard colonies / 100 mL	TMDL Total Maximum Daily Load 10 ⁹ colonies / day	MOS ² Margin of Safety 10 ⁹ colonies / day	LA + WLA Load Allocation + Wasteload Allocation 10 ⁹ colonies / day
0.005	54	0.233	0.0117	0.222
0.01	54	0.467	0.0233	0.443
0.025	54	1.17	0.0583	1.11
0.05	54	2.33	0.117	2.22
0.075	54	3.50	0.175	3.32
0.1	54	4.67	0.233	4.43
0.25	54	11.7	0.583	11.1
0.5	54	23.3	1.17	22.2
0.75	54	35.0	1.75	33.2
1	54	46.7	2.33	44.3
5	54	233	11.7	222

mL: milliliter; L: Liter, m³: cubic meters
¹Water quality standard is a geometric mean of the samples.
²Margin of safety is 5% of the water quality standard.

Formula 1: Enterococci Freshwater Rivers and Streams Daily Loads

$$TMDL\left(\frac{10^9 \text{ colonies}}{\text{day}}\right) = Flow\left(\frac{m^3}{\text{sec}}\right) \times WQS\left(\frac{\text{colonies}}{100mL}\right) \times 86,400\left(\frac{\text{sec}}{\text{day}}\right) \times 10\left(\frac{100mL}{L}\right) \times 1000\left(\frac{L}{m^3}\right) \div 10^9$$

Freshwater Lakes and Ponds – Figure 2, Table 2, and Formula 2 show the allowable loads for freshwater lakes and ponds. The example below is based on the freshwater primary contact fecal coliform geometric mean criterion of 200 MPN (most probable number) per 100mL. The allowable 90th percentile load would be calculated in the same manner, using the fecal coliform 90th percentile criterion of 400 MPN per 100mL. These daily load calculations are based on the water residence time. Average daily water outflow is the rate at which water exits the lake or pond. The daily load calculation would be similar if calculating loads for any concentration-based bacteria water quality criteria, including when calculating the allowable loads for the recreational enterococci geometric mean criterion or when calculating the allowable loads for the fecal coliform geometric mean and 90th percentile criteria, applied at the terminal reservoir in a drinking water supply.

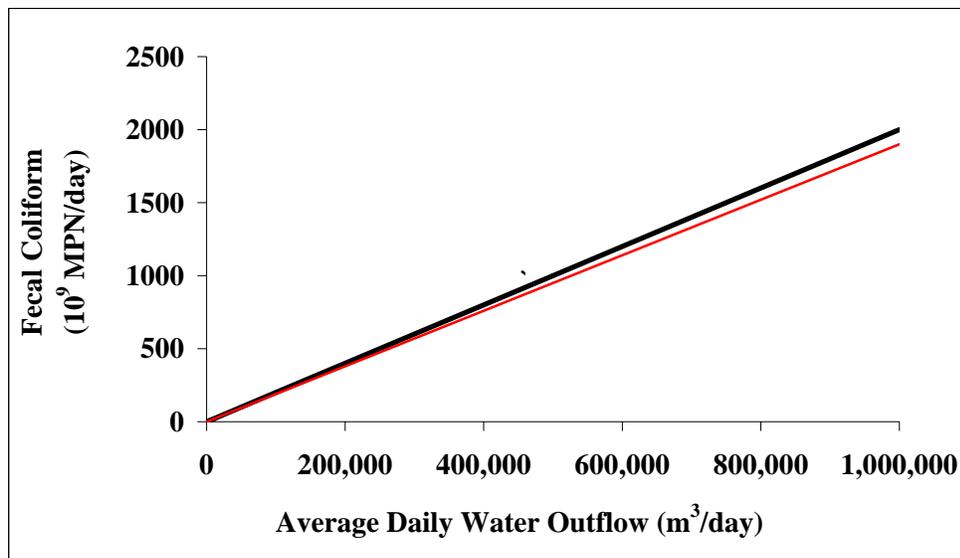


Figure 2: Fecal Coliform Freshwater Lakes and Ponds Daily Loads

Table 2: Fecal Coliform Freshwater Lakes and Ponds Daily Loads

Q Average Daily Water Outflow ¹ m ³ / day	WQS ² Water Quality Standard colonies / 100 mL	TMDL Total Maximum Daily Load 10 ⁹ colonies / day	MOS ³ Margin of Safety 10 ⁹ colonies / day	LA + WLA Load Allocation + Wasteload Allocation 10 ⁹ colonies / day
1000	200	2	0.1	2
5000	200	10	0.5	10
10000	200	20	1	19
50000	200	100	5	95
100000	200	200	10	190
500000	200	1000	50	950
1000000	200	2000	100	1900

mL: milliliter; L: Liter, m³: cubic meters

¹The Average Daily Outflow is obtained by dividing the basin volume by the flushing time. Flushing time in lakes is often referred to as the hydraulic water residence time and it is amount of time that water will spend in a particular basin of water.

²Water quality standard is a geometric mean of the samples.

³Margin of safety is 5% of the water quality standard.

Formula 2: Fecal Coliform Freshwater Lakes and Ponds Daily Loads

$$TMDL \left(\frac{10^9 \text{ colonies}}{\text{day}} \right) = \text{average daily outflow} \left(\frac{m^3}{\text{day}} \right) \times WQS \left(\frac{\text{colonies}}{100mL} \right) \times 10 \left(\frac{100mL}{L} \right) \times 1000 \left(\frac{L}{m^3} \right) \div 10^9$$

Where: $\text{average daily outflow} \left(\frac{m^3}{\text{day}} \right) = \frac{\text{Volume}(m^3)}{\text{Flushing Time}(days)}$

Estuarine Waters - Figure 3, Table 3, and Formula 3 show allowable loads for estuarine waters based on the estuarine enterococci primary contact geometric mean criterion of 35 colonies per 100 mL. These daily load calculations are based on the flushing time for the estuary. Flushing time is the mean time that a parcel of water will spend in a particular estuarine embayment or cove before it is replaced by waters from outside the system. The daily load calculation would be similar if calculating loads using any concentration-based bacteria water quality criteria, including when calculating the allowable loads for the fecal coliform recreational criterion or the allowable loads for the shellfish harvesting fecal coliform criteria.

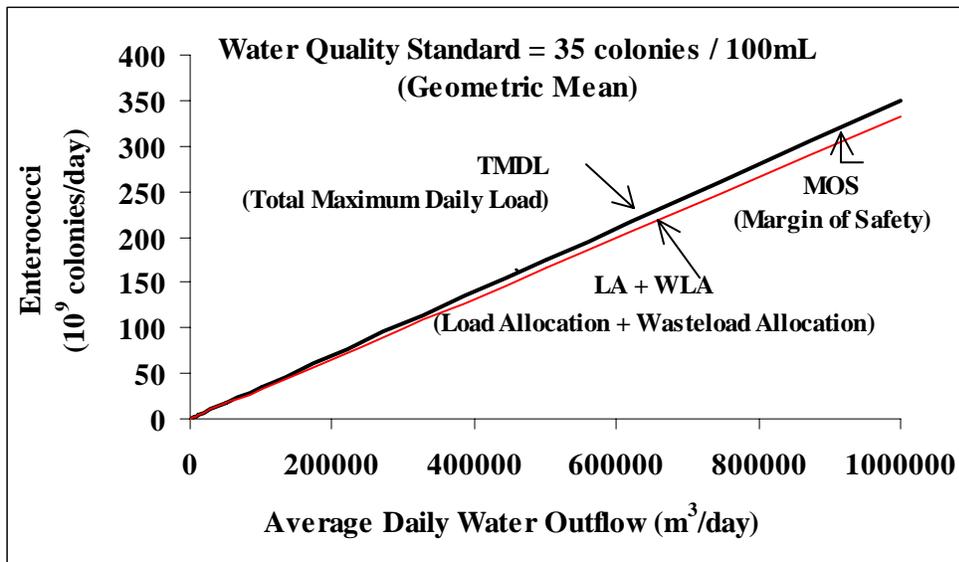


Figure 3: Enterococci Estuarine Waters Daily Loads

Table 3: Enterococci Estuarine Waters Daily Loads

Q Average Daily Water Outflow ¹ m ³ / day	WQS ² Water Quality Standard colonies / 100 mL	TMDL Total Maximum Daily Load 10 ⁹ colonies / day	MOS ³ Margin of Safety 10 ⁹ colonies / day	LA + WLA Load Allocation + Wasteload Allocation 10 ⁹ colonies / day
1000	35	0.35	0.018	0.33
5000	35	1.75	0.088	2
10000	35	3.5	0.18	3
50000	35	17.5	0.88	17
100000	35	35	1.75	33
500000	35	175	8.75	166
1000000	35	350	17.50	333

mL: milliliter; L: Liter, m³: cubic meters

¹The Average Daily Outflow is obtained by dividing the estuarine volume by the flushing time. Flushing time is amount of time that water will spend in a particular estuarine embayment or cove.

²Water quality standard is a geometric mean of the samples.

³Margin of safety is 5% of the water quality standard.

Formula 3: Enterococci Estuarine Water Ponds Daily Loads

$$TMDL \left(\frac{10^9 \text{ colonies}}{\text{day}} \right) = \text{average daily outflow} \left(\frac{m^3}{\text{day}} \right) \times WQS \left(\frac{\text{colonies}}{100mL} \right) \times 10 \left(\frac{100mL}{L} \right) \times 1000 \left(\frac{L}{m^3} \right) \div 10^9$$

Where: $\text{average daily outflow} \left(\frac{m^3}{\text{day}} \right) = \frac{\text{Volume}(m^3)}{\text{Flushing Time}(days)}$

Appendix N Response to Comments Received During the Public Comment Period

The following comments were received by RIDEM during the public comment period for the draft Statewide Bacteria TMDL document. The complete text of all comments received is on file in the Office of Water Resources at DEM.

Save the Bay

**John Torgan, Narragansett Baykeeper, Director of Advocacy
(letter sent by email August 1, 2011)**

Save The Bay appreciates this opportunity to comment on the Draft Total Maximum Daily Load study for bacteria-impaired waters. In general, Save The Bay strongly supports the findings and recommendations in the study, and agrees with DEM about the extent to which stormwater pollution is responsible for use impairments in many coastal waters and tidal rivers.

We are concerned, however, by the slow progress of the regulatory and practical implementation aspects of the TMDL program, and urge the Department to move quickly to implement and enforce its regulations relating to MS4 stormwater discharges.

Save The Bay encourages DEM to act as quickly as possible to address pollution sources to sensitive estuarine and coastal waters, particularly for those water bodies identified as having bacteria impairment in Middletown (Bailey's Brooks, Maidford River, and Paradise Brook), Jamestown, East Greenwich and North Kingstown (Frenchtown Brook, Hunt River, Sandhill Brook), the Pawtuxet River, the Woonasquatucket River, and the Wood/Pawcatuck Rivers.

We believe the stormwater regulations outlined in the new manual and through EPA Region 1's MS4 program present the strongest opportunity to address those bacteria sources in these waterways that are most likely not coming from wastewater treatment facilities, septic systems, or cesspools.

We recognize that some areas of the draft TMDL fall outside of the MS4 regulations. We urge the Department to consider expanding MS4 service areas to incorporate and remedy these sources.

Where the bacteria contamination does appear to be coming from wastewater, septic or cesspools, the Department should use its enforcement authority to mandate compliance.

Other ways to better achieve compliance with bacteria standards include stormwater education and outreach, promoting and providing incentives for Low-Impact Development (LID) practices, increasing municipal assistance for LID, and by encouraging and supporting the development of stormwater utility districts and management plans for municipalities with impaired water bodies.

Save The Bay strongly encourages the DEM to aggressively pursue the establishment of stormwater utility districts and corresponding management plans wherever practicable. These

represent the best hope of providing the kind of long-term revenue base for implementing effective stormwater pollution control strategies.

We recommend that DEM develop a prioritized list of the State's most severe stormwater pollution hotspots, and a corresponding plan to address each one, including enforceable dates and performance measures.

Wherever possible, Save The Bay encourages the use of vegetated buffers and wetland and coastal restoration over the use of technologies and disinfection systems to treat stormwater. We believe this represents the most cost-effective and environmentally-sustainable approach in general.

RIDEM Response

RIDEM will continue its work with municipalities through a variety of regulatory and non-regulatory avenues to assist them in implementing local stormwater and wastewater management programs. The challenges of addressing the state's stormwater quality issues are significant and will take the cooperative efforts of all levels of government, private property owners and Non-Governmental Organizations to restore the state's stormwater impaired waters. The state is making strides to address these problems. We look forward to continuing our work with Save the Bay to realize further improvements in the state's water quality.

Town of Jamestown

Justin Jobin, Environmental Scientist (email sent July 28, 2011)

Jamestown Comment 1

After review of the Jamestown Brook TMDL Document, The Town feels that there is not enough information for the Jamestown Brook to be listed on the Statewide TMDL for bacteria impaired waters. RIDEM's basis for adding Jamestown Brook to the TMDL is quarterly sampling over a 4-year period, the most recent sampling event being in December of 2003, almost 8 years ago. The Town has been very proactive, adopting and implementing several ordinances since December 2003. It is also important to note that the bacteria indicator used was Fecal Coliform, not Enterococci, which have become the standard.

In addition, it appears that the brook is listed on the TMDL based only on 3 wet weather samples over a 4 year period, as stated on page 4 of the report: "The dry-weather geometric mean and 90th percentile values did not exceed the water quality criteria for fecal coliform. However, wet-weather values did suggest a potential wet-weather source". The Town feels that a more focused sampling and monitoring effort between RIDEM, RIDOT, and The Town, over the next few years, should be explored before listing The Jamestown Brook on the Statewide TMDL for bacteria impaired waters.

RIDEM Response

Jamestown Brook has been listed as impaired for pathogens, as seen in elevated fecal coliform levels, since the 1992 303(d) Impaired Waters List. The Brook was sampled until 2003. The sample results reaffirmed the impaired waters listing. Rhode Island's Water Quality Regulations allow for use of fecal coliform to assess swimming use if enterococci data are not available. Once a waterbody is identified as impaired and placed on the state's impaired waters list, the state is required by federal law (Clean Water Act) to prepare a Total Maximum Daily Load

analysis addressing the impairment. As such, the impaired water listing and subsequent TMDL are appropriate for this waterbody.

The Jamestown Brook Waterbody Summary acknowledges the actions that the Town of Jamestown has undertaken to improve water quality throughout the Town. Future monitoring can track the progress of water quality improvements. RIDEM intends to include Jamestown Brook in its Rotating Basin Monitoring Program. The Rotating Basin Monitoring Program aims to collect water quality samples from freshwater rivers throughout Rhode Island on a rotating basis with each basin sampled every three to five years. Monitoring parameters include fecal coliform and/or enterococci. If this monitoring data indicates that the brook complies with criteria, RIDEM will propose that Jamestown Brook is de-listed from the List of Impaired Waters.

As shown in Table 1 of the Jamestown Brook waterbody summary, Jamestown Brook violates water quality standards when geometric mean and 90th percentile statistics are calculated on all available data (wet and dry) collected between 2000 and 2003. Percent reductions were set using the complete data set, which included both wet and dry weather samples. The listing is not based on a particular weather condition. Data were broken into wet and dry weather categories solely for possible source identification purposes.

Jamestown Comment 2 – Summary of The Town’s Efforts Since 2003 – Ordinances

- The Onsite Wastewater Management Ordinance was adopted in 2001 and initial inspections were implemented between 2003 and 2006. In July of 2011 The Jamestown Town Council Adopted Amendments to the Onsite Wastewater Management Ordinance which included a Town-Wide Phase-Out of Cesspools and Steel Tank Septic Systems by January 1st 2016.
- The High Groundwater and Impervious Cover Overlay District Ordinance (Zoning Section 314) was adopted in 2003 and amended in 2007. This ordinance requires advanced treatment OWTS systems, Stormwater infiltration and management practices, and enforces impervious coverage restrictions in the Jamestown Shores and Northern end of the Island.
- Zoning Section 308 was also adopted in 2003, which requires a 150-foot buffer between an OWTS system and freshwater wetland.
- The Stormwater Management and Illicit Connection ordinances were adopted in 2005. In 2006, The Town hired a full time Environmental Scientist and GIS Coordinator and began a focused implementation of Phase II Stormwater Management Program.

RIDEM Response

RIDEM had added this information to the waterbody summary.

Jamestown Comment 3 – Summary of The Town’s Efforts Since 2003 – Land Use Protection

Since 2003 the Town has made great efforts in preserving open space in Jamestown. In 2009 the Town of Jamestown in conjunction with several State, Private and Federal agencies, preserved the development rights to 150 acres of farmland, much of which is within our Town drinking water watershed. In addition, the Town purchased several key public water supply drinking water watershed parcels. The Town's goal is to purchase all parcels within this watershed. To date, the Town has protected over 95% of this watershed. The Town also purchased 100 "old filed record plat" lots in the Jamestown Shores area. These lots were purchased to prevent development and protect the groundwater quality of this fragile area. The Conanicut Island

Land Trust has also assisted in preservation of more than 75 acres of land on the island in the last 10 years.

RIDEM Response

RIDEM had added this information to the waterbody summary.

Jamestown Comment 4

There is a discrepancy between the percentages of developed area in the Jamestown Brook Watershed. Page one specifies 14% while page six specifies 26%. The Town feels that 14% is more accurate, however, we will work on providing GIS maps, and calculating impervious and developed percentages.

RIDEM Response

RIDEM re-evaluated the land use data, and the 26% number is incorrect. The document has been modified on the first page pie chart and on page 6.

Jamestown Comment 5

The GIS Map on Page 2 does not accurately indicate the Urban Water and Sewer District. The Town can either provide a map, or can send the GIS Files to RIDEM's GIS Coordinator.

RIDEM Response

The map has been updated with information submitted by Jamestown.

Jamestown Comment 6

Page 5 should be updated to reflect the amendments to the Onsite Wastewater Management Ordinance adopted on July 18th 2011. It is also important to note that the Onsite Wastewater Management Program was developed and adopted in 2001 not 2002 as listed.

RIDEM Response

RIDEM had added this information to the waterbody summary and changed the date the program was developed and adopted to 2002.

Jamestown Comment 7

The Jamestown Shores is not in the Jamestown Brook Watershed. The map from the source water assessment is not accurate or up to date. Updated Mapping and breakdown of Jamestown Shores Septic System types can be made available.

RIDEM Response

Given the information submitted by the Town of Jamestown, references to failing OWTS in the Jamestown Shores have been eliminated from the waterbody summary.

Town of South Kingstown

Stephen Alfred, Town Manager (letter sent August 1, 2011)

CORE REPORT

COMMENTS – SECTION 1.0

South Kingstown Comment 1

We recommend that RIDEM add a sentence in the introductory paragraph recognizing that because indicator bacteria are ubiquitous in the environment occasional exceedances of water quality criteria are possible even in undeveloped watersheds. The TMDL should clearly state that natural sources of bacteria (wildlife mammals and birds and in organic and mineral sediments)

are not the responsibility of local governments if they are not transported via the municipal drainage systems.

RIDEM Response

The first paragraph already mentions that bacterial contamination may result from wildlife sources. Local governments' role in addressing bacterial sources including wildlife sources is addressed in implementation section of the document.

South Kingstown Comment 2

We recommend changing the language in the second paragraph from “specifies the pollutant reductions needed to meet water quality standards” to “provides guidance on the possible pollutant reductions needed to meet water quality standards”. In Section 5.5 the TMDL indicates that the “TMDL reductions provide a rough estimation of the pollutant abatement action needed for each segment to meet water quality standards” which in our judgment is more appropriate language than the definitive statement in Section 1.0.

RIDEM Response

South Kingstown comment noted. No changes made to document.

South Kingstown Comment 3

We agree and support the strengthening of the statement regarding a phased-implementation strategy and community-based approach.

RIDEM Response

South Kingstown comment noted. No changes made to document.

COMMENTS – SECTION 1.1

South Kingstown Comment 4

This section describes what is typically included in a TMDL. The typical process as described, will among other items, define that “loads will be allocated between point and non-point sources” and that a “detailed implementation plan identifying specific actions necessary to achieve the TMDL water quality targets” will be developed. From our review, there is no methodology presented to characterize the relative significance of point and non-point sources to estimate the relative proportion of these sources and therefore no way to identify specific actions necessary to achieve the TMDL water quality targets. We also question the validity of defining loads using a concentration basis given that this does not account for discharge flow rate. We would request that RIDEM acknowledge the limitations of the concentration approach in the introductory section and clearly state the limitation of the assumption that a TMDL load will be met if discharges stay below a concentration threshold due the lack of in-stream, point and non-point source discharge flow data.

RIDEM Response

Rhode Island's Statewide Bacteria TMDL approach is one promoted by US EPA Region 1 and either adopted or in the process of being developed by the five other New England states as an efficient and effective means to advance water quality improvements for the region's bacteria impaired waters. The approach relies upon readily available information to characterize the bacteria impairment and to identify common sense management actions to address sources of bacteria in the contributing watershed. Also see response to Comment 22 below.

COMMENTS – SECTION 5.1

South Kingstown Comment 5

Overall, TMDL Tables and the Table of Contents need to be evaluated for correct numbering. There is a misidentified footnote reference in Table 0-1. Table 5-3 is listed in the footnote but does not exist in the document. It is assumed to be Table 0-3. Please correct.

RIDEM Response

Document has been corrected.

South Kingstown Comment 6

In Table 0-1 there is no Waste Load Allocation (WLA) (concentration) posted for Rhode Island Pollution Discharge Elimination System (RIPDES) stormwater discharges. It would presumably be 54 cfu/100 mL Enterococci for Class B water but we are not clear why the omission of a WLA for RIPDES discharges in Table 0-1. Please clarify in Section 5.1. Will defining a WLA for RIPDES discharges compromise the ability of RIDEM to allow for a scaled implementation strategy based on watershed impervious cover as described in Section 6.2?

RIDEM Response

Consistent with EPA guidance, RIDEM does not typically establish end-of-pipe water quality limits on stormwater discharges but instead relies upon implementation of best management practices as the primary means by which stormwater discharges are regulated. Compliance with water quality standards is determined via ambient water quality sampling at representative sampling locations.

COMMENTS – SECTION 5.5

South Kingstown Comment 7

Please explain the logic of only using the sampling station with highest geometric mean and/or 90th percentile statistical value to calculate target reduction of bacteria in each watershed. It would appear to us that given the limited sampling data the use of all data would be advisable to determine a target reduction assuming that the samples are actually independent.

RIDEM Response

All data are evaluated in the process of developing the reduction targets. Data are evaluated by station so as to discern localized conditions within the waterbody. Reduction targets are calculated using the station with the highest geometric mean and/or 90th percentile value to ensure that the TMDL is protective of all portions of the waterbody. This is the method that EPA prefers that RIDEM use. RIDEM is not sure what South Kingstown means by calculating a reduction assuming the samples are actually independent and what this would mean for reduction calculations.

COMMENTS – SECTION 6.2

South Kingstown Comment 8

The Municipal Separate Storm Sewer System (MS4) Permit states that a TMDL Implementation Plan (TMDL IP) is required by regulated entities within 180 days of the issuance of written notice from RIDEM concerning the TMDL. Section 6.2 describes this requirement in detail and may need a cross-reference to Section 6.3 in order to avoid confusion regarding specific MS4 requirements in light of the scaled approach described in Section 6.3.

RIDEM Response

Section 6.3 has been modified to clarify the MS4 requirements (specifically, TMDL implementation plan and annual reporting requirements) for those watersheds with impervious cover between 10 and 15%. Waterbody summaries for those waters with watersheds having 10 and 15 % impervious cover (Tiogue Tributaries, Belleville Pond, Long Brook, Maidford River 2A, Dry Brook, Hunt River, White Horn Brook, and Mosshasuck 1A) have also been modified to clarify these requirements.

COMMENTS – SECTION 6.3 AND 6.6

South Kingstown Comment 9

6.3 and Section 6.6 - It is our judgment that unless distributed “upstream” Best Management Practices (BMPs) are specifically designed for infiltration, even the most technologically-advanced structural stormwater BMP may not be effective in reducing bacteria concentrations at stormwater drainage system outfalls due to regrowth of bacteria in catch basins, manholes and pipe systems “downstream” of the BMP. Because infiltration-based approaches will not be able to be employed in every setting, we suggest that these “regrowth” issues be acknowledged in the TMDL document. We would suggest that a more detailed description of where and what type of BMPs will be effective in reducing bacteria concentrations is necessary. “End-of-pipe” treatment just prior to discharge to a receiving water body may be the only effective BMP when infiltration is not available in a drainage area. It should also be noted that reducing indicator bacteria through a stormwater BMP does not necessarily reduce the pathogen or virus associated with the indicator. This topic has not been well researched and sets up a potential scenario where a BMP was highly effective at removing the indicator bacteria, while not abating the associated pathogen load and as such would produce effluent that has simply been stripped of its pathogen signal, regardless of how safe the water actually was.

RIDEM Response

RIDEM continues to monitor emerging scientific findings related to re-growth of bacteria within drainage systems. This issue should be considered as part of the catchment area feasibility studies conducted for high priority outfalls to determine the location and types of BMPs most effective at reducing bacteria stormwater loads.

INDIVIDUAL WATERBODY REPORTS

GENERAL COMMENTS

South Kingstown Comment 10

We feel that there are several shortfalls in each of the Town of South Kingstown TMDL “watershed summaries”. A more complete description of our rationale for these limitations is in the “Comments on TMDL Science” section that follows. In general, our concern is that the limitations of these studies may misrepresent the magnitude of the issue and may misdirect limited financial resources to presumed problems while other pollution mitigation opportunities that are more obtainable go unaddressed. The following summarize the concern over establishing indicator bacteria target reductions in the two South Kingstown watersheds.

Very limited sampling data obtained, and in some cases even less utilized, for target pollutant reductions. Given the well-documented variability in bacteria data, the paucity of data in this TMDL creates uncertainty in actual target pollutant reductions and makes the statistical validity of assessment of the impact of improvements under adaptive management untenable.

No microbial source tracking was utilized to identify sources and therefore proposed implementation strategy can not identify specific actions necessary to achieve TMDL water quality targets.

RIDEM Response

The sources of bacteria to Fresh Meadow Brook and White Horn Brook are varied, intermittent, and unpredictable. As such, it is not feasible to accurately quantify concentrations from each source nor is it necessary for the development and implementation of an appropriate phased mitigation strategy. The TMDL identifies all actual and potential sources/inputs and outlines the recommended abatement measures to address identified sources. The Town may opt to collect additional samples to further inform and refine implementation activities.

**INDIVIDUAL WATERBODY REPORTS – FRESH MEADOW BROOK
COMMENTS – WATERSHED DESCRIPTION**

South Kingstown Comment 11

The following description is incorrect: “The headwaters of Fresh Meadow Brook are in a forested area in the southern portion of North Kingstown. The brook flows south parallel to the Saugatucket River, and joins with a tributary originating in a residential development to the northeast. The brook crosses Route 138 and continues south, parallel to Broad Rock Road. Fresh Meadow Brook then flows east into Indian Pond in eastern South Kingstown.” The correct description should be “Fresh Meadow Brook originates at the outlet of Indian Lake and flows toward the southwest, and then turns toward the north and joins a major unnamed tributary before flowing toward the west under Broad Rock Road where it joins the Saugatucket River. The headwaters of this major unnamed tributary are in a forested area in the southern portion of North Kingstown. This tributary crosses Route 138 and continues south parallel to the Saugatucket River and Broad Rock Road to where it joins Fresh Meadow Brook.”

RIDEM Response

The document has been revised accordingly.

South Kingstown Comment 12

It is not clear in this TMDL what the source and dates of land use data were that were used in the watershed analysis. Please revise watershed summary to include date and source of land use and impervious cover data in order to allow communities to evaluate how this information may be correlated with in-stream sampling data and to track changes related to land use.

RIDEM Response

The source and dates of land use data used in the watershed summaries has been added to the Core document.

COMMENTS – POTENTIAL SOURCES/ONSITE WASTEWATER TREATMENT SYSTEMS

South Kingstown Comment 13

The following sentence should be edited since there is no data provided to confirm that there are cesspools in the watershed: “All residents in the Fresh Meadow Brook watershed rely on onsite wastewater treatment systems (OWTS), such as cesspools and septic systems.”

RIDEM Response

The statement as written merely gives examples of types of OWTS. Lacking confirmatory information that there are no cesspools in this watershed, it is reasonable to cite cesspools as an example of OWTS.

South Kingstown Comment 14

The following sentence should be deleted, as it refers to the whole town, with no data to document that it is relevant to this watershed: “Most of the unsewered portions of South Kingstown have soils with moderate to severe septic system limitations (Geremia, 2006)”

RIDEM Response

The statement as written clearly indicates that it refers to the entire town.

South Kingstown Comment 15

In reference to the: “OWTS Notice of Violation/Notice of Intent to Violate”, should be either deleted, or a statement should be included with the date of the notice: and whether or not this notice has been resolved.

RIDEM Response

The statement is a general statement about the prevalence of onsite wastewater system failures or lack thereof in the watershed.

South Kingstown Comment 16

The following sentence should be removed, as it does not necessarily apply to this watershed and no source is provided: “Almost 50 percent of the unsewered, residentially zoned land under two acres in South Kingstown has constraints relative to the proper functioning of OWTS.”

RIDEM Response

The statement as written clearly indicates that it refers to the entire town.

**INDIVIDUAL WATERBODY REPORTS – WHITE HORN BROOK
COMMENTS – WATERSHED DESCRIPTION**

South Kingstown Comment 17

It is not clear in this TMDL what the source and dates of land use data were that were used in the watershed analysis. Please revise watershed summary to include date and source of land use and impervious cover data in order to allow communities to evaluate how this information may be correlated with in-stream sampling data and to track changes related to land use.

RIDEM Response

The source and dates of land use data used in the watershed summaries has been added to the Core document.

COMMENTS – POTENTIAL SOURCES/ONSITE WASTEWATER TREATMENT SYSTEMS

South Kingstown Comment 18

The following sentence should be deleted, as it refers to the whole town, with no data to document that it is relevant to this watershed: “Most of the unsewered portions of South Kingstown have soils with moderate to severe septic system limitations (Geremia, 2006)”

RIDEM Response

The statement as written clearly indicates that it refers to the entire town.

South Kingstown Comment 19

In reference to the: “OWTS Notice of Violation/Notice of Intent to Violate”, should be either deleted, or a statement should be included with the date of the notice: and whether or not this notice has been resolved.

RIDEM Response

The statement is a general statement about the prevalence of onsite wastewater system failures or lack thereof in the watershed.

South Kingstown Comment 20

The following sentence should be removed, as it does not necessarily apply to this watershed and no source is provided: “Almost 50 percent of the unsewered, residentially zoned land under two acres in South Kingstown has constraints relative to the proper functioning of OWTS.”

RIDEM Response

The statement as written clearly indicates that it refers to the entire town.

COMMENTS – ILLICIT DISCHARGES

South Kingstown Comment 21

The sentence “As shown in Figure 2, multiple MS4 outfalls have been identified along the brook.” Should be edited or deleted as outfalls are not, in and of themselves, illicit discharges.

RIDEM Response

The previous statement makes clear that MS4 outfalls by themselves are not illicit discharges.

COMMENTS ON TMDL SCIENCE

CONCENTRATION VERSUS LOADING-BASED TMDL STRATEGY

South Kingstown Comment 22

The principle of the Total Maximum Daily Load process is to determine the pollutant quantity (i.e., load) that a waterbody can accept while still meeting water quality standards and then to allocate that load (or load reduction) among pollutant sources in the watershed. According to TMDL regulations, a TMDL must identify the loading capacity of a waterbody for the applicable pollutant. Environmental Protection Agency (EPA) regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)). Although regulations state that TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure, regulations express a clear preference for using pollutant load to determine the greatest amount of a pollutant that a water body can receive without violating water quality standards. Alternative approaches can overlook the capacity of waterbodies to assimilate some quantity of pollutant without violating water quality standards.

The RI Statewide Bacteria TMDL, however, relies entirely on concentration (i.e., bacteria counts) for the target pollutant reduction. We acknowledge that bacteria loads are discussed in Appendix M of the RI Statewide Bacteria TMDL but this discussion is generic and in no way specific to actual flows or loads in the impaired watersheds.

The reliance on concentration is justified by RIDEM in a number of ways, such as:

- the approach provides a direct link between existing water quality and the numeric target,
- using concentration in a bacteria TMDL is more relevant to water quality standards

- bacteria loads are difficult to interpret because the magnitude of allowable loads depend on flow conditions
- expressing bacteria as loads would be confusing to the public
- follow-up monitoring will compare concentrations, not loadings, to water quality standards.

These justifications are arguable. A TMDL is the link between pollutant loads, existing water quality, and numeric targets, based on an analysis of what mass of a pollutant a waterbody can accept and still attain water quality standards, not simply equating instantaneous concentrations with water quality criteria. Concentrations may appear to be more relevant to water quality standards compared to loads only if the analysis ignores issues of fate and transport (such as mixing, dilution, and assimilative capacity) in the receiving waters; these processes are crucial to understanding the impacts of pollutants on waterbodies and should not be ignored. The dependence of loads on flow conditions is in fact the reason that loads are most commonly considered in TMDLs rather than concentrations. A trickle of input at extremely high concentration can be far less significant to a water body than a flood at low concentration if the load carried in the higher flow is greater. Using bacteria loads (i.e., #/day) seems no more or less confusing to the public than the use of load for phosphorus, sediment, or lead. Finally, it is true that follow-up monitoring will assess bacteria counts rather than loads, but the same is true of any other pollutant for which water quality criteria exist and are applied through water quality standards and this is irrelevant to follow-up monitoring. What is being measured in follow-up monitoring is compliance with water quality standards, not pollutant loads.

It should be noted that numerous bacteria TMDLs do in fact handle bacteria as loads, not just bacteria concentrations. Examples include:

- Appoquinimink River DE (DNREC, 2006)
- Buzzards Bay MA (MADEP et al., 2009)
- Lower Pocomoke Basin MD/VA (MDE and VADEQ, 2009)
- Malibu Creek CA (CRWQCB, 2004)
- Monocacy River Basin MD (MDE, 2009)
- Moore's Creek VA (VADEQ and VADCR, 2002)
- Rock Creek DC (DCDOH, 2004)
- White Oak River NC (NCDENR, 2009)

This issue is important for several reasons. First, consideration of concentration alone may result in questionable conclusions. For example, the policy that percent concentration reductions needed in receiving water should be accomplished by applying the same percentage to all tributary inputs may work mathematically, but makes prioritization of impacts difficult. Requiring a 75% reduction in a small, low-concentration source (e.g., 20 cfu/100 mL) will be difficult, will probably necessitate a very high marginal cost to achieve, and will be of little impact to the water body, while a comparable reduction on a high-concentration source (e.g., 650 cfu/100 mL) may be less expensive, more practical, and have a greater impact on water quality. Secondly, consideration of concentration without load (and without flow) fails to account for important processes that influence the effects of pollutant discharge on a waterbody including the following.

- Dilution, Mixing and Dispersion: According to the EPA's Draft Guidance for Water-Quality based Decisions: The TMDL Process (1999), states are to compile information "which must include dilution calculations, trend analysis, or predictive models for determining the physical, chemical or biological integrity of streams, rivers, lakes and estuaries" in order to account for natural processes of dilution, mixing and dispersion. These processes are fundamental to natural watershed processes and also pollutant abatement but cannot be accounted for in a concentration-based TMDL.
- Settling and Adsorption: Indicator bacteria are known to adsorb to suspended sediments which may increase settling velocities and movement of the bacteria out of the water column (Shillinger, 1985). Instantaneous concentrations sampled at fully mixed discharges may exaggerate bacteria counts due to suspended sediments but would not account for settling at areas just downstream of the discharge depending on receiving water flow conditions.
- Bacteria die-off and Growth: Indicator bacteria are living organisms and therefore may persist, grow or die in the natural environment. Different indicator organisms have different die-off rates, which are a function of exposure to sunlight, temperature and moisture conditions, and die-off rates correlate with pathogenic indicators in different ways. Depending on the nature of the receiving water (i.e. temperature, exposure to sunlight and nutrient availability) the effect of die-off and/or regrowth may be an important component of in-stream indicator bacteria concentration and is typically accounted for in some way in TMDL analysis.

These processes influence the assimilative capacity of the waterbody and in turn influence the quantity of a pollutant that can be accepted before violating water quality standards. This is the fundamental logic of a TMDL and simply requiring incoming concentrations to meet receiving water criteria is, from our perspective, a potentially overly restrictive simplification and may not be achievable given current best available treatment technologies for existing build landscapes.

RIDEM Response

As described in detail in the TMDL document, federal regulations state TMDLs can be expressed in terms of mass per time (i.e. daily load), concentration, or other appropriate measure (40 CFR Part 103.2 (i)). Rhode Island bacteria TMDLs are expressed as concentrations and are set equal to the state's water quality criteria for bacteria. EPA Region 1 has approved concentration-based bacteria TMDLs from all of the New England States, further affirming the validity of the approach.

We absolutely agree that the various processes (Dilution, Mixing, Dispersion, Settling and Dispersion, and Bacteria Die-off and Growth) influence the effects of pollutant discharges on a waterbody. However, Rhode Island's Statewide Bacteria TMDL relies upon ambient water quality data, and not pollution source discharge data, to establish the necessary pollutant reductions. By nature of the fact that they are in-stream sampling results, the data reflects the various processes mentioned in the comment above.

As noted in the TMDL, the concentration-based TMDL reductions provide a rough estimation of the pollution abatement action needed for each segment to meet water quality standards. It is incorrect to say that RIDEM sets the same percent reduction to all sources. RIDEM sets percent reductions based on instream sampling criteria. If a waterbody requires 50% percent reduction,

that reduction is set at the instream sampling station. Compliance will be measured in the receiving waters. Measuring compliance in the receiving waters takes into consideration that a trickle input at extremely high concentration could be far less significant to a waterbody than a flood at low concentration. In the case of MS4 operators who are required to build structural BMPs to meet TMDL requirements (and it should be noted that this scenario applies to neither of the waterbodies included in the Statewide Bacteria TMDL within South Kingstown), South Kingstown is rightly concerned that if you treat small and large source equally, you may miss sources that will have the greatest impact on water quality. Under the Phase II permit, MS4 operators may prioritize outfalls for implementation of TMDL related requirements and thus may focus efforts on the sources delivering the larger loads first.

QUANTITY AND DISTRIBUTION OF WATER QUALITY DATA

South Kingstown Comment 23

Water quality data that support a TMDL analysis need to be of sufficient quantity and appropriate distribution with respect to ambient conditions, both in terms of seasonal variations and weather conditions, to allow for useful scientific analyses and ultimately to guide implementation. We acknowledge that single statewide TMDL development clearly has limitations in regard to data quantity and distribution, but the paucity of data will limit the ability of watershed stakeholders to make meaningful decisions regarding prioritization of actions and reduces the value of the TMDL proposed implementation recommendations.

- The Fresh Meadow Brook TMDL pollutant reduction target was based on monitoring of 5 dry weather days in 2008-2009, and no wet-weather events.
- The White Horn Brook watershed dataset included 10 dry-weather samples and 6 wet weather samples. Pollutant reduction target was based on 4 dry-weather samples and 3 wet weather samples. As the TMDL used only the station with the highest geometric mean value to establish the pollutant reduction target (discussed below in Rejection of Data) the data utilized to establish reduction targets in the White Horn Brook is based on even fewer samples than shown in the watershed summaries.

In contrast, bacteria TMDLs developed by other states are based on considerably more extensive datasets. For example, the Pocomoke Maryland/Virginia TMDL required a minimum of 30 samples over three years (MDE and VADEQ, 2009), the Connecticut cumulative frequency distribution analysis procedure requires a minimum of 21 samples during the recreation season (CTDEP, 2006), and the Buzzards Bay TMDL was based on thousands of bacteria observations (MADEP et al., 2009).

In some cases, the spatial coverage of sampling supporting other South Kingstown TMDLs has been extensive (e.g., Green Hill Pond TMDL, Narrow River TMDL), allowing an assessment of potential pollutant source areas. However, in this TMDL, the spatial and temporal distribution of monitoring is very limited. In both cases, monitoring has been conducted only during the summer/fall season (e.g., May – October) and winter and spring conditions have generally not been included. This could represent a significant bias, especially for bacteria, where sources, fate, and transport are strongly seasonally-dependent with typical increases in the warmer seasons.

TMDLs routinely rely upon aggregating water quality data for comparison and analysis. Selection of data to use, methods of simple statistical analysis such as geometric means (geomean), use of laboratory results where a constituent is not detected, and use of assumptions in analysis, all need to follow basic scientific principles to arrive at valid results.

Most of the water quality standards applicable to the TMDLs are expressed as geomean concentrations. In general, the geomean is intended to compute an estimate of central tendency of highly variable independent data over some representative time period in order to reasonably reflect ambient conditions and reduce the influence of a single extreme value. It is unclear if Rhode Island water quality standards include a requirement for the time span or number of samples to be covered by a geomean. Water quality standards for indicator bacteria in several New England states are based on geomeans covering some minimum time period or number of samples, e.g., Vermont (>3 samples over 30 days), New Hampshire (>3 samples over 60 days), and Massachusetts (all samples in preceding 6 months). The RIDEM Shellfish program requires consideration of the last 30 observations in a geomean, effectively considering conditions over a 5-year period. Bacteria TMDLs in Delaware (DNREC, 2006) and in California (CRWQCB, 2004) are both based on geomeans representing a minimum of 30 days of data. The averaging period used for development of the Maryland Pocomoke River TMDL required at least 30 samples and used a three-year window of data to identify current baseline conditions (MDE and VADEQ 2009).

Because of the limited datasets used in formulating the TMDLs, it is difficult to fully support the conclusions about water quality conditions in these watersheds, as well as the assumptions regarding pollutant delivery and establishment of reduction requirements.

RIDEM Response

Consistent with EPA guidelines, Rhode Island's Statewide Bacteria TMDL relies upon available ambient water quality data to characterize conditions and to set the TMDL reductions. As noted above, the TMDL itself is set equal to the applicable bacteria criteria and compliance with the TMDL will be determined by ambient water quality monitoring results. RIDEM acknowledges the limited data set available for certain waters included in the TMDL, however notes that all data are in compliance with the data quality and quantity requirements for use in conducting water quality assessments and impaired water listings in the "Rhode Island Consolidated Assessment and Listing Methodology" (CALM).

Data availability was considered when preparing recommended implementation actions in the Statewide Bacteria TMDL. The statewide TMDL document primarily recommends implementation of established management practices for the various bacteria pollution sources. The waterbody specific recommendations are based upon readily available information such as pollution source and other data available through the RI Geographic Information System and community specific planning documents. Structural abatement practices are required only for those waterbodies located in highly urban watersheds where sampling conducted in support of previously completed TMDLs has determined wet weather impacts. Based on multiple studies that demonstrate a link between impervious cover and decreased water quality, the TMDL also relies upon watershed impervious cover to establish a scaled approach for enhancements to local (MS4) stormwater management programs. As stated previously, it is the expectation that the

management practices initiated with implementation of the Statewide Bacteria TMDL will be adapted and refined through the work of municipalities and others as more watershed specific information is collected.

In response to the comment, “It is unclear if Rhode Island water quality standards include a requirement for the time span or number of samples to be covered by a geomean”, the commenter is referred to TABLE 1. 8.D.(2). Class-Specific Criteria - Fresh Waters of RI’s Water Quality Standards. There is no time span or number of samples specified in the standards themselves.

Lastly, it is noted that the description of the RI Shellfish Program data requirements describes only Growing Areas classified as “Approved” and affected by nonpoint sources. The National Shellfish Sanitation Program establishes sampling and data analysis requirements specific to growing area classification. For example, an area classified as Conditionally Approved must be sampled twelve times per year when the area is open for harvesting with the last fifteen samples analyzed for compliance. An area classified as Approved in a remote area is sampled a minimum of twice per year with at least the last fifteen samples analyzed for compliance.

REJECTION OF DATA

South Kingstown Comment 24

As stated previously and in subsequent comments the limited water quality sampling data is a major shortcoming of the RI Statewide Bacteria TMDL approach. Given the limited amount of water quality sampling data, it is not clear why RIDEM chose to ignore sampling results and instead selected the most conservative (i.e., highest geomean or 90th percentile concentration) sampling location for use in calculation of the geomean and subsequently to establish pollutant reduction targets. In White Horn Brook for example, the available in-stream concentration dataset includes 16 samples, but only seven samples are used to calculate the pollutant reduction target. The target reduction for White Horn Brook is listed at 52% (including the 5% MOS). If all available data was used to determine the geomean, the resulting geomean would be 90 cfu/100 mL as opposed to 102 cfu/100 mL and the target reduction would be 40% as opposed to the listed 52%. While this percent reduction is likely well within a margin of error given even 16 samples, it is not clear why, given the sparse data set, that RIDEM would not utilize all the available data to determine a target load reduction assuming that the samples are independent. Please clarify this rationale.

RIDEM Response

It is not accurate to state that “RIDEM chose to ignore sampling results and instead selected the most conservative sampling location for use in calculation of the geomean and subsequently to establish pollutant reduction targets.” Statistics were calculated on data collected at each monitoring station so as to evaluate any localized impacts that may be occurring within the waterbody assessment unit. Pooling of data from various stations within a waterbody segment to generate statistics may mask these localized impacts. TMDLs must establish pollutant reduction targets protective of all portions of the waterbody. Therefore, statistics from individual stations are calculated and the most conservative value is used to establish pollutant reduction targets protective of all portions of the waterbody.

FUTURE MONITORING AND ATTAINMENT UNCERTAINTY

South Kingstown Comment 25

Water quality data are needed to assess the effectiveness of TMDL implementation strategies during the course of implementation and to over time refine and redirect management measures to address the most important locations and issues in the watershed. Section 1.0 of the TMDL indicates that the TMDLs are phased TMDLs, which presumably require additional monitoring to evaluate the effectiveness of ongoing water quality improvement efforts, track the response of in-stream water quality as load reductions are made over time, and ensure that water quality standards are met as remedial actions are accomplished. It is implied that monitoring results will be used in adaptive management to fine-tune or redirect implementation efforts.

Because of the high variability of indicator bacteria data and the low sampling frequency in these watersheds, it is extremely unlikely that any existing monitoring program will be able to document incremental improvements in water quality in the TMDL watersheds with any statistical confidence.

The value of monitoring data to evaluate changes in a watershed can be assessed using Minimum Detectable Change Analysis, which uses prior knowledge of a water quality constituent to determine how much change must occur from implementation of water quality practices for the change to be detected in a statistically significant way. For example, using five years of data from Station GA10-3 in Point Judith Pond (one of the more extensive datasets available among previous South Kingstown TMDLs), it is estimated that the current sampling program (six samples/year for five years) can determine fecal coliform levels at +75% of the true mean (at $P=0.90$). On an annual basis, six samples per year can determine fecal coliform only +198% of the true mean. This means that it will be extremely difficult to detect small changes in bacterial indicator levels from one year to the next. Using the same dataset, an analysis of minimum detectable change (Richards and Grabow, 2003) assuming five years of post-implementation monitoring at the same six samples per year frequency, suggests that a 3,756% change in bacterial indicator count would be required to accept with 90% statistical confidence that change has occurred. A decrease of 3,700% is impossible, but more importantly, the current infrequent sampling program is likely to be incapable of detecting modest changes in indicator bacteria over a five year span with statistical confidence. Additionally, there appears to be one anomalously high concentration dry weather sampling event that appears to skew the geomean upward in each monitoring station for the Fresh Meadow Brook (8/27/09) and White Horn Brook (9/20/08). Statistically representative datasets would also put these values in context, as to whether they are anomalous or representative of the range of dry weather conditions.

It can be argued that only compliance monitoring is required and that bacterial indicator counts below the water quality standard constitute the end-point measure of success. However, assessing TMDL effectiveness based on compliance monitoring alone is a binary situation – either the waterbody complies with water quality standards or it does not. Without intermediate data on changes in bacteria levels as implementation proceeds, it will be difficult or impossible to target important remaining sources, understand background contributions, redirect additional or new treatments, and engage in other forms of adaptive management. This situation is exacerbated by the likely importance of background sources of bacteria in many of the South Kingstown watersheds. For example, the town might implement measures that yield a 99%

reduction in anthropogenic sources of indicator bacteria, while such sources comprise only 40% of the total bacteria load. If monitoring could not reliably detect the consequent 39.6% reduction in bacteria counts, it would be possible to conclude that the measures had had no effect and that the town must do more, without additional insight on where to go from there. Substantially improved monitoring is essential if the TMDLs are to engage in genuine adaptive management.

RIDEM Response

DEM acknowledges the importance of follow-up monitoring to document water quality improvements and ultimately compliance with water quality standards. We are committed to working with municipalities and other stakeholders to develop appropriate monitoring strategies, as part of municipalities' adaptive management approach.

HYDROLOGIC DATA

South Kingstown Comment 26

Hydrologic data (e.g., streamflow and point source discharges) are important for a number of reasons:

- Hydrology (e.g., precipitation and runoff) is a critical driver of nonpoint source pollution;
- Hydrologic data are crucial to assess the relative magnitudes of pollutant sources and to interpret the potential impact on receiving waters. Simply because a tributary exhibits a high indicator bacteria count, for example, does not mean that it is a significant source of bacteria to a waterbody if the tributary flow is very small; a larger tributary with a lower bacteria count may in fact have a much more important influence;
- Precipitation and flow data are key components of seasonal variations; the Clean Water Act requires that TMDLs be established with consideration of seasonal variations; and
- Flow data are required to compute constituent load (mass per unit time) from constituent concentration (mass per unit volume).

There is no consideration of hydrology in the TMDL with the exception of general explanation of how loading might work if flow data was available (Appendix M). In part, this may be due to the fact that the TMDLs considered only concentration, rather than load and consequently had no apparent need for flow data. Even so, it is difficult to assess the true magnitude and dynamics of potential pollutant sources based on indicator bacteria concentrations alone, further reducing the value of the recommended TMDL implementation plans. Different flow regimes demand different management approaches, and therefore it is essential that hydrology be used in evaluating implementation strategies.

RIDEM Response

As noted previously, RIDEM utilized all available data (including ambient water quality data, and pollution source and other data available through the RI Geographic Information System and community specific planning documents) in establishing the pollutant reduction target and in determining appropriate implementation actions. We agree that hydrologic data may assist in prioritizing source control efforts however the lack thereof does not invalidate the recommendation of established management practices to address common nonpoint sources of pollution. Municipalities may opt to collect hydrologic or other data to further guide and prioritize implementation of best management practices.

WATERSHED MODELING

South Kingstown Comment 27

Watershed and receiving water modeling has long been a key component of TMDL development, so much so that EPA published a Compendium of Watershed-Scale Models for TMDL Development in 1992 and maintains a “TMDL Modeling Toolbox” to support TMDL development and to establish consistency and defensibility for TMDL modeling tools to address a broad range of waterbody types and pollutants. Numerous bacteria TMDLs have used modeling to simulate bacteria generation and transport in the watershed, to understand fate and transport of bacteria in the receiving water, and to evaluate alternative load reduction scenarios. The Moore’s Creek Virginia fecal coliform TMDL used BASINS and HSPF and modeled hydrology intensively (VADEQ and VADCR, 2002). The Malibu Creek California bacteria TMDL also used HSPF, both to estimate bacteria loads in the watershed and to predict bacteria counts resulting from alternative loading scenarios (CRWQCB, 2004). The District of Columbia Rock Creek fecal coliform TMDL used a watershed model to generate bacteria loads, and SWMM to simulate in-stream transport (DCDOH, 2004). In North Carolina, the White Oak River TMDL used a combined watershed and tidal prism model to estimate fecal coliform loads in the watershed and their dispersion in bays (NCDENR, 2009).

The RI Statewide TMDL analysis did not include the use of simulation modeling. Although there is no regulatory requirement to do so, this lack of modeling does present a significant challenge in understanding pollutant sources and delivery, pollutant fate and transport in the receiving water, and evaluation of alternative scenarios for effective load reductions. We acknowledge the financial challenges associated with conducting modeling on multiple watersheds, but without an evaluation of source areas and loads there remains significant uncertainty on how to prioritize limited resources to address the impairment. Watershed pollutant loading, typical in other TMDLs, would greatly enhance the ability of the Town (and other regulated entities) to prioritize resources to make meaningful forward progress on the impairments within its jurisdiction.

Further, waterbodies within the boundaries of the Town of South Kingstown are now subject to a total of eight TMDLs, six of which are specific to bacteria. Given the reality of limited financial and technical resources, it is becoming increasingly important that RIDEM consider the larger context of water quality regulatory requirements and water quality goals as a whole when releasing this and other individual TMDLs, providing some sense of priority in order not to dilute implementation efforts across the State with an “excess of priorities.”

RIDEM Response

Watershed modeling is commonly based on land use, impervious cover, drainage area, and literature based values of bacteria export coefficients, and can provide some insight into drainage area bacteria loading, and alternative load reduction strategies. Given the intermittent and variable nature of most non-point and stormwater sources of bacteria, the accuracy of these models is questionable. We believe that reliance upon watershed specific information gleaned from statewide databases and available municipally generated planning documents addressing stormwater and wastewater provides a comparable level of insight to sources as watershed modeling results. As described previously, DEM has gathered all readily available pollution source information in preparing the TMDL implementation recommendations and urges municipalities to do the same with data available to them in preparing their TMDL Implementation Plans. If the Town of South Kingstown believes that watershed modeling can

contribute meaningful information, it could be included as part of its TMDL Implementation Plan.

NATURAL AND BACKGROUND SOURCES OF BACTERIA

South Kingstown Comment 28

Indicator bacteria can originate from wildlife (natural/background sources) as well as domestic animals and humans (anthropogenic sources); in many watersheds wildlife contributions can be significant. It is important to distinguish between natural background and anthropogenic sources to enable the selection of appropriate management measures. EPA regulations require that a TMDL identify the portion of the loading capacity attributed to nonpoint sources and to natural background and recommend that where possible, load allocations should be described separately for natural background and nonpoint sources. In general, EPA and most states do not recommend management measures targeting naturally occurring wildlife to achieve TMDL goals.

Background sources of indicator bacteria may not be controllable, particularly in wet weather, unless drastic wildlife eradication or control measures are contemplated. Bacteria TMDLs generally recognize that background sources of bacteria are important, may be uncontrollable, and that the reduction of wildlife or changing a natural background condition is not an intended goal of a TMDL (although most TMDLs recognize that nuisance concentrations of wildlife due to human intervention should be controlled). In the Pocomoke River basin (VA/MD), wildlife contributions are considered natural conditions with a background level of bacteria loading (MDE and VADEQ, 2009). The TMDL recognizes that some waterbodies will not meet water quality standards after controls are implemented for all anthropogenic sources. However in this TMDL, neither MD or VA, nor the EPA propose the elimination of wildlife to allow for the attainment of water quality standards; the reduction of wildlife or changing a natural background condition is not the intended goal of a TMDL. The Allen Brook CT TMDL did not allocate wildlife a percent bacteria reduction because the TMDL management goal is to foster a sustainable natural habitat (CTDEP, 2006). The Buzzards Bay MA TMDL report notes that bacteria from wildlife would be considered a natural condition unless some form of human inducement (e.g., feeding) causes congregation of wild birds or animals and cites data in runoff from “pristine” areas containing fecal coliform at levels that can sometimes violate Class SA criteria (MADEP et al., 2009).

While the RI Statewide Bacteria TMDLs do not generally address wildlife or background sources as distinct from anthropogenic sources with respect to required reductions, other TMDLs address the matter differently. Most TMDLs, e.g., the Monocacy River Basin MD (MDE, 2009) clearly emphasize addressing anthropogenic sources of bacteria first, especially dry-weather discharges. Several TMDLs – including the Lower Pocomoke Basin MD/VA and Moore’s Creek VA - recognize that if water quality standards are not attained, the states may consider developing either a risk-based adjusted water quality assessment or a Use Attainability Analysis to reflect the presence of naturally high bacteria levels from uncontrollable (natural) sources. The Malibu Creek CA bacteria TMDL addresses the issue of background bacteria sources differently. The Malibu Creek CA bacteria TMDL approach is two-fold. First, the TMDL considers bacteria levels from a nearby reference watershed that includes only wildlife or other natural sources in comparison to bacteria levels in Malibu Creek. Second, the TMDL permits a certain number of exceedances of water quality standards (depending on season and weather) in receiving waters due to natural circumstances (CRWQCB, 2004).

Bacteria from natural background sources are likely to continue to cause violations of water quality standards even if anthropogenic sources are entirely controlled. This is shown in studies in Massachusetts and California where reference watersheds have been utilized in evaluation of indicator bacteria background levels (Rees et al. 2005, Griffith, et al. 2009). Despite the clear importance of wildlife or natural sources of indicator bacteria in the South Kingstown watersheds, based on previous microbial source tracking analysis conducted by RIDEM, no consideration for background levels are made in the required bacteria reductions specified in the TMDLs. In fact, in some watersheds outside of South Kingstown, the TMDL target reductions are set at 100% which would presumably include all contribution by wildlife under any flow conditions.

We recommend that the RI Statewide Bacteria TMDL address the importance of wildlife/background sources on in-stream bacteria concentrations and consider the use of reference watersheds to establish probable dry and wet weather background concentrations of bacteria in order to create a target pollutant reduction that will result in achievable water quality goals related to anthropogenic sources. As referenced above, a possible solution is to establish wet weather benchmarks for expectations of likely exceedances under natural conditions based on seasonality, storm duration and intensity.

RIDEM Response

The term natural background as it relates to indicator bacteria is used in several different contexts in the above comments. DEM agrees that indicator bacteria from a non-nuisance population of wildlife is a “natural background source of bacteria” and that when this source is deposited on an un-altered landscape where wildlife/waterfowl are not fed, it results in a natural background concentration of indicator bacteria in the receiving water. DEM also agrees that non-nuisance wildlife populations are sources of indicator bacteria that may not be controllable; however, the impact of these sources on receiving waters particularly when they are rapidly and efficiently transported over impervious surfaces and through storm water drainage systems is controllable. The above referenced TMDLs also address sources of bacteria in this same manner.

RIDEM does not agree that the TMDLs cited above take an entirely different approach to abatement of anthropogenic and natural sources of bacteria. The Statewide Bacteria TMDL focuses on simple, common sense actions that municipalities and residents can take to reduce the impact of nuisance populations of waterfowl – such as discouraging the feeding of waterfowl and the re-establishment of natural vegetated riparian buffers, on receiving water bacteria concentrations. Elimination of wildlife sources is not a goal of Rhode Island’s TMDL Program as inferred by the first two paragraphs of this comment.

Based on the comments above, it appears that the commenter has interpreted the Statewide Bacteria TMDL target reductions as the percent reduction in bacteria from each source. However, the reduction targets are the reductions in receiving water concentrations that must be achieved; it does not reflect the reduction from each individual source that can vary based on the impact of the individual sources on the receiving water. The TMDL requires that the responsible entities develop a prioritized plan for identifying sources and implementation alternatives, and where appropriate, structural BMPs are identified to address significant sources. It is RIDEM’s position that this approach is more appropriate than that proposed by the commenter (i.e.

attempting to establish reference watersheds, pollution reduction targets for anthropogenic sources, and estimates of likely exceedances under natural conditions).

The ultimate goal of the state's TMDL program is the restoration of "fishable/swimmable" uses, and where applicable shellfishing uses. Federal/state regulations/policy does not allow for consideration of biological sources of the indicator bacteria in decisions related to classification of shellfishing waters or to beach closures. More specifically, the determination of whether estuarine/marine waters are suitable for shellfish harvesting/consumption is based upon National Shellfish Sanitation Program requirements which do not allow consideration of the source of bacteria (i.e. human or non-human). In other words, regardless of the source of bacteria (human or non-human) if either the applicable geometric mean or variability portion of the criteria are exceeded, the affected waters would be closed to the harvest of shellfish. The same is true with decisions regarding beach closures and swimming use in non-designated beach areas.

As noted by the commenter, some of the TMDLs referenced above indicate that a Use Attainability Analysis may be appropriate in the future if water quality standards can not be achieved. RIDEM does agree that a UAA is a potential tool and has modified the Statewide Bacteria TMDL to explain how the UAA process could be utilized to address compliance with water quality standards. RIDEM is willing to work with the town to obtain further guidance from EPA regarding the UAA process, and level of BMP implementation required. Additional detail on UAA process is provided in the response to RIDOT Comment 28.

DATA VARIABILITY

South Kingstown Comment 29

Water quality data—especially indicator bacteria—can be extremely variable. It is well established in the literature that indicator bacteria concentrations in a single storm event can vary in concentration by an order of magnitude or more, even in pristine undeveloped watersheds (Rees et al., 2005, Griffith, et al., 2009) and can vary by time of day based on ambient air temperature and stream reach exposure to sunlight (Traister, 2006). In a local example, a recent evaluation by Woodard & Curran of RI Department of Health enterococci data in Middletown, RI a triplicate sample had concentrations ranging from a low of 1597 cfu/100mL to a high of 2613 cfu/100mL.

Although the high degree of variability in the water quality data used in these TMDLs is not unusual, it must be considered in the analysis to be sure that apparent patterns are meaningful. It does not appear that consideration for natural variability in bacterial indicator concentration was utilized in this TMDL document presumably due to limited data set. Duplicate samples are encouraged by EPA as recommended field quality assurance/quality control in order to evaluate the precision of the sampling (<http://water.epa.gov/type/rsl/monitoring/vms511.cfm>, 2011). Given lack of duplicate sampling for the two impaired watersheds in South Kingstown, it is impossible to determine the natural variation one would expect for whether a stream reach is in compliance with specific target reduction percentages. And, as will be discussed in more detail below, a clear understanding of this variation will have important implications for future efforts to assess the effectiveness of implementation measures.

RIDEM Response

RIDEM relied upon available water quality data in preparing the Statewide Bacteria TMDL. Section 4.2 of the Core document describes the various monitoring programs that assess bacteria concentrations in Rhode Island's coastal and fresh waters. All data utilized in the Statewide Bacteria TMDL have met the data quality assurance and data quality objectives outlined in the Consolidated Assessment and Listing Methodology (CALM) document. With that said, it is acknowledged that the data available for the White Horn Brook, collected by the URI Watershed Watch Program, while collected under a Quality Assurance Program Plan do not include duplicate sampling for bacteria samples. Use of a geometric mean as the enterococci and fecal coliform standards accounts for the inherent variability in bacteria sample results.

SOURCE IDENTIFICATION

South Kingstown Comment 30

Identification of sources of the specific water quality impairment is a key element of any TMDL. Source identification is, for example, essential in developing load and wasteload allocations and in formulating implementation plans to reduce pollutant loads.

In the RI Statewide TMDL approach, identification of sources of indicator bacteria in the South Kingstown watersheds is not supported by data. Septic systems are repeatedly emphasized as components of an implementation plan, yet no supporting data are presented. We acknowledge that increased density of septic systems may contribute to potential failures in any developed watershed but previous work in South Kingstown watersheds, such as the Green Hill Pond watershed, microbial source tracking conducted by RIDEM indicated that human sources were minority contributors to the fecal coliform isolates identified in the watershed, the documented failure rate of septic systems was quite low (~3%), and optical brightener studies showed no evidence of septic effluent. It is the intention of the Town of South Kingstown to continue to address septic sources through its Onsite Wastewater Management program but the lack of microbial source tracking in the White Horn Brook or Fresh Meadow Brook makes prioritization of other actions impossible.

Similarly, pet waste is often cited as a source of indicator bacteria without presentation of supporting data. Bacteria source tracking in the Green Hill Pond watershed showed that just 3% of bacteria isolates in the Factory Brook and Teal Brook drainage were from dogs. In Allen Cove, only 14% of isolates were attributed to dogs. To the extent that the anecdotal references to bacterial indicator sources in the White Horn and Fresh Meadow Brooks replace actual microbial source tracking, the implications may be a misdirected focus on low priority sources of bacteria in the TMDL watersheds and a misappropriation of mitigation funding.

RIDEM Response

As stated previously, the TMDL's potential pollution source descriptions and implementation sections rely upon readily available information on watershed specific pollution sources as well as literature based information on common sources of bacteria contributing to water quality impairments. It is expected that towns will utilize information available to them regarding these and other known bacteria pollution sources in developing TMDL Implementation Plans. For example, South Kingstown's On-Site Wastewater Management Program and Stormwater Management Programs are excellent sources of information to flag priority areas for illicit discharge detection and elimination efforts.

DRY WEATHER AND WET WEATHER EVENTS

South Kingstown Comment 31

As described above, seasonal variations and in particular wet-weather conditions must be considered in a TMDL and weighted appropriately. For pollutants derived mainly from nonpoint sources, wet weather and particularly wet seasons are critical. In general, TMDLs accomplish this by considering mass rather than concentration, by factoring hydrology into the analysis, or by explicitly considering data from critical conditions of pollutant delivery.

According to the TMDL “Core” document, the Wet/Dry Weather Analysis was conducted to “enable investigators to evaluate where or not bacteria violations occur during wet or dry weather conditions, supporting the identification and prioritization of bacteria pollutant sources for mitigation”. While we generally agree with the logic for this evaluation, the TMDL only considered whether rainfall fell on the same day that the sample was obtained. This simplified analysis does not lend itself to an accurate determination of whether the sample was actually obtained before or after a rain event and may potentially misrepresent the sampling event as wet or dry thereby reducing the usefulness of the categorization. Furthermore, in a simple statistical analysis of all samples on White Horn Brook (both sample sites), the difference in concentration between the wet and dry events are not statistically significant based on the Moods Median Test (Minitab Version 15).

Variations in rainfall intensity, duration, antecedent moisture conditions, existing stream flow condition and proximity of stormwater outfalls and other factors will influence whether there is a surface runoff response in a stream channel. While we agree that determination of wet versus dry weather may assist in identification of impact of stormwater runoff on water body bacteria concentrations we do not believe the TMDL methodology can accurately do so given the limits of the weather evaluation based only on daily rainfall. The lack of statistical significance and unknowns associated with whether these actually represent “wet or dry” conditions, in our judgment, creates more uncertainty rather than supporting the “identification or prioritization of pollutant sources” as alleged in the TMDL.

A range of more appropriate techniques are more commonly applied to account for the differences in pollutant delivery in dry or wet conditions. Bacteria TMDLs in the states of Connecticut and Delaware use the cumulative distribution function approach (Becker and Dunbar, 2005) that encompasses the range of bacteria counts expected under the full continuum of flow/seasonal conditions. The Buzzards Bay TMDL used flow-duration analysis to scale bacteria loads with respect to flow conditions.

RIDEM Response

The comment does not accurately describe how a wet weather condition was determined. RIDEM did not only look at rainfall on the day of the sample collection but at rainfall up to 96 hours (4 days) prior to the sampling date. As stated in Section 5.4 of the Core Document, “The following rule was used to indicate wet weather: >0.1” in the past 24 hours; or >0.25” in the past 48 hours; or >2.0” in the past 96 hours.”

MARGIN OF SAFETY

South Kingstown Comment 32

In a TMDL, the margin of safety (MOS) is added to the load allocation calculation to account for uncertainties in load estimation and receiving water response and to provide capacity for future development. There are two fundamental approaches to providing the MOS: implicit (where conservative assumption(s) are made at various steps in the process) and explicit (where the allowable pollutant load is reduced before required reductions are calculated). In an analysis of sources of uncertainty in TMDLs for lakes, Walker (2001) recommended that the TMDL analysis use the best scientific estimates of input values and keep the margin of safety as a discrete (i.e., explicit) element in the MOS term. In comments on the Point Judith Pond TMDL, USEPA Region I recommended the use of a 5 – 10% explicit MOS on the pollutant load. In its statewide bacteria TMDL, Maine includes an explicit 10% MOS for bacteria mass loading.

The two South Kingstown TMDLs in the RI Statewide Bacteria TMDL incorporate an explicit MOS. Unfortunately, in both cases, the MOS is applied incorrectly. The concept of the explicit MOS is to reduce the estimated pollutant load allowed to enter the waterbody to account for uncertainty and provide future capacity. In both the Fresh Meadow and White Horn Brook, however, an explicit MOS of 5% was applied not to a computed input target concentration (in this case a surrogate for load) but to the required in-stream pollutant reduction target. We request that RIDEM reconsider the use of the MOS in the RI Statewide Bacteria TMDL and apply it to load reduction targets as opposed to in-stream pollutant reduction targets.

RIDEM Response

As stated in Section 5.2 of the document, compliance with this TMDL will be determined by achieving water quality standards as measured at ambient stations representative of conditions throughout the water body. The percent reductions are presented as guidance in implementing the TMDL. There is no difference in the actual required reductions whether the margin of safety is applied to the load and wasteload allocations (referred to as load reduction targets in the comment above) or to the in-stream pollutant reduction targets. No change to the document was made.

IMPLEMENTATION RECOMMENDATIONS

South Kingstown Comment 33

Management measures need to be both watershed and source specific, as well as consistent with the constituents being addressed by the TMDL. Given the lack of source identification and watershed loading information it is impossible to correctly identify the implementation measures needed to address the identified bacteria impairments. As stated previously, we commend RIDEM for acknowledging this uncertainty by defining its scaled implementation approach but would request that RIDEM more clearly state the scaled implementation in the introduction section of the “recommended next steps” sections of the watershed summaries. Subsequent discussions of other management measures could follow with the introduction regarding the value of these actions after further consideration of watershed data. We would also suggest that entities responsible for wildlife management be more explicitly identified in the implementation section as opposed to only the Town. The Town of South Kingstown is actively engaged in outreach to residents regarding wildlife feeding and pet waste management but more aggressive management of wildlife will be required in these watersheds to reduce bacteria loadings

(especially in the absence of consideration of natural background levels of indicator bacteria) and these efforts are not the jurisdiction of the Town of South Kingstown.

RIDEM Response

As stated in the document, “The Rhode Island Bacteria TMDLs quantify the reductions in ambient bacteria concentrations required to achieve water quality standards. An implementation plan is needed to achieve the reductions specified in the TMDL. The success of TMDL implementation efforts rests largely with watershed stakeholders. The watershed summaries include both broadly applicable and watershed specific management practices based upon available pollution source information. It is intended that utilizing the information contained in the TMDL core document and watershed summaries that more detailed watershed plans and/or TMDL implementation plans will be developed.

Section 6.9 of the Core Document has been modified to more explicitly mention agencies responsible for wildlife management. We note that the cooperation of towns working together with state and federal agencies and private property owners is necessary to effectively manage nuisance waterfowl populations.

GENERAL BACKGROUND RATIONALE

South Kingstown Comment 34

Concentrations of bacteria such as *Escherichia coli* (*E. coli*), enterococci, and fecal coliform are measured in waters as an indicator of possible fecal contamination and an indicator of the possible presence of disease-causing pathogens and viruses. The types of viruses and pathogens potentially present in water are highly variable and can be difficult and/or expensive to assess, therefore indicators are used. Indicator bacteria are not generally a health risk themselves, and are instead used to indicate the likelihood that pathogenic organisms are present. The Environmental Protection Agency’s (EPA) current guidance indicates that Fecal Coliform is now considered “a poor indicator of the risk of digestive system illness” and that *E. coli* and Enterococci are preferable indicators for human health risks (<http://water.epa.gov/type/rsl/monitoring/vms511.cfm>, updated 2011). In freshwaters, such as White Horn Brook and Fresh Meadow Brook, the primary reason for evaluating these indicator organisms is to prevent sickness in swimmers (primary contact) or during non-immersion water uses (secondary contact) such as boating or fishing. The indicator bacteria do not necessarily impact the ecological health of a water body as they are a natural component in the environment and occur in all waterbodies. Wet-weather sample concentrations of fecal coliform in undeveloped (but wildlife influenced) water reservoir tributary watersheds in Massachusetts ranged from 10 colony forming units/ 100 milliliters (cfu/100mL) during winter storms to over 1200 cfu/100mL during summer storms (Rees, et al., 2005).

It is well established that high concentrations of indicator bacteria can be found in stormwater runoff (Pitt et al., 2005) and that human activity in a watershed has the potential to influence bacterial indicator concentrations in receiving water bodies. It is less clear, however, the extent to which high levels of bacteria found in stormwater discharges can be positively correlated with viruses and pathogens given the propensity for bacteria to regrow in conducive environments such as storm drains, swales and street gutters.

“These findings raise important questions as to whether enterococci and fecal coliform bacteria replicating in biofilm located in street gutters and storm drains confound testing for fecal contamination and potential health issues. Health officials agree that enterococci and fecal coliform bacteria originating from human fecal sources indicate a health risk to swimmers not because of the presence of E. coli and enterococci but because of the presumed presence of human enteric viruses. It is the enteric viruses, including Enterovirus, Adenovirus, and Norovirus, that are believed to be the primary cause of swimmer-related gastrointestinal illnesses (Glass et al. 2009). These enteric viruses multiply in the human gut but not in the environmental biofilms such as those found in street gutters or storm drains.” (Skinner et al., 2010)

It is not our intention here to argue that indicator bacteria presence in South Kingstown’s watersheds should be taken lightly. It is our understanding that it is in the best interest of the Town to be as proactive as possible given current state of the knowledge on bacteria issues and to meet their obligations under the current RIPDES municipal stormwater discharge permit. But it is our intention to constructively discuss and to attempt to reach consensus with RIDEM on the extreme challenges related to addressing indicator bacteria at a watershed scale with very limited data and to identify the most viable actions to address pathogens and viruses that can be legally controlled through town action.

We assume that RIDEM has elected to pursue this statewide TMDL as a cost-effective way to meet it’s obligations to develop TMDLs for impaired waters. We generally commend RIDEM for looking for less expensive ways to meet its TMDL obligations through a statewide TMDL approach. Our concern is that the scientific limitations of these studies misrepresents the magnitude of the issue and may misdirect limited financial resources to presumed problems that cannot be reasonably addressed while other pollution mitigation opportunities that are more obtainable go unaddressed.

RIDEM Response

RIDEM recognizes that achieving compliance with WQ standards is a difficult challenge. RIDEM believes that the Statewide Bacteria TMDL has carefully analyzed bacteria sources and available options utilizing all readily available information. Uncertainties have been considered, and a phased implementation has been recommended to focus limited resources on those sources that have the greatest impact on these waters. DEM looks forward to working with the Town of South Kingstown in implementing actions to restore these impaired waters.

Rhode Island Department of Transportation

Peter A Healey, PE, Chief Civil Engineer (letter sent August 1, 2011)

CORE REPORT

RIDOT Comment 1

Table Numbers and Figure Numbers are not correct. (Table 0-1 should be Table 1-1 (page 7, 8,13, 18, 35, 36, 37...))

RIDEM RESPONSE

Document has been modified.

RIDOT Comment 2

Page 22: Developed Area Stormwater Runoff

First sentence does not make sense.

RIDEM RESPONSE

Document has been modified.

RIDOT Comment 3

Page 22: Stormwater runoff is one of the leading sources...

This statement needs citation

RIDEM RESPONSE

Citation added.

RIDOT Comment 4

Page 23: Illicit Discharges...

TMDL should include examples from rural & suburban areas (as some impaired waterbodies are outside of the urban area)

RIDEM RESPONSE

Document has been modified to delete the term urban communities. The listed examples are not specific to urban communities and can occur in rural and suburban communities.

RIDOT Comment 5

Page 24: Agriculture.... Communities, farmers, horse owners.... are responsible for mitigating bacteria pollution... naming responsible parties belongs in section 6.10 (and should probably not include 'communities')

RIDEM RESPONSE

Document has been modified as suggested.

RIDOT Comment 6

Page 25: Contact Recreation:

Bacteria from people swimming... Is this seriously thought to be a significant source? If so, there is no mention of it anywhere else in the TMDL document.

RIDEM RESPONSE

It is a potential source.

RIDOT Comment 7

Page 25: Summary... In each impaired stream, stakeholders should investigate... to determine...sources. As part of TMDL implementation... sources are identified. These two sentences contradict each other. A TMDL proposal must include a description of the point and nonpoint sources of the pollutant of concern, including the magnitude and location of the sources. RIDEM has the responsibility to determine sources as part of the TMDL process, not the stakeholders.

RIDEM RESPONSE

Paragraph has been modified including deletion of the sentence beginning, 'In each impaired stream...' The last sentence has been changed to read, 'As part of TMDL implementation, described in Section 6, specific bacteria sources are identified and mitigation activities are identified utilizing readily available bacteria source information. With subsequent development

of watershed plans and/or TMDL Implementation Plans, municipalities and other stakeholders are encouraged to further investigate and/or utilize all available information to further refine bacteria sources and appropriate mitigation activities.”

PAGE 35, 36, 37 – TABLE 0-3: NOTES FOR TABLES 5-1 AND 5-2

RIDOT Comment 8

1. Unless otherwise stated by statute or regulation, compliance with this TMDL will be based on ambient concentrations.

Does this imply MS4 compliance or Water Body compliance? An MS4 Operator could be able to demonstrate an outfall has no impact (i.e. either no flow or flow during dry &/or wet weather has no indicator bacteria) and the MS4 could be compliant without the ambient waterbody necessarily meeting water quality standards.

RIDEM RESPONSE

This statement refers to whether the waterbody meets water quality standards.

RIDOT Comment 9

6. Discharges of untreated wastewater are prohibited... Examples of point source discharges of untreated wastewater include sanitary sewer overflows, ...

What about CSOs?

RIDEM RESPONSE

CSOs are permitted discharges that are allowed to discharge provided that they comply with all conditions of their RIPDES permits. It is expected that watershed specific evaluations will be undertaken upon implementation of relevant CSO Long Term Control Plans to determine whether additional pollution abatement measures are necessary.

RIDOT Comment 10

Page 38: Wet/Dry Weather Analysis...

Rainfall data source for Foster, RI. Document states that a station in Willimantic was used for two stations in Foster; the google map indicates that Danielson Airport was used. As Willimantic is 30 miles away from Foster, and in a different watershed, it is presumed that the Danielson Airport station was used. Also, actual stations should be noted in Appendix documents (airports?), not just the town.

RIDEM RESPONSE

The Willimantic weather station used to determine weather conditions for the two watersheds in Foster. Future TMDLs will consider using rain stations closer to the watershed. The google map has been changed.

RIDOT Comment 11

Page 44: Structural BMPs

DEM should provide common structural BMPs that are designed, and accepted by RIDEM, to mitigate/treat bacterial pollution (Detention/Retention systems for flood control only...)

RIDEM RESPONSE

The revised Rhode Island Stormwater Design and Installation Standards Manual (dated December 2010) and specifically, Chapter 5 and Appendix H provide detailed information on the effectiveness of structural BMPs in removing bacteria and other contaminants. This document is specifically referenced in Section 6.6 – Stormwater BMP Overview.

RIDOT Comment 12

Several reports state that Structural BMPs are not effective for bacterial removal (see Page 59 comments), and focus should be on source control.

RIDEM RESPONSE

See response to Comment 23 below.

RIDOT Comment 13

Page 48: Table 6-1

Include non-traditional MS4s (RIDOT, URI, etc...) and NON-Regulated municipalities

RIDEM RESPONSE

This table was focused on the regulated municipalities. Additional language has been added before Table 6.1 that mentions non-traditional MS4s.

RIDOT Comment 14

Page 48, 49, 52: Operators must also address any previously non-regulated areas/Expansion of MS4-Regulated Area

What delineates the regulated area expansion? Watershed basin, sub-basin, or the affected waterbody's immediate watershed (as depicted on Figures in individual waterbody reports?).

It is stated clearly what MS4s are required to do if they are currently regulated under RIPDES (expand 6 minimum measures, develop TMDL IP), but it is not stated what non-regulated municipalities are required to do (Hopkinton, Richmond, Foster, etc).

RIDEM RESPONSE

This language is referring to areas that are brought into the Phase II program through the TMDL process. No new areas were brought into the Phase II program within the 57 waterbodies included in this submittal of the Statewide Bacteria TMDL. If an expansion of the regulated area were required, it would be clearly stated in the waterbody summary with its boundaries clearly defined. In the case of these 57 waterbodies, there are no additional stormwater requirements resulting from this TMDL, for any municipalities or portions of municipalities that are not currently regulated.

RIDOT Comment 15

Also, it would be very useful to have the individual waterbody watersheds available as a ArcGIS layer.

RIDEM Response

This will be sent to RIDOT.

RIDOT Comment 16

Page 53: Evaluation of Sufficiency of Six Minimum Measures

RIDOT does not consider this a feasible recommendation/requirement. MS4s do not have the resources (staff, equipment, expertise, money) to evaluate the effectiveness of the 6 minimum measures. RIDEM is charged with water body monitoring, not the MS4s. If RIDEM continues monitoring the impaired water bodies, and reductions are not being seen with the implementation of the 6 minimum measures, then it should be RIDEM to recommend/require further measures. MS4s are charged with implementing the measures, which already stresses budgets and

resources. MS4 resources should be appropriately placed with source reduction and good housekeeping measures, and point discharge (outfall) monitoring; not stream monitoring.

RIDEM Response

This recommendation does not require instream water quality monitoring, unless the MS4 chooses to do so. The recommendation is asking the MS4 to evaluate whether the minimum measures address the pollutant of concern (i.e. bacteria). For example, outfall monitoring data and complaint information should be evaluated to determine if IDDE measures are sufficient. Another example would be a determination by the MS4 whether additional good housekeeping measures, such as additional street sweeping or catch basin cleaning, could more effectively reduce the sources of the pollutant of concern discharged by the MS4.

RIDOT Comment 17

Page 53: Public Education/Public Involvement

As DEM noted in the TMDL core document, RIDOT funded the URI CE Stormwater Phase II Public Education and Outreach Project as part of DOT's compliance measures with the 2003 RIPDES General Permit. RIDOT anticipates funding another URI/DEM/DOT agreement for Public Education and Outreach under the next RIPDES Stormwater Permit. It is also anticipated that TMDL-specific material will be developed as part of this agreement. RIDOT considers this the most effective use of resources, and considers this program to meet and exceed DOT's requirement for this TMDL component. No change to RIDOT SWMPP anticipated.

RIDEM Response

RIDOT comment noted. RIDOT will have to document these activities in a TMDL IP for those waters that require modifications to the minimum measures.

RIDOT Comment 18

Page 54: Illicit Discharge Detection and Elimination

RIDOT samples outfalls throughout the state, not just within the RIPDES regulated areas. RIDOT will continue this state-wide approach, and follow-through with any/all IDDE investigative work as necessary. No change to RIDOT SWMPP anticipated.

RIDEM Response

RIDOT comment noted. RIDOT will have to document these activities in a TMDL IP for those waters that require modifications to the minimum measures.

RIDOT Comment 19

Page 55: Construction/Post-Construction

RIDOT does not have any regulatory authority to create/revise ordinances, or to develop enforcement mechanisms to ensure long-term maintenance of BMPs.

RIDOT has created both large site (>1-acre) and small site (<1-acre) Construction Site Stormwater Pollution Prevention Plans (SWPPPs), and these are used on all applicable RIDOT construction projects. Both SWPPPs require impaired water body review and appropriate BMPs to ensure construction site pollution is prevented.

Each RIDOT Maintenance facility also has a Site Specific Stormwater Pollution Prevention Plan, that has just recently been updated and training was provided.

RIDOT Design engineers, environmental scientists, construction inspectors, and Maintenance personnel have also been extensively trained on the new Rhode Island Stormwater Design and Installation Standards Manual, and LID techniques. Though RIDOT has many constraints on the actual implementation of LID on our linear roadway projects, RIDOT will ensure that each project implements LID to the maximum extent practicable. RIDOT feels that it currently meets this TMDL requirement. No change to RIDOT SWMPP anticipated.

RIDEM Response

RIDOT comment noted. RIDOT will have to document these activities in a TMDL IP for those waters that require modifications to the minimum measures.

RIDOT Comment 20

Page 56: Structural BMP Requirements

It would be very useful to have a summary table documenting BMP recommendations with their associated outfalls (as done in other RIDEM TMDL reports (Table 6.2 in TOTAL MAXIMUM DAILY LOAD TO ADDRESS THE PHOSPHORUS IMPAIRMENT TO BELLEVILLE PONDS AND BELLEVILLE UPPER POND INLET, Sept 2010)).

RIDEM RESPONSE

Structural BMP requirements are addressed in the individual waterbody summaries. The Core Document is intended to include general, non-waterbody specific information.

RIDOT Comment 21

Page 56: LID and Future Development and Redevelopment

RIDOT adheres to all permitting requirements, including the RIDEM and CRMC requirements to design to the new Stormwater Design and Installation Manual. RIDOT feels that it currently meets this TMDL requirement. No change to RIDOT SWMPP anticipated.

RIDEM Response

RIDOT comment noted. Where appropriate, RIDOT will have to document these activities in a TMDL IP.

RIDOT Comment 22

Page 58: Stormwater from Industrial Activities

RIDOT does not fall under the Multi-Sector General Permit. No change to RIDOT SWMPP anticipated.

RIDEM Response

RIDOT comment noted.

RIDOT Comment 23

Page 59: Stormwater Best management Practices

Many reports state that structural BMPs are not effective at reducing bacterial loading to water quality standards.

December 2010: *International Stormwater BMP Database: Pollutant Category Summary: Fecal Indicator Bacteria*, Prepared by Wright Water Engineers, Inc. and Geosyntec Consultants, <http://www.bmpdatabase.org/Docs/BMP%20Database%20Bacteria%20Paper%20Dec%202010.pdf>

Those working to address pathogen impairments on streams should focus first and foremost on source controls. This requires clear identification of the primary sources of fecal indicator bacteria relative to site-specific conditions. Focusing on controllable sources of bacteria, particularly those of human origin, is believed to be the most important first step in protecting human health (Pitt 2004; Clary et al. 2009), although source control alone may not be sufficient to meet ambient water quality standards.

The majority of conventional stormwater BMPs in the BMP Database do not appear to be effective at reducing fecal indicator bacteria concentrations to primary contact stream standards, which is the ultimate target of TMDLs.

May 2008: *Can Stormwater BMPs Remove Bacteria? New findings from the International Stormwater BMP Database* By Jane Clary, Jonathan E. Jones, Ben Urbonas, Marcus M. Quigley, Eric Strecker, Todd Wagner

<http://www.stormh2o.com/may-2008/bacterial-research-bmps.aspx>

As a result, stormwater managers, permit writers, and TMDL participants should not assume that structural BMPs can meet numeric effluent limits for bacteria for all storms and under all conditions.

Retention ponds may be well suited for development with significant land area and adequate water rights (typically a challenge in semiarid and arid states, such as Colorado) or abundant rainfall. In ultra-urban areas, infill development, and arid/semiarid climates, retention ponds are often impractical. Another potential disadvantage with retention ponds is that they can attract waterfowl and wildlife, which can increase bacterial levels.

Media filters and bioretention cells show promise in removing bacteria at the site level. For new developments based on LID techniques, the use of bioretention cells or rain gardens is becoming more common in some parts of United States. The key unit treatment process (filtration) associated with media filters is well proven in the drinking-water arena, so it is not surprising that these BMPs would reduce bacteria, provided that the facilities are properly maintained. For existing developments, some targeted retrofitting in bacteria “hot spot” areas could be possible, but costs of watershed-wide retrofits with many media filters will likely be cost prohibitive. One of the important aspects of long-term functioning of distributed controls, such as bioretention cells, is ensuring that these facilities are maintained and continue to function as designed in perpetuity. In many cases, local governments are already stretched to ensure maintenance of regional stormwater facilities, so although these practices may hold promise, “ensuring” their continued function may be administratively challenging.

Swale and detention pond BMPs appear to have low effectiveness in reducing bacteria and in some cases have the potential for exporting bacteria. The authors hypothesize that potential causes could include the fact that these types of BMPs tend to attract ducks, geese, other wildlife, and domestic pets, which may contribute to bacteria loading.

RIDOT will continue to implement the 6 minimum measures state-wide, and will carefully consider any structural BMP requirements that are recommended by this TMDL document.

However, before any structural implementation, RIDOT will fully assess the impairment and contribution of RIDOT roadways.

RIDEM Response

The implementation recommendations included in the Statewide Bacteria TMDL document focus primarily on source control measures as the means by which these bacteria impairments are addressed. As stated in one of the excerpted quotes above, it is likely that for some of these impaired waters, particularly those with highly developed watersheds, that source controls alone will not be sufficient to restore water quality. As noted previously, the revised Rhode Island Stormwater Design and Installation Standards Manual provides information on the bacterial removal efficiency of various best management practices.

RIDOT Comment 24

Page 62: Onsite Wastewater Management

RIDOT does not have legal authority to develop or enforce ordinances. RIDOT must rely on cities/towns and RIDEM for this requirement. RIDOT will continue IDDE investigations, and forward any suspected OWTS issues to RIDEM for enforcement. No change to RIDOT SWMPP anticipated.

RIDEM Response

RIDOT comment noted.

RIDOT Comment 25

RIWIS should be added to Available Resources:

<http://www.uri.edu/ce/wq/RESOURCES/wastewater/Resources/RIWIS.htm>

RIDEM Response

RIWIS had been added.

RIDOT Comment 26

Page 63: Boats and Marine Pump-out facilities

RIDOT does not have legal authority to develop or enforce ordinances. No change to RIDOT SWMPP anticipated.

RIDEM Response

RIDOT comment noted.

RIDOT Comment 27

Page 64: Waterfowl, Wildlife, Domestic Animals

Domestic Pets: URI CE has already completed a “Scoop the Poop” campaign under the initial URI/DEM/DOT Agreement. http://www.ristormwatersolutions.org/SW_petcare.html

Waterfowl: This TMDL states that allowing vegetation to grow and not feeding waterfowl (swans, geese, ducks) will minimize waterfowl impact. While these measures are sound, it is unrealistic to assume that these will minimize their impact. At most, it will just move the population to a different area. A state-wide wildfowl program under RIDEM is required to have any significant impact, and until there is a state-wide initiative, managing waterfowl on the local level may be a poor use of limited resources. Also, a state-wide, comprehensive population count and an assessment of ‘unacceptable habitat’ areas and ‘acceptable habitat’ areas should be completed before resources are invested.

RIDEM Response

RIDOT comment noted.

RIDOT Comment 28

What if it is not feasible to reach Water Quality Standards due to wildlife & waterfowl contributions? Virginia DEQ answers this question with the possibility of removing ‘primary contact recreational use’ designation from some waters:

<http://www.deq.virginia.gov/tmdl/faqbacimp.html>

DEQ's focus in this area is to ensure that the water quality goals we are trying to achieve are appropriate and worth the resources that will need to be spent to achieve them. In some streams, bacteria contributed by wildlife result in standards violations. In order to begin to address this issue, the Commonwealth has developed criteria to protect the secondary contact recreational uses. These new criteria will become effective pending EPA approval. In order for the new criteria to apply to a stream segment, the primary contact recreational use must be removed. To remove a designated use, the state must demonstrate that the use is not an existing use, that downstream uses are protected, and that the source of bacterial contamination is natural and uncontrollable by effluent limitations and BMPs. This and other information is collected through a special study called a Use Attainability Analysis (UAA). All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. For additional information, go to <http://www.deq.virginia.gov/wqs/rule.html>.

Does RIDEM feel that this could be a useful tool in Rhode Island to de-list some waterbodies from the 303(d) and TMDL listings?

RIDEM Response

RIDEM believes that the restoration measures described in the statewide bacteria TMDL are reasonable and that, in the waterbodies covered by the TMDL, a use removal is not justifiable at this time. RIDEM is confident that the implementation of the TMDL will result in water quality improvements. With that said, RIDEM agrees that there may be some circumstances under which a justification could be made to remove/partially remove a primary contact recreation use from specific water bodies and is willing to work with interested parties to obtain further guidance from EPA regarding the UAA process, and level of BMP implementation required.

EPA regulations describing the Use Attainability Analysis (UAA) process are found at 40 CFR 131.10). The removal of a use is a water quality standards revision that would be subject to public comment as well as review and approval by EPA. For more information on the UAA process, RIDEM recommends EPA's resources at:

<http://water.epa.gov/scitech/swguidance/standards/uses/uaa/>.

RIDOT Comment 29

Page 66: Agriculture

What authority does RIDEM have to directly regulate individual nonpoint source activities? If a homeowner, farmer, agricultural producer, etc... refuses to establish best management practices, and runoff from their property is flowing on to MS4 property (roads → catch basins → outfalls), what can a MS4 do?

RIDEM Response

RIDEM has authority to prevent illegal discharges of pollutants to the state's waters consistent with Rhode Island's Water Quality Regulations. Rule 9 A states "No person shall discharge pollutants into any waters of the State or perform any activities alone or in combination which the Director determines will likely result in the violation of any State water quality criterion or interfere with one or more of the existing or designated uses assigned to the receiving waters or to downstream waters in accordance with rules 8.B., 8.C., 8.D., and 18 of these regulations. In addition, Best Management Practices, as determined by the Director, shall be used to control erosion, sedimentation and runoff in accordance with rule 15."

Relative RIDOT's ability to control runoff discharging to its drainage system, we suggest reviewing the RIDOT's Rules and Regulations concerning Permission for Use of State Highway Rights-of-Way. Rule 12.1 states that "It is unlawful for any person, firm or corporation to make any connection into a State road drainage system, or to drain or pump water onto the traveled surface of a State Highway without first obtaining written permission from the Director of the State Department of Transportation." Rule 12.6 goes on to state, "In addition, if a connection to the State Drainage System is proposed, the applicant will be required to address water quality impacts through incorporation of special drainage structures such as vortechs, stormceptors, swirl chambers, sediment ponds, created wetlands (Structural Stormwater Treatment) deep sump catch basins and through use of Best Management Practices (BMPs)."

INDIVIDUAL WATERBODY REPORTS – GENERAL COMMENTS

RIDOT Comment 30

Data sources and data age should be listed for all data used in reports and provided on maps (land use, impervious cover, etc).

RIDEM RESPONSE

This information has been added to the core document.

RIDOT Comment 31

It would be very useful for MS4s to have access to the TMDL waterbody watershed boundaries in a workable format (ArcGIS shapefile); especially as they are different than the sub-basin delineations.

RIDEM Response

This will be sent to RIDOT.

RIDOT Comment 32

Each Appendix states: RIDOT has completed a SWMPP for state-owned roads in the watershed. Storm Water Pollution *Prevention* Plans (SWMPP) are being utilized for RIDOT construction projects.

RIDEM Response

Comment noted.

RIDOT Comment 33

Each Appendix document states that additional bacteria data collection would be beneficial to support identification of sources of potentially harmful bacteria. These activities could include sampling at several different locations and under different weather conditions (e.g., wet and dry).

Field reconnaissance surveys focused on stream buffers, stormwater runoff, and other source identification may also be beneficial. Who will be responsible for the additional data collection? It should be clearly stated which entity (RIDEM, MS4s, volunteer groups) is responsible for collecting data, and which entity is responsible to analyze it to determine if the water bodies are achieving water quality standards.

RIDEM Response

The referenced language regarding additional bacteria data collection speaks to the merits of additional data collection and does not establish a requirement for any particular entity. Ongoing efforts by any of the groups listed above could include additional monitoring helpful in identifying pollution sources.

Responsibility for assessing and reporting on the quality of the State's surface waters lies with the RIDEM Office of Water Resources, following the decision-making process documented in the "Rhode Island Consolidated Assessment and Listing Methodology".

RIDOT Comment 34

Single Sample Enterococci Results

- Each Table lists the data source as: 2006-2008 from RIDEM. The actual source of data (DEM, Watershed Watch, etc.) should be listed.

RIDEM Response

The data sources are listed in the Core document.

RIDOT Comment 35

Single Sample Enterococci Results

- What 'lumping' technique was used to determine which samples were used to calculate Geometric Mean? Specifically, why was 2007 data sometimes lumped with 2008 data for some water bodies (ex. Dry Brook, Chickasheen), but not for others (ex. Baileys, Belleville, Hunt)?
- Are less than 3 data points considered a valid sample size (ex. Dry Brook (2 dry weather; 3 wet weather), Frenchtown Brook (1 wet weather))?
- Are 3 data points considered a valid sample size for one year (ex. Chickasheen Brook at Rte 2, 2007)?
- Is one year of data considered a valid sample size for a station (ex. Chickasheen at Potter Road (Skagg's old dam), 2008)?

RIDEM Response

In general, statistics used for percent reduction calculations were determined on an annual basis if more than five samples were collected at a station in any given year. If less than five samples were collected in any given year, then data across multiple years were combined. In the case of Chickasheen Brook at Route 2, one geometric mean statistic was calculated on the three 2007 samples and the four 2008 samples. One year of data with five sample points is considered a valid sample size. While wet versus dry weather statistics may have been calculated using less than five samples, this information was used for informational purposes only. For example, a station that exhibited much higher wet weather than dry weather geometric mean concentrations could have a stormwater problem and implementation could be focused on wet weather solutions.

RIDOT Comment 36

Where can a stakeholder find the RIDEM (2010) MS4 Status Report? It is not listed on the RIDEM website, or found on the RI.gov web search.

RIDEM Response

The reference refers to a “report” from a database used by RIPDES staff to track plans and reports submitted by MS4 operators in compliance with their Phase II Stormwater Permit. However, it is not a final “report”, it is a working database and contains notes and impressions. It is not considered a public document. However, much of the information in the MS4 status reports has been extracted and included in the watershed summaries. The detailed description of MS4 activities is found in the annual reports, which may be obtained directly from the MS4 or RIDEM.

INDIVIDUAL WATERBODY REPORTS – BAILEY’S BROOK

RIDOT Comment 37

Page 1 states that the Bailey’s Brook watershed covers 3.1 square miles and is highly developed. Agricultural uses occupy 15% of the land area. The 2005 GeoSyntec report states that Rhode Island Nursery is the only active agriculture in the Bailey Brook watershed. Two Rhode Island Nursery properties (totaling 126 acres) comprise 5.3 % of the land uses within in the 2,344-acre watershed, which is 6% of DEM’s 3.1 square mile Bailey Brook watershed. Also, at that time, NRCS was working with Rhode Island Nursery to install a vegetative field border buffer zone along the western edge of the property. Additionally, the GeoSyntec 2005 report states that the Rhode Island Nursery property appeared well-maintained, with no signs of erosion or significant sediment transport/deposition related to stormwater runoff. From the GeoSyntec report, it appears that agriculture, and Rhode Island Nursery in particular, is not a significant source of bacteria.

RIDEM Response

The watershed contains 292 acres of “agricultural” land use identified in the 2003/2004 land use / land cover data. That equals 15% of the land area. The land use / land cover, like most GIS data, can have inconsistencies. If the GeoSyntec study was an on the ground study, its likely to have less inconsistencies. In a manual review of the 2008 aerial photos of those 292 agricultural acres that was conducted by the RIDEM GIS coordinator in response to this question, almost 100 acres of fields coded as pasture look more like simple hay fields. Eliminating those 100 acres would still leave 192 acres or 10% of the land use within the watershed. This is still a large discrepancy with the Geosyntec report. GIS is only as good as the available data and will always suffer in small analysis areas without very high quality inputs. Regardless of the exact amount of agricultural land within a watershed, the recommendations in the Waterbody Summary still apply with a goal to minimize the impact of these operations on water quality in Baileys Brook.

RIDOT Comment 38

Page 5 states that the Bailey’s Brook watershed has an impervious cover of 32%. The above-cited GeoSyntec 2005 report states: “*The SWAP report estimated that impervious surfaces cover 35% of the watershed (based on 1997 land use data). GeoSyntec’s analysis, based on 2004 IKONOS satellite imagery, estimated 24% imperviousness.*”
<http://projects.geosyntec.com/bw0051/documents/Final/Table%20of%20Contents%20and%20Executive%20Summary.pdf>

What data source (and what was data year) did RIDEM use to estimate 32% imperviousness? If RIDEM used the RIGIS Impervious Surfaces data (impervious07.shp), this data is also based on 2003-2004 data. Please explain the difference between GeoSyntec's estimate and RIDEM's.

RIDEM Response

The 32% imperviousness is based on the RIGIS 2003/2004 impervious surface coverage. Geosyntec apparently created their own impervious surface from the IKONOS imagery. The two calculations are expected to be different simply as a result of the source data, the methodology, and the degree of quality control. The RIGIS data was developed from 2 ft pixel (GSD) photography without the benefit of a 4th (infrared) band. If the IKONOS data is of higher resolution and/or included infrared or even multi-spectral it's probably the more accurate of the two.

RIDOT Comment 39

Page 5 states that soils in the watershed are 98% hydrologic group "C", characterized as slowly permeable and having a hardpan layer that restricts infiltration (Geosyntec, 2005). Page 8 states that in addition, the 2007 Eutrophic Ponds TMDL required that the Town of Middletown and the RIDOT develop and implement appropriate infiltration, filtration, and/or retention. The soils in the Bailey Brook watershed do not support the recommendation of infiltration practices; the core TMDL document (page 44) states that retention systems are acceptable only for flood control. Additionally, the watershed is 68% developed, which may inhibit the implementation of any structural BMP.

RIDEM Response

Soil maps are a broad-brush tool intended to be used for planning purposes. As part of an outfall specific catchment area feasibility study, site-specific conditions would be evaluated to identify possible BMP locations and types of BMPs, with consideration to the pollutant of concern and site constraints within the catchment area, such as hydrologic C soils. While infiltration type BMPs may be preferred for bacteria removal, gravel wet vegetated treatment systems are also effective at removing bacteria and are suitable for use in poorly drained soils.

RIDOT Comment 40

Page 7: Recommended Next Steps

Proper citations needed for documents that stakeholders should review.

RIDEM Response

References were checked and all seem to be properly cited.

RIDOT Comment 41

On Page 8, RIWIS is improperly cited; the Pawcatuck River TMDL is not the original citation. <http://www.uri.edu/ce/wq/RESOURCES/wastewater/Resources/RIWIS.htm>

RIDEM Response

Comment noted.

RIDOT Comment 42

On Page 9, educational programs should emphasize ... water quality impairments in the Maidford River should be changed to Bailey's Brook.

RIDEM Response

Document has been modified.

RIDOT Comment 43

On Page 13, the Geosyntec (2005) document was prepared for NRCS, not NCSC. Document is available on the web at: <http://projects.geosyntec.com/bw0051/>

RIDEM Response

Document has been modified.

INDIVIDUAL WATERBODY REPORTS – CHICKASHEEN BROOK

RIDOT Comment 44

Page 5 states that the watershed has an impervious cover of approximately 4.7%. Page 51 of Core Document states that in general, for implementation of this TMDL, bacteria impaired waters having watersheds with less than 10% impervious cover are assumed to be caused by sources other than urbanized stormwater runoff and MS4 operators will have no changes to their current Phase II permit requirements. Why does this impaired water body, with an impervious cover of < 10%, have Stormwater Management requirements when the core document states otherwise?

RIDEM Response

The Core Document states on page 52 that the impervious cover thresholds will generally guide implementation of stormwater requirements, but that additional watershed specific information may result in different requirements for specific waterbodies regardless of the watershed percent impervious cover. In the case of Chickasheen Brook, the stormwater requirements are those that were required in the Chickasheen Brook Phosphorus TMDL. This TMDL reiterates the stormwater activities that were previously required.

INDIVIDUAL WATERBODY REPORTS – JAMESTOWN BROOK

RIDOT Comment 45

On Page 10 (Single Sample Fecal Coliform Results), the data is from 2000 – 2003; RIDOT and the town of Jamestown have been regulated under the RIPDES General Permit since 2003, and have implemented the 6 minimum measures. Does RIDEM feel that this data is truly representative of 2011 conditions? Additionally, why is all 4 years of data ‘lumped’ to develop the Geometric Mean and the 90th percentile values?

RIDEM Response

States are required to use all readily available information in preparing TMDL documents. The Jamestown Brook Waterbody Summary acknowledges the actions that RIDOT and the Town of Jamestown have undertaken to improve water quality throughout the Town. Future monitoring can track the progress of water quality improvements. RIDEM intends to include Jamestown Brook in its Rotating Basin Monitoring Program. The Rotating Basin Monitoring Program aims to collect water quality samples from freshwater rivers throughout Rhode Island on a rotating basis with each basin sampled every three to five years. Monitoring parameters include fecal coliform and/or enterococci. If this monitoring data indicates that the brook complies with criteria, RIDEM will propose that Jamestown Brook is de-listed from the List of Impaired Waters.

The data are “lumped” together because there were not enough data points to examine each year separately. Combining multiple years of data together is consistent with previous TMDLs. See above response.

INDIVIDUAL WATERBODY REPORTS – MAIDFORD RIVER (SEGMENT 2B)

RIDOT Comment 46

On Page 10 (Single Sample Fecal Coliform Results), data is from 2000 – 2004; RIDOT and the town of Middletown have been regulated under the RIPDES General Permit since 2003, and have implemented the 6 minimum measures. Does RIDEM feel that this data is truly representative of 2011 conditions?

RIDEM Response

See response to Jamestown Brook Comment 1 above. RIDEM intends to include Maidford Brook in its Rotating Basin Monitoring Program. If this monitoring data indicates that the brook complies with criteria, RIDEM will propose that Maidford Brook is de-listed from the List of Impaired Waters.

INDIVIDUAL WATERBODY REPORTS – MASHAPAUG POND

RIDOT Comment 47

Page 4: WW25 did not exceed water quality criteria for fecal coliform.

Why isn't the RIDEM *Total Maximum Daily Load For Dissolved Oxygen and Phosphorus - Mashapaug Pond, Rhode Island, Sept 2007 - Appendix B - Mashapaug Pond Data Report and Analysis* fecal coliform and *E. Coli* data used in the analysis? The September 25, 2001 rain event data is not presented in the data Table (page 10).

RIDEM Response

These data were not used in the pollutant reduction calculations, however as shown below and as noted in the watershed summary, the data on whole (including the 2001 data) do not show violations of the primary contact recreation/swimming criteria. The geometric mean and 90th percentile statistics for the 2001 data is consistent with the statistics used in the waterbody summary.

Station Name	Station Location	Date	Result	Wet/Dry	Geometric Mean	90th Percentile
MP-2	North Section - Mashapaug Pond	6/27/2001	29	Dry	24	96
MP-2	North Section - Mashapaug Pond	7/12/2001	7	Dry		
MP-2	North Section - Mashapaug Pond	7/31/2001	10	Dry		
MP-2	North Section - Mashapaug Pond	8/9/2001	11	Dry		
MP-2	North Section - Mashapaug Pond	8/29/2001	30	Dry		
MP-2	North Section - Mashapaug Pond	9/20/2001	15	Dry		
MP-2	North Section - Mashapaug Pond	9/25/2001	103 ¹	Wet		
MP-2	North Section - Mashapaug Pond	9/26/2001	93	Wet		

¹Three samples were taken at this location on this day (90, 160, 75). As in previous TMDLs, when multiple samples are taken on one day, one daily value is calculated for each station by taking the geometric mean of these multiple samples.

Station Name	Station Location	Date	Result	Wet/Dry	Geometric Mean	90th Percentile
MP-1	South Section - Mashapaug Pond	6/27/2001	38	Dry	53	148
MP-1	South Section - Mashapaug Pond	7/12/2001	100	Dry		
MP-1	South Section - Mashapaug Pond	7/31/2001	30	Dry		
MP-1	South Section - Mashapaug Pond	8/9/2001	19	Dry		
MP-1	South Section - Mashapaug Pond	8/29/2001	27	Dry		
MP-1	South Section - Mashapaug Pond	9/20/2001	38	Dry		
MP-1	South Section - Mashapaug Pond	9/25/2001	238	Wet		
MP-1	South Section - Mashapaug Pond	9/26/2001	110	Wet		

¹Three samples were taken at this location on this day (70, 1200, 160). As in previous TMDLs, when multiple samples are taken on one day, one daily value is calculated for each station by taking the geometric mean of these multiple samples.

INDIVIDUAL WATERBODY REPORTS – MOSWANSICUT STREAM

RIDOT Comment 48

On Page 10 (Single Sample Fecal Coliform Results), Why is Station Location and Wet/Dry Weather N/A? What is the source of the data? Wet/Dry weather can be determined using Weather Underground.

RIDEM Response

RIDEM has added additional data and information to the Moswansicut Stream Waterbody Summary. The Providence Water Supply Board provides data from this stream to RIDEM. Data collected between 2008 and July 2010 were added to Table 1. Geometric mean calculations were made on this additional data, resulting in the required percent reduction increasing to 42%. (This includes the 5% margin of safety.) The station location is Old Danielson Pike. The Providence Water Supply Board provided exact sampling dates, which allowed RIDEM to calculate the wet versus dry weather geometric mean values for the entire data set using data from TF Green Airport in Warwick, Rhode Island. Table 8.1 of the Core Document has been modified accordingly.