

BRISTOL-KICKEMUIT RIVER WATERSHED PLAN

*Bristol and Warren, RI
Rehoboth and Swansea, MA*



November 2012



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A. Executive Summary

i. Project Overview

Development of a **watershed-based plan** is a key step in watershed management, leading to restoration of polluted or otherwise impaired waterbodies and protection for unpolluted waterbodies. The plan's strength lies in addressing specific sources of pollution, especially **nonpoint sources**, with the ultimate goal of reducing or removing the pollutants, so the waterbodies can meet their **water quality standards**. At the same time, other environmental resource issues within the watershed can be addressed to protect the long-term health of the watershed.

This plan for the Bristol-Kickemuit River Watershed Planning Area was developed using a watershed approach, which organizes a study area based on natural drainage divides rather than municipal or state boundaries. Using a watershed approach to protect a waterbody is beneficial because it addresses problems in a holistic manner. Planning encompassed a broad array of stakeholders from Rhode Island and Massachusetts, including municipalities, non-profit and conservation organizations and state agencies. Through a series of meetings, stakeholders had the opportunity to provide input in the development of this plan. This plan is the result of collaboration among these groups and the U.S. Environmental Protection Agency (USEPA), Rhode Island Department of Environmental Management (RIDEM), Massachusetts Department of Environmental Protection (MADEP), and local citizens.

Collaboration among these stakeholders was crucial in characterizing existing watershed conditions, identifying and prioritizing problems, and recommending management solutions. The following statement captures the vision and goals expressed throughout the public process:

“Residents of the Bristol-Kickemuit River Watershed recognize that good stewardship of water is essential for the long-term vitality of the community. The water resources in the watershed are a central feature of the landscape and provide quality drinking water, habitat for wildlife and waterfowl, recreation opportunities such as swimming, birding, and boating, and economic activities such as shellfishing and tourism. It is important to protect and restore the quality of these waters for these uses, while maintaining the rural character of much of the watershed and

Watershed – is the total area of land where all the water that is under it or drains off it goes to the same waterbody. Topography is the key element to establishing watershed boundaries.

Watershed-Based Plan– is a strategy and a work plan for achieving water resource goals in a watershed. It includes a description of the existing water quality conditions, identifies and prioritizes problems, and outlines what needs to be done to restore and/or protect the water resources.

Nonpoint Source Pollution – is polluted runoff that cannot be traced to a single origin, but accumulates from overland flow from many small, dispersed watershed sources.

Water Quality Standards – define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions to protect waterbodies from pollutants. **Designated uses** for a specific waterbody can include drinking water supply, habitat for fish and wildlife (known as aquatic life use), recreation (swimming and boating), fish consumption, and shellfish consumption.

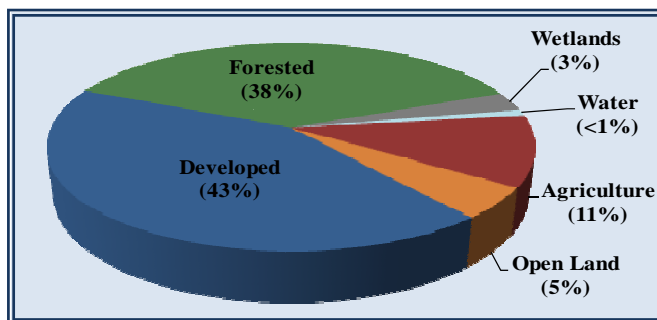
allowing for the sustainable development of other areas to enhance economic progress in the watershed.”

ii. Watershed Description

The RIDEM Office of Water Resources has delineated twenty-four watershed planning areas throughout the state. A watershed planning area will include multiple municipalities and smaller watersheds and, in many cases, cross state lines. This plan is for the Bristol-Kickemuit River watershed planning area, which includes the Kickemuit River watershed, where all waters drain to the same point, and the Bristol peninsula. The waters from the Bristol peninsula do not drain to one location, but drain to Mount Hope Bay, Bristol Harbor, and Upper Narragansett Bay. These multiple drainages have been combined into one area. Furthermore, for practical planning purposes, the Bristol peninsula is combined with the adjacent Kickemuit River watershed in this plan, which for simplicity, will be referred to as the Bristol – Kickemuit River (or BK) watershed.

The BK watershed is located in southeastern Massachusetts and eastern Rhode Island. The majority of the watershed is in Rhode Island (76%) including portions of Warren and Bristol. The watershed includes portions of Rehoboth and Swansea, MA. The major waterbodies include the Kickemuit River, Bristol Harbor, and portions of Mt.

Hope Bay and Upper Narragansett Bay. Land use within the watershed is highly varied, including developed, forested, agriculture, open lands, and wetlands.



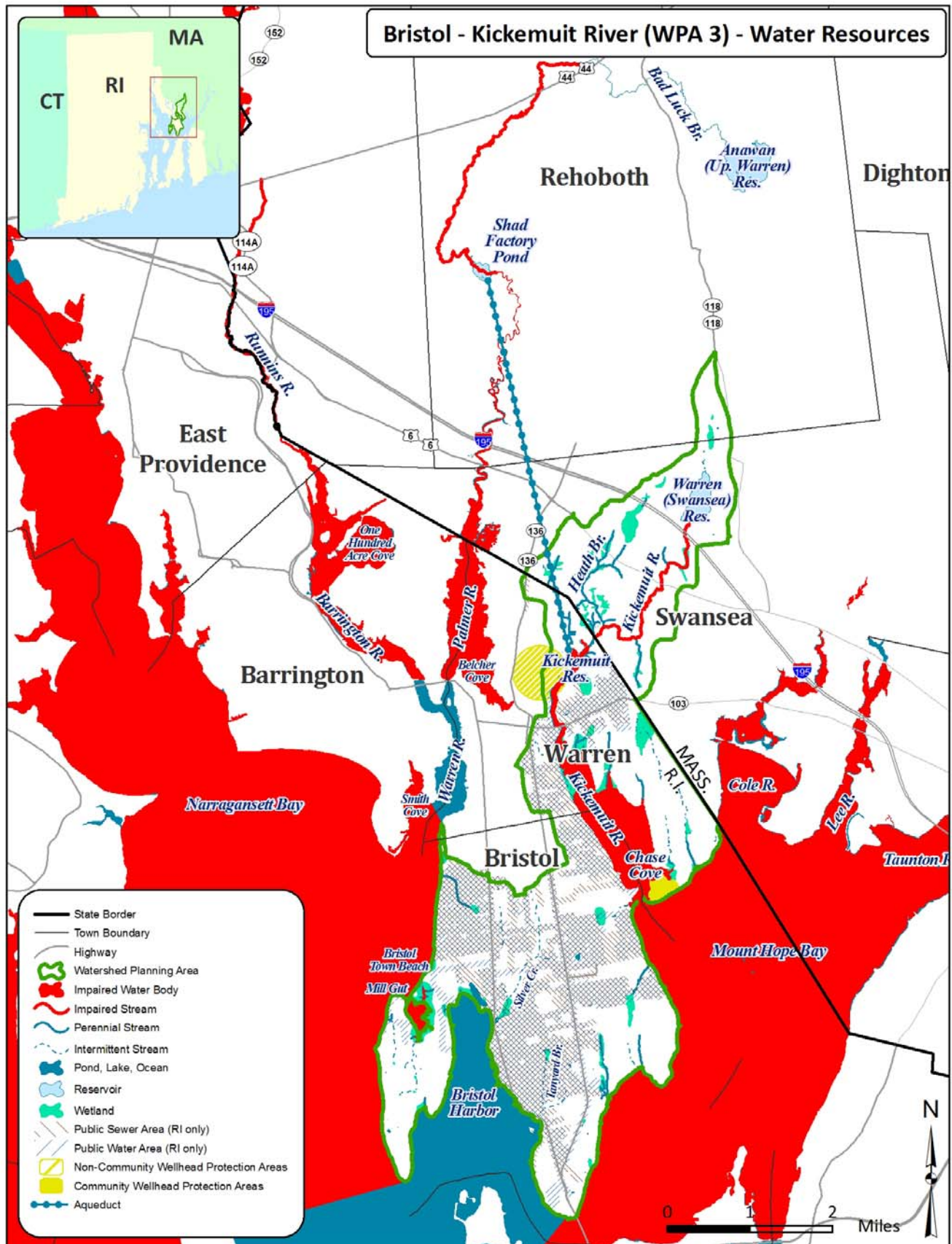
Land Use in the BK Watershed

iii. Existing Water Quality Conditions

Under the Federal Clean Water Act, all waterbodies have been assigned a classification defined by the designated uses which it is intended to protect. Waterbodies that do not meet their Water Quality Standards (designated uses and the criteria to protect those uses) are considered impaired and placed on the state’s List of Impaired Waters, known as the 303(d) List. This list identifies the impaired waterbodies and provides a scheduled timeframe for development of water quality restoration plans, also known as **Total Maximum Daily Loads (TMDLs)**. The TMDL describes the impairments and identifies the measures needed to restore water quality.

Total Maximum Daily Load (TMDL) – represents the total amount of a pollutant (e.g. bacteria, nutrients) that a waterbody can receive while still meeting water quality standards. A TMDL must be developed for all waterbodies on the state’s 303(d) List.

Figure A-i: The Bristol Kickemuit River Watershed Water Resources



In the BK watershed multiple waterbodies are considered impaired and are listed on Rhode Island and Massachusetts's 303(d) lists (shown on [Figure A-i](#)). Although the BK watershed has a few point sources of pollution (e.g., wastewater treatment plants, industrial discharges, etc.), its impairments mostly stem from nonpoint sources of pollution.¹ TMDLs and monitoring data have documented that these include urban stormwater (polluted runoff), malfunctioning onsite wastewater treatment systems, agricultural runoff, and wildlife. Sediments entering surface waters from stormwater and agricultural runoff have documented impacts on aquatic life and stream condition, especially from activities that disturb soil such as construction and plowing. These pollution sources and the resulting water quality are directly related to priority issues identified by stakeholders, including compromised drinking water supplies, shellfish bed and beach closures ([Table A-i](#)), protecting fish and wildlife habitat and maintaining the cultural identity and character of the watershed.

Table A-i: BK Watershed Shellfish Harvesting Closures (RIDEM, 2011a) and Beach Closures (HEALTH, 2011)

Waterbody	Shellfish Area Closure	Beach Closures
Freshwater Kickemuit River	--	--
Saltwater Kickemuit River	Growing Area 5-1 (prohibited) Growing Areas 5-2 and 5-3 (seasonally approved) Growing Area 5-4 (conditionally approved)	--
Mt. Hope Bay (near Bristol)	Growing Area 17-1 (conditionally approved)	--
Bristol Harbor	Growing Area 3-1 (prohibited) Growing Area 3-2 (seasonally approved)	--
Upper Narragansett Bay (near Bristol)	Growing Area 1-1 and 1-2 (conditionally approved)	Bristol Town Beach (17 closings since 2006) Camp St. Dorothy (2 closings since 2006)

¹ Stormwater is considered in this plan a nonpoint source of pollution. However, as described later in this plan, municipalities are subject to point source permitting programs for managing stormwater in urban areas once stormwater is collected in a conveyance system, it is discharged to surface waters as a "point source."

iv. The BK Watershed Action Plan – Restoration and Protection

TMDLs identify the pollutant reductions needed to restore waterbodies to meeting water quality standards, but achieving those reductions often requires many steps. This plan for the watershed recommends a variety of actions, collectively referred to as **Best Management Practices (BMPs)** that include specific improvements, primarily in the areas of stormwater management, onsite wastewater management, and low impact development (LID). The plan also outlines responsible parties and approximate costs for priority actions, lists potential funding sources to implement the plan, and provides examples of successful similar efforts. While recommendations are most detailed for the Rhode Island portion of the watershed, the plan offers opportunities for communities in both states to work together on common priorities.

Best Management Practices (BMPs) – are techniques, measures, or structural controls implemented to reduce potential pollutant generation and/or facilitate pollutant removal. There are three general types of BMPs: structural, non-structural, and housekeeping.

The complete BK Watershed Plan is available online at:

<http://www.dem.ri.gov/programs/benviron/water/quality/index.htm>



Mt. Hope Bay, Bristol, RI



Bristol Harbor, Bristol, RI

1. Introduction

1.1 Purpose of the Plan

Development of a **watershed-based plan** is a key step in **watershed** management, leading to restoration of polluted or otherwise impaired waterbodies and protection for unpolluted waterbodies. A watershed-based plan describes the environmental impairments of a waterbody due to conditions in the surrounding watershed, and indicates steps that can be taken to improve, restore, and protect the waterbody. The plan's strength lies in addressing specific sources of pollution, especially **nonpoint sources**, with the ultimate goal of reducing or removing the pollutants, so the waterbodies can meet their **water quality standards**. At the same time, other environmental resource issues within the watershed can be addressed to protect the long-term health of the watershed.

This document is a plan for restoration and protection of the Bristol-Kickemuit River watershed planning area that outlines actions needed to meet established water quality goals and objectives. Long-term management and financing options for water quality improvement are discussed. This plan is intended as a guide for the Rhode Island and Massachusetts municipalities and stakeholder groups within the watershed planning area. Much has already been accomplished by all levels of government, private groups, and individuals to protect and restore water quality. But to no one's surprise, more needs to be done. Building a strong, lasting base of stakeholder commitment is crucial in order to take action when opportunities arise. Regular review and updates to this watershed plan will be necessary to account for progress made in the watershed, as well as new goals as they are identified.

Watershed -- is the total area of land where all the water that drains off it goes to the same waterbody. Topography is the key element to establishing watershed boundaries.

Watershed-Based Plan– is a strategy and a work plan for achieving water resource goals in a watershed. It includes a description of the existing water quality conditions, identifies and prioritizes problems, and outlines what needs to be done to restore and/or protect the water resources.

Nonpoint Source Pollution – is polluted runoff that cannot be traced to a single origin, but accumulates from overland flow from many small, dispersed watershed sources.

Water Quality Standards – define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions to protect waterbodies from pollutants. **Designated uses** for a specific waterbody can include drinking water supply, habitat for fish and wildlife (known as aquatic life use), recreation (swimming and boating), fish consumption, and shellfish consumption.

1.2 How Was the Plan Developed?

This plan was developed using a watershed approach, which organizes the study area based on natural drainage divides where practicable, rather than municipal or state boundaries. RIDEM has designated 24 watersheds that include all land area in the state. The Bristol-Kickemuit watershed includes the Kickemuit River watershed, where all waters drain to the same point, and the Bristol peninsula. The waters from the Bristol peninsula do not drain to one location, but drain to Mount Hope Bay, Bristol Harbor, and Upper Narragansett Bay. These multiple drainages have been combined into one area. Furthermore, for practical planning purposes, the Bristol peninsula is combined with the adjacent Kickemuit River watershed in this plan, which for simplicity will be referred to as the Bristol-Kickemuit River (or BK) watershed. As a result, this watershed encompasses a broad array of stakeholders from two states, several towns, many non-profit organizations, and various state agencies. The development of this plan is the result of collaboration between the US Environmental Protection Agency (USEPA), Rhode Island Department of Environmental Management (RIDEM), Massachusetts Department of Environmental Protection (MADEP), local municipalities, non-governmental organizations, watershed associations, and local citizens. Their collaboration was crucial in characterizing existing conditions, identifying and prioritizing problems, and selecting management strategies to solve problems in the watershed. A series of meetings provided a forum to all stakeholders to provide input in the development of this plan, and these efforts are outlined in [Section 7](#).



Mt. Hope Bridge

1.3 Watershed Vision and Goals

As part of the watershed planning process, it is important to collect the ideas and priorities of local stakeholders when establishing guiding principles for future management activities. The following statement is based on meetings with local stakeholders in the watershed and suggests an overall vision for the future of the BK watershed.

“Residents of the Bristol-Kickemuit River Watershed recognize that good stewardship of water is essential for the long-term vitality of the watershed. The water resources in the watershed are a central feature of the landscape and provide quality drinking water, adequate habitat for wildlife and waterfowl, recreation opportunities such as swimming, birding, and boating, and economic activities such as shellfishing and tourism. It is important to protect the quality of these waters for these uses, while maintaining the rural character of much of the watershed and allowing for the sustainable development of other areas to enhance economic progress in the watershed.”

1.4 Compelling Issues in the BK Watershed

Management of water resources should focus on issues central to the long-term vision of the watershed. In the BK watershed, these issues include protecting drinking water sources, reducing closures of shellfish beds and beaches, protecting fish and wildlife habitat, and maintaining the cultural identity of the watershed. Watershed boundaries often span multiple municipal and state borders which can result in difficulties in recognizing this vision. Interstate and inter-municipal cooperation is essential to protect and restore water quality within watershed boundaries.

1.4.1 Protecting Drinking Water Sources

Residents in Bristol, Barrington, and Warren are provided public water from the Bristol County Water Authority, which receives its water supply primarily from the Scituate Reservoir in Scituate, RI. These residents may also receive water from four separate reservoirs maintained by the Water Authority. In this system, water from Anawan Reservoir flows into Shad Factory Pond in Rehoboth and then a portion of this water is piped outside of the watershed to the Kickemuit Reservoir in Warren, which also receives flow from the Swansea Reservoir in Swansea. Water from the Kickemuit Reservoir is then treated for distribution. Due to the poor quality and insufficient quantity of drinking water, and need for rehabilitation of the aging BCWA water treatment plant, statewide approval and funding was provided for construction of the cross bay pipeline bringing Scituate Reservoir water to the East Bay communities of East Providence, Warren, Barrington, and Bristol beginning in December 1998.

The Kickemuit Reservoir is currently not meeting water quality standards due to high levels of phosphorus and bacteria. Restoring and protecting the quantity and the quality of the Kickemuit Reservoir now will ensure its suitability as a drinking water source in the future.

1.4.2 Reducing Shellfish Bed Closures

In New England, shellfish such as clams, quahogs, oysters, and mussels are an important economic resource. However, many areas historically harvested for shellfish currently suffer from the impacts of water pollution and are closed to the harvest of shellfish. Many pollutants, including bacteria, viruses, and toxic compounds may become concentrated in the shellfish because they are filter-feeders.

In Rhode Island, the RIDEM Office of Water Resources Shellfish Monitoring Program is responsible for ensuring waters designated for shellfish consumption meet the water quality standards for this use. In the BK watershed, many waterbodies historically used for shellfishing are currently closed on either a permanent, seasonal, or conditional basis. Improving the water quality in these waters could result in a re-opening of these shellfish beds, providing a sustainable economic resource to the residents of the BK watershed. More information on shellfish closures and the Shellfish Monitoring Program can be found in **Sections 3 and 6**.



Historic image of a Conservation Officer checking the shellfish harvest

1.4.3 Reducing Beach Closures

Beaches in the BK watershed attract both local residents and tourists. However, poor water quality has resulted in the closing of beaches to swimming in the watershed for several days at a time every year. The Rhode Island Department of Health (HEALTH) oversees water quality monitoring at all public beaches and is responsible for closing beaches if water quality fails to meet the water quality standards for primary contact recreation (swimming). In the BK watershed, 17 beach closures have been reported at the Bristol Town Beach and two beach closures have been reported at Camp St. Dorothy Beach since 2006 (see [Appendix B, Table B-6](#)). Improving the water quality in these waters would prevent or limit beach closures, which would encourage more residents and tourists to visit the beaches each year. More information on beach closures and the HEALTH Monitoring Program can be found in [Section 6](#).

1.4.4 Protecting Fish and Wildlife Habitat

Habitat for native fish and wildlife becomes degraded as pollution increases from development and agriculture. Threats include loss of habitat due to erosion and sedimentation in waterbodies, removal of natural vegetation which buffers streams, changes to the pH and temperature of streams, reduced streamflow resulting from decreased infiltration of precipitation and increased runoff, disconnection of natural fish habitat due to the presence of dams, and the cumulative effects of harmful pollutants such as pesticides and other toxic substances. All waters of the state are designated for fish and wildlife habitat, commonly referred to as aquatic life use. Improving the water quality to protect this designated use will improve opportunities for fishing and wildlife viewing, encourage other outdoor recreation in the watershed, and ensure there is adequate habitat for wildlife.

1.4.5 Maintaining the Cultural Identity of the Watershed

Aquatic resources and natural lands within the BK watershed play a key role in defining residents' cultural identity and provide a vital link to the region's history. For generations, residents have relied on water resources for their livelihood, including shellfishing, fishing, agriculture, and more recently, to drive industrial and economic development. Despite the increased development of the past century, the watershed maintains a rural character that many residents wish to protect. By restoring and protecting the water quality of waterbodies in the BK watershed, residents can re-establish this identity and maintain it for future generations.

1.5 How to Use the Plan

This watershed plan is designed to provide municipalities and other stakeholders with the information and resources necessary to work together or individually to protect and restore waterbodies in the BK watershed. This plan is organized as follows:

- **Section 2: Watershed Description**

This section provides a description of the BK watershed including major waterbodies and land use.

- **Section 3: Water Quality**

This section provides a summary of the water quality of the waterbodies in the BK watershed including identification of which waterbodies are not meeting water quality standards. Shellfish closures are discussed in detail in this section.

- **Section 4: Current Activities in the BK Watershed to Restore and Protect Water Quality**

This section provides a summary of current activities being conducted by municipalities to restore and protect water resources in the BK watershed. This section includes a summary of the stormwater, onsite wastewater treatment system, and land development programs in Rhode Island and Massachusetts and detailed summaries and evaluations of these programs in all municipalities in the BK watershed.

- **Section 5: Actions to Restore and Protect Water Quality**

This section provides an action plan for restoration and protection of waterbodies in the BK watershed at the watershed, municipal, and individual level. Each action identified includes a responsible party, suggested timeframe, and rough approximation of cost.

- **Section 6: Implementation Tools**

This section provides a series of tools for stakeholders to implement the actions proposed in Section 6. These tools include a summary of funding sources, public involvement, current water quality monitoring efforts in the watershed, and indicators of progress to assess the success of actions taken towards restoration and protection.

- **Section 7: List of Relevant Plans**

This section provides links to relevant plans, documents, and studies that have been completed in the BK watershed.

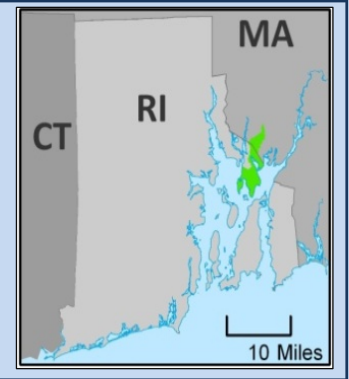
- **Call-Out Boxes**

Throughout the plan, a series of case studies are used to demonstrate actions that municipalities and other organizations are taking to positively affect water quality. Some of these projects, although they lie outside of the BK watershed boundaries, are included in this plan as they provide excellent examples of actions initiated at the municipal level.

2. Watershed Description

General Watershed Facts

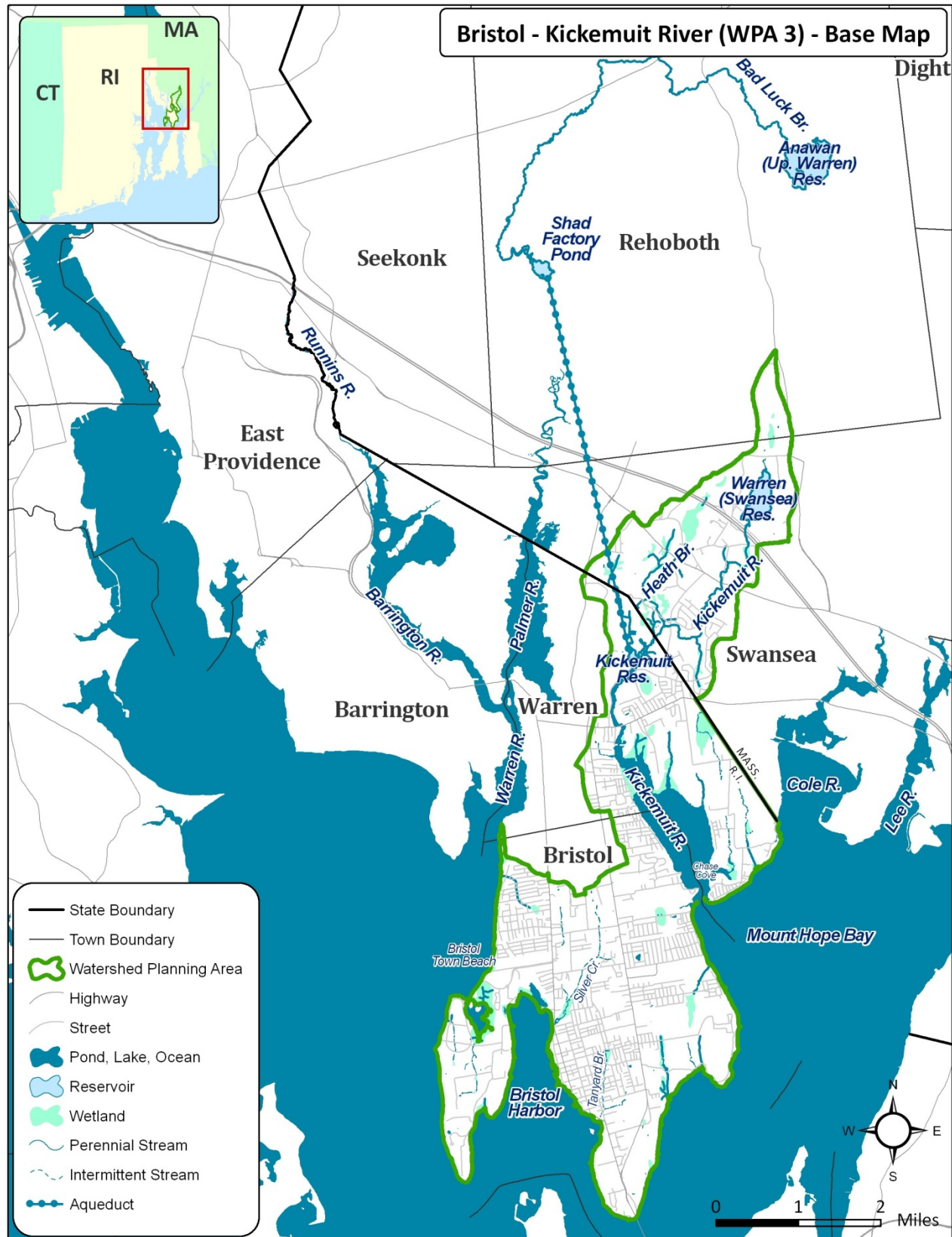
- **Direct Watershed Area:** 16.8 square miles (76% in RI, 24% in MA)
- **MA Towns:** Rehoboth and Swansea
- **RI Towns:** Warren and Bristol
- **Major Waterbodies:** Kickemuit River, Bristol Harbor, Mt. Hope Bay, and Upper Narragansett Bay



2.1 General Watershed Description

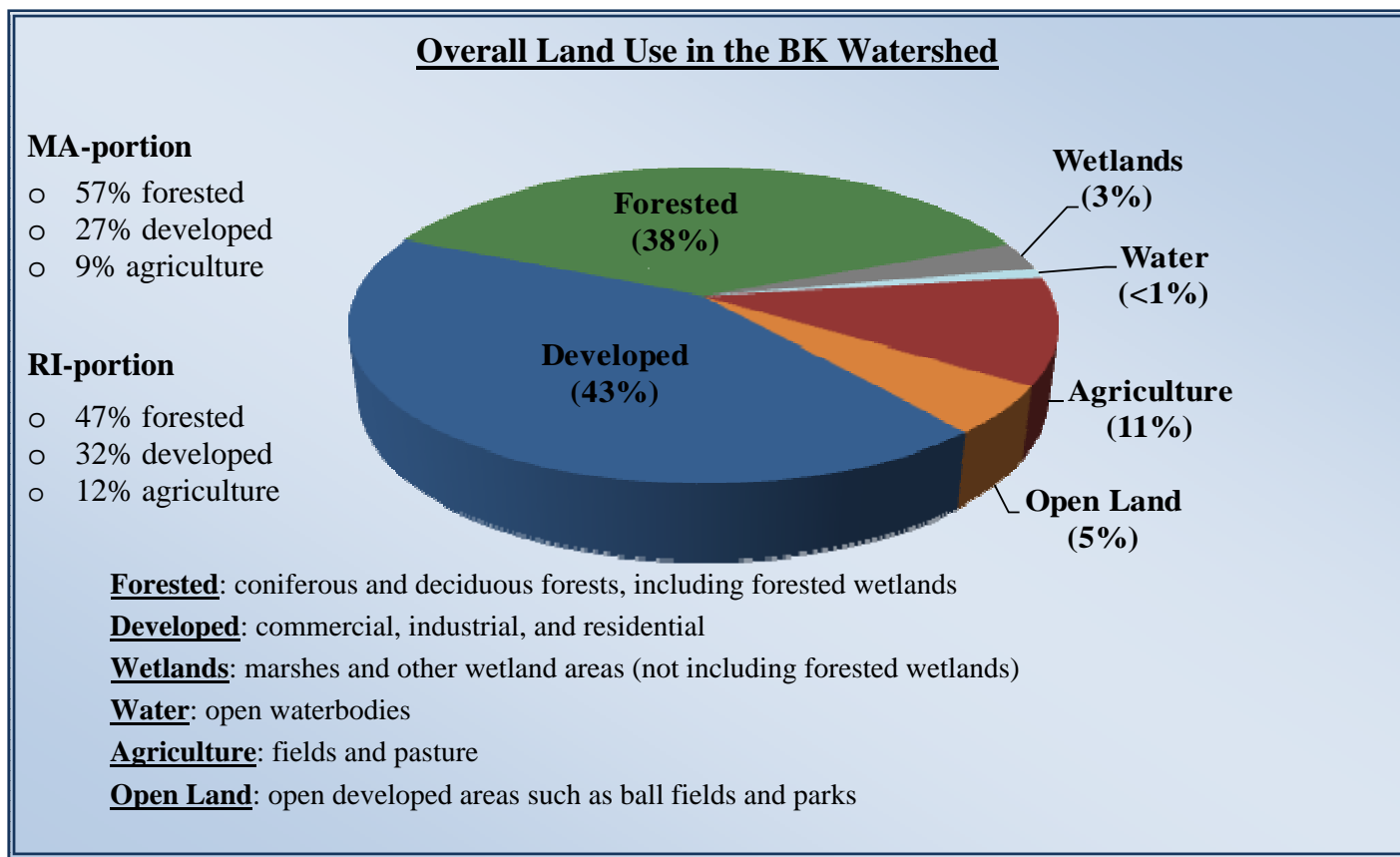
- The Bristol-Kickemuit River watershed is located in southeastern Massachusetts and eastern Rhode Island.
- The major waterbodies located in the watershed are the Kickemuit River and Bristol Harbor. The waters ultimately discharge to Mt. Hope Bay and Upper Narragansett Bay (Figure 2-1).
- The freshwater portion of the watershed begins in Rehoboth, MA, and flows into the Warren Reservoir in Swansea, MA, and then into the Kickemuit River (Figure 2-1).
- The Kickemuit River continues over the MA-RI border and empties into the Kickemuit Reservoir. The Kickemuit Reservoir is a source of drinking water to residents of Bristol, Warren, and Barrington, RI. Water from Shad Factory Reservoir (outside of the watershed) is piped into the Kickemuit Reservoir (Figure 2-1).
- The saltwater portion of the Kickemuit River begins at the dam at the southern end of the Kickemuit Reservoir. This is a valuable recreational area for boating and shellfishing on a conditional basis. The river empties into Mt. Hope Bay, which forms the northeast corner of the Narragansett Bay estuary (Figures 2-1 and 2-2).
- Bristol Harbor is a saltwater harbor in the southwestern section of Bristol, RI that is a very popular area for boating. The harbor is fed by multiple tributaries including Tanyard Brook and Silver Creek.
- The portion of the BK watershed located in RI is predominately sewered. However, many residents in this portion of the watershed rely on onsite wastewater treatment systems. The vast majority of residents in the watershed are served by public water systems.

Figure 2-1: The Bristol-Kickemuit River Watershed (a more detailed map of the watershed is located in Appendix A)



2.2 Land Use

The type of land use in a watershed has a direct effect on affect water quality (USEPA, 2011a). In an undeveloped watershed, natural processes such as soil infiltration and plant uptake of water and nutrients occur, providing reduced runoff and groundwater recharge. As watersheds become more developed with commercial, residential, and industrial land uses, the amount of stormwater runoff increases due to increasing areas of impervious surfaces, such as rooftops, roads, and parking lots. This stormwater carries pollutants such as bacteria, nutrients, metals, oils, sediment and chemicals that negatively affect nearby waterbodies. Agricultural land use activities, such as fertilizer and pesticide application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011a).



The BK watershed is predominately developed (43%) and is characterized by a residential, commercial, and industrial uses. Approximately 26% of the watershed is considered forested, and includes mixed deciduous and coniferous forests. Other land uses in the watershed include agriculture (11%), open land which includes open developed areas such as ball fields and parks (5%), wetlands (3%), and water (1%). A detailed map of land use within the entire BK watershed is located in **Appendix A**. Land use and impervious surface data for Massachusetts is based on digital images captured in 2005. These data are available online at <http://www.mass.gov/mgis/lus2005.htm> and at

http://www.mass.gov/mgis/impervious_surface.htm. Land use and impervious cover data for Rhode Island is based on digital imagery from 2003-2004. These data are available online at <http://www.edc.uri.edu/rigis/data/all.aspx>.

Most of the forested areas of the watershed are located in the northern portion of the watershed, and this area is also characterized by agricultural uses. Developed areas are concentrated in the southern portion of the watershed, particularly in Bristol, RI and portions of Warren, RI (Figures 3-2 and 3-3).

Developed areas are often characterized by relatively high levels of impervious cover, or surface areas such as roofs and roads that cause water to run off land surfaces rather than infiltrate into the soil. In the BK watershed, impervious surfaces cover 18% of the land area. Past studies have shown a link between the amount of impervious area in a watershed and a decrease in water quality (RIDEM, 2011c). Data suggest that water quality impacts can occur when impervious surfaces are as little as 10 percent of a watershed; at 25 percent impervious cover, significant water quality degradation is almost assured.

Sub-Watersheds Description and Land Use

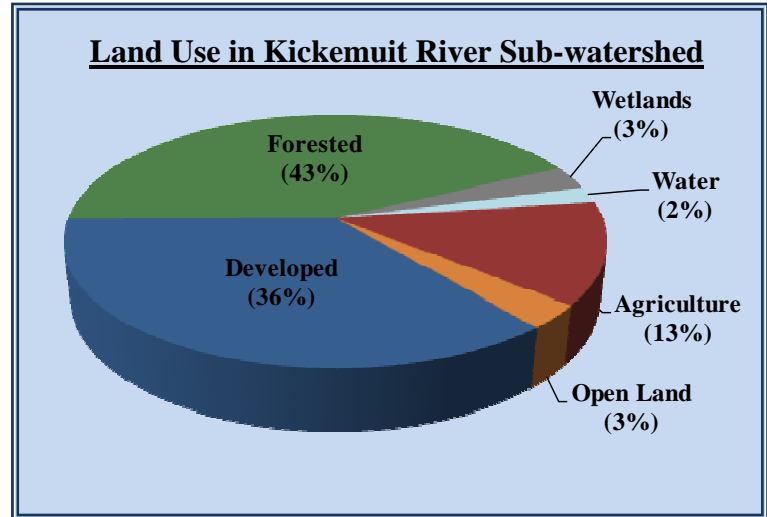
The BK watershed has been divided into two sub-watersheds to allow for a more in-depth identification of potential pollutant sources based on land use. These sub-watersheds are associated with the Kickemuit River and the Bristol Peninsula. Detailed land use and impervious cover values can be found in Table 3-1. Maps of each sub-watershed are provided below. A detailed land use map for the BK watershed can be found in **Appendix A**. Note: In all of the land use maps that follow, impervious surfaces are shown as part of the “Developed” land use category.

Table 2-1: Land Use for the Kickemuit River and Bristol Peninsula Sub-Watersheds (square miles and percent of total land cover)

Land Use Category	Kickemuit (sq. mi.)	Kickemuit (Percent)	Bristol (sq. mi.)	Bristol (Percent)
Developed	2.87	36%	4.11	51%
Forested	3.46	43%	2.58	32%
Agriculture	1.08	13%	0.51	6%
Open Land	0.20	2%	0.57	7%
Water	0.17	2%	0.03	0%
Wetland	0.25	3%	0.21	3%
Total	8.02	100%	8.01	100%
Impervious Area	1.14	14%	1.81	23%
Watershed Area in MA	4.00	50%	0.00	0%
Watershed Area in RI	4.02	50%	8.01	100%

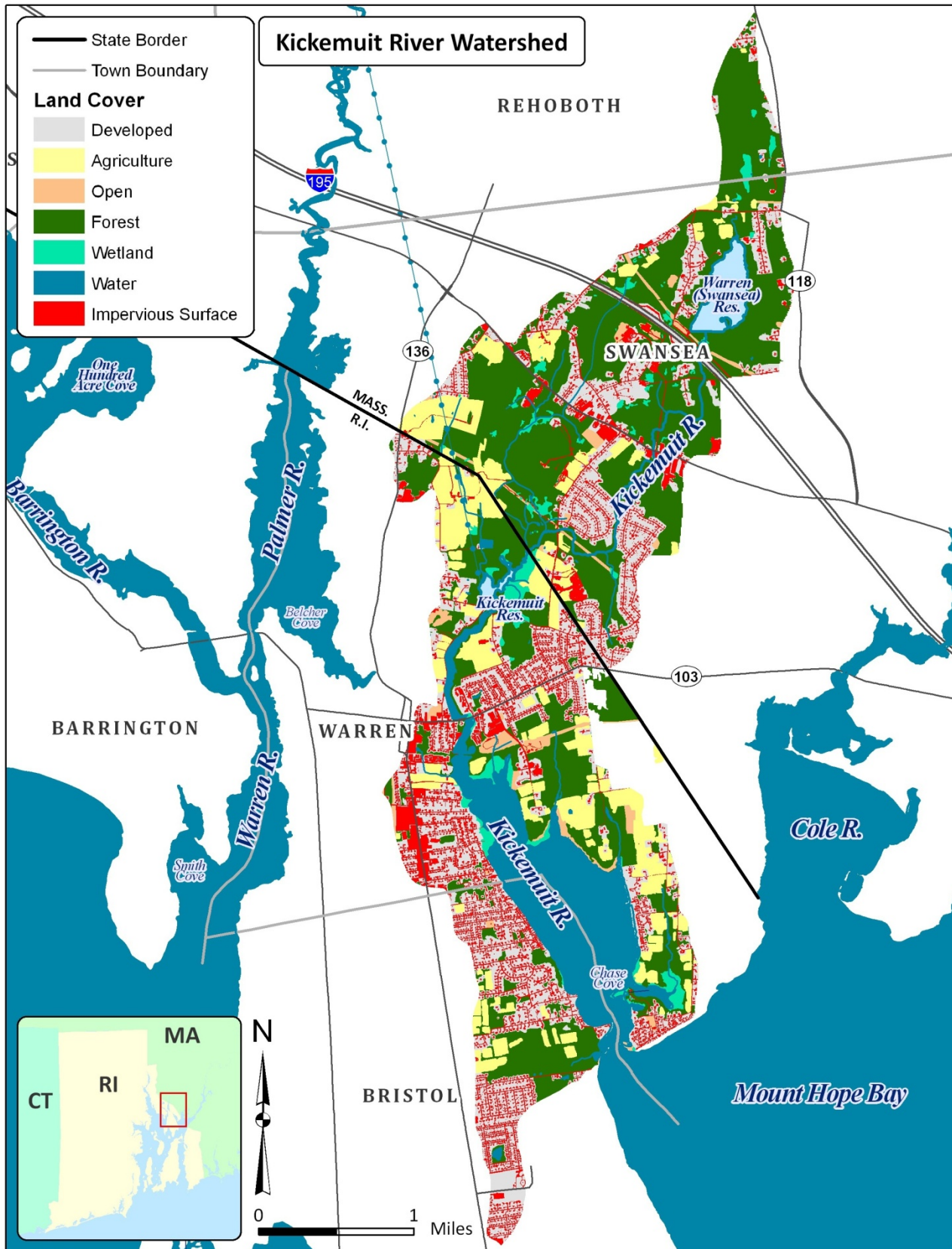
Kickemuit River Sub-Watershed

The Kickemuit River sub-watershed (Figure 3-2) is approximately 8 square miles in area and includes the Towns of Rehoboth and Swansea, MA, and Warren and Bristol, RI. Approximately 50% of the Kickemuit River sub-watershed is located in MA and 50% of the sub-watershed is located in RI.



- Its freshwater headwaters flow from southeastern Rehoboth, MA into the Warren Reservoir in Swansea and then into the Kickemuit River.
- The Kickemuit River continues south under Interstate 195 and Route 6, a developed commercial corridor, where it empties into the Kickemuit Reservoir at the MA-RI border. The Kickemuit Reservoir provides drinking water to residents of Bristol, Warren and Barrington, Rhode Island. The Kickemuit Reservoir also obtains water from the Shad Factory Reservoir in the Palmer River watershed in Massachusetts.

Figure 2-2: Map of the Kickemuit River Watershed with Land Use Indicated

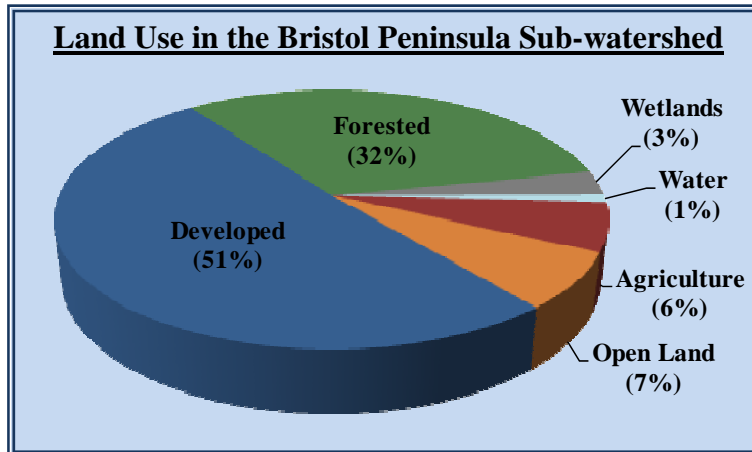


- A small tributary, known as Heath Brook, begins between I-195 and Route 6 and flows parallel to the Kickemuit before joining the river just north of the Kickemuit Reservoir.

- South of the Kickemuit Reservoir, the Kickemuit River becomes tidal as it makes its way south through the Towns of Warren and northeastern Bristol. The western side of the River here is heavily developed and sewerred, while the eastern side is mostly forest and agriculture. The river empties into Mt. Hope Bay, which forms the northeast corner of the Narragansett Bay estuary.
- Impervious surfaces cover 14% of the land area.

Bristol Peninsula

- The Bristol Peninsula sub-watershed (Figure 3-3) is approximately 8 square miles in area and extends from Narragansett Bay on the west to Mt. Hope Bay on the east. The entire sub-watershed is located in RI.

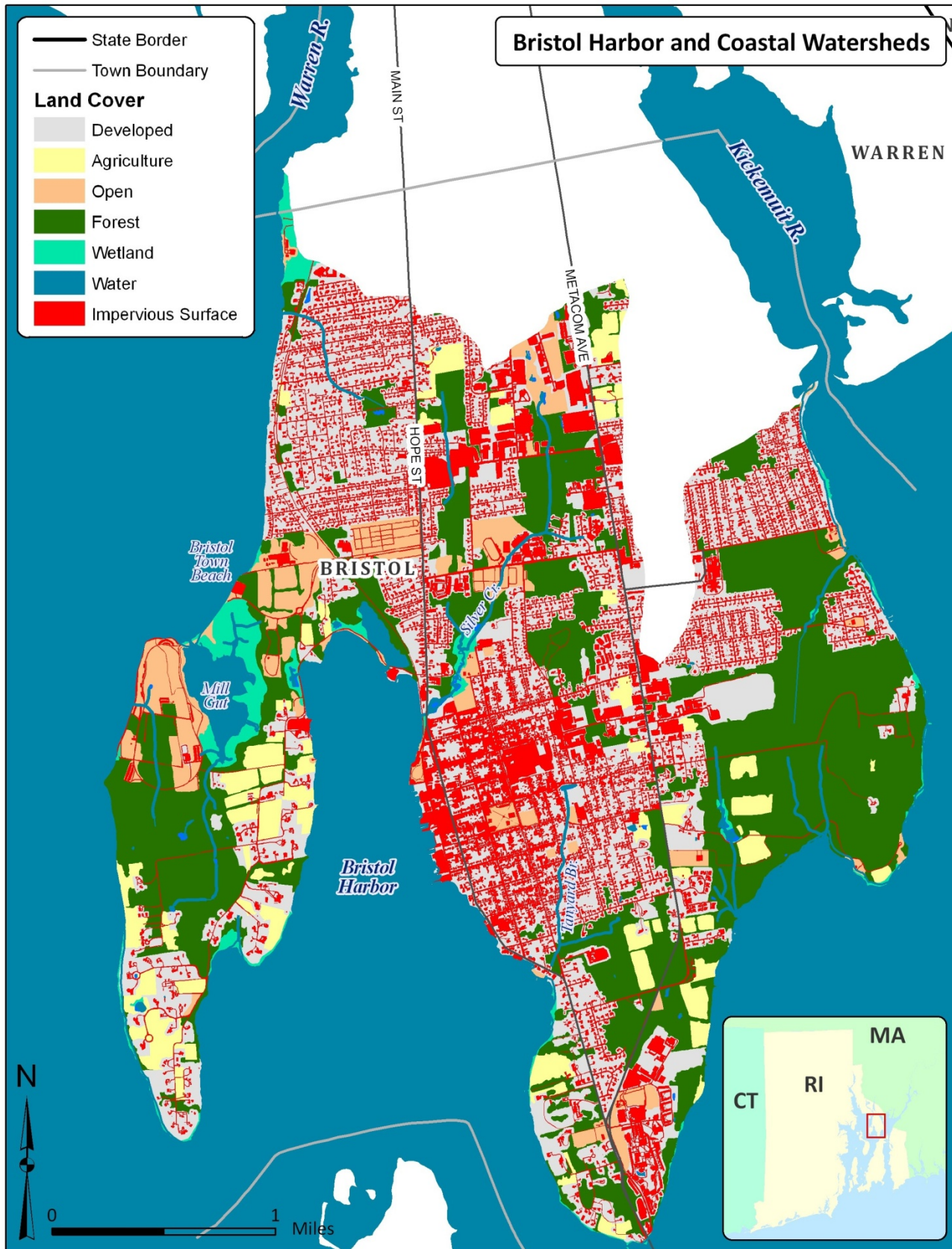


- A smaller, sub-peninsula on the eastern side of Bristol, RI is known as Poppasquash.
- More than half of this sub-watershed is developed. Impervious surfaces cover 23% of the land area.
- Colt State Park, a 465-acre state park with biking trails and other recreation opportunities forms a portion of the western border of the peninsula directly on Narragansett Bay.
- Bristol Harbor is a saltwater harbor in the southwestern corner of Bristol, RI. The harbor is fed by multiple tributaries including Tanyard Brook and Silver Creek. The harbor is part of Shellfish Growing Area 3 and portions of it are closed either seasonally or permanently to shellfishing.



Bristol Harbor

Figure 2-3: Map of the Bristol Peninsula with Land Use Indicated



2.3 Additional Resources

For additional visual resources, see the Rhode Island Digital Atlas, an online mapping initiative lead by the University of Rhode Island Geospatial Extension Program, in partnership with the URI Environmental Data Center. This website features simple, easy-to-use maps that tap into the wealth of information available from the Rhode Island Geographic Information System (RIGIS). Maps are organized by municipality and by watershed, and may be viewed directly on the RI Digital Atlas website, on Google Earth, or imported into GIS software.

An index of maps is available online at: <http://www.edc.uri.edu/atlas/maps/mapIndex.aspx>.

The land use maps contained in the detailed map in **Appendix A** indicate a 100 foot riparian buffer distance from streams as a thin black line. To view this area in more detail, the Rhode Island Digital Atlas contains a series of maps which show *only* land use within 100 feet of either side of streams.

Riparian buffer map series at the RI Digital Atlas are found at the following website:

<http://www.edc.uri.edu/atlas/maps/map.aspx?MAP=019>.



Recreation is a significant use along the western shore of the southern Kickemuit River.

3. Water Quality Issues in the Watershed

In order to focus management actions for improving and protecting water quality in the BK watershed, it is necessary to understand the current water quality conditions. This section provides a summary of the water quality of the waterbodies in the BK watershed including identification of which waterbodies are not meeting water quality standards.

3.1 Water Quality Impairments

The waters in Rhode Island and Massachusetts are assigned to an assessment unit, which refers to a specific waterbody or segment of a larger waterbody. Each of the major waterbodies in the BK watershed has been divided into more than one assessment unit segments. Each assessment unit has been given a water quality classification with the associated designated uses for that class. Waterbodies where water quality does not support their designated uses are deemed “impaired.” A water quality restoration plan, also known as a Total Maximum Daily Load report (TMDL), is required to be developed for each impaired waterbody.

Following the Integrated Reporting format and assessment and listing methodology described in each state's Consolidated Assessment and Listing Methodology, each assessment unit is assessed and placed into one of five Categories (see call out box at right). Categories 4 and 5 list waters that are considered impaired for at least one designated use. Category 4 waters are considered impaired for one or more designated uses but do not require development of a TMDL for one of three reasons. Category 5 is the list of waters that are impaired for one or more designated uses by a pollutant and which require a TMDL - the Section 303(d) List of Impaired Waters.

Through the TMDL development process, water quality conditions are more thoroughly characterized and pollution sources are identified providing the technical basis for the pollution abatement actions specified in the water quality restoration plans. More information about RIDEM's TMDL Program is available

Water Quality Impairment

Once every two years, all states are required to report to the USEPA on the quality of their surface waters and to provide a list of those waters that do not meet water quality standards. Waterbodies not meeting standards are deemed “impaired” and require a TMDL. These impaired waters are placed in Category 5 the “303(d) List of Impaired Waters.”

Category 1: Waters are considered to be “fully supporting” all designated uses;

Category 2: Some designated uses are “fully supporting” however more data are needed to assess other uses;

Category 3: More monitoring is needed to assess any designated use; associated waters are considered to have insufficient data or no data to be 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;

B. Other pollution control requirements are reasonably expected to result in attainment of the water quality standard in the near future;

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.

online at: <http://www.dem.ri.gov/programs/benviron/water/quality/rest/>, and the MADEP TMDL Program at: <http://www.mass.gov/dep/water/resources/tmdls.htm>.

As shown in Figure 3-1 and summarized in Table 3-1, multiple waterbodies in the BK watershed are considered “impaired” for at least one pollutant. These specific impairments are discussed in detail below. Note that although the eastern side of Bristol Harbor has water quality that has been impacted (e.g., shellfish consumption is not allowed), this area is not designated as “impaired” because the water quality standards for the eastern side are not as stringent as those for the western side.



Excessive nutrients in the upper Kickemuit Reservoir often cause algae blooms.

Figure 3-1: The Bristol-Kickemuit River Watershed Water Resources and Impairment Classifications

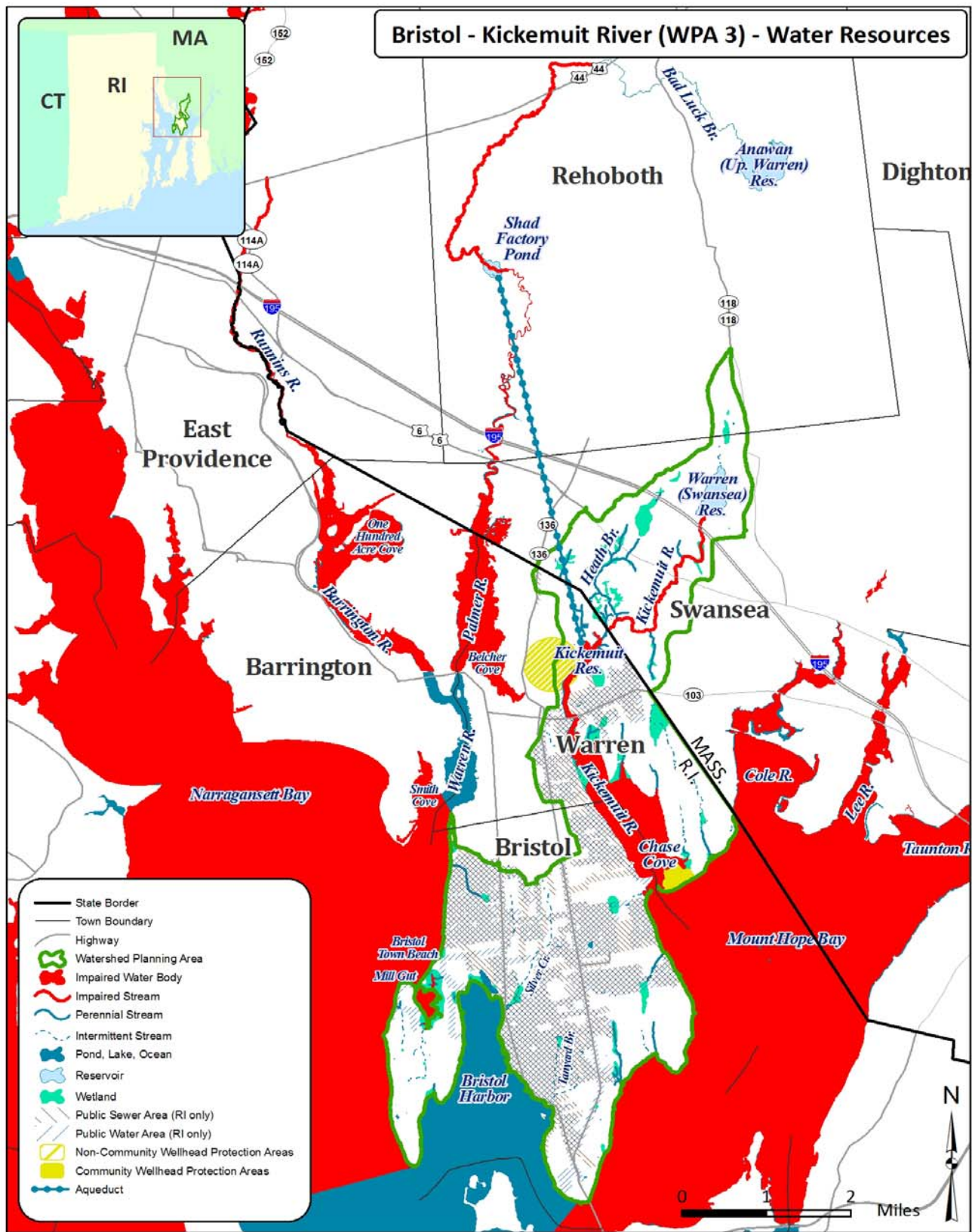


Table 3-1: Waterbody Classification and Impairments in the BK Watershed from the Rhode Island 2010 303(d) List (RIDEM, 2011b) and the Massachusetts's 2010 303(d) List (MADEP, 2010)

Waterbody	Waterbody Classification (State) and Designated Use	Impaired Use (pollutant of concern)
Freshwater Kickemuit River (Includes Kickemuit Reservoir)	<p style="text-align: center;">B (MA)</p> <p>Designated uses include habitat for fish, aquatic life, and wildlife, and for recreation such as swimming and boating.</p>	<p style="text-align: center;">Recreation (bacteria)</p>
	<p style="text-align: center;">AA (RI)</p> <p>Designated uses include a public drinking water supply, recreation (such as swimming and boating), fish consumption, and fish and wildlife habitat (aquatic life use).</p>	<p style="text-align: center;">Public Drinking Water Supply (phosphorus, turbidity, excess algal growth, and taste and odor) Recreation (bacteria) Fish and Wildlife Habitat/Aquatic Life Use (phosphorus, turbidity, excess algal growth, and taste and odor)</p>
Saltwater Kickemuit River	<p style="text-align: center;">SA (RI)</p> <p>Designated uses include shellfish consumption, recreation (including swimming and boating), fish consumption, and habitat for fish and wildlife (aquatic life use).</p> <p style="text-align: center;">SA {b} (RI)</p> <p>Designated uses include recreation (such as swimming and boating), fish consumption, and fish and wildlife habitat (aquatic life use). The Class SA {b} designation is a partial use designation for a concentration of vessels. These waters are in the vicinity of marinas and/or mooring fields and therefore seasonal shellfishing closures will likely be required, however, all SA criteria must be attained.</p>	<p style="text-align: center;">Shellfish Consumption (fecal coliform)</p>
Mt. Hope Bay (near Bristol)	<p style="text-align: center;">SA (RI)</p> <p>Designated uses include shellfish consumption, recreation (including swimming and boating), fish consumption, and habitat for fish and wildlife (aquatic life use).</p>	<p style="text-align: center;">Shellfish Consumption (fecal coliform bacteria) Fish and Wildlife Habitat/Aquatic Life Use (nitrogen and dissolved oxygen)</p>

Table 3-1: Waterbody Classification and Impairments in the BK Watershed from the Rhode Island 2010 303(d) List (RIDEM, 2011b) and the Massachusetts's 2010 303(d) List (MADEP, 2010) (Continued)

Waterbody	Waterbody Classification (State) and Designated Use	Impaired Use (pollutant of concern)
Bristol Harbor (Eastern Side)	<p style="text-align: center;">SB (RI)</p> <p>Designated uses include recreation (such as swimming and boating), fish consumption, shellfish harvesting for controlled relay and depuration, and fish and wildlife habitat (aquatic life use).</p> <p style="text-align: center;">SB1 (RI)</p> <p>Designated uses include recreation (such as swimming and boating), fish consumption, and fish and wildlife habitat (aquatic life use). Primary contact recreational activities may be impacted due to bacteria from approved discharges. However Class SB water quality criteria must be met.</p>	No Impairments
Bristol Harbor (Western Side)	<p style="text-align: center;">SA {b} (RI)</p> <p>Designated uses include recreation (such as swimming and boating), fish consumption, and fish and wildlife habitat (aquatic life use). The Class SA {b} designation is a partial use designation for a concentration of vessels. These waters are in the vicinity of marinas and/or mooring fields and therefore seasonal shellfishing closures will likely be required, however, all SA criteria must be attained.</p> <p style="text-align: center;">SA (RI)</p> <p>Designated uses include shellfish consumption, recreation (including swimming and boating), fish consumption, and habitat for fish and wildlife (aquatic life use).</p>	No Impairments
Upper Narragansett Bay (West Side of Bristol)	<p style="text-align: center;">SA (RI)</p> <p>Designated uses include shellfish consumption, recreation (including swimming and boating), fish consumption, and habitat for fish and wildlife (aquatic life use).</p>	<p style="text-align: center;">Shellfish Consumption (fecal coliform bacteria) Fish and Wildlife Habitat/Aquatic Life Use (nitrogen and dissolved oxygen)</p>

3.2 Shellfish Growing Area Closures

RIDEM's Office of Water Resources is responsible for regulating shellfish harvesting by conducting routine bacteriological monitoring and pollution source assessments and inventories of the State's shellfish growing waters. Shellfish harvesting has been divided into two designated uses: shellfish harvesting suitable for direct human consumption (Class SA waters), and shellfish harvesting for controlled relay (Class SB waters). Sanitary conditions of growing areas are re-assessed annually to confirm that the state's shellfish growing areas are appropriately classified. The Office of Water Resources assesses the results of sanitary surveys and ambient water quality monitoring of shellfish growing waters to determine the potential for fecal material, pathogenic microorganisms, or other poisonous or deleterious substances in conducting this annual review of shellfish waters classification. According to the National Shellfish Sanitation Program, a growing area is defined as any site that supports or could support the propagation of shellfish stock by natural or artificial means. Growing areas may be designated as approved, conditionally approved (including seasonal closures), or prohibited. It is important to note that any shellfish area, regardless of classification, may be temporarily closed to all activities when a potential public health emergency emerges as a result of a storm event, flooding, sewage, chemical, or petroleum discharges, or a hazardous algal bloom. The three types of shellfish closure classifications are described in greater detail below:

1. **Prohibited** – Shellfish growing areas that are closed to shellfish harvesting year-round. Any growing area without a current sanitary survey or with consistently high bacteria levels must be classified as Prohibited. There are several growing areas adjacent to the BK watershed which are currently classified as Prohibited. Shellfishing is prohibited in growing area GA5-1 in the saltwater portion of the Kickemuit River (Figure 3-2). Shellfishing is prohibited in growing area GA17-3 in Mt. Hope Bay (near Bristol) (Figure 3-3) and shellfishing is prohibited in growing area GA3-1 in Bristol Harbor (Figure 3-5).
2. **Conditional** - Shellfish growing areas that are closed periodically to shellfish harvesting during predictable pollution events where high levels of bacteria or other pollutants may reach the growing area. Examples of predictable pollution events include a wastewater treatment facility discharging known levels of effluent or nonpoint source pollution and/or stormwater impacts following a rain event. By way of example, the Upper Narragansett Bay Conditional Area A (near western Bristol) closes for 7 days following either a WWTF bypass of 0.5 Million Gallons or greater or a 0.8 inch rainfall event (in 24 hours). There are several growing areas adjacent to the BK watershed that currently have a conditional closure classification. The saltwater portion of the Kickemuit River has a conditional closure in effect at all times in growing area GA5-4 (Figure 3-2). Mt. Hope Bay (near Bristol) has conditional closures in effect in growing area GA17-2 and growing area GA17-1 (Figure 3-3). As mentioned above, Upper Narragansett Bay (near western Bristol) has conditional closures in effect in Conditional Area A. Upper Narragansett Bay (near western Bristol) also has conditional closures in effect in Conditional Area B. Those wishing to harvest shellfish from growing areas with conditional closures must first check with RIDEM's Division of Enforcement by calling (401) 222-2900 prior to harvesting.

3. **Seasonal** – Seasonal Closures are put in place for those shellfish growing areas where the sanitary quality may be affected by seasonal populations or seasonal use of a marina, dock or harbor. Unless otherwise noted, seasonal closures begin at sunrise on the Saturday immediately prior to Memorial Day and end at sunrise on the Tuesday immediately following Columbus Day. Sanitary surveys and/or monitoring data in these growing areas indicate that pollutants will reach growing areas in predictably high concentrations during this season. There are several growing areas adjacent to the BK watershed that currently has a seasonal closure classification. The saltwater portion of the Kickemuit River has seasonal closures in effect for growing area GA5-2 and growing area GA5-3 (Figure 3-2). Bristol Harbor has a seasonal closure in effect for growing area GA3-2 (Figure 3-5).

Shellfish harvesting has a long history in the coastal communities of Rhode Island and Massachusetts, particularly in Narragansett Bay. In order for this strong tradition to continue, restoration of polluted shellfish harvesting areas must be accomplished. Consistent with the state's water quality regulations, it is the goal that SA classified waters be suitable for shellfish harvesting (among other uses) at all times. Water quality restoration efforts should focus on restoring shellfish harvesting in SA waters classified as either prohibited or conditionally approved. SB classified waters are designated for shellfish harvesting for controlled relay. These waters are considered prohibited for shellfish harvesting for direct human consumption and it is not a goal that they be suitable for shellfish harvesting for direct human consumption. As shown in Table 3-1, the saltwater portion of the Kickemuit River, Mt. Hope Bay (near Bristol), and Upper Narragansett Bay (near Bristol) are on the impaired list for shellfish consumption. Targeted water quality restoration efforts in the BK watershed may help reduce pollutant levels in these waterbodies. If efforts are successful, closures may be lifted for growing areas with prohibited and conditional closures, allowing for the return of shellfish harvesting to these growing areas.

3.3 Kickemuit River Sub-Watershed

Kickemuit River (Freshwater Portion)

The freshwater portion of the Kickemuit River begins in Rehoboth, MA (Figure 3-1). The river flows into the Warren Reservoir in Swansea, MA, before it crosses the state line into RI and empties into the Kickemuit Reservoir. The Kickemuit Reservoir provides drinking water to the residents of Bristol, Warren, and Barrington, RI. Water from Shad Factory Reservoir in the Palmer River watershed is piped into the Kickemuit Reservoir.

The Kickemuit River is listed in Category 4A (Figure 3-1). A TMDL has been written for its recreational use impairment due to bacteria, and for its public drinking water supply and fish and wildlife (aquatic life use) impairments due to phosphorus, turbidity, excess algal growth, and taste and odor.

Approved Water Quality Reports

RIDEM Fecal Coliform (Bacteria) and Total Phosphorus TMDLs for the Kickemuit Reservoir (RI), Upper Kickemuit River (RI), and Kickemuit River (MA) (2006)

Pollutant Reductions Required to Meet Water Quality Standards for Bacteria: 66% - 99%

Pollutant Reductions Required to Meet Water Quality Standards for Total Phosphorus: 30% - 63%

TMDL Pollutant Load Reductions – are based on the most impaired location in an impaired waterbody. These percent reductions represent a rough estimation of the amount of pollution abatement actions needed to meet water quality standards. Often, these percent reductions are expressed as ranges as each impaired segment of a larger waterbody is assessed individually

Bacteria Sources Identified in Water Quality Reports

The largest sources of bacteria and phosphorus to this section of the Kickemuit River are thought to be failing onsite wastewater treatment systems (OWTS) in the Smoke Rise housing development in Swansea, MA, and

unmanaged runoff from agricultural operations along the upper portions of the river.

Other potential sources of bacteria and phosphorus identified in the TMDL include piped input from the Shad Factory Reservoir and stormwater runoff particularly in areas directly adjacent to the main branch of the river in RI and MA. Waterfowl and wildlife may also be contributing bacteria and phosphorus to the river.

Available Data Addressing Impairments in the Freshwater Kickemuit River (Appendix B)

- RIDEM Fecal Coliform and Total Phosphorus TMDLs for the Kickemuit Reservoir (RI), Upper Kickemuit River (RI), and Kickemuit River (MA) (2006) (Table B-1)

Other Available Data for the Freshwater Kickemuit River

- MADEP Water Quality Assessment Report Program: *E. coli*, total nitrogen, ammonia, total phosphorus, temperature, specific conductivity, total dissolved sediments, and dissolved oxygen (DRAFT data only)

Kickemuit River (Saltwater Portion)

The saltwater portion of the Kickemuit River begins at the dam at the southern end of the Kickemuit Reservoir in Warren, RI (Figure 3-1). The river empties into Mt. Hope Bay which forms the northeast corner of the Narragansett Bay estuary. The estuarine portion of the Kickemuit River is designated for shellfishing (Growing Area 5 – Figure 3-2).

The saltwater portion of the Kickemuit River is listed in Category 4A. A TMDL has been written to address its shellfish consumption use impairment due to bacteria. Shellfishing is prohibited in the very

northern portion of the estuary (area 5-1); seasonally approved in areas 5-2 and 5-3; and conditionally approved in area 5-4, which is the majority of the estuary.

Approved Water Quality Reports

RIDEM Study for Bacteria for Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL (2010)

Pollutant Reductions Required to Meet Water Quality Standards for Bacteria: 41%-90%

Bacteria Sources Identified in Water Quality Reports

The primary sources of bacteria to the saltwater portion of the Kickemuit River include contributions from the freshwater portion of the river and stormwater runoff.

Other pollutant sources include suspected sewer leaks, overflows, and illicit connections, failing or malfunctioning OWTS, marine vessel discharges, and waterfowl (particularly swans and geese) and other wildlife.

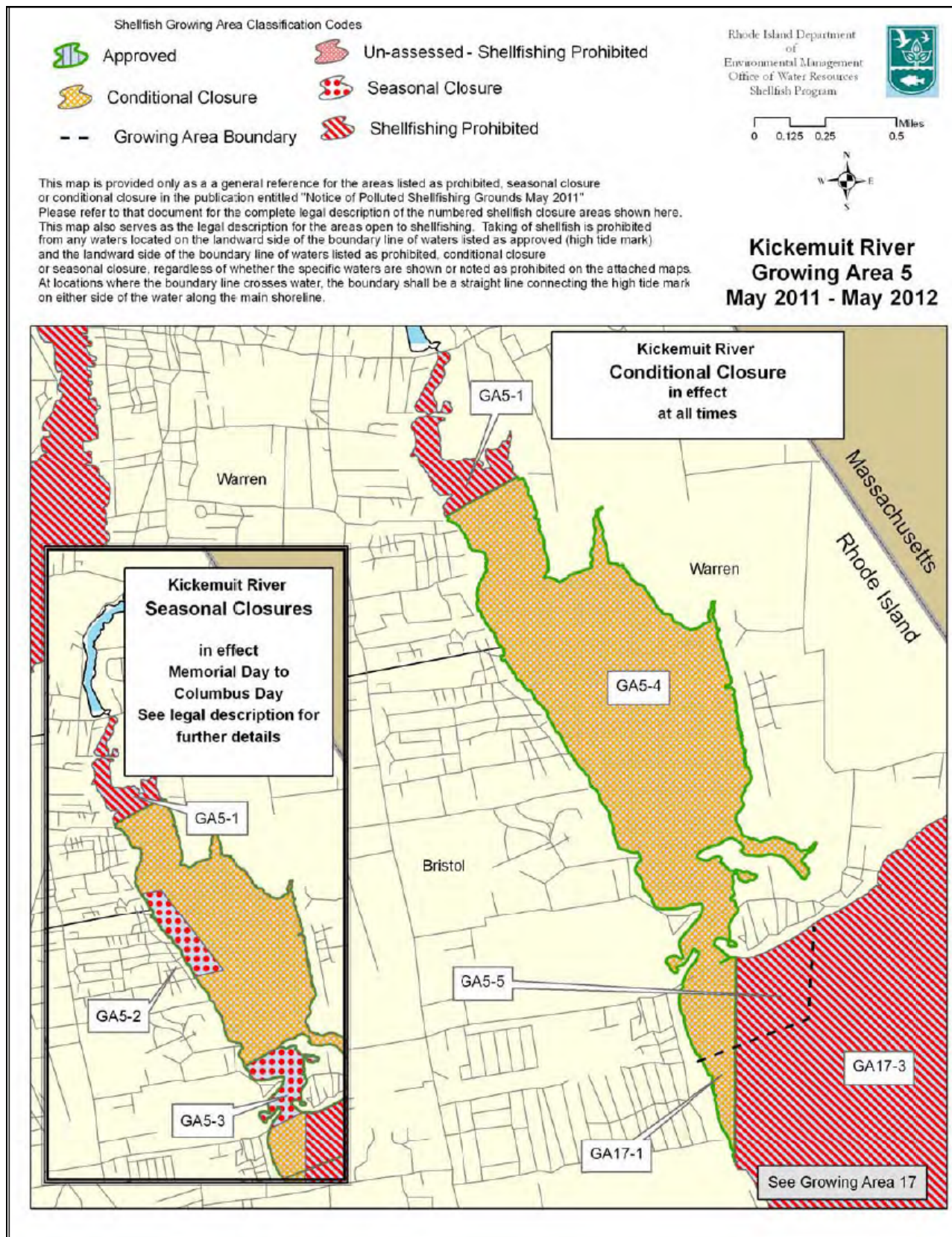
Available Data Addressing Impairments in the Saltwater Portion of the Kickemuit River **(Appendix B)**

- RIDEM TMDL Study for Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL (2010) (Table B-2 and B-3)
- RIDEM Shellfish Monitoring Program (Fecal Coliform) (Table B-4)



The Narrows

Figure 3-2: Shellfish Growing Areas and Closures for the Kickemuit River (Growing Area 5)



3.4 The Bristol Peninsula

Mt. Hope Bay (near Bristol)

The southern and eastern portions of Bristol are included in the Mt. Hope Bay watershed (Figure 3-1). Mt. Hope Bay forms the northeast corner of the Narragansett Bay estuary. This portion of Mt. Hope Bay includes shellfish Growing Area 17 (Figure 3-3). Shellfishing is conditionally approved in areas 17-1 and 17-2, and prohibited in area 17-3, which is most of Mt. Hope Bay in RI.

This portion of Mt. Hope Bay is listed on Category 5. Although impairments for shellfish consumption due to bacteria have been addressed in approved TMDLs, impairments for fish and wildlife habitat (aquatic life use) due to nitrogen and dissolved oxygen have not yet been addressed by a TMDL.

Approved Water Quality Reports

RIDEM TMDL Study for Bacteria for Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL (2010)

Pollutant Load Reductions Required to Meet Water Quality Standards for Bacteria: 56%

Bacteria Sources Identified in Water Quality Reports

Sources of bacteria to this portion of Mt. Hope Bay include stormwater pollutants in runoff from six MS4 outfalls in Bristol, sewer leaks, failing onsite wastewater treatment systems, marine vessel discharges, and waterfowl (particularly swans and geese) and other wildlife.

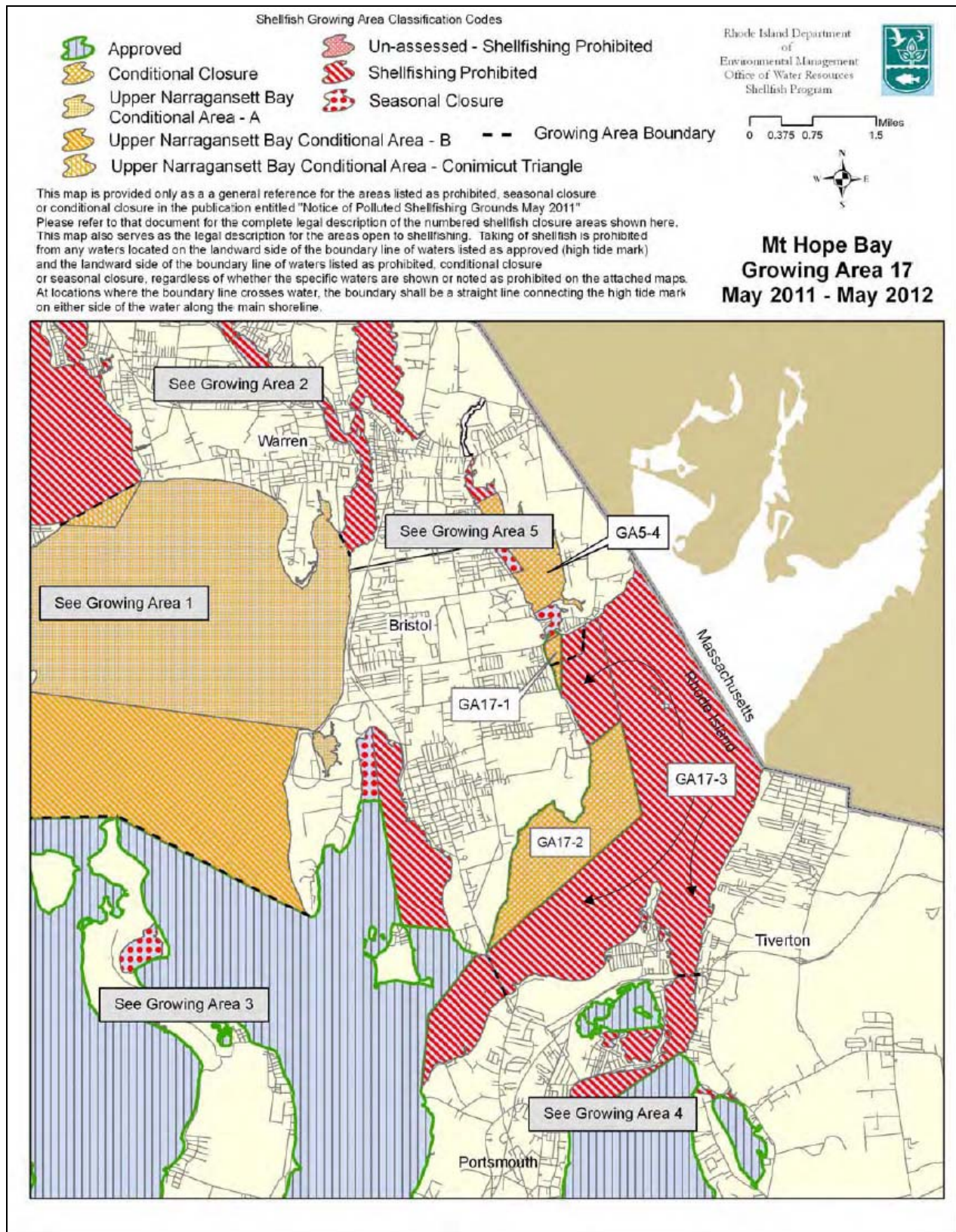
Available Data Addressing Impairments in Mt. Hope Bay (Near Bristol) (Appendix B)

- RIDEM TMDL Study for Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL (2010) (Table B-5)
- RIDEM Shellfish Monitoring Program (Fecal Coliform) (Table B-6)



Mt. Hope Bay Bridge

Figure 3-3: Shellfish Growing Areas and Closures for Mt. Hope Bay (Growing Area 17)



Western Portion of the Bristol Peninsula

Waterbodies in the western Bristol Peninsula include Bristol Harbor and portions of Upper Narragansett Bay (Figure 3-1). Bristol Harbor is located in the southwestern corner of Bristol. The mouth of the Warren River is located near the northwest corner of Bristol and discharges directly to Upper Narragansett Bay. This portion of Bristol includes Bristol Town Beach and Colt State Park. Bristol Town Beach has had 17 beach closings from 2006 through 2011. These waterbodies include Shellfish Growing Areas 1 and 3 (Figures 3-4 and 3-5). Shellfishing is conditionally approved in areas 1-1 and 1-2; prohibited in area 3-1, seasonally approved in area 3-2.

Available Data Addressing Impairments in the Western Portion of Bristol Peninsula (Appendix B)

- RIDEM Shellfish Monitoring Program (Fecal Coliform) (Table B-7)
- RI HEALTH Beach Monitoring Program for Bristol Town Beach and Camp St. Dorothy (Enterococci) (Table B-8)

Other Available Data for Bristol Harbor

Save Bristol Harbor: dissolved oxygen, temperature, salinity, chlorophyll, nitrogen and phosphorus.



Colt State Park



The Bulls at Colt State Park entrance



Shoreline at Colt State Park

Figure 3-4: Shellfish Growing Areas and Closures for Upper Narragansett Bay (Growing Area 1)

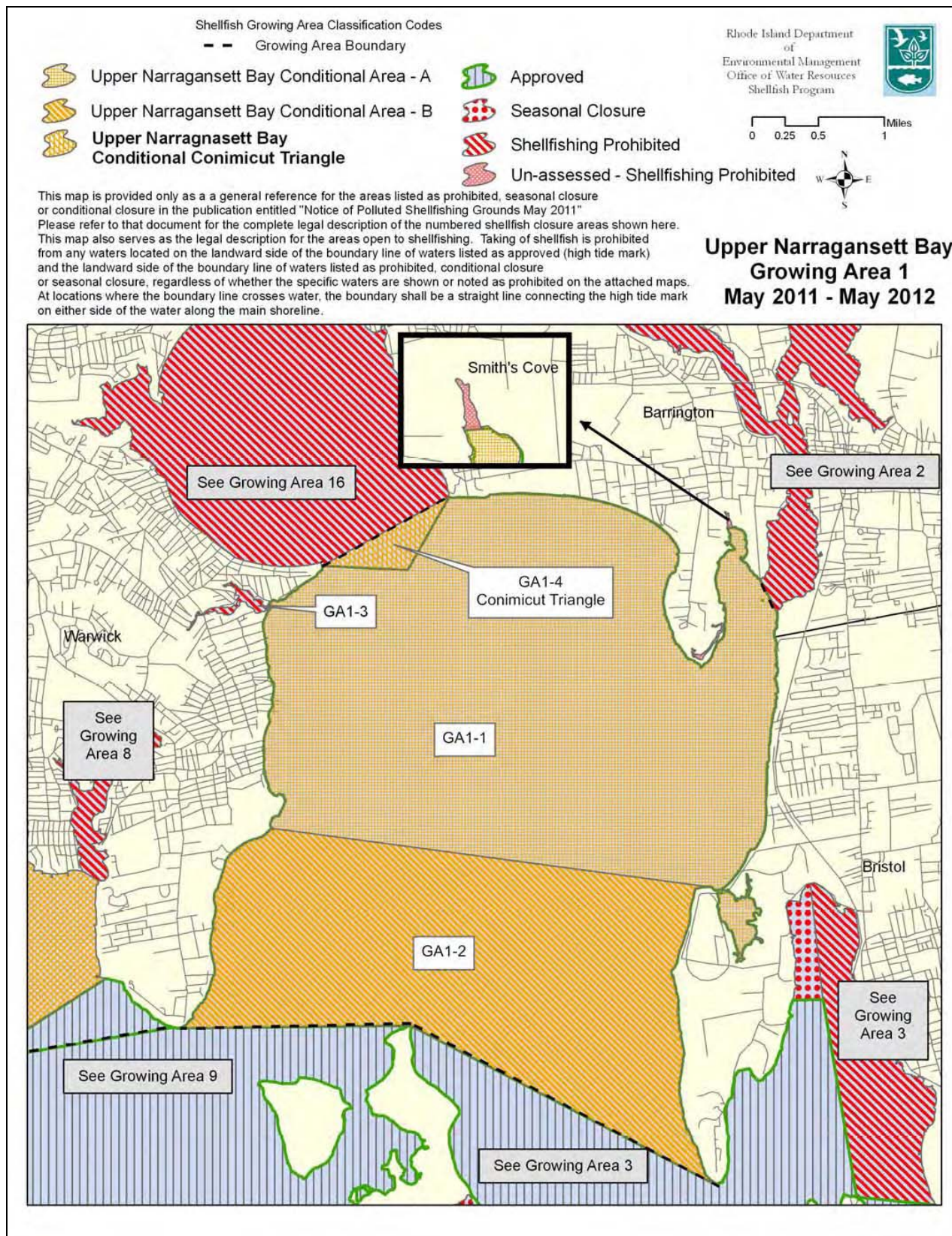
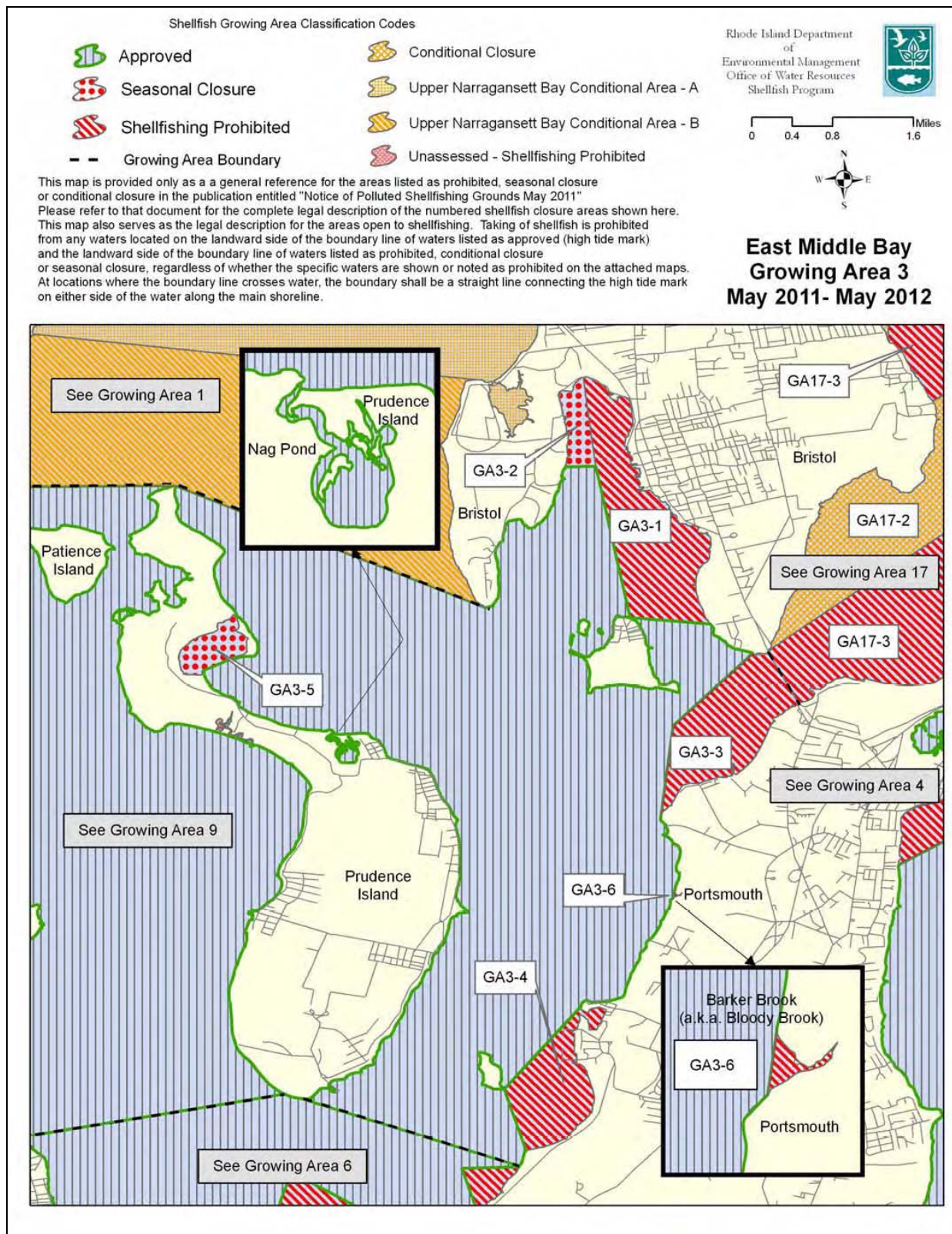


Figure 3-5: Shellfish Growing Area for Bristol Harbor (Growing Area 3)



3.5 Other Pollutants of Concern

Portions of the waterbodies in the BK watershed have been sampled for fecal coliform, total phosphorus, dissolved oxygen, temperature, total suspended sediments, and chlorophyll A. Based on land use data in the BK watershed, other pollutants of concern include Enterococci bacteria, nutrients, chloride, and sediment.

Enterococci

Like fecal coliform, enterococci are bacterial indicators of water pollution. Bacteria can enter waterbodies from sources such as, stormwater, failed OWTS, and agricultural runoff, and domestic and wild animal waste. RI has switched to using enterococci as an indicator of bacterial contamination in fresh and salt water to assess primary contact recreation/swimming criteria. Fecal coliform bacteria are still used to assess shellfish consumption use.

Nutrients

Excess nutrients, such as phosphorus and nitrogen, have been shown to cause algal blooms in fresh and salt water, respectively. Nutrients can enter waterbodies from sources such as wastewater treatment facilities, stormwater from residential and agricultural runoff, and from OWTS.

Chloride

Chloride from de-icing salts has been shown to enter both surface water and groundwater. Chloride has the potential to negatively affect aquatic life, as well as threaten drinking water supplies. High levels of chloride in streams can occur year round when adjacent groundwater that supplies streamflow has high levels of chloride.

Sediment

Sediment can enter surface waters from sources such as stormwater and agricultural runoff, especially when activities that disturb soil such as construction and plowing are present. Excess sediment in surface waters can destroy fish spawning beds, reduce useful storage volumes in reservoirs, clog streams, reduce aquatic plant life, and alter stream ecology. Sediment often serves as a carrier of organic matter, animal or industrial wastes, pesticides, metals, chemicals, and nutrients such as phosphorus.



Salting the roads in the winter leads to an increase in chloride in nearby waterbodies

3.6 Unassessed Designated Uses in the Watershed

As described in **Section 3.1**, all states are required to report to the USEPA on the quality of their surface and groundwater resources every two years. These “Integrated Water Quality Monitoring and Assessment Reports,” describe the use attainment status for every designated use on every waterbody. This includes not only which designate uses are impaired, but also which designated uses have no or

insufficient data and are therefore not assessed. Unassessed uses in waterbodies in the BK watershed are shown in Table 3-2.

Table 3-2: Unassessed Designated Uses for Waters in the BK Watershed (RIDEM, 2011)

Waterbody	State	Classification	Unassessed Uses
Kickemuit River	RI	AA	Fish Consumption
Kickemuit River	RI	SA	Fish and Wildlife Habitat/Aquatic Life Use
Bristol Harbor	RI	SA{b}	Fish and Wildlife Habitat/Aquatic Life Use

4. Current Management Activities in the BK Watershed to Restore and Protect Water Quality

The following section summarizes the primary threats to water quality in the BK watershed and provides a review of current actions for managing these threats, particularly in regards to stormwater, low impact development as it relates to stormwater, and onsite wastewater treatment systems. **Section 5** then provides a detailed action plan.

4.1 Stormwater

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.



Stormwater runoff entering a storm drain

In developed areas, large areas of natural landscape cover have been replaced with non-porous, or impervious, surfaces (e.g. buildings, streets, and parking areas). Impervious surfaces significantly change both the quality and quantity of runoff. As water is unable to infiltrate into the soil, the volume of stormwater runoff increases and that water picks up pollutants and transports them to nearby lakes, streams, and bays. This greater volume of water also moves much faster, increasing soil erosion, especially where natural vegetation is no longer present.

As noted earlier, impervious surfaces cover approximately 18% of the BK watershed. The Kickemuit River and Bristol Peninsula sub-watersheds have impervious surfaces that cover approximately 14% and 23%, respectively. In areas with increased impervious cover, water quality impairments from stormwater runoff are more likely.

4.1.1 Summary of RI Stormwater Program

In Rhode Island, the RIDEM Rhode Island Pollutant Discharge Elimination System (RIPDES) Program administers the Phase II program using a General Permit that was established in 2003. Most Rhode Island municipalities (including Bristol and Warren), the Rhode Island Department of Transportation (RIDOT), and federal, state, and quasi-state agencies serving more than 1,000 people per day (e.g. University of Rhode Island) are regulated under the Phase II program.

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 six minimum measures are listed below (USEPA, 2008).

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

The new Rhode Island Stormwater Design and Installation Standards Manual became effective January 1, 2011 and establishes low impact development (LID) as the standard for managing stormwater (see [Section 4.2](#)). All development and redevelopment projects subject to state permitting must comply with the Stormwater Manual. RI municipalities have the authority to adopt ordinances requiring any new developments to be in compliance with the RI Stormwater Design and Installation Standards Manual. The state is also in the process of developing the next round of MS4 regulations which are likely to be more stringent than the existing measures.

4.1.2 Stormwater Checklist for Rhode Island Municipalities

The stormwater programs for Bristol and Warren has been reviewed based on these six minimum measures and their compliance with TMDL implementation ([Table 4-1](#)). In summary, Bristol and Warren have completed mapping of stormwater outfalls, adopted ordinances for addressing illicit discharges and construction and post-construction runoff control, implemented annual street sweeping programs, and installed multiple BMPs not specified in existing TMDLs. Neither municipality has created a Stormwater Utility to finance stormwater management.

Table 4-1: Compliance with the Six Minimum Measures of the MS4 Program for Bristol and Warren, RI

Minimum Measure	Bristol	Warren
1. Public education/outreach program?	Yes	No
2. Public involvement/participation program?	Yes	No
3. Illicit discharge, detection and elimination program		
3a. Outfall map showing the location of all outfalls and names of receiving waters?	Yes	Yes
3b. Ordinance to prohibit and enforce illicit discharge to the MS4?	Yes	Yes
3c. Inspect catch basins and man holes at least once?	Yes	Yes
3d. Conduct a minimum of two dry weather surveys?	No	No
4. Construction site runoff control		
4a. Ordinance to reduce erosion and sediment controls, control of other wastes, and sanctions to ensure compliance?	Yes	Yes
5. Post-construction runoff control		
5a. Ordinance to address post-construction runoff from new development and re-development, and sanctions to ensure compliance?	Yes	Yes
6. Pollution prevention and good housekeeping		
6a. Annual catch basin cleaning program?	No	Yes
6b. Road sweeping program?	Yes	Yes
SWMPP amended to incorporate a TMDL implementation plan?	No ¹	Yes ¹
Has the municipality designed or constructed any of the BMPs for restoration as specified in the TMDL?	NA	NA
Has the municipality designed or constructed any stormwater BMPs (not identified in the TMDL)?	Yes	Yes
Has the municipality created a Stormwater Utility or other means to finance stormwater management?	No	No
¹ TMDL Implementation Plan addressing Mt. Hope Bay & Kickemuit River Pathogen TMDL must be submitted along with new SWMPP required by re-issued Phase II General Permit.		

4.1.3 Summary of MA Stormwater Programs

In Massachusetts, the USEPA National Pollutant Discharge Elimination System (NPDES) Program administers the Phase II Program. The Phase II Program requires Massachusetts MS4 operators to develop a Stormwater Management Program Plan (SWMPP) that is based on the same six minimum measures outlined for Rhode Island above. Massachusetts municipalities will be subject to more stringent MS4 requirements with the new draft NPDES permit requirements. These draft requirements for Massachusetts force municipalities to implement stormwater outfall monitoring programs and develop mechanisms to meet bacteria and nitrogen TMDLs.

The stormwater programs for the two municipalities in Massachusetts have been evaluated based on their compliance with NPDES standards.

4.1.4 Summary of Stormwater Programs for Rehoboth and Swansea, MA

Rehoboth, MA is an MS4 community and as such, is required to comply with the six minimum measures required by the Phase II Program. The Rehoboth Highway Department is responsible for ensuring compliance with the MS4 program. Highlights of Rehoboth's stormwater program are as follows:



Rehoboth, MA Town Hall

- Catch basin cleaning and street sweeping programs are generally completed annually though budget cuts in the last few years have led to delays in these programs;
- There has been some mapping of stormwater outfalls before the budget cuts, but focus has shifted away from that portion of the MS4 program in order to comply with other sections of the permit;
- Rehoboth has also completed some catch basin stenciling;
- Rehoboth adopted a bylaw in 2007 entitled “Governing Stormwater Discharge, Land Disturbance, & Post-Construction Stormwater Runoff” to address concerns about the health of the environment and the residents of Rehoboth. A Stormwater Management Committee was formed out of this adopted bylaw to address MS4 permit compliance for the town. The ordinance prohibits the illicit discharge of pollutants to MS4s that are connected to waterbodies.
- Rehoboth requires site plan and sub-division permits to submit an Operation and Maintenance Plan for erosion control Best Management Practices (BMPs) as part of the Standards of the Massachusetts Stormwater Management Policy.
- Rehoboth recently appointed a volunteer Stormwater Officer to help enforce the ordinances.

Swansea, MA is also an MS4 community and as such, is required to comply with the six minimum measures required by the Phase II Program. Swansea's stormwater program is headed by the Conservation Commission Agent, the Highway Engineer, and the Town Administrator. Some highlights of their stormwater program are as follows:

- Annual catch basin cleaning and inspecting and street sweeping programs are in place;
- Swansea involved a local Boy Scout troop to stencil all catch basins that discharge to salt water in an effort to raise public awareness of stormwater flows;
- Swansea has received state help in mapping and monitoring outfalls, which have been focused around the town's major shellfish beds. The town hopes to expand this mapping and monitoring project to all outfalls;
- The Board of Health also checks for pollutant loading on beaches several times over the summer swim season; and
- There is currently a stormwater by-law in process that will address any MS4 permit compliance concerns.

4.2 Low Impact Development

Low Impact Development (LID) is different from conventional stormwater treatment (pipe-to-pond management). It is a comprehensive approach to project design to minimize the hydrologic impacts of development or re-development, therefore reducing the need for stormwater treatment infrastructure. In the past, the landscape was altered to fit the style of development. In the LID process, the development is shaped to fit into the landscape. This new approach to site planning and stormwater management focuses on the preservation and use of natural systems to achieve stormwater management objectives where possible (USEPA, 2011b).



4.2.1 Summary of RI LID Programs

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 update was completed in January 2011, and focuses on using LID techniques as the primary method of stormwater control (<http://www.dem.ri.gov/pubs/regs/regs/water/swmanual.pdf>). A companion Rhode Island Low Impact Development Site Planning and Design Guidance Manual (March 2011) is also available (<http://www.dem.ri.gov/programs/bpoladm/suswshed/pdfs/lidplan.pdf>) to provide examples for local officials of how to amend their ordinances to avoid and reduce the impacts from development and encourage more effective implementation of LID practices.

4.2.2 Low Impact Development Checklist for RI Municipalities

The LID programs for Bristol and Warren have been reviewed following the objectives of the LID Site Planning and Design Guidance Manual (Table 4-2). The manual contains over 45 specific techniques that can be used by communities to avoid and reduce the stormwater impacts to water quality from development. These techniques can also preserve community character, reduce flooding, and save money. The checklist allows a community to quickly determine what specific LID site planning and design techniques they have adopted or may need to adopt to more effectively encourage LID practices for development. Communities are encouraged to adopt alternative techniques not listed below that can meet the desired objectives. Moreover, not all LID site planning and design techniques are applicable to every community.

Table 4-2: Summary of LID Programs for Bristol and Warren, RI

Low Impact Development Objectives	Bristol	Warren
GOAL: Avoid the impacts of development to natural features and pre-development hydrology.		
Objective I: <i>Protect as much undisturbed open space as possible to maintain pre-development hydrology and allow precipitation to naturally infiltrate into the ground.</i>		
1. Has Conservation Development been adopted to protect open space and pre-development hydrology?	Yes	No
2. Has a transfer of development rights ordinance been adopted to provide an incentive for landowners to preserve natural lands?	No	Yes
3. Are limits of disturbance required to be marked on all construction plans?	Yes	Yes
4. Are there limits on lawn area for residential lots to protect open space?	No	No
5. Are undisturbed vegetative areas required on new lots as visual screens?	No	No

Table 4-2: Summary of LID Programs for Bristol and Warren, RI (continued)

Low Impact Development Objectives	Bristol	Warren
Objective II: Maximize the protection of natural drainage areas, streams, surface waters, wetlands, and jurisdictional wetland buffers.		
6. Do regulations require or encourage new lots to exclude freshwater and /or coastal wetland jurisdictional areas, to the extent practicable?	Yes	No
7. Do regulations direct building envelopes away from steep slopes, riparian corridors, hydric soils, and floodplains, to the extent practicable?	Yes	Yes
8. Has a community buffer program been created to establish or restore a naturally vegetated buffer system along all surface waters and wetlands to supplement and expand upon the minimum requirements of the RIDEM and CRMC programs, where applicable?	No	No
9. Are zoning setback distances flexible in residential districts to avoid requiring house lot locations to be unnecessarily close to surface waters, wetland, and riparian corridors?	No	No
Objective III: Minimize land disturbance, including clearing and grading, and avoid areas susceptible to erosion and sediment loss.		
10. Has your community adopted an erosion and sediment control ordinance?	Yes	Yes
11. Did your community adopt a grading ordinance to require applicants to maintain as much natural vegetation as possible and limit clearing, grading, and land-disturbing activities to the minimum needed for construction maintenance and emergency services?	No	No
12. Has your community adopted a forest cover, tree protection, or tree canopy ordinance?	No	No
13. Do you require permits before removing trees on new or re-development sites?	No	No
14. Have minimum tree preservation standards been established for new development?	No	No
15. Do capital improvement plans include tree planting as part of project budgets?	Yes	No
16. Do you require that public trees removed or damaged during construction be replaced with an equivalent amount of tree diameter? (for example, if a 24-inch diameter tree is removed, it should be replaced with six four-inch diameter trees).	No	No
Objective IV: Minimize soil compaction as a result of construction activities or prior development.		
17. Have you adopted provisions within land development regulations that prohibit the compaction of soils in areas needed for stormwater recharge?	No	No
18. Have you adopted requirements for construction site inspections to ensure that soils are not compacted?	No	Yes

Table 4-2: Summary of LID Programs for Bristol and Warren, RI (continued)

Low Impact Development Objectives	Bristol	Warren
GOAL: Reduce the impacts of land alteration to decrease stormwater volume, increase groundwater recharge, and minimize pollutant loadings from a site.		
Objective V: Provide low-maintenance, native vegetation that encourages retention and minimizes the use of lawns, fertilizers, and pesticides.		
19. Have LID landscaping standards been adopted that require the preservation of as much natural vegetation as possible and encourage low-maintenance native landscaping?	No	No
Objective VI: Minimize impervious surfaces.		
20. Did your community adopt compact growth ordinances such as conservation development, planned development, or mixed use development?	Yes	Yes
21. Has your community identified growth centers where increased density is appropriate and encouraged?	Yes	Yes
22. Are residential streets required to be as narrow as possible to accommodate traffic volumes without compromising safety?		
22A. Do you require road widths of 22 feet or less for subdivisions of 40 or fewer homes or average daily trips less than 400?	No	No
22B. Do you require road widths of 26 feet or less for subdivisions of 40-200 homes or average daily trips of 400-2,000?	No	No
23. Are street right-of-way widths required to be less than 45 feet?	No	No
24. Are driveway lengths and widths required to be reduced to the extent possible with pervious surfaces and shared driveways encouraged wherever appropriate?		
24A. Do you require driveways to be nine feet or less (one lane) and 18 feet or less (two lanes)?	No	No
24B. Do you allow pervious surfaces to be used for residential driveways?	Yes	Yes
24C. Do you allow shared driveways to be used in residential developments?	Yes	Yes
25. Do you allow the flexibility with curbs in residential streets to encourage side-of-the-road drainage into vegetated open swales, where possible?	Yes	Yes
26. Where curbs are needed, do you allow opening in curbs that allow runoff to flow into swales?	Yes	Yes
27. Have flexible sidewalk design standards been adopted to limit impervious cover?		
27A. Is the minimum sidewalk width four feet or less?	No	No
27B. Do you require sidewalks on one side of the street only in low-density neighborhoods?	Yes	No

Table 4-2: Summary of LID Programs for Bristol and Warren, RI (continued)

Low Impact Development Objectives <i>Objective VI (continued)</i>	Bristol	Warren
27C. Are sidewalks required to be gently sloped so that they drain into the front yard rather than the street?	No	No
27D. Can alternative pedestrian access such as trails or unpaved footpaths be used instead of sidewalks?	No	Yes
27E. Can pervious surfaces be used for sidewalks?	No	No
28. Did your community modify the dimension, design, and surface material of cul-de-sacs to reduce total impervious cover?		
28A. Is the minimum radius allowed for cul-de-sacs less than 45 feet?	Yes	No
28B. Can a landscaped island or native vegetation be within the cul-de-sac?	Yes	Yes
28C. Are alternative turnarounds allowed such as hammerheads or tees?	Yes	Yes
29. Have both minimum and maximum parking ratios been adopted to provide adequate parking while reducing excess impervious cover?	Yes	No
30. Do you allow pervious materials to be used for parking areas and overflow parking?	Yes	Yes
31. Are parking ratios reduced if the site is served by mass transit or has good pedestrian access?	Yes	No
32. Is shared parking encouraged and implemented wherever feasible in order to reduce total impervious cover?	Yes	No
33. Do off-site parking allowances exist to accommodate re-development and mixed-use compact growth?	Yes	Yes
34. Are parking stalls and aisles reduced to the extent feasible in order to decrease total impervious cover?		
34A. Are the minimum stall dimensions nine feet wide by 18 feet long?	No	Yes
34B. Is 20% or more of the parking lot required to have smaller dimensions (8 feet by 16 feet) for compact cars?	Yes	No
35. Are parking lot landscaping requirements flexible and do they encourage LID techniques?		
35A. Do parking lots of ten or more spaces require that 10% of the parking lot area be dedicated to landscaped areas that can include LID stormwater practices?	No	No
35B. Is landscaping required within parking areas to "break up" pavement at fixed intervals?	Yes	Yes
35C. Is a 25-30% tree canopy coverage over on-site parking lots required?	No (20%)	No
36. Have impervious cover limits been adopted to reduce impervious cover on a community or partial-community-basis?	No	Yes
GOAL: Manage the impacts at the source.		
Objective VII: Infiltrate precipitation as close as possible to the point it reaches the ground using vegetated conveyance and treatment systems.		
37. Have you amended regulations to require all development projects comply with LID pursuant to the <i>Rhode Island Stormwater Design and Installation Standards Manual</i> ?	Yes	No

Table 4-2: Summary of LID Programs for Bristol and Warren, RI (continued)

Low Impact Development Objectives <i>Objective VII (continued)</i>	Bristol	Warren
38. Have you revised regulations to allow and encourage LID vegetated treatment systems such as bioretention, swales, and filter strips to promote recharge and the treatment of runoff?	Yes	No
Objective VIII: Break up or disconnect the flow of runoff over impervious surfaces.		
39. Have you amended regulations to encourage runoff to be diverted over pervious surfaces to foster infiltration, runoff reduction, and pollutant removal, where appropriate?	Yes	No
Objective IX: Provide source controls to prevent or minimize pollutants in stormwater.		
40. Do you encourage or require appropriate pet waste disposal to prevent pet waste from entering stormwater runoff?	Yes	No
41. Are commercial and industrial developments required to sweep their impervious areas on an annual basis?	No	No
42. Is street sweeping done regularly on community streets to limit pollutant transport to waterbodies and reduce maintenance of catch basins?	Yes	Yes
43. Are community road salt storage piles covered?	Yes	Yes
44. Has a community wastewater management district been adopted to encourage or require all onsite wastewater treatment systems be inspected and maintained regularly?	Yes	Yes
45. Have you adopted a stormwater utility district to manage the existing impacts of stormwater runoff?	No	No
Objective X: Re-vegetate previously cleared areas to help restore groundwater recharge and pollutant removal.		
46. Have regulations been adopted to encourage re-vegetation with native species, where possible?	No	No
BONUS		
47. Did you revise your comprehensive plan to include the three goals and then objectives described above?	No	No

4.2.3 Summary of MA LID Programs

In 1996, MADEP worked with the Massachusetts Office of Coastal Zone Management (MCZM) to develop a Stormwater Management Standards and Handbook, available at <http://www.mass.gov/dep/water/laws/policies.htm#storm>. Having recently revised the handbook to include LID, the associated policies became part of Massachusetts' Wetlands Protection Act (310 CMR 10.00) and Water Quality Certification Regulations (314 CMR 9.00) in 2008. The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) developed a Smart Growth/Smart Energy Toolkit for LID practices (http://www.mass.gov/envir/smart_growth_toolkit/pages/mod-lid.html). MCZM also created the Coastal Smart Growth Program in 2004 and has published a packet on "The Practice of Low Impact Development" (http://www.mass.gov/czm/smartgrowth/pdf/practice_of_lid.pdf).

Summary of LID Programs for Rehoboth and Swansea, MA

Rehoboth, MA

- The Conservation Agent/Town Planner is currently working to pass an Open Space by-law for subdivision development. Having recognized the impact of residential sprawl on the town's water quality and natural resources, the town wants to pass this by-law on Open Space Design (OSD) to promote both economic development and natural space preservation;
- As a long-term goal, the town will likely incorporate LID options into their subdivision zoning by-laws; and
- The Rehoboth Land Trust is very active in obtaining land within the town for preservation. For example a private landowner is subdividing his property for 40B development for residents 55 years old or more. Twenty-five percent of the subdivision will be low-income housing for the elderly. The landowner is also teaming up with the University of New Hampshire to develop a stormwater design that includes LID practices.

Swansea, MA

- The Swansea Planning Board is considering changes to its rules and regulations for small subdivisions to include LID techniques, but only as an encouragement to developers;
- The town has a third-party consultant review all stormwater site plans for new development. The Planning Board and Conservation Commission work together to ensure that developers know all the necessary rules and regulations. A recent CVS development included a bioretention rain garden, which met stormwater control regulations set by the town;
- Swansea has a Community Preservation Committee that has identified all open spaces. The committee has secured an agreement to put at least one of the larger open space areas into a conservation trust (see Swansea Warren Country Club and Kee Farm); and
- The town is looking to include Open Space Design in future zoning bylaw amendments put toward the Planning Board.

4.3 Onsite Wastewater Treatment Systems

A properly designed and operating onsite wastewater treatment system (OWTS) prevents pollutants, such as bacteria, from impacting the surrounding surface and groundwaters. These pollutants can be reduced through proper OWTS maintenance and the repair or replacement of failed and/or substandard systems.

As noted previously, developed areas, including residential neighborhoods, cover approximately 43% of the BK watershed. In the Rhode Island portion of the watershed, developed areas cover 47% of the total land area. Though most of these developed areas are serviced by a municipal sanitary sewer system, many residents in the watershed rely on OWTS.

4.3.1 Summary of RI Onsite Wastewater Treatment Systems (OWTS) Programs

In Rhode Island, all OWTS must follow the *Rules Establishing Minimum Standards Relating to the Location, Design, Construction, and Maintenance of OWTS*, July 2012 (<http://www.dem.ri.gov/pubs/regs/regs/water/owts12.pdf>). In addition to administering these Rules, Rhode Island has established the programs below to limit the impacts of pollutants from OWTS to nearby waterbodies and assist municipalities with the repair and replacement of malfunctioning OWTS.

Onsite Wastewater Management Plan (OWMP) - The required elements of a municipal OWMP necessary to be approved by RIDEM are provided below. RIDEM approval enables a municipality to qualify for the State's Community Septic System Loan Program (CSSLP).

- Summarizes the status of OWTS in a town;
- Identifies areas or resources of particular concern and outlines goals for a wastewater management program;
- Provides a complete summary of issues related to wastewater such as development, land use, population pressures, and natural resources; and
- Outlines a strategy to complete the goals of a wastewater management program including public outreach and education, an inspection and maintenance program, and zoning.

Community Septic System Loan Program (CSSLP)

- CSSLP is a program that provides low-interest loans to municipalities so that they may issue low interest loans to homeowners to repair or replace failed, failing, or substandard OWTSs
- Loans to homeowners are offered at 2% interest rate with a 10-year term.
- RIDEM approval of an onsite wastewater management plan is necessary before a community can be eligible for CSSLP funds.

Cesspool Replacement

- Failed cesspools anywhere in RI are required to be replaced under OWTS rules.
- 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 the inland edge of a coastal shoreline feature bordering a tidal area, within 200 feet of all public wells, and within 200 feet of a waterbody with an intake for a drinking water supply by January 1, 2014.

Watershed Case Study: Warren's Septic System Pump-Out Program

Currently, all Warren, RI residents pay a sanitation tax (approximately 6% of the owner's property tax bill), part of which goes to maintaining the sewer system. In an effort to repay residents not connected to sewer, Warren offers free pump-outs (up to twice per year) to residents with onsite wastewater treatment systems. Roughly 25% of the total 5,600 parcels in Warren have septic systems. Many residents take advantage of the program, and the town is working to identify all sewer and septic parcels.



Regular pumping of your septic system is necessary to prevent malfunction

The pump-out program will change as the town adopts a new Onsite Wastewater Management District (OWMD) that will be headed by an OWMD Manager. The OWMD Manager will inspect all onsite wastewater treatment systems before pump-out to ensure pump-out is necessary. This will ultimately increase efficiency. Warren is now eligible to receive funds under the CSSLP to provide financial assistance to residents who repair their systems.

4.3.2 Onsite Wastewater Treatment Systems Checklist for Rhode Island Municipalities

Owners of OWTSs are responsible for maintaining their systems, and each municipality has the opportunity to establish a management program to support property owners in these efforts. Each municipality's OWTS Program has been evaluated based on criteria established by RIDEM, which represents the preferred management scenario (Table 4-3). It should be noted that none of the elements below are required by state or federal rule or law. Municipalities can develop OWTS Programs to improve proper operation and maintenance and provide funding assistance. As shown in Figure 3-1, most of the BK watershed in Rhode Island is serviced by a municipal sanitary sewer system. However, both Bristol and Warren have active OWTS programs. For instance, they have approved onsite wastewater management plans which makes them eligible for the Community Septic System Loan Program, and they have also adopted an Onsite Wastewater Management ordinance. Neither municipality has a computer-based system to track OWTS or a staff person responsible for enforcement and management of the Onsite Wastewater Management Program.

Table 4-3: Summary of Onsite Wastewater Programs for Warren and Bristol, RI

OWTS Documentation/Regulation	Bristol	Warren
Does the town have an approved Onsite Wastewater Management Plan?	Yes	Yes
Does the town participate in the Community Septic System Loan Program?	Yes	Pending
Has the town adopted an Onsite Wastewater Management ordinance?	Yes	Yes
Does the Onsite Wastewater Management Plan have mandatory inspections?	No	Yes
If so, has the town taken enforcement actions in cases of non compliance?	NA	NA
Does the town have a web-based tracking system? (e.g. RI Wastewater Information System?)	No	Pending
Does the town have a website for information and education of OWTS issues?	Yes	Yes
Does the town have a staff person whose primary responsibility is management of the OWMP?	No	Pending
Does the town have a cesspool phase out program?	No	No
If so, has the town taken enforcement actions in cases of non compliance?	NA	NA
Has the town adopted an ordinance for more stringent OWTS standards than the RIDEM rules?	No	Pending

4.3.3 Summary of MA Onsite Wastewater Treatment System Programs

Title V of the State Environmental Code (<http://www.mass.gov/dep/service/regulations/310cmr15.pdf>) is MADEP's regulations for the siting, construction, upgrade, and expansion of onsite sewage treatment and disposal systems. MA Title V also requires inspections of all systems at the time of property transfer. Failing systems identified at this time, must be replaced. Massachusetts has established programs to limit the contribution of OWTS to water quality impairments in nearby waterbodies and assist municipalities with the repair and replacement of malfunctioning OWTS by means of:

Community Septic Management Program (CSMP)

- Provides funding of up to \$200,000 in the form of low cost loans to allow communities to devise a Community Inspection Plan or a Local Septic Management Plan. MADEP funds these loans through the Massachusetts Water Pollution Abatement Trust.
- Using the State Revolving Fund loans from the Trust, communities can provide betterment loans to assist homeowners who must address onsite wastewater treatment system failures.

Community Inspection Plan or a Local Septic Management Plan

- The Community Inspection Plan is a plan to protect environmentally sensitive areas from contamination from onsite wastewater treatment systems. Inspections must be performed every seven years.
- The Community Inspection Plan requires onsite wastewater treatment system inspections every seven years and eliminates the Title V requirement for mandatory inspection after any property use changes or transfers.
- The Local Septic Management Plan identifies, monitors, and addresses proper operation, maintenance, and upgrade of onsite wastewater treatment systems in a comprehensive manner.
- The Local Septic Management Plan has voluntary system inspections; therefore Title V inspections are still required.
- Over 4,000 onsite wastewater treatment systems have been upgraded through the use of \$22 million in CSMP loans in the last 15 years.

In order to account for the differences in state government programs, a different set of questions was developed for these MA towns (Table 4-4).

Table 4-4: Summary of Onsite Wastewater Programs for Rehoboth and Swansea, MA

OWTS Documentation/Regulation	Rehoboth	Swansea
Does the municipality have an approved Community Inspection Plan or a Local Septic Management Plan?	No	No
Does the municipality participate in the Community Septic Management Program?	No	No
Has the municipality adopted a septic management ordinance other than what is mandated through Title V?	Yes	No
If so, has the municipality adopted standards more stringent than MADEP?	Yes	No
If the municipality has a Community Inspection Plan, has the town taken enforcement actions in cases of non-compliance?	NA	NA
Does the municipality have a tracking system for their OWTS?	No	Yes
Does the municipality have a website for information and education of onsite wastewater issues?	No	No
Does the municipality have a staff person whose primary responsibility is management of the CSMP?	No	No

4.4 Other Issues

4.4.1 Agriculture

Properly managing agricultural runoff is important to the water quality in the watershed. As shown in **Section 3**, land use within the watershed is approximately 11 percent agricultural (See **Appendix A** for a detailed map of agricultural lands in the watershed.). Agricultural land use has a long history in the watershed and includes dairy farming, raising livestock and poultry, growing crops, and keeping horses and other animals for pleasure or profit. Activities and facilities associated with agriculture can be a source of pollution to nearby waterbodies through the direct deposition of fecal matter from farm animals standing or swimming in surface waters and the runoff of farm animal waste and fertilizer and pesticides from land surfaces. Properly managing manure and other farm wastes through BMPs including the maintenance of a vegetated buffer near surface waters will reduce the impacts of agricultural land use while protecting water quality.

The focus in this section has been on the role of the municipalities, but in regards to controlling pollution from agricultural lands, municipalities have a very limited role. Farmers are encouraged to contact the local US Department of Agriculture Natural Resources Conservation Service office and the Conservation Districts for assistance in preparing farm management plans and for information on grants for installing best management practices to control water pollution.

4.4.2 Land Conservation and Preservation

Protecting open space through land conservation practices is important to the water quality in a watershed. Natural landscapes remove pollutants through processes such as infiltration of stormwater into the soil and plant uptake of water and nutrients. Protecting areas along the shoreline of a waterbody is particularly important as natural riparian buffers will reduce the amount of pollutants that enter the waterbody.

In Massachusetts and Rhode Island, natural landscapes are protected through municipal conservation efforts and land trusts, and as State Parks and privately-owned land. A helpful resource to assist municipalities and local citizens with land protection is the Rhode Island Conservation Easement Guidance Manual (http://www.nbwctp.org/programs/easements_openspace.html). This manual provides information on how conservation easements are drafted, reviewed, put into action, and effectively enforced, and also goes into detail on how to manage, monitor, and steward such parcels. Lands that are currently protected through some of these efforts in the BK watershed are shown in **Figure 4-1**.

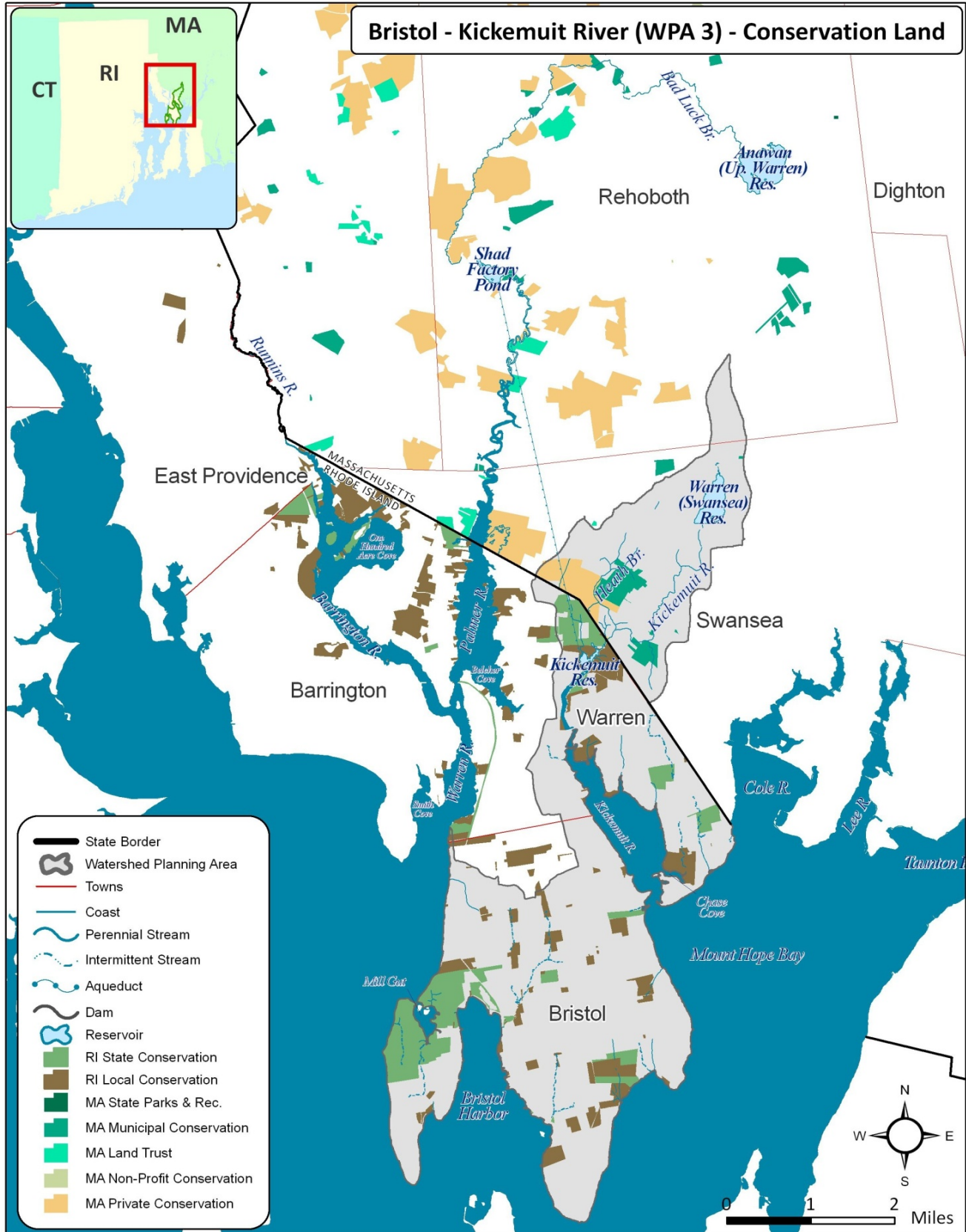
Watershed Case Study: Kee Farm Conservation Easement in Warren

Supported by state and federal officials, the Town of Warren recently purchased the development rights to a portion of Kee Farm for \$1 million. The conservation easement is a 60-acre forested area along Long Lane that overlooks the Kickemuit River. The acquisition was a joint collaboration between the Town of Warren (\$140,000), the US Department of Agriculture (\$472,500), RI Department of Environmental Management (\$250,000), and the Massachusetts Agricultural Commission (\$137,500). The dairy farm has been in the Kee family for more than a century, and is currently owned and actively farmed by Margaret Kee and her son, Byron Kee. This 60-acre open land purchase will add to the 70 acres of land on Kee Farm already protected from development.



Aerial View of Kee Farm, Warren, RI

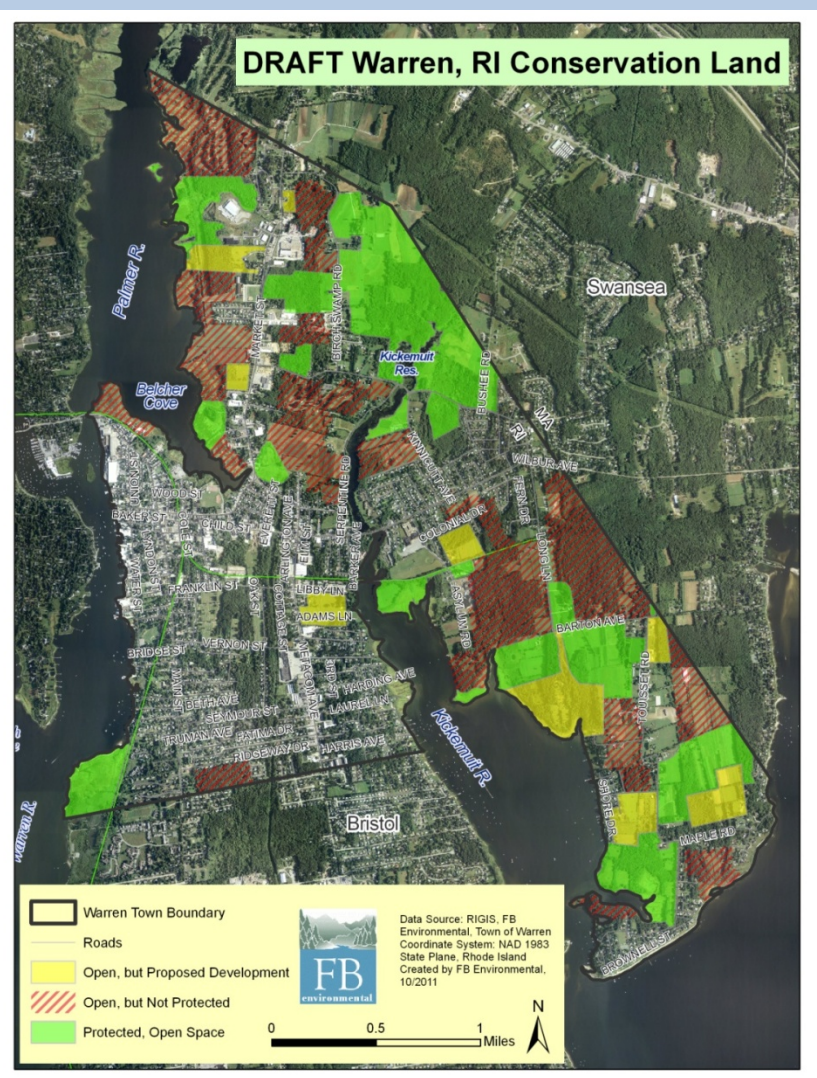
Figure 4-1: Open Space and Protected Lands in the BK Watershed



Watershed Case Study: Open Space Mapping in Warren

Characterizing a town’s open space can provide valuable information as to current and projected development priorities. The Town of Warren recognizes open space mapping as a chance to obtain a holistic perspective of its dynamic landscape. Davison Bolster, a Warren Town Council member, and Caroline Wells, the Warren Town Planner, are working together to generate a detailed GIS file of all open space in Warren from hand-annotated tax parcel maps.

Davison Bolster helped delineate the map shown to the right as a general idea of what is to come from this effort. Once completed, the map will be used for several purposes, including determining the size and remaining integrity of Warren’s “Green Belt.”



Maintaining connective corridors between protected spaces is highly valuable and will help make the case for further open space protection in Warren.

5. Actions to Restore and Protect Water Quality

This Action Plan for restoring and protecting water quality was developed to include specific actions recommended in other plans and TMDLs and from feedback received at municipal meetings held in each municipality. The Action Plan identifies specific tasks to address water pollution issues in the three management categories indentified in Section 4 (stormwater, low impact development as it relates to stormwater and onsite wastewater treatment systems). The Plan outlines responsible parties, approximate costs, estimates of value to the watershed, and an implementation schedule for each task. Action items for other sources of pollution are also identified.

5.1 Watershed-Wide Actions

There are several opportunities for cities, towns, utilities, and other organizations to work together to achieve water quality goals. Advantages to working together include cost and labor savings and access to greater expertise. In addition, a wider geographic scope means a larger pool of potential project ideas, resulting in a better ability to prioritize tasks on a region wide-basis.

5.1.1 Create a Watershed-Wide Organization

While not absolutely necessary, it is highly recommended that a formal organization be created to implement this plan and to advocate for watershed action into the future. A dedicated, stakeholder-led group provides an valuable forum for building consensus among the many public and private stakeholders in the watershed. A clear consensus among all major participants is critical if watershed-level goals are to be attained across the multiple jurisdictions and communities within the watershed. If such a multi-jurisdictional effort cannot be developed or maintained, an alternative is to establish a municipal committee (or designate an existing committee) to implement the Plan and coordinate activities within the municipality. Successful plan implementation will depend on strong leadership. Relevant stakeholders include:

- Residents
- Businesses
- Nonprofit groups
- Municipal officials
- State agencies
- Federal agencies
- Scientists
- Non-residents and concerned citizens

A joint powers agreement is recommended to facilitate coordination among the many levels of government that are involved in watershed planning. These agreements are usually brief (a few pages), non-binding documents aimed at building consensus on issues that span more than one political jurisdiction. They typically contain:

- A list of parties and agencies formally in the plan;
- A vision statement for the partnership;
- Watershed issues to be addressed under the agreement;
- Commitment to provide assistance and coordinate planning efforts through a central management structure;
- Agreement to use the watershed plan to guide land use or water management decisions by each partner;
- Details on funding sources, length of the agreement, and how new partners may be added; and
- Signatures of all the parties involved.

The Long Creek Restoration Project in Portland, Maine (predecessor to the Long Creek Watershed Management District) offers a good example of an initial interim organizational structure. It consisted of a steering committee, specialized subcommittees, and a larger watershed committee composed of business, nonprofit, government, and other stakeholders. The steering committee informs and listens to all stakeholders, oversees the subcommittees, articulates the mission and goals of the effort, and ultimately shapes a specific plan and timeline. A technical subcommittee provides expertise in watershed science and reviews the technical merit of specific proposals. A governance subcommittee develops administrative and funding mechanisms to implement the plan equitably and reliably. An outreach subcommittee conducts ongoing public education, organizes tours, and stimulates engagement with the community. More information is available online at <http://restorelongcreek.org/>.

The National Estuary Program (NEP) offers another good organizational framework which works across political boundaries to address watershed-scale efforts. The Narragansett Bay Estuary Program (NBEP) is already working across state boundaries to protect water quality, and is developing a Narragansett Bay regional plan. More information about NBEP is available at <http://nbep.org/>.

The Piscataqua Region Estuaries Partnership (PREP) is an example of a bi-state National Estuary Program (New Hampshire and Maine) working toward implementing a detailed watershed-level plan with specific implementation goals. More information is available online at <http://www.prep.unh.edu/>.

5.1.2 Form a Stormwater Utility for the BK Watershed

A stormwater utility is a public utility established to provide stormwater management services. It is to stormwater what a sewer utility is to sewage, and a water utility is to drinking water. Stormwater utilities generate revenue through user fees that are based upon the amount of stormwater generated on a property.

An important distinction between stormwater utility fees and real estate taxes is that they are user-based and are tied to stormwater management services provided by the utility, whereas taxes are not tied to specific services. Stormwater utilities provide a dedicated, stable and predictable source of revenue to finance local stormwater management services. More specifically, this stable funding source can be used to ensure ongoing maintenance of stormwater infrastructure, conduct long-term strategic planning, incentivize water quality protection among landowners, and facilitate MS4 permit compliance.

This is appropriate since large rooftops and large parking lots generate high demands on city services in terms of the volume of stormwater that flows to municipal drainage systems, and catch basin cleaning and maintenance. Another key benefit of a stormwater utility is that it can assume responsibility for maintaining drainage infrastructure on private lands via easements. This prevents the scenario in which treatment structures (e.g., detention basins) are installed as a condition to planning board approval, but then are gradually forgotten, deteriorate, and cease to function as the development ages. Finally, a stormwater utility can respond to permit requirements and evolving regulations more efficiently and with greater expertise than individual land owners acting alone. The Long Creek Watershed Management District in the greater Portland, Maine, area is one example of an inter-municipal stormwater utility with the above advantages (<http://restorelongcreek.org>).

In Rhode Island, the Rhode Island Stormwater Management and Utility District Act of 2002 authorizes municipalities to create stormwater management districts, and empowers them to charge fees, provided 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. Today, there are over 2,000 stormwater utilities nationwide that either partially or completely fund municipal stormwater services. While stormwater utilities have been most commonly implemented to date in the Pacific Northwest and the Southeast, they are located in all regions of the country with about a half dozen utilities in New England. Stormwater utilities have focused on a variety of needs, including flood management, erosion control, stormwater treatment for water quantity and quality, and infrastructure maintenance.

Recently, the Rhode Island Department of Environmental Management has been working with the Towns of Westerly and Middletown to assess whether establishing a stormwater utility as a funding source might be a practical solution for these towns. With input from town professional staff, the Department has completed stormwater utility district feasibility studies for each town, both of which are available on the RIDEM website.

Many resources are available to assist communities in developing a stormwater utility:

- ***USEPA Funding Stormwater Programs Fact Sheet***

This document includes information on various stormwater funding mechanisms and types of stormwater utilities. It also describes how to create a stormwater utility and provides a list of resources.

Online at: <http://www.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf>

- ***New Hampshire Department of Environmental Services Stormwater Utilities Webpage***

This webpage provides information about creating stormwater utilities, provides examples, and a list of resources.

Online at: <http://des.nh.gov/organization/divisions/water/stormwater/utilities.htm>

- ***Florida Stormwater Association Manual for Establishing a Stormwater Utility***

This manual was prepared to assist communities that are considering the development and implementation of a stormwater utility. It is written for citizens, elected officials, and city or county administrators and staff who want to understand the issues, benefits, and community investment associated with stormwater utilities.

Online at: <http://www.florida-stormwater.org/content.asp?pl=8&contentid=33>

5.1.3 Form an Onsite Wastewater Management District for the BK Watershed

Similar to a stormwater utility, an onsite wastewater management district is a good candidate for inter-municipal cooperation. As noted in Section 5.2.1, both Bristol and Warren have onsite wastewater management plans. Opportunities exist to coordinate implementation efforts in order to reduce costs in such areas system pumping, inspections, tracking, and financing repairs.

5.1.4 Conduct Water Quality Monitoring

Water quality monitoring represents another good opportunity for coordinated efforts. Monitoring requires specialized equipment and expertise, much of which already exists at various government, educational, and non-profit organizations. An inter-municipal monitoring effort can likely provide a better sense of priority areas on a region-wide basis. See the “Indicators of Progress” section for more detail.

5.2 Municipal Actions

As discussed in Section 4, the municipalities within the BK watershed have already taken significant action to protect their water resources. However, additional actions are necessary to achieve long-term water quality goals, particularly through the improvement of stormwater management and onsite wastewater management and through the improvement of development practices. These actions are outlined in the tables below.

5.2.1 Improving Stormwater Management at the Municipal Level

Structural Best Management Practices (BMPs) are engineered, constructed systems designed to provide water quality and/or water quantity benefits. They function by reducing or disconnecting these impervious surfaces from collection systems leading to ponds or streams, or otherwise mimicking natural hydrology to minimize the adverse impacts to receiving waters. Examples of structural BMPs include porous pavement, created wetland, vegetated soil filters (bioretention), and infiltration systems.

Non-structural BMPs include land use planning techniques, maintenance practices, changing public behavior, and public education are generally less costly than structural BMPs. Examples of non-structural approaches include conservatoin development, regularly scheduled street sweeping to reduce sediment

loads, and education programs focused on avoiding dumping waste into storm drains. In practice, both structural and non-structural approaches work well together. For example, an effective maintenance program will extend the life of structural BMPs and help avert expensive repairs. The tasks listed in Tables 5-1 provide a starting point for improving stormwater management in the BK watershed and include a mix of structural and non-structural BMPs.

Table 5-1: Action Items for Improving Stormwater Management

Bristol, RI					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Comply with Phase II Stormwater Management requirements.	Kickemuit Fecal Coliform & Phosphorus TMDL 2006	Town of Bristol, RIDOT	Ongoing	***	\$\$\$
Educate community on benefits of a stormwater utility.	Draft Plan Public Meeting, May 2012	Town of Bristol	2-5 years	***	\$
Form a stormwater utility.	Draft Plan Public Meeting, May 2012	Town of Bristol	2-5 years	***	\$\$\$
Update Stormwater Management Program Plan to address the TMDL Phase II provisions.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Bristol, RIDOT	1-2 years	***	\$
Improve public education /outreach about stormwater and the pollutants of concern.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Bristol, RIDOT	1-2 years	***	\$
Prioritize IDDE work within the catchments associated with priority outfalls and streams.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Bristol, RIDOT	1-2 years	***	\$
Revise the post construction ordinance to ensure that 1) new land development employs controls to prevent any net increase in bacterial pollution and 2) redevelopment employs controls to reduce bacterial pollution to the maximum extent practicable.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Bristol	1-2 years	***	\$
Construct BMPs for priority outfalls.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010; Draft Plan Public Meeting, May 2012	Town of Bristol	5-10 years	***	\$\$\$
Implement restoration efforts on wetlands around Silver Creek.	Draft Plan Public Meeting, May 2012	Town of Bristol	2-5 years	***	\$\$\$

Table 5-1: Action Items for Improving Stormwater Management (continued)

Bristol, RI (continued)					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Complete catchment area analysis and design work for TMDL identified priority outfalls and streams.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Bristol	5-10 years	**	\$\$\$
Install retrofits at end of dead end roads where stormwater empties into a waterbody.	Draft Plan Public Meeting, May 2012	Town of Bristol, Save the Bay	5-10 years	**	\$\$\$
Implement BMPs and LID at Mt. Hope High School.	Draft Plan Public Meeting, May 2012	Town of Bristol	2-5 years	**	\$\$\$
Develop a comprehensive inventory of storm drains discharging directly to the river and major tributaries of the Kickemuit River.	Mt Hope Bay & Kickemuit Estuary Pathogen TMDL, 2010	Town of Bristol	2-5 years	**	\$\$
Increase enforcement and requirements for BMP maintenance at developments with large stormwater BMPs.	Draft Plan Public Meeting, May 2012	Town of Bristol	Ongoing	**	\$\$
As wastewater system upgrades are completed, test priority outfalls for coliphage and bacteria to assess progress.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Bristol	Ongoing	**	\$
Restore portions of the Bristol Golf Course to a wetland.	Draft Plan Public Meeting, May 2012	Town of Bristol	2-5 years	**	\$\$
Conduct feasibility study for stormwater infiltration BMPs in priority areas.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Bristol	1-2 years	**	\$\$
Conduct a minimum of two dry weather surveys.	--	Town of Bristol	Ongoing	**	\$
Conduct annual cleaning of all catch basins in the town.	--	Town of Bristol	Ongoing	**	\$\$
Monitor discharges from the water/sewer pipe underdrain system for bacteria to prioritize inflow and infiltration reduction work.	--	Town of Bristol	Ongoing	*	\$

Table 5-1: Action Items for Improving Stormwater Management (continued)

Warren, RI					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Comply with Phase II Stormwater Management requirements.	Kickemuit Fecal Coliform & Phosphorus TMDL 2006	Town of Warren, RIDOT	Ongoing	***	\$\$\$
Educate community on benefits of a stormwater utility.	Draft Plan Public Meeting, May 2012	Town of Warren	2-5 years	***	\$
Form a stormwater utility.	Draft Plan Public Meeting, May 2012	Town of Warren	2-5 years	***	\$\$\$
Update Stormwater Management Program Plan to address the TMDL Phase II provisions.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Warren, RIDOT	1-2 years	***	\$
Improve public education /outreach about stormwater and the pollutants of concern.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Warren, RIDOT	1-2 years	***	\$
Prioritize IDDE work within the catchments associated with priority outfalls and streams.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Warren, RIDOT	1-2 years	***	\$
Revise the post construction ordinance to ensure that 1) new land development employs controls to prevent any net increase in bacterial pollution and 2) redevelopment employs controls to reduce bacterial pollution to the maximum extent practicable.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Warren	1-2 years	***	\$
Construct BMPs for priority outfalls.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010; Draft Plan Public Meeting, May 2012	Town of Warren	5-10 years	***	\$\$\$
Construct Stormwater BMPs along Serpentine Road.	Kickemuit Fecal Coliform & Phosphorus TMDL 2006	Town of Warren	5-10 years	***	\$\$\$
Complete catchment area analysis and design work for TMDL identified priority outfalls and streams.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Warren	5-10 years	**	\$\$\$
Install retrofits at end of dead end roads where stormwater empties into a waterbody.	Draft Plan Public Meeting, May 2012	Town of Warren, Save the Bay	5-10 years	**	\$\$\$

Table 5-1: Action Items for Improving Stormwater Management (continued)

Warren, RI (cont'd)					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Develop a comprehensive inventory of storm drains discharging directly to the river and major tributaries of the Kickemuit River.	Mt Hope Bay & Kickemuit Estuary Pathogen TMDL, 2010	Town of Warren	2-5 years	**	\$\$
Increase enforcement and requirements for BMP maintenance at developments with large stormwater BMPs.	Draft Plan Public Meeting, May 2012	Town of Warren	Ongoing	**	\$\$
As wastewater system upgrades are completed, test priority outfalls for coliphage and bacteria to assess progress.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Warren	Ongoing	**	\$
Conduct feasibility study for stormwater infiltration BMPs in priority areas.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Warren	1-2 years	**	\$\$
Conduct a minimum of two dry weather surveys.	--	Town of Warren	Ongoing	**	\$
Establish a maximum number of parking spaces in municipal ordinances.	Draft Plan Public Meeting, May 2012	Town of Warren	2-5 years	**	\$
Monitor discharges from the water/sewer pipe underdrain system for bacteria to prioritize inflow and infiltration reduction work.	--	Town of Warren	Ongoing	*	\$
Massachusetts					
Educate communities on benefits of a stormwater utility.	--	Towns of Rehoboth and Swansea	2-5 years	***	\$
Increase enforcement and requirements for BMP maintenance at developments with large stormwater BMPs.	--	Towns of Rehoboth and Swansea	Ongoing	**	\$\$
Establish a maximum number of parking spaces in municipal ordinances.	--	Towns of Rehoboth and Swansea	2-5 years	*	\$
<p>*** Provides maximum progress towards improving water quality, due to strategic value, large geographic scope, or scale of pollutant source being addressed.</p> <p>** Provides broad opportunity to improve water quality.</p> <p>* Provides localized improvement to water quality, or addresses smaller pollutant sources.</p> <p>\$\$\$ Expected to cost over \$100,000</p> <p>\$\$ Expected to cost approximately \$25,000 to \$100,000</p> <p>\$ Expected to cost less than \$25,000</p> <p>¹ Depending on RIDEM reissuance of the revised Phase II General Permit for MS4s.</p>					

Case Study: Bristol Town Beach Stormwater Control Project

Project Summary: A multi-phased project at the Bristol Town Beach has been implemented to treat stormwater runoff and improve water quality. The early phases of the project are complete, and have shown notable success in detaining and treating runoff, reducing standing water and numbers of geese on the lawn between the beach and parking lot, and decreased bacteria concentrations in the water by 80%. A final phase of this work is underway.

Collaborating Partners: Bristol’s Parks and Recreation Department, RI Department of Health (HEALTH), RI Department of Environmental Management (RIDEM), RI Coastal Resources Management Council (CRMC), and Save the Bay.

Funding Sources: USEPA Supplement Environment (SEP), RIDEM Clean Water Act Section 319 Nonpoint Source Grant (319), State Revolving Fund (SRF)

Project Details:

In 2008, the parking lot at the Bristol Town Beach was re-designed using a \$70,000 SEP grant. The following actions were taken:

- Installation of a drainage and piping system to control stormwater runoff;
- Installation of hoods and bacteria filters in catch basins;
- Installation of a Vortechs stormwater treatment system to capture fine-particle pollutants; and
- Installation of a vegetated swale at the outfall of the drainage system.
- Redesign of the parking lot to include bioretention areas between the parking lanes.
- In 2010, RIDEM and CRMC permits for “Bristol Town Beach Stormwater Pipe Retrofit Design and Permitting Project” were approved, and the project was funded in part by a \$36,620 Section 319 grant. The Town of Bristol also took out a \$1,000,000 SRF loan for bio-retention cells and vegetation buffers. The following actions were taken:
 - Organization of a drainage system and watershed study to assess the source of water to two existing storm drain outfall pipes north of the Town Beach;



Vegetative buffer between parking lot and beach at Bristol Town Beach

***Watershed Case Study: Bristol Town Beach Stormwater Control Project
(continued)***

- Installation of bio-retention inlets for stormwater runoff treatment from the parking lot;
- Re-grading of the town beach field by 3½ ft; addition of vegetative buffers (over one hundred trees planted to deter geese); and
- Creation of a long-term Master Plan to address all Beach and Sport Complex renovations and environmental issues.



Bio-retention system for stormwater runoff from the parking lot at Bristol Town Beach

The final stages of the project include:

- Installation of a gravel wet vegetated treatment system funded by a second Section 319 grant for \$195,000 awarded to Bristol in 2010-11. This system will collect and treat stormwater discharge from a drain pipe leading from Fales Road that was designed with the earlier Section 319 grant. An additional \$100,000 Trails Grant provided funding to:
 - Install nine memorial benches;
 - Plant an endangered coastal plant, “black grass,” with the help of Save the Bay and local school children; and
 - Installed educational kiosks on the importance of water quality.



Vegetative infiltration basin at Bristol Town Beach

This project detains and treats stormwater runoff from the parking lot and neighborhood to the north of the beach, has reduced the number of Canadian geese using the area near the beach, reduced the amount of standing water on the re-graded lawn between the beach and parking lot, and has decreased bacteria concentrations in the water by 80% since the bio-retention and plantings went in last year. This project was a topic of the keynote address at the USEPA’s 2010 National Conference in Kennebunkport, ME.

Bristol’s Parks and Recreation Department, in conjunction with the RI Department of Health, continues to monitor water quality at Bristol Town Beach (north and south side) by conducting enterococci bacteria testing twice a week during the primary swim season from Memorial Day to Labor Day. There was only one beach closing in 2011 as compared to three or four closings per year in previous years. Historical water quality results for Bristol Town Beach are posted on the Department of Health website: <http://www.ribeaches.org/beach.cfm?beachID=RI627966>.

5.2.2 Improving Development Practices at the Municipal Level

The tasks listed in Table 5-2 provide a starting point for improving development practices in the BK watershed through low impact development and other conservation practices.

Table 5-2: Action Items for Improved Low Impact Development

Bristol, RI					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Identify and adopt ordinances necessary to advance LID.	--	Town of Bristol	2-5 years	***	\$
As it becomes available, use the Bristol Harbor Habitat Model and associated regional expertise when evaluating land use management options.	--	Town of Bristol, Bristol Harbor Commission, Save Bristol Harbor, Mt. Hope High School, Brown Univ., RI RIDEM, USEPA	Ongoing	***	\$
Consider zoning and/or purchase options to restore wetlands and their natural flood mitigation and water quality improvement functions to the landscape.	--	Town of Bristol, Bristol Harbor Commission, Save Bristol Harbor	5-10 years	***	\$\$\$
Continue developing GIS data and capacity within town to enhance education and strategic planning regarding land use.	--	Town of Bristol	Ongoing	**	\$
Form a volunteer citizen committee to review and propose updates to comprehensive plan and town ordinances, in order to overcome budget limitations in this area.	--	Town of Bristol	1-2 years	**	\$
Warren, RI					
Identify and adopt ordinances necessary to advance LID.	--	Town of Warren	2-5 years	***	\$
Adopt ordinances requiring stormwater volume reductions for commercial and industrial redevelopment.	Kickemuit Fecal Coliform & Phosphorus TMDL, 2006	Town of Warren	1-2 years	***	\$

Table 5-2: Action Items for Improved Low Impact Development (continued)

Warren, RI (continued)					
Action Item		Responsibility	Timeframe	Value Added	Cost
Develop a conservation development ordinance, especially for the eastern half of town.	--	Town of Warren	2-5 years	**	\$
Continue developing GIS data and capacity within town to enhance education and strategic planning regarding land use.	--	Town of Warren	Ongoing	**	\$
Form a volunteer citizen committee to review and propose updates to comprehensive plan and town ordinances, in order to overcome budget limitations.	--	Town of Warren	1-2 years	**	\$
Massachusetts					
<i>None Identified – Needs Further Analysis</i>	--	--	--	--	--
<p>*** Provides maximum progress towards improving water quality, due to strategic value, large geographic scope, or scale of pollutant source being addressed.</p> <p>** Provides broad opportunity to improve water quality.</p> <p>* Provides localized improvement to water quality, or addresses smaller pollutant sources.</p> <p>\$\$\$ Expected to cost over \$100,000</p> <p>\$\$ Expected to cost approximately \$25,000 to \$100,000</p> <p>\$ Expected to cost less than \$25,000</p>					

5.2.3 Improving Onsite Wastewater Management at the Municipal Level

As noted previously, a properly designed and operating onsite wastewater treatment system prevents bacteria from impairing the surrounding surface and groundwaters. However, inadequately treated wastewater from substandard or malfunctioning OWTS causes nearby water quality to suffer. The tasks listed in Table 5-3 provide a starting point for improving onsite wastewater management in the BK watershed.

Case Study: Shellfish Beds Re-Open in Swansea, MA

While not in the BK watershed, the shellfish beds in Swansea, MA, have had a history of closures. Prior to 2009, shellfish beds along the Coles and Lee Rivers had been closed for over 25 years. Pollution from onsite wastewater treatment systems and stormwater runoff were major contributors. In the last five years, the Towns of Swansea and Fall River have worked to protect its most valued natural resources: soft shell clams, quahogs and oysters.

A recent study on stormwater runoff linked water quality contamination to failing sewer lines, storm drains and onsite wastewater treatment systems. Other major sources of stormwater runoff were also identified.

Work has been initiated to remedy these and other pollution issues through the following actions:

1. Swansea developed a Comprehensive Wastewater Management Plan to identify failing septic systems.
2. Fall River has a combined sewer overflow control strategy, which includes tunnel storage.
3. Swansea instituted a more rigorous and regulated catch basin cleaning schedule.
4. Swansea passed ordinances for stricter enforcement of BMPs for stormwater.

After an in-depth study of the area's water quality, the MA Department of Marine Fisheries approved a conditional reopening of the Coles and Lee Rivers' shellfish beds in July 2009. In 2011, the 746 acres of shellfish beds in Swansea and Somerset have passed the two year conditional phase and have expanded for recreational and commercial harvesting. The season extends from May 1 to December 1 with closings occurring where 24-hour rainfall exceeds 0.3 inches. Since the reopening, Swansea has sold more than 550 commercial and recreational shellfishing licenses. In 2009 alone, 60 bushels of soft shell clams and 175 bushels of quahogs were harvested for recreational purposes while 500 bushels of chowder quahogs and 250 bushels of littleneck quahogs were harvested for commercial purposes.



Quahog harvest in Fall River after a conditional reopening of Coles River shellfishing beds

Table 5-3: Action Plan for Improving Onsite Wastewater Management

Bristol, RI					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Implement onsite wastewater management plan.	--	Town of Bristol	Ongoing	***	\$\$
Inspect existing OWTS and prioritize systems for replacement.	Draft Plan Public Meeting, May 2012	Town of Bristol	2-5 years	***	\$
Increase education and outreach through local programs about water quality issues from wastewater.	Draft Plan Public Meeting, May 2012	Town of Bristol	Ongoing	**	\$
Develop a web-based tracking system for all OWTS in town.	--	Town of Bristol	2-5 years	**	\$\$
Warren, RI					
Implement the onsite wastewater management plan.	Town of Warren WMD ordinance, 2011	Town of Warren via Warren Wastewater Management District	On-going	***	\$\$
Increase education and outreach through local programs about water quality issues from wastewater.	Draft Plan Public Meeting, May 2012	Town of Warren	Ongoing	**	\$
If high bacteria levels are found in outfalls to the river and major tributaries of the Kickemuit River and tributaries, search for cross-connections from wastewater pipes.	--	Town of Warren Wastewater Management District and Warren Sewer District	1-2 years	**	\$
Develop a web-based tracking system for all OWTS in town.	--	Town of Warren	2-5 years	**	\$\$
Massachusetts					
Inspect existing OWTS and prioritize systems for replacement.	Draft Plan Public Meeting, May 2012	Towns of Rehoboth and Swansea	2-5 years	***	\$\$
Institute septic management plans that emphasize inspections, pump-outs, and repairs.	Draft Plan Public Meeting, May 2012	Towns of Rehoboth and Swansea	2-5 years	***	\$\$
<p>*** Provides maximum progress towards improving water quality, due to strategic value, large geographic scope, or scale of pollutant source being addressed.</p> <p>** Provides broad opportunity to improve water quality.</p> <p>* Provides localized improvement to water quality, or addresses smaller pollutant sources.</p> <p>\$\$\$ Expected to cost over \$100,000</p> <p>\$\$ Expected to cost approximately \$25,000 to \$100,000</p> <p>\$ Expected to cost less than \$25,000</p>					

5.2.4 Other Action Items at the Municipal Level

Table 5-4 provides a list of other actions for the improvement of water quality in the BK watershed.

Table 5-4: Other Action Items for Improving Water Quality in the BK Watershed

Bristol, RI					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Increase land preservation within the watershed through targeted education to landowners. Identify key areas for conservation easements, and designated open space. Create open space maps for the entire watershed and collaborate to pursue funding for land purchases.	Draft Plan Public Meeting, May 2012	Local Land Trusts and Town of Bristol	Ongoing	***	\$\$\$
Reduce inflow and infiltration in area sanitary sewers.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Bristol	5-10 years	***	\$\$\$
Encourage farmers to work with NRCS to reduce pollution.	--	Town of Bristol	Ongoing	**	\$
Control sediment erosion, and manure/fertilizer runoff, and limit livestock access to streams.	Kickemuit Fecal Coliform & Phosphorus TMDL 2006	Private landowners, RIDEM, MA DAR	1-2 years	**	\$
Educate public on success of Bristol Town Beach stormwater upgrades among beach goers, residents, and neighboring municipalities.	--	Town of Bristol	2-5 years	**	\$
Recruit farmers interested in water quality to do outreach with farming community.	Draft Plan Public Meeting, May 2012	Town of Bristol, RIDEM, NRCS, Local farmers	2-5 years	**	\$
Provide information and outreach to encourage proper pet waste disposal, deter feeding waterfowl, and to restore riparian corridors.	Kickemuit Fecal Coliform & Phosphorus TMDL, 2006	RI DOT, Mass Highway, Town of Bristol	1-2 years	**	\$
Perform an assessment of the buffers along the waterbodies within the watershed to identify areas that need an increased buffer.	Draft Plan Public Meeting, May 2012	Town of Bristol, RIDEM, and RI NRCS	2-5 years	**	\$\$

Table 5-4: Other Action Items for Improving Water Quality in the BK Watershed (continued)

Bristol, RI (continued)					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Encourage land management, education, enforcement, and other measures to reduce nuisance waterfowl.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Bristol	Ongoing	*	\$
Place informational signs at stream crossings in town to increase awareness about water quality issues.	--	Town of Bristol	Ongoing	*	\$
Support connections between water quality science in schools and municipal government by having students participate in monitoring where appropriate	--	Save Bristol Harbor, School Dept., Town of Bristol	2-5 years	*	\$
Perform an inventory of culverts in the watershed and target undersized culverts in estuarine areas for replacement.	Draft Plan Public Meeting, May 2012	Town of Bristol	Ongoing	*	\$
Provide residents better access to regulations and water quality plans.	Draft Plan Public Meeting, May 2012	Town of Bristol, RIDEM	Ongoing	*	\$
Warren, RI					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Increase land preservation within the watershed through targeted education to landowners. Identify key areas for conservation easements, and designated open space. Create open space maps for the entire watershed and collaborate to pursue funding for land purchases.	Draft Plan Public Meeting, May 2012	Local Land Trusts and Town of Warren	Ongoing	***	\$\$\$
Reduce inflow and infiltration in area sanitary sewers.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Warren	5-10 years	***	\$\$\$

Table 5-4: Other Action Items for Improving Water Quality in the BK Watershed (continued)

Warren, RI (continued)					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Encourage farmers to work with NRCS to reduce pollution.	--	Town of Warren	Ongoing	**	\$
Recruit farmers interested in water quality to do outreach with farming community.	Draft Plan Public Meeting, May 2012	Town of Warren, RIDEM, NRCS, Local farmers	2-5 years	**	\$\$
Control sediment erosion, and manure/fertilizer runoff, and limit livestock access to streams.	Kickemuit Fecal Coliform & Phosphorus TMDL 2006	Private landowners, RIDEM, MA DAR	1-2 years	**	\$
Provide information and outreach to encourage proper pet waste disposal, deter feeding waterfowl, and to restore riparian corridors.	Kickemuit Fecal Coliform & Phosphorus TMDL, 2006	RI DOT, Mass Highway, Town of Warren	1-2 years	**	\$
Perform an assessment of the buffers along the waterbodies within the watershed to identify areas that need an increased buffer.	Draft Plan Public Meeting, May 2012	Town of Warren, RIDEM, and RI NRCS	2-5 years	**	\$\$
Form a volunteer citizen committee to review and propose updates to comprehensive plan and town ordinances, in order to overcome budget limitations in this area.	--	Town of Warren	1-2 years	**	\$
Perform an inventory of culverts in the watershed and target undersized culverts in estuarine areas for replacement.	Draft Plan Public Meeting, May 2012	Town of Warren	Ongoing	*	\$
Investigate through bacteria testing whether cow pasture on Libby Lane in Warren is source of bacteria.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Warren	1-2 years	*	\$
Encourage land management, education, enforcement, and other measures to reduce nuisance waterfowl.	Mt Hope Bay & Kickemuit Estuary Bacteria TMDL, 2010	Town of Warren	Ongoing	*	\$
Provide residents better access to regulations and water quality plans.	Draft Plan Public Meeting, May 2012	Town of Warren, RIDEM	Ongoing	*	\$

Table 5-4: Other Action Items for Improving Water Quality in the BK Watershed (continued)

Warren, RI (continued)					
Action Item	Source	Responsibility	Timeframe	Value Added	Cost
Place informational signs at stream crossings to increase awareness about water quality issues.	--	Town of Warren	Ongoing	*	\$
Support connections between water quality science in schools and town government by having students participate in monitoring where possible.	--	School Dept., Town of Warren	2-5 years	*	\$
Perform an inventory of culverts in the watershed and target undersized culverts in estuarine areas for replacement.	Draft Plan Public Meeting, May 2012	Town of Warren	1-2 years	*	\$
Massachusetts					
Accelerate upgrades at wastewater treatment plants.	Narragansett / Mt Hope Bay Pathogen TMDL, 2010	MADEP	5-10 years	***	\$\$\$
Create a formal agreement between RI and MA to guide water quality planning for Narragansett Bay.	Narragansett / Mt Hope Bay Pathogen TMDL, 2010	MADEP, RIDEM	2-5 years	**	\$\$
Control sediment erosion, and manure/fertilizer runoff, and limit livestock access to streams.	Kickemuit Fecal Coliform & Phosphorus TMDL 2006	Private landowners, RIDEM, MA DAR	1-2 years	**	\$
Encourage farmers to work with NRCS to reduce pollution.		Towns of Rehoboth and Swansea	Ongoing	**	\$
Place informational signs throughout the watershed to increase awareness about water quality issues.	--	Towns of Rehoboth and Swansea	Ongoing	*	\$
<p>*** Provides maximum progress towards improving water quality, due to strategic value, large geographic scope, or scale of pollutant source being addressed.</p> <p>** Provides broad opportunity to improve water quality.</p> <p>* Provides localized improvement to water quality, or addresses smaller pollutant sources.</p> <p>\$\$\$ Expected to cost over \$100,000</p> <p>\$\$ Expected to cost approximately \$25,000 to \$100,000</p> <p>\$ Expected to cost less than \$25,000</p>					

5.3 Individual and Non-Governmental Actions

Though many actions to improve water quality in a watershed are the responsibility of the municipal, state, and federal agencies, other actions taken by local residents and non-governmental groups have the potential to make a large difference in local water quality.

Non-governmental groups in the watershed include watershed associations, universities, and other research-based and non-profit organizations whose focus is protecting the water resources in the watershed. These groups contribute to the improvement and protection of the water quality of waterbodies in the BK watershed by continuing water quality monitoring, public education, stormwater abatement, and other water quality improvement projects. Descriptions of two Narragansett Bay regional efforts are listed below and a description of other watershed groups is provided in [Section 6.2](#).

- **Save the Bay:** Founded in 1970, Save the Bay has been working to protect and restore the Narragansett Bay and its watershed for over 40 years. Save the Bay has completed multiple projects in the East Bay watersheds in their continued efforts to improve the water quality of Narragansett Bay and its watershed. Projects have included stormwater abatement and habitat restoration. **Online:** <http://www.savebay.org>.
- **Narragansett Bay Estuary Program (NBEP):** Since 1987, the Narragansett Bay Estuary Program (NBEP) has strived to protect and preserve Narragansett Bay and its watershed through partnerships that conserve and restore natural resources, enhance water quality and promote community involvement. While funding and oversight comes largely from USEPA, support also comes from stakeholder commitment and the Association of National Estuary Programs (ANEP). NBEP is mandated by the U.S. Government to update the existing Comprehensive Conservation and Management Plan (CCMP), which will be renamed as the Narragansett Bay Region Plan. This plan is a multi-state consensus of goals and priority actions regarding the Narragansett Bay watershed. The NBEP has worked on a number of habitat restoration and water quality monitoring programs throughout Rhode Island. **Online:** <http://www.nbep.org/>.
- **Narragansett Bay National Estuarine Research Reserve (NBNERR) Coastal Training Program (CTP):** The NBNERR CTP provides coastal decision-makers with science-based trainings and tools to help them make informed decisions about how to best protect the health of their communities and Narragansett Bay. Training programs include, among others, Low Impact Development Site Planning and Design, Conservation Development, and Conservation Easements and Open Space Management. **Online:** <http://www.nbwctp.org>.

Local residents also play an important role in protecting water resources in the BK watershed. [Table 5-5](#) lists actions that individuals can take to help improve water quality in their watershed. Many of these actions are described in greater detail at the Rhode Island Stormwater Solutions webpage (<http://ristormwatersolutions.org/>)

Table 5-5: Individual Actions to Improve Water Quality

General Actions			
Action Items	Specific Actions	How Will This Help?	Link to Information
Become involved in your watershed	1) Join an existing watershed association	Learning about and becoming involved in your watershed is the first step towards taking action to protect and restore the quality of your water resources for future use.	Kickemuit River Council: http://www.kickemuitriver.org/ USEPA Adopt a Watershed Webpage: http://water.epa.gov/action/adopt/index.cfm University of Rhode Island Watershed Watch: http://www.uri.edu/ce/wq/ww/index.htm USEPA 10 Things you can do in your Watershed: http://water.epa.gov/action/adopt/earthday_index.cfm
	2) Form a watershed association		
	3) Volunteer as a water quality monitor		
	4) Attend public education opportunities about the water resources in your watershed		
Do not feed waterfowl		Unnatural concentrations of waterfowl contribute to pollution.	
Conserve water		This will either result in reduced discharge from a municipal wastewater treatment facility or increased OWTS longevity .	
Dispose of medicines properly	Do not flush or pour down the drain unused medications and supplements	Prevent these drugs and other supplements from entering water resources where they may have an adverse effect on aquatic life and drinking water resources.	USEPA “How to Dispose of Medicines Properly: http://water.epa.gov/scitech/swguidance/ppcp/upload/ppcpflyer.pdf New England Interstate Water Pollution Control Commission: http://www.neiwpcc.org/ppcp/

Table 5-5: Individual Actions to Improve Water Quality (continued)

Stormwater Management			
Action Items	Specific Actions	How Will This Help?	Link to Information
Install BMPs on your property to treat stormwater runoff	1) Install a rain garden or other filtering system	Encouraging stormwater to infiltrate into the soil will allow the soil to naturally filter the water before it reaches a waterbody.	University of Rhode Island Rain Garden Fact Sheet: http://www.uri.edu/ce/healthylandscapes/raingarden.htm
	2) Install a vegetated buffer between your property and local waterbodies	Vegetated areas limit erosion and encourage stormwater to infiltrate into the soil.	USEPA Vegetated Buffer Fact Sheet: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=50 RI CMRC Buffer Zone Planting Guide: www.crmc.ri.gov/coastallandscapes/Coastal_Buffer_Planting_Guide.pdf
	3) Install a rain barrel to collect roof runoff	This water can be re-used on your property and will then be filtered through the soil before it reaches a waterbody.	University of Rhode Island Rain Barrel Fact Sheet: http://www.uri.edu/ce/healthylandscapes/rainbsources.html
Limit the amount of impervious surfaces on your property	1) Install pervious pavers or gravel in place of a traditional driveway	Pervious materials allow stormwater to enter the soil instead of just running off your property.	USEPA Fact Sheets: http://www.epa.gov/owow/NPS/lid/#fact
	2) Limit sidewalks or pathways on your property or ensure they are made of pervious material		
Limit "lawn" pollution	1) Establish "no mow" zones	Vegetated areas discourage erosion and encourage stormwater to infiltrate into the soil.	USEPA Fact Sheets: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=50

Table 5-5: Individual Actions to Improve Water Quality (continued)

Stormwater Management (continued)			
Action Items	Specific Actions	How Will This Help?	Link to Information
Limit "lawn" pollution (continued)	2) Use less or natural fertilizer	Fertilizers contain nutrients such as nitrogen and phosphorus that pollute waterbodies.	USEPA Fact Sheets: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=97
	3) Use less or natural pesticides	Pesticides contain toxic substances that can enter nearby waterbodies.	USEPA Fact Sheets: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=98
Manage your pet's waste	1) Pick up after your pet and dispose of pet waste properly	Pet waste contains pollutants including bacteria and nutrients that pollute waterbodies.	USEPA Fact Sheets: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=4
	2) Utilize public dog parks		
Proper driveway maintenance	If sealing the driveway, use asphalt based sealants, <u>not</u> coal tar based	Particles of sealant wash off with stormwater. Asphalt based sealants contain much less pollutants than coal tar based sealants.	US Geological Survey Fact Sheet: http://pubs.usgs.gov/fs/2011/3010/

Table 5-5: Individual Actions to Improve Water Quality (continued)

Onsite Wastewater Treatment System Management			
Action Items	Specific Actions	How Will This Help?	Link to Information
Maintain your OWTS	Inspect your system regularly, pump it and repair it as necessary.	A properly functioning OWTS will prevent failures.	RIDEM Septic System Handbook: http://www.dem.ri.gov/pubs/regs/regs/water/isdsbook.pdf
Manage what you put into your OWTS	1) Limit the use of your garbage disposal	Garbage disposals can overload the septic tank.	
	2) Limit the amount of chemicals that enter your OWTS	Certain chemicals can pollute groundwater and can kill the bacteria essential to breaking down the sludge.	
Low Impact Development			
Action Items	Specific Actions	How Will This Help?	Link to Information
Protect open space	Donate land to and/or support a local land trust	Land trusts help protect land from development.	Land Trust Alliance: http://findalandtrust.org/

6. Implementation Tools

6.1 Financial Support

Funding assistance for water quality improvement actions and other watershed management projects is available from various government and private sources. This section provides overview and contact information for financial assistance programs that ultimately improve water quality.

6.1.1 Federal Clean Water Act, Section 319 Nonpoint Source Implementation Grants

Section 319 Grants are available to assist projects that promote restoration and protection of water quality through reducing and managing nonpoint source pollution. 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) 222-4700

6.1.2 Clean Water Finance Agency, 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. 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. Funds are 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 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

The Community Septic System Loan Program allows homeowners in participating communities to obtain low interest loans to repair or replace failed, failing, or substandard 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. Loans to homeowners are offered at 2% interest rate with a 10-year term.

Eligible applicants: Statewide. Municipal participation requires RIDEM approval of an onsite wastewater management plan. Funds are awarded to communities 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 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

Sewer Tie-In Loan Fund

Modeled after the Community Septic System Loan Program, the Sewer Tie-In Loan Fund allows homeowners to access funds to connect to the local sewer system. Individual loans are funded from a Clean Water State Revolving Fund loan to a sewer system owner and are administered locally by Rhode Island Housing. Loans to homeowners up to \$10,000 are offered at a 2% interest rate for up to a five year term.

Eligible applicants: Statewide. Funds are awarded to communities based on ranking of environmental benefits of the project, readiness to proceed, and availability of funds.

Online at: <http://www.ricwfa.com/>

Contact: RIDEM 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

6.1.3 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.

RIDEM has determined that the current status of pump-out facilities in the BK watershed is satisfactory, with pump-out facilities located at Bristol Town Dock and Bristol Marine, both of which also operate pump-out boats. The Bristol Town pump-out boat also provides regular service into the Kickemuit River.

Eligible applicants: Rhode Island marina owners and city or town harbor departments may apply for grants. For marinas, a non-owner operator may apply for such a grant, but only if the owner co-signs the application and grant award.

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

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

6.1.4 Community Development Block Grants

Title 1 of the Housing and Community Development Act of 1974 authorized the Community Development Block Grant program. The program is sponsored by the US Department of Housing and Urban Development, 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

6.1.5 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 support for local planning initiatives, improving bike paths to promote sustainable transportation, and support for geographic information system projects.

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

6.1.6 U.S. Department of Agriculture Natural Resources Conservation Service Grants

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. Examples of eligible EQIP activities include practices for farm waste storage, nutrient management, riparian buffers and stream bank improvements, wetland restrictions, and groundwater and surface water conservation activities. EQIP payment rates may cover up to 75 percent of the costs of installing certain conservation practices. In 2006, NRCS EQIP expanded its program to include shellfish management funding.

Eligible applicants: Any person engaged in livestock, agricultural production, aquaculture, shellfishing, 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.

Case Study: Environmental Quality Incentives Program (EQIP) Shellfish Management Funding

In 2006, NRCS EQIP expanded its program to include shellfish management funding. Eleven out of 30 growers in Rhode Island signed contracts for this new sub-program, and approximately \$282,212 were allocated to implement best management practices (BMPs) on 55 acres of shellfish farms across the state. By 2008, 8 more applicants were added, requesting over \$1 million to restore oyster habitat and improve water quality in Rhode Island coastal waters.



Oyster bed transplants

Wildlife Habitat Incentives Program (WHIP)

This program is a voluntary program for landowners who want to develop and improve fish and wildlife habitat on private agricultural land, non-industrial private forest land, and tribal land. Through WHIP, farmers and forestland managers may receive financial and technical help to develop upland, wetland, aquatic, and other types of wildlife habitat on their property. The current focus of WHIP in RI is on coastal habitats, freshwater wetlands, vernal pools, riparian habitats, upland habitats of State significance (early successional habitats), and the restoration of native habitats impacted by invasive species.

Eligible applicants: Any person owning private agricultural land, non-industrial private forest land, or tribal land.

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

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

Easement Programs

NRCS offers various easement programs to landowners who want to maintain or enhance their land in a way beneficial to agriculture and/or the environment. NRCS provides technical help and financial assistance to protect private lands through a variety of programs. These programs include the Farm and Ranch Land Protection Program, the Grasslands Reserve Program, the Healthy Forests Reserve Program, and the Wetlands Reserve Program.

Eligible applicants: Private landowners.

Online at: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements>

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

6.1.7 Land Trusts

Land trusts seek to preserve open spaces, natural areas, scenic character, watersheds, drinking water sources, farmland, forests, historic sites, and shorelines that uniquely define communities.

The most traditional tool for conserving private land is through conservation easements that permanently limit the use of the land in order to protect its conservation value. This type of preservation can take various forms. For instance, an easement on property containing rare wildlife habitat might prohibit any development, while an easement on a farm might allow continued farming and the addition of buildings.

There are economic benefits to placing a conservation easement on private land. First, it will usually lower property value and therefore lower property taxes, making ownership more affordable. Second, if the landowner decides to donate the land to a local land trust, the donation can qualify as a tax deductible charitable donation.



Tom's Island is owned by the Warren Land Trust

Land trusts can help private landowners begin the process of developing a conservation easement. There are a number of land trusts in Rhode Island and Massachusetts that are likely interested in land conservation in the BK watershed, including:

- American Farmland Trust (<http://www.farmland.org/>)
- Audubon Society (<http://www.asri.org/>)
- Bristol Land Conservation Trust
- Northeast Wilderness Land Trust (<http://www.newwildernesstrust.org/>)
- NE Forestry Foundation (<http://www.newenglandforestry.org/>)
- Orenda Wildlife Land Trust (<http://www.orendalandtrust.org/>)
- Rehoboth Land Trust
- Swansea Land Trust
- Trust for Public Land (<http://www.tpl.org/>)
- Trustees of Reservations (<http://www.thetrustees.org/>)
- Wildlands Trust (<http://www.wildlandstrust.org/>)

Watershed Case Study: Swansea Country Club Conservation Easement
(Note: not in the BK Watershed)

Recognizing the need to protect great birding habitat, the Swansea Country Club is donating a portion of land along the Palmer River to both Swansea, MA and Warren, RI to be put into conservation easement. The area was historically used as a private hunting preserve until it became a golf course in the 1960's. Fortunately, for conservation the marshy woodland habitat in the back of the golf course was deemed unsuitable for development and was left natural.

Swansea will receive approximately 80 acres, which includes the freshwater pond, and Warren will receive approximately 45 acres, which abuts 50 acres of conservation land owned by the town.



Merriman's Pond located on the golf course property and included in the conservation easement.



Osprey with fish taken on land between Merriman's Pond and the Palmer River. The Audubon Society's Osprey Monitoring Program has classified the Palmer River as having one of the highest concentrations of Ospreys in Rhode Island.

The Country Club plans to keep the new conservation land as undisturbed as possible, providing only limited access to conservation groups, school groups or Audubon members. Access to the property is already limited either via the golf course itself or the Palmer River. With the addition of Warren's easement, additional access points could be used through public trails. While the land is still attached to the deed of the property, the towns now own the conservation rights according to the agreements signed.

6.1.8 RIDEM Open Space Grants

Offered through RIDEM's Planning and Development Grant Program, Open Space Grants help land trusts, cities, towns, and other non-profit organizations acquire and protect their communities' open space lands.

Eligible applicants: Land trusts, conservation commissions, watershed councils, non-profit environmental agencies, municipal agencies, and Native American tribes.

Online at: <http://www.dem.ri.gov/programs/bpoladm/plandev/grants.htm>

Contact: RIDEM – Division of Planning and Development, 235 Promenade Street, Providence, RI 02908, (401) 222-2776.

6.1.9 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 that serve to protect watersheds:

Online at: <http://water.epa.gov/aboutow/owow/funding.cfm>

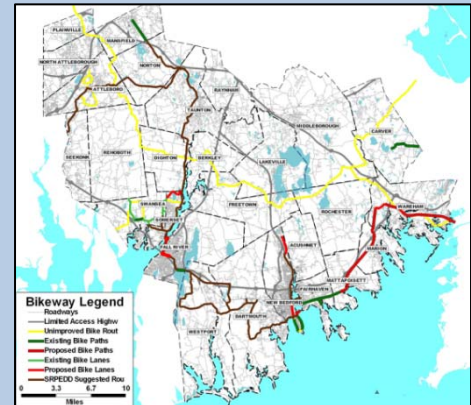


The Narrows – where the Kickemuit River joins Mount Hope Bay

Case Study: Southeast Regional Planning and Economic Development District

The Southeastern Regional Planning & Economic Development District (SRPEDD) serves 27 cities and towns in southeastern Massachusetts in land use, transportation, economic, and environmental planning. Since 1968, this public agency has served 808 square miles of urban, suburban and rural areas with over 600,000 people. SRPEDD provides research, technical assistance, and bylaw and ordinance preparation through the following initiatives:

1. **Transportation Planning:** SRPEDD is a Metropolitan Planning Organization that programs federal highway and transit funds through various regional authorities, while also conducting traffic counts, pavement management, and traffic/parking studies.
2. **GIS Database Maintenance:** SRPEDD hosts an elaborate GIS database on regional population, housing, employment, water and tax rates, and buildings.
3. **Comprehensive Planning:** SRPEDD's Comprehensive Planning division offers assistance on open space plans, zoning bylaws, subdivision regulations, resource management plans, housing studies, and community development.
4. **Economic Development:** SRPEDD focuses on economic development through infrastructure investment, workforce training, and capital incentives.



Example of GIS mapping performed by SRPEDD

SRPEDD can also assist towns through the Cooperative Purchasing Program. If capital investment in equipment is too much for a single town, SRPEDD can help team up towns for joint-share purchases. Contact SRPEDD at (508) 824-1367, info@srpedd.org, or 88 Broadway, Taunton, MA 02780.

6.2 Public Information and Outreach

6.2.1 Outreach Efforts for Rhode Island TMDLs

USEPA regulations require that calculations to establish TMDLs be subject to public review (40 CFR 130.7 (c)(1)(ii)). Following the presentation and publication of a draft Rhode Island TMDL, the public has a 30-day period to review and submit comments on this study and its findings.

For some TMDLs, a pre-meeting is also held to discuss environmental activities and studies being conducted in the watershed. In either case, the key stakeholders are identified and contacted by RIDEM prior to the public comment period. More information about the RI TMDL program is available online: <http://www.dem.ri.gov/programs/benviron/water/quality/rest/>

6.2.2 Outreach Efforts for This Watershed Plan

Outreach efforts for this watershed plan and the Barrington-Palmer-Warren Rivers watershed plan are described jointly below. Detailed information about this process (flyers, meeting summaries, etc.) is in a separate document -- "Outreach Efforts for the Barrington-Palmer-Warren Rivers Watershed Plan and the Bristol-Kickemuit Watershed Plan 2011-2012" that is available from the RIDEM Office of Water Resources.

RI-MA Kickoff Meetings

Two kick-off meetings were held in April 2011. The purpose of these meetings was to introduce the watershed-based planning process, engage stakeholders to solicit their input in the process, and identify key water quality issues and concerns about the watersheds. Stakeholders included town board/council members, town/regional planners, watershed association members, natural resource professionals, non-profit organizations, and watershed landowners.

Outreach efforts and meeting summaries are documented below.

- **March 30, 2011:** Flyers announcing the meetings sent to all stakeholders
- **April 1, 2011 – April 10, 2011:** Follow-up phone calls to all stakeholders made by FBE.
- **April 19, 2011:** First meeting held at the Warren Town Hall, Warren, RI (27 attendees)
- **April 27, 2011:** Second meeting held at the Seekonk Town Hall, Seekonk, MA (17 attendees)
- **May 10, 2011:** All meeting documents and maps were made publicly available on the FBE website (<http://www.fbenvironmental.com/projectPostings.html>)



*Warren Town
Hall*

- **May 11, 2011:** Meeting notes with a list of attendees and contact information were sent to all stakeholders

Municipal Meetings

Meetings were held in the individual watershed towns in July 2011. The purpose of these meetings was to complete and review municipal checklists, to get feedback on draft recommendations and identify feasible options for implementation in each town.

Outreach efforts and meeting summaries are documented below.



Entrance to the Bristol, RI Town Hall

- **April 19 and April 27, 2011:** Municipal employees and other stakeholders to include in the municipal meetings were identified at the two kickoff meetings.
- **June 2011:** Phone calls and emails were sent to those stakeholders by FBE inviting them to the meetings.
- **July 20, 2011:** All meeting documents were emailed to the confirmed attendees for each town.
- **July 26, 2011:** First municipal meeting was held in Swansea, MA.
- **July 27, 2011:** Two municipal meetings were held in Warren, RI and Rehoboth, MA.
- **July 28, 2011:** Final municipal meeting was held in Bristol, RI.
- **August 2, 2011:** Draft summaries of the municipal meetings were submitted to each town for review before final submittal to RIDEM and USEPA.
- **August 5, 2011:** All comments received from the towns.
- **August 11, 2011:** Final summaries of the municipal meetings with a list of attendees were submitted to RIDEM and USEPA.

Public Meetings and Public Comments

The DRAFT Bristol-Kickemuit Watershed Plan was posted for review and comment in April 2012. A public meeting was held on May 9, 2012 at the Bristol Town Hall in Bristol, RI and public comments were accepted on the draft document until May 25, 2012. Comments from the meetings (including proposed action items) and comment period were addressed in the final version of this plan. A summary of this meeting and the responses to public comments are located in Appendix C.

6.2.3 Importance of Continued Public Involvement

Local stakeholders, RIDEM, and the USEPA have a responsibility to continue to work together to implement the actions proposed in this watershed plan. These actions are designed to protect and restore the quality of local waterbodies. Specific actions and responsible parties have been outlined in **Section 5**.

Watershed associations are integral for the long-term protection of a waterbody. Watershed associations are formed by groups of concerned citizens within a watershed with the shared goal of maintaining or restoring the water quality of a local waterbody for the use of its residents for generations. The Kickemuit River Council (formed in 1973) is the only active watershed association in the BK watershed designated by the RI Rivers Council pursuant to RI General Laws Chapter 46-28. Watershed councils designated by the RI Rivers Council are eligible to receive notice of state and local projects in their watershed, are empowered to testify before local and state hearings on issues affecting their watershed, and are eligible for small state grants through the RI Rivers Council (<http://www.ririvers.org/>). Other research-based and non-profit organizations whose focus is protecting the water resources in the watershed are either located within the BK watershed or work within the BK watershed. These organizations include:

- Save Bristol Harbor
- Save the Bay
- Narragansett Bay Estuary Program
- Narragansett Bay National Estuarine Research Reserve
- Roger Williams University
- University of Rhode Island Watershed Watch

Watershed Case Study: Kickemuit River Council



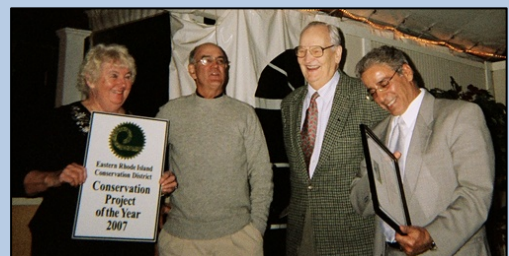
In response to degrading water quality in the Kickemuit River in Rhode Island, a group of people from the Butterworth Ave Association, Cedar Crest Association, Touisset Highlands, and Laurel Park Improvement Association and Touisset Point Association came together in 1973 to form what is now the Kickemuit River Council (KRC) (<http://www.kickemuitriver.org/>).

The primary purpose of this non-profit 501(c) (3) organization is to preserve, protect, and improve the Kickemuit River for the benefit of current and future generations. After the river's shellfish beds were closed in 1990, residents of Warren and Bristol took action and have fueled the organization's activism over the last two decades.

The KRC works to pinpoint major stormwater discharge areas, encourage repopulation of blue crabs, control invasive plants, and conduct river shoreline clean-ups with other organizations. Other projects include:

- Enforcing air and water pollution discharge regulations at the Brayton Point Power Station in Somerset, MA.
- Developing the Kickemuit River Project which identifies problem stormwater outfalls and illicit discharges.
- Helping to address sewer issues in Warren and Bristol and encouraging collaboration between the towns for a sewer line expansion.
- Developing a "Caring for Your Septic System Brochure" with RIDEM, the towns of Warren and Bristol, Save the Bay, the Eastern RI Conservation District, and the New England Grassroots Environment Fund.

KRC, along with the Bristol County Water Company (BCWC) won the "2007 Conservation Project of the Year" Award for developing the first NRCS-supported fish ladder in Rhode Island. The KRC's ultimate goal of achieving "clean" waters is to have the Kickemuit River qualify for wet-weather quahogging and be open for shellfishing throughout the river.



KRC Members Receiving the 2007 Conservation Project of the Year Award

6.3 Monitoring and Measuring Progress

6.3.1 Summary of Water Quality Monitoring Efforts

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 in 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 water quality in coastal and freshwaters are listed below.

RIDEM Monitoring Programs

Rotating Basin Assessments of Rivers and Streams Program

This statewide freshwater sampling program run by the RIDEM Office of Water Resources assesses one to two basins (of ten total basins) each year over a five year period using an intensive sampling design. Data from this program are used to assess whether water quality is sufficient to support the applicable designated uses based on water quality criteria. The BK watershed has not yet been monitored under this ongoing program.

Data collected: Dissolved oxygen, metals, nutrients, pathogens, and macroinvertebrate and fish assemblages.

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. The purpose of this program is to maintain national health standards by regulating the interstate shellfish industry. The program 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 National Shellfish Sanitation Program and are conducted by the RI Shellfish Monitoring Program. This sampling program monitors approximately 300 stations in salt waters annually and analyzes the samples for fecal coliform bacteria.

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

Data collected: Fecal coliform bacteria

Waterbodies in the BK watershed sampled: Kickemuit River, Bristol Harbor, Western Bristol, and the Bristol Area of Mt. Hope Bay

Other Governmental Monitoring Programs

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 for these waterbodies.

Online: <http://www.ribeaches.org/>

Data collected: Enterococci bacteria

Waterbodies in the BK watershed sampled: Bristol Town Beach, Camp St. Dorothy (Bristol), and Warren Town Beach

Volunteer Monitoring Programs

University of Rhode Island Watershed Watch Program

The University of Rhode Island Watershed Watch (URI WW) program is a volunteer-based freshwater and saltwater sampling program providing supplemental data to state programs in Rhode Island. Watershed Watch works with local communities and shoreline residents to assess water quality and provide information for more effective management of critical water resources. URI WW also helps local governments, watershed, tribal and other organizations to recruit and train volunteers to become citizen scientists gathering detailed, quality-assured monitoring data. Their watershed-based program focuses on long-term ecological monitoring of RI's fresh and saltwater resources including lakes, ponds, streams, and coastal waters. URI WW provides training, equipment, supplies, and analytical services tailored to organizational needs while meeting strict quality assurance and quality control guidelines in the field and in their state-certified laboratory.



Online: <http://www.uri.edu/ce/wq/ww/index.htm>

Data collected: Water clarity, algal density, dissolved oxygen, water temperature, alkalinity, pH, nutrients, and pathogens

Waterbodies in the BK watershed sampled: Multiple locations throughout Bristol Harbor.

Watershed Case Study: Predictive Habitat Model for Bristol Harbor

A new predictive habitat model for Bristol Harbor is being developed by the University of Rhode Island (URI) and Save Bristol Harbor through a \$5,000 grant from the Rhode Island Foundation. For the last 3 summers, this funding has supported volunteer collection of water quality data for the predictive model, which will be used by the Town of Bristol and the Harbor Commission to make sound management decisions regarding future development projects with the potential to impact Bristol waters.



Volunteers Dr. Joe Orchardo and Joe Arruda from Save Bristol Harbor

To ensure the success of the model, Save Bristol Harbor and URI have accomplished the following tasks:

1. Installed 12 flow meters in Bristol Harbor to determine the direction of water flow into and out of the harbor over time. Understanding the direction of flow will help determine where water quality problems originate and how the monitoring sites are connected;
2. Recruited a strong volunteer base to monitor water quality biweekly from May to October at the 12 sampling sites for salinity, water temperature, water clarity, chlorophyll-a, nitrogen, phosphorous, dissolved oxygen, and bacteria; and
3. Identified Silver Creek as a potential hotspot for multiple pollutants in 2009, then expanded testing in that area in 2010. Through these efforts, it was determined that this creek is a likely source of bacterial pollution to Bristol Harbor.

Save Bristol Harbor has also been working with Mt. Hope High School, Brown University, Roger Williams University, the Kickemuit River Council, the Bristol Harbor Commission, the Town of Bristol, RIDEM and USEPA. The URI Watershed Watch helps train volunteers for the Water Quality Testing Program. Students at Mt. Hope High School helped construct water sample collection poles. Dr. Kincaid from URI has been maintaining a database of monitoring results, and will present findings to the Bristol Harbor Commission and Town Council in spring 2012.

6.3.2 Indicators of Progress

There are a wide variety of indicators of progress that can be used to measure and document improvements in water quality protection and watershed restoration. The most direct and straightforward indicators are water quality measurements, such as concentrations of bacteria, phosphorus, and nitrogen; dissolved oxygen (in particular, the periods of low oxygen that lead to fish kills); and suspended sediment loads. Monitoring can extend to biological indicators, such as aquatic macroinvertebrates, anadromous fish, eelgrass, clams, and oysters. Biological monitoring can look at species population levels, species composition, and/or contaminant levels in tissues. A region-wide monitoring program is best suited to measuring these indicators.

As shown in Section 6.3.1, significant monitoring efforts are already underway by a diverse group of government, university, and non-profit organizations within the watershed including:

- RI Department of Environmental Management
- RI Department of Health
- Save the Bay
- Save Bristol Harbor
- Narragansett Bay Estuary Program
- University of Rhode Island Watershed Watch Program
- MA Department of Environmental Protection

There is active collaboration among monitoring groups in the region, evidenced by the Watershed Counts effort (<http://watershedcounts.org>), RI Bays, Rivers, and Watersheds Coordination Team (<http://www.coordinationteam.ri.gov/>), the Narragansett Bay Region Indicator Development Workgroup (<http://www.ci.uri.edu/Projects/Indicators/NarrBayIndicators.html>), and the NarrBay.org data portal (<http://www.narrbay.org>). The Watershed Counts effort lists 35 partners, to give an idea of idea of the breadth of participation in watershed indicator development (<http://watershedcounts.org/partners.html>).

The following is a proposed list of topics to indicate progress in the watershed. Many of these indicators are listed in the 2011 Watershed Counts report

(<http://watershedcounts.org/documents/WatershedCountsReport2011.pdf>).

1. Impervious Cover

- Percent of watershed area which is impervious cover; and

- Total treated impervious surface in the watershed (i.e., impervious cover that drain to adequate stormwater treatment, which could be defined as compliance with current stormwater standards for new development).

2. Water Quality Assessment

- Percent of water (stream miles, estuarine acreage, etc) within the watershed that is listed as impaired;
- Percent of waterbodies assessed for attainment within past 5 years; and
- Percent of recently assessed streams which show water quality impairment.

3. Specific Water Quality Parameters

- Number of beach closures per year;
- Dry weather bacteria concentrations;
- Dissolved oxygen levels;
- Nutrients, such as phosphorus and nitrogen;
- Metals and other toxins; and
- Pharmaceuticals (measures of this water quality impairment are still experimental).

4. Conservation and Habitat Restoration

- Percent of watershed in conservation;
- Invasive species counts; and
- Acres of degraded habitat restored.

5. Other Potential Indicators

- Opening of shellfish areas;
- Number of BMPs installed;
- Municipal progress in implementing strategies for improved OWTS, Stormwater, and LID programs;
- Number of contact hours of outreach attained;

- Awareness among residents or certain stakeholder groups as measured by surveys; and
- Extent of conservation land.

Watershed Case Study: Watershed Counts

Watershed Counts (<http://watershedcounts.org>) is a broad coalition of agencies and organizations that have committed to work together to examine and report regularly on the condition of land and water resources of the Narragansett Bay watershed. Formed in 2011, the coalition is using five environmental indicators (climate change, impervious cover, beach closures, freshwater flow, and invasive species) to evaluate and describe the condition of the watershed region and to communicate this information to the public.



Current project partners include:

Audubon Society of Rhode Island
 Blackstone River Coalition
 Blackstone Watershed Council/
 Friends of Blackstone
 Conservation Law Foundation
 Environment Council of Rhode Island
 Friends of the Moshassuck
 Grow Smart RI
 MA Audubon Society
 Narragansett Bay Commission
 Narragansett Bay Estuarine Research Reserve
 Narragansett Bay Estuary Program
 Office of Senator Sheldon Whitehouse
 RI Bays, Rivers, and Watersheds Coordination
 Team
 RI Coastal Resources Management Council
 RI Department of Administration
 RI Dept of Environmental Management
 RI Department of Health
 Wood Pawcatuck Watershed Association

RI Department of Transportation
 Rhode Island Foundation
 RI Nursery and Landscape Association
 RI Resource Conservation and Development
 Council
 RI Natural History Survey
 RI Water Resources Board
 Save the Bay
 RI Surfrider Foundation
 North Kingstown Planning Department
 U.S. Fish and Wildlife Service
 URI Coastal Institute
 URI Cooperative Extension
 URI Graduate School of Oceanography
 URI Natural Resources Science
 URI Watershed Watch
 US EPA Atlantic Ecology Division
 US EPA Region 1

7. Lists of Relevant Plans/Studies

Total Maximum Daily Load Reports

Rhode Island: <http://www.dem.ri.gov/programs/benviron/water/quality/rest/reports.htm>

Massachusetts: <http://www.mass.gov/dep/water/resources/tmdls.htm>

- RIDEM Study for Bacteria for Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL (2010)
- RIDEM Fecal Coliform and Total Phosphorus TMDLs for the Kickemuit Reservoir (RI), Upper Kickemuit River(RI), and Kickemuit River (MA) (2006)
- RIDEM TMDL Study for Bacteria for Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL (2010)

Town Comprehensive/Master Plans

Rhode Island:

- Warren: <http://www.townofwarren-ri.gov/documentlibraries/draftcomprehensiveplan.html>
- Bristol: http://www.bristolri.us/community/comprehensive_plan.php

Massachusetts:

- Rehoboth: Town of Rehoboth Master Plan, 2000
- Swansea: Comprehensive Plan Town of Swansea, 2003

Stormwater Management Plans

Rhode Island:

- Bristol:
<http://www.bristolri.us/documents/community/Revised%20Phase%20II%20Storm%20Water%20Management%20Plan.pdf>
- Warren:

Onsite Wastewater Management Plans

Rhode Island:

- Warren: http://www.townofwarren-ri.gov/images/touisset_summary.pdf
- Bristol: <http://www.bristolri.us/documents/community/Bristol%20OWMP.pdf>

RI Department of Health Source Water Assessments

- ***Bristol County:***

<http://www.uri.edu/ce/wq/RESOURCES/dwater/Assessments/index.htm#AssessmentResults>

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9. Appendices

Appendix A: Detailed Watershed Maps

A-1: Detailed Base Map for the BK Watershed

A-2: Detailed Land Use Map for the BK Watershed

A-3: Potential Nonpoint Agricultural Sources within the Limits of the Palmer and Kickemuit River Watersheds

Appendix B: Water Quality Summaries

B-1: Data Summary for the Kickemuit River

Table B-1A: Summary of the 2000 Fecal Coliform and Total Phosphorus Data for the Freshwater Portion of the Kickemuit River from the RIDEM Fecal Coliform and Total Phosphorus TMDLs for the Kickemuit Reservoir (RI), Upper Kickemuit River (RI), and Kickemuit River (MA) (2006)

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Table B-1C: Summary of October, 2006 Wet-Weather Fecal Coliform Data (MPN/100 mL) From the Monitoring Program for the saltwater portion of the Kickemuit River and Mount Hope Bay

Table B-1D: Summary of Wet and Dry-Weather Fecal Coliform Data for Priority Outfalls draining to the Saltwater Portion of the Kickemuit River from the RIDEM TMDL Study for Bacteria for Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL (2010)

Table B-1E: RIDEM Shellfish Monitoring Data (2005-2010). Stations are organized from upstream to downstream reaches.

B-2: Data Summary for Mt. Hope Bay (near Bristol)

Table B-2A: Summary of Data Used in the Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL from Growing Area 17 (from RIDEM shellfish monitoring data (2007-2009))

Table B-2B: RIDEM Shellfish Monitoring Data (2005-2010).

B-3: Data Summary for Waterbodies in the Western Bristol Peninsula

Table B-3A: Summary of RIDEM Shellfish Monitoring Data for Shellfish Growing Areas 1 and 3 (2005-2010)

Table B-3B: Summary of Recent Beach Closures for Bristol Town Beach (2006-2011) and Camp St. Dorothy Beach (2006-2011). Closures based on single sample enterococci results (colonies/100mL).

Appendix C: Public Meetings and Response to Public Comments

C-1: Summary of the RI WBP Public Meeting for the DRAFT BK Watershed Plan

C-2: Summary of Public Comments Received for the DRAFT BK Watershed Plan

C-3: Action Item Handouts for the Prioritization Group Exercise at the Public Meetings in May 2012

BRISTOL-KICKEMUIT RIVER WATERSHED PLAN

*Bristol and Warren, RI
Rehoboth and Swansea, MA*

APPENDICES

November 2012

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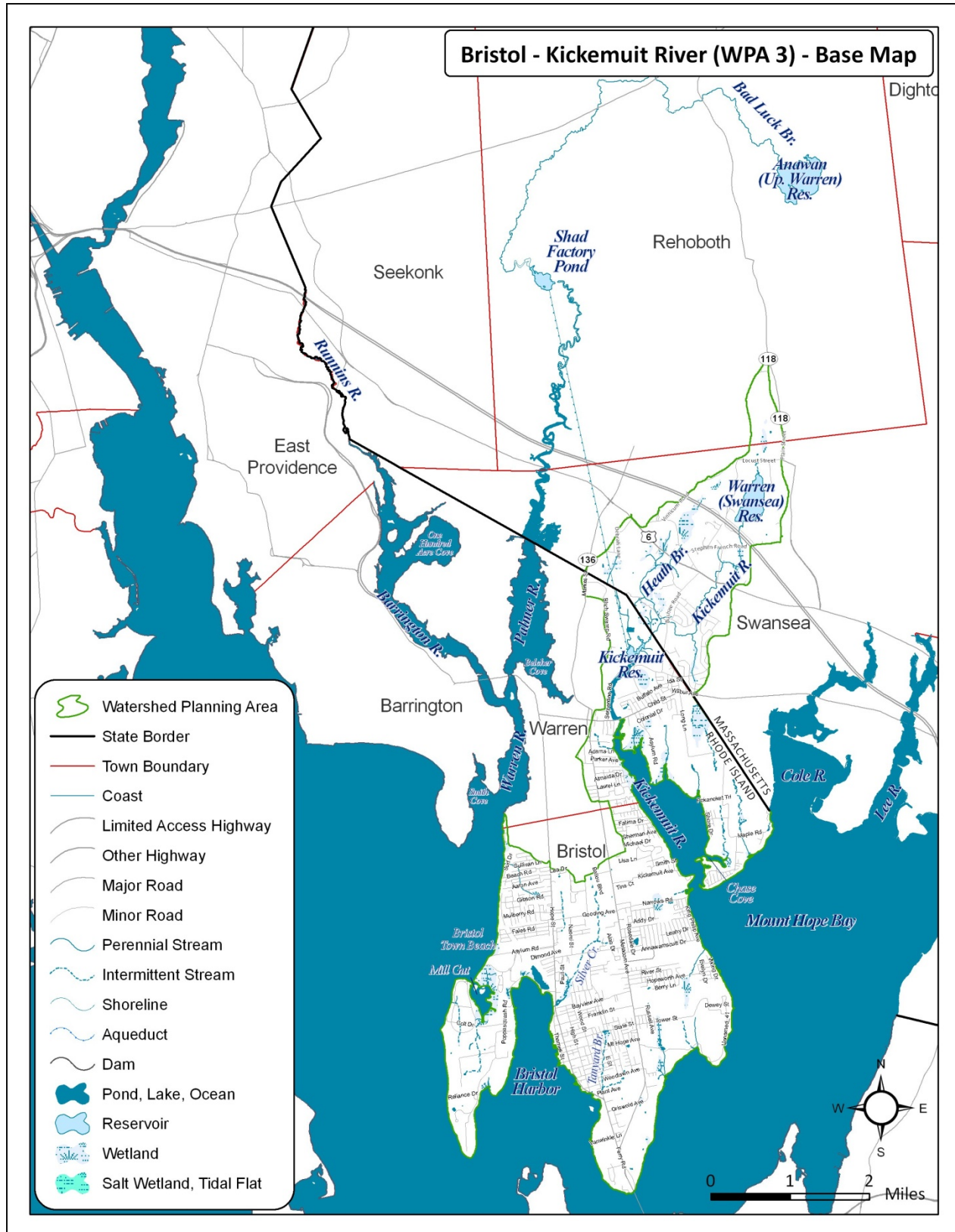
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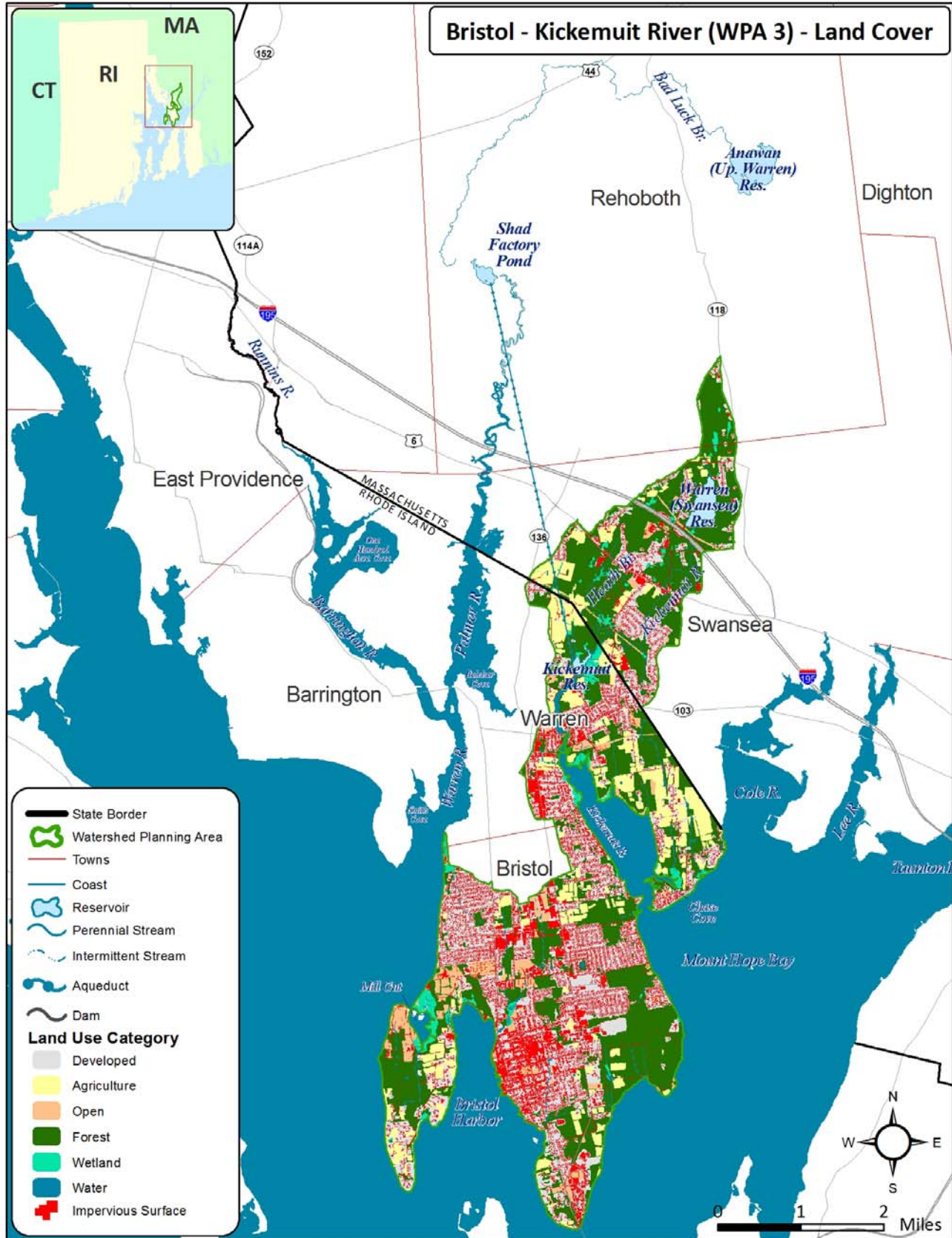
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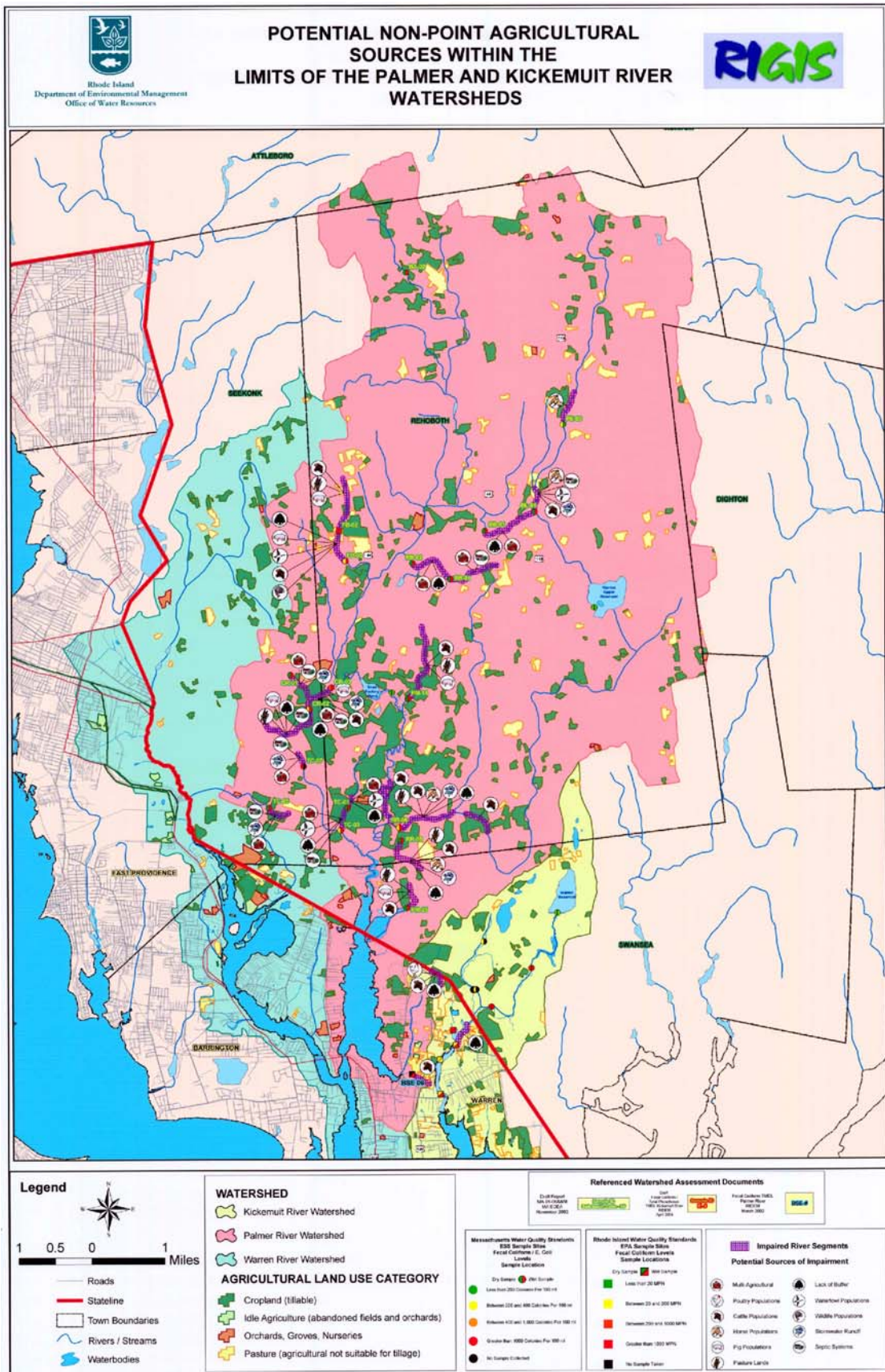
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Station	State	Location	Geometric Mean Fecal Coliform (MPN/100 mL)	Mean Total Phosphorus (µg/L)
K11	MA	Warren Upper Reservoir (Anawan)	5	24
K10	MA	Shad Factory Reservoir	90	66
K7	MA	Outlet of Warren Reservoir (Swansea)	7	28
K6	MA	Route 6 (upstream of Smoke Rise)	976	34
K13	MA	Smoke Rise Housing Development	5000	-
K5	MA	Poverty Corner Rd (DS of Smoke Rise)	2785	100
K8	MA	Unnamed Trib at MA-RI border	234	132
K9	MA	Upper Heath Brook	232	42
K3A	MA	Lower Heath Brook	20494	46
K3	RI	Upper Kickemuit River*	4899	100
K4	RI	Outlet of Upper Kickemuit Reservoir*	134	61
K2	RI	North end of Lower Kickemuit Reservoir*	59	77
K1	RI	Outlet to Tidal Waters*	84	39

MA Class B Fecal Coliform standards = 200 MPN/100 mL
*RI Class AA Fecal Coliform standards for drinking water = 20 MPN/100 mL
RI total phosphorus standards = 25 µg/L
Shaded cells indicate an exceedance of water quality standards

Table B-1B: Summary of 2006 5-Day, Wet-Weather and 2009 Dry-Weather Fecal Coliform Data for the Saltwater Portion of the Kickemuit River from the RIDEM Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL (2010) and 2010 Dry-Weather Fecal Coliform Data from the Monitoring Program

Station	2006 Wet-Weather Geometric Mean Fecal Coliform (MPN/100 mL)	2009 Dry-Weather Geometric Mean Fecal Coliform (MPN/100 mL)	2010 Dry-Weather Geometric Mean Fecal Coliform (MPN/100 mL)
GA5-1	3	4	4
GA5-2	4	5	5
GA5-3	10	4	4
GA5-4	8	4	3
GA5-5	6	3	3
GA5-6	14	3	5
GA5-7	22	4	5
GA5-8	19	3	7
GA5-9	7	4	4
GA5-10	10	-	3
RI Class SA and SA{b} shellfishing standards = 14 MPN/100mL Shaded cells indicate an exceedance of water quality standards			

Table B-1C: Summary of October, 2006 Wet-Weather Fecal Coliform Data (MPN/100 mL) From the Monitoring Program for the saltwater portion of the Kickemuit River and Mount Hope Bay

Station	October 11, 2006 (MPN/100 mL)	October 12, 2006 (MPN/100 mL)	October 13, 2006 (MPN/100 mL)	October 14, 2006 (MPN/100 mL)	October 15, 2006 (MPN/100 mL)	October 16, 2006 (MPN/100 mL)	October 17, 2006 (MPN/100 mL)	Event Mean*
GA5-1	2	9	7	2	2	2	4	4.3
GA5-2	2	93	4	2	2	2	4	17.8
GA5-3	4	9	43	4	2	2	2	10.3
GA5-4	2	23	7	2	2	2	2	6.3
GA5-5	2	9	4	9	2	2	2	4.7
GA5-6	2	230	23	4	4	2	2	44.2
GA5-7	2	430	43	4	2	2	4	81.7
GA5-8	2	430	23	22	23	9	9	86.2
GA5-9	2	93	7	2	2	2	2	18.0
GA5-10	4	43	9	4	2	2	2	10.3
* Event Mean does not include Dry-Weather data								

Table B-1D: Summary of Wet and Dry-Weather Fecal Coliform Data for Priority Outfalls draining to the Saltwater Portion of the Kickemuit River from the RIDEM TMDL Study for Bacteria for Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL (2010)

Outfall Name	Town	Maximum Fecal Coliform Concentration During Dry Weather	Maximum Fecal Coliform Concentration During Wet Weather
Broken RR Bridge at Barker Ave.	Warren, RI	43,000	15,000
Parker Ave. Box Culvert	Warren, RI	15,000	23,000
Child St., West of Bridge	Warren, RI	>24,000	Not Sampled
Parker Ave.	Warren, RI	4,300	23,000
Libby Lane	Warren, RI	23,000	21,000
Narrows Road Stream	Bristol, RI	430	2,300
RI Class SA and SA {b} shellfishing standards = 14 MPN/100 mL			
Shaded cells indicate an exceedance of water quality standards			

Table B-1E: RIDEM Shellfish Monitoring Data (2005-2010). Stations are organized from upstream to downstream reaches.

Waterbody	Station	Years	Fecal Coliform (MPN/100 mL)	
			Range	Geometric Mean
Kickemuit River	GA 5-6	2005-2010	2 - 43	3
Kickemuit River	GA 5-5	2005-2010	2 - 11	4
Kickemuit River	GA 5-10	2005-2010	2 - 15	3
Kickemuit River	GA 5-4	2005-2010	2 - 43	3
Kickemuit River	GA 5-3	2005-2010	2 - 43	4
Kickemuit River	GA 5-2	2005-2010	2 - 43	5
Kickemuit River	GA 5-1	2005-2010	2 - 15	4
RI Class SA shellfishing standards = 14 MPN/100mL				

B-2: Data Summary for Mt. Hope Bay (near Bristol)**Table B-2A: Summary of Data Used in the Mt. Hope Bay/Kickemuit Estuary Bacteria TMDL from Growing Area 17 (from RIDEM shellfish monitoring data (2007-2009))**

Waterbody	Station	Years	Fecal Coliform (MPN/100 mL)	
			Geometric Mean	90th Percentile
Mt. Hope Bay	GA 17-16	2007 - 2009	4	14
Mt. Hope Bay	GA 17-14	2007 - 2009	4	12
Mt. Hope Bay	GA 17-13	2007 - 2009	4	34
Mt. Hope Bay	GA 17-12	2007 - 2009	3	10
RI Class SA and SA {b} shellfishing standards = 14 MPN/100 mL				
Shaded cells indicate an exceedance of water quality standards				

Table B-2B: RIDEM Shellfish Monitoring Data (2005-2010)

Waterbody	Station	Years	Fecal Coliform (MPN/100 mL)	
			Range	Geometric Mean
Mt. Hope Bay	GA 17-16	2005 - 2010	2-1100	5
Mt. Hope Bay	GA 17-14	2005 - 2010	2-430	4
Mt. Hope Bay	GA 17-13	2005 - 2010	2-750	5
Mt. Hope Bay	GA 17-12	2005 - 2010	2-460	4
RI Class SA shellfishing standards = 14 MPN/100mL				

B-3: Data Summary for Waterbodies in the Western Bristol Peninsula**Table B-3A: RIDEM Shellfish Monitoring Data for the Growing Areas 1 and 3 (2005-2010)**

Waterbody	Station	Years	Fecal Coliform (MPN/100 mL)	
			Range	Geometric Mean
Western Bristol	GA 1-1	2005 - 2010	2-93	5
Western Bristol	GA1-4	2005 - 2010	2-240	5
Western Bristol	GA 1-5C	2005 - 2010	2-93	5
Western Bristol	GA 1-3C	2005 - 2010	2-43	3
Bristol Harbor	GA 3-10	2005 - 2010	2-93	3
Bristol Harbor	GA3-9	2005 - 2010	2-93	3
Bristol Harbor	GA 3-8	2005 - 2010	2-930	8
Bristol Harbor	GA 3-6A	2005 - 2010	2-240	6
Bristol Harbor	GA 3-7A	2005 - 2010	2-240	5
Bristol Harbor	GA3-7	2005 - 2010	2-43	4
Bristol Harbor	GA 3-6	2005 - 2010	2-240	4
Bristol Harbor	GA 3-5	2005 - 2010	2-240	4
Bristol Harbor	GA 3-4	2005 - 2010	2-93	3
Bristol Harbor	GA 3-3	2005 - 2010	2-21	3
Bristol Harbor	GA 3-1	2005 - 2010	2-43	3

RI Class SA and SA {b} shellfishing standards = 14 MPN/100 mL
Shaded cells indicate an exceedance of water quality standards

Table B-3B: Summary of Recent Beach Closures for Bristol Town Beach (2006-2011) and Camp St. Dorothy Beach (2006-2011). Closures based on single sample enterococci results (colonies/100mL).

Sample Date	Bristol Town Beach Enterococci Results	Bristol Town Beach Closure Date	Bristol Town Beach Re-Open Date
6/1/2011	379	6/2/2011	6/6/2011
8/16/2010	754	8/17/2010	8/19/2010
6/23/2010	1071	6/24/2010	6/25/2010
6/7/2010	389	6/8/2010	6/10/2010
8/19/2009	496	8/20/2009	8/25/2009
7/24/2009	336	7/24/2009	7/25/2009
7/2/2009	301	7/2/2009	7/4/2009
6/22/2009	327	6/23/2009	6/25/2009
8/12/2008	638	8/13/2008	8/15/2008
6/25/2008	247	6/26/2008	6/27/2008
6/2/2008	794	6/5/2008	6/6/2008
8/9/2007	364	8/10/2007	8/15/2007
6/5/2007	241	6/5/2007	6/6/2007
8/28/2006	246	8/29/2006	8/31/2006
6/26/2006	880	6/26/2006	7/1/2006
6/15/2006	341	6/16/2006	6/17/2006
6/5/2006	1043	6/6/2006	6/13/2006
Sample Date	Camp St. Dorothy Beach Enterococci Results	Camp St. Dorothy Beach Closure Date	Camp St. Dorothy Beach Re-Open Date
7/14/2010	143	7/15/2010	7/20/2010
7/26/2006	3811	7/27/2006	8/2/2006
RI Class SA Primary Contact/Recreational Swimming Standard = 104 colonies/100 mL			
Shaded cells indicate an exceedance of water quality criteria			

Appendix C: Public Meetings and Response to Public Comments

C-1: Summary of the RI WBP Public Meeting for the DRAFT BK Watershed Plan

C-2: Summary of Public Comments Received for the DRAFT BK Watershed Plan

C-3: Action Item Handouts for the Prioritization Group Exercise at the Public Meetings in May 2012

C-1: Summary of the RI WBP Public Meeting for the DRAFT BK Watershed Plan

DRAFT - MEMORANDUM

To: RI/MA Bristol-Kickemuit River WBP Stakeholders

From: FB Environmental Associates

Subject: Bristol-Kickemuit River WPA Draft watershed-based plan public meeting – May 9th 2012

Date: June 14, 2012

This memo summarizes the RI WBP public meeting for the draft watershed-based plan for the Bristol-Kickemuit River watershed planning area (WPA). The meeting was held at the Burnside Memorial Building in Bristol, RI on Wednesday, May 9, 2012 and ran from 2-5 PM.

At this meeting, it was essential to get the attendees opinions on how to best move forward with improving water quality within the WPA. Two key aspects of the meeting were the detailed discussion of action items for the WPA and the public's comments on the plans. The draft plan was modified to incorporate the action items and comments made at the meeting. Where and how the changes were made to the draft plan are outlined within this memo under the sections "summary of action item prioritization exercise" and "summary of important questions / comments raised in the meeting."

Attendees – 24 Attendees

Ann Morrill - Kickemuit River Council – annmorrill@verizon.net

Owen E. Trainor III - Bristol Conservation Commission – ispoke2000@yahoo.com

Wenley Ferguson - Save The Bay – wferguson@savebay.org

Richard Fennessy – Bristol County Water Authority – rfennessy_bcwa@msn.com

Diane Williamson – Town of Bristol Community Development Director – dianew@bristolri.us

Stan Dimock – Save The Bay – sdimock@savebay.org

Bob Aldrich – Save Bristol Harbor – bbaldrich@gmail.com

Don Pryor – Brown University – Donald_Pryor@brown.edu

James Boyd – RI Coastal Resources Management Council – jboyd@crmc.ri.gov

Jessica Blackledge – Eastern RI Conservation District – info@easternriconservation.org

Everett Castro – Green Futures – info@greenfutures.org

Colleen Brown – Swansea Conservation Commission – swanseaconcom@aol.com

Steven Roth – Kickemuit River Council – stevenroth@verizon.net

Keith Maloney – Save Bristol Harbor – ekm2x@cox.net

Ray Payson – Bristol Conservation Commission – ray_payson@earthlink.net
Sarah Klein – Town of Bristol Parks and Rec. Dept. – sarahk@bristolri.us
Walter Burke – Town of Bristol Parks and Rec. Dept. – wburke@bristolri.us
Patrick Barosh – Consulting Geologist from Bristol – pjbarosh@fullchannell.net
Caroline Wells – Town of Warren Senior Planner – cwells@townofwarren-ri.gov
Kenneth Booth – Bristol County Water Authority – kbooth@bcwari.com
Amie Parris – RI Department of Health – amie.parris@health.ri.gov
Edward Tanner – Town of Bristol Planner – etanner@bristolri.us
Jennifer West – Narragansett Bay Research Reserve – Jennifer@nbnerr.org
Margherita Pryor – US EPA - Pryor.Margherita@epamail.epa.gov
Ernie Panciera – RIDEM - Ernie.Panciera@DEM.RI.GOV
Elizabeth Scott – RIDEM - Elizabeth.Scott@DEM.RI.GOV
Betsy Dake – RIDEM - elizabeth.dake@DEM.RI.GOV

Summary of responses to Keypad Polling Questions

1.) I am from:

- Rhode Island, watershed resident: **45%**
- Massachusetts, watershed resident: **0%**
- Rhode Island, non-watershed resident: **37%**
- Massachusetts, non-watershed resident: **11%**
- Away: **7%**
- **27 responding**

2.) As a watershed stakeholder, I am a:

- Non-profit: **22%**
- Municipal official: **26%**
- State official: **19%**
- Other Professional: **19%**
- Interested Resident: **7%**
- Other: **7%**
- **27 responding**

3.) What priority is stormwater and LID?

- Not worth pursuing: **0%**
- Worth doing a little: **4%**
- Medium priority: **26%**
- Highest Priority: **70%**
- **27 responding**

4.) What priority is Wastewater?

- Not worth pursuing: **0%**
- Worth doing a little: **0%**
- Medium priority: **48%**

- Highest Priority: **52%**
- **25 responding**

5.) What priority is drinking water, land conservation, and agriculture?

- Not worth pursuing: **0%**
- Worth doing a little: **4%**
- Medium priority: **27%**
- Highest Priority: **69%**
- **26 responding**

6.) What priority is governance and monitoring?

- Not worth pursuing: **0%**
- Worth doing a little: **4%**
- Medium priority: **31%**
- Highest Priority: **65%**
- **26 responding**

7.) How would you rank these sectors (which one do you see as the MOST important)?

- Stormwater / LID: **50%**
- Wastewater: **4%**
- Drinking water, land conservation, agriculture: **32%**
- Governance and monitoring: **14%**
- **22 responding**

Summary of Action Item Prioritization Exercise

After the presentation of the plans there was a group exercise to prioritize the action items for the Bristol-Kickemuit River WPA. The attendees volunteered to be in one of four groups for the prioritization exercise based off the following sectors:

- Stormwater and Low Impact Development (LID),
- Drinking Water / Land Conservation / Agriculture,
- Wastewater, and
- Governance and Monitoring.

The four groups were given handouts containing action items for their sector, taken directly from the watershed based plan. The handouts for each sector are attached at the end of this memo. The action items included a description, an estimate of the value added, and an estimate for the cost of implementing the action item. The cost estimates were broken down as follows: \$ = expected to cost less than \$25,000 to implement, \$\$ = expected to cost approximately \$25,000 to \$100,000 to implement, and \$\$\$ expected to cost over \$100,000 to implement. Attendees were encouraged to come up with their own action items, beyond those provided on the hand outs. When a new action item was added to the list, the group

discussed the estimated cost to implement the action item, and it was assigned an appropriate number of dollar signs.

Before the attendees were broken up into groups, the sectors were assigned a number of poker chips. A total of 52 poker chips were assigned and they were distributed based roughly off the percentage of the attendees that felt the sector was the most important. The poker chips were used by the groups to “fund” their most important action items. One poker chip was equal to one \$. The cumulative total of \$ from the groups action items could not exceed the number of poker chips they were assigned

Since stormwater / LID received 50% of the vote, that sector was initially assigned 25 poker chips. Two chips were “donated” to wastewater and two chips were “donated” to drinking water, land conservation, agriculture, giving stormwater / LID a total of 21 poker chips. Wastewater received only 5% of the vote and was initially assigned three poker chips. Since that was such a small amount, they took out a “loan” for two poker chips, and the two “donated” from stormwater / LID, gave wastewater a total of seven poker chips. Drinking water, land conservation, agriculture received 31% of the vote and was initially assigned 15 poker chips. With the two chips “donated” from stormwater / LID gave the group a total of 17 poker chips. Governance and monitoring received 14% of the vote and was assigned seven poker chips.

Individuals in each group were given a chance to discuss the action items they felt were the most important for their sector. The group facilitator placed all of the discussed items on a flip chart. The groups then decided the specific action items they would “fund” with their allotted poker chips. This forced the groups to pick the highest priority action items for their sector within a hypothetical budget. Having a prioritized list of action items is an important step in implementing a watershed based plan. Below are the results from the prioritization exercise for each sector (in no particular order).

Stormwater and LID – (21) \$

- Form a stormwater utility in Bristol, and other watershed towns - \$\$\$
 - **Reference to a stormwater utility is included in the plan in Section 6.1.2 and in Table 6-1.**
- Develop BMPs for the primary outfalls identified in each of the watershed towns - \$\$\$
 - **Action item is already included in Table 6-1.**
- Increase education efforts pertaining to stormwater issues in the watershed for local residents - \$
 - **Action item is already included in Table 6-1.**
- Improve the enforcement for Bristol’s ordinances pertaining to stormwater BMP maintenance in the town. In order to do this, the town may need to add staff specific for this task - \$\$\$
 - **Action item added to Table 6-1.**
- Implement restoration efforts on impacted wetlands along Silver Creek in Bristol - \$\$\$
 - Action item added to Table 6-1.

- Implement LID retrofits and stormwater best management practices (BMPs) at the Mt. Hope High School in Bristol - \$\$\$
 - Action item added to Table 6-1.
- Move forward with restoration efforts to return portions of the Bristol Golf Course into a wetland - \$\$
 - Action item added to Table 6-1.
- Move forward with plans to implement retrofits and BMPs at dead end roads in Bristol that end at Narragansett Bay or Bristol Harbor. The Town of Bristol and Save the Bay are currently collaborating on these projects - \$\$\$
 - Action item added to Table 6-1.

Drinking Water / Land Conservation / Agriculture – (17) \$

- Increase outreach to farmers. Recruit farmers interested in water quality to do outreach within farming community. Provide a list of financial incentives to farmers for implementing agriculture BMPs - \$\$
 - Action item added to Table 6-4.
- Develop nutrient management plans and designated BMPs for farms to decrease nutrient and pollutant loads to surface waters - \$\$
 - Action item added to Table 6-4.
- Better understand the geology and hydrology of the watershed - \$\$\$
 - Action item added to Table 6-4.
- Develop list of critical land parcels to protect by looking at what is available in the watershed, going to town councils to get extra funding, and protecting smaller natural parcels in more developed areas - \$\$\$
 - Action item added to Table 6-4.
- Develop geese management plans for drinking water reservoirs - \$\$
 - Action item added to Table 6-4.
- Reclassify Kickemuit River in MA to protect drinking water for RI - \$
 - Action item already included in Table 6-4.
- Create a “Watershed Protection Network” of interested citizens and organizations - \$\$
 - Action item already included in Section 6.1.1.
- Increase education at the earliest level - \$\$
 - Action item added to Table 6-1.

Wastewater – (7) \$

- Implement the recently approved Warren Onsite Wastewater Management District Plan - \$\$
 - Action item already included in Table 6-2.
- Create ordinance for mandatory tie in to sanitary sewer for properties that area adjacent to a sewer line - \$
 - Action item added to Table 6-2.

- Continue to reduce the inflow/infiltration of the sanitary sewer pipes by relining the sewer system - \$\$\$
 - Action item added to Table 6-2.
- Increase education and outreach (in layman's terms) within localized programs for the water quality issues brought about by wastewater - \$
 - Action item added to Table 6-2.

Governance and Monitoring – (7) \$

- Create a watershed planning area-wide organization with a focus on drinking water supplies, communication amongst towns and organizations, and implementing the watershed-based plan. This organization must have authority - \$\$
 - Action item already included in Section 6.1.1.
- Support non-profit and volunteer monitoring programs that work to connect schools and municipal entities and expand upon the existing monitoring in the watershed - \$\$
 - Action item included in Section 6.1.4.
- Provided area residents more public access to local regulations and existing plans for waterbodies in the WPA - \$
 - Action item added in Table 6-4.
- Support the investigation of regional stormwater management district, and a regional onsite wastewater management district - \$
 - Action item included in Section 6.1.3.

Summary of important questions / comments raised in the meeting and responses

- Comment: Massachusetts is not doing enough to protect Rhode Island's drinking water resources located in Massachusetts. Specifically, the freshwater portion of the Kickemuit River, the Kickemuit Reservoir, and the Warren (Swansea) Reservoir are located in MA and provide drinking water to Warren and Bristol, RI. To better protect Rhode Island's drinking water, the MA DEP should reclassify the drinking water resources to require more stringent regulations on development and land use practices surrounding these waterbodies. The plan should say that MA DEP needs to provide better protections for RI drinking water resources.
 - Response: RIDEM has tried to work with MA DEP in the past on this issue. MA DEP claims that its current classifications on these waterbodies provide adequate protections for RI's drinking water. MA DEP claims that the regulations pertaining to its current classifications on these waterbodies provides the same level of protection that RI gives to surface drinking water resources located within RI. RIDEM will look into those regulations.
 - Response: It is important for citizens to speak up and talk with local, state, and federal regulators about this issue. It is important for the EPA understands how important this issue is for Bristol and Warren, RI.
 - Response: Colleen Brown, the Conservation Agent for Swansea, MA spoke briefly about how she would like to better protect the RI drinking water resources located in Swansea. Sadly, given the regulations, she does not have the authority to regulate development near these waterbodies in the

same way she can regulate development surrounding MA drinking water sources. If the waterbodies provided drinking water to MA residents, then she would be able to enforce stricter regulations on development adjacent to these waterbodies.

- Question: Silver Creek in Bristol is not listed as impaired in the plans, why is it not listed as impaired and what is its classification?
 - Response: All waters in the state are classified and Silver Creek does have a classification, most likely B. The reason why it is not listed as impaired is because 1) the data collected in Silver Creek is sufficient to prove that it meet its designated class, or 2) there is not sufficient data to determine if Silver Creek meets its classification.
 - Response: *Save Bristol Harbor* appears to have collected quite a bit of data on Silver Creek as part of their habitat model they are working on in collaboration with URI and others. This data should be provided to RIDEM, who will consider that information as a possible basis to formally list Silver Creek as impaired on the 303d list.
- Comment: The use of the term “impaired” seems very narrow in scope here. There are areas not shown as “impaired” which we know do not contain clean water.
 - Response: The term “impaired” is used in the sense of formal listing under the Clean Water Act by RIDEM, which undergoes review and approval by EPA every two years. “Impaired” means that the water body did not meet specific water quality criteria associated with a given designated use (for example, shellfishing, or recreation). Not all waters have every designated use, and not all waters in Rhode Island have been evaluated for every possible criterion. It is true that “impaired” has a very specific meaning here.
- Question: Bristol Harbor is not shown as impaired on the map with impairments. Since shellfishing is prohibited in portions of Bristol Harbor, why is it not shown as impaired?
 - Response: Bristol Harbor is not listed as impaired due to the shellfish bed closures, because shellfishing is not one of its designated uses due to a wastewater treatment facility (WWTF) outfall in the area. The impairments shown on the map represent designated use impairments. In order for a waterbody to have a designated impairment, it must be impaired for a specific water quality designation. Since shellfishing is not one of the designated uses for that portion of Bristol Harbor, it is not considered impaired, even though shellfishing is prohibited.

Summary of Next Steps – Who will move this plan forward and how can that be done?

- At the end of the meeting, time did not allow for a detailed discussion of next steps for the watershed planning area. However, a detailed next steps discussion did occur at the meeting for the Barrington-Palmer-Warren River’s watershed planning area. The following points are applicable to the Bristol-Kickemuit WPA:
 - The Eastern RI Conservation District will be working with representatives from RIDEM about how to move forward with implementing the watershed-based plan.
 - There are other state and federal organizations in the area that have expertise in water quality. The RI Department of Health, RI Coastal Resources Management Council, and NRCS are a few examples of organizations that can be counted on to help move the process forward.

- The US EPA would like to provide support for this plan as local individuals and organizations move to implement the plan. EPA can help facilitate discussions and look for funding sources to help with implementation.
-
- RIDEM would like to hold an annual meeting and stay in touch with individuals / organizations interested in administering the watershed-based plan. This will help to keep an organizational structure and to keep the momentum moving in the right direction.
- **Individuals that are interested in receiving more information on how they can help to move the planning process forward should contact Ernie Panciera at RIDEM: Ernie.Panciera@DEM.RI.GOV. mailto: This way a list of interested individuals can be generated and a committee can be formed to help guide this process.**

C-2: Summary of Public Comments Received for the DRAFT BK Watershed Plan



MEMORANDUM

To: Ernie Panciera (RIDEM), Margherita Pryor and Steve Winnett (EPA)

From: Patrick Marass (FBE)

Subject: Public Comments for Barrington-Palmer-Warren and Bristol-Kickemuit watershed-based plans

Date: June 14, 2012

cc: Forrest Bell, Cayce Dalton, and Emily DiFranco (FBE)

Introduction

This memo summarizes the public comments received by FB Environmental for the Barrington-Palmer-Warren (BPW) and the Bristol-Kickemuit (BK) watershed-based plans. The public comment period closed on Saturday, May 26, 2012. This memo is organized as follows: the watershed-based plan the comments were made for, the person submitting the comments and their affiliation, the exact text of the comment, and then FBE's plan on addressing the comment. A total of nine individuals submitted written comments to FBE during the public comment period.

Public Comments for both Plans

Submitted by: James Boyd – RI Coastal Resources Management Council - jboyd@crmc.ri.gov

- **Comment:** I think both watershed plans should note in the Stormwater Implementation Sections (5.1) that pending RI legislation (S2445a) would authorize municipalities to adopt ordinances requiring compliance of any development with the RI Stormwater Manual. See: <http://www.rilin.state.ri.us/BillText12/SenateText12/S2445A.pdf>. I think the notation could also be made in Section 6.1 for local city/town implementation.
 - **Response to Comment :** Added a reference within Section 5.1 (Stormwater) in both plans. Also, included a footnote in Section 6.2.1 (Improving Stormwater Management at the Municipal Level) explaining that pending the above legislation, municipalities will have the ability to regulate any new development by requiring compliance with the RI Stormwater Manual.

Submitted by: Ken Orenstein – Providence, RI - kenorenstein@gmail.com

- **Comment:** A number of years ago, as I was driving on Interstate 88 east of Binghamton, NY, I noticed a roadside sign reading “Entering Chesapeake River Watershed.” I thought how brilliant, I wondered how many people living in/driving thru this area of New York’s Southern Tier realize that anything that drains

into a storm sewer ends up two states and hundreds of miles away in Chesapeake Bay. As you emphasize in your report reported on the Sundays ProJo, a large portion (the largest, I believe) of the Narragansett Bay

watershed is in Massachusetts. How many people understand or appreciate the extent of the watershed. Hundreds of thousands of vehicles a day drive up/down 95, 195, 495 and various RI and Mass state roadways. Putting signs on these roads reading “entering Narragansett Bay Watershed” would help them to do so and remind them every time they drive past the sign.

- **Response to Comment:** In Table 6-4 (Other Action Items for Improving Water Quality) an Action Item was added: “Increase awareness about the extent of the watershed-planning areas by placing informational signs throughout the watershed-planning area.”

Submitted by: Jean Burritt Robertson - burrittrobertson@fullchannel.net

- **Comment:** All in all good plans with nice graphics. Not sure that it needs to be part of the plan but it would be good to have guidance for property owners as to types of plantings that are best for properties that abut the water, like Hundred Acre Cove. Many people want to do the right thing but there is often conflicting information on planting and no clear guidance and no clear guidance for the average homeowner. Particularly for waterfront properties it would be helpful to have a list of desired plantings as well as information on where to source them. Where is Massachusetts? It seems based on the data that no real solution to the pollution can be secured without the active participation and commitment of Massachusetts communities within the watershed.

- **Response to Comment:** In Table 6-5 (Small-Scale Actions to Improve Water Quality at the Local Level) there is already a reference to how landowners can help protect water quality through vegetated buffers. Added a reference to the RI Coastal Resources Management Councils “Coastal Buffer Planting Guide” to help landowners understand what plants would be native to the area.

Submitted by: Jennifer West – Narragansett Bay Research Reserve – Jennifer@nbnerr.org

- **Comment:** In lines 5 and 6, section 5.2.1, it should read “...Rhode Island Low Impact Development Site Planning and Design Guidance Manual (March 2010), is ...”
 - **Response to Comment:** The change suggested above was made in both plans. However, the date used was March 2011.
- **Comment:** Consider mentioning protected open space within cluster and conservation subdivisions in section 5.4.2 (b/c Bristol has adopted Conservation Development and Warren is considering it). It is another way that communities can protect substantial amounts of open space (for ex. 40% of North Kingstown’s total amount of protected open space is held in cluster and conservation subdivisions). A helpful resource is the “Rhode Island Conservation Easement Guidance Manual” http://www.nbwctp.org/programs/easements_openspace.html. In addition to providing information on how conservation easements are drafted, reviewed, put into action, and effectively enforced, it also goes into detail on how to manage, monitor, and steward such parcels (it includes an example of a property management plan and a checklist, a baseline documentation report checklist, and a sample stewardship endowment calculation worksheet).
 - **Response to Comment:** The above document was mentioned in Section 5.4.2 in both plans.

- **Comment:** 1st line of 1st paragraph of section 6.2.1 - non-structural BMPs are really land-use planning techniques such as conservation development, minimizing clearing and grading, minimizing impervious cover via shorter and narrower roads, etc. Public education, etc is really a category of its own.
 -
 - **Response to Comment:** Examples of the land-use planning non-structural BMPs mentioned in the comment above were added to Section 6.2.1 in both plans. Non-structural BMPs are not only land-use planning techniques and also include maintenance, changing public behavior, and public education. Therefore, those examples of non-structural BMPs should not be removed from this section and added to another, as requested in the comment.
- **Comment:** Sections 6.3 and 7.2.3- is there a reason why only those groups are mentioned? There are quite a few other organizations in RI and MA that are working on these issues and provide training and technical assistance to communities. If you'd like to add more, please let me know and I can send you a blurb about my program and have my partners do the same.
 - **Response to Comment:** A paragraph about NBNERR was added to Section 6.3 and the organization was listed in Section 7.2.3 in both plans.
- **Comment:** In the references section I noticed that the LID Manual (mentioned above) isn't included. You might also want to include the RI Conservation Easement Guidance Manual as a reference.
 - **Response to Comment:** A reference for both manuals was added to the References Section of both plans.

Public Comments for the BK Plan

Submitted by: Ann Morrill – Kickemuit River Council 1st VP – annmorrill@verizon.net

- **Comment:** Pat, I just found out Massachusetts does not have any regulations about boats discharging fecal waste into waters. This is incredible. I think the plan should mandate that in Mt. Hope Bay & Rivers that empty into it. We have worked so hard to control fecal counts. Please include that suggestion for MA DEP.
 - **Response to Comment:** This suggestion is already made in the plan. Table 6-4 includes an action item titled “Create a No Discharge Zone for boats in MA portions of Narragansett Bay, and support installation of marine pump-out facilities” the listed responsibility is “MADEP.”

C-3: Action Item Handouts for the Prioritization Group Exercise at the Public Meetings in May 2012

Stormwater			
Action Item	Timeframe	Value Added	Cost
Complete mapping of stormwater outfalls discharging to Kickemuit Estuary	1-2 years	***	\$
Submit Phase II Stormwater Management Plans and general permits, as required	Ongoing	***	\$
Update SWMPP addressing the TMDL Phase II provisions.	1-2 years ¹	***	\$
SWMPP Modification Public Education /Outreach specifically about stormwater and the pollutant of concern/Impairments.	1-2 years ¹	***	\$
SWMPP Modification Prioritize IDDE work within the catchments associated with priority outfalls and streams.	1-2 years ¹	***	\$
SWMPP Modification Revisions to post construction ordinance to ensure that 1) new land development employs controls to prevent any net increase in bacterial pollution and 2) redevelopment employs controls to reduce bacterial pollution to the maximum extent practicable.	1-2 years ¹	***	\$
Complete Catchment Area Analysis and Design Work for TMDL identified priority outfalls and streams.	5-10 years	**	\$\$\$
Construct BMP's for priority outfalls.	5-10 years	***	\$\$\$
Develop a comprehensive inventory of storm drains discharging directly to the river and major tributaries of the Kickemuit River	2-5 years	***	\$\$
As wastewater system upgrades are completed, test priority outfalls for coliphage and bacteria to assess progress	Ongoing	**	\$
Conduct feasibility study for filtration/infiltration stormwater BMPs in priority catch basin areas	1-2 years	*	\$
Form a stormwater utility	5-10 years	***	\$\$\$
Conduct a minimum of two dry weather surveys	Ongoing	**	\$
Conduct annual cleaning of all catch basins in the town	Ongoing	**	\$\$
Monitor discharges from the water/sewer pipe underdrain system for bacteria to prioritize inflow and infiltration reduction work.	Ongoing	*	\$
Construct Stormwater BMPs along Serpentine Road in Warren	5-10 years	***	\$\$\$

*** Provides maximum progress towards improving water quality, due to strategic value, large geographic scope, or scale of pollutant source being addressed.

** Provides broad opportunity to improve water quality.

* Provides localized improvement to water quality, or addresses smaller pollutant sources.

\$\$\$ Expected to cost over \$100,000

\$\$ Expected to cost approximately \$25,000 to \$100,000

\$ Expected to cost less than \$25,000

Low Impact Development			
Action Item	Timeframe	Value Added	Cost
As it becomes available, use the Bristol Harbor Habitat Model and associated regional expertise when evaluating land use management options	Ongoing	***	\$
Consider zoning and/or purchase options to restore wetlands and their natural flood mitigation and water quality improvement functions to the landscape	5-10 years	***	\$\$\$
Identify and adopt ordinances necessary to advance LID	2-5 years	***	\$
Adopt ordinances requiring stormwater volume reductions for commercial and industrial redevelopment	1-2 years	***	\$
Develop a conservation development ordinance for Warren	2-5 years	**	\$
Continue developing GIS data and capacity within towns to enhance education and strategic planning regarding land use	Ongoing	**	\$
Form a volunteer citizen committee to review and propose updates to comprehensive plan and town ordinances to advance LID, in order to overcome budget limitations.	1-2 years	**	\$

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\$\$\$ Expected to cost over \$100,000

\$\$ Expected to cost approximately \$25,000 to \$100,000

\$ Expected to cost less than \$25,000

¹ Depending on DEM reissuance of the revised Phase II General Permit for MS4s

Wastewater			
Action Item	Timeframe	Value Added	Cost
Implement onsite wastewater management plan to help ensure the few hundred homes in Bristol have safe wastewater treatment	2-5 years	**	\$
Develop a web-based tracking system for all OWTS in town	2-5 years	**	\$\$
Support the recently created onsite wastewater management district in Warren by implementing and administering its provisions	2-5 years	***	\$\$
If high bacteria levels are found in outfalls to the river and major tributaries of the Kickemuit River and tributaries, search for cross-connections from wastewater pipes	Ongoing	**	\$
Continue to reduce inflow and infiltration in area sanitary sewers	5-10 years	***	\$\$\$
Accelerate upgrades at wastewater treatment plants	5-10 years	***	\$\$\$
Conduct additional sanitary sewer investigations to identify areas for connection	2-5 years	***	\$\$\$
Require all residences near sanitary sewer lines to be hooked up to sewer system	2-5 years	***	\$\$\$

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Agriculture			
Action Item	Timeframe	Value Added	Cost
Work with the USDA, NRCS, and local Conservation Districts to prepare farm management plans	1-5 years	***	\$\$
Distribute educational materials to local farms outlining actions they can take to reduce their impact on surface waters	Ongoing	***	\$
Apply for grants to install BMPs to control water pollution	1-5 years	**	\$
Control sediment erosion, and manure/fertilizer runoff, and limit livestock access to streams in the watershed planning area	1-2 years	**	\$
Land Conservation			
Action Item	Timeframe	Value Added	Cost
Collaborate with local land trusts in their purchase and stewardship of shoreline conservation lands, which can help protect water quality	Ongoing	***	\$\$\$
Increased education of environmental and watershed initiatives, such as zoning changes, grant-funded initiatives, and conservation	Ongoing	*	\$
Encourage land management, education, enforcement, and other measures to reduce nuisance waterfowl	Ongoing	*	\$
Drinking Water Source Protection			
Action Item	Timeframe	Value Added	Cost

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\$ Expected to cost less than \$25,000

Watershed Governance/Monitoring			
Action Item	Timeframe	Value Added	Cost
Form a watershed-wide organization/steering committee to implement priority actions for the BK watershed planning area	1-5 years	***	\$
Form a stormwater utility for the BK watershed planning area	5-10 years	***	\$\$\$
Form an onsite wastewater management district for the BK watershed planning area	5-10 years	***	\$\$\$
Create a plan for inter-municipal water quality monitoring efforts to identify priority areas in the BK watershed planning area	1-5 years	**	\$
Create a formal agreement between RI and MA to guide water quality planning for Narragansett Bay	2-5 years	**	\$\$
Examine land use patterns and flow response to storms, and set specific target levels for runoff	1-5 years	***	\$\$
Support non-profit and volunteer monitoring programs	5-10 years	**	\$
Educate public on success of Bristol Town Beach stormwater upgrades among beach goers, residents, and neighboring municipalities	2-5 years	***	\$
Support connections between water quality science and municipal government as local schools participate in monitoring programs	2-5 years	**	\$
Consider seeking a volunteer citizen committee to review and propose updates to comprehensive plan and town ordinances, in order to overcome budget limitations in this area	1-2 years	**	\$
Create a No Discharge Zone for boats in MA portions of Narragansett Bay, and support installation of marine pump-out facilities	2-5 years	*	\$\$

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