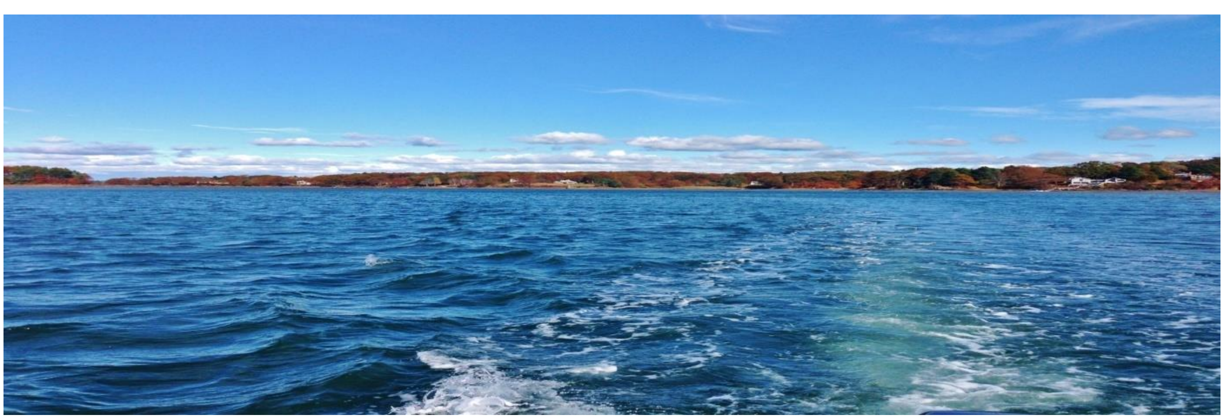
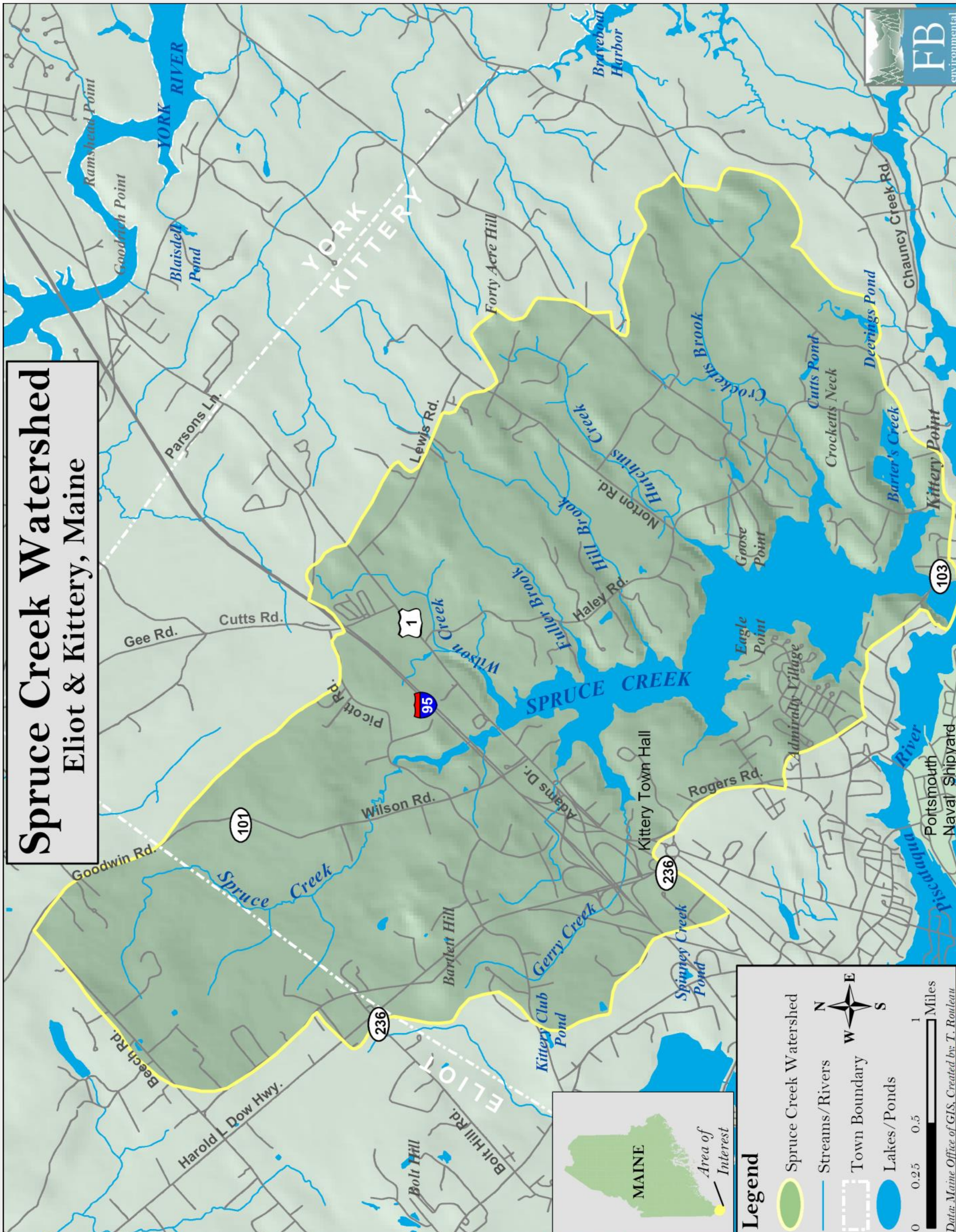
SPRUCE CREEK

Watershed-Based Management Plan

Kittery & Eliot, Maine



FB environmental


Spruce Creek Watershed
Eliot & Kittery, Maine
Legend
Spruce Creek Watershed
Streams/Rivers
Town Boundary
Lakes/Ponds
0 0.25 0.5 1 Miles
Data: Maine Office of GIS, Created by: T. Rouleau
MAINE
Area of Interest
YORK
KITTERY
ELIOT
SPRUCE CREEK
Spruce Creek
Wilson Creek
Fuller Brook
Hill Brook
Hutchins Creek
Crocketts Brook
Barter's Creek
Gerry Creek
Spinney Creek Pond
Kittery Club Pond
Cutts Pond
Deerings Pond
Blaisdell Pond
YORK RIVER
Piscataqua River
Portsmouth Naval Shipyard
Kittery Town Hall
Eagle Point
Goose Point
Admiralty Village
Crocketts Neck
Kittery Point
Brave Boat Harbor
Forty Acre Hill
Bartlett Hill
Bolt Hill
Ramshead Point
Goodrich Point
Goodwin Rd.
Wilson Rd.
Adams Dr.
Rogers Rd.
Picott Rd.
Gee Rd.
Cutts Rd.
Parsons Ln.
Lewis Rd.
Norton Rd.
Haley Rd.
Chauncy Creek Rd.
Beech Rd.
Harold L. Dow Hwy.
Bolt Hill Rd.
101
236
103
1
95

Spruce Creek Watershed-Based Management Plan

Prepared by FB Environmental Associates

in cooperation with the Towns of Kittery and Eliot,

and the Spruce Creek Association.

March 2008

Updated in 2014

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1. Executive Summary

1.1 Plan Background

***TMDL**: An acronym for Total Maximum Daily Load, which represents the total amount of a pollutant (e.g., bacteria) that a waterbody can receive whilestill meeting water quality standards.*

***Nonpoint Source (NPS) Pollution:** Polluted runoff that cannot be traced to a specific source, but comes from many different watershed sources. NPS pollution is often delivered to a waterbody in stormwater runoff. Examples of NPS pollution include bacteria and nutrients from malfunctioning septic systems and sediment from eroding soil.*

Due to poor water quality, Spruce Creek is listed in Maine's 2012 Integrated Water Quality Monitoring and Assessment Report (303d) as impaired under Category 4-A: Estuarine & Marine Waters with Impaired Use (TMDL completed). The impairment refers to the Spruce Creek estuary near the Piscataqua River and is listed due to elevated levels of fecal indicator bacteria. This body of water is also identified by the Maine DEP as one of 17 Nonpoint Source Priority Coastal watersheds due to bacterial contamination, low dissolved oxygen, toxic contamination, and a compromised ability to support commercial marine fisheries. The Spruce Creek watershed is also listed by the DEP as one of seven Coastal watersheds most at risk from development in the state.

Development of a watershed management plan is a key step in watershed management, leading to restoration of a polluted or otherwise impaired waterbody. To this end, the Spruce Creek Association (SCA) and the Towns of Kittery and Eliot developed the Spruce Creek Watershed-Based Management Plan in 2008, which served as a blueprint for restoring and protecting the estuary. Incorporating input from stakeholders, this plan identified the most pressing problems in the Spruce Creek estuary and established goals, objectives, and actions for resolving them. The plan also contained strategies for monitoring progress and financing implementation.

View of Spruce Creek from Duncan Rd., off Rte. 103. (Photo: Rachel Bell, 2007)

Since the development of the plan in 2008, many of the actions outlined in the plan have been addressed. One goal of the original plan was to assess progress in five years. In 2013, the Town of Kittery funded the revision of the original plan to include a detailed assessment of all actions taken to protect and restore water quality to Spruce Creek. This new plan is the product of that work. Where appropriate, the original plan was left intact. With the exception of the Executive Summary, revisions to the plan are noted in bold italics throughout the plan.

1.2 Description of Watershed

The Spruce Creek watershed (HUC Code 01060003) is an ecologically and economically significant estuarine resource in southern Maine supporting a diverse array of recreational and commercial water-based activities. Spruce Creek originates in Eliot where three small, unnamed brooks converge. As it enters Kittery it becomes tidal. After passing under the I-95 and Route 1 bridges, it widens and flows in a south and southeasterly direction for two miles through Kittery, to the Piscataqua River, which forms the border between Maine and New Hampshire. The watershed area consists of a variety of land uses including forested, developed, agriculture, and wetlands.

1.3 Plan Goals and Objectives

The goal of the Spruce Creek Watershed-Based Management Plan (WBMP) is to safeguard and enhance the watershed, its water quality and its diversity of habitats and wildlife as part of a regional landscape so that present and future generations can benefit from the full potential of its natural resources. Specific goals include:

- Re-open shellfish beds in Spruce Creek;
- Ensure that Spruce Creek meets minimum Class B and SB water quality standards;
- And ensure that Spruce Creek is useful and healthy for drinking, recreation, fish, birds, and other wildlife now and in the future.

1.4 Taking Action

Watershed partners can review and adjust activities, regulations, and community awareness to reduce the occurrence of new sources of pollution in the Spruce Creek watershed and can also implement a variety of techniques, referred to collectively as Best Management Practices (BMPs),to manage nonpoint pollution inputs. Section 5.2 of this plan outlines recommended BMPs that can be applied to NPS problems identified in the watershed the Spruce Creek watershed.

> ***Best Management Practices (BMPs)****:* *Techniques, measures, or structural controls implemented to reduce potential pollutant generation and/or facilitate pollutant removal in stormwater runoff.*

Section 9.2 of this plan provides a stakeholder-based Action Plan for the implementation of tasks specific to improving water quality in Spruce Creek. Action Plan items were developed in collaboration with watershed partners including local town officials, watershed landowners, and SCA members. Section 9.4 lists potential sources of additional funding.

2. Introduction

2.1 Why is this plan needed?

All watershed projects using State of Maine Department of Environmental Protection (ME DEP) Section 319 funds must develop a Watershed-Based Management Plan (WBMP), whether they are designed to protect unimpaired waters, restore impaired waters or both. The 319 grant program is intended to support NPS projects which aim to prevent or reduce nonpoint source pollutant loadings entering water resources so that beneficial uses of the water resources are maintained or restored. According to the Maine DEP, NPS projects help local communities recognize water pollution sources in watersheds and take action to restore or protect clean water. A grant-eligible NPS project is implemented in a specific watershed to help restore or protect a lake, stream, or coastal water that is impaired or considered threatened by polluted runoff. Spruce Creek has been officially designated by the state of Maine as a nonpoint source priority watershed due to bacterial contamination, low dissolved oxygen, toxic contamination, and compromised ability to support commercial marine resources, meets these qualifications.

Aerial view of Kittery and Portsmouth, October 2007 (Photo: Phyllis Ford, 2007)

This plan was originally developed in 2008. Since the development of the plan, the Town of Kittery and the Spruce Creek Association have worked hard to implement the actions outlined in the Action Plan. The town applied for and received three phases of 319 grants (Spruce Creek Watershed Improvement Project Phases I-III) from Maine DEP and has separately funded multiple water quality monitoring and assessment projects to address other action items that were not eligible for grant funding. One goal of Phase III of the Spruce Creek Watershed Improvement Project was to revisit the action items from the original plan to assess progress, determine the feasibility of the remaining action items, and to develop additional action items based on current conditions of the watershed. This updated plan is the product of

this initiative. Many pieces of the original plan have been left intact, with updates indicated in bold italics.

2.2 How was this plan developed?

This plan was developed using a watershed-approach. Using a watershed approach to restore impaired waterbodies is beneficial because it is a holistic approach in which local stakeholders are actively involved in selecting management strategies that will be implemented to solve problems in the watershed. The Spruce Creek WBMP worked within this framework by using a series of cooperative, iterative steps to characterize existing conditions, identify and prioritize problems, define management objectives, develop protection or remediation strategies, and implement selected actions. The outcomes of this process are documented within this Spruce Creek WBMP.

The 2014 update to this plan involved an assessment of all work accomplished since 2008, both through the multiple phases of 319 grants and through town-funded water quality monitoring projects. This assessment provided the framework through which to update the Action Plan. A public stakeholder meeting was held to bring the public up-to-date on the condition of the watershed and on the progress the town has made since 2008. Ideas and priorities discussed at these meetings have been incorporated into the Action Plan. This Action Plan outlines responsible parties, potential sources of funding, approximate costs, and an implementation schedule for each task within each category.

2.3 Who was involved?

The Spruce Creek WBMP is part of a long-term effort initiated and supported by a number of towns, agencies, organizations, and individuals including: the Towns of Kittery and Eliot, Spruce Creek Association (SCA), York County Soil & Water Conservation District (YCSWCD), Maine Department of Environmental Protection (MEDEP), United States Environmental Protection Agency (USEPA), local businesses, Wells National Estuarine Research Reserve (WNERR), Maine Department of Marine Resources (DMR) and Kittery Land Trust (KLA).

In April of 2007, the Town of Kittery contracted with FB Environmental Associates in Portland, Maine to oversee the watershed management plan process. A series of forums and meetings, critical to the development of this plan, followed:

- A Spruce Creek Watershed Community Forum was hosted by the Wells NERR and the Spruce Creek Association on November 29, 2006. The forum was attended by 30 individuals from towns, organizations, and State agencies. Participants defined and prioritized the Spruce Creek proposed project goals and objectives.
- A Spruce Creek WBMP Steering Committee meeting was held on June 4, 2007. The 19

participants in this meeting further prioritized the project goals and objectives.

- On July 24, 2007, a second Spruce Creek WBMP Steering Committee meeting was held in which 16 participants discussed a proposed outline for the Spruce Creek Watershed-Based Management Plan.
- On October 15, 2007, the draft Plan was presented for comments and discussion at a Spruce Creek WBMP Steering Committee Meeting.

To evaluate new priorities in the watershed and to determine what actions have been completed since the development of the original plan in 2008, a new Spruce Creek Action Plan Team was developed. As described in Section 2.2, a meeting was held on Tuesday, March 4, 2014 at the Kittery Community Center. Meeting attendees were presented with the existing and newly recommended action items and were asked to prioritize them by importance. The updated action items were also made available to other community members, watershed stakeholders, and town employees via an online survey where each action item could be voted on. Survey takers could also propose actions that were not included in the action item list. Approximately 40 stakeholders participated in the Action Plan Update.

2.4 Who should read this plan?

Because the Spruce Creek WBMP defines existing and future problems that need to be addressed, any group that influences or is affected by water quality and habitat management and land use decisions should read this report. Municipalities and local groups in and around the Spruce Creek watershed should use this plan as a foundation for local action, from stream restoration projects to development ordinance changes. State and federal agencies can use this plan to enhance understanding of local watershed conditions and as a basis for coordinating basin planning, permitting, and regulatory decisions.

2.5 How is this plan organized?

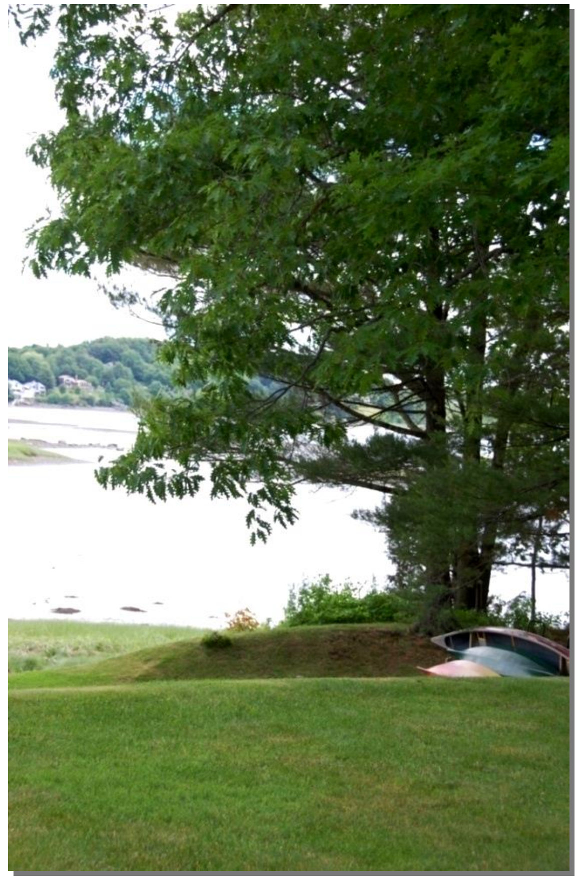
EPA Guidance lists nine components required to be included in watershed-based management plans to restore waters impaired by nonpoint source pollution. The following describes the nine required elements and where they are found in this plan:

1. An **identification of the causes and sources** or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this WBMP (and to achieve any other watershed goals identified in the WBMP), as discussed in item (2) immediately below is located in **Sections 5.1 and 5.2**.

2. An **estimate of the load reductions expected** for the management measures described under (3) below is described in Section 7.4.

3. A **description of the NPS management measures** that will need to be implemented to achieve the load reductions estimated under (2) above (as well as to achieve other watershed goals identified in **this** WBMP), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan are located in Section 8.2 and Section 6.2, respectively.

4. An **estimate of the technical and financial assistance needed**, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan is described in Section 9.4.



View of Spruce Creek from Newson Rd. (Photo: Rachel Bell, 2007)

5. An **information/education component** that will be used to enhance public understanding of the project is located in Section 9.5.

6. A **schedule for implementing the NPS management measures** identified in this plan is in Section 9.2.

7. A **description of interim, measurable milestones** for determining whether NPS management measures or other control actions are being implemented can be found in Section 9.3.

8. A **set of criteria** that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards water quality standards; and if not, the criteria for determining whether this WBMP needs to be revised is in Section 9.7.

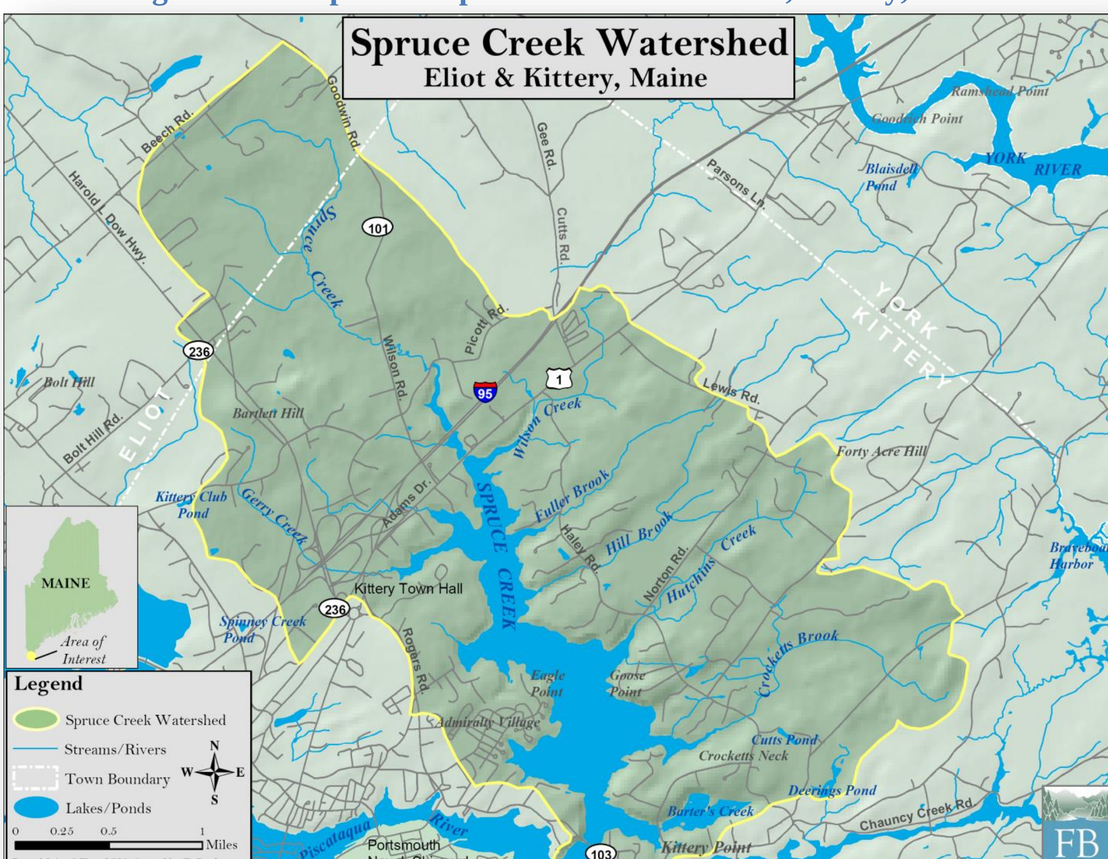
9. A **monitoring component** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (8) above is can be found in Section 9.6.

3. Description of the Spruce Creek Watershed

3.1 Location

The Spruce Creek watershed covers 9.8 square miles (6,112 acres) in the towns of Kittery (90% - 5,498 acres) and Eliot (10% - 611 acres) in the southernmost corner of the State of Maine. The headwaters of Spruce Creek are located in Eliot and the Creek flows in a southeasterly direction through Kittery for 2 miles before eventually emptying into the Piscataqua River, which forms the border between Maine and New Hampshire. Spruce Creek is fed by six small fresh water streams: Wilson Creek, Fuller Brook, Hill Creek, Hutchins Creek, Crockett's Brook, and Barter's Creek. Near its confluence with the Piscataqua River, the Creek is a coastal, tide-dominated system with a significant estuarine area approximately 2.25 miles long and a half-mile wide. This watershed is part of the Atlantic Coastal Plain with the land from the coast to several miles inland appearing as flat or gently undulating terrain. Spruce Creek is influenced by the tidal flow from the Piscataqua River and at low tide; approximately 2.5 square miles of clam flats are exposed. The marine environment consists of mud flats, high salt marsh, and ledge. Farther up the estuary toward US Route 1, much of the creek is classified as low salt marsh. This area is rich in marine life, particularly soft shell clams.

Figure 3-1: Map of the Spruce Creek Watershed, Kittery, Maine



3.2 Population and Demographics

U.S. Route 1, leading to Kittery.

Spruce Creek is located in Maine's fastest growing county. As of 2010, the Southern Maine county's population was at 197,131, up over 30,000 people, or more than 20 percent, since 1990. In fact, 33 percent of Maine's total population growth over the last six years has occurred in York County. From 1990 to 2010 the population change for Kittery and Eliot were 1% and 16% respectively. This compares with 20% for York County, and 8.2% for Maine as a whole (SMRPC, 2010). Like most coastal New England communities, Kittery and Eliot draw their existence from the sea and the presence of a deep water harbor. These historic seacoast towns consist of economically diverse neighborhoods, working waterfronts, natural habitats and resources, rural landscapes, and commercial businesses. However, the rapidly growing population, and accompanying development, may have an important influence on the character and environment of these communities.

Although the population growth rates in Kittery and Eliot are lower than the county average, development pressure is steadily increasing. Kittery issued 350 building permits between 2000 and 2005, and Eliot issued 221 during the same period. ***According to the Southern Maine Regional Planning Commission (SMRPC), the Town of Eliot has a residential growth cap in place, allowing for a maximum of 48 new units per year. Kittery currently has no cap in place (2014).*** With both I-95 and U.S. Route One entering Maine in Kittery, the community serves as the gateway to Maine. Over the past twenty years, this role has greatly changed and expanded with the development of the factory outlet centers along U.S. Route 1.

As of 2010, the population of Kittery was 9,490. 26% of the population was under the age of 25. 26% of the population ranged in age from 25 to 44 years, 30% was between the ages of 45 and 64, and 18% of the total population in Kittery was 65 years of age or older. Between 2000 and 2010 the number of households in Kittery increased by 413 homes. In that time, 473 new housing units were built. The 2010 population for the Town of Eliot was 6,307. This is an increase from the 2000 population in Eliot of 4,954. In 2010, almost 30% of the population was under the age of 25. 22% of the population was between 25 and 44 years if age, 35% of Eliot's population was 45 and 64 years old, and 14% of Eliot residents are over the age of 65. 2,612 housing units exist in the Town of Eliot based on the 2010 US Census. This is an increase from 2000 when 2,418 housing units were reported in the town.

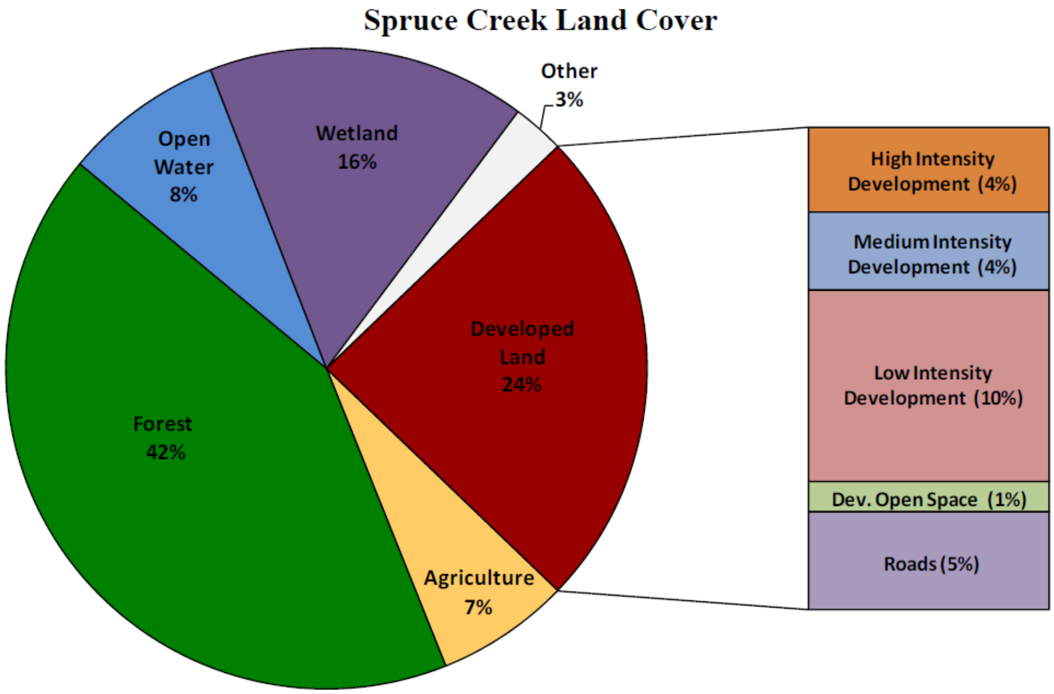
Table 3-1: Census data for the towns of Kittery and Eliot, Maine – 2010

Town	<25 years	25-44 years	45-65 years	65+	Total Pop.	Number of Housing units
Kittery	26%	26%	30%	18%	9,490	4,834
Eliot	29%	22%	35%	14%	6,307	2,612

3.3 Land Use and Land Cover

Land cover in the Spruce Creek watershed is dominated by upland forest, which covers 42% (2578 acres) of the watershed land area. Developed land is the second-largest land cover class, covering 1492 acres (24%) of the watershed and consisting of high intensity development (261 acres), medium intensity development (242 acres), low intensity development (594 acres), developed open space (92 acres), and roads (302 acres).There are approximately 985 acres (16%) of wetlands scattered throughout the watershed. Agricultural land, including crops, hayland and pasture, covers 7% (414 acres), and the remaining 3% is covered by other land uses, including unconsolidated shore, scrub-shrub, and grassland. An extensive retail outlet corridor serving over 3 million shoppers per year is located along Route 1 and Interstate 95, transecting the Spruce Creek watershed. The west side of the watershed is high density residential, largely served by the Town sewer and containing many impervious surfaces and lawns. The east and north side are mostly rural residential with private septic systems often located in marginal soils, based on soil data from the Maine Office of GIS. Impervious area covers approximately 11% of the Spruce Creek watershed. Studies have shown that the percentage of impervious cover (% IC) in a watershed strongly effects the health of aquatic systems because land surfaces that block infiltration of rainwater cause increased amounts of stormwater to run off into gutters, untreated storm sewers or directly to streams. In general, surface water quality declines as imperviousness exceeds 10% of watershed area (Schueler 1994, CWP 2003).

Figure 3-2: Watershed Land Cover in the Spruce Creek Watershed



3.4 Physical Features

3.4.1 Topography

Spruce Creek flows primarily north to southeast, originating in Eliot at approximately 60 feet above sea level. Topography in the watershed is characterized by extensive wetlands, with some small hills on the eastern side of Spruce Creek in Kittery, and elevation generally ranging from 20 to 80 feet. The highest point in the watershed is Bartlett Hill (approximately 100 feet), located on the western side of the

(Photo: Phyllis Ford, 2007)

watershed in the town of Kittery. Slopes in the watershed range from 8 to 15%.

3.4.2 Soils

There are two general soil associations in the watershed: Lyman-Tunbridge-Dixfield and Scantic-Lamoine-Buxton-Lyman. Lyman-Tunbridge-Dixfield soils are predominantly loamy soils derived from glacial till parent materials. Scantic-Lamoine-Buxton-Lyman soils are clayey and loamy soils formed in glaciomarine sediments and loamy till. Smaller areas of peat, mucky peat, silt loam, and gravel are scattered throughout the watershed. Over 40% of soils in the watershed are mapped as hydric, or wet. Rock outcrops are found in the southeast corner of the watershed and on Crockett's Neck and Goose Point. Over 63% (3907 acres) of soils in the watershed are considered poor or very poorly suited to low density development and septic systems.

Additionally, approximately 1,234 acres (20%) of the soils in the Spruce Creek watershed are highly erodible and 2,130 acres (35%) are potentially highly erodible (Map 3, Appendix B) (USDA/NRCS and MEGIS 2005). Highly erodible soils have a potential to erode at a rate far greater than what is considered tolerable soil loss. The potential erodibility of soil is dependent on a combination of factors including rainfall and runoff, susceptibility of the soil to erosion, and slope length and steepness (USDA/NRCS and MEGIS 2005). A highly erodible soil has a higher potential to negatively affect water quality (PBYM 2006).

3.5 Land Resources

There are approximately 756 acres of conservation land within the Spruce Creek watershed (Map 5, Appendix B). Of the conserved land in the watershed, only 216 acres of land are permanently preserved.

Among the non-permanently protected lands in the watershed are 434 acres of land enrolled in Maine’s Current Use Tax programs. The Tree Growth Tax Law and the Farm and Open Space Tax Law were established in the 1970's to prevent property taxes from forcing productive woodlands, farms and significant open spaces into tax delinquency or conversion to development. Under the tree growth and farmland programs, land is assessed depending on its productive value. Only properties that are undeveloped can be enrolled in the Tree Growth and Farm and Open Space Tax Programs. For tree growth classification, the property must be forested, managed according to a forest management plan, and contain at least ten contiguous acres. For farmland classification, the land must be used for agricultural activities, must contain at least five contiguous acres, and the landowner must earn an agricultural income of at least $2,000 annually from the land. In the Spruce Creek watershed, 273 acres are in the tree growth program and 161 acres are in the farmland program. Although not permanent, the Current Use

Tax programs can be a useful tool that gives landowners monetary incentives to keep their properties undeveloped, providing a temporary level of protection from development sprawl.

The Town of Kittery owns 203 acres, including Roger's Park and Eagle Point which are protected and open to the public. State-owned land in the watershed consists of 18 acres on the site of Fort McClary. This site, located at the southern end of the watershed where Spruce Creek meets the Piscataqua River, is one of Maine's most important historic forts. The remaining 101 acres of conservation land in the Spruce Creek watershed are non-profit land managed by the Kittery Land Trust (KLT).

The Kittery Land Trust "is a not-for-profit organization dedicated to working creatively with landowners, citizens and the Town to conserve and steward important natural areas that improve the quality of life in Kittery now and for the future (KLT, 2007)." The land trust manages 4 properties within the Spruce Creek watershed. Two of these properties are owned by the Trust: the Cutts property, 22 acres of forest and wetlands off Haley Road, and the Remick property, 88 acres of upland forest off Dennett Road. The remaining two properties are under conservation easement: the Moulton farm, 12-acre farm with buildings and duck pond on Haley Road, and the Thompson property, 18 acres of woods at the end of Mill Pond Road on Spruce Creek.

In 2014, the Kittery Land Trust closed on the Rustlewood Farm conservation easement. This easement permanently protects 300-acres of farm and woodlands in the towns of Kittery and Eliot. Southern portions of this property lie within the Spruce Creek watershed near the headwaters of the Creek. Protecting the Rustlewood Farm property will greatly impact the continued efforts to restore water quality in Spruce Creek.

New England Cottontail. (Photo: UNH)

The Kittery Land Trust is also part of the Mount Agamenticus to the Sea Conservation Initiative, a coalition of ten national, regional and local partners representing federal and governmental agencies, statewide land protection organizations, and three local land trusts working to conserve a mosaic of critical lands, waterways and working landscapes in the six-town area between the Tatnic Hills of Wells and Gerrish Island in Kittery Point. The area is the largest unfragmented coastal forest between Acadia

National Park and the New Jersey Pine Barrens and is home to numerous threatened and endangered species. The Mt. Agamenticus to the Sea focus area, if protected, would include over 800 acres in the Spruce Creek watershed. However, Spruce Creek itself is not within the proposed protection area. According to data from the Gulf of Maine (GOM) Program, the Spruce Creek watershed contains over 1,070 acres of critical habitat (Map 4, Appendix B). The GOM

Program mapped and ranked important fish and wildlife habitat for 91 priority species throughout the Gulf of Maine Watershed, including federally endangered, threatened and candidate species, migratory birds, and waterfowl. Additionally, there are over 350 acres of deer wintering area in the Spruce Creek watershed. (Banner and Schaller 2001) In 2004, a study conducted by researchers from the University of New Hampshire (UNH) and the Maine Department of Inland Fisheries and Wildlife (MDIFW) identified a total of five New England Cottontail habitat sites within the Spruce Creek watershed, three in Kittery and two in Eliot (Litvaitis and Jakubas 2004). One site in Kittery, near the intersection of Route 1 and Haley Road, is one of only six sites in Maine with a sustainable New England Cottontail population and sufficient habitat area (greater than 25 acres) to support the population (D. Tibbetts, personal communication). There are fewer than 320 New England Cottontail remaining statewide (Litvaitis and Jakubas 2004). The ideal habitat type for New England Cottontail is successional shrubland, such as abandoned farmland. Development is the largest threat to this species as it fragments large blocks of habitat necessary for viable Cottontail populations (D. Tibbetts, personal communication).

3.6 Water Resources

There are over 18 miles of rivers and streams in the watershed. As mentioned earlier, Spruce Creek has six tributaries: Wilson Creek, Fuller Brook, Hill Creek, Hutchins Creek, Crockett's Brook, and Barter's Creek. Other bodies of water in the watershed include 60 acres of lakes and ponds, including 1 unnamed great pond, Cutts Pond, Deering Pond, and Kittery Club Pond. Wetlands in the watershed cover approximately 921 acres, or 16% of the watershed area.

There are no aquifers in the Spruce Creek watershed. Public water is supplied to Kittery by four surface water sources, which are not located within the Spruce Creek watershed. The Distribution Division of the Kittery Water District maintains 1,900,000 gallon tank located in Eliot and a 3,000,000 gallon tank in Kittery.

3.6.1 Shellfishing

The Maine Department of Marine Resources (DMR) collects water quality data from Maine's coastal waters monthly between January and December. This year-round data is crucial to the proper management and regulation of Maine's shellfish growing areas, and also ensures that only high quality, non-polluted waters are open for shellfish harvesting. The marine waters of Spruce Creek (Area No. 2-A Portsmouth Harbor, Kittery, and the Isle of Shoals) are prohibited for shellfishing due to pollution. There are currently no open recreational shellfishing areas within the Town of Kittery, but recent water quality improvements within the creek in the more recent years have made Spruce Creek the location of a potential location of the opening of recreational clam harvesting areas.

DMR has several sampling stations along Kittery's coastline. Six samples are collected annually and analyzed for bacteria. In 2014, Maine DMR, with the assistance of certified water quality monitors at the Kittery Shellfish Conservation Committee, began collecting the first of a series of six samples needed to potentially re-open harvesting areas in Spruce Creek. Each sample must be collected less than two weeks apart and must all be below the Maine water quality standard for bacteria (Kittery Shellfish Conservation Committee, personal communication, March 5, 2014). The results of this sampling will guide the goals of this watershed plan. A meeting between representatives from the Town of Kittery and Maine DMR will be held in August 2014 to discuss the potential of conditionally re-opening portions of Spruce Creek's shellfish beds for recreational harvesting.

View of Spruce Creek from I-95 crossing in Kittery (Rachel Bell, 2007).

4. Baseline and Future Conditions

4.1 Applicable Water Quality Standards

Table 4-1: Applicable Water Quality Standards for Spruce Creek

Waterbody Class	Criteria
Fresh water	
Class B[1]	**Dissolved oxygen:** should be greater than or equal to 7 ppm (or 75% saturation) except for the period critical to spawning of indigenous fish species (Oct 1st – May 14th) when the 7 day mean dissolved oxygen concentration shall not be less than 9.5 ppm. ***E. coli:*** Between May 15th and Sept. 30th, *E. coli* of human and domestic animal origin shall not exceed a geometric mean of 64/100mL or an instantaneous level of 236/100mL.
Estuarine and Marine Waters	
Class SB[1]	**Dissolved oxygen:** should be greater than or equal to 85% at any time. ***E. coli:*** Between May 15th and Sept. 30th, *E.coli* of human and domestic animal origin shall not exceed a geometric mean of 8/100mL or an instantaneous level of 54/100mL .
Coastal Beaches[2]	***Enterococci:*** Between May 15th and Sept. 30th, Failure results from single sample enterococcus level exceeding 104/100mL or a geometric mean of 35/100mL for five samples within a 30-day period.
Shellfish Growing Areas[3]	
Area	**Fecal Coliform**
Approved (Growing Areas affected by Point Sources)	Adverse Pollution Conditions: Geometric mean shall not exceed 14/100mL and estimated 90th percentile shall not exceed 31/100mL.
Conditionally Approved (Growing Areas affected by Nonpoint Sources)	Adverse Pollution Conditions: Geometric mean shall not exceed 14/100mL and estimated 90th percentile shall not exceed 31/100mL .
Restricted (Growing Areas affected by Point Sources and Used as a Source for Shellstock Depuration)	Adverse Pollution Conditions: Geometric mean shall not exceed 88/100mL and estimated 90th percentile shall not exceed 163/100mL.
Conditionally Restricted (Growing Areas affected by Nonpoint Sources and Used as a Source for Shellstock Depuration)	Adverse Pollution Conditions: Geometric mean shall not exceed 88/100mL and estimated 90th percentile shall not exceed 163/100mL.
Prohibited	Geometric mean exceeding 88/100mL and estimated 90th percentile exceeding 163/100mL.

[1] MEDEP 2004; [2] USEPA 1986; [3] Maine DMR 2007

4.2 Summary of Available Data

Since the development of the original plan in 2008, the Town of Kittery has conducted multiple bacteria source tracking and water quality assessment projects in the Spruce Creek watershed. Full reports are available from the town and data summary tables are located in Appendix G. All water quality data from the 2008 plan is also located in Appendix G. Projects include:

4.2.1 2014 Bacteria Source Tracking at Manson Avenue

In 2012, two outfalls on Manson Avenue in Admiralty Village were found to exceed water quality standards for E.coli in both wet and dry weather. A follow-up project in 2013 revealed a complex storm drain system including catch basins located on private property. The actual source of bacteria to the storm drain system is unknown. All inflow and outflow pipes to each catch basin will be documented and water quality conditions within the system under varying water quality conditions will be documented. This project will begin in July 2014.

4.2.2 2012-2014 Spruce Creek Main Channel Investigations

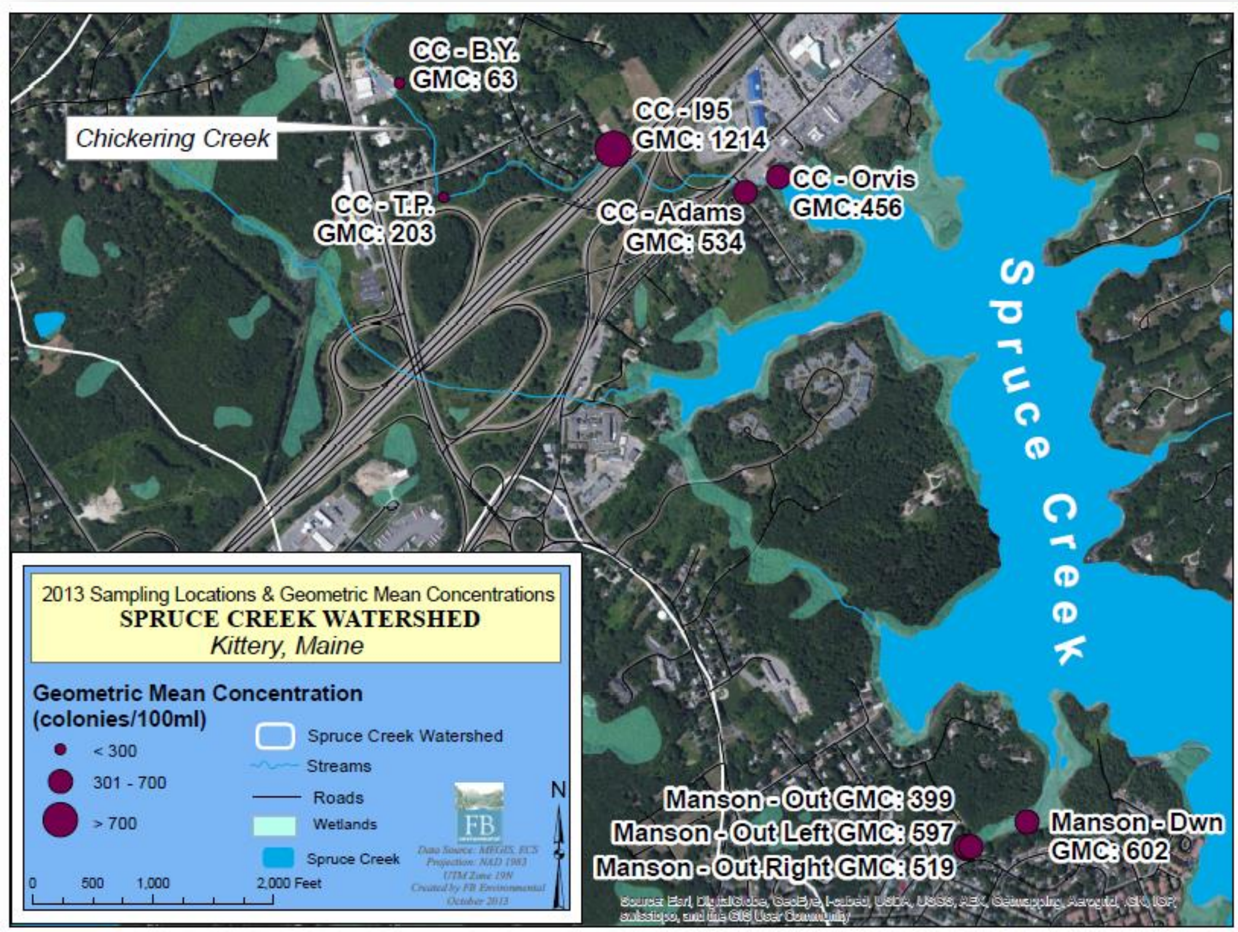
Developing a baseline of the water quality in the main channel of Spruce Creek is crucial to understanding the effects of future activities within the watershed. This sampling includes the collection of continuous dissolved oxygen, depth and conductivity data (with the use of a data sonde) at three locations in 2012, and at one central location in the channel in 2013. In addition, surface water grab samples were collected for analysis of bacteria, nutrients, organic carbon, and total suspended solids. Data are available in Appendix G.

4.2.3 2013 Bacteria Source Tracking in Chickering Creek

Chickering Creek was identified as a hotspot of bacterial contamination to Spruce Creek through a hotspot identification study in 2012. Chickering Creek is a small tributary to Spruce Creek with a watershed area of 0.4 square miles. The watershed consists largely of residential development to the north, with dense commercial development to the south along the Route 1 corridor. Bacteria concentrations in Chickering Creek are highest in the portion of the creek downstream of the Dana Avenue/Manson Road neighborhood. Results from the bacteria sampling in 2013 showed concentrations were well above the water quality standard at the Adams Drive road crossing and at the outlet of Chickering Creek. In addition to regular bacteria sampling, canine detection methods were also utilized in the Chickering Creek Watershed. Eleven locations on Chickering Creek were assessed for the presence of human wastewater using canine detection. Six of the eleven sites were positive for human wastewater receiving positive responses from the dogs. During this investigation, two sampling locations ("Orvis Out" and "CC-Adams") were also sampled for E. coli bacteria. These sites both

exceeded Maine's bacteria standard and tested positive for human waste. Tables listed in Appendix G.

Figure 4-1: Water quality sampling locations and concentrations along Chickering Creek in Kittery, Maine

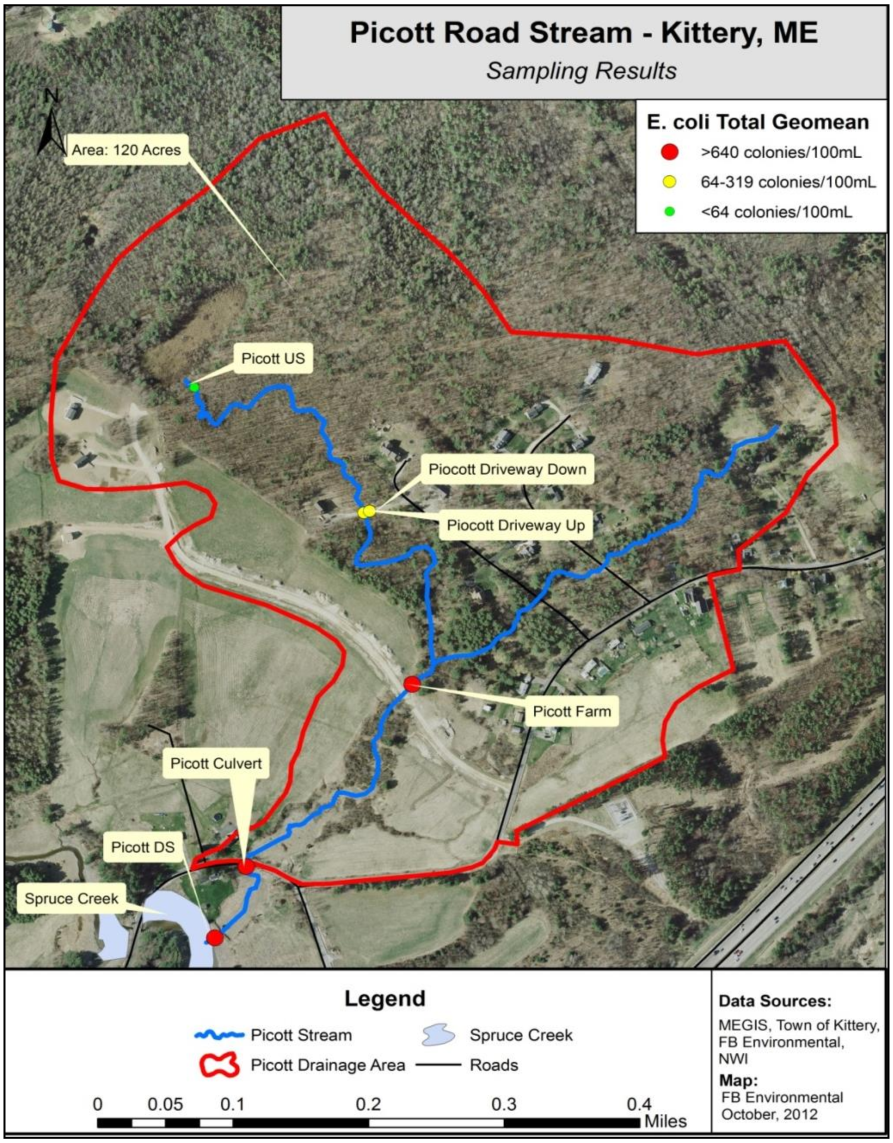


4.2.4 2013 Bacteria Source Tracking at Picott Road and Trafton Roads

In response to high bacteria concentrations found at the culvert on Picott and Trafton Roads during the 2011 outfall sampling project, a more detailed analysis of the drainage areas and upstream land uses was conducted. The drainage areas to these culverts were mapped and bracket sampling was conducted to "bracket" or isolate the sources of bacteria by sampling upstream and downstream of the culverts where high concentrations of bacteria were found Bracket sampling was conducted during four dry weather days and two wet weather days at six locations on the stream draining to Picott culvert and at three locations along Fuller Brook

(Trafton Lane). Sources of bacteria likely include stormwater runoff and malfunctioning septic systems (Picott and Trafton) and agricultural runoff (Picott only).

Figure 4-2: Water quality sampling locations and concentrations in the Picott Road watershed



4.2.5 2009, 2011, and 2012 Spruce Creek Outfall and Tributary Sampling

Since 2009, the Town of Kittery has been working to identify and sample all stormwater outfalls and tributaries within the Spruce Creek watershed. This sampling program aims to identify hotspots of bacterial pollution to the main stem of Spruce Creek. Samples are taken under both wet and dry weather conditions in an effort to determine potential bacteria sources.

Since 2009, over 50 stormwater outfalls and tributaries have been identified and sampled. Tables located in Appendix G.

4.2.6 2012 and 2013 Canine Detection

As a follow-up to hotspots of bacteria identified in the 2009, 2011, and 2012 stormwater outfall and tributary sampling, canine detection was used in an effort to identify specific sources of bacteria. Canine detection is an EPA-approved method to identify human fecal contamination in waterbodies. Through these projects, human sources of bacteria were identified in an outfall in Admiralty Village. The Town of Kittery is in the process of following up on these sources.

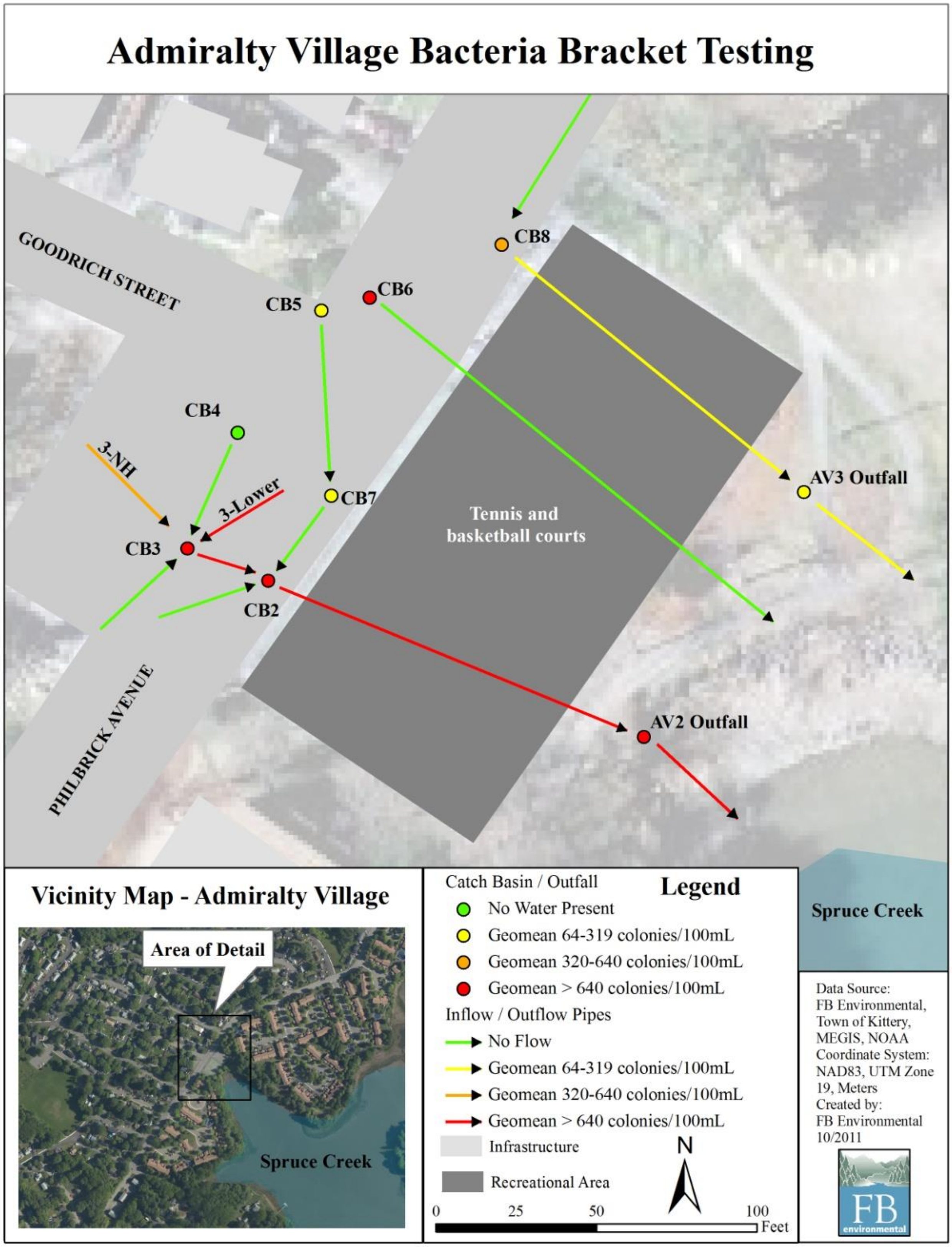
4.2.7 2011 and 2012 Bacteria Source Tracking Admiralty Village

In response to high bacteria concentrations found at an outfall in Admiralty Village (Outfall AV2) in the 2009 Outfall Sampling Project, a more detailed analysis of the storm drain system in Admiralty Village was conducted. The storm drain system was more accurately mapped to understand connections between the outfall and the catch basins. Bracket sampling was conducted to locate the sources of bacteria entering a storm drain by sampling up gradient and down gradient of potential sources (in this case, catch basins draining to the problem outfall) to "bracket" (or isolate) pollutant source locations.

Two inflow pipes, three catch basins, and one outfall were found to have bacteria levels greater than ten times the state water quality standard for E. coli (64 colonies/100 mL). One pipe (3-Lower) consistently had the highest levels of bacteria and is likely the major source of bacteria to the outfall (AV2). A video inspection of this pipe was conducted in 2012 to locate the origin of the pipe. Upon inspection, the condition of the pipe was obviously deteriorated and was not functioning properly. This pipe will be removed in the Summer 2014 (Figure 4-3).

Spruce Creek from Duncan Rd. (Photo: Rachel Bell)

Figure 4-3: Results from Admiralty Village Mapping and Bracket Sampling



4.3 Summary of Spruce Creek Water Quality Data

Table 4-2: Spruce Creek Impairment and Sources

Impairment Causes and Sources		
Causes	**Possible Sources**	**Impaired Uses**
Bacteria	septic systems, human and animal waste, NPS pollution	One concern in both surface and ground waters is the potential degradation of public and private water supply sources. Pathogens reaching a lake or other surface water body may also limit primary contact recreation, such as swimming and result in a compromised ability to support commercial marine fisheries.
Low Dissolved Oxygen (DO)	NPS pollution	Primary concern is a reduction of essential habitat for aquatic organisms.
Toxic Contamination - Heavy Metals	industrial sites	Principle concern in surface water is entry into food chain, bioaccumulation, and toxic effects on habitat for aquatic organisms, other wildlife and microorganisms.

Due to the continued poor water quality discussed in Section 4.2,***Spruce Creek is listed in Maine's 2012 305(b) report as impaired under Category 4-A: Estuarine & Marine Waters Impaired by Bacteria (TMDL completed) for nonpoint pollutant sources.*** Spruce Creek is also identified by the Maine DEP as a "nonpoint source pollution priority watershed" due to bacterial contamination, low dissolved oxygen, toxic contamination, and a compromised ability to support commercial marine fisheries. Finally, the Spruce Creek watershed is listed by the DEP as one of seven coastal watersheds in the state being "most at risk from development. Table 4-2 lists the impairment causes, sources, and possible impacts to the watershed.

4.4 Water Quality Goals and Objectives

While the primary goal of the Spruce Creek WBMP is to advance locally supported water quality goals, objectives and action strategies for protecting Spruce Creek, the specific water quality goals within the plan are focused on ensuring that Spruce Creek meets minimum Class B and SB standards and is useful and healthy for drinking, recreation, fish, birds, and other wildlife now and in the future.

Since the development of this plan in 2008, many efforts have been taken to address these water quality goals, as outlined in this plan update. Though Spruce Creek is still considered impaired and its shellfish beds are closed, these efforts are currently being assessed through the development of a baseline dataset of the water quality in the main channel of the creek. The primary water quality goals developed in 2008 remain the same.

5. Threats to Water Quality

5.1 5.1 Nonpoint Sources

Nonpoint source (NPS) pollution is the largest water quality threat to Spruce Creek. In an effort to document the sources and types of NPS pollution that affect Spruce Creek, SCA, watershed towns, organizations, state agencies, and local volunteers have worked to survey and inventory problem areas in the watershed. Two such studies were initiated in 2005. ***The results of these surveys can be found in Appendix G.***

5.1.1 2014 Bacteria Hotspot Assessment and Non-point Source Pollution Survey

Since 2009, the Town of Kittery has been working to identify hotspots of bacteria to Spruce Creek through annual bacteria sampling programs. Through these projects and through follow-up monitoring and investigation, multiple hotspots have been identified (Table 5-1). All sites listed in this table had high bacteria concentrations under both wet and dry weather conditions.

Table 5-1: Bacteria Hotspots in the Spruce Creek Watershed (2014)

Bacteria Hotspots			
Neighborhood	**Specific Site**	**Bacteria Sampling**	**Range of *E.coli* *concentrations***
Admiralty Village	Tennis Court Outfalls	2009, 2011-2013	80 - TNC
Admiralty Village	Manson Avenue Outfalls	2012 - 2014	87 - TNC
Dion Avenue	Outfalls at end of street	2009	1 - 1300
Chickering Creek	Portion of creek near Route 1	2011-2013	93 - TNC
Wilson Road	Culvert on Wilson Road on SC; septic failure currently being addressed by town	2012	74 - TNC
Picott Road	Multiple sites south of the farm	2012	200 - TNC
Trafton Road	Multiple sites on Fuller Brook	2011-2012	85 - TNC
Kittery Trading Post	Seeps leading from parking lot	2012	65 - TNC
Goosepoint Bridge	Culvert under bridge at 12 Goose Point Road	2012	291 - TNC
MPR Stream	Mill Pond DS of pipe	2012	121 - TNC
Trolley Bridge	Stream underneath old trolley bridge at end of Tilton	2012	24 - TNC

In 2014, a non-point source pollution survey was conducted to identify other potential sources of pollution to Spruce Creek. The survey was based on local knowledge of known pollution sources identified through watershed restoration efforts since 2005.

Picott Farm

Picott Culvert

Picott Downstream

Trafton Upstream (Trafton US)

Trafton Culvert

Trafton Downstream (Trafton DS)

Table 5-2: Identified NPS pollution sites in the Spruce Creek Watershed (2014)

Non-point Source Pollution Survey		
Site	**NPS Issue**	**Proposed BMP**
Dion Avenue	Road is old runway - flows directly to creek	Decrease width of road through median or sidewalk BMPs
Chickering Creek	Obvious green algae in creek indicating nutrient issues	Identify sources of nutrients to Chickering Creek; continue sampling; conduct dye/smoke tests to determine wastewater connections
Kittery Community Center	Runoff from recently redesigned KCC causing reported problems on Mill Pond Road	Treebox filters or other infiltration BMPs to collect parking lot runoff; rain barrels
Orvis Outlet Parking Lot	Runoff from parking lot flows directly into Chickering Creek; obvious erosion present	Treebox filters or other infiltration BMPs to collect parking lot runoff
Kittery Trading Post	Large parking lot adjacent to Spruce Creek	Treebox filters or other infiltration BMPs to collect parking lot runoff
Picott Road - Animal farm	Small, residential goat barn on Spruce Creek at outlet of small stream from Picott Road	Buffers; work with homeowner to keep animals out of creek
Picott Road	Erosion along culvert on small stream flowing to Spruce Creek	Infiltration BMPs or rip rap
Picott Road - Farm	Manured agricultural field adjacent to small stream flowing to Spruce Creek	Work with farmer to manage manure application; install buffers
Trafton Road - Eco community	New development may be contributing SW runoff to Fuller Brook	Treat stormwater runoff in neighborhood using infiltration BMPs
Trafton Road Culvert	Runoff from Haley Road flowing to Fuller Brook	Treat stormwater runoff using infiltration BMPs and rip rap
Ox Point Drive	Lack of buffers/Runoff from Ox Point Drive flowing to Chickering Creek	Install buffers/treat stormwater runoff in neighborhood using

Non-point Source Pollution Survey		
		infiltration BMPs
Adams Drive	Potential septic system/sewer issues near Chickering Creek	Conduct smoke/dye tests of homes in area
Coleman Avenue	Runoff from Coleman Avenue flowing to Spruce Creek	Treat stormwater runoff in neighborhood using infiltration BMPs
Philbrick Avenue	Runoff from Philbrick Avenue and other neighborhoods in Admiralty Village are flowing to Spruce Creek; lack of buffer; high level of impervious cover	Treat stormwater runoff in neighborhood using infiltration BMPs; consider end of pipe treatment at outfalls near Admiralty Village
Mill Pond Road	Lack of buffers/runoff from Mill Pond Road reaching Spruce Creek	Install buffers/treat stormwater runoff in neighborhood using infiltration BMPs
Bond Road	Runoff from Bond Road flowing to Spruce Creek	Treat stormwater runoff in neighborhood using infiltration BMPs
Rosellen Drive	Runoff from Rosellen Drive flowing to Spruce Creek; inadequate buffer	Treat stormwater runoff in neighborhood using infiltration BMPs

In both the 2005 and 2014 NPS surveys, the most common sources of NPS pollution found include:

***<u>Bacteria</u>*:**

Bacteria are naturally present in the environment. However, some disease-causing microbes are associated with human or animal activities. Runoff from agricultural areas where manure is generated or spread on fields can be a source of bacteria. Other animal sources including pet and wildlife waste can also contribute bacteria to surface waters. Human sources of bacteria include cracks or leaks in sanitary sewer lines and malfunctioning septic systems. Identifying and mitigating these sources of bacteria are important to protect human health as well as to prevent the closing of shellfish beds.

Nutrients:

Nutrient pollution is the result of excess nutrients accumulating within a waterbody. Excess nutrients in the water can result from erosion, cut vegetation, logging debris left in streams, use of fertilizers, and animal / pet waste. Although the term 'nutrient' is often considered a desirable word, it can have detrimental effects to the quality of water when added at a rate that is highly excessive then would naturally occur. Excess of nutrients can cause algal blooms and excessive plant and bacteria growth in the water. This not only changes the ecological environment of the subsurface water through the loss of sunlight, but can also cause depletion in the amount of dissolved oxygen available in the water. Often the potential for nutrients entering the Creek was associated with a lack of shoreline vegetation. In a majority of sites, the vegetated buffer has been reduced to residential lawns.

Survey site with potential nutrient issues in SpruceCreek

Lack of a vegetated shoreland buffer:

Vegetation in the shoreland zone (area adjacent to streams, brooks and lakes) helps absorb fertilizers, sediment-laden runoff and nutrients from developed areas before they enter waterways. Removing vegetation along streams, rivers and lakes may have a number of implications including: direct flow, shoreline and bank erosion, altered stream flow, warming of surface waters-loss of aquatic species and reduced recreational opportunities. Loss of buffers also decreases the amount of habitat available to native species that depend on this vegetation for breeding, and changes the natural scenic beauty of the water course.

The network of tree roots along the shoreline (or buffer zone) stabilize the stream banks, holding soil in place. The above ground network of trunks, branches, leaves and needles alters the way and which precipitation reaches the ground, greatly reducing its erosion impact. The canopy of leaves and needles provides shade to keep water temperature cool and reduce the growth of undesirable algae that can degrade fish spawning and feeding habitats.

Trash, such as tires, is one source of pollution in Spruce Creek. (Photo: Phyllis Ford)

Trash and debris:

Trash and debris is a source of both nutrients and toxics into the watershed. Trash is sometimes thrown directly into creeks, where it washes downstream during periods of heavy rain. Debris pileups and logjams are partly responsible restrict flow. Debris consists of natural and human-made materials that can obstruct the normal water flow. Debris along streams and creeks interfere with the natural vegetative growth that stabilizes the banks on the waterway.

Impervious surfaces:

Impervious surfaces are hard surfaces such as asphalt, concrete, rooftops, and highly compacted soils. Unlike pervious areas where soil and vegetation absorb rainwater, impervious surfaces are areas that water cannot go through. In many places, as little as 10% impervious cover has been linked to stream impacts, which increases in severity as impervious cover increases (Schueler, 1995). The amount of impervious cover in the watershed can be used as an indicator to predict how severe these impacts might be. Research has shown that as the amount of impervious surface increases, the amount of runoff generated increases. This leads to increased amounts of water flowing in Spruce Creek, especially during heavy rainfalls; less ground water flowing through the soil; and more erosion of the stream bed because of faster flowing water. These changes may lead to flooding; habitat loss; erosion, which widens the stream channel; and physical changes in how the stream looks and functions. Roads and parking lots were the most common types of NPS found in the watershed, yet other types of NPS recorded included driveways, boat ramps, docks, and building rooftops. Impervious surfaces contribute nutrients, sediment, bacteria, and toxics to the watershed.

Flow restrictions:

Flow restrictions may result from road crossings and inadequately sized or placed or deteriorating culverts. They can also include places where erosion has added sediment buildup to the stream, places in which excess vegetation and trash have fallen and collected in the stream, and at places where dams have been created. In general, flow restrictions can affect water quality by preventing aquatic organisms from freely traveling the stream and can cause water to pool. This can affect ecosystems and prevent nutrients from being naturally washed through the watershed and out to the ocean. Pooling water can also disrupt bank growth, which can cause an excess of nutrients to enter the water, and can greatly contribute to thermal pollution, allowing the water's temperature to increase dramatically. Flow restrictions due to logging / vegetative debris, can add excess nutrients to the water and flow restrictions from deteriorating culverts can add rust, metals, and other toxic substances. Inadequate and inadequately placed culverts (hanging, misaligned, unstable, clogged) can change water flow speed, direction, and volume that can "blow out" crossings during big storms, erode banks, change natural stream channels and ecosystems, and prevent fish migration upstream.

Other NPS pollution sources documented included (listed in decreasing occurrences): septic systems, ATV / recreational paths (many crossing through the stream), trail / foot paths, construction sites / construction site debris (old and new sites), pet / animal waste, possible pesticide / fertilizer use, storm drains, and pipe discharges. Parked cars near waterways, a diverted stream, a burnt site, a drainage ditch, a water intake site, a salt pile, and a couple of soil piles were also mentioned as NPS sites occurring in the watershed.

5.1.2 Stormwater Assessment and Retrofit Inventory of Route 1

In addition to the studies mentioned above, a stormwater assessment and retrofit inventory of Route 1 in Kittery was conducted by Hillier & Associates, Inc. in the fall and winter of 2004. The study was designed to identify and track the movement of storm runoff from the many impervious road and parking lot surfaces along the commercial corridor of Route 1 and to identify potential best management practice stormwater retrofit locations. The stormwater assessment revealed nine discrete subcatchment areas that convey a combination of public and private stormwater runoff. The study also identified 21 stormwater outfall locations as candidates for stormwater best management practice retrofit. The identified subcatchments conveyed a combination of public and private stormwater and contained high levels of suspended sediments. Stormwater samples also revealed high levels of bacteria loading and high levels of hydrocarbon loading from selected subcatchments.

5.2 Point Sources

Unlike NPS pollution, point source pollution can be traced to a single identifiable source; such as overboard discharges (OBDs). As of 2007, there are currently four known OBD sites within the watershed. Two of these are licensed and on the Maine Departments of Environmental Protection's Priority for Removal list. The other two were previously undocumented until the summer of 2006.

Municipal and industrial point source stormwater discharges are addressed under the authority of the National Pollutant Discharge Elimination System (NPDES). The Stormwater Phase II Final Rule (1999) addresses storm water discharges from small municipal separate storm sewer systems (MS4s) (those serving less than 100,000 persons). This rule requires operators of regulated small municipal separate storm sewer systems (MS4s) to obtain a National Pollutant Discharge Elimination System (NPDES) permit and develop a stormwater management program designed to prevent harmful pollutants from being washed by stormwater runoff into the MS4 (or from being dumped directly into the MS4) and then discharged from the MS4 into local waterbodies.

As part of this program, the towns of Kittery and Eliot are required to develop, implement, and enforce a stormwater program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable (Edwards and Kelcey 2005). The stormwater management program must include these six minimum control measures:

1. Public education and outreach on stormwater impacts
2. Public involvement/participation
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post-construction stormwater management in new development and redevelopment
6. Pollution prevention/good housekeeping for municipal operations

5.3 Other Potential Pollution Sources

5.3.1 Septic Systems

Septic systems are another potential source of pollution to Spruce Creek. Most of the Spruce Creek watershed is not served by municipal sewer. The exceptions are the southwest corner of the watershed (east of Remick Corners) and along US Route 1 north of Ox Point Drive. Failing septic systems are a potential source of nutrients and bacteria. The fate and transport of nutrients from septic systems depends on several factors, including the age and type of system, distance from waterbody, number of people in the household, holding tank efficiency, soil type, and leach field porosity, among others(Castro et al., 2003).In Maine, systems put in place before 1975 have a much higher chance of malfunctioning than newer systems (Rocque, 2005).

The Maine Department of Marine Resources (DMR) has conducted septic surveys in portions of the Spruce Creek watershed three times since 1996. The most recent survey, in October of 2005, was aimed at identifying potential sources of contamination of shellfish in the Goose Point area. Septic systems on the Haley Road side of Spruce Creek were surveyed and notes pertaining to the location and pumping frequency of each system, along with signs of potential system failure were recorded. Of the 29 properties inspected, two showed signs of possible failing septic systems.

5.3.2 2014 Wastewater Database –

In 2014, a database of all properties in the Spruce Creek watershed was developed. This database included information on wastewater treatment system (septic system vs. sewer) and all available history regarding those systems. The overall goal of the database is to facilitate municipal management of septic systems by ranking systems according to risk of pollution to Kittery's streams, estuaries, and beaches. The database will assist town departments in ensuring that septic systems are properly maintained and is a starting point for further action. Recommended next steps include filling in data gaps on systems with no permits on file, and

considering an ongoing septic system maintenance and inspection program at the municipal level for aging systems.

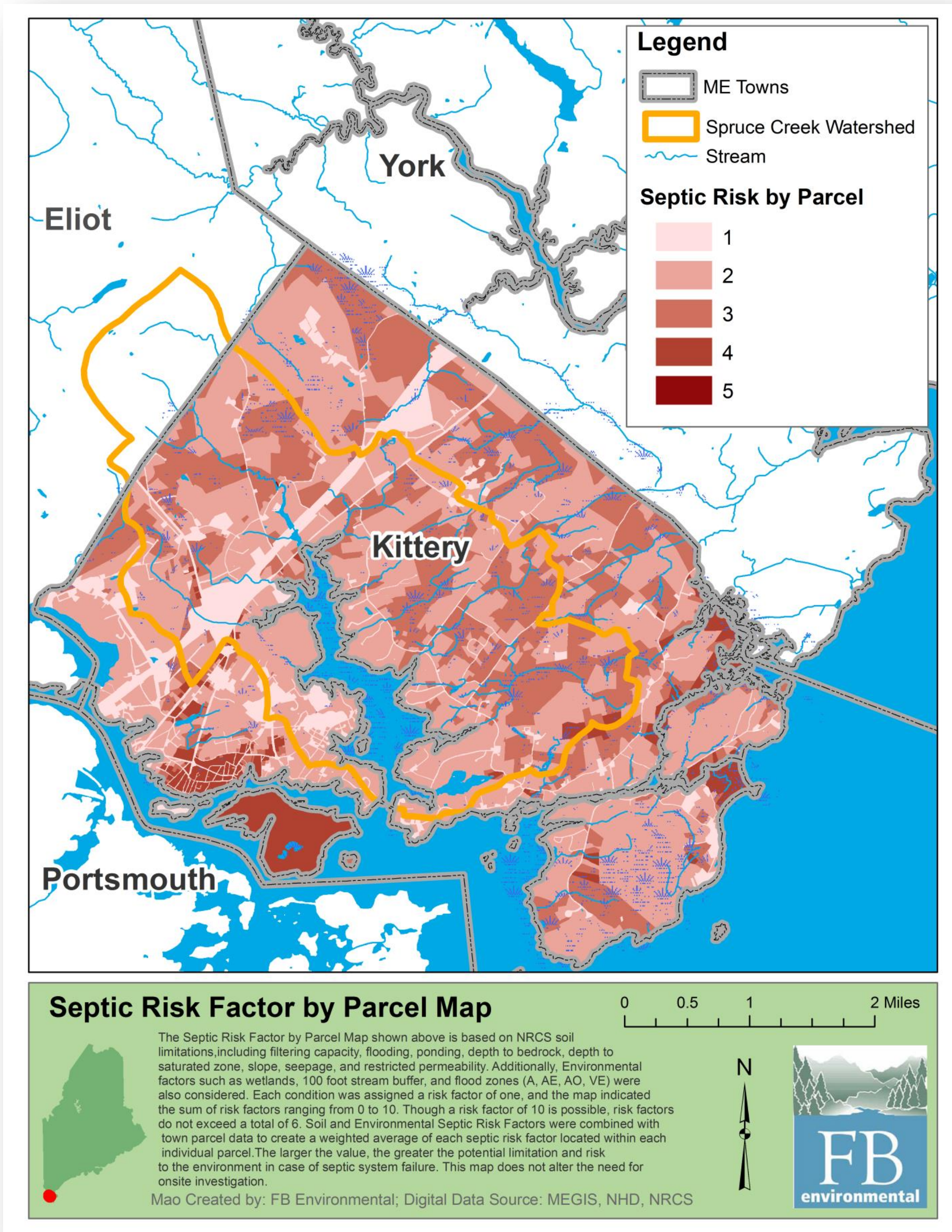
The database includes a list of properties prioritized based on a number of factors including soil type, availability of records, and land use for ensuring that septic systems are maintained and functioning properly. Although there is a thorough state-level permitting and inspection process to ensure that new septic systems are properly designed and built, there is no program to track systems over its long service life of approximately forty years. Research and real-world experience shows that systems of all ages can malfunction for a wide variety of reasons, including poor maintenance, excessive loading with fats or solids, overloading due to water supply leaks, damage from tree roots or vehicles, old age, and even occasional errors in design or installation which were not discovered upon installation. Malfunctions can persist for years with or without the homeowner's knowledge, polluting streams and beaches with multiple pollutants including bacteria. It is impractical to check all systems in a town or watershed at one time. Therefore a prioritized list was created to direct resources in an orderly and efficient manner to provide the greatest benefit to health and safety.

The database consists of several categories of properties, covering the entire watershed of Spruce Creek. Within each of the categories, properties are ranked by environmental sensitivity. There are two major components to the septic systems database, soil and environmental risk factors, and system age as indicated by permit records. Soil and environmental risk factors refer to the sensitivity to septic failure in various areas of the town. Higher risk factors indicate a greater risk to health and safety if a septic system should fail, because bacteria and algae-causing nutrients will have a more direct route to swimming areas. These risk factors were determined using GIS (computer mapping), along with publicly available data (Figure 5-1).

In addition to documenting all available records on septic systems, a database of properties within the Spruce Creek watershed thought to rely on municipal sewer were also documented. This database provides a tracking system for the town to verify that all properties that receive a sewer are actually connected to the municipal sewer system. In 2013, multiple neighborhoods in Admiralty Village in the Spruce Creek watershed were evaluated to ensure connection through smoke testing. The smoke testing resulted in a list of homes for Kittery's Code Enforcement Officer to visit to ensure proper connection to the sewer system.

For more information of the Spruce Creek Watershed Wastewater Database please contact the Town of Kittery's Shoreland Zoning Officer, Jessa Kellogg at jkellogg@kitteryme.org.

Figure 5-1: Septic Risk Score for Kittery Parcels (2014)



5.3.3 Steps toward a Town-wide Septic System Pump-out Ordinance

Septic systems typically consist of a tank which allows for primary and partial treatment of waste through settling and microbial processes, and a disposal field where most of the microbial treatment occurs. One of the key roles of the tank is to allow solids to settle, grease and other low density constituents to float, and only water-based effluent is sent to the disposal field. While microbial processes in the tank provide some level of treatment and therefore reduction in solids and floating matter, both accumulate over time. They must be removed periodically by a septic system pump-out, or they will flow into the disposal field, clogging and ultimately destroying it.

It is widely reported in reference material that septic tanks should be pumped out every three to five years. However, scientific literature of experimental studies on the effects to streams of not pumping out is not available. Such studies would be addressing what is essentially self-evident: clogged septic tanks cause disposal field failures and can lead to untreated wastewater leaking out to a nearby waterbody.

The most authoritative document is the EPA onsite wastewater manual from 2002. It states clearly on page 2-24 that failure to maintain septic systems is a recurring weakness across the country. It addresses septic tank pumping on page 4-45, citing a three to five year frequency for residential systems (or when 30% of the tank volume is sludge and scum, for regularly inspected systems). Chapter 2 outlines many state and local management programs, ranging from mandatory inspections to documented pump-outs. This is the best resource overall for understanding septic systems and considering management options.

Like a handful of other coastal Maine towns that have created their own septic system ordinance, the Town of Kittery is taking steps towards introducing a town-wide septic system pump out ordinance which creates a baseline for septic management within the town. The first draft of the proposed ordinance was written during Phase II of the SCWIP grant, and has been edited continually by the town to date. Currently, the proposed ordinance has yet to be enacted by the Kittery Town Council, but efforts are underway to make selected changes to the proposed ordinance to ensure sufficient support within the town.

6. Linking Pollutant Sources to Water Quality

6.1 Estimation of Pollutant Loads

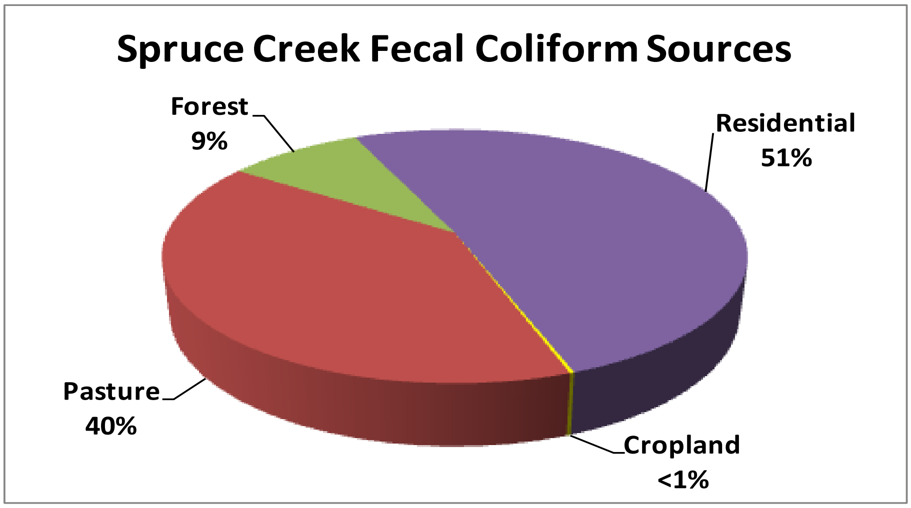
For the 2008 plan, estimates of fecal coliform loads and sources in the Spruce Creek watershed were determined using the Bacteria Source Load Calculator (BSLC),developed by the Center for TMDL and Watershed Studies. The BSLC is a spreadsheet model that characterizes how bacterial loads are spatially and temporally distributed by inventorying bacterial sources and estimating loads generated from these sources.

The BSLC incorporates user-generated, watershed-specific inputs, including land use distribution and livestock, wildlife, and human population estimates, to calculate monthly bacterial loadings (For Spruce Creek inputs, see Appendix D). Results are displayed by source (land use) in cfu's, or "colony forming units", per month and year. In the Spruce Creek watershed, yearly bacterial loads from all sources totaled just over 116,000 x 106 per year (Table 6-1). However, although land use data and additional model inputs gathered for the Spruce Creek watershed are as accurate as possible given all of the available information and resources utilized, final numbers for the land use analysis and bacteria loading numbers are approximate and should be viewed only as carefully researched estimations.

Table 6-1: Monthly bacteria loads in Spruce Creek Watershed

Month	Fecal Coliform loadings ($x10^{10}$ cfu/month)			
	Cropland	Pasture	Forest	Residential
Jan.	13	4,108	1,194	5,034
Feb.	18	3,744	1,089	4,588
Mar.	44	4,271	841	5,034
Apr.	38	4,179	814	4,872
May.	19	4,318	841	5,034
Jun.	12	4,179	292	4,872
Jul.	13	4,318	302	5,034
Aug.	13	4,318	302	5,034
Sep.	12	4,179	1,156	4,872
Oct.	19	4,318	1,194	5,034
Nov.	22	4,133	1,156	4,872
Dec.	13	58	1,194	5,034
Total	234	46,123	10,375	59,314

Figure 6-1: Sources of bacteria to Spruce Creek

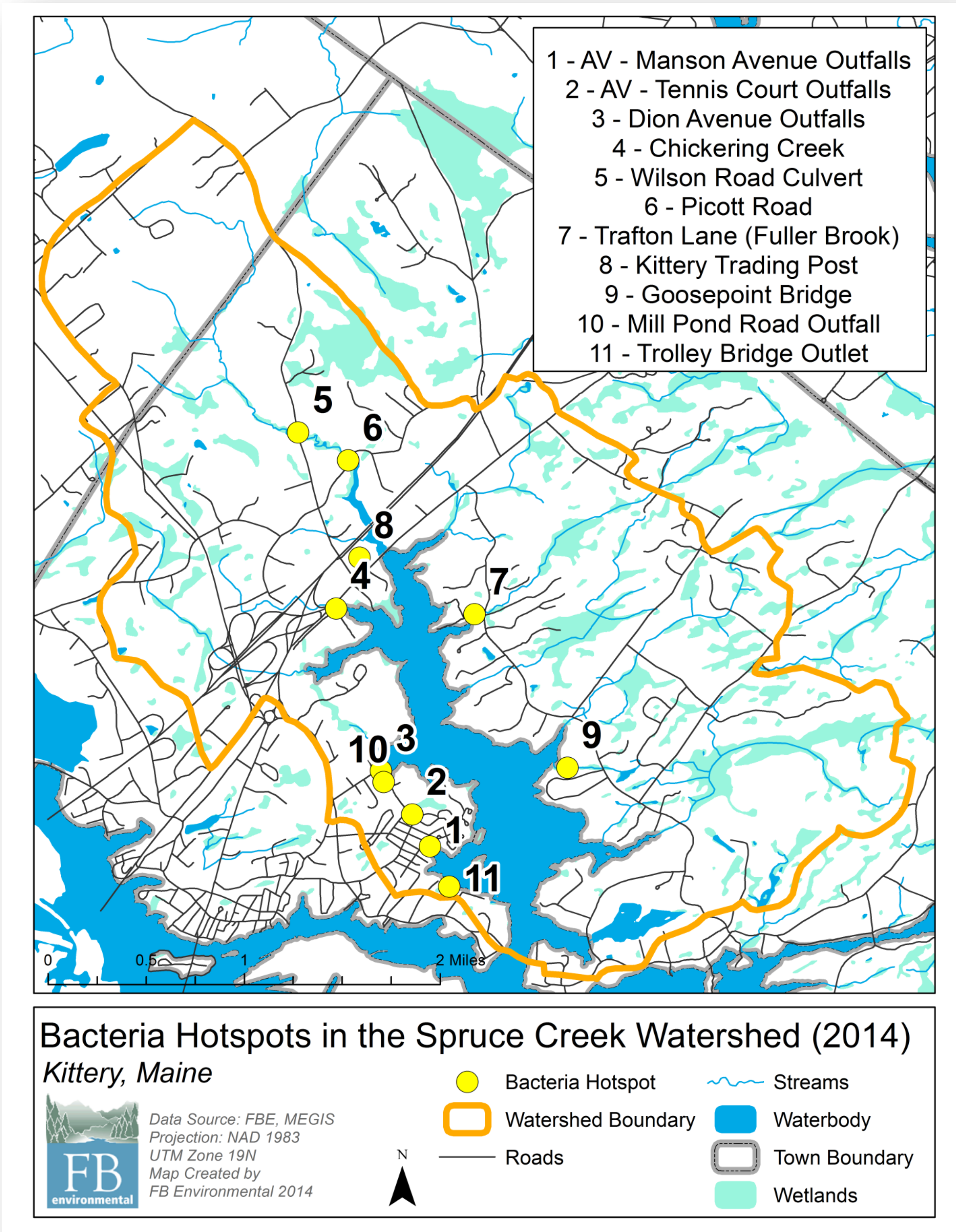


6.2 *Identification of Critical Areas*

To help prioritize and target management efforts within the Spruce Creek watershed, critical areas where the pollutant sources are causing the most damage have been identified (*see Section 5.1*). It is recommended that management measures be applied to these areas first. See Figure 6-2 for a map of potential sites.

Outfall located at the end of Tilton Road in Kittery, Maine underneath an old trolley bridge

Figure 6-2: Bacteria Hotspots in the Spruce Creek Watershed (2014)



7. Watershed Goals and Objectives

7.1 Management Objectives

Objectives of the management plan are focused on improving water quality in Spruce Creek for the benefit of fish, birds, and other wildlife, as well as local residents, landowners, and visitors. The following objectives were established by stakeholders at the 2006 Spruce Creek Community Forum; ***underlined objectives were identified by the Spruce Creek Action Plan Development Team as continued priorities in 2014***:

1. **Reduce bacterial loads (open shellfish beds).**
    a. Continue and enhance water and shellfish sampling
    b. Curb bacterial loading
    c. Restore flounder
    d. Identify and repair failing septic systems (OBDs)
    e. Identify homes not connected to sewer system (legally and illegally) and encourage them to connect
2. **Protect and restore vegetated buffers.**
    a. Educate citizens and businesses about new shoreland zoning rules
    b. Enforce Shoreland Zoning
    c. Incentivize maintaining, restoring, and expanding riparian buffers
    d. Restore a structurally diverse vegetated buffer throughout the watershed
    e. Educate the public and adjacent landowner of the value of maintaining vegetated buffers
    f. Establish Youth Conservation Corps projects
    g. Restore/protect eel grass
3. **Stop trash and debris dumping, including yard waste and clean up current sites**.
    a. Clean up sites
    b. Change regulations and code to enable enforcement
    c. Educate landowners
4. **Limit impervious surfaces and minimize their impacts.**

   a. Encourage innovations in new construction
   b. Retrofit existing sites whenever possible
   c. Encourage naturalized landscaping
   d. Reduce/eliminate chemical inputs

5. **Improve stream crossings and reduce flow restrictions**
   a. Learn more about impacts and better engineering
   b. Reduce restrictions (replace culverts, etc.)
   c. Reduce erosion, silting and obstructions
   d. Improve road crossings by planting additional low-growing shrubs
   e. Improve fish passage

6. **Increase amount of conservation land.**
   a. Work on open space plan for the whole watershed
   b. Work with Open Space Committee and Land Trust

7. **Continue assessments and evaluations.**
   a. Gather existing data, assessments & studies
   b. Establish water quality trends
   c. Continue the search for sources of pollution
   d. Conduct fish survey
   e. Conduct analysis of soils and sediments
   f. Quantify current silt loads at crossings
   g. Conduct analysis of fecal population and sources (especially in agricultural areas)
   h. Explore purchase of data sondes & webcams for continual water quality monitoring

8. **Enforce ATV laws**

9. **Control and treat stormwater from commercial areas.**
   a. Reduce or eliminate private sources of water to the public stormwater drainage network when opportunities exist
   b. Develop a comprehensive stormwater mitigation plan

c. Explore source area controls on private property and selected "upstream" disconnections

d. Establish and manage traded "pollutant credits" to incentivize use of new technologies to control and treat stormwater on private lands

e. Pursue funds through MEDEP 319 program to assist private landowners with pollution treatment strategies

f. Use publicly owned land for stormwater improvement location

g. Encourage more curb break sites

h. Better understand maintenance of public and private catch basin and stormwater treatment systems and encourage stormwater retrofits as maintenance activity

i. Establish pet walking zones for shoppers within the commercial district

j. Consider other retrofit opportunities within the subcatchment areas, including bioretention swales in the locations of existing raised parking dividers, modifications to the existing "detention basin", etc.

k. Identify available resources for stormwater retrofit funding

l. Increase exposure of the extensive influence of stormwater on the lower Spruce Creek watershed through public education

10. **Address docks/piers/jetties issues.**

    a. Coordinate town regulations with state and federal standards

    b. Work with boaters and home owner to understand impacts of docks and piers and their maintenance

11. **Control invasive species.**

    a. Work with Rachel Carson National Wildlife Refuge (RCNWR) on bio-control sites

    b. Coordinate efforts with volunteers and town officials on removal of species

12. **Develop and implement outreach programs.**

    a. Homeowner land practices (implement a program such as Yardscaping)

    b. Integrate watershed and water quality topics into K-12 programs (including state curriculum and storm drain stenciling)

    c. Develop Shoreland Zoning brochure/materials

d. Work with residents on improved farming practices
e. Explore developing a demonstration LID site at malls
f. Consider creating a watershed information center
g. Signs at watershed boundary
h. Boater Education
i. Gardening events
j. Archaeological interest
k. Realtor education and disclosure program

13. **Improve land use ordinances, design standards and evaluate comprehensive plan to incorporate citizen concerns for water quality and watershed issues.**
    a. Minimize water quality impacts of land conversion from rural to more developed uses
    b. Stormwater ordinances
    c. Evaluate and strengthen septic ordinances (mandatory pumpout, system inspections, joint purchase of pumpouts, GIS layers, get more folks connected to sewer)
    d. Develop LID guidance
    e. Enhance building permit requirements related to water quality
    f. Evaluate implementation of Comp Plan: Shoreland Overlay Zone, Conservation of Kittery Wetlands, and Resource Protection District
    g. Work closely with Planning Board
    h. Create a Business certification (“creek friendly”) program
14. **Implement Builder and Landscaper certification program.**
    a. Include mandatory participation in workshop and enforcement elements
15. **Supplement Town GIS layers.**
    a. Create a database of watershed issues and fixes

7.2 Load Reduction Targets

When enough data are available, reductions in the concentration bacterial TMDL or loading capacity necessary to meet water quality standards are calculated for a rough estimation of pollution abatement action needed. For Spruce Creek, the estimate of percent reduction needed was calculated based on the difference between measured fecal coliform data from the years 2004 through 2007 and the water quality criteria for approved shellfish growing areas (Geometric mean shall not exceed 14/100mL and estimated 90th percentile shall not exceed 31/100mL. (Maine DMR (2007)). Water quality criteria were compared to both the geometric mean and the highest concentration level measured at each of the seven monitoring sites.

To calculate the estimated % reduction necessary to achieve the fecal coliform water quality standard in Spruce Creek:

Percent fecal coliform reduction = ((Fecal coliform measured value – Fecal coliform standard) /Fecal coliform measured value) x 100

(Calculation based on the draft MDEP methodology for developing bacteria TMDLs)

Table 7-1: Spruce Creek Fecal Coliform Reduction Targets (2008) (Map 10, Appendix B)

Site[1]	Fecal coliform maximum measure	Fecal coliform geometric mean	% Reduction (Max)[2]	% Reduction (Geomean)[2]
WA024	43	12	28%	0%
WA028	460	62	93%	77%
WA029	460	46	93%	70%
WA030[3]	240	61	87%	77%
WA031	180	30	83%	53%
WA033	460	42	93%	67%
WA034	27	7	0%	0%
WA035[3]	23	9	0%	0%
WA036	93	10	67%	0%
All Sites	**460**	**8**	93%	0%

[1] For map of site locations, see Map 10, Appendix B.

[2] For all maximum measures, % reduction was calculated using 90th percentile (P90) standard (31 fecal coliforms/100 mL); For all geometric means, % reduction was calculated using geomean standard (14 fecal coliforms/100 mL).

[3] Analysis for sites WA030 and WA035 based on 2004-2005 data only.

Results show the overall reduction target to be 93%, based on the highest measured concentrations at all sites. Site WA028 (below the Route 1 overpass) has the highest reduction targets at 93% based on highest measured concentrations and 77% based on geometric means. ***Until the baseline water quality dataset has been established in the main channel of Spruce Creek, the water quality reduction target calculated in 2008 will remain the target.***

7.3 Load Reduction Estimates

The management guidance provided above is intended to support evaluation of BMP alternatives and identification of next steps in the process of mitigating water quality impairment in Spruce Creek. It is difficult to predict in detail the pollutant loading reduction that may be achieved using a management practice or BMP. Additional site-specific evaluation will be required to support precise quantification of the nature and extent of pollutant reductions that would be achieved through implementation of the mitigation measures described above. Table 7-2 provides estimates of pollutant removal efficiencies for various types of practices and BMPs. These estimates are the result of investigations conducted throughout the United States and were compiled by the U.S. Environmental Protection Agency. These removal efficiency values are useful to support planning and selection of appropriate mitigation measures, but should be considered rough estimates of actual removal performance. Factors that can affect the reporting of BMP performance include:

- Number of storms sampled
- Manner in which pollutant removal efficiency is computed
- Monitoring technique employed
- Sediment/water column interactions
- Soil type
- Rainfall, flow rate, and particle sizes of the influent
- Size and land use of the contributing catchment
- Incoming pollutant concentrations

Rain barrel BMP installed at Bobs Clam Hut, Kittery, Maine

Table 7-2: Estimated Pollutant Removal (percent) of Best Management Practices

BMP Type	Typical Pollutant Removal (percent)				
	Suspended Solids	Nitrogen	Phosphorus	Pathogens	Metals
Dry Detention Basins	30 - 65	15 - 45	15 - 45	< 30	15 - 45
Retention Basins	50 - 80	30 - 65	30 - 65	< 30	50 - 80
Constructed Wetlands	50 - 80	< 30	15 - 45	< 30	50 - 80
Infiltration Basins	50 - 80	50 - 80	50 - 80	65 - 100	50 - 80
Infiltration Trenches/ Dry Wells	50 - 80	50 - 80	15 - 45	65 - 100	50 - 80
Porous Pavement	65 - 100	65 - 100	30 - 65	65 - 100	65 - 100
Grassed Swales	30 - 65	15 - 45	15 - 45	< 30	15 - 45
Vegetated Filter Strips	50 - 80	50 - 80	50 - 80	< 30	30 - 65
Surface Sand Filters	50 - 80	< 30	50 - 80	< 30	50 - 80
Other Media Filters	65 - 100	15 - 45	< 30	< 30	50 - 80

Source: US EPA 1993

7.4 Pollutant Load Reductions by BMPs in the Spruce Creek Watershed since 2008

The reduction in the pollutant load to Spruce Creek in response to the installation of Best Management Practices (BMPs) was calculated during each phase of the Spruce Creek Watershed Improvement Project. The primary objective of these BMP projects is to prevent or reduce non-point source pollutant loadings entering water resources so that beneficial uses of the water resources are maintained or restored. BMPs are methods designed to protect water quality through the prevention or reduction of the movement of pollutants from the land to surface or ground water. Structural BMPs are generally engineered, constructed systems that can be designed to provide water quality and/or water quantity control benefits.

7.4.1 Pollutant Reduction Methodology

The EPA Region 5 Model was used to calculate the reduction in pollutant load in response to the implementation of the BMPs installed in the Spruce Creek watershed. The Region 5 Model provides a gross estimate of sediment and nutrient load reductions from the

implementation of agricultural and urban BMPs. While it is recognized that this system has limitations, it does provide a uniform system of estimating pollutant reductions to impaired waters.

7.4.2 SCWIP Phase I Pollutant Reductions

In SCWIP Phase I, 22 BMPs were installed to control polluted runoff. 11 of these BMPs were installed at private residences, 9 installations were located at commercial sites, and 2 BMPs were implemented on industrial property. A total of 2,781 pounds of TSS are captured by these BMPs annually. Additionally, annual reductions of 28 pounds of nitrogen and 1 pound of phosphorus are also estimated for these six sites. Since completion of these BMPs in 2010, a total of 11,124 pounds of TSS, 112 pounds of nitrogen, and 4 pounds of phosphorus have been captured by these BMPs and prevented from entering the Creek. See table 7-3 for individual BMP pollutant load reductions for BMPs installed during Phase I of the SCWIP.

Table 7-3: Total Pollutant Reductions in the Spruce Creek Watershed during SCWIP Phase I

Site ID	Brief Description of NPS Site	Estimation Method/Sub-Method Used	Sediment Tons/Year	Phosphorus Pounds/Year	Nitrogen Pounds/Year	TSS Pounds/Year
Residential Site 1	35 Mill Pond Road	R5/Urban Runoff	N/A	--	--	86
Residential Site 2	7 Mill Pond Road	R5/Urban Runoff	N/A	--	--	47
Residential Site 3	7 Ox Point Road	R5/Urban Runoff	N/A	--	1	85
LID Site 1	Old Navy	R5/Urban Runoff	N/A	1	26	606
LID Site 2	Bagel Caboose	R5/Urban Runoff	N/A	--	--	102
LID Site 3	Kittery Town Hall	R5/Urban Runoff	N/A	--	1	1855
		Total	**N/A**	**1**	**28**	**2781**

7.4.3 SCWIP Phase II Pollutant Reductions

Phase II of the SCWIP resulted in the installation of 25 individual BMPs located at 9 sites within the Spruce Creek Watershed. Five of these sites were located on residential property, and the remaining four sites were installed on commercial properties. The 25 BMPs installed during phase II prevented a total of 458 pounds of Total Suspended Solids (TSS) per year, and 2 pounds of Nitrogen from entering the Creek annually. Since the completion of the phase II BMPs in 2012, almost 1,000 pounds of TSS, and 4 pounds of nitrogen have been reduced in the Spruce Creek Watershed. See table 7-4 for individual BMP reductions (below).

Table 7-4: Total Pollutant Reductions in the Spruce Creek Watershed during SCWIP Phase II

Site ID	Brief Description of NPS Site	Estimation Method/Sub-Method Used	Sediment Tons/Year	Phosphorus Pounds/Year	Nitrogen Pounds/Year	TSS Pounds/Year
Residential Site 1	381 Haley Rd.	R5/Urban Runoff	N/A	--	--	53
Residential Site 2	8 Moore Street	R5/Urban Runoff	N/A	--	--	19
Residential Site 3	19 Bond Rd.	R5/Urban Runoff	N/A	--	--	47
Residential Site 4	21 Bond Rd.	R5/Urban Runoff	N/A	--	--	2
Residential Site 5	Bond Rd. (shared driveway)	R5/Urban Runoff	N/A	--	--	98
LID Site 1	Gap Outlet	R5/Urban Runoff	N/A	--	2	198
LID Site 2	Bob's Clam Hut	R5/Urban Runoff	N/A	--	--	20
LID Site 3	Robert's Maine Grill	R5/Urban Runoff	N/A	--	--	6
LID Site 4	Shapleigh Middle School	R5/Urban Runoff	N/A	--	--	15
		Total	**N/A**	--	**2**	**458**

7.4.4 SCWIP Phase III Pollutant Reductions

As of December 2013, three BMPs were installed at a residential property on Cottage Way in Spruce Creek. Three Additional residential BMPs, and three LID installations on commercial and municipal property are scheduled for the summer of 2014. One of the planned LID projects includes a large gravel wetland/detention basin that will be installed at commercial

site on Route 1 in Kittery. This site, along with all others will be featured during an end-of-project BMP tour throughout the Spruce creek Watershed in 2014.

The one residential site installed in 2013 as part of phase III of the SCWIP consisted of 3 BMPs that were estimated to prevent 23 pounds of TSS from entering Spruce creek annually. Pollutant reduction estimates will be calculated after completion of the remaining BMP scheduled for installation in 2014.

7.4.5 Total Pollutant Reductions as of April 2014

As of April 2014, a total of 3,262 pounds of TSS have been reduced from Spruce Creek annually. A total reduction of 30 pounds/year of nitrogen is also estimated as a result of the installed BMPs since 2008.

Spruce Creek at Route 1 overpass.
(Photo: Rachel Bell, 2007)

8. Management Strategies

8.1 Existing Management Strategies

For nearly 20 years, the Spruce Creek Association, the towns of Kittery and Eliot, and the primary watershed stakeholders have been effectively working to better understand the types and sources of pollution in the Spruce creek watershed. Table 8-1.summarizes water quality accomplishments and activities in the watershed to date.

Table 8-1: Water Quality Accomplishments in the Spruce Creek Watershed since 2002

Date	Accomplishment
2002	Kittery adopted Comprehensive Plan (March 25 2002)
2004	Stormwater Assessment and Retrofit Inventory of Rt. 1 (MSPO)
2004	SCA Annual Meeting and "What is a Watershed?" Presentation (SCA)
2005	Tidal Restriction Removal Assessment (Kittery)
2005	Inventory of Habitat Restoration Opportunities (Maine State Planning Office)
2005	Healthy Beaches Enterococcus Monitoring (SCA, Maine Healthy Beaches)
2005	MS4 Watershed Survey Report (Kittery)
	SCA Annual Meeting & Buffers and the Use of Native Plants Presentation (SCA)
2005-2006	Nonpoint Source Pollution Survey (Kittery. Eliot, SCA)
2005,2007	Storm Drain Stenciling (Kittery, Eliot, SCA)
2005-2007	Water Quality Monitoring (SCA)
2006	SCA Annual Meeting & Environmental History of Spruce Creek Presentation (SCA)
2007	Purple Loosestrife Beetle Release Program (SCA, Rachel Carson NWR)
2007	Culvert Assessment (Kittery)
2007	Coastal Connections: Coastal Watershed Unit aligned with State of Maine Learning Results (SCA Steering Committee, Shapleigh Middle School, Kittery, Mark Gunter, Maine Sea Grant Extension
2007-2008	Thompson Mill Pond Restoration Opportunity Assessment (Kittery Land Trust, SCA)
2008-2010	***Spruce Creek Watershed Improvement Project Phase I (FBE)***
2009	***Stormwater Outfall and Tributary Sampling (FBE)***
2009-2012	***Spruce Creek Watershed Improvement Project Phase II (FBE)***
2011-2014	***Stormwater Outfall and Tributary Sampling; Bacteria Hotspot Follow-up (FBE)***
2013-2015	***Spruce Creek Watershed Improvement Project Phase III (FBE)***

8.1.1 Spruce Creek Watershed Improvement Project Phase I

Upon completion of the 2008 Spruce Creek Watershed Management Plan, the Town of Kittery applied for and successfully received funding for a Section 319 Water Quality Improvement and Restoration Grant from Maine Department of Environmental Protection. The primary purpose of the Spruce Creek Watershed Improvement Project (SCWIP) Phase I was to address the cumulative impacts of increasing development and polluted runoff to surface waters in the Spruce Creek watershed. In particular, this project focused on reducing bacteria loading and the export of sediment and nutrients into Spruce Creek to improve water quality and help re-open shellfish harvest areas. See Appendix E for the SCWIP Phase I Final Report.

Some of the major project outcomes included:

- ***The installation of 22 BMPs to control polluted runoff.***
- ***Direct education of over 1,000 watershed citizens and visitors through outreach.***
- ***Three septic socials (total of 45 attendees) and six residential socials (total of 110 attendees) held.***
- ***Over 3,000 volunteer hours logged.***
- ***The establishment of a discounted rain barrel program with dispersal to over 100 local residents.***
- ***The launch of the Save Kittery Waters website.***
- ***The development of the Save Kittery Waters Pledge program which has received pledges from 34 local citizens to implement a total of 444 watershed-friendly practices on their properties.***
- ***Presentations at over 10 events.***

Photo: Forrest Bell of FB Environmental discussing SCWIP Phase I and II and the impacts of stormwater on local waterbodies during the October 5, 2011 tour of the Spruce Creek Watershed

Buffer plantings at a residential BMP in Kittery, Maine.

8.1.2 Spruce Creek Watershed Improvement Project Phase II

To continue the momentum of SCWIP Phase I, the Town of Kittery applied for and received a second grant from ME DEP. SCWIP Phase II addressed the cumulative impacts of increasing development and polluted runoff to surface waters in the Spruce Creek. This was accomplished through the installation of structural Best Management Practices (BMPs) at residential, commercial, and town properties. The project also aimed to raise awareness about watershed problems and foster long-term watershed stewardship. See Appendix F for the SCWIP Phase II Final Report. Some of the major project outcomes include:

- ***The installation of 25 BMPs to control polluted runoff (21 residential and 4 commercial).***
- ***Direct education of over 300 watershed citizens and visitors through outreach.***
- ***Over 1,526 volunteer hours logged.***
- ***The maintenance of the Save Kittery Waters website.***
- ***The continuation of the Save Kittery Waters Pledge program which has received pledges from 54 local citizens to implement a total of 648 watershed-friendly practices on their properties.***
- ***Presentations at over 8 events.***

8.1.3 Spruce Creek Watershed Improvement Project Phase III

The Town of Kittery received an additional 319 grant in 2013. The Spruce Creek Watershed Improvement Project (SCWIP) Phase III is ongoing through 2015. This project will to continue to address the impacts of development and polluted runoff to surface waters in Spruce Creek. Major Project outcomes will include:

- ***LID and Stormwater BMP Installations***
- ***Identify/Map/Inventory all Septic Systems within the Watershed***
- ***Maintenance and updates to Save Kittery Waters website***
- ***Septic Socials, NPS Workshops, Public Awareness Presentations***

8.2 Additional Strategies Needed to Achieve Goals

8.2.1 NPS Management Strategies

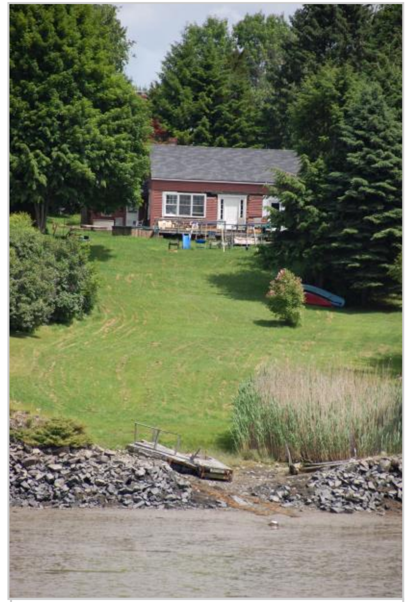
Stormwater runoff is one of the largest water quality concerns in Spruce Creek. There are two primary problems associated with stormwater runoff: the increased volume and rate of runoff from impervious surfaces and the concentration of pollutants in the runoff. Both components, which are directly related to development, cause changes in hydrology and water quality that result in a variety of problems, including habitat modification and loss, increased flooding, decreased aquatic biological diversity, and increased sedimentation and erosion. Effective management of stormwater runoff offers many possible benefits, including protection of wetlands and aquatic ecosystems, improved quality of receiving waterbodies, conservation of water resources, protection of public health, and flood control.

Conservation Best Management Practices, or BMPs, are any structural or non-structural practice to treat, prevent or reduce water pollution. These practices can be as simple as re-vegetating bare soil and planting shrubs along the water front, to installing sediment detention basins to capture and filter sediments before they enter the water course. Often, a variety of BMPs may be needed to adequately treat NPS pollution. The following list provides examples of many different BMPs that can be applied to NPS problems identified in the watershed the Spruce Creek watershed:

<u>Erosion on Roads and Driveways</u>

- Add new surface material to stabilize roadways
- Install runoff diverters e.g.) broad-based dip, rubber razor, waterbar
- Install ditch turnouts or diversion channels to send overland flows to stable areas

- Use detention basins at ditch turnouts to retain water between runoff events, and remove suspended sediments and adsorbed pollutants.
- Remove grader berms
- Remove excess winter sand
- Reshape/vegetate road shoulder
- Reshape or crown roads to reduce water on surface
- Pave dirt roads
- Install permeable pavement to allow water infiltration in high traffic areas



Example of inadequate riparian buffer along Spruce Creek. (Photo: Rachel Bell).

Inadequate Vegetated Buffer and Bare Eroding Soil

- Establish buffers to reduce direct flow to waterbody
- Extend buffers to a minimum of 75' on all streams
- Plant trees, shrubs and ground covers to stabilize soil and reduce runoff
- Seed bare soil with grass to provide temporary or permanent cover
- Mulch bare soil with straw, wood fiber or chips etc. over a seeded area to protect the bed from erosion and drying
- Use sod transplants to stabilize erosion prone areas

Poorly Functioning Culverts

- Clean out culverts regularly to minimize blockage and backflow
- Enlarge, replace, or lengthen culverts to account for type of flow
- Install plunge pools to reduce downstream erosion
- Stabilize inlets/outlets with rock and vegetation to reduce erosion

Inadequate Ditches

- Install new ditches to capture runoff from roads
- Armor ditches with stone to stabilize ditch and minimize erosion by runoff water
- Stabilize ditches with a grass to allow for concentrated flow without erosion
- Reshape ditches to minimize pitch and maximize storage
- Install turnouts to convey water to reduce flow to waterbody

- Install check dams to reduce erosive flows in drainage ditches/allow re-vegetation

Direct Flow from Roof Runoff

- Install a stone-filled dripline trench to capture and infiltrate rainwater
- Install a drywell at gutter down spout to capture water and prevent overland flow
- Install rain barrels and/or rain gardens to collect and filter rainwater

Unstable Shoreline/Beach Access

- Re-vegetate or terrace steep eroding slopes
- Establish a defined path for foot traffic
- Install steps to reduce erosion on steep foot paths
- Design winding paths to waterfront instead of straight paths
- Minimize path widths (must be less than 6')

Stormwater Runoff in Urbanized Areas

- Use Oil/Grit Separators to remove coarse sediment and oils in stormwater
- Install sumps on catch basins to capture solids before they enter the sewer system
- Create sediment detention basins to receive, detain and reduce sediments in stormwater from heavily impervious areas
- Use flow control devices to release water at non-erosive flow rate
- Install infiltration basins to impound water over permeable soils and allow controlled infiltration and removal of fine sediments and adsorbed pollutants

Construction Site Erosion Controls

- Put up fences and signs to contain damage caused by heavy equipment
- Use Grading plans to minimize erosion
- Use filter strips and buffers to prevent runoff, and stabilize erosion prone slopes.
- Place soil piles where they will not erode into watercourse
- Seed and install effective erosion barriers (temporary BMPs) around spoil piles
- Stage projects to minimize area of exposed soil at any one time
- Select and protect trees to the maximum extent possible, prior to construction.
- Dewater with well points/ cofferdams and pumps to remove ground and surface water from a construction site to reduce scarring and erosion
- Install Filters of crushed stone, straw or geotextile to remove sediment from stormwater before it exits a construction site

Other

- Install watercourse crossings to confine erosional impacts and minimize flow alterations at points of crossing
- Practice good fertilizer management techniques to minimize nutrient inputs to the water course

8.2.2 Point Source Management Strategies

Illicit Discharge Detection and Elimination

- Phase II MS4s are required to develop a program to detect and eliminate these illicit discharges. This primarily includes developing:
    - ⇒ a storm sewer system map,
    - ⇒ an ordinance prohibiting illicit discharges,
    - ⇒ a plan to detect and address these illicit discharges, and
    - ⇒ an education program on the hazards associated with illicit discharges.
- Audit Existing Resources and Programs
- Establish Responsibility, Authority, and Tracking
- Complete a Desktop Assessment of Illicit Discharge Potential

Sable of ECS uses canine detection to investigate a catch basin

9. Plan Implementation

9.1 Plan Oversight

The Spruce Creek WBMP Steering Committee, along with the towns of Kittery and Eliot, will need to continue to meet regularly and be diligent in coordinating resources to implement practices that will reduce NPS pollution in the Spruce Creek watershed. This task cannot be accomplished alone, and will require the support of a number of watershed groups including the Kittery Land Trust, York County Soil and Water Conservation District, Maine DEP, schools, and individual landowners.

9.2 Action Plan

The SCA Steering Committee will work toward improving and implementing an Action Plan which consists of action items within five major categories: Buffers and Invasive, Bacteria Reduction, Impervious Cover and Stormwater, Conservation Lands, and Water Quality Assessment (Table 9.2-1). This Action Plan was developed to follow-up on objectives developed in the 2005 watershed survey, and from feedback received by 30 community members at the 2006 Spruce Creek Watershed Community Forum. Forum participants (local town officials, watershed landowners, and SCA members) formed small groups to discuss critical watershed issues related to water quality, wildlife habitat, recreation, and land development issues that need to be addressed in the watershed. Participants then prioritized potential watershed objectives. These ideas have been incorporated into the Action Plan. This Action Plan outlines responsible parties, potential funding sources, approximate costs, and an implementation schedule for each task within each of the five categories.

As previously discussed, the Spruce Creek Watershed-Based Management Plan was updated in 2014. Project staff facilitated a steering committee meeting with the goal of assessing progress and re-prioritizing the proposed action items from the 2008 watershed plan as well as proposing new actions. Meeting attendees were presented with existing and newly recommended action items and were asked to prioritize them by importance. The updated action items were also made available to other community members, and watershed stakeholders, town employees online via a survey where each action item could be voted on. Survey takers could also propose actions that were not included in the original action item list. Over 40 people participated in the update to this action plan. The updated action items as a result of the 2014 meeting and online community survey are presented in this section below.

9.2.1 Buffers and Invasives

The buffer action items place a strong emphasis on improving protection of shoreland vegetated buffers, to meet or exceed the existing state guidelines requiring that no more than 40% of existing woody vegetation in the 250 foot wide shoreland zone is removed. Action items include encouraging stewardship through buffer planting demonstrations and encouraging strict enforcement of Riparian Zoning Laws. Additionally, the watershed towns will coordinate with local land trusts in acquiring land within riparian zones. In order to reduce invasive plant species, action items in this category also include the removal of invasive species in high priority areas and encouraging the use of native species and beneficial habitat types. Additional actions include installing signs at the watershed boundary, holding Creek clean-up days, and enforcing ATV laws.

9.2.2 Bacteria Reduction

The bacteria reduction component of the Action Plan focuses on reducing the effects of septic systems on Spruce Creek through educating citizens and identifying problem sites. Actions also include working with watershed residents to reduce the impacts of livestock and pets.

9.2.3 Impervious Cover and Stormwater

The Action Plan focuses on reducing the impacts of impervious cover and stormwater through the education of residents, developers, and business owners. Actions include encouraging residential stormwater practices and awarding businesses using IC reduction practices, as well as holding informational seminars for developers.

9.2.4 Conservation Lands

The Conservation Lands component of the Action Plan requires continued cooperation between watershed towns, local land trusts, and project stakeholders to strategize land protection on a watershed level and develop an open-space plan for the watershed. Tasks include encouraging "green infrastructure" at the municipal level and looking into allowing greater public access to open space. Additionally, the watershed towns will coordinate with local land trusts in acquiring land within riparian zones.

9.2.5 Water Quality Assessment

While SCA has a strong water quality monitoring component, additional action is required to monitor the health of Spruce Creek on a long-term basis. This requires seeking funding to increase efficiency and obtain additional equipment such as continuous data loggers (data sondes). Additional stormwater sampling in the spring and fall may include both high/low tide and wet/dry monitoring. To better prioritize monitoring efforts and monitor Plan effectiveness, it is also important to continuously link management strategies to measurable results. Results will be displayed on the Town of Kittery website as well as the websites of other stakeholders where appropriate. Additional actions include creating photo documentation of baseline shoreland conditions, researching the effects of the Portsmouth Naval Shipyard and the Piscataqua River on Spruce Creek, and establishing a chemical spill assessment program.

(Photo: Phyllis Ford, 2007)

Table 9.2-1: Spruce Creek Action Plan: Buffers and Invasive Species (2008 and 2014)

Action Items	Priority (2008)	Priority (2014)	Responsible Party: SCA	Responsible Party: YCSWCD	Responsible Party: Land Trusts	Responsible Party: Towns	Responsible Party: Schools	Responsible Party: Land Owners	Funding Source: ME DEP 319	Funding Source: Other Federal	Funding Source: Other State	Funding Source: Town of Kittery	Funding Source: Private	Funding Source: Volunteer	Schedule (2008)	Status of Task (as of February 2014)	Next Steps	New Schedule (2014)	Approx. Annual Cost
BUFFERS AND INVASIVE SPECIES																			
Encourage stricter enforcement of riparian zoning laws, utilizing alternative penalties such as replanting and mandatory community service in lieu of fines.	M	15	x			x			x					x	Immediate/ongoing	--	Research options for stricter zoning laws; work with town to develop alternative options.	2015	$2,000
Develop informational materials to educate citizens and businesses about shoreland zoning rules.	M	13	x	x		x						x	x	x	2009	Educational materials developed in each phase of the ME DEP 319 grants.	Continue to develop information materials with a focus on shoreland zoning rules.	Ongoing	$1,000
Utilize resources such as TV, newspaper, SCA website, and public meetings for watershed education.	H	12	x				x	x				x	x	x	Immediate/ongoing	Press releases, website, etc. used for public education for all water quality work.	Continue to utilize media, SCA website, & public meetings for education.	Ongoing	$5,000
Encourage stewardship through buffer demonstrations. Hold volunteer work parties to install BMPs at high-profile sites. Hold neighborhood meetings about shoreland buffers.	H	12	x	x			x	x				x	x	x	Summer 2008 and ongoing	Over 50 stormwater BMPs have been installed since 2008; over 10 educational workshops have been held since 2008.	Develop a "Beautiful Buffer" program through partnerships with local landscaping companies, consultants, & SCA.	Annual and ongoing	$25,000
Coordinate efforts with volunteers and town officials on removal of invasive species, beginning with high priority sites from 2005 Habitat Survey.	M	12	x	x				x				x	x	x	2008 and ongoing	--	Seek grant to address invasive species; conduct 2015 Habitat Survey.	2014	$25,000
Photo document shoreline from water.		10	x	x	x	x		x	x			x	x	x	--	--	Photo document shoreline from water	2015-2016	$
Develop an incentive program for voluntary buffer increases.	M	9	x			x		x	x			x		x	2008 and ongoing	Cost-share programs were developed through ME DEP 319 grants.	Expand existing cost-share programs for BMPs to focus on increasing buffer width.	2015-2017	$20,000
Promote beneficial habitat types and the use of native species, and discourage non-beneficial habitat types.	M	9	x	x		x		x	x			x		x	2008 and ongoing	Native species used in each phase of the ME DEP 319 grants.	Continue to use native species in BMP installations; conduct workshops on native plantings.	Ongoing	$2,000
Install watershed signs along road to delineate watershed boundary (ex: "You are entering the Spruce Creek Watershed").	M	5	x	x		x			x			x		x	2008 and ongoing	--	Install watershed signs along road to delineate watershed boundary (ex: "You are entering the Spruce Creek Watershed").	2015-2016	$500
Provide educational materials on keeping geese off of properties as one benefit of a developed buffer.	--	5	x	x		x			x			x	x	x	--	--	Provide educational materials on keeping geese off of properties as one benefit of a developed buffer.	2014	$4,000
Investigate areas throughout the watershed where animals congregate (e.g. geese).	--	5	x	x		x			x			x	x	x	--	--	Investigate areas throughout the watershed where animals congregate (e.g. geese).	2015-2017	$2,500
Enforce ATV Laws.	M	4	x		x	x		x						x	Beginning 2008	--	Enforce ATV Laws.	Beginning 2015	$2,000
Coordinate Creek clean-up days and educate citizens.	M	3	x	x		x	x		x			x	x	x	Annually, starting 2008	Creek clean-up days were held in 2007 and 2008.	Re-start Creek Clean-up Day program.	Annually beginning 2015	$1,000
Work with local nurseries to get plant discounts and donated time for buffer plantings.	M	2	x					x						x	2008 and ongoing	Piersons Nursery sells SCA plants at cost for buffer plantings and BMPs.	Continue to seek donations, discounts.	Ongoing	N/A
Research/Use aerial photography as a method to identify septic break-outs.	--	0	x	x		x			x			x	x	x	--	--	Research/Use aerial photography as a method to identify septic break-outs.	2015-2017	$2,000-$100,000

Progress has been made on Action Item (green shading)
Proposed in 2014 (blue shading)

SCA = Spruce Creek Association
YCSWCD = York County Soil & Water Conservation District

Table 9.2-1: Spruce Creek Action Plan: Wastewater (2008 and 2014)

Action Items	Priority (2008)	Priority (2014)	Responsible Party: SCA	Responsible Party: YCSWCD	Responsible Party: Land Trusts	Responsible Party: Towns	Responsible Party: Schools	Responsible Party: Land Owners	Funding Source: ME DEP 319	Funding Source: Other Federal	Funding Source: Other State	Funding Source: Town of Kittery	Funding Source: Private	Funding Source: Volunteer	Schedule (2008)	Status of Task (as of February 2014)	Next Steps	New Schedule (2014)	Approximate Annual Cost
WASTEWATER																			
Establish a septic system tracking program; identifying homes not connected to the sewer system and identify failing systems.	H	26	x			x		x	x		x	x		x	Starting 2008	Septic system database developed in 2014; Smoke tests conducted in 2013 and 2014 to determine homes not connected to sewer system.	Continue to identify homes not connected to the sewer system through smoke/dye testing. Continue to identify homes with failing or malfunctioning septic systems.	Annual and ongoing	$20,000
Create a Septic System Ordinance for regular system pump-out requirements throughout the Spruce Creek watershed.	--	22	x			x						x			--	--	Create a Septic System Ordinance for regular system pump-out requirements throughout the Spruce Creek watershed.	Immediately	$5,000
Develop a cost-share program to help off-set the cost of septic system replacement.	--	15	x	x		x		x	x		x	x			--	--	Develop a cost-share program to help off-set the cost of septic system replacement.	2015-2017	$30,000
Free Mandatory Septic System Inspections	--	15	x	x		x			x		x	x			--	--	Free Mandatory Septic System Inspections	2015-2017	TBD
Seek funding through the Small Community Grants Program to help replace septic systems that have been shown to pollute Spruce Creek.	--	12	x			x						x	x		--	--	Seek funding through the Small Community Grants Program to help replace septic systems that have been shown to pollute Spruce Creek.	Immediately	N/A
Conduct a build-out analysis of the watershed to assess the impact of future development.	--	9	x	x	x	x		x	x		x	x			--	--	Conduct a build-out analysis of the watershed to assess the impact of future development.	2016-2018	$25,000
Hold "Septic Socials" to inform residents about the relationship between septic systems and water quality.	H	7	x	x		x		x	x			x	x	x	Starting 2008	Five socials held since 2008.	Hold socials in neighborhoods prioritized in bacteria sampling projects.	Annual and ongoing	$5,000
Develop a program to handle seasonal use properties. Homeowners could be required to register with the town to document number of visitors per year and as a result, have a more frequent pumping schedule.	--	6	x			x						x			--	--	Develop a program to handle seasonal use properties. Homeowners could be required to register with the town to document number of visitors per year and as a result, have a more frequent pumping schedule.	2015-2017	$3,000
Conduct Sanitary Survey	--	5	x	x		x			x		x	x			--	--	Conduct Sanitary Survey	2016-2018	$10,000
Aerial Photography for septic breakouts	--	4	x			x			x			x			--	--	Aerial Photography for septic breakouts	2016	TBD

Legend	
Progress has been made on Action Item	SCA = Spruce Creek Association
Proposed in 2014	YCSWCD = York County Soil & Water Conservation District

Table 9.2-1: Spruce Creek Action Plan: Impervious Cover and Stormwater (2008 and 2014)

Action Items	Priority (2008)	Priority (2014)	Responsible Party: SCA	Responsible Party: YCSWCD	Responsible Party: Land Trusts	Responsible Party: Towns	Responsible Party: Schools	Responsible Party: Land Owners	Funding Source: ME DEP 319	Funding Source: Other Federal	Funding Source: Other State	Funding Source: Town of Kittery	Funding Source: Private	Funding Source: Volunteer	Schedule (2008)	Status of Task (as of February 2014)	Next Steps	New Schedule (2014)	Approximate Annual Cost
IMPERVIOUS COVER AND STORMWATER																			
Encourage residential stormwater prevention practices (ex: rain gardens/barrels) and educate homeowners about lawn alternatives.	H	21	x	x		x			x		x	x	x	x	Immediately and ongoing	Over 50 residential BMPs have been installed since 2008; multiple educational workshops have been held.	Continue residential BMP program. Target specific neighborhoods identified as "hotspots" in bacteria sampling projects. Encourage "neighborhood" projects.	Immediately and ongoing	$15,000
Develop a comprehensive stormwater mitigation plan.	H	17	x	x		x		x	x	x	x	x	x	x	Beginning in 2008	--	Develop a comprehensive stormwater mitigation plan.	Beginning in 2015	$75,000
Create additional developer incentives.	H	11	x				x	x				x		x	Beginning in 2008 and ongoing	--	Create additional developer incentives for installing BMPs or hosting educational workshops on their properties.	Beginning in 2015	$3,000
Create cost estimates for existing stormwater retrofit plan.	M	10	x	x		x			x	x	x	x			Beginning in 2008	Costs were estimated for each recommended BMP.	Re-visit 2008 stormwater survey.	2015	$15,000
Recognize / award businesses using impervious cover reduction practices.	M	9	x			x					x	x			Beginning in 2008	Local businesses participating in BMP program through the ME DEP 319 grant have been recognized in press releases, on website, and through signage.	Continue to recognize businesses using IC reduction practices; work with Town of Kittery and SCA to develop a "Blue Business Award" for businesses implementing BMPs.	Beginning in 2015 and ongoing	$1,500
Identify available resources for stormwater retrofit funding.	M	8	x	x		x			x		x	x			Beginning in 2008	--	Identify available resources for stormwater retrofit funding.	2014	$2,000
Develop a stormwater ordinance.		7	x	x		x					x	x			--	--	Develop a stormwater ordinance.	2016-2017	$20,000
Inventory % lawn area in the watershed to determine overall IC impacts.	M	6	x	x		x						x		x	2009	--	Inventory % lawn area in the watershed to determine overall IC impacts.	2016	$5,000
Conduct ordinance review to determine if requirements provide adequate protections.	M	6	x				x	x					x	x	Beginning in 2008	--	Conduct ordinance review to determine if requirements provide adequate protections.	2015	$1,000
Contractor and Landscaper Certification Program	--	6	x	x		x			x			x			--	--	Contractor and Landscaper Certification Program	2016	$3,500
Research stormwater ordinance options.		5	x	x		x			x			x			--	--	Research stormwater utility ordinance options.	2015-2016	$5,000
Conduct public outreach and encourage more business involvement.	H	3	x					x	x			x	x	x	Beginning in 2008	Multiple educational workshops and outreach activities have been conducted since 2008.	Expand public outreach program with a focus on local businesses.	Beginning in 2015	$5,000
Coordinate with Kittery Planning Departments to hold pre-development/permitting seminars for developers.	M	0	x			x						x		x	Beginning in 2009	--	Set up meeting with planning department to discuss this task.	2015	$1,000
Visit UNH Stormwater Center to learn more about BMPs.	H	0	x					x						x	Immediately	Consultants and town representatives have attended workshops at the UNHSWC.	Organize a field trip to UNHSWC for municipal staff.	2015	$1,500
Continue working with ME DOT's SWQPP program.	M	0				x									Ongoing	Work is ongoing.	Continue working with ME DOT's SWQPP program.	Ongoing	N/A
Conduct a watershed NPS survey and update priority sites from original list from 2005.		0	x			x			x			x			--	--	Conduct a watershed NPS survey and update priority sites from original list from 2005.	2014 - 2015	$15,000

Progress has been made on Action Item
Proposed in 2014

SCA = Spruce Creek Association
YCSWCD = York County Soil & Water Conservation District

Table 9.2-1: Spruce Creek Action Plan: Conserved Lands (2008 and 2014)

Action Items	Priority	Priority (2014)	Responsible Party: SCA	Responsible Party: YCSWCD	Responsible Party: Land Trusts	Responsible Party: Towns	Responsible Party: Schools	Responsible Party: Land Owners	Funding Source: ME DEP 319	Funding Source: Other Federal	Funding Source: Other State	Funding Source: Town of Kittery	Funding Source: Private	Funding Source: Volunteer	Schedule (2008)	Status of Task (as of February 2014)	Next Steps	New Schedule (2014)	Approx Annual Cost
CONSERVED LANDS																			
Coordinate with local land trusts to acquire land to protect riparian areas.	H	34		x	x	x		x			x	x	x	x	Beginning in 2008		Continue to work with local land trust to acquire land to protect riparian areas.	Ongoing	N/A
Develop a Watershed Committee (including representatives from the town, land trust, conservation commission, SCA, and other.	--	25	x	x	x	x	x	x	x			x	x	x	--	--	Develop a Watershed Committee (including representatives from the town, land trust, conservation commission, SCA, and other.	Beginning 2014	$4,000
Work with open space committee and land trusts to strategize protection of watershed open space and develop a watershed-based open space plan.	H	20	x		x	x		x				x		x	Beginning in 2008	--	Organize meeting of the open space committee, Kittery Land Trust, SCA, and the Town; this meeting will lead to the development of a prioritized list of parcels to protect and the development of a watershed-based open space plan.	2016-2018	$25,000
Use conservation or open space subdivisions to reduce numbers of lots in the shoreland zone.	M	18	x		x	x		x				x		x	Beginning in 2008	--	Use conservation or open space subdivisions to reduce numbers of lots in the shoreland zone.	Beginning 2014	N/A
Encourage "green infrastructure" to reduce municipal costs.	H	17	x	x	x	x								x	Summer 2007 and Ongoing	Two BMPs have been installed on Town Hall property since 2008.	Develop prioritized list of other town-owned property to install BMPs.	2015	$3,000
Look into allowing greater public access to watershed open spaces (and consider the potential negative effects of doing so).	M	6	x		x	x		x			x	x		x	Beginning in 2008	--	Look into allowing greater public access to watershed open spaces (consider the potential negative effects of doing so).	Beginning 2014	$500

Legend	Abbreviations
Progress has been made on Action Item	SCA = Spruce Creek Association
Proposed in 2014	YCSWCD = York County Soil & Water

Table 9.2-1: Spruce Creek Action Plan: Water Quality Assessment (2008 and 2014)

Action Items	Priority (2008)	Priority (2014)	SCA	YCSWCD	Land Trusts	Towns	Schools	Land Owners	ME DEP 319	Other Federal	Other State	Town of Kittery	Private	Volunteer	Schedule (2008)	Status of Task (as of February 2014)	Next Steps	New Schedule (2014)
			Responsible Party						Funding Source									
WATER QUALITY ASSESSMENT																		
Use bacteria source tracking techniques such as smoke tests, dye tests, and catchbasin sampling to find storm/sewer cross connections or illicit discharges to the storm drain system.	--	22	x			x			x			x	x		--	Annual projects since 2009	Use bacteria source tracking techniques such as smoke tests, dye tests, and catchbasin sampling to find storm/sewer cross connections or illicit discharges to the storm drain system.	Annual
Conduct stormwater monitoring (ex: wet/dry weather, low tide bacteria sampling).	H	17	x	x					x	x		x		x	Beginning spring 2008	Annual town-funded projects since 2009	Continue annual stormwater monitoring programs.	Continue annual projects
Research impact of Navy yard and Piscataqua River on Spruce Creek and look into need for related sampling.	M	16	x			x				x	x			x	Beginning spring 2008	--	Research impact of Navy yard and Piscataqua River on Spruce Creek and look into need for related sampling.	Beginning 2014
Conduct baseline water quality analysis of the main stem of Spruce Creek.	--	15				x						x	x		--	2012 and 2013	Continue to collect data for a baseline water quality analysis of the main stem of Spruce Creek.	2014- 2016
Develop a multi-parameter water quality sampling program in Spruce Creek.	--	12	x			x			x			x	x		--	Some data collected in 2012 and 2013	Develop a multi-parameter water quality sampling program in Spruce Creek.	Annual
Utilize canine detection to determine "hotspots" of human sources of bacteria throughout the watershed.	--	11	x	x		x						x	x		--	2012, 2013, and ongoing	Utilize canine detection to determine "hotspots" of human sources of bacteria throughout the watershed.	Annual
Conduct baseline sediment study (including benthic communities).	H	8		x		x					x			x	2008-2009	--	Conduct baseline sediment study (including benthic communities).	2016-2017
Explore funding options to increase volunteer efficiency and purchase new monitoring equipment (ex: data sondes, webcam).	H	6	x			x		x			x	x		x	Immediately and Ongoing	--	Explore funding options to increase volunteer efficiency and purchase new monitoring equipment (ex: data sondes, webcam).	Immediately and Ongoing
Create a watershed database for use with town GIS data layers.	H	5	x			x							x	x	Beginning spring 2008	An interactive map of all installed stormwater BMPs in the watershed was	Continue to update interactive map with additional BMPs. Work with Town GIS staff to incorporate all water quality information into town GIS layer.	Beginning fall 2014
Establish a chemical spill assessment program.	M	2	x			x				x	x	x		x	2009	--	Establish a chemical spill assessment program.	2015
Link management strategies to measurable results and provide periodic updates on SCA website.	H	0	x			x		x	x					x	Immediately and Ongoing	SCA website updated in 2014	Continue to update SCA website.	Immediately and Ongoing
Create photo documentation of baseline shoreline conditions.	H	0	x	x		x		x				x		x	Immediately and Ongoing	Stormwater outfalls were documented in 2012	Create photo slideshow of baseline shoreline conditions including location of stormwater outfalls and tidal restrictions.	2015

Progress has been made on Action Item (green)
Proposed in 2014 (blue)

SCA = Spruce Creek Association
YCSWCD = York County Soil & Water Conservation

Table 9.2-1: Spruce Creek Action Plan: Other Issues (2008 and 2014)

Action Items	Priority (2008)	Priority (2014)	Responsible Party: SCA	YCSWCD	Land Trusts	Towns	Schools	Land Owners	Funding Source: ME DEP 319	Other Federal	Other State	Town of Kittery	Private	Volunteer	Schedule (2008)	Status of Task (as of February 2014)	Next Steps	New Schedule (2014)	Approx Annual Cost
OTHER ISSUES																			
Workshops for planning boards and all town boards/commissions/staff and Port Authority	--	26	x	x		x			x			x	x	x	--	--	Workshops for planning boards and all town boards/commissions/staff and Port Authority.	2015-2017	$2,500
Create a Watershed Committee charged with carrying out the plan (town/SCA/ect.)	--	21	x	x	x	x	x	x	x			x		x	--	--	Create a Watershed Committee charged with carrying out the plan (town/SCA/ect.)	Beginning 2015	$1,500
Assess potential impacts of agriculture in the watershed by surveying the locations and numbers of livestock and horses. Work with farmers on improved animal management practices.	H	19	x	x				x				x		x	Beginning 2008	--	Develop an education program targeting agricultural operations in the SC watershed.	2016-2017	$5,000
Prioritize sites for tidal restriction removal.	M	18	x			x				x	x	x		x	Beginning 2008	--	Conduct a survey of all major tidal restrictions in the SC watershed and prioritize them for removal.	2015-2016	$25,000
Promote pet waste management (ex: create dog park, post pet waste bags in shoreland zone).	H	15	x			x		x				x	x	x	Immediately and Ongoing	--	Promote pet waste management (ex:create dog park, post pet waste bags in shoreland zone).	Beginning 2015	$2,000
Increase Impact Fees	--	12				x						x			--	--	Increase impact fees.	Beginning 2015	TBD

Progress has been made on Action Item

Proposed in 2014

SCA = Spruce Creek Association

YCSWCD = York County Soil & Water Conservation District

9.3 Indicators to Measure Progress

Establishing indicators to measure progress provides short term input on how successful the Plan has been in meeting the established goals and objectives for the watershed. It provides for periodic updates to the plan, maintains and sustains the action items, and makes the plan relevant ongoing basis. In addition to water quality monitoring the following environmental, social, and programmatic indicators will be used to measure the progress of the Spruce Creek WBMP:

9.3.1 Programmatic indicators

Programmatic indicators are indirect measures of watershed protection and restoration activities. Rather than indicating that water quality reductions are being met, these programmatic indicators will indicate actions intended to meet the water quality goal.

⇒ Number of BMPs installed.
⇒ Amount of funding secured for plan implementation.
⇒ Number of acres of preserved open space.
⇒ Number of illicit discharges removed from the watershed.
⇒ Number of stream cleanups conducted.
⇒ Number of septic socials held.
⇒ Number of flow restrictions removed.

9.3.2 Social Indicators

Social indicators measure changes in social or cultural practices and behavior changes that lead to implementation of management measures and water quality improvement.

⇒ Number of homeowners who participate in septic socials.
⇒ Number of homeowners who participate in shoreland buffer neighborhood meetings and demonstration projects.
⇒ Number of homeowners who participate in residential stormwater educational programs.
⇒ Number of residents who participate in Creek clean-up days.
⇒ Number of requests for information (from Towns and SCA).
⇒ Amount of Towns' and stakeholders' website hits (install hit counter).
⇒ Number of new SCA and KLT members.

The number of individuals who participate in watershed surveys is an example of a social indicator.

9.3.3 Environmental Indicators

Environmental indicators are a direct measure of environmental conditions. They are measurable quantities used to evaluate the relationship between pollutant sources and environmental conditions.

⇒ Number of Spruce Creek sampling stations meeting water quality standards.
⇒ Reduction in the number of closed shellfish harvesting areas.
⇒ Reduction in the frequency of peak flows.

⇒ Number of acres of improved riparian habitat.
⇒ Reduction in the amount of trash found in Creek.
⇒ Number of septic systems repaired.

9.4 Estimated Costs and Technical Assistance Needed

Estimated costs for each action item are listed in Table 9.2-1. Additionally, following agencies are either currently funding water quality protection and remediation projects or are potential sources of funding:

- National Fish and Wildlife Foundation
- Maine Department of Environmental Protection
- Maine Department of Transportation
- USDA National Resource Conservation Service - Farm Bill
- Maine Department of Conservation
- US Fish and Wildlife
- New England Grassroots Environmental Fund
- Richard Saltonstall Charitable Foundation
- Davis Conservation Foundation
- Gulf of Maine Council Action Plan Grants Program
- Gulf of Maine Habitat Restoration Habitat Restoration Grants Program
- Jessie B. Cox Charitable Trust: A New England Philanthropy
- Maine Community Foundation (Fund for Maine Land Conservation)

Funding assistance for water quality improvement actions and other watershed management projects is available from various government and private sources, specifically:

<u>Federal Clean Water Act, Section 319 Nonpoint Source Implementation Grants</u>

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 ME DEP by the USEPA under Section 319 of the Clean Water Act.

<u>Clean Water Finance Agency, Clean Water State Revolving Fund Loans</u>

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, Maine 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.

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 Maine program is administered through the State of Maine Office Community Development. These grants include water and sewer system improvements.

Small Community Grant Program (SCG)

The Small Community Grant Program provides grants to towns to help replace malfunctioning septic systems that are polluting a waterbody or causing a public nuisance. Grants can be used to fund from 25% to 100% of the design and construction costs, depending upon the income of the owners of the property, and the property's use. An actual pollution problem must be documented in order to qualify for funding. The highest priority is given to problems which are polluting a public drinking water supply or a shellfishing area.

9.5 Educational Component

This Plan includes an educational component that will be used to enhance public understanding of the plan and encourage community participation in watershed restoration and protection activities (*outlined in the Action Plan)*. The educational goal of the Plan is to elevate public understanding of these connections and to encourage actions that maintain the highest water quality and a healthy watershed ecosystem.

9.6 Monitoring Plan

Water quality monitoring will be evaluated annually both on a seasonal basis and compared with long-term water quality records to determine if improvements are occurring as implementation proceeds. When possible, water quality monitoring will be conducted before and after repair of a site in order to determine effectiveness. ***See Appendix E and F for water quality monitoring reports for the Spruce Creek watershed 2009 – 2013.***

9.7 Evaluation Plan

To stay abreast on the effectiveness of the Management Plan, the SCA WBMP Steering Committee will work towards releasing (or posting to the website) an annual report that highlights the progress and activities in comparison to the timeline set forth in the Action Plan. Tasks listed in the Action Plan should be tracked and recorded as they occur, and new tasks should be added to the plan as needed. All achievements, such as press releases, outreach activities, number of sites repaired, number of volunteers, amount of funding received, number of sites documented, will be tracked. The stakeholders will use the established indicators (Section 9.3) to determine the effectiveness of the Plan. ***These actions should be taken every five years.***

10. Bibliography & References

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11. Appendices

A. Glossary of Terms

B. Watershed Maps

C. Regulations

D. Bacteria Model Inputs

E. SCWIP Phase I Final Report

F. SCWIP Phase II Final Report

G. Water Quality Reports for the Spruce Creek Watershed 2009-2013

Appendix A: Glossary of Terms

Algae Bloom: A growth of algae resulting from excessive nutrient levels or other physical and chemical conditions that enable algae to reproduce rapidly.

Best Management Practices (BMPs): Techniques to reduce nonpoint source pollution impacts from construction, agriculture, timber harvesting, marinas, and stormwater.

Buffers (Riparian Zone): Land bordering a river, stream, or wetland for the protection of water quality, wildlife, and/or recreation.

Culvert: A conduit through which surface water can flow under or across roads and driveways. Culverts are usually a pipe and can be made of metal, wood, plastic, or concrete.

Direct Flow: Overland flow of water with attached sediments, nutrients and pollutants which causes increased surface runoff to nearby water bodies. This type of flow is enhanced by, and associated with other NPS problems such as inadequate buffers, and poorly designed or failing culverts and ditches.

Dissolved Oxygen (DO): Oxygen dissolved in the water is essential for all plants and animals living in the water. DO is a measurement of the amount of oxygen in the water that is available to these plants and animals. The amount of DO is used as an indicator of water quality and the level of life that the water can support.

Diversion: A BMP used to intercept and direct surface runoff. Diversions are usually channels or depressions with a supporting ridge on the lower side, constructed across or at the bottom of a slope.

Ecosystem: A system formed by the interaction of a community of organisms with its environment.

Erosion: Wearing away of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical and chemical forces. Human activities can greatly speed this process.

Fecal Coliform Bacteria: A group of bacteria that are passed through the fecal excrement of humans, livestock, and wildlife. They aid in the digestion of food. Escherichia coli (E. coli) are the most common member of fecal coliform bacteria. They can be separated from the total coliform group by their ability to grow at elevated temperatures and are associated only with the fecal material of warm-blooded animals.

Glaciofluvial: Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, deltas, kames eskers, and kame terraces.

Glaciolacustrine Deposits: Sand, silt and clay deposited on the bottom of huge temporary lakes that formed either due to the melting glacial ice or by the blocking out of outlets for meltwater. Sand, silt and clay remains suspended in fast-moving river water, but in slow-moving water such as lakes these fine materials are deposited.

Leach Field: The part of a septic system where the effluent from the septic tank disperses into the soil.

Mulch: A layer of hay or other material covering the land surface that holds soil in place. It aids in the establishment of vegetation by preventing erosion, conserving moisture, and minimizing temperature fluctuations.

Nonpoint Source Pollution (NPS): Runoff that has picked up contaminants or nutrients from the landscape (or air), as it flows over the surface of the land to a body of water.

Overboard Discharges (OBDs): The discharge of wastewater from residential, commercial, and publicly owned facilities to streams, rivers lakes, and the ocean.

Phosphorus: An element found throughout the environment; it is a nutrient essential to all living organisms. Phosphorus binds to soil particles, is found in fertilizers, sewage, and motor oil, and is found in high concentrations in stormwater runoff. The amount of phosphorus present in a lake determines the lake's production of algae. A very small change in phosphorus levels can dramatically increase algae growth.

Point Source Pollution: Readily identifiable inputs where waste is discharged to the receiving waters from a pipe or drain. Most industrial wastes are discharged to rivers and the sea in this way. With few exceptions, most point source waste discharges, are controlled by EPA.

Runoff: Water that drains or flows across the surface of the land.

Sediment: Mineral and organic soil material that is transported in suspension by wind or flowing water, from its origin in another location.

Septic System: An individual sewage treatment system that typically includes a septic tank and leach field that area buried in the ground. The septic tank allows sludge to settle to the bottom and a scum of fats, greases and other lightweight materials to rise to the top. The remaining liquid flows to the leach field where it disperses through soil to reduce the number of bacteria and viruses.

Shoreland: The area of land from the water line stretching inland. The definition of this distance may vary by county zoning and state definitions.

TMDL: A Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.

Tributaries: Streams or rivers that flow to a large body of water.

Vegetated Buffer: Areas of vegetation, left undisturbed or planted between a developed area and a waterbody that are used to capture pollutants from surface water and groundwater. Buffer vegetation can include trees, shrubs, bushes, and ground cover plants.

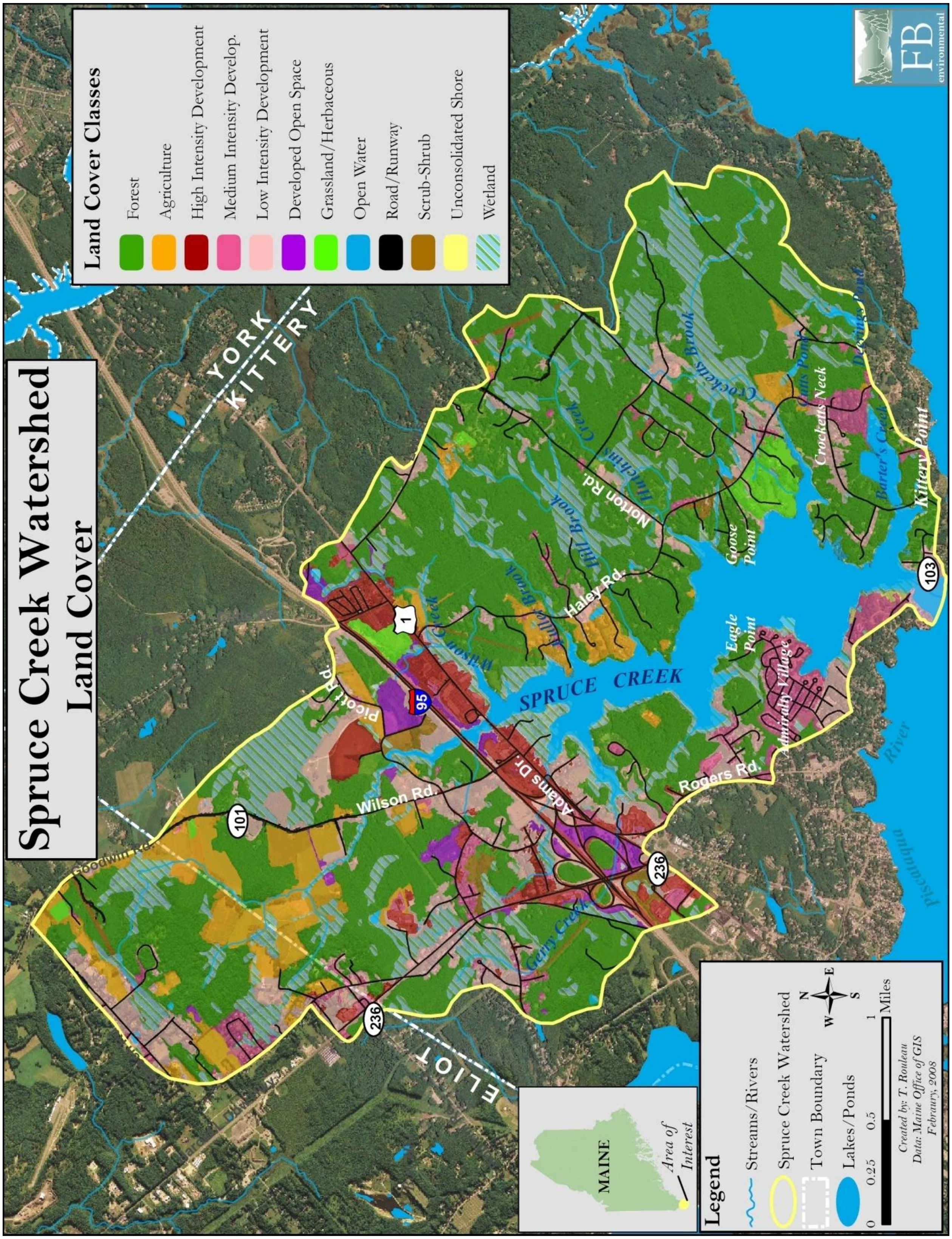
Vernal Pools: Seasonally flooded depressions found on ancient soils with an impermeable layer such as a hardpan, claypan, or volcanic basalt.

Water Quality: Pertaining to the presence and amounts of pollutants in water.

Watershed: The geographic region within which water drains into a particular river, stream, or body of water. A watershed includes hills, lowlands, and the body of water into which the land drains. Watershed boundaries are defined by the ridges of land separating watersheds.

Appendix B: Watershed Maps

Map 1

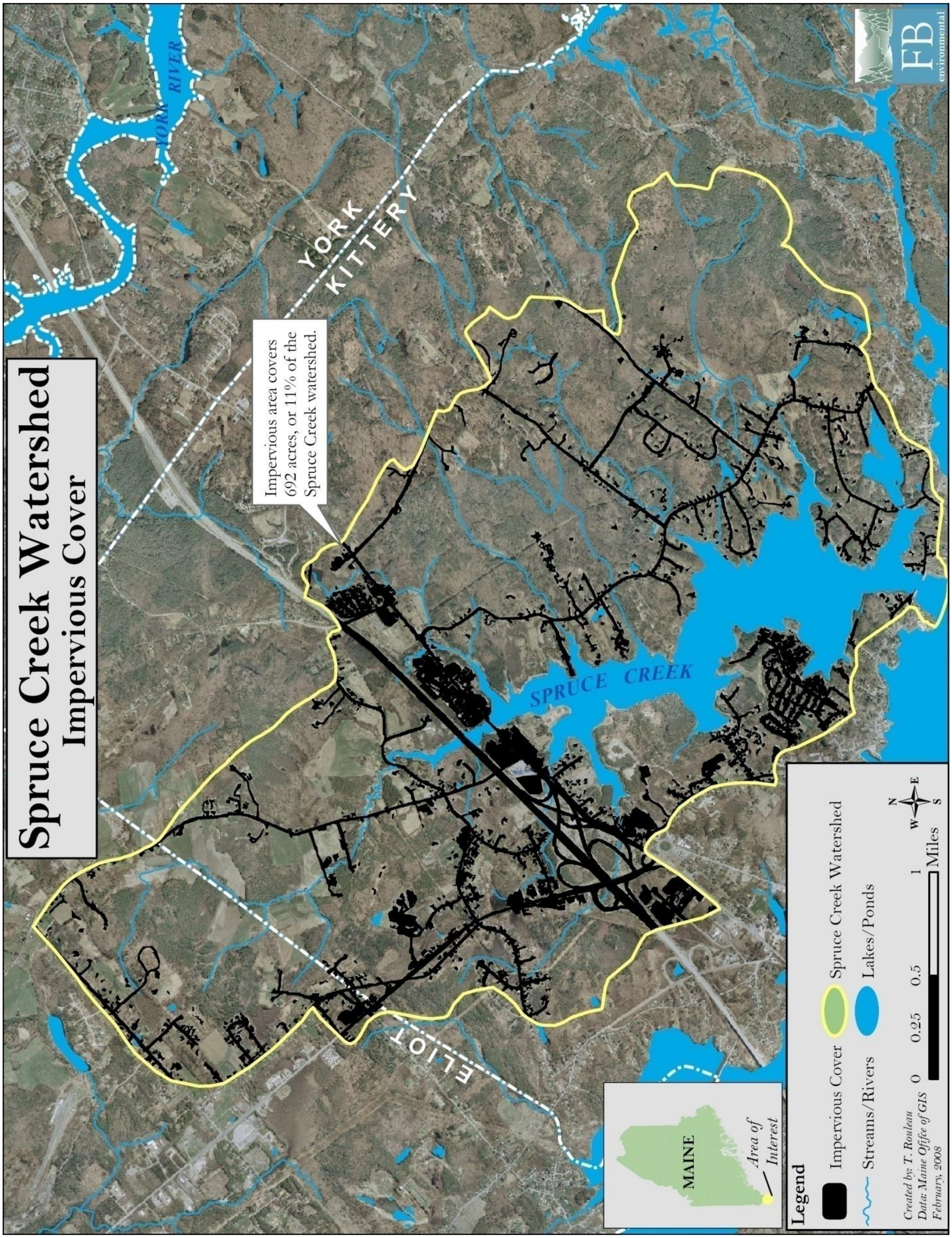


Maine Land Cover Class Descriptions

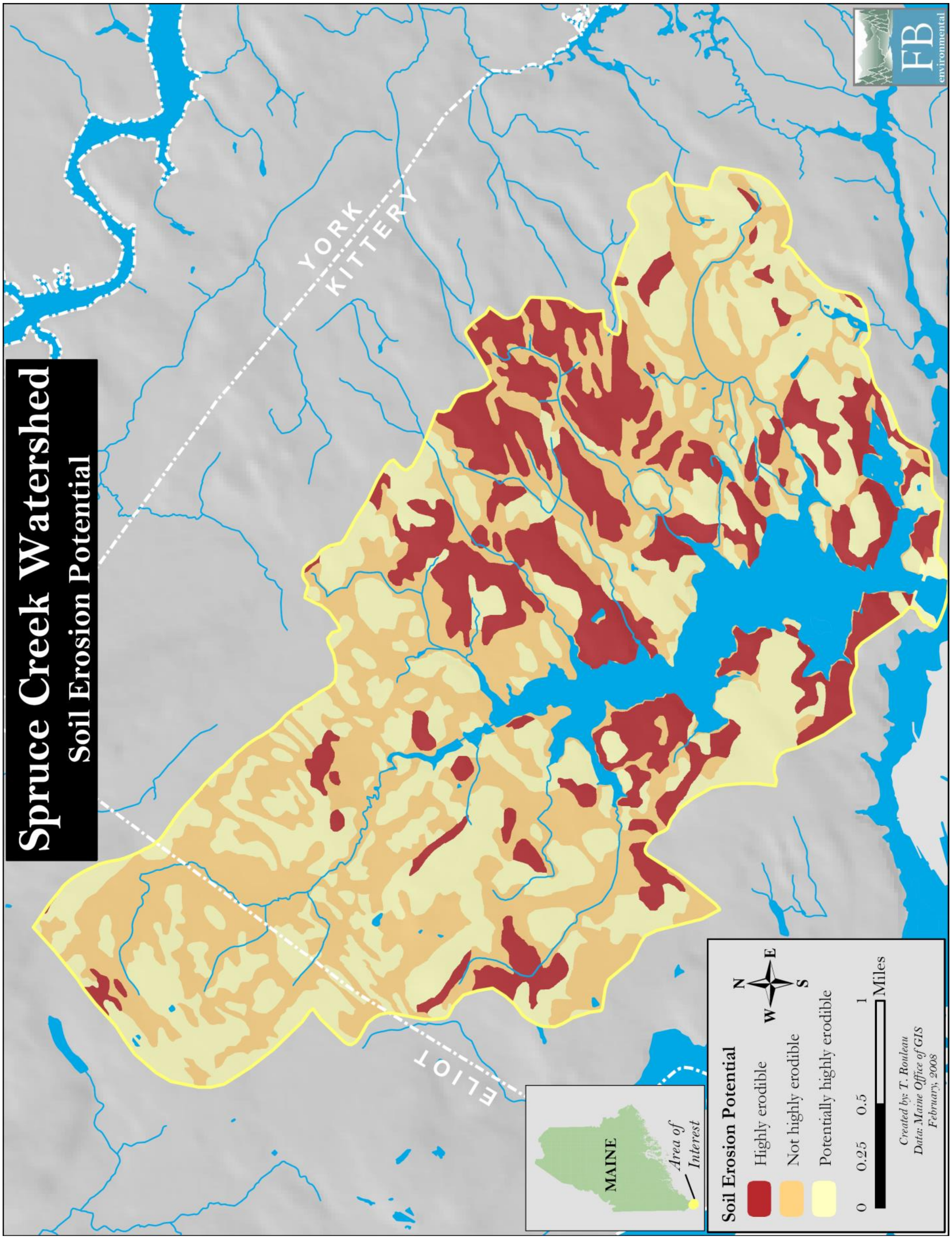
-

Developed High Intensity - Includes highly developed areas where people reside or work in high numbers. Impervious surfaces account for

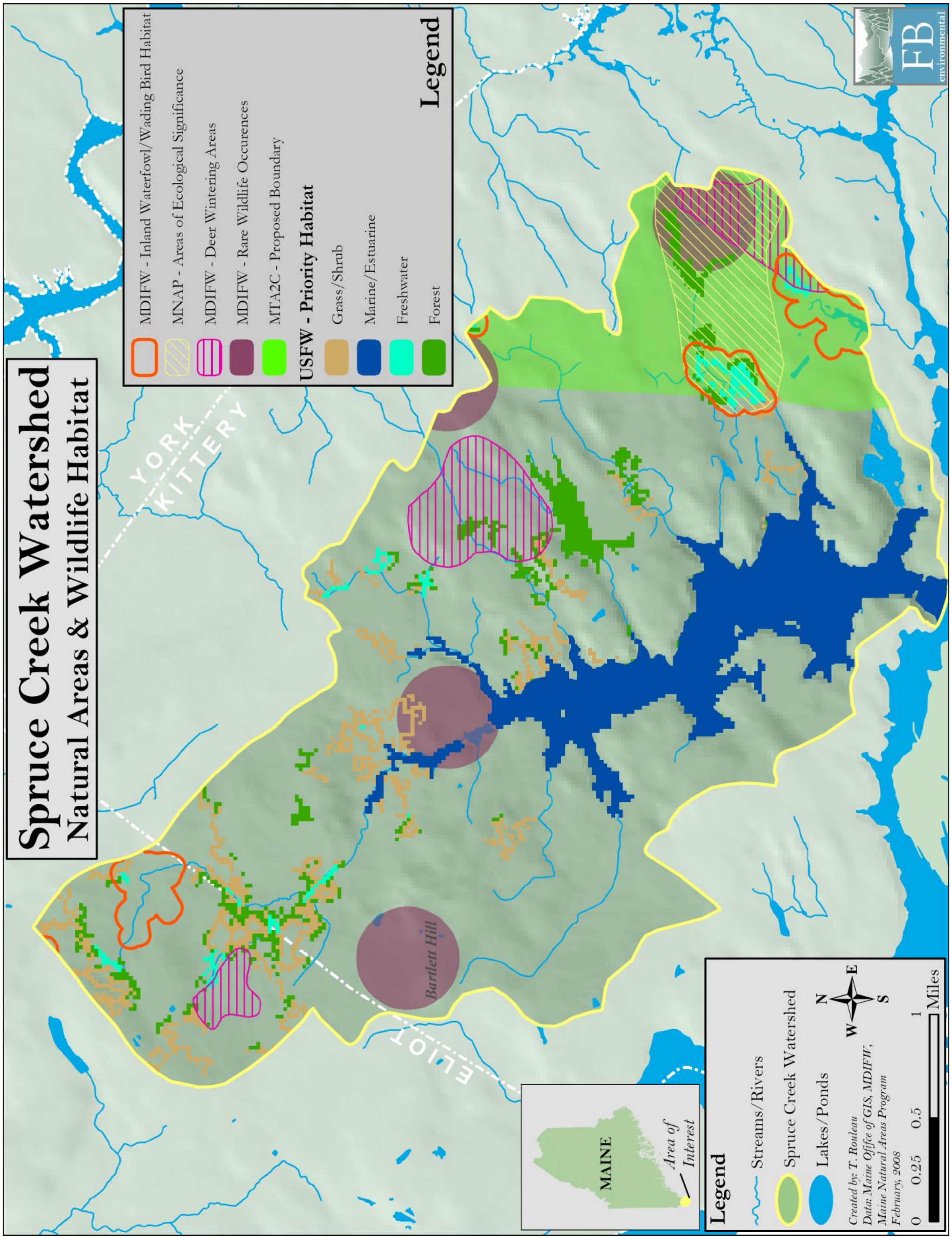
Map 2


Spruce Creek Watershed
Impervious Cover
Impervious area covers 692 acres, or 11% of the Spruce Creek watershed.
YORK
KITTERY
ELIOT
YORK RIVER
SPRUCE CREEK
FB environmental
MAINE
Area of Interest
Legend
Impervious Cover
Streams/Rivers
Spruce Creek Watershed
Lakes/Ponds
0 0.25 0.5 1 Miles
N E S W
Created by: T. Rouleau
Data: Maine Office of GIS
February, 2008

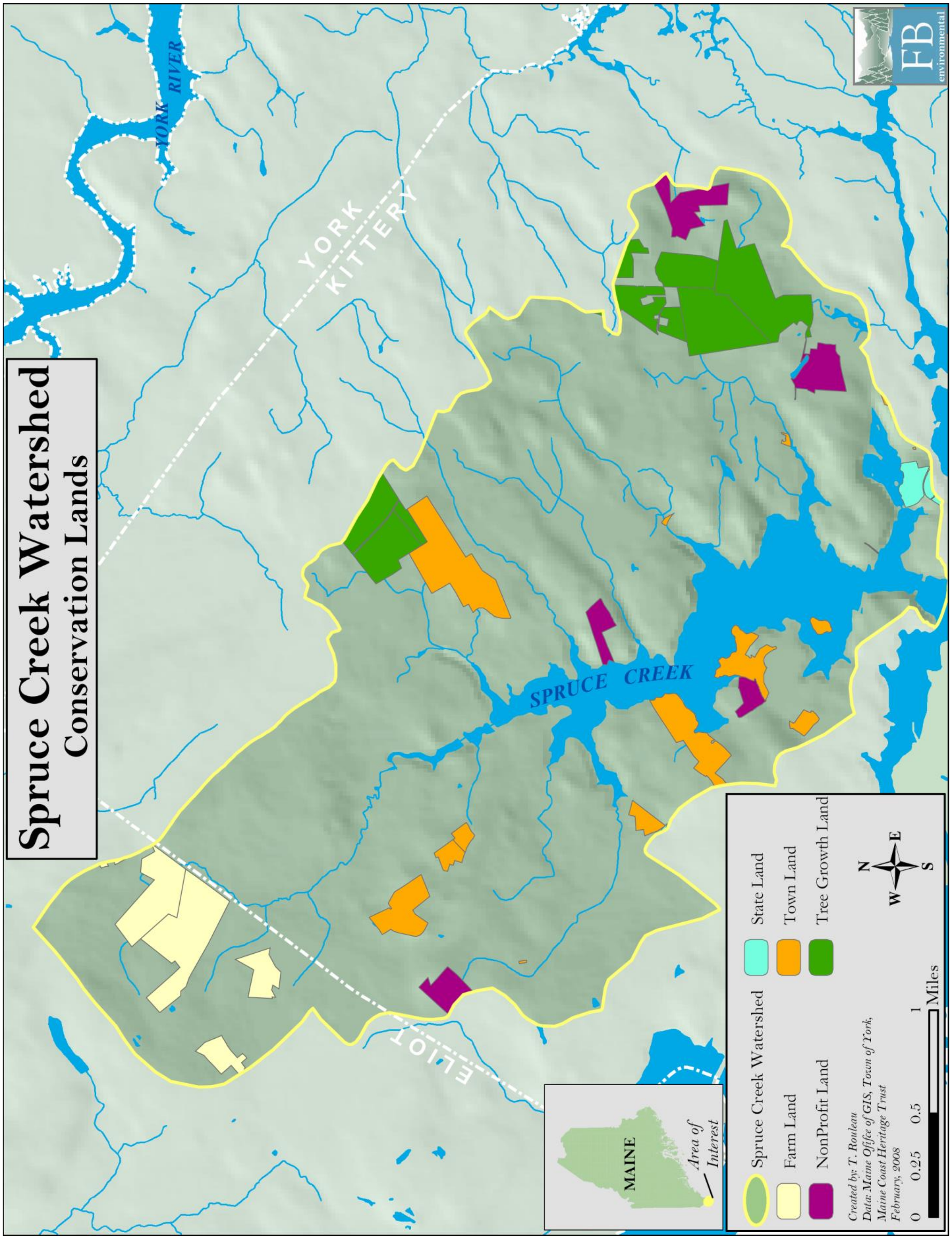
Map 3


Spruce Creek Watershed
Soil Erosion Potential
YORK
KITTERY
ELIOT
FB
environmental
MAINE
Area of Interest
Soil Erosion Potential
Highly erodible
Not highly erodible
Potentially highly erodible
N
E
S
W
0 0.25 0.5 1 Miles
Created by: T. Rouleau
Data: Maine Office of GIS
February, 2008

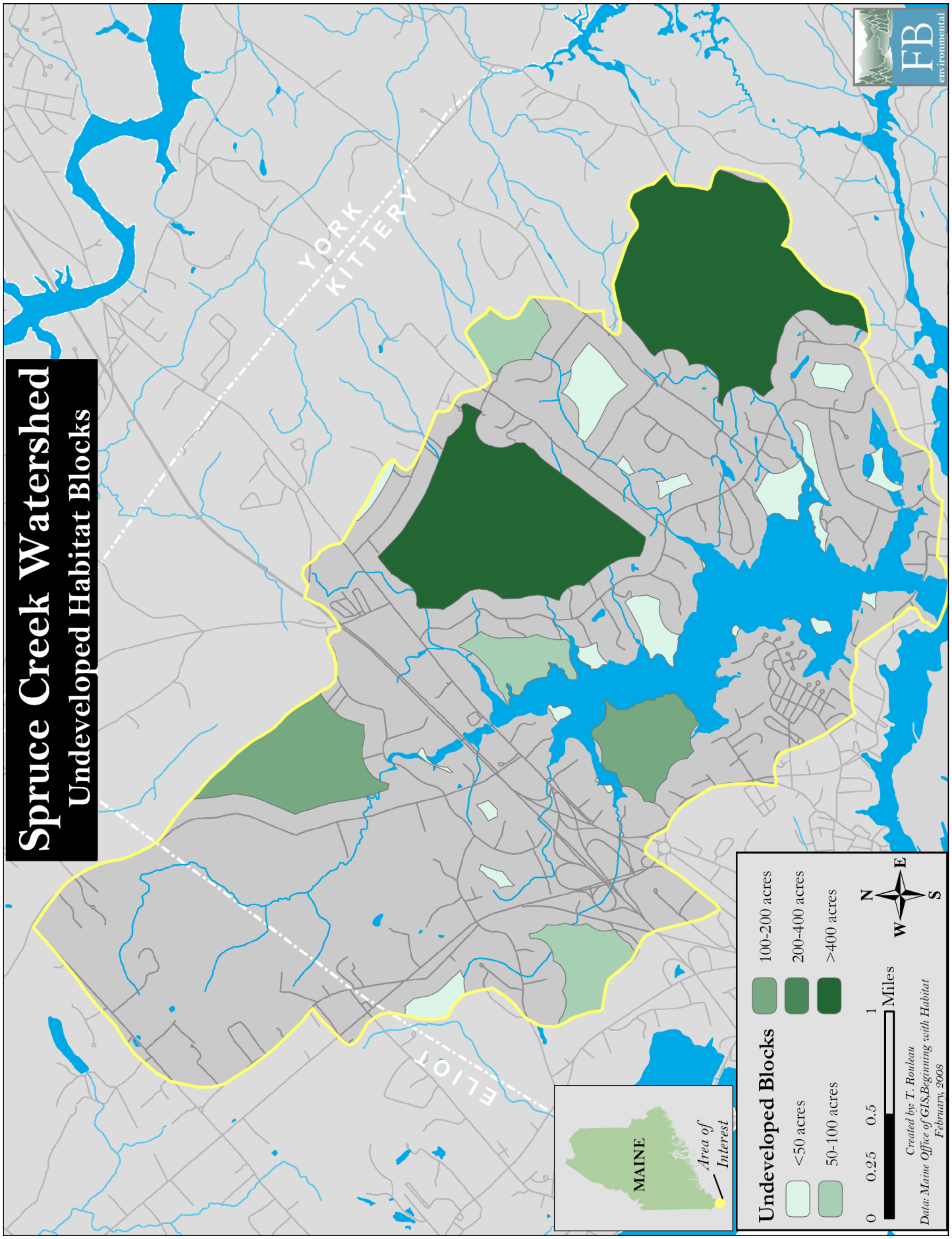
Map 4


Spruce Creek Watershed
Natural Areas & Wildlife Habitat
Legend
MDIFW - Inland Waterfowl/Wading Bird Habitat
MNAP - Areas of Ecological Significance
MDIFW - Deer Wintering Areas
MDIFW - Rare Wildlife Occurences
MTA2C - Proposed Boundary
USFW - Priority Habitat
Grass/Shrub
Marine/Estuarine
Freshwater
Forest
YORK
KITTERY
ELIOT
Bartlett Hill
MAINE
Area of Interest
Legend
Streams/Rivers
Spruce Creek Watershed
Lakes/Ponds
Created by: T. Rouleau
Data: Maine Office of GIS, MDIFW, Maine Natural Areas Program
February, 2008
0 0.25 0.5 1 Miles
N
E
S
W
FB environmental

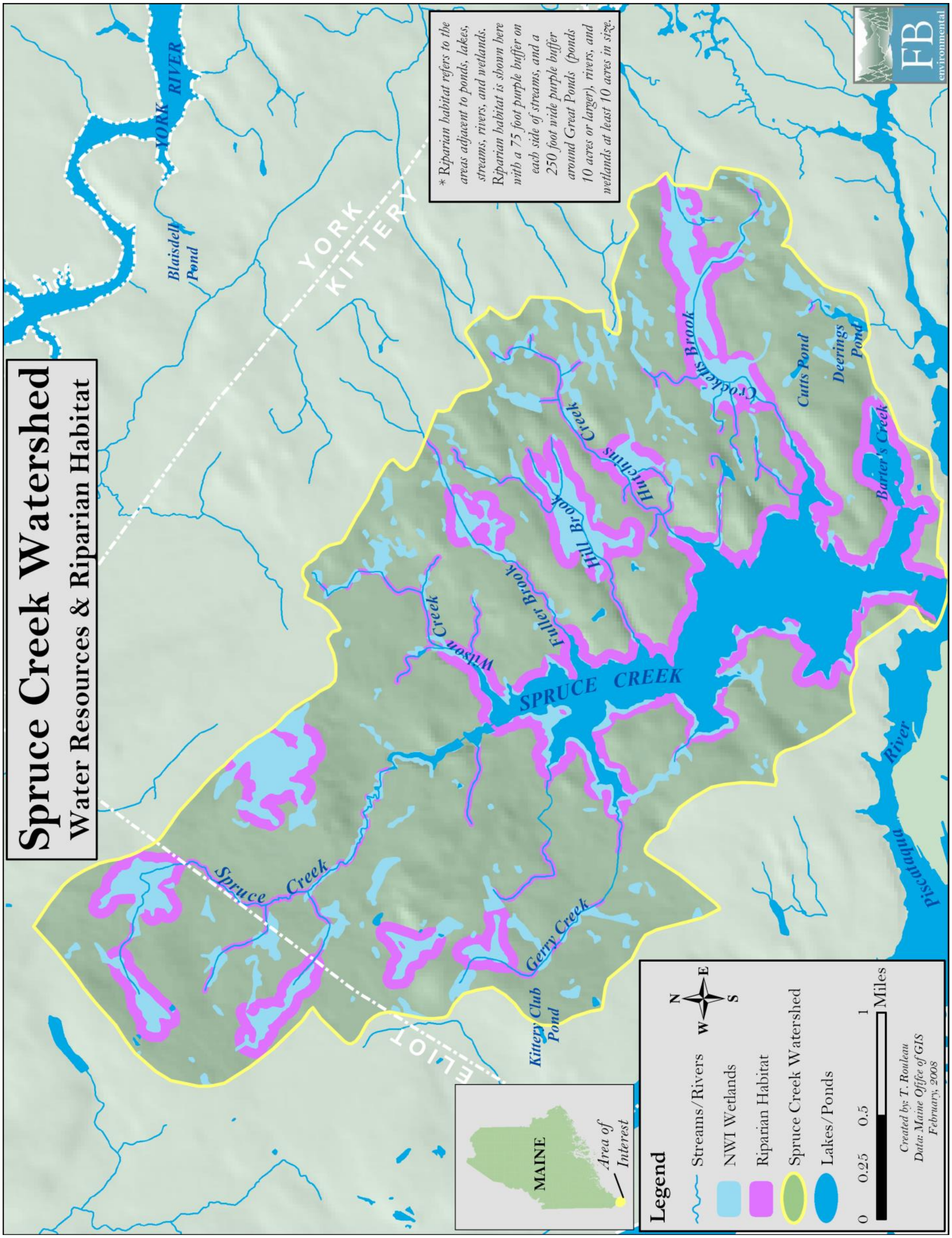
Map 5


Spruce Creek Watershed
Conservation Lands
YORK RIVER
YORK
KITTERY
ELIOT
SPRUCE CREEK
FB environmental
MAINE
Area of Interest
Spruce Creek Watershed
Farm Land
NonProfit Land
State Land
Town Land
Tree Growth Land
N
E
S
W
Created by: T. Rouleau
Data: Maine Office of GIS, Town of York, Maine Coast Heritage Trust
February, 2008
0 0.25 0.5 1 Miles

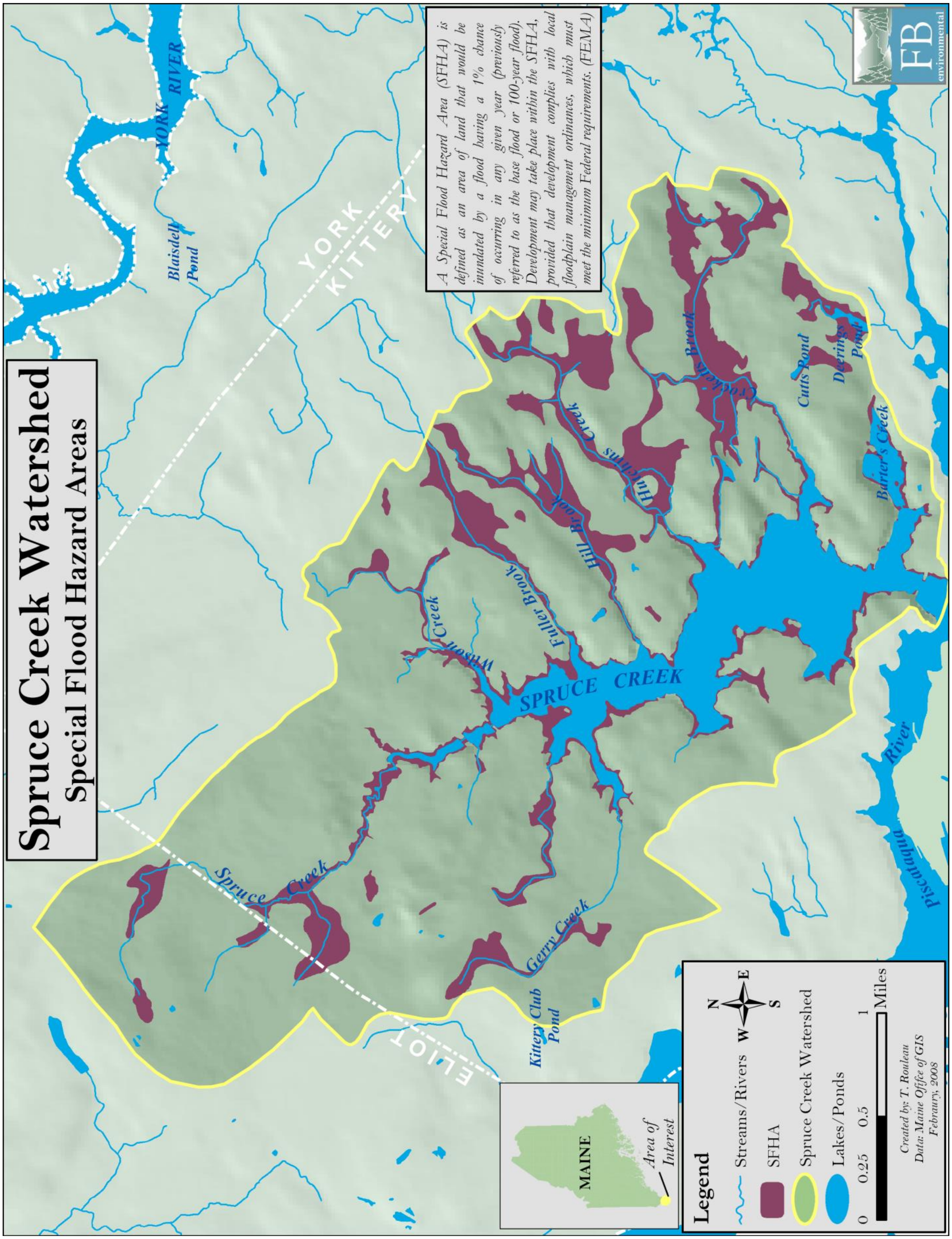
Map 6


Spruce Creek Watershed
Undeveloped Habitat Blocks
YORK
KITTERY
ELIOT
FB
environmental
Undeveloped Blocks
<50 acres
50-100 acres
100-200 acres
200-400 acres
>400 acres
N
E
S
W
0
0.25
0.5
1
Miles
Created by: T. Rouleau
Data: Maine Office of GIS,Beginning with Habitat
February, 2008
MAINE
Area of Interest

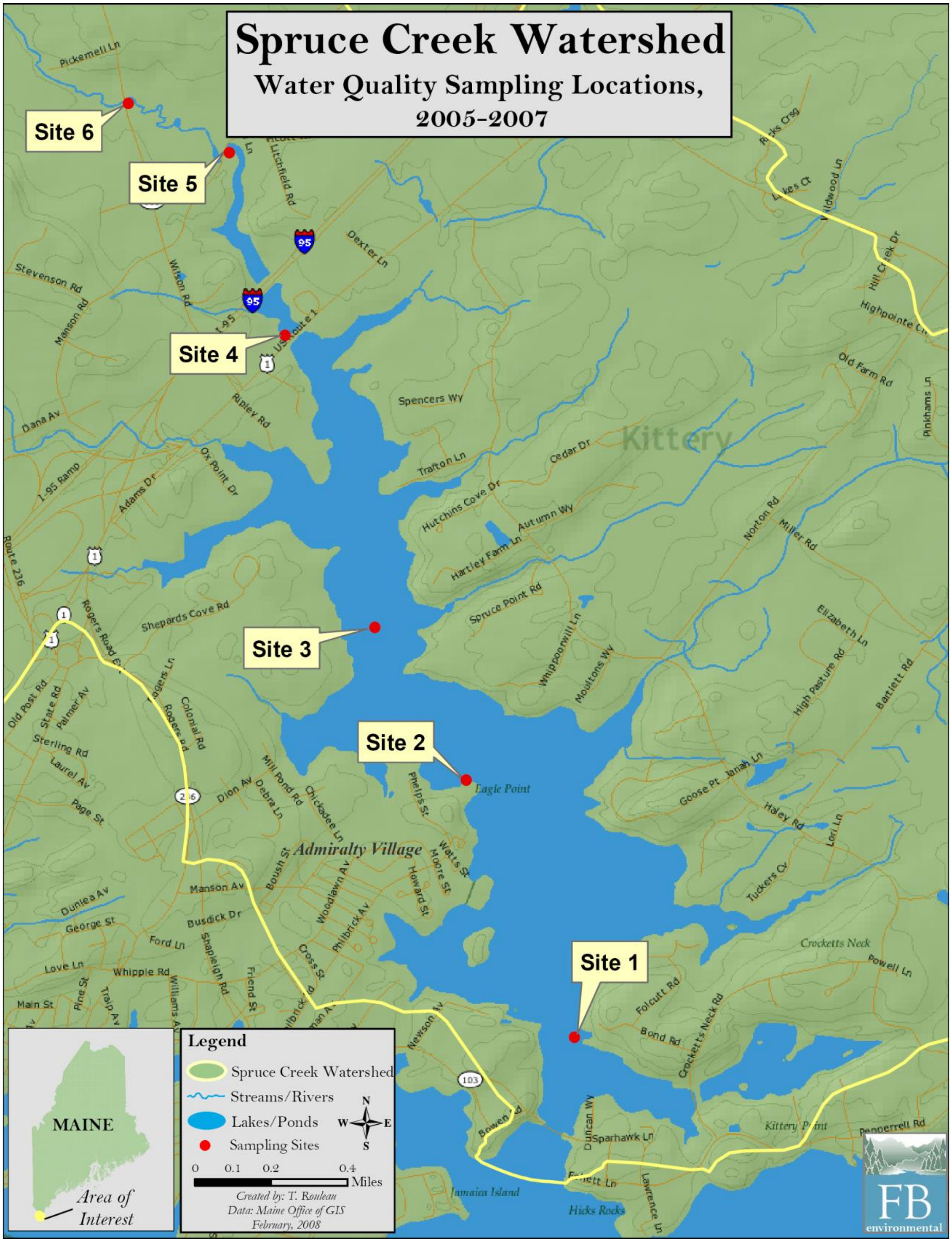
Map 7


Spruce Creek Watershed
Water Resources & Riparian Habitat
* Riparian habitat refers to the areas adjacent to ponds, lakes, streams, rivers, and wetlands. Riparian habitat is shown here with a 75 foot purple buffer on each side of streams, and a 250 foot wide purple buffer around Great Ponds (ponds 10 acres or larger), rivers, and wetlands at least 10 acres in size.
FB environmental
YORK RIVER
Blaisdell Pond
YORK
KITTERY
ELIOT
Spruce Creek
Wilson Creek
Fuller Brook
Hill Brook
Hutchins Creek
Crocketts Brook
Cutts Pond
Deerings Pond
Barter's Creek
SPRUCE CREEK
Piscataqua River
Gerry Creek
Kittery Club Pond
MAINE
Area of Interest
Legend
Streams/Rivers
NWI Wetlands
Riparian Habitat
Spruce Creek Watershed
Lakes/Ponds
N E S W
0 0.25 0.5 1 Miles
Created by: T. Rouleau
Data: Maine Office of GIS
February, 2008

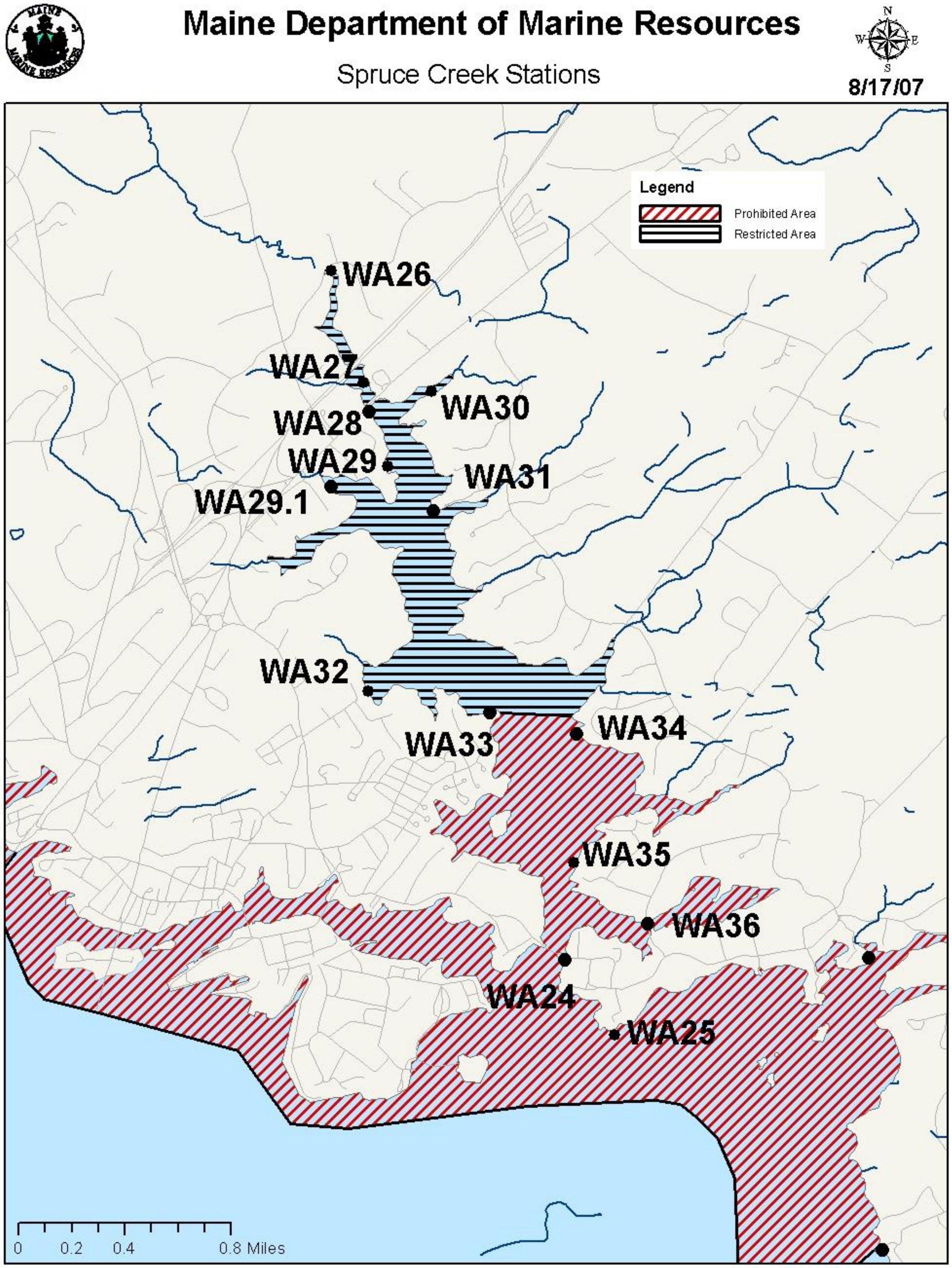
Map 8


Spruce Creek Watershed
Special Flood Hazard Areas
A Special Flood Hazard Area (SFHA) is defined as an area of land that would be inundated by a flood having a 1% chance of occurring in any given year (previously referred to as the base flood or 100-year flood). Development may take place within the SFHA, provided that development complies with local floodplain management ordinances, which must meet the minimum Federal requirements. (FEMA)
FB environmental
YORK RIVER
Blaisdell Pond
YORK
KITTERY
ELIOT
Spruce Creek
Wilson Creek
Fuller Brook
Hill Brook
Hutchins Creek
Crockett's Brook
Cutts Pond
Deerings Pond
Barter's Creek
SPRUCE CREEK
Piscataqua River
Gerry Creek
Kittery Club Pond
MAINE
Area of Interest
Legend
Streams/Rivers
SFHA
Spruce Creek Watershed
Lakes/Ponds
N
E
S
W
0 0.25 0.5 1 Miles
Created by: T. Rouleau
Data: Maine Office of GIS
Febraury, 2008

Map 9

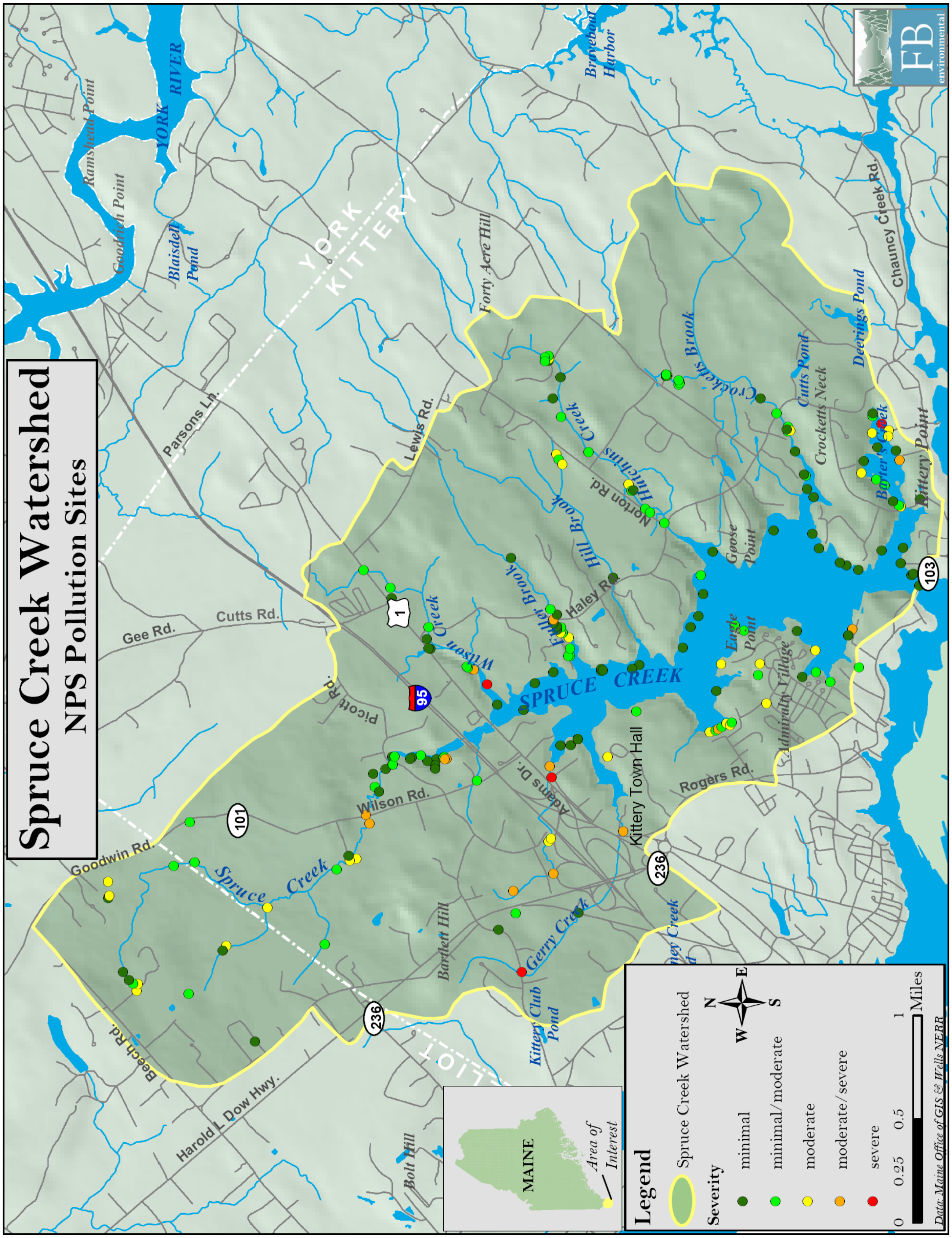

Spruce Creek Watershed
Water Quality Sampling Locations, 2005-2007
Site 6
Site 5
Site 4
Site 3
Site 2
Site 1
Kittery
Admiralty Village
Eagle Point
Crocketts Neck
Kittery Point
Jamaica Island
Hicks Rocks
MAINE
Area of Interest
Legend
Spruce Creek Watershed
Streams/Rivers
Lakes/Ponds
Sampling Sites
0 0.1 0.2 0.4 Miles
Created by: T. Rouleau
Data: Maine Office of GIS
February, 2008
FB
environmental

Map 10

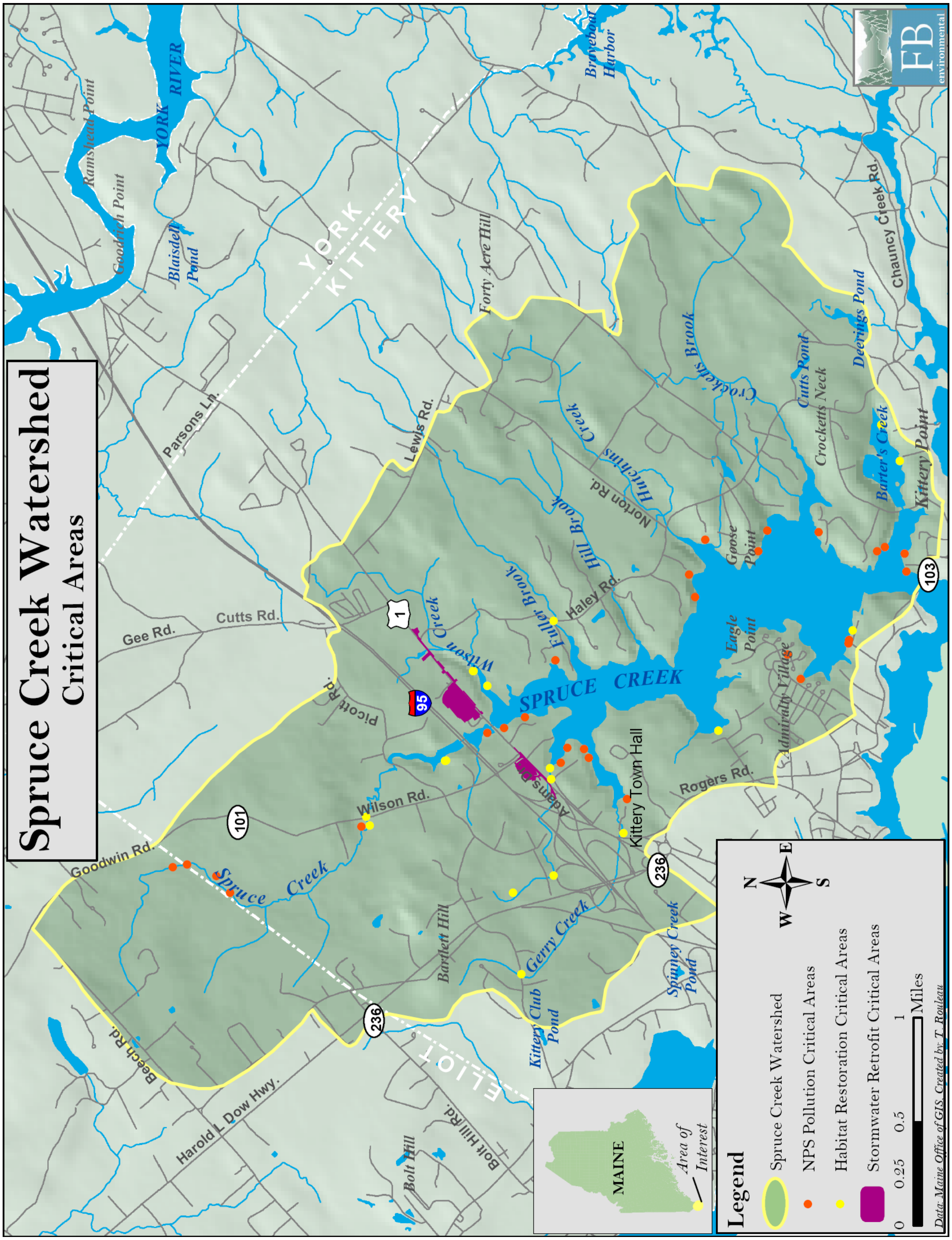


Maine Department of Marine Resources
Spruce Creek Stations
8/17/07
N
W
E
S
Legend
Prohibited Area
Restricted Area
WA26
WA27
WA28
WA29
WA29.1
WA30
WA31
WA32
WA33
WA34
WA35
WA36
WA24
WA25
0
0.2
0.4
0.8 Miles

Map 11


Spruce Creek Watershed
NPS Pollution Sites
Legend
Spruce Creek Watershed
Severity
minimal
minimal/moderate
moderate
moderate/severe
severe
0 0.25 0.5 1 Miles
Data: Maine Office of GIS & Wells NERR
MAINE
Area of Interest
SPRUCE CREEK
YORK
KITTERY
Kittery Town Hall
Wilson Rd.
Rogers Rd.
Adams Dr.
Picott Rd.
Goodwin Rd.
Cutts Rd.
Gee Rd.
Parsons Ln.
Lewis Rd.
Norton Rd.
Haley Rd.
Chauncy Creek Rd.
Beech Rd.
Harold L Dow Hwy.
Crocketts Brook
Hill Brook
Fuller Brook
Wilson Creek
Gerry Creek
Barters Creek
Cutts Pond
Crocketts Neck
Deerings Pond
Goose Point
Eagle Point
Admiralty Village
Kittery Point
Kittery Club Pond
Bartlett Hill
Forty Acre Hill
Bolt Hill
Brave Boat Harbor
YORK RIVER
Blaisdell Pond
Ramsheads Point
Goodrich Point

Map 12


Spruce Creek Watershed
Critical Areas
Legend
Spruce Creek Watershed
NPS Pollution Critical Areas
Habitat Restoration Critical Areas
Stormwater Retrofit Critical Areas
0 0.25 0.5 1 Miles
Data Maine Office of GIS. Created by: T. Rouleau
MAINE
Area of Interest
N E S W
FB environmental
SPRUCE CREEK
YORK
KITTERY
ELIOT
YORK RIVER
Kittery Town Hall
Kittery Point
Goodwin Rd.
Wilson Rd.
Rogers Rd.
Haley Rd.
Norton Rd.
Lewis Rd.
Picott Rd.
Cutts Rd.
Gee Rd.
Parsons Ln.
Chauncy Creek Rd.
Harold L Dow Hwy.
Bolt Hill Rd.
Beech Rd.
Adams Rd.
Bolt Hill
Bartlett Hill
Forty Acre Hill
Eagle Point
Goose Point
Admiralty Village
Crocketts Neck
Cutts Pond
Deerings Pond
Barter's Creek
Crocketts Brook
Hutchins Creek
Hill Brook
Fuller Brook
Wilson Creek
Gerry Creek
Spruce Creek
Spinney Creek Pond
Kittery Club Pond
Blaisdell Pond
Goodrich Point
Ramshead Point
Brave Boat Harbor
1
95
101
103
236

Appendix C: Regulations

There exist a number of federal and state laws designed to protect the environment. These laws are intended to be incorporated into local town ordinances, providing protection for wildlife habitat, water and air quality, and endangered and threatened species. Major laws pertaining to habitat conservation and local land-use planning include: the Federal Endangered Species Act, the Clean Water Act, and the Coastal Zone Management Act, all of which are federally mandated laws. Additional laws mandated by the state of Maine include:

- **The Protection and Improvement of Waters Law** regulates activities which discharge or could potentially discharge materials into waters of the state (rivers, streams, brooks, lakes and ponds and tidal waters). This law requires that a license be obtained before directly or indirectly discharging any pollutant.
- **The Erosion and Sedimentation Control Law** regulates activities involving filling, displacing or exposing soil. The law is based on the premise that all areas drain to some type of waterbody and erosion of soil material must be prevented to keep these waterbodies from becoming degraded.
- **The Natural Resources Protection Act** regulates activities in, on, over, and adjacent to lakes, ponds, rivers, streams, brooks, freshwater wetlands and tidal areas. Activities regulated under the NRPA include disturbing soil, placing fill, dredging, removing or displacing soil, sand or vegetation, draining or dewatering, and building permanent structures, in, on, over or adjacent to these areas.
- **The Seasonal Conversion Law** was enacted to regulate the conversion of seasonal dwellings within the shoreland zone to year round use.
- **Shoreland Zoning** was enacted to prevent water pollution, and damage to the natural beauty and habitat provided by Maine's surface waters. The law targets development along the immediate shoreline of these resources and requires towns to enact a shoreland zoning ordinance at least as stringent as a model ordinance developed by the state.
- **The Maine Endangered Species Act** was passed in 1975 by the State Legislature. The Act provides MDIFW with a mandate to conserve all of the species of fish and wildlife found in the State, as well as the ecosystems upon which they depend. (Source: http://maine.gov/ifw/wildlife/species/endangered_species/es_act_part13.htm)
- **The Coastal Management Policy,** established in 1978 in Maine, establishes that there are special needs in the conservation and development of the State's coastal resources that require a statement of legislative policy and intent with respect to state and local actions affecting the Maine coast, including:

  1. Port and harbor development. Promote the maintenance, development and revitalization of the State's ports and harbors for fishing, transportation and recreation;

  2. Marine resource management. Manage the marine environment and its related resources to preserve and improve the ecological integrity and diversity of marine communities and habitats, to expand our understanding of the productivity of the Gulf of Maine and coastal waters and to enhance the economic value of the State's renewable marine resources;

  3. Shoreline management and access. Support shoreline management that gives preference to water-dependent uses over other uses, that promotes public access to the shoreline and that considers the cumulative effects of development on coastal resources;

  4. Hazard area development. Discourage growth and new development in coastal areas where, because of coastal storms, flooding, landslides or sea-level rise, it is hazardous to human health and safety;

  5. State and local cooperative management. Encourage and support cooperative state and municipal management of coastal resources;

6. Scenic and natural areas protection. Protect and manage critical habitat and natural areas of state and national significance and maintain the scenic beauty and character of the coast even in areas where development occurs;

7. Recreation and tourism. Expand the opportunities for outdoor recreation and encourage appropriate coastal tourist activities and development;

8. Water quality. Restore and maintain the quality of our fresh, marine and estuarine waters to allow for the broadest possible diversity of public and private uses; and

9. Air quality. Restore and maintain coastal air quality to protect the health of citizens and visitors and to protect enjoyment of the natural beauty and maritime characteristics of the Maine coast." (Source: http://janus.state.me.us/legis/statutes/38/title38sec1801.html)

- **The Comprehensive Planning and Land Use Regulation Act (also known as the "Growth Management Act"),** enacted in 1988, established a cooperative program of Comprehensive Planning and Land Use Management among municipalities, regional councils, and the state. Under this law, each municipality is required to develop a Local Growth Management Program that is consistent with the State goals set forth in the Act. The Growth Management Program consists of two parts: a Comprehensive Plan, and an Implementation Program that includes a zoning ordinance.
- **The State Subdivision Law** requires municipalities to review and approve proposed or expanded subdivisions. Under this regulation, a subdivision refers to a division of a parcel of land into three or more lots within any five-year period that begins on or after September 23, 1971. The term subdivision also includes the division of an existing structure previously used for commercial or industrial purposes into three or more dwelling units.
- **The Site Location of Development Law** requires review of developments that may have a substantial effect upon the environment. These types of development have been identified by the Legislature, and include developments such as projects occupying more than 20 acres, metallic mineral and advanced exploration projects, large structures and subdivisions, and oil terminal facilities. A permit is issued if the project meets applicable standards addressing areas such as stormwater management, groundwater protection, infrastructure, wildlife and fisheries, noise, and unusual natural areas. The applicant for a new Site Law development (except for a residential subdivision with 20 or fewer developable lots) is required to attend a pre-application meeting. This meeting is an opportunity for the applicant to determine the requirements that apply to the project. The meeting with licensing staff is intended to help identify issues, processing times, fees, and the types of information and documentation necessary for the DEP to properly assess the project. Pre-application meetings are available on request when they are not required.

The Wetlands and Waterbodies Protection rule recognizes important roles of wetlands in our natural environment and supports the nation-wide goal of no net loss of wetland functions and values. In some cases, however, the level of mitigation necessary to achieve no net loss of wetland functions and values through construction of replacement wetlands will not be practicable, or will have an insignificant effect in protecting the State's wetlands resources. In other cases, the preservation of unprotected wetlands or adjacent uplands may achieve a greater level of protection to the environment than would be achieved by strict application of a no net loss standard through

- construction of replacement wetlands. Therefore, the rule recognizes that a loss in wetland functions and values may not be avoided in every instance. The purpose of this rule is to ensure that the standards set forth in Section

480-D of the Natural Resources Protection Act, Section 464, Classification of Maine Waters and Section 465, Standards for Classification of Fresh Surface Waters are met by applicants proposing regulated activities in, on, over or adjacent to a wetland or water body.

The Towns of Kittery and Eliot have adopted the model Maine Shoreland Zoning Ordinance. Each water body is classified by Shoreland District. Resource Protection Districts include areas in which development would adversely affect water quality, productive habitat, biological ecosystems, or scenic and natural values. The resource Protection District includes areas within 250 feet of wetlands rated moderate or high value by MDIFW, 100 year flood plains and other areas. Limited Residential Districts include areas suitable for residential development. Limited Commercial Districts include areas of mixed, light commercial and residential uses, 2 or more contiguous acres in size, and prohibits industrial uses. General Development Districts include areas with a mix of development, and areas with a discernable pattern of industrial development. Stream Protection Districts include all areas within 75 feet of the normal high water level of a stream.

Sources:

MDEP. (2000). Maine Department of Environmental Protection Homeowner's Guide To Environmental Laws Affecting Shorefront Property in Maine's Organized Towns, DEPLW-38-C2000.

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Appendix D: Bacteria Model Inputs

Land Use Estimates

The GIS land cover layer used for this analysis was created at the request of the Maine DEP Bureau of Land and Water Quality (BLWQ). Though released in 2006, the Maine Land Cover Data (MELCD) used for this analysis is a land cover map for Maine primarily derived from Landsat Thematic Mapping imagery from the years 1999-2001, which was further refined using panchromatic imagery from the spring and summer months of 2004. Land uses within these maps were further refined by the Spruce Creek Association based on field verification using ground-truthing. (for more information, see page 11).

Wildlife Habitat Areas and Population Estimates*

Wildlife Type	Habitat	Population Density (animal/ha-habitat)	Source of Information
Deer [1]	Entire watershed	0.12	MapTech (2000)
Raccoons [2]	Low density on forests not in high density area; high density on forest within 183 m of a permanent water source or 0.8 km of cropland	Low density: 0.040 High density: 0.12	Virginia Department of Game and Inland Fisheries (personal communication, 2004)
Muskrats	26/km of ditch or medium sized stream[a] intersecting cropland; 13/km of ditch or medium sized stream intersecting pasture; 16/km of pond or lake edge; 81/km of slow-moving river edge	-see habitat column-	Virginia Department of Game and Inland Fisheries (personal communication, 2004)
Beavers	91-m buffer around streams and impoundments in forest and pasture	0.037	Density calculated from colony size estimates from MDC (1997) and colony density estimates by Stromayer (1999); habitat modified from estimates by MapTech (2000)
Geese	91-m buffer around main streams and impoundments	0.13 – off season 0.27 – peak season	Moyer and Hyer (2003)
Ducks	91-m buffer around main streams and impoundments	0.15 – off season 0.23 – peak season	Habitat area from Moyer and Hyer (2003)
Wild Turkey	Entire Watershed except urban and farmstead	0.025	Brannan et al. (2002)

[1]Spruce Creek deer population estimate = 291 (based on 2,430 ha habitat).

[2]Spruce Creek raccoon population estimate = 126 (based on 1,043 ha habitat).

[3]Spruce Creek muskrat population set at zero due to inadequate data.

[4]Spruce Creek beaver population estimate = 12 (based on 300 ha habitat)

[5]Spruce Creek geese population estimate = 65 - off season), 135 - peak season (based on 500 ha

Human Population and Septic Estimates

Spruce Creek watershed population was determined by multiplying the population for each town (based on 2000 US Census data: Kittery—9,543, Eliot—5,954) by the percent of the watershed land area within that town (Kittery - 43%, Eliot –5%). The entire portion of the watershed within Eliot was assumed to be non-sewered. The portion of the watershed within Kittery was estimated to be 40% sewered. This is based on an estimate of 40-50% sewer customers in the Town of Kittery (S. Tapley, personal communication). For the Spruce Creek watershed, the lower end of this range was used.

Livestock Estimates

Livestock in the Spruce Creek watershed were estimated to total 33 animal units (AEUs), including a combination of cows, horses, chickens, turkeys, deer geese, sheep, alpaca, goats, and miniature donkeys. This determination was based on an initial survey of livestock numbers and locations. However, a more thorough investigation is recommended.

References:

Benham, B., K. Brannan, K. Christophel, T. Dillaha, L. Henry, S. Mostaghimi, R. Wagner, J. Wynn, G. Yagow, and R. Zeckoski. 2004. Total maximum daily load development for Mossy Creek and Long Glade Run: Bacteria and general standard (Benthic) impairments. Richmond, Va.: Virginia Department of Environmental Quality.

MapTech, Inc. 2000. Fecal coliform TMDL (Total Maximum Daily Load) development for the south fork of the Blackwater River, Virginia. Richmond, Va.: Virginia Department of Environmental Quality, Virginia Department of Conservation and Recreation.

Moyer, D. L. and K. E. Hyer. 2003. Use of the hydrological simulation program – FORTRAN and bacteria source tracking for development of the fecal coliform total maximum daily load (TMDL) for Christians Creek, Augusta County, Virginia. USGS Water-Resources Investigations Report 03-4162. U.S. Geological Survey.

Appendix E: SCWIP Phase I Final Report


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I. Project Overview

Project Purpose

The primary purpose of the Spruce Creek Watershed Improvement Project (SCWIP) Phase I was to address the cumulative impacts of increasing development and polluted runoff to surface waters in the Spruce Creek watershed (see Appendix A for watershed description). In particular, this project focused on reducing bacteria loading and the export of sediment and nutrients into Spruce Creek to improve water quality and help re-open shellfish harvest areas. This was accomplished through the installation of structural Best Management Practices (BMPs) at residential, commercial, and town properties. The project also aimed to raise awareness about watershed problems and foster long-term watershed stewardship. Some of the major project outcomes include:

- The installation of 22 BMPs to control polluted runoff (11 residential, 9 commercial, and two industrial).
- Direct education of over 1,000 watershed citizens and visitors through outreach.
- Three septic socials (total of 45 attendees) and six residential socials (total of 110 attendees) held.
- Over 3,000 volunteer hours logged.
- The establishment of a discounted rain barrel program with dispersal to over 100 local residents.
- The launch of the Save Kittery Waters website.
- The development of the Save Kittery Waters Pledge program which has received pledges from 34 local citizens to implement a total of 444 watershed-friendly practices on their properties.
- Presentations at over 10 events.

Project Highlights and Difficulties

Overall, Phase I of the SCWIP was a success. Major highlights of the project include the completion of many of the tasks outlined in the grant agreement as well as tasks originally beyond the scope of the plan. These "extras," such as the establishment of the rain barrel program and residential socials, engaged many more local citizens than was originally anticipated. At the end of this project, more than 1,000 watershed citizens and visitors were exposed to the work being completed through this grant.

Despite the successes of this project, there were some difficulties that complicated and delayed the completion of some of the original tasks. For instance, many of the BMPs installed during this project were on commercial property. The "go-ahead" for work to be completed on these properties often had to go through many levels of approval. The long-time frame associated with this type of work was not anticipated and prevented the installation of some of the BMPs originally planned on commercial properties. Another major difficulty of this project was the overlap of Phase I and Phase II of the SCWIP in 2010.

Key Personnel

Key personnel for SCWIP Phase I include the following (leaders identified in bold):

SCWIP Team	Key Personnel
Project Manager (Task 1)	Sue Cobler
Steering Team (Task 2)	**Sue Cobler**, Forrest Bell, Jonathan Carter, Phyllis Ford, Don Kale, Paula Ledgett
LID Team (Task 3)	**Dave Gooch**, Jeff Clifford, Megan Kline, Glenn Shwaery
Septic Team (Task 4)	Will Brewster, Richard Chiango, Dan Clapp, Ken Lemont, Emily Maxfield, John Robinson, Peter Walsh
Residential Conservation Team (Task 5)	Steve Hall, Maura Khan, Mara Lamstein, Dick Loehr, Elaine Manning, Kalle Matso, Lorna Perry, Martha Petersen, Shaye Robbins, Karen Young
Stream Crossing Erosion and Culvert Replacement (Task 6)	Elaine Manning, Bruce Haedrich, Dale Small, Steve Hall
Community Outreach Team (Task 7)	**Phyllis Ford**, Jude Battles, Janet Dunham, Marcia Griffith, Barney Hoop, Johanna Mangion, Marty Rea, Carolyn Hanson, Karen Young
Resources Team	Kent Allyn, Jude Battles, Joanne Charles, Chris Kelly, Clayton Smith

II. Task Summary

Task 1: Project Management

The Town of Kittery and MDEP finalized the contract for this project in May 2008. The Town of Kittery tracked project progress, expenses, and local match. Four semi-annual progress reports were completed. Sue Cobler was hired as project manager of SCWIP Phase I in June 2008.

Task 2: Steering Committee

The Steering Committee met five times throughout the course of this project. Committee members included Sue Cobler, Forrest Bell, Jonathan Carter, Phyllis Ford, Don Kale, and Paula Ledgett. The Steering Committee organized this project into "teams" based on project tasks and met to discuss progress and next steps.

Task 3: LID and Stormwater Best Management Practices

In the first year of the project, the LID Team inventoried the Spruce Creek watershed during wet and dry weather to identify potential commercial and industrial sites for the implementation of stormwater BMPs. From this inventory, approximately ten sites were selected as good candidates for remediation. Upon the completion of this project, a total of 11 stormwater BMPs were installed at three of these sites. The worked completed at each site is thoroughly documented in the NPS reports in Appendix B. A brief summary of the work completed by the LID Team includes the following:

- **LID Site 1: Old Navy Outlet**: Improvements to this site include the installation of two under-drains, a rain garden, a no-mow zone, a curb-cut, and a stone apron.
- **LID Site 2: Bagel Caboose**: Improvements to this site include the installation of a vegetated under-drain, a mulched area, and a soil filter.
- **LID Site 3: Kittery Town Hall**: Improvements to this site include the installation of a rain garden and a treebox filter.

Task 4: Septic System Maintenance and Repair

The Septic System Maintenance and Repair Team held three septic socials, with a total of 45 attendees. Each social included a presentation by a guest speaker on the importance of septic system maintenance, and the dispersal of septic system and optical brightener fact sheets and pump-out coupons from a local septic company (Appendix D).

The Team also identified 44 potential properties with overboard discharges (OBDs) through town tax records. As a result, the town replaced two OBDs throughout the project period.

Task 5: Residential Conservation Practices

In the first year of SCWIP Phase I, the Residential Team identified potential properties for BMP installation. From this work, Technical Assistance Reports were generated for 13 residences (Appendix C). Throughout the project, 11 structural BMPS were installed at three residential properties with the help of 12 volunteers donating over 330 hours of their time. These BMPs included two rain gardens, two no-mow zones, four vegetated buffers, one drywell, one rain barrel, and one set of infiltration steps. From the Technical Assistance Reports, approximately four other BMPs were completed by the residents.

The worked completed at each site is thoroughly documented in the NPS reports in Appendix B. A brief summary of the work completed by the Residential Team includes the following:

- **Residential Site 1: 35 Mill Pond Road**: Improvements to this site include the installation of a rain garden, two vegetated buffers, infiltration steps, and a drywell.
- **Residential Site 2: 7 Mill Pond Road**: Improvements to this site include the installation of a vegetated buffer and a no-mow zone.
- **Residential Site 3: 7 Ox Point Road**: Improvements to this site include the installation of a vegetated buffer, a no-mow zone, a rain barrel and a rain garden.

The Residential Team organized and held six residential socials to encourage interest and participation in this task. Over 110 people attended these events.

The Residential Team also completed a number of projects beyond the original scope of the SCWIP Phase I. In collaboration with the rain barrel company SkyJuice, the Residential Team organized a discounted rain barrel program for residents both inside and outside of the Spruce Creek watershed. Over 100 rain barrels were sold at a discounted rate to residents throughout the Spruce Creek watershed. The rain barrels were distributed in a heavily publicized and attended event utilizing a gundalow and culminating in a residential social. More information about this event is available in Appendix D.

Task 6: Stream Crossing Erosion and Culvert Replacement

In the first year of the SCWIP Phase I, ten culverts were identified as potential sites for replacement or repair. Due to logistical issues, no culverts were replaced during the course of this project. Maine DEP gave permission to roll the funds originally allotted for Task 6 into Task 5 (Residential Conservation Practices). These funds would be used to hold six residential socials to introduce homeowners to the need for residential conservation practices and to identify potential properties on which to install BMPs.

Task 7: Public Outreach

A major goal of SCWIP Phase I was to raise community awareness about water quality in the Spruce Creek watershed through public outreach. The "Outreach Team" not only assisted the Residential and Septic Teams with the organization of socials and the creation of fact sheets, they also implemented a variety of other programs. Detailed information about these programs and more can be found in Appendix D:

- **Protect Kittery Waters Website** (www.savekitterywaters.org): Created in 2009, this website provides a central location for information about the SCWIP, an overview of steps each resident or business owner can take to improve water quality in the watershed, a calendar of events for SCWIP projects, as well as links to other resources.

- **Intercept Surveys**: In order to gauge the type of public outreach and education needed in the Spruce Creek watershed, pre-project intercept surveys were completed in the Fall 2008. Volunteers gathered responses from approximately 212 local residents. 75 local residents were surveyed in October for a post-project intercept survey. Results from these surveys will guide outreach efforts in Phase II of this project. Copies of the surveys are available in Appendix D.

- **Watershed Pledge**: The Watershed Pledge (Appendix D) is a public outreach tool that encourages local residents to discuss what they can do to improve water quality in the Spruce Creek watershed with their families, and commit to implementing these actions. Residents can pledge to improve buffers around their homes, care for their lawns and gardens in a more watershed-friendly way, prevent erosion and reduce runoff from their property, or simply spread the word to other residents. For their pledge, homeowners received a yard sign indicating their participation (Appendix D). During Phase I, 34 people pledged to complete a total of 444 watershed-friendly practices on their properties.

- **Press Releases**: Press releases were released for every event held by the SCWIP Phase I. Many news articles covered the events (Appendix D).

- **Tour of SCWIP Phase I Sites**: A tour of the residential and LID BMPs installed during Phase I of the SCWIP is planned for October 2010.

- **Save Kittery Waters Tote Bags and Note cards**: These items were sold as fundraisers for the project.

Task 8: Pollutant Load Reduction Estimates

Pollution reduction estimates were calculated for all sites where applicable. The EPA Region 5 Model was used to estimate load reduction. As the "Urban Runoff" tab was used, total sediment controlled was not calculated. It is estimated that a total of 2,781 pounds/year of Total Suspended Solids, 1 pound/year of Total Phosphorus, and 28 pounds/year of Total Nitrogen were reduced through the implementation of BMPs.

Pollutant reductions calculated with the Region 5 Model are reported in a Pollutant Load Report for the Maine DEP, as well as a memo generated by FB Environmental for the Town of Kittery. Both reports are available in Appendix E.

As of October 2010, water quality in the Spruce Creek watershed is still considered impaired based on recent water quality data. Shellfish harvesting areas still remain closed.

III. Deliverables Summary

Task 1: Project Management

- Contract between the Town of Kittery and MDEP was signed in May 2008.
- Semi-annual progress reports were submitted four times throughout the project.
- This final report was submitted in October 2010.

Tasks 3 (LID and Stormwater Best Management Practices) and 5 (Residential Conservation Practices):

- Non-point source (NPS) site reports for each NPS site can be found in Appendix B.

Task 7: Public Outreach

- Copies of newspaper articles, brochures, presentations, outreach materials, citizen surveys, and a summary of the septic and residential socials can be found in Appendix D.

Task 8: Pollutant Load Reduction Estimates

- Pollutants Controlled Reports were submitted throughout the grant period. A summary of the 2010 pollutant load estimates can be found in Appendix E.

IV. Summary of Total Expenditures

	Federal NPS Grant	Non-Federal Match	Total
Funds Originally Allocated	$69,670.00	$106,326.00	$175,996.00
Funds Expensed	$69,670.00	$113,865.00	$183,535.00
Funds Remaining	$0	- $7,539.00	- $7,539.00

SCWIP Phase I Grant Expense and Non-Federal Match Summary

		Non-Federal Match					Grant + Match
Watershed Project Activity or Workplan Element	**Grant Funds Expended**	**Volunteer Match**	**In -Kind Services**	**Kittery Match**	**Cost Share**	**Total Match**	
Task 1: Project Management and Administration	$ 1,936.60		$1,200	$ 176		$ 1,376	$ 3,330
Task 2: Steering Committee	$ 4,220.62	$ 1,458	$ 1,845	$ 264		$ 3,567	$7,788
Task 3: Stormwater Retrofit / (LID) Implementation	$ 21,484.63	$ 24,110	$ 10,545	$ 1,328	$ 200	$36,183	$ 57,668
Task 4: Septic System Maintenance and Repair	$ 3,536.95	$ 2,461		$ 521		$ 2,982	$6,519
Task 5: Residential & Business Conservation Practices	$ 25,467.44	$27,194	$ 5,797	$ 841	$ 992	$34,824	$ 60,292
Task 6: Stream Crossing Erosion Control and Culvert Replacement	$ 245.00	$ 2,751		$ 120		$ 2,871	$3,116
Task 7: Public Outreach	$ 9,982.76	$ 17,847	$13,963	$ 208		$32,018	$ 42,001
Task 8: Pollutant Load Reduction Assessment and Monitoring	$ 2,796.00			$ 44		$ 44	$2,840
TOTAL	**$ 69,670.00**	**$ 75,821**	**$ 33,350**	**$ 3,502**	**$ 1,192**	**$113,865**	**$183,553**

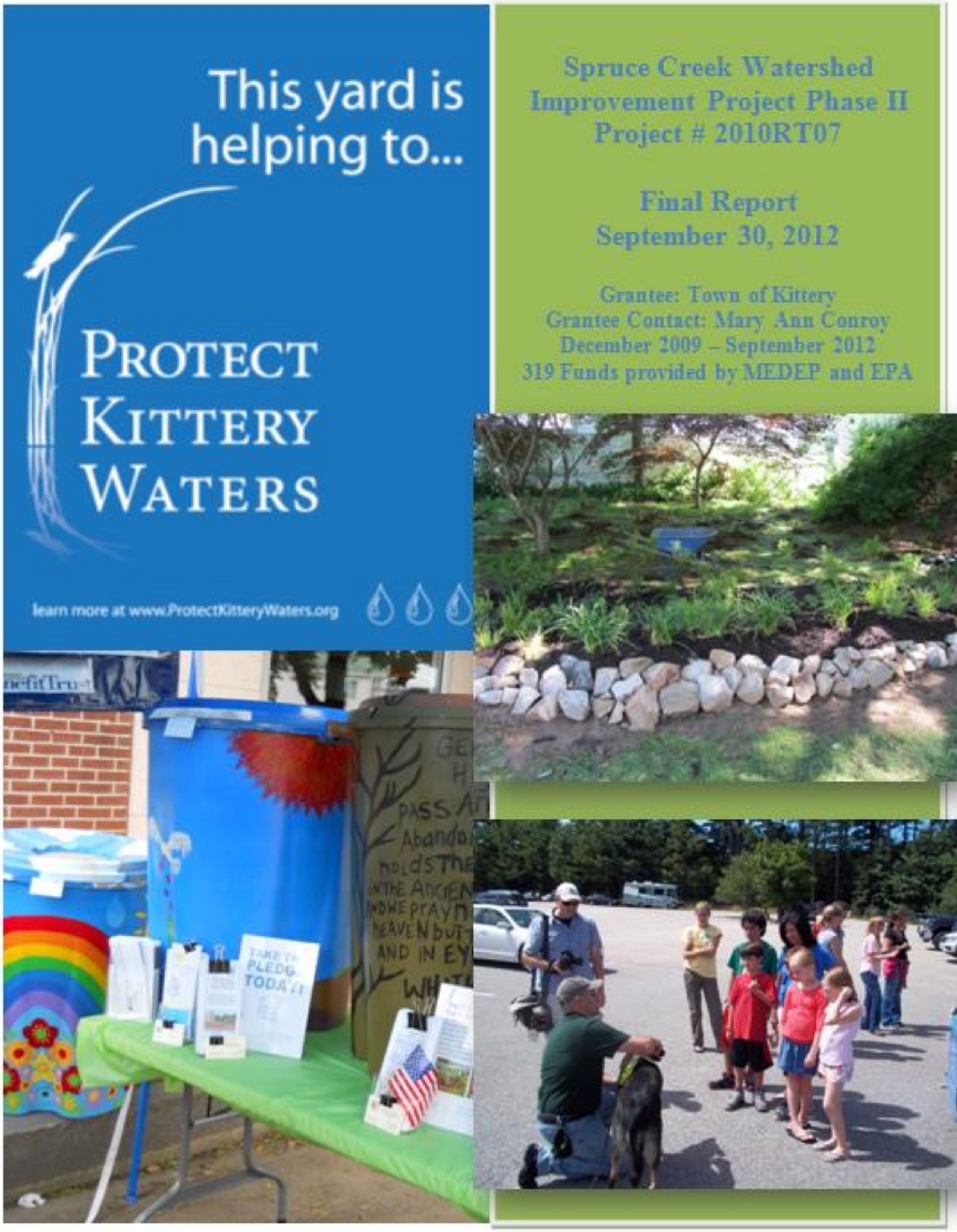
V. Non-Federal Match Documentation and Certification

See Appendix F for Match Certification Form and table of match sources.

VI. Appendices

Appendices are not attached. Contact the town or FB Environmental for a copy of the full report with appendices.

Appendix F: SCWIP Phase II Final Report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Spruce Creek Watershed Improvement Project Phase II
Project # 2010RT07
Final Report
September 30, 2012
Grantee: Town of Kittery
Grantee Contact: Mary Ann Conroy
December 2009 – September 2012
319 Funds provided by MEDEP and EPA
TAKE THE PLEDGE TODAY!

TABLE OF CONTENTS

1. Project Overview

1.1 Project Purpose

The primary purpose of the Spruce Creek Watershed Improvement Project (SCWIP) Phase II was to address the cumulative impacts of increasing development and polluted runoff to surface waters in the Spruce Creek watershed (see Appendix A for watershed description). In particular, this project focused on reducing bacteria loading and the export of sediment and nutrients into Spruce Creek to improve water quality and help re-open shellfish harvest areas. This was accomplished through the installation of structural Best Management Practices (BMPs) at residential, commercial, and town properties. The project also aimed to raise awareness about watershed problems and foster long-term watershed stewardship. Some of the major project outcomes include:

- The installation of 25 BMPs to control polluted runoff (21 residential and 4 commercial).
- Direct education of over 300 watershed citizens and visitors through outreach.
- Over 1,526 volunteer hours logged.
- The maintenance of the Save Kittery Waters website.
- The continuation of the Save Kittery Waters Pledge program which has received pledges from 54 local citizens to implement a total of 648 watershed-friendly practices on their properties.
- Presentations at over 8 events.

1.2 Project Highlights and Difficulties

Overall, Phase II of the SCWIP was a success. Major highlights of the project include the completion of the tasks outlined in the grant agreement as well as tasks originally beyond the scope of the plan. These "extras," such as hosting exhibit booths at local events engaged many more local citizens than was originally anticipated. At the end of this project, more than 300 watershed citizens and visitors were exposed to the work being completed through this grant.

Despite the successes of this project, there were some difficulties that complicated and delayed the completion of some of the original tasks. For instance, many of the BMPs installed during this project were on commercial property. The "go-ahead" for work to be completed on these properties often had to go through many levels of approval. The long-time frame associated with this type of work was not anticipated and prevented the installation of some of the BMPs originally planned on commercial properties. Another major difficulty of this project was the transition to a new town manager in 2011.

1.3 Key Personnel

To simplify task management, the number of key personnel involved in the management and organization of SCWIP Phase II was reduced from the previous grant. The key personnel involved in this project served on the Steering Committee and met multiple times throughout the project to ensure the requirements for each task were met. Members of the Steering Committee included:

1. Mary Ann Conroy – Commissioner of Public Works, Kittery, ME

2. Jonathan Carter – Kittery Town Manager (previous)
3. Robert Markel – Kittery Town Manager (current)
4. Sue Cobler – SCWIP Grant Business Manager
5. David Ramsey – SCWIP Grant Manager
6. Phyllis Ford – Spruce Creek Association
7. Amber Harrison – Kittery Shoreland Resource Officer
8. Wendy Garland – Maine Department of Environmental Protection
9. Forrest Bell – FB Environmental Associates
10. Emily DiFranco – FB Environmental Associates

2. Task Summary

2.1 Task 1: Project Management

The Town of Kittery and MEDEP finalized the contract for this project in December 2009. The Town of Kittery tracked project progress, expenses, and local match. Four semi-annual progress reports were completed. David Ramsey was hired as the Project Manager and Sue Cobler was hired as the business manager for SCWIP Phase II in January 2010.

2.2 Task 2: Steering Committee

The Steering Committee met six times throughout the course of this project. Committee members included Mary Ann Conroy, Jonathan Carter, Robert Markel, Sue Cobler, David Ramsey, Phyllis Ford, Amber Harrison, Wendy Garland, Forrest Bell, and Emily DiFranco. The Steering Committee managed this project based on project tasks and met to discuss progress and next steps.

2.3 Task 3: LID Team: LID and Stormwater Best Management Practices

In SCWIP Phase I, the LID Team inventoried the Spruce Creek watershed during wet and dry weather to identify potential commercial and industrial sites for the implementation of stormwater BMPs. From this inventory, approximately ten sites were selected as good candidates for remediation. In Phase I, a total of 11 stormwater BMPs were installed at three of these sites. In Phase II, four additional sites were addressed. The worked completed at each site is thoroughly documented in the NPS reports in Appendix B. A brief summary of the work completed in Task 3 includes the following:

- **LID Site 1: Shapleigh School**: Improvements to this site include the installation of permeable pavers in the school parking lot;
- **LID Site 2: Bob's Clam Hut**: Improvements to this site include the installation of a rain barrel;
- **LID Site 3: Robert's Maine Grill**: Improvements to this site include the installation of a rain barrel;
- **LID Site 4**: **GAP Outlet:** Improvements to this site include the installation of a vegetated underdrain.

2.4 Task 4: Septic Team: IDDE Evaluation Follow-up and Technical Assistance

For Task 4, SCWIP Phase II focused on identifying human sources of bacteria in Kittery and worked to promote the recently drafted septic pump-out ordinance and tracking system.

Illicit Discharge Detection

SCWIP Phase II focused efforts on areas identified as "hotspots" of bacteria in outfall and tributary sampling in 2009 and 2011. Admiralty Village, a residential neighborhood along Spruce Creek that includes Navy housing, was identified as one area that consistently had high bacteria counts even in dry weather. A follow-up camera inspection of one section of the storm drain system led to the discovery of a system of catch basins in the backyards of private homes in the area. As part of this project, FB Environmental mapped this storm drain system and began the outreach process to educate residents about proper maintenance and use of these catch basins. A report including the map of the private storm drain system can be found in Appendix C.

Septic Pump-out Ordinance

The Town of Kittery is currently working to pass a septic pump-out ordinance that would require regular pump-outs and inspections of privately owned septic systems. Members of the SCWIP Phase II team worked to support this ordinance by attending two public information sessions and producing and dispersing multiple septic system brochures and informational packets. All outreach materials, including press releases and a copy of the ordinance can be found in Appendix C.

2.5 Task 5: Residential Team: Residential Socials and Residential Conservation Practices

In SCWIP Phase II, Technical Assistance reports were generated for seven residences (Appendix D). From these reports, 25 BMPs were installed on five residential properties with the help of 14 volunteers donating over 1,526 hours of their time. From the Technical Assistance Reports, approximately four other BMPs were completed by the residents.

The worked completed at each site is thoroughly documented in the NPS reports in Appendix D. A brief summary of the work completed by the Residential Team includes the following:

- **Residential Site 1: 381 Haley Road**: Improvements to this site include the installation of a rain garden, an infiltration trench and a plunge pool.
- **Residential Site 2: 8 Moore Street**: Improvements to this site include the installation of two vegetated buffers, two rain gardens, and a gravel walkway.
- **Residential Site 3: 19 Bond Road**: Improvements to this site include the installation of three rain gardens, infiltration steps, a vegetated buffer, a no-mow zone, and two infiltration trenches.
- **Residential Site 4**: **21 Bond Road**: Improvements to this site include the installation of an infiltration trench.
- **Residential Site 5: Bond Road Shared Driveway**: Improvements to this site include the repaving of a private driveway to ensure the pitch of the driveway pushes water into constructed BMPs. The driveway is shared by five homes.

2.6 Task 6: Public Outreach

A major goal of SCWIP Phase II was to raise community awareness about water quality in the Spruce Creek watershed through public outreach. Upon the completion of this project, four public presentations were held, two educational exhibits were organized at local events, two workshops on non-point source pollution management were hosted, and one end-of-project intercept survey was conducted.

Public Presentations

Four public presentations were given by FB Environmental and Maine NEMO (See Appendix D for more detailed descriptions):

- La Marr Clannon from NEMO presented about non-point source pollution at the Phase II kickoff meeting in March 2011 held at the Kittery Trading Post.
- FB Environmental held a brief presentation on the SCWIP and the effect of stormwater on local waterbodies during the tour of residential and commercial projects completed during Phases I and II, on October 5, 2011.
- FB Environmental presented about non-point source pollution and the results of the 2011 stormwater outfall sampling at a Kittery Town Council Meeting in January of 2012.
- FB Environmental presented at a residential BMP installation event (8 Moore Street), in which the health of the Spruce Creek watershed was discussed as well as best management practices to apply to residential neighborhoods.

Workshops on NPS Management

Two workshops on NPS Management were organized by the Outreach Team as part of Phase II (See Appendix D for more detailed descriptions):

- La Marr Clannon from NEMO hosted a workshop for the Kittery Planning Board on October 2, 2011.
- Landscaping at the Water's Edge Workshop, a 2-day workshop for professional landscapers and homeowners, was held in collaboration with the UNH Cooperative Extension at the Kittery Trading Post on March 30 and 31, 2011.

Educational Exhibits

In addition to the public presentations, three educational exhibits were organized and staffed by the Spruce Creek Association and the Town of Kittery.

- In a separate project, the Town of Kittery, working with FB Environmental, brought the dogs from Environmental Canine Services to conduct an investigation of storm drains and tributaries throughout Kittery to identify human sources of bacteria to Spruce Creek. These dogs are trained to detect, through scent, human-specific sources of bacteria. As part of this investigation, an education and outreach event was held in the parking lot of the Kittery Trading Post, in which members of the press and local citizens were invited and the Spruce Creek Association and the Town of Kittery hosted an educational booth.

- The Spruce Creek Association and the Town of Kittery organized a booth at the Kittery Block Party on June 16, 2012 in which exhibits showcased information about the SCWIP Phase II, a rain barrel program, and gave information about Kittery's revisions to the septic ordinance.
- The Spruce Creek Association organized a booth at Kittery's Zero Waste Event held on September 23, 2012 at Fort Foster in Kittery Maine, which showcased information about protecting Spruce Creek and collecting pledges.

<u>Intercept Survey</u>

In 2008 and 2010, intercept surveys were conducted in the Spruce Creek watershed to gauge the type of public outreach and education needed. An end-of-project intercept survey conducted in September of 2012, given to a sample of part-time and full-time Kittery and Eliot residents was used to gather responses and information regarding the success of those outreach and educational efforts put forth during Phase II of this project. Copies of the surveys and results can be found in Appendix D.

<u>Technological Outreach</u>

As part of Phase II, one blog was created and one website was updated to spread information about Spruce Creek and best management practices (See Appendix D).

- **Protect Kittery Waters Website** (www.savekitterywaters.org): Created in 2009, this website provides a central location for information about the SCWIP, an overview of steps each resident or business owner can take to improve water quality in the watershed, a calendar of events for SCWIP projects, as well as links to other resources.
- A blog was created by a homeowner whose property was the site of a residential BMP project documenting the process of building a rain garden and posted it online as a guide to other interested homeowners.

<u>Additional Outreach Efforts</u>

- **Press Releases:** Four press releases were published during Phase II and many news articles covered the events (Appendix D).
- **Watershed Pledge**: The Watershed Pledge (Appendix D) is a public outreach tool that encourages local residents to discuss what they can do to improve water quality in the Spruce Creek watershed with their families, and commit to implementing these actions. Residents can pledge to improve buffers around their homes, care for their lawns and gardens in a more watershed-friendly way, prevent erosion and reduce runoff from their property, or simply spread the word to other residents. For their pledge, homeowners received a yard sign indicating their participation (Appendix D). During Phase II, 54 people pledged to complete a total of 648 watershed-friendly practices on their properties.

- **Tour of SCWIP Phase I and II Sites**: One tour of the Spruce Creek watershed residential and commercial projects that have been installed in SCWIP Phases I and II was held on October 5, 2011. This tour was organized in collaboration with the Wells Reserve National Estuarine Research Center (See Appendix D).
- **Flyers/Brochures**: A new BMP flyer/brochure was designed for the tour of SCWIP Phase I and II sties held on October 5, 2011 (See Appendix D).

2.7 Task 7: Pollutant Load Reduction Estimates

Pollution reduction estimates were calculated for all sites where applicable. The EPA Region 5 Model was used to estimate load reduction. As the "Urban Runoff" tab was used, total sediment controlled was not calculated. It is estimated that a total of 458 pounds/year of Total Suspended Solids and 2 pounds/year of Total Nitrogen were reduced through the implementation of BMPs. Pollutant reductions calculated with the Region 5 Model are reported in a Pollutant Load Report for the Maine DEP (Appendix E).

As of September 2012, water quality in the Spruce Creek watershed is still considered impaired based on recent water quality data. Shellfish harvesting areas still remain closed.

3. Deliverables Summary

Task 1: Project Management

- Contract between the Town of Kittery and MDEP was signed in December 2009.
- Semi-annual progress reports were submitted four times throughout the project.
- This final report was submitted on September 28, 2012.

Task 3 (LID and Stormwater Best Management Practices) and 5 (Residential Conservation Practices):

- Non-point source (NPS) site reports for each NPS site can be found in Appendix B.

Task 6: Public Outreach

- Copies of newspaper articles, brochures, presentations, outreach materials, and citizen surveys can be found in Appendix D.

Task 7: Pollutant Load Reduction Estimates

- Pollutants Controlled Reports were submitted throughout the grant period. A summary of the 2012 pollutant load estimates can be found in Appendix E.

4. Summary of Total Expenditures

	Federal NPS Grant	Non-Federal Match	Total
Funds Originally Allocated	$79,780.00	$81,346.00	$161,126.00
Funds Expensed	$79,780.00	$134,108.20	$213,888.20
Funds Remaining	$0	($52,762.20.00)	($52,108.20.00)

SCWIP Phase II Grant Expense and Non-Federal Match Summary

		Non-Federal Match					
Watershed Project Activity or Workplan Element	**Grant Funds Expended**	**Volunteer Match**	**In - Kind Services**	**Kittery Match**	**Cost Share**	**Total Match**	**Grant + Match**
Task 1: Project Management	$13,488.88	$21,600	$1,110	$480	--	$23,190	$36,678.88
Task 2: Steering Committee	$5,482.30	$240	$840	$1,200	--	$2,280	$7,762.30
Task 3: LID Team	$22,462.93	--	$7,040	$16,056	$1,179	$24,275	$46,737.93
Task 4: Septic Team	$6,163.91	--	$2,000	$800	$44,000	$46,800	$52,963.91
Task 5: Residential Team	$22,314.51	$3,660.20	$1,233	$2,125	$21,075	$28,083.20	$50,397.71
Task 6: Outreach Team	$5,088.75	$2,940	$3,460	$1,040	--	$7,440	$12,528.75
Task 7: Pollutant Reduction Estimates	$4,778.72	--	$2,040	--	--	$2,040	$6,818.72
TOTAL	**$79,780**	**$28,440.20**	**$17,713**	**$21,701**	**$66,254**	**$134,108.20**	**$213,888.20**

5. Non-Federal Match Documentation and Certification

GRANTEE INFORMATION:

Name:	Town of Kittery
Address:	200 Rogers Road Extension
	Kittery, Maine 03904
Telephone:	(207) 439-0333
Contact Person:	Mary Ann Conroy

PROJECT INFORMATION:

Project Title: Spruce Creek Watershed Improvement Project Phase II

Project ID#: 2010RT07

Match Amount planned under the Grant Agreement	$ 81,346.00
Match Amount Claimed	$ 134,108.20

CERTIFICATION STATEMENT:

I certify that the non-federal match detailed in the attached information were expended in the course of completing work described in the Grant Agreement for the Project referenced above, and that detailed documentation of the match information is on file and available for review at the Grantee address shown above.

Date 9/30/2012 Signature of Grantee - Authorized Official

Table 2: Total Non-Federal Match for all Tasks for the SCWIP Phase II

Donor	Service	Task	Hours	Rate or Value	Total
Town Manager	Project Management	1	4	$40/hour	$ 160.00
DPW Director	Project Management	1	8	$40/hour	$ 320.00
Phyllis Ford	Project Management	1	1080	$20/hour	$ 21,600.00
FB Environmental	Project Management	1	55	$20/hour	$ 1,100.00
Town Manager	Attendance at Steering Committee Meetings	2	12	$40/hour	$ 480.00
DPW Director	Attendance at Steering Committee Meetings	2	12	$40/hour	$ 480.00
Shoreland Resource Officer	Attendance at Steering Committee Meetings	2	12	$20/hour	$ 240.00
FB Environmental	Attendance at Steering Committee Meetings	2	42	$20/hour	$ 840.00
Phyllis Ford	Attendance at Steering Committee Meetings	2	12	$20/hour	$ 240.00
Kittery DPW	Materials and Labor	3 - GAP Outlet		$1,956	$ 1,956.00
FB Environmental	Re-design Meeting	3 - GAP Outlet	2	$20/hour	$ 40.00
CMA Engineers	Design	3 - GAP Outlet		$3,000	$ 3,000.00
GAP Outlet Lawyers	Design approval	3 - GAP Outlet		$4,000	$ 4,000.00
Kittery DPW	Materials and Labor	3 - Shapleigh School		$14,100	$ 14,100.00
Michael Landgarten	Facilities Manager's Hours and Cash	3 - Bob's Clam Hut		$778	$ 778.00
Michael Landgarten	Facilities Manager's Hours and Cash	3 - Robert's Maine Grill		$401	$ 401.00
Shoreland Resource Officer	Hours	4	40	$20/hour	$ 800.00
FB Environmental	Admiralty Village investigation and report	4	100	$20/hour	$ 2,000.00
Phyllis and Dan Ford	Installation of New Septic (upon discovery of OBD directly into Spruce Creek)	4		$44,000	$ 44,000.00
FB Environmental	Site Design and Installation	5 - 381 Haley Road	12	$20/hour	$ 240.00
Kittery DPW	Materials and Labor	5 - 381 Haley Road		$400	$ 400.00
Spruce Creek Association	Volunteers for Installation	5 - 381 Haley Road	42	$15/hour	$ 630.00
Spruce Creek Association	Volunteer Mileage	5 - 381 Haley Road	50	$0.55/mile	$ 27.50
Lorna Perry	Plant Donation	5 - 381 Haley Road		$73	$ 73.00

Donor	Service	Task	Hours	Rate or Value	Total
FB Environmental	Site Design and Installation	5 - 8 Moore Street	16	$20/hour	$ 320.00
Kittery DPW	Materials and Labor	5 - 8 Moore Street		$750	$ 750.00
Spruce Creek Association	Volunteers for Installation	5 - 8 Moore Street	40	$15/hour	$ 600.00
Spruce Creek Association	Volunteer Mileage	5 - 8 Moore Street	30	$0.55/mile	$ 16.50
FB Environmental	Site Design and Installation	5 - 21 Bond Road	6	$20/hour	$ 120.00
Kittery DPW	Materials and Labor	5 - 21 Bond Road		$250	$ 250.00
Spruce Creek Association	Volunteers for Installation	5 - 21 Bond Road	16	$15/hour	$ 240.00
Spruce Creek Association	Volunteer Mileage	5 - 21 Bond Road	42	$0.55/mile	$ 23.10
FB Environmental	Site Design and Installation	5 - 19 Bond Road	24	$20/hour	$ 480.00
Kittery DPW	Materials and Labor	5 - 19 Bond Road		$725	$ 725.00
Spruce Creek Association	Volunteers for Installation	5 - 19 Bond Road	140	$15/hour	$ 2,100.00
Spruce Creek Association	Volunteer Mileage	5 - 19 Bond Road	42	$0.55/mile	$ 23.10
Dan and Phyllis Ford	Material Donation/Cash	5 - 19 Bond Road		$5,675	$ 5,675.00
George Frank	Cash	5 - 18 Bond Road Driveway		$3,300	$ 3,300.00
Dan and Phyllis Ford	Cash	5 - 19 Bond Road Driveway		$2,200	$ 2,200.00
Arthur Lutts	Cash	5 - 20 Bond Road Driveway		$3,300	$ 3,300.00
Victor Messier	Cash	5 - 21 Bond Road Driveway		$3,300	$ 3,300.00
Kate Johnston	Cash	5 - 23 Bond Road Driveway		$3,300	$ 3,300.00
LaMarr Clannon	Presentations	6	8	$40/hour	$ 320.00
FB Environmental	Presentations	6	56	$20/hour	$ 1,120.00
FB Environmental	Stormwater brochure	6	8	$20/hour	$ 160.00
Shoreland Resource Officer	Planning/Attendance at Outreach Events	6	52	$20/hour	$ 1,040.00
Spruce Creek Association	Volunteers at Outreach Events	6	122	$15/hour	$ 1,830.00
Spruce Creek Association	Volunteers for Intercept Survey	6	74	$15/hour	$ 1,110.00
FB Environmental	Intercept Survey	6	18	$20/hour	$ 360.00
FB Environmental	Other Outreach Efforts	6	75	$20/hour	$ 1,500.00

Donor	Service	Task	Hours	Rate or Value	Total
FB Environmental	Pollutants Controlled Report/Final Report	7	102	$20/hour	$ 2,040.00
				TOTAL	**$ 134,108.20**

Appendix G: Water Quality Reports for the Spruce Creek Watershed 2009-2013

Chickering Creek data 2013

Sample ID	Site Location	8/13/2013	9/20/2013	9/23/2013	9/26/2013	10/7/2013	10/23/2013	11/1/2013	Geometric Mean
		0” in 48 hours	0” in past 96 hours	0.6” in past 48 hours	0” in past 48 hours	0.2” in past 24 hours	0” in past 96 hours	0.1” in past 24 hours	
		Dry	Dry	Wet	Dry	Wet	Dry	Wet	
CC-ORVIS OUT	Outlet of Chickering Creek	93	687	1414	380.5 *	2420		108	456
CC-ADAMS	Culvert downstream of Adams Dr.	99	649	1414 *	770	1986		166	534
CC I95	I-95 at end of Manson Road		>2420	2420	1203	>2420		1046	1214
CC-T.P.	Off Dana Ave. - Downstream of the trailer park	52	140	249	70	227.5 *		>2420	203
CC-BY	Chickering Creek behind Boat Yard facility	99	65	157	35	68		26.5 *	63

Gray cells indicate an exceedance of WQS for E. coli (Single sample = 236 colonies/100 mL; Geometric Mean = 64 colonies/100 mL).

*** indicates that a field duplicate was collected. Result is the average of two samples.**

Wet weather sampling is determined using the following parameters for precipitation in Kittery, ME.

Precipitation totals must meet at least 1 of the 3 parameters to be a wet weather sample:

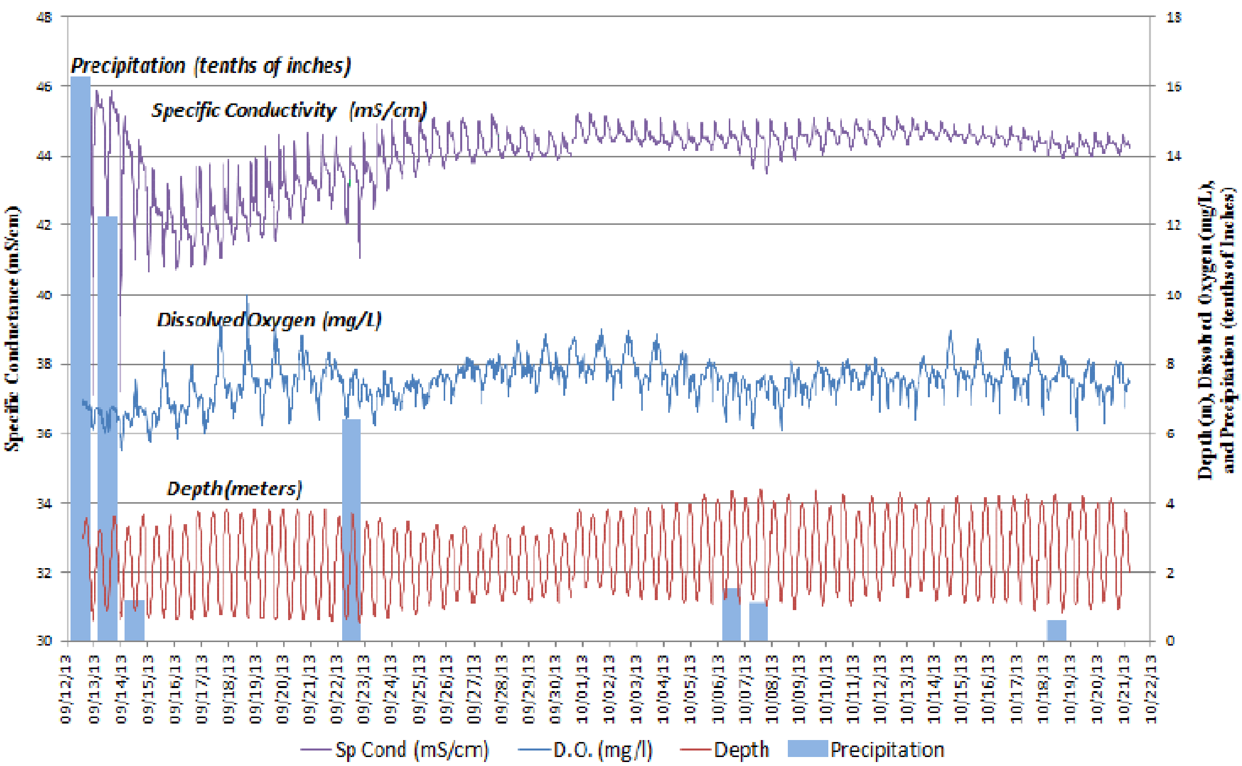
> 2.0 inches in the past 96 hours

>0.25 inches in the past 48 hours

>0.1 inches in the past 24 hours

Main Channel Investigation:

Continuous sonde data collected in Spruce Creek for specific conductivity, dissolved oxygen, and depth with daily precipitation from September 12 – October 21, 2013



2013 Spruce Creek Main Stem Water Quality Sample Results:

Grab Sample Results *Spruce Creek Middle Estuary Location*		
Parameter	**Result**	
	September 30, 2013	*October 21, 2013*
Ammonia Nitrogen (NH_3) (mg/L)	<0.05	<0.05
Biological Oxygen Demand (BOD) (mg/L)	<6	<6
Chloride (mg/L)	18000	22000
E. coli (colonies/100mL)	9	13
Nitrate Nitrogen (NO3) (mg/L)	< 20	<20
Nitrite Nitrogen (NO_2) (mg/L)	<0.01	<0.01
Total Kjeldal Nitrogen (TKN) (mg/L)	<0.20	0.21
Total Organic Carbon (TOC) (mg/L)	3.1	2.6
Total Suspended Solids (TSS) (mg/L)	93	54

Sampling results from bacteria source tracking and canine detection on July 31, 2013 in the Chickering Creek watershed in Kittery, ME.

Site Name	Description	E. coli (col./100mL)	Dog Response (Sable/Logan)	Comments
Orvis Out	Outlet to Spruce Creek	**166**	**Y/Y**	
CC- Adams	Downstream side of Adams Drive crossing	**161**	**Y/Y**	
Ox-CB1	Catch Basin on Ox Point Drive	--	N	
Ox-CB2	Catch Basin on Ox Point Drive	--	N	
Ox-CB3	Catch Basin on Ox Point Drive	--	N	
Ox-OF	Storm outfall to Spruce Creek on Ox Point	--	**Y**	Pipe from residence adjacent to storm outfall. May be perimeter drain, sub-pump, or laundry drain?
Adams-CB1	Catch Basin on Adams Drive	--	N	
Adams-CB2	Catch Basin on Adams Drive	--	N	
Adams-CB3	Catch Basin on Adams Drive	--	N	
Adams-CB4	Catch Basin on Adams Drive	--	N	
Culvert Grate	Route 1 culvert grated cover.	--	**Y**	
Dana-CB1	Catchbasin on Dana Ave.	--	N	
Dana-CB2	Catchbasin on Dana Ave.	--	N	
Dana-CB3	Catchbasin on Dana Ave.	--	N	Observed flow from small pipes in Catchbasin. Water cloudy and grey. Laundry odor.
Dana-CB4	Catchbasin on Dana Ave.		**Y**	
Dana-CB5	Catchbasin on Dana Ave.	--	N	
Dana-CB6	Catchbasin on Dana Ave.	--	N	
CC-TP	Chickering Creek behind trailer park on Dana Ave.	--	N/N	

Gray cells indicate an exceedance of the water quality standard (236 colonies/100mL).
Red cells indicate a positive response via canine detection from both dogs.
Blue cells indicate a positive response via canine detection from one dog only.

E. coli **results (colonies/100 mL) for bracket sampling conducted at Picott from June to September 2012**

Sampling Location	6/27/2012 (Wet)	7/10/2012 (Dry)	7/19/2012 (Dry)	7/23/2012 (Dry)	8/7/2012 (Dry)	8/9/2012 (Dry)	9/5/2012 (Wet)	Geometric Mean
Picott US	60	9	13	9	29	--	73	23
Picott Driveway Down	115	49	205	81	99	--	336	121
Picott Driveway Up	179	43	83	73	--	--	--	83
Picott Farm	238	>2420	1553	>2420	727	921	4106^	1290
Picott Culvert	461	>2420	>2420	>2420	308	107	1565	856
Picott DS	365	1203	1413	1120	1986	534	728	915

- Gray cells indicate an exceedance of instantaneous WQS for *E. coli* (236 colonies/100 mL)
- Red cells indicate a geometric mean > 640 colonies/100 mL (greater than 10 times the WQS of 64 colonies/100 mL)
- Orange cells indicate a geometric mean of 320 – 640 colonies/100 mL (between 5 and 10 times the WQS of 64 colonies/100 mL)
- Yellow cells indicate a geometric mean of 64- 319 colonies/100 mL (up to 5 times the WQS of 64 colonies/100 mL)
- Green cells indicate a geometric mean of < 64 colonies/100 mL (does not exceed the WQS)

> 2420 is the maximum number that the analytical method can measure before being cited as too numerous to count

^ Indicates that a sample was assumed to have a high bacteria concentration and therefore was diluted prior to analysis

-- Indicates that no sample was taken on that date.

E. coli results (colonies/100 mL) for bracket sampling conducted on Fuller Brook

Sampling Location	6/27/2012 (Wet)	7/10/2012 (Dry)	7/19/2012 (Dry)	7/23/2012 (Dry)	8/7/2012 (Dry)	8/9/2012 (Dry)	9/5/2012 (Wet)	Geometric Mean
Trafton US	68	96	--	--	--	--	435	142
Trafton Culvert	157	435	387	687	980	921	2755^	642
Trafton DS	345	235	261	--	>2420	--	2909^	683

- Gray cells indicate an exceedance of instantaneous WQS for *E. coli* (236 colonies/100 mL)
- Red cells indicate a geometric mean > 640 colonies/100 mL (greater than 10 times the WQS)
- Orange cells indicate a geometric mean of 320 – 640 colonies/100 mL (between 5 and 10 times the WQS)
- Yellow cells indicate a geometric mean of 64- 319 colonies/100 mL (up to 5 times the WQS)

> 2420 is the maximum number that the analytical method can measure before being cited as too numerous to count

^ Indicates that a sample was assumed to have a high bacteria concentration and therefore was diluted prior to analysis

-- Indicates that no sample was taken on that sample date

E. coli **results (colonies/100 mL) for outfall sampling conducted throughout the Spruce Creek Watershed**

Outfall ID	Outfall Location	8/7/2012 (Dry)	8/9/2012 (Dry)	8/23/2012 (Dry)	9/4/2012 (Wet)*	9/5/2012 (Wet)	9/20/2012 (Wet)	10/4/2012 (Wet)	10/22/2012 (Dry)	Geometric Mean
Manson Avenue	Stream on Manson Ave	>2420	>2420	1553	>2420	3130^	2420	1414	>2420	2182
Goose Point Bridge	Culvert under bridge at 12 Goose Point Road	>2420		488	>2420	3255^	>2420	548	291	1068
MPR Stream	Mill Pond DS of pipe	>2420	816	121	--	1086	248	1300	461	628
WR Cul	Wilson Road culvert	272	980	1046	2420	2064	1414	93	74	477
Trolley Bridge	Stream underneath old trolley bridge at end of Tilton	>2420	36	961	--	169	>2420	2420	24	411
WR Telephone	Wilson Road telephone house	517	548	291	>2420	1723	1414	365	24	404
KTP	Drainage ditch behind KTP			68	1300	5172^	461	105	579	397
Wyman House	Outfall behind 578 Haley Road	115	231	411	1550	3255^	1046	411	62	370
Barter's Creek	Outlet of Barter's Creek	594	>2420	167	1300	10	>2420	1733	33	318
Wilson Creek	Wilson Creek outfall on Haley	435	1120	157	>2420	677	210	105	27	227
Hill Creek	At Spruce Creek Point Rd	--		68	210	1483	>2420	68	25	211
Coachmen Inn	Culvert on Route 1	62	36	58	>2420	414	194	84	49	89
MPR Pipe	Outfall pipe behind house on Mill Pond Road	921	124	6	649	1450	86	32	12	85
Rt 103	Outfall across Rt 103 from pump station	39	>2420	17	225	63	73	13	11	52
Robert's	Outfall Pipe next to Robert's			15	579	697	25	285	4	50
Duncan Way	Pipe behind house	--	--	--	--	--	--	--	--	--

Goose Point Pond	Area where Goose Point Pond drains	--	--	--	--	--	--	--	--	--
Newson Ave	Pipe behind house at end of street	--	--	--	--	--	--	--	--	--
Old Ferry Lane	Outfall pipe on Old Ferry Lane	--	--	--	--	--	--	--	--	--
Wyman Outfall	Outfall in Admiralty Village by playground	--	--	--	--	--	--	--	--	--

* Sample taken at the beginning of a rain event and was not used to calculate geometric mean

- Gray cells indicate an exceedance of instantaneous WQS for *E. coli* (236 colonies/100 mL)

- Red cells indicate a geometric mean > 640 colonies/100 mL (greater than 10 times the WQS of 64 colonies/100 mL)

- Orange cells indicate a geometric mean of 320 – 640 colonies/100 mL (between 5 and 10 times the WQS of 64 colonies/100 mL)

- Yellow cells indicate a geometric mean of 64- 319 colonies/100 mL (up to 5 times the WQS of 64 colonies/100 mL)

- Green cells indicate a geometric mean of < 64 colonies/100 mL (does not exceed the WQS)

> 2420 is the maximum number that the analytical method can measure before being cited as too numerous to count

^ Indicates that a sample was assumed to have a high bacteria concentration and therefore was diluted prior to analysis

-- Indicates that no sample was taken due to no flow conditions or inaccessibility or not enough data to calculate a geometric mean

Water Quality Data from 2008 plan:
2005-2007 Water Quality Monitoring (SCA)

In 2005, the SCA began monitoring dissolved oxygen, salinity, and temperature in Spruce Creek weekly during the months of June through September with a DEP-approved Quality Assurance Project Plan (QAPP). The goal of this monitoring is to establish a water quality baseline to be compared to Maine DEP water quality standards to better understand the Creek’s current stress levels. Sampling has been conducted at six sites in the Creek, three sites above the bridge at US Route 1 and three below (Map 9, Appendix B) from 2005 to 2007. Table 4.2.1 describes the parameters measured.

***Table 4.2.1** Spruce Creek Water Quality Parameters*

Description of Spruce Creek Water Quality Parameters		
Data	Units	Description
Dissolved Oxygen (DO) Concentration	mg/l	Since most aquatic organisms such as shellfish and other living resources require oxygen to survive, this is a very important measure of water quality. DO concentrations below 5 mg/l can stress organisms. DO concentrations of around 1 mg/l can result in fish kills.
DO Percent Saturation	% normal maximum	DO saturation percent shows the level of dissolved oxygen as a percentage of the normal maximum amount of DO that will dissolve in water. Colder water can hold more DO than warmer water. Super-saturation (over 100% DO saturation) can occur when the input of oxygen from algae or plants is greater than the transfer of oxygen to the air.
Salinity	ppt (parts per thousand)	Salinity in Spruce Creek comes from the ocean. Therefore, areas closer to the ocean have higher salinities. During periods of low precipitation and river flow, salinity increases as it intrudes further up the Creek, while during wetter periods, salinity decreases. Salinity cycles related to the tides may also be evident in these graphs as salinity increases during flood tides and decreases during ebb tides. Salinity levels are important to aquatic organisms, as some organisms are adapted to live only in brackish or salt water, while others require fresh water. If the salinity levels get too high, the health of freshwater fish as well as grasses can be affected.
Water Temperature	°C	Water temperature is another variable affecting suitability of the waterway for aquatic organisms. If water temperatures are consistently higher or lower than average, organisms can be stressed and may even have to relocate to areas with a more suitable water temperature. Water temperature directly affects the solubility of oxygen.

Dissolved Oxygen:

Sampling results show that the downstream stations 1, 2, and 3 have less variability in oxygen saturation than the upstream stations 4, 5 and 6. The variability increases with increasing distance upstream. While stations 5 and 6 have the highest mean measured saturation, they also have a higher frequency of low readings, indicating how variable the measurements were at those stations. This can be typical of tidally influenced waters, where changes in salinity and temperature can result in variable DO levels. Site 5 had dissolved oxygen measurements of less than 85% saturation 21% of the time and site 6 had dissolved oxygen measurements of less than 75% saturation 15% of the time. Based on similar measures of DO at each depth, the water column at each station appears to be fully mixed. This is likely due to the tidal currents and/or shallow depths.

High levels of dissolved oxygen (supersaturation) were noted at all sites, particularly sites 4, 5 and 6, during each sampling season. High oxygen concentrations may be indicative of increased phytoplankton activity and could have a negative effect on aquatic plants and animals.

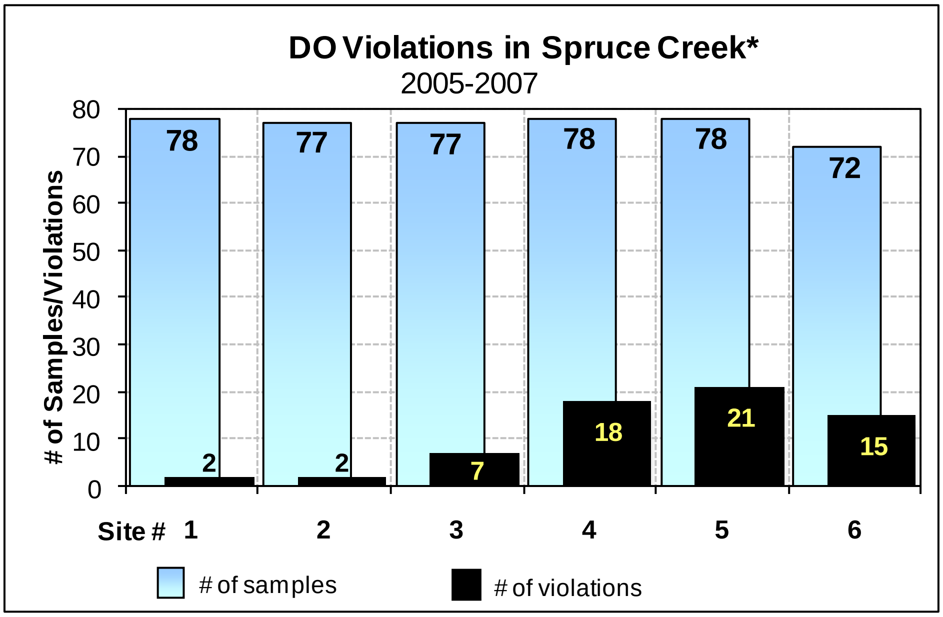


Figure 4.2.1. *DO Violations in Spruce Creek. *readings taken at 0 meters; violations defined as <85% DO for sites 1-5 and <75% DO for site 6 (see Table 4.1.1).*

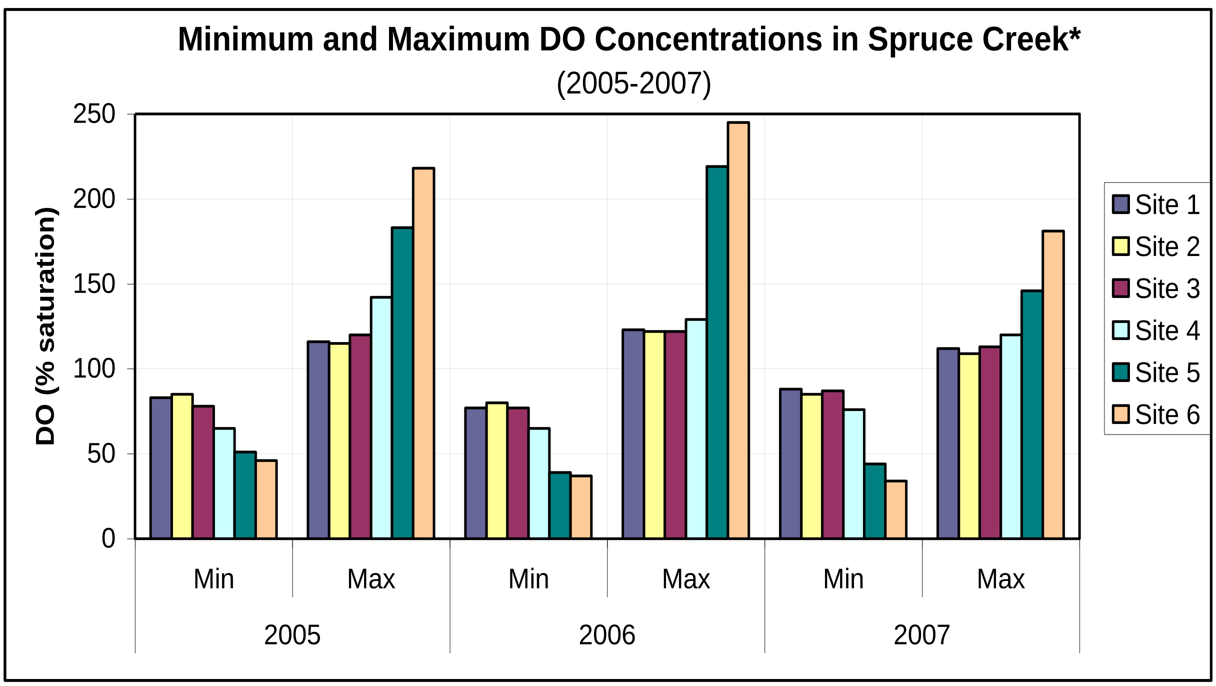


Figure 4.2.2. *DO Variations in Spruce Creek. *readings taken at 0 meters*

Salinity affects chemical conditions within the estuary, particularly levels of dissolved oxygen in the water. The amount of oxygen that can dissolve in water, or solubility, decreases as salinity increases. The solubility of oxygen in seawater is about 20 percent less than it is in fresh water at the same temperature. In Spruce Creek, all sampling stations appear to be tidally influenced based on salinity measurements. Stations 1, 2, 3, and 4 (from Bond Road to the Trading Post) have higher salinity levels in general than the upstream stations, which is due to the downstream stations' proximity to the ocean influences. Figure 5 (above) shows average salinity at each station during the 2005, 2006 and 2007 monitoring seasons. Measurements have been fairly consistent from year to year.

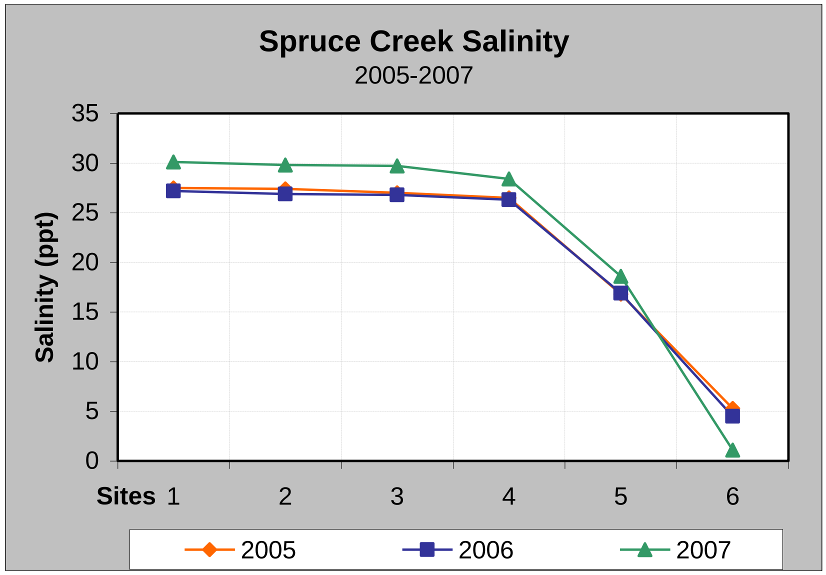


Figure 4.2.3. Spruce Creek Average Salinity

Temperature:

Water temperature is another indicator of how much oxygen can be dissolved into water. Generally, as water temperature increases, the amount of oxygen that can dissolve in the water decreases. In Spruce Creek, the upstream sites 4, 5 and 6 have the highest average temperature and also show the lowest minimum DO readings. The average temperature the three upstream sites has decreased slightly since 2005. Otherwise, average temperatures have remained fairly consistent over the sampling period.

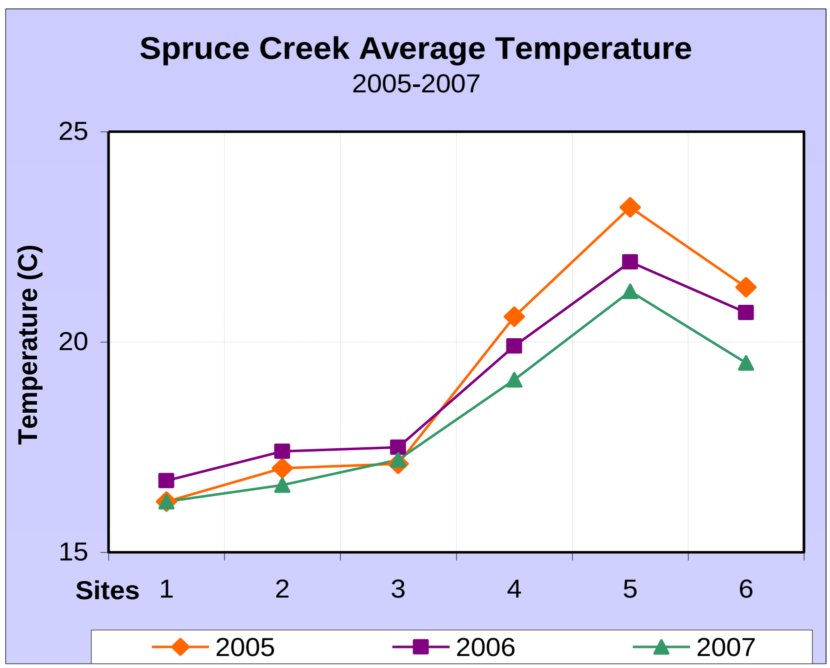


Figure 4.2.4. Spruce Creek Average Temperature

2005 Maine Healthy Beaches Bacteria Monitoring

In 2005, bacteria monitoring was conducted at three sites in the Spruce Creek watershed through the Maine Healthy Beaches Program. Site 1 was located off Bond Road at the convergence Barter and Spruce Creeks, Site 2 was off Eagle Point in Admiralty Village, and Site 3 was located at Roger's Park. Water samples were collected each Wednesday morning throughout the summer and tested for enterococci. Enterococci is an indicator organism used in water quality criteria for bacteria. Although these organisms do not cause illness directly, enterococci identifies where fecal contamination has occurred and indicates the presence of other harmful pathogens. According to the EPA recommended criterion for marine recreational waters, Enterococci samples should not exceed a criterion of 104 colonies per 100 ml for a single sample or a geometric mean of 35 colonies per 100 ml based on 5 or more samples collected within a 30-day period (EPA 1986). Over the course of 11 sampling events, site 1 exceeded the EPA limit for marine waters 4 times and sites 2 and 3 exceeded the limit 3 and 2 times, respectively.

Volunteers with Maine Healthy Beaches staff. *(Photo: P. Ford, 2005)*

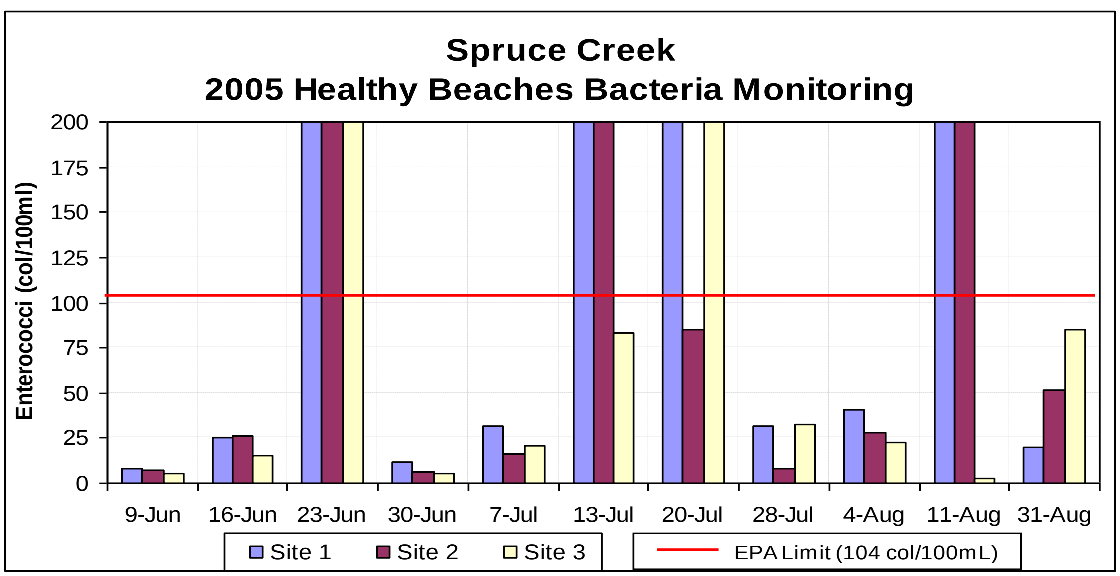


Figure 4.2.5. MHB Monitoring Results for Spruce Creek, 2005

1989-2007 Department of Marine Resources Fecal Coliform Monitoring

The Maine Department of Marine Resources (DMR) has had an ongoing water monitoring program in Spruce Creek since 1989 where fecal coliform levels are tested to ensure safe shellfish harvesting. In 2005 and 2006, additional fecal coliform samples were collected by SCA at five sites above Route 1 in Spruce Creek.

Fecal coliform is a type of bacteria that lives in the intestines of warm-blooded animals. The presence of fecal coliform bacteria in a sample indicates that there has been a recent contamination event but does not necessarily indicate that disease-causing bacteria are present. Bacterial results can be greatly influenced by storm events and all sites often have higher than normal levels of bacteria after heavy rainstorms. When only an occasional fecal coliform test at a specific site is high, it is probably due to contamination from animals along the banks or in the water and most likely does not indicate a problem. Consistently high levels at a specific site may indicate a discharge into the water which could have a harmful effect over time and warrants investigation.

In July of 2005, clam samples from Spruce Creek were found to have very high fecal coliform concentrations. High fecal coliform counts were found at all three sampling locations at least once during the 2005 and 2006 sampling seasons (see figure 4.2.6). According to DMR monitoring data, the three sampling stations above Route 1 (WA028, WA029, and WA031) have historically had the highest fecal counts of all of the sampling locations. Sampling results from 2007 show a similar trend (Figure 4.2.7). Portions of Spruce Creek are currently classified restricted for depuration harvesting only. As of April 20, 2007, the portion of Spruce Creek north of a line from Eagle Point to Goose Point is classified as restricted and is closed to harvesting “due to a sewage bypass” (Maine DMR 2007b).

Figure 4.2.7. (below) *Spruce Creek Fecal Coliform. (Samples collected by Kittery Shellfish Conservation Commission (KSCC) Volunteers/DMR)*

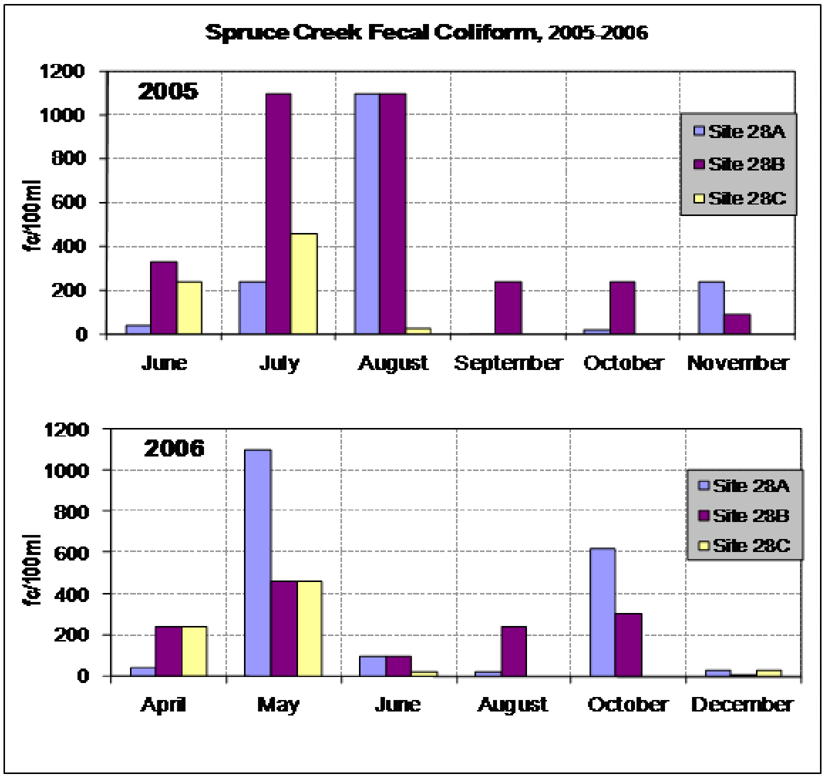


Figure 4.2.6. (left) *Spruce Creek Fecal Coliform. (Samples collected by SCA Volunteers/DMR)*

Note: *Sites 28A, 28B, and 28C correspond to sites WA28, WA27, and WA26, respectively on Map 9 ,*

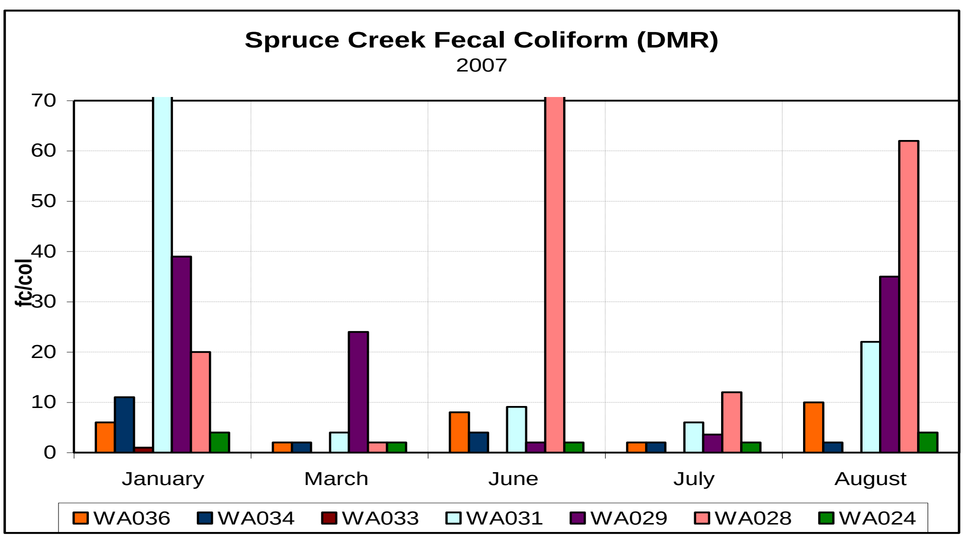


Figure 4.2.7. (above) *Spruce Creek Fecal Coliform. (Samples collected by Kittery Shellfish Conservation Commission (KSCC) Volunteers/DMR)*

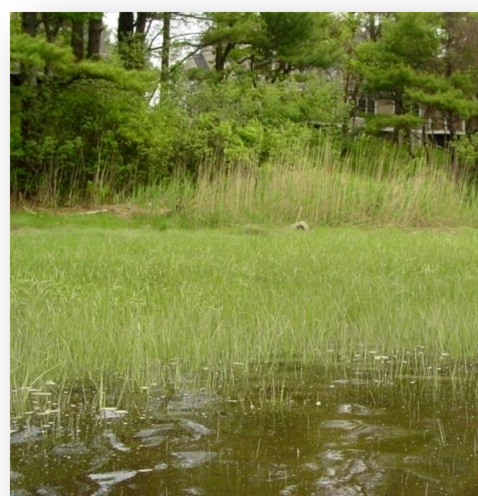
In the late 1980s, Maine Department of Environmental Protection initiated a project to assess the levels and locations of toxic contaminants along the coast. Spruce Creek was chosen as one of the sample sites for their study, "A Decade of Monitoring Toxic Contaminants along Maine's Coast", due to the fact that the mouth of Spruce Creek is directly across from the Jamaica Island landfill Superfund site and the area has a history of industrial uses. The results for the Spruce Creek sampling area show that both lead and mercury are found in above normal levels. Other metals present include silver, cadmium, chromium, copper, nickel, zinc, aluminum, and iron. Results of metal analyses reflect the historic industrial and urban uses of Spruce Creek.

1995-1996 MDEP and WNERR Dissolved Oxygen Study

In 1995 and 1996, the Wells National Estuarine Research Reserve (WNERR) and Maine Department of Environmental Protection (MDEP) monitored Dissolved oxygen levels in a variety of coastal systems in Maine, including Spruce Creek. The goal of the data collection and analysis was to gain insight into factors affecting DO in Maine coastal waters (Kelly and Libby 1995). Samples were collected in 1995 from July to September and additional samples were collected in 1996 in an attempt to further study the importance of freshwater inputs and nutrients in these systems (Kelly 1996). Results from four sampling stations showed that Spruce Creek was "lower in DO than most of the systems" (Kelly and Libby 1995). "Results for the mean % saturation suggested that both Little River and Spruce Creek were significantly different from each other and from the remainder of the systems. These two systems were distinctly heterotrophic, as they had mean % saturation values well below 100%." Similar to the SCA monitoring results, the results of this study show that there is little vertical stratification in the Spruce Creek sampling stations and profile DO readings were generally uniform with depth. DO concentrations also decreased at upstream sites.

NPS Surveys from 2005: Habitat Restoration Inventory

In the spring of 2005 Northern Ecological Associates (NEA) was hired by the Maine State Planning Office, Maine Coastal Program to identify, evaluate, and document potential habitat and environmental restoration opportunities in, and directly adjacent to, specific areas along the southern Maine coast (including Kennebec River, Royal River, Presumpscot River, and Spruce Creek).



Shepard's Cove was noted as a degraded site, due to the presence of invasive plants. *(Photo: NEA)*

The primary objectives of the study were to identify potential restoration sites; screen and prioritize restoration sites; and organize restoration information into a database of potential restoration sites. In Kittery, a secondary objective was to inventory all docks and piers in the Spruce Creek system, regardless of restoration need. The survey team evaluated characteristics within Spruce Creek, along the shoreline bank, and up to 250 feet of the adjacent riparian and buffer areas to identify areas in need of restoration.

The NPS-related survey findings in Spruce Creek are summarized below:

- Ninety-two (92) potential restoration sites were identified in Spruce Creek watershed.
- One hundred fifty-seven (157) individual examples of sources of degradation were observed. The most common sources of degradation were land clearing and land use activity.
- 48 of the 92 sites recorded **cleared land** as a source of degradation.
- 35 of 92 sites recorded **land use activity** as a source of degradation.
- Most sites (87%), had more than one source of degradation.

The report's recommendations suggest that the Towns of Kittery and Eliot work to restore vegetated buffers, educate land owners, improve road crossings, and addressing invasive species issues. The sites selected by the Habitat Assessment study for restoration opportunities closely mirror those identified in the NPS Watershed Survey (below). (NEA 2005)

2005 Spruce Creek 319 Non-point Source Pollution Survey

The Spruce Creek Watershed Shoreland Survey of NPS Pollution was conducted during the spring and summer of 2005. The majority of the survey was conducted by local volunteers over two days of surveying. The first day of surveying was accomplished with over 50 volunteers who walked designated sections of the watershed by foot on June 4th, 2005 through an organized gathering led by the Wells NERR. The second day of surveying consisted of over a dozen volunteers surveying by boat, canoe, and kayak on June 16th, 2005. The survey involved identifying and recording sources of possible non-point source pollution. (True 2006)

The survey team found 197 sites of nonpoint source pollution, representing over 400 impacts (more than one type of pollution often occurred at each site).

Sample ID	Sample Location	5/25/2011 (Wet)		6/2/2011 (Dry)		7/14/2011 (Wet)		8/24/2011 (Dry)		8/29/2011 (Wet)		9/14/2011 (Dry)		Geometric Mean	
		FC	*E. coli*	FC	*E. coli*	FC	*E. coli*	FC	*E. coli*	FC	*E. coli*	FC	*E. coli*	FC	*E. coli*
Picott	Culvert on Picott Road	> 4000	> 4000	600	540	2760†	2280†	600	400	2840	2680	1240	> 4000	**1058**	**1133**
I95	Storm drain off of I95	165†	154†	260	240	260	260	120	0	360	320	7600	80	**353**	**190**
GW95	GW seep near I95	22	20	6	6	360	360	280	80	120	80	200	80	**83**	**53**
MOC1	Concrete pipe behind MOC parking lot	> 4000	> 4000	--	--	140	120	--	--	200	0	--	--	**224**	**219**
MOC2	Concrete pipe behind the Burger King	TMS	TMS	--	--	--	--	--	--	--	--	--	--	--	--
MOC3	GW seep behind MOC parking lot	6	6	6	2	940	740	80	0	80	80	80	80	**51**	**36**
Orvis	Small stream behind Orvis outlet	--	--	60^	60^	--	--	320	120	1280	1040	480	240	**411**	**282**
Trafton	Culvert at Haley and Trafton	66	60	460	420	1600	1480	3280	560	860†	850†	2640	1720	**844**	**559**
Norton	Storm drain off of Haley and Norton	8	6	16	4	--	--	--	--	> 4000	> 4000	--	--	**253**	**126**
Coleman	Storm drain at the end of Coleman	40	24	2200	2100	--	--	400	360	240	240	240	40	**289**	**177**
Wyman	Seep off of Wyman in Admiralty Village	36	28	22	20	--	--	--	--	1360	400	1000	440	**181**	**100**
Cole	Concrete pipe in Admiralty Village off of Cole	400	400	--	--	> 4000	> 4000	--	--	--	--	--	--	**1265**	**1265**
Howard	Concrete pipe in Admiralty Village off of Howard	TMS	TMS	--	--	> 4000	> 4000	--	--	--	--	--	--	--	--