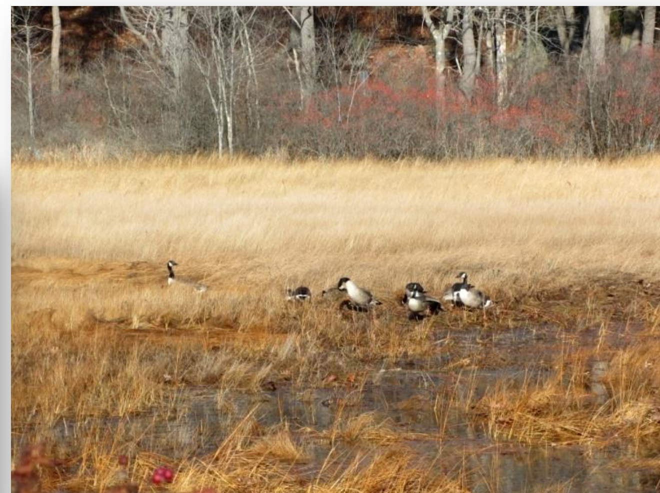
Cape Neddick River
Watershed Based Plan

June 2014



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Cape Neddick River Watershed Based Management Plan

1. Executive Summary

This watershed based management plan is intended to help protect and improve water quality in the Cape Neddick River. Bacteria are the primary pollutant of concern in the watershed due to high value, highly frequented beaches on the Cape Neddick River and along the southern Maine coastline. Erosion and sedimentation are considered the secondary pollutant of concern. This plan focuses primarily on remediating these two pollutant sources.

The Cape Neddick River is a Class B stream and Class SB estuary, whose watershed is in York County in southern Maine. The watershed is approximately nine square miles in size and is located entirely within the Town of York, accounting for 16% of the town's total land area. The river's outlet, estuary, and beach are located in a predominantly developed residential area. The downstream portion of the watershed, particularly east of US Route 1, is densely developed and experiences heavy influx of population due to tourism in the summer. The western portion of the watershed is primarily low to medium density residential. The river's headwaters are impounded at Chase's Pond and used for public water supply. The Chase's Pond watershed covers an area of approximately 2,090 acres, of which, 88% is owned by York Water District (YWD). The York Sewer District (YSD) treatment plant outfall is also located near the mouth of the Cape Neddick River (Frick *et. al*, 2013).

The estuary portion of the river is listed as impaired by Maine Department of Environmental Protection's (ME DEP) Category 4-A "Estuarine and Marine Waters with Impaired Use" with an approved TMDL completed in 2009. However, there is insufficient new data available to determine if attainment has been achieved, or if water quality is improving (ME DEP, 2012 Integrated Water Quality Monitoring and Assessment Report, Appendix V - Estuarine and Marine Waters).

Data have been collected in the watershed for many years by ME DEP, Maine Healthy Beaches, and the Town of York. Bacteria results have led to beach advisories on occasion, and the Cape Neddick Beach was closed in the summer of 2013 following a bacteria investigation using canine detection. Studies by Maine Healthy Beaches and the Town of York suggest that bacteria levels in the Cape Neddick River often exceed the State water quality standard for fecal indicator bacteria.

Nonpoint source pollution from residential and commercial development is considered the primary sources of bacteria to the Cape Neddick River. A large portion of the bacteria load to the river can be linked to human sources, based on the Bacteria Source Load Calculator developed by Virginia Polytechnic Institute, with 62% of the load estimated as human sources, 29% as pet waste, and 9% as wildlife.

The Action Plan for improving water quality in the Cape Neddick River begins with the formation of a Cape Neddick River Watershed Committee, comprised of stakeholders throughout the watershed and led by the Cape Neddick River Association and the Town of York. On-the-ground work will consist of establishing adequate vegetated buffers around streams, finding and repairing wastewater system malfunctions (septic), installing best management practices along roadways and stream crossings which treat urban runoff, conducting an education and outreach program, and continuing to monitor water quality to assess progress. The timeline to implement this plan is expected to take ten years. The Action Plan should be re-visited every three years to assess progress and to determine the feasibility and applicability of the remaining action items. The total cost to implement all actions proposed in this plan ranges from $866,500-$914,500.

NOTE: This watershed based management plan includes information from the 2012 Cape Neddick River Watershed-Based Management Plan written by Albert Frick Associates, Drumlin Environmental, LLC and Watershed Solutions, Inc. for the Town of York, Maine. Any information taken directly from the original plan is indicated in this plan by using italic font.

2. Description of the Watershed

2.1 Location and Physical Characteristics

The following overview of the watershed and the river's journey to the sea was taken from Watershed Conservation Strategies: Cape Neddick River Watershed (WNERR, 2003).

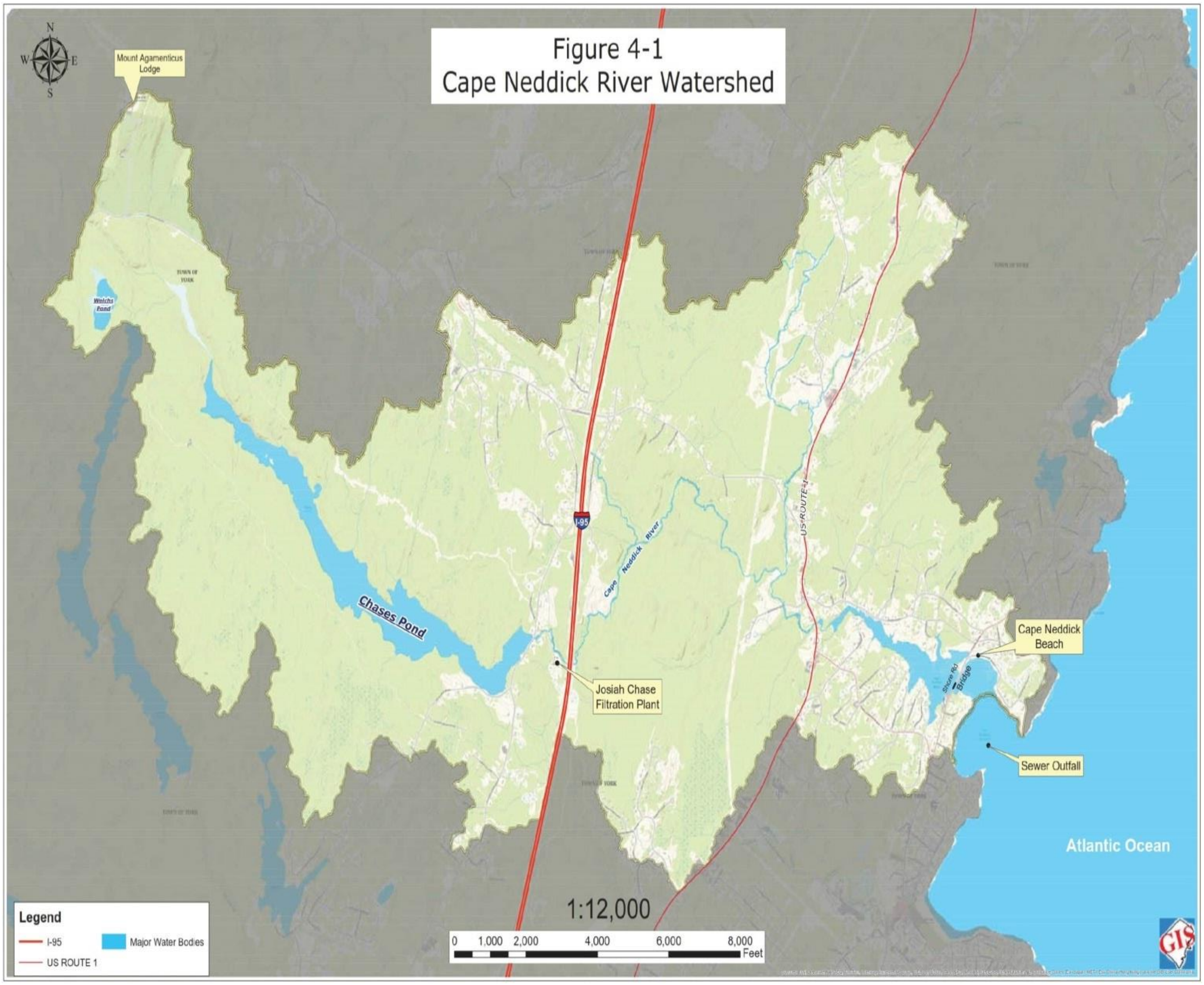
*"The Cape Neddick Watershed is entirely in the Town of York beginning on the forested slopes of Mt. Agamenticus. The main stream and numerous tributaries are dammed to form the two mile long Chase's Pond. From the dam, the river travels southeast for a short distance, then turns to the northeast after flowing under the Maine Turnpike. It continues in this direction through forested landscape for about a mile, where it gently bends back to flow southeast, meeting a few small tributaries over the course of its journey. One major tributary from the north converges with the river shortly before it flows under Route 1 where it encounters a more developed landscape while coming under the influence of the tides. The tidal portion then gradually widens until its flow is restricted by the bridge crossing on Shore Road, after which it again widens and empties into the Gulf of Maine between Weare Point and Cape Neddick"(*Figure 2-1*).*

2.2 Population and Demographics

2010 United States demographic census data show a total population in York, Maine of 12,529. A total of 8,649 dwelling units are located within the town: 5,440 occupied year round, with 2,733 seasonal units, and the remaining 476 properties available for rent, on the market for sale, or vacant. These figures are reflective of the situation statewide, where 44% of the population lives in the coastal zone that only contains 12% of the land. These communities are continuing the rapid growth experienced in the 1990s into the current decade. From 1990 to 2010, York's population has steadily grown by 23%. Housing units have increased by 25% in York from 1990 – 2010 (SMRPC, 2013).

Seasonal population is also a large factor in changing land use especially for coastal communities like York. In 2004 a study determined that an additional 17,400 people stayed overnight in York during the peak summer months. This number is a 72% increase from the year round population of York, and boosted the population to 30,940 in the summer of 2004. In addition, these estimates do not account for the significant number of day visitors that come to York during the peak season (SMRPC, 2004).

Figure 2-1: Cape Neddick River Watershed (Figure 4-1 from Frick et al, 2013)



2.3 Land Use and Land Cover

In the last 30 years, the Town of York as a whole has experienced one of the highest growth rates in the State of Maine. Approximately 68% of the parcels in York are utilized for residential use, and another 25% of the parcels are classified as being residential but undeveloped (York, 2004). Therefore, over 90% of the parcels are either in residential use or have the potential for residential use. Acreage figures break out differently, however, with a relatively reduced proportion of the land area for residential use and an increased proportion for utility use (e.g., watershed protection zone around Chase's Pond). Even then, residential remains the predominant land use in the Town of York with 69% of the total land area.

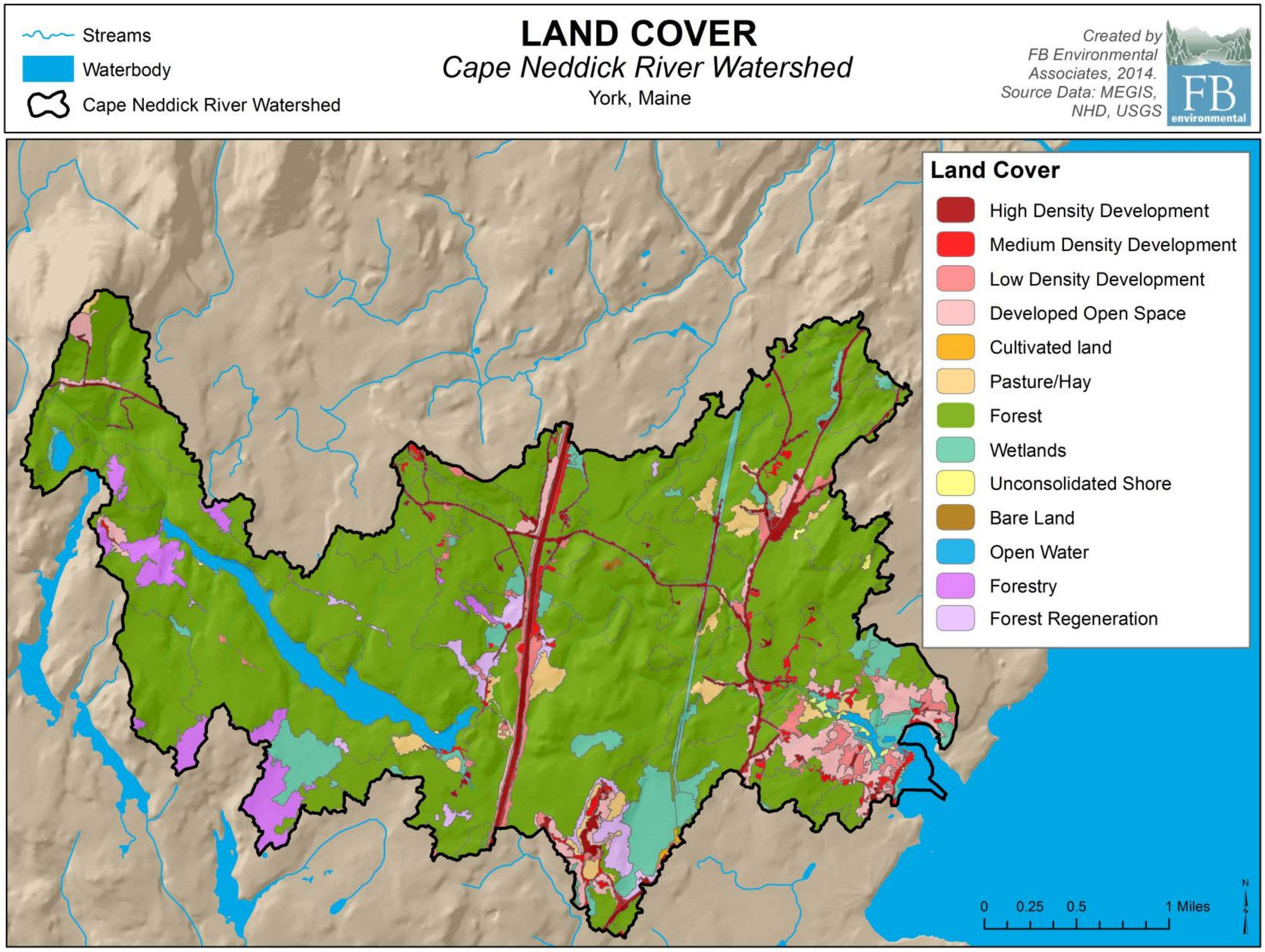
Land cover data shows 21% of the area of York as developed land (York, 2004). Not surprisingly, residential development accounts for the vast majority of the developed land. The majority of the land area in York is undeveloped, with forest being the most common land cover.

Route 1 divides the CNR Watershed approximately into two distinct land use patterns. The watershed east of Route 1, particularly on the southern side of the river, is relatively dense residential whereas the watershed west of Route 1 is more rural. There is presently no municipal sewer within the watershed, although the YSD wastewater treatment plant is located nearby on the southern shore of the Cape Neddick Harbor. Overall, the watershed is relatively free of heavy industrial development with only light to moderate commercial land use mostly located along the Route 1 corridor. The Cape Neddick Harbor, where the river enters the Gulf of Maine, houses roughly a dozen commercial fishing/lobster boats and approximately 30 pleasure craft.

About 27% of the watershed is conserved, mostly through the efforts of the YWD (YWD, 2012). All of the conservation land is located west of Route 1 and all but 90 acres is west of the Turnpike. Both the Turnpike and Route 1 are major transportation routes that cross the watershed. East of the Turnpike, there exists three blocks of land each greater than 500 acres and unfragmented by paved roads (WNERR, 2003). These blocks have been identified as representing an opportunity for conservation and/or development. If developed irresponsibly, they could present a risk to the watershed in terms of degradation of wildlife habitat and water quality.

Based on 2004 Maine Land Cover Data (MLCD), about 77% of the Cape Neddick River Watershed is forested. 11% of the watershed area consists of developed areas including roadways. Wetlands account of just less than 10% of the watershed area, and agriculture contributes 2% land area in the Cape Neddick River Watershed (Figure 2-2).

Figure 2-2: Land Cover in the Cape Neddick River Watershed



2.4 Potential for Future Development

The Maine State Office of Policy and Management has calculated projections for every town in Maine through the year 2030. These projected population estimates are based on past trends of birth and survival rates. Immigration rates are also considered. The projected figures do not account for any future scenarios that may have an effect on population. Based on this methodology, the population in the Town of York will reach 14,081 by 2030. This is a 12% increase in population from 2010-2030 (Maine Office of Policy and Management, 2013).

Another study by the U.S. Census Bureau reviews population and housing demographics in coastal counties throughout the United States from 1960 through 2008. Maine coastal population has shown a steadily increasing trend. Coastal populations in Maine have increased 62% since 1960. A similar trend is seen in housing units in coastal areas as Maine coastal housing units have increased from 185,603 units in 1960 to 383,142 units in 2008. This is a 106% increase in housing development in just less than 50 years (U.S. Census Bureau, 2010). The increase in development within the coastal towns of Maine could mean an increase in potential sources of bacteria and other pollutants in coastal waters. Additionally, The York Build-out Analysis conducted in 2001 concludes that between 2,800 and 3,600 homes could potentially be built in the Town of York on remaining available developable land areas.

2.5 Water Resources

2.5.1 Community Resources

Public Water Supply

The YWD intake at Chase's Pond currently feeds most of the Town of York's public water supply. Two recently constructed distribution system interconnections and associated pump stations link the YWD to the Kennebunk, Kennebunkport, and Wells Water District to the north and the Kittery Water District to the south. They provide the three Districts with back-up water supply in case of a water emergency in any of the areas serviced by those districts.

The YWD operates the Josiah Chase Filtration Plant located off Chase's Pond Road. The Plant has the capacity to treat 4 million gallons per day (MGD) but typically operates at much lower flow rates. An average of 0.95 MGD of water was withdrawn from Chase's Pond and treated in 2011 (YWD, 2012). The Plant is designed to meet all primary and secondary drinking water standards. Water test results for 2011 (most recent annual report available on their website) showed that levels of all contaminants monitored during that period were below the maximum contaminant levels allowed in drinking water. There were no water quality violations in 2011.

Wastewater Treatment Plant

The YSD treatment plant is located on the south shore of Cape Neddick Harbor. The plant was upgraded in 1994 to provide treatment for an average flow of 3.0 MGD and a peak flow of 7.5 MGD. It incorporates a secondary treatment process to treat the incoming wastewater. Chlorination is used from May 15th to September 30th in order to disinfect the effluent and eliminate potential pathogens. The secondary treatment process is designed to break down the various components in the incoming waste such that over 90% of the biochemical oxygen demand (BOD) and 90% of the total suspended solids (TSS) are removed. The Annual Treatment Performance Summary for 2012 showed that the average monthly BOD removal rate ranged from 92.5% to 97.4% and the average monthly TSS removal rate ranged from 94.2% to 97.8% (YSD, 2013). The permit issued by the MEDEP requires an 85% removal rate for BOD and TSS influent concentrations 200 milligrams per liter (mg/l) and greater. There were no violations of the required BOD and TSS removal rates in 2012. Fecal coliform bacteria tests on the plant effluent from May 15th to September 30th yielded monthly geomean concentrations ranging from 1.09 Most Probable Number (MPN)/100 milliliters (ml) to 2.48 MPN/100ml, well *below standards used for approved shellfish growing areas. Average daily flow ranged from 0.84 MGD in November to 1.59 MGD in June. Average daily flow during the summer months (June – August) ranged from 1.21 MGD to 1.59 MGD. Effluent discharged from the plant enters Cape Neddick Harbor through a 10-meter long diffuser attached to the end of the outfall pipe. At low tide, approximately 15 feet of water covers the diffuser. In 2012, the YSD superintendent received the Charles Perry Award for "excellence in operations and maintenance of wastewater collection systems." The YSD also received a Certificate of Achievement for 2012 from the MEDEP to recognize 11 years of continuous improvement in all aspects of the district's operations.*

Beach and Boat Launch

The Cape Neddick Beach is a small, locally popular beach located near the mouth of the river (see Figure 4-1). Extensive tidal flats are associated with the beach, and the distance between swimmable water depths at high tide versus low tide extends over several hundred feet. There is very limited parking on the road bordering the beach and there are no restrooms or other facilities. On the south shore of the river, just upstream of the Shore Road Bridge, there is a private boat launch facility located at the Cape Neddick Lobster Pound Restaurant. Navigation in this part of the river is limited to above mid tide.

2.5.2 Natural Resources

Greater Agamenticus Conservation Area

Approximately 50% of the watershed (3,300 acres) is located west of the Turnpike and falls within the Greater Mount Agamenticus Conservation Area (WNERR, 2003). This 33,000-acre, five-town conservation area, contains the highest diversity of species and the largest number of rare and endangered species in the state. It also includes some of the largest unfragmented (undivided by paved roads) coastal forest in the northeast between southern New Jersey and Acadia National Park. More than 2,000 acres of the largest block of unfragmented forest falls within the Cape Neddick River watershed. This area also includes a large mapped deer wintering area just south of Chase's Pond and over a dozen documentations of rare animal occurrences.

Shorebird Habitat

The estuary portion of the river contains important shorebird habitat for tidal waterfowl and wading birds. In 1986, a Maine Department of Inland Fisheries and Wildlife study done for the State Planning Office gave Cape Neddick River the highest rating for riparian habitat and waterfowl wintering area (WNERR, 2003).

Shellfishing

The tidal flats located in the estuary and at the mouth of the river provide prime habitat for a variety of shellfish species. Unfortunately, this area lies within a safety zone around the wastewater treatment plant outfall where the DMR has declared the digging, taking, or possessing of any clams, quahogs, oysters, or mussels from the shores, flats, and waters to be prohibited (DMR, 2008). The safety zone was created to protect public health in the unlikely event a disruption at the treatment plant caused untreated sewage to be released into Cape Neddick Harbor. The DMR enforces a safety zone around any "overboard discharge" that discharges treated sewage into marine waters.

2.6 Climate Change

Climate Change in the U.S. Northeast published by the Northeast Climate Impacts Assessment in October 2006 predicts several climatic changes for the Northeast that if true will directly affect the Cape Neddick River in negative ways. Both temperature and precipitation are expected to increase and sea level is expected to rise.

Current scenarios have precipitation amounts for southern Maine increasing and the pattern of rainfall shifting from less in summer to more in winter. "Extreme" rain events such as the "Mother's Day 06" and "Patriots Day 07" storms are predicted to increase in frequency (12% more). Three month droughts are expected to increase in occurrence from once every 10-15 years to become annual events by the end of this century.

Temperatures will increase – most noticeably in winter months, resulting in less snow, earlier breakup of ice, earlier spring snow melt and runoff. The frequency of extreme heat days (heat index greater than 90 degrees F) could increase from today's seven days to 60 days annually by 2100, making the climate then similar to what is currently experienced in North Carolina and Georgia. These higher temperatures will directly affect evaporation, soil moisture, transpiration, and accentuate periods of drought. Sea level could rise, accelerating toward the end of the century. Even an increase at the lower end would likely reshape the Cape Neddick River estuary.

3. Baseline and Future Conditions Assessment

3.1 Water Quality Classification

The estuary portion of the Cape Neddick River is listed as impaired for bacteria on the ME DEP's 303(d) list of impaired waters. The Cape Neddick River is classified as Class B and the estuary portion as "SB" by the State (S is for Saline). "Class B" is the 3rd highest classification. The classification states that Class B waters shall be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; and navigation; and as habitat for fish and other aquatic life. The habitat shall be characterized as unimpaired."

In 2009, the Cape Neddick River was addressed in the Maine Statewide Bacteria TMDL for Marine and Estuarine Waters. It is also listed in Maine's 2012 Integrated Report as impaired under Category 4-A: Estuarine and Marine Water Impaired by Bacteria (TMDL completed) for elevated fecal levels.

Separate standards apply to freshwaters, the estuary, and beaches within the CNR Watershed. This section identifies the regulatory classification for each of those waters, lists the numeric standards for each classification, and provides a narrative of how water quality in the CNR compares to the standards.

Freshwater

The freshwater portions of the CNR are classified as Class B and, as such, "must be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as habitat for fish and other aquatic life. The habitat must be characterized as unimpaired." Table 3-1 *shows that E. coli bacteria are used as an indicator of potential public health risk in Class B waters, and monitoring conducted by the YCDD during the 2009 summer season showed that the standard for E. coli was exceeded at freshwater sampling locations on numerous occasions, indicating that some of the tributaries are not suitable for recreation in the water, such as children playing in the water. Monitoring using enterococci as substitute indicator bacteria at some of those same locations during other years (i.e., 2007, 2008, 2010, 2011, and 2012) also suggests that freshwaters are unsuitable for recreation in the water. Dissolved oxygen (DO) concentrations met the applicable summer standard in the majority of the tributaries during early season high flows. However, as freshwater flows decreased over the summer, the DO concentration fell below the standard in many of the tributaries. Low DO is undesirable and potentially presents a threat to some aquatic organisms.*

Table 3-1: Numeric Standards for Cape Neddick River Waters (Frick et al., 2013)

Waterbody Class	Dissolved Oxygen Standard	Bacteria Standard
Class B (freshwater)	*Between May 15th and September 30th:* *Not less than 7 parts per million or 75% of saturation, whichever is higher.* *Between October 1st to May 14th in identified fish spawning areas:* *The 7-day mean dissolved oxygen concentration may be not be less than 9.5 parts per million and the 1-day minimum dissolved oxygen concentrations may not be less than 8.0 parts per million.*	*Between May 15th and September 30th:* *E. coli of human and domestic animal origin shall not exceed a geometric mean of 64 per 100 milliliters or an instantaneous level of 236 per 100 milliliters.*
Class SB (salt/brackish)	*Not less than 85% of saturation.*	*Between May 15th and September 30th:* *Enterococcus of human and domestic animal origin shall not exceed a geometric mean of 8 per 100 milliliters or an instantaneous level of 54 per 100 milliliters.*
*Coastal Beach**	*None*	*Between May 15th and September 30th:* *Failure results from single sample enterococcus level exceeding 104 per 100 milliliters or a geometric mean of 35 per 100 milliliters for five samples within a 30-day period.*

Sources: 38 MRSA Ch.3 §464 & 465
National Shellfish Sanitation Program Manual of Operations, Part I, Sanitation of Shellfish Growing Areas, USFDA

**Beach Standards for Bacteria are provided by the US EPA*

Estuary

The CNR estuary is classified as Class SB and, as such, "must be of such quality that it is suitable for the designated uses of recreation in and on the water, fishing, aquaculture, propagation and harvesting of shellfish, industrial process and cooling water supply, hydroelectric power generation, navigation and as habitat for fish and other estuarine and marine life. The habitat must be characterized as unimpaired." Table 3-1 *shows that Enterococci bacteria are typically used as an indicator of potential public health risk in Class SB waters and monitoring during the 2007-2011 summer seasons showed that the standard for Enterococci was exceeded at estuary sampling locations on several occasions, depending on the year. More controlled monitoring during the 2012 summer season showed that Enterococci was* *exceeded at main stem sampling locations within the estuary only after storm events, when higher flows from the tributaries and overland stormwater runoff was a strong influence on the composition of estuary waters. The monitoring data indicates that the estuary may not be suitable for recreation in the water, such as swimming, during the approximately 24-hour period following storm events. DO levels in the main stem generally met the applicable summer standard. Although fecal coliform standards exist for shellfish growing areas in estuaries and marine waters, shellfish harvesting is permanently prohibited in the CNR estuary because of the safety zone that has been assigned around the YSD outfall. Additionally, the Department of Marine Resources (DMR) no longer monitors for fecal coliform in the prohibited area.*

Cape Neddick Beach

The Cape Neddick Beach is classified as a Coastal Beach and, as such, is subject to water quality standards for recreation in the water as determined by the US EPA. Similar to the Class SB standard that has been applied to the estuary, Table 3-1 shows that enterococci bacteria are used as an indicator of potential public health risk at coastal beaches. However, the Coastal Beach standard for enterococci is considerably higher than the standard for Class SB waters, consequently, it is less conservative. The YPRD has been monitoring water quality at the beach using protocol developed by the Maine Healthy Beaches Program since 2003. Maine Healthy Beaches compiles the data and continues to oversee the program. Although less stringent than the Class SB standard for bacteria, the Coastal Beach standard was still exceeded at the Cape Neddick Beach on a sufficient number of occasions to raise concern. When the standard is exceeded, an advisory is posted and the beach water resampled on the following day. Although storm events were not specifically targeted for beach sampling, the data indicates that stormwater runoff has a significant influence on bacteria levels at the beach. High bacteria levels were often observed shortly after storm events (similar to the estuary monitoring) but usually receded to below the standard when the beach water was resampled on the following day.

Although there are no standards for phosphorus and nitrogen in CNR waters, they were monitored to determine if polluted runoff from potential sources such as lawn fertilizer or failing septic systems could be affecting water quality. If present in sufficient concentrations, they could contribute to the lowering of DO in the water column. Phosphorus and nitrogen concentrations are generally low in the main stem and the majority of the tributaries. Somewhat elevated concentrations were measured on a few of the tributaries, but the levels do not indicate that nutrients pose a threat to water quality.

3.2 Summary of Available Data

3.2.1 Water Quality Monitoring Past and Present

Several organizations have conducted water quality monitoring on the CNR. Table 3-2 *identifies some of the organizations, the years when they monitored, and the parameters that they analyzed.*

Table 3-2: Cape Neddick River Water Quality Monitoring History 1995-2012 (Frick et al., 2013)

Year	*York Conservation Commission*[1]	*Department of Marine Resources*[2]	*University of New Hampshire*[3]	*Parks and Recreation Department*[4]	*Community Development Department*[5]
1995	--	*Fecal Coliform*	--	--	--
1996	*Fecal Coliform*	*Fecal Coliform*	--	--	--
1997	*Fecal Coliform*	*Fecal Coliform*	--	--	--
1998	*Fecal Coliform*	*Fecal Coliform*	--	--	--
1999	--	*Fecal Coliform*	--	--	--
2001	--	*Fecal Coliform*	--	--	--
2002	--	*Fecal Coliform*	*E. coli*	--	--
2003	--	*Fecal Coliform*	--	*Enterococci*	--
2004	--	*Fecal Coliform*	--	*Enterococci*	--
2005	--	*Fecal Coliform*	--	*Enterococci*	--
2006	--	--	--	*Enterococci*	--
2007	--	--	--	*Enterococci*	*Enterococci*
2008	--	--	--	*Enterococci*	*Enterococci*
2009	--	--	--	*Enterococci*	*Enterococci, E. coli, Optical Brightener*
2010	--	--	--	*Enterococci*	*Enterococci, Optical Brightener*
2011	--	--	--	*Enterococci*	*Enterococci, Optical Brightener*
2012	--	--	--	*Enterococci*	*Enterococci*

Notes: [1]*Sampled four locations (Hutchins Lane Bridge to Shore Road Bridge) during summer months.*
[2]*Sampled three locations near mouth of CNR.*
[3]*Sampled two locations (Hutchins Lane Bridge and Shore Road Bridge) during a single rain storm.*
[4]*Sampled two locations (Cape Neddick Beach and Shore Road Bridge) during summer months.*
[5]*Sampled up to 27 locations during summer months.*

3.2.2 Maine Department of Marine Resources Data

The Maine Department of Marine Resources (DMR) conducted water quality testing for fecal coliform and salinity on the estuary portion since of the Cape Neddick River until 2005. The testing resulted in the expansion of the prohibited shellfishing areas around York Wastewater Treatment plant outfall located near the mouth of the Cape Neddick River. Due to elevated bacteria concentrations, the prohibited areas increased to include all shores, flats, and waters between Cape Neddick Nubble and Bald Head Cliff to the North, and to East Point to the south.

The DMR program assures the health and safety of shellfish harvested in the estuary and near shore waters. Testing is done mainly between October and May to coincide with the shellfish harvesting season that is scheduled to occur between from November 1- May 31st.

3.2.3 Maine Healthy Beaches Data

The Maine Healthy Beaches Program has been testing the Cape Neddick River Beach since June of 2003 using the indicator bacteria, enterococci. The sampling is conducted from June through August to coincide with heavy beach recreational use. The collected data show a trend over the four years towards an increasing number of days per season when enterococci levels exceed the standard and increasing numbers of bacterial colonies in the highest readings. To date, there have been 178 sampling days at the Cape Neddick Beach location (YK-02) with 31 days resulting in bacteria concentrations above the state water quality beach standard of 104 colonies/100mL. Table 3-3 below summarizes Maine Healthy beaches enterococci data at site YK-02 from 2003 to 2013.

Table 3-3: Maine Healthy Beaches Enterococci Results at Cape Neddick Beach in York, Maine (colonies/100mL)

Maine Healthy Beaches Bacteria Results 2003 - 2012					
Year	**Days Above 104 colonies/100 mL** (ME Beach Standard)	**Max** (colonies/100 mL)	**Min**	**Geometric mean**	**# Beach Advisory Days**
2003	0	30	10	15	0
2004	0	30	10	12	0
2005	3	200	10	36	0
2006	1	155	10	25	0
2007	4	563	10	35	8
2008	4	852	10	37	6
2009	5	3076	10	43	15
2010	2	24196	10	41	4
2011	4	987	10	29	6
2012	3	1624	10	36	6
2013	5	799	10	42	17

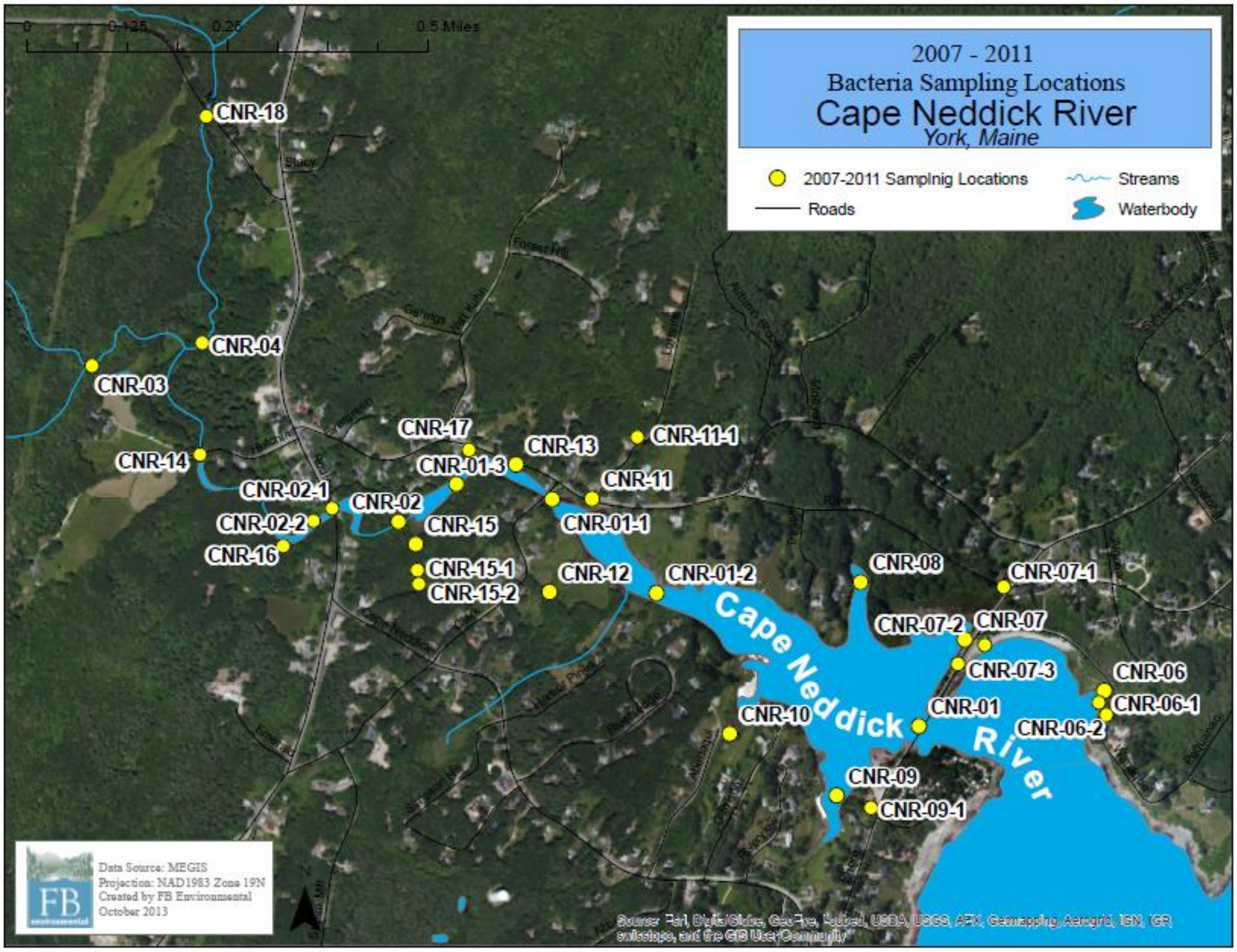
**Gray cells indicate exeedance of the* USEPA *beach standard for bacteria for an instantaneous sample of 104 colonies/100mL OR 35 colonies/100 mL for a geometric mean of more than 3 samples.*

3.2.4 York Community Development Department

In 2007 water was sampled at five locations along the CNR, primarily along the main stem of the river between the Maine Turnpike and the ocean (CNR-01 to CNR-05). Sample location CNR-01 was located in the tidal portion of the river at Shore Road. CNR-02 and CNR-03 were located along the freshwater portion of the main stem of the river. CNR-04 and CNR-05 are located on tributaries in the upper reaches of the Cape Neddick River watershed.

In 2008, the sampling expanded to 10 additional tributary locations (designated CNR-06 to CNR-15) and continued in 2009. In 2010, sampling focused on locations CNR-01, CNR -04, CNR -09 and CNR -10, and in 2011, sampling locations were expanded higher up into several tributaries. Figure 3-1 *shows the locations where water quality samples were collected from 2007 to 2011.*

***Figure 3-1: Bacteria Sampling Locations in the Cape Neddick River Watershed from 2007 – 2011* (Frick et al., 2013)**



The 2007 to 2011 water quality data show that many of the sampling locations had bacteria concentrations that frequently exceeded bacteria standards. Figure 3-2 and 3-3 *show the percentage of main stem samples and tributary samples, respectively, that exceeded EPA Enterococci bacteria standards of 61 MPN/100ml in freshwater (for 2007, 2008, 2010, and 2011) and 104 MPN/100ml in saltwater (2007 – 2011) (EPA, 1986). During 2009, the EPA E. coli standard of 236 MPN/100ml was used for freshwater tests. These bacteria standards are less conservative (i.e., higher numeric value) than the applicable CNR standards presented in Table 3-1, so the percentage of exceedances shown in* Figures 3-2 and 3-3 *would actually be higher if the Table 3-1 standards for fresh and saltwater were applied).*

Figure 3-2: Cape Neddick River Main Stem Sample Locations Percent Tests Exceeding US EPA Enterococci Standards from 2007 to 2011(Frick et al., 2013)

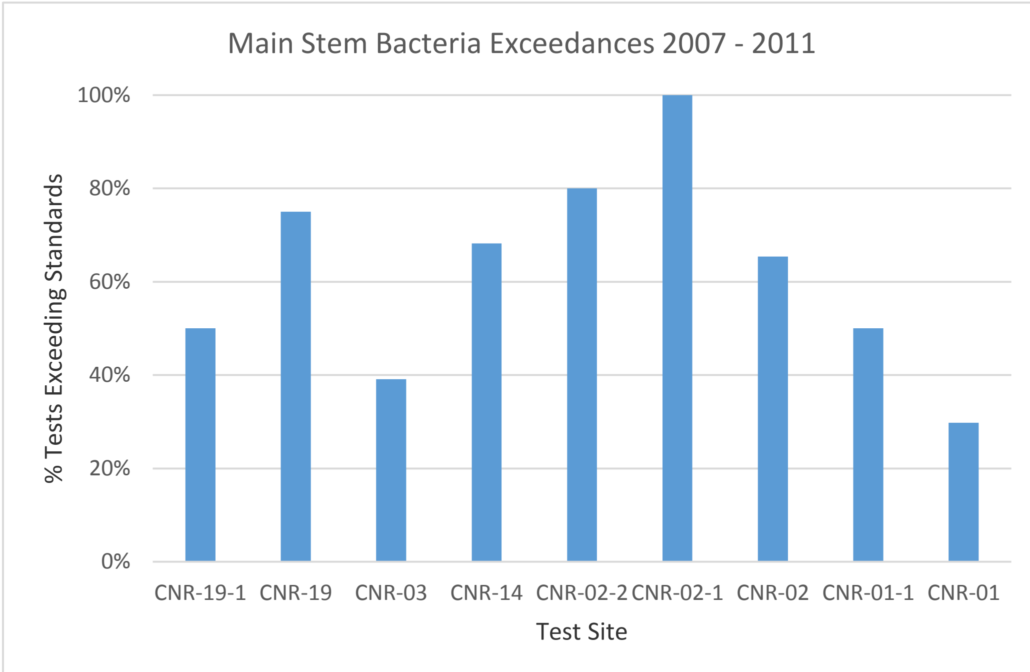
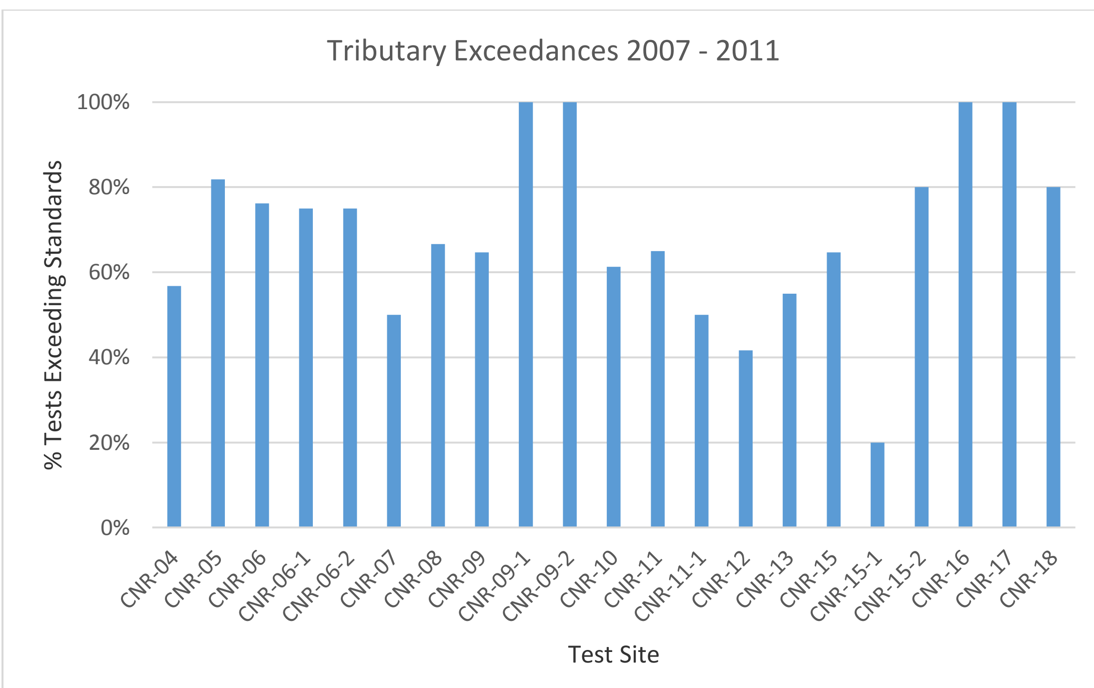


Figure 3-3: Cape Neddick River Tributary Sample Locations Percent Tests Exceeding US EPA Enterococci Standard from 2007 to 2011(Frick et al., 2013)



3.2.5 Summary of York Community Development Department Water Quality Data

A general overview of these data is provided below. As indicated in the sampling location overview, some locations were sampled during only one season (e.g., CNR-19 and CNR-19-1 in 2011) so conditions for that year may have biased test results from those samples as compared to locations that were sampled over several years.

Figure 3-2*indicates that, downstream of CNR-03, there is a generally increasing trend in the percentage of tests exceeding bacteria standards in the main stem of the river as it approaches developed areas in the vicinity of Route 1, and a generally decreasing trend as the river enters the estuary. Dilution of bacteria concentrations in the incoming freshwater by tidal influences is likely responsible for the decreasing trend in the estuary.*

Figure 3-3 shows a high percentage of tests exceeding bacteria standards in nearly all tributaries. *Only two tributary test locations had a percentage less than 50% (CNR-12 and CNR-15-1). Except for CNR-05, the test locations with the highest percentages (80% and greater) were tested only during 2011.*

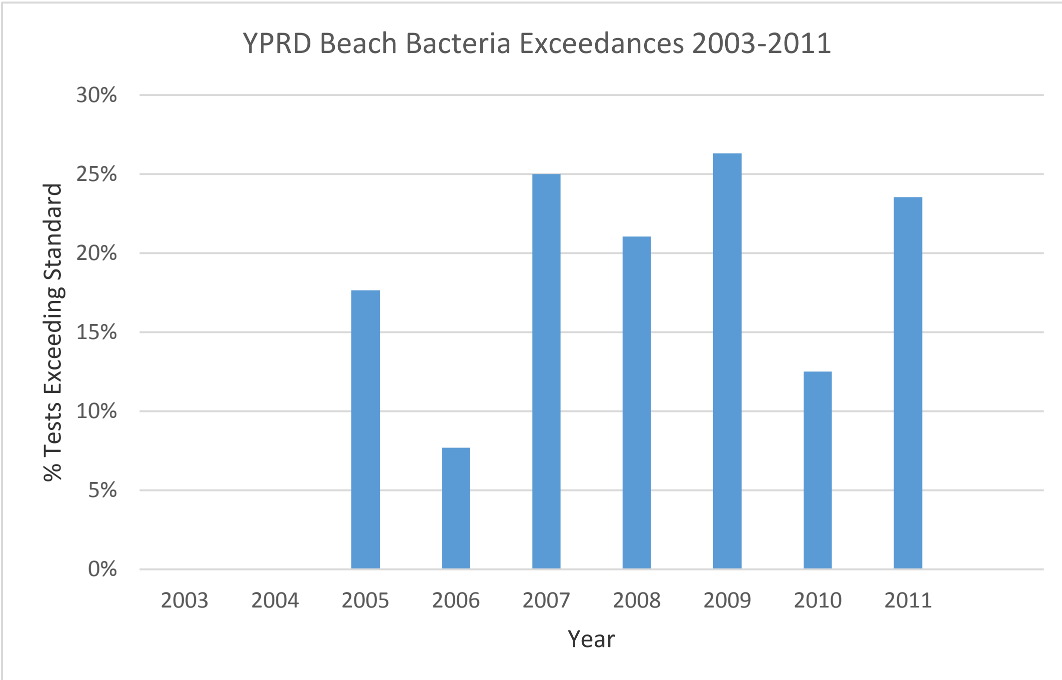
Review of the overall water quality database indicates wet weather is an important factor associated with elevated concentrations of bacteria. During sampling events that followed precipitation, bacteria concentrations tended to be higher than during drier periods, particularly in the tributaries. Water samples from the main stem of the river at Shore Road (CNR-01) were below the standard the majority of sampling rounds in 2007, 2009, 2010 and 2011 and 70% overall between 2007 and 2011. Most of the samples that exceeded the standard were collected shortly after a rain event.

During 2011, additional samples were collected on tributaries CNR-06, -09, -11, and -15 at points where the tributaries either branched or at points above and below specific potential bacteria source areas. Some of the new subsampling locations provided an indication that one branch of a tributary had consistently higher levels than another branch. Other data were inconclusive. Perhaps the most successful subsampling was along the CNR-15 tributary, where the eastern branch (CNR-15-1) had only one sample that exceeded the bacteria standard while the western branch (CNR-15-2) had 4 samples that exceeded this value.

3.2.6 Summary of York Parks and Recreation Department (YPRD) Bacteria Sampling Data

The YPRD has been monitoring water quality at Cape Neddick Beach (and Shore Road Bridge) each summer since 2003. Beach sampling follows MHB protocol. Figure 3-4 *shows the percentage of samples annually that exceeded the Enterococci bacteria standard of 104 colonies/100ml from 2003 to 2011. This is the same standard as that listed for Maine Coastal Beaches in* Table 3-1. *A general overview of these data is provided below.*

Figure 3-4: York Parks and Recreation Department Bacteria Sampling Results by Percent Exeedance of the Maine Water Quality Standard 2003 – 2011(Frick et al., 2013)



Review of the overall beach database indicates that rainfall and runoff appear to be a major contributor to bacteria exceedances, but significant rainfall did not result in high bacteria concentrations in every case. Tidal influences may mitigate the effects of bacteria in runoff in some cases.

Test results from several of the years showed that some bacteria exceedances coincided with relatively low salinity in the sample, indicating that the sample was collected when stormwater runoff was dominating estuary chemistry. The highest recorded bacteria concentration was 24,196 colonies/100ml on July 14, 2010, when the salinity was 3 as opposed to an average of around 31.

No bacteria exceedances occurred in 2003 and 2004. This may have been due in part to the fact that 2003 was the driest year since 2000. However, 2004 was the fourth wettest year since 2000, so the test results may have been more influenced by sample collection timing which just happened to avoid runoff from storm events. The trend appears to be an overall increase in exceedances of the bacteria standard at Cape Neddick Beach.

3.2.7 Previous Non-Bacteria Water Quality Data.

In comparison to the extensive database of bacteria data, water quality data on other parameters is limited for the CNR. The most comprehensive data set was collected by MHB and EPA in 2008. The 2008 data includes samples collected in June, July and August from the majority of the 15 CNR sampling locations. Water analyses included dissolved oxygen (DO) and the *nutrients nitrogen and phosphorus, which have the potential to promote algae growth that degrades water quality.*

Review of this non-bacteria water quality data indicated that overall, the water quality of the CNR was good. The main stem of the river (CNR-01, CNR-02 and CNR-03) had generally high DO and low concentrations of nitrate and phosphorus, except a nitrate concentration above 1 mg/l in CNR-01 in the June sample.

Water quality data from the tributaries summarized below exhibited low DO or somewhat elevated concentrations of nitrate or phosphorus.

- *CNR-06 had low DO and somewhat elevated phosphorus in most samples;*
- *CNR-07 had one low DO reading, one elevated nitrate reading, and two elevated phosphorus readings;*
- *CNR-08 had some slightly elevated nitrate readings and one elevated phosphorus reading;*
- *CNR-10 had two elevated nitrate readings;*
- *CNR-11 had one elevated phosphorus reading; and*
- *CNR-12 had two elevated nitrate and one elevated phosphorus readings.*

3.2.8 Other Relevant Reports

A number of other water quality reports have been generated that include data from the CNR. Data from these reports (noted below) have been reviewed and were valuable in developing a strategy for conducting additional sampling in 2012 and in evaluating the 2012 water quality data.

- *In 1995, the Wells Reserve and MEDEP commissioned a study of DO and circulation in several southern Maine estuaries, including the CNR (Kelly and Libby, 1996). The study found fairly high DO concentrations in the CNR. The study also developed circulation and tidal flushing data for the estuary that have been used in this WBMP for comparison with estimated flows from tributaries in the lower CNR.*
- *In 2001, the Town commissioned a built-out analysis that included the lower portions of the CNR watershed (RKG Associates, Inc., 2001). This analysis included estimation of the land capacity to accommodate septic systems and identified the lower CNR Watershed as an area where further study is warranted to evaluate water quality.*
- *In 2003, Dr. Stephen Jones of the University of New Hampshire (UNH) reported on a ribotyping analysis he had conducted to evaluate the potential source of bacteria in two water samples collected from the CNR (Jones, 2003). Based on his analysis, the water*

sample collected at the Shore Road Bridge contained E. coli from birds, wildlife and pets. A water sample collected just downstream of the Hutchins Lane Bridge contained bacteria from humans, birds, wildlife, pets and livestock.

- *During 2011, Dr. Kim Borges from the University of Maine at Fort Kent collaborated with the MHB program to collect and analyze water samples using DNA-based microbial source tracking (Borges, 2012). Three sample locations from the CNR (CNR-06, CNR-06-2 and CNR-13) were included in the study. The data indicated human-related bacteria at CNR-06 and CNR-06-2, but no human-related bacteria in water collected at CNR-13.*

3.2.9 Summer 2012 Field Investigation

Goals and Approach

Three primary goals were identified for the 2012 sampling in order to provide data to supplement the existing historical database and to assist with identifying strategies to mitigate elevated bacteria levels.

1. *Recognizing that from the ocean to the head-of-tide just downstream of CNR-02, tidal flushing is the predominant water input to the main stem of the river, the first goal was to collect samples that reflected the upland component of the river flow as much as possible. To do this, all samples were collected at or shortly after low tide, when the water reflected the maximum freshwater input.*

   The second goal was to specifically examine the influence that water flowing from the tributaries has on the water quality of the main stem of the river. The volume of tidal flow into and out of the river is very large in comparison to the estimated volume of freshwater input from the tributaries. To develop a better understanding of the influence that individual tributaries have on the main stem water quality, two new sampling locations were added along the main stem of the river below CNR-02. Location CNR-01-3 was added near the head of tide, just downstream of the confluence with CNR-15. Location CNR-01-2 was added near the old railroad trestle and is located downstream of tributary inputs from CNR-11 and CNR-12The third goal was to assess the potential influence from selected point source locations. The primary point source was the YSD treatment plant outfall, and sampling point YK-A3 was added directly over the outfall. In addition, two new sampling locations were added between Shore Road and the ocean (YK-A1 and YK-A2) to gather data that might identify indirect inputs from the Campground.

Testing Activities

During 2012, sampling was conducted on four dates in May, June, July and September. Samples from the main stem of the river were collected at low tide consistent with the first goal *outlined above. Representatives from Watershed Solutions, Drumlin, and Frick Associates assisted Town staff during the May sampling round. Town staff conducted the remainder of the sampling.*

The sampling on May 9, 2012 was conducted a few hours after a rain event where the Cape Neddick weather monitoring station measured 0.86 inches of rain. There was no rain during the days before the June 12 and July 7 sampling events. The September 6 sampling event was preceded by 0.75 inches of rain, mostly on September 4, but no rain fell within the 24-hour period before samples were collected.

Sampling was conducted in each of the three zones described above in Section 6.

- *Zone 1: Samples were collected from CNR-03, CNR-04, CNR-05 and CNR-19. A new sampling location designated CNR-05-D was added immediately downstream of the former dump.*
- *Zone 2: Samples were collected from CNR-02, CNR-01-3, CNR-01-1, CNR-01-2 and CNR-01 along the main stem of the river (upstream to downstream). Tributary samples were collected in Zone 2 from CNR-15, CNR-13, CNR-12, CNR-11, CNR-10, CNR-09, CNR-08 and CNR-07.*
- *Zone 3: Samples were collected from YK-A1 and YK-A2 in the main channel, YK-A3 over the YSD treatment plant outfall and from the tributary CNR-06.*

During all sampling events, the water was analyzed in the field for temperature, specific conductance (salinity), and DO. Samples from all locations except CNR-03 and CNR-04 were analyzed for Enterococci during all events. During the May and July sampling events, selected samples were also analyzed for non-bacteria parameters including nitrate, total kieldahl nitrogen, total phosphorus and 13 heavy metals.

Non-Bacteria Test Results

Select water samples were analyzed for nutrients (nitrogen and phosphorus) and heavy metals during the May and/or July sampling events. In general, the nitrate concentrations were lower than reported in 2008, when several samples had reported concentrations of greater than 1 mg/l. The total phosphorus concentrations were also lower than reported in 2008. Only 2 samples had detectable phosphorus at concentrations slightly above the detection limit.

The majority of the 13 priority pollutant heavy metals were not detected in the water samples. Low concentrations of copper, lead, nickel and zinc were detected. The copper, lead and/or zinc concentrations of some of the samples are slightly above the aquatic water quality criteria. However, these elements also occur naturally at trace concentrations in soil. The low levels detected and the absence of 9 of the 13 heavy metals suggests that these compounds are more likely to be natural in origin, rather than the result of specific land use activities.

The water samples collected downstream of the former dump (CNR-05-D) do not indicate significant waste-related input to the stream for either nutrients or heavy metals. Dissolved oxygen and specific conductance (SC)/salinity were similar to the CNR-05 sample collected upstream of the dump.

DO was measured in all water samples as part of the 2012 sampling protocol. As noted earlier in Table 3-1, freshwater portions of the CNR are designated as Class B water, which have a DO concentration standard of 7 mg/l or 75% of saturation. Brackish and salt portions of the river are designated Class SB, which has a DO concentration standard of 85% saturation.

The DO data collected during 2012 are summarized in Table 3-4. *DO concentrations were typically at or above the classification concentration along the main stem of the river in the lower (brackish and salt) reaches, although the DO dipped below these levels in two samples collected near Shore Road in the September samples. Tributaries to the Zone 2 portion of the river all had DO concentrations above the classification values in the May sampling event. In June, three tributaries had dropped below the DO target values. In July, two tributaries were dry and two had dropped below the DO target values. In September, one tributary was dry and six had low DO concentrations. In the Zone 1 tributaries, DO values were above the target concentrations in May, June and July, and dropped below the target concentration in September.*

The DO data from the CNR tributaries indicate that as summer progresses, there are a number of locations where the concentrations drop below the classification standards. This is likely to be partly, and perhaps mostly, the result of decreasing flow in many tributaries. As flow decreases there is less mixing and more quiescent flow and/or stagnant conditions.

Table 3-4: Dissolved Oxygen Data – 2012 Cape Neddick River (Frick et al., 2013)

Sample	Date				Sample	Date			
	5/9/2012	6/12/2012	7/10/2012	9/6/2012		5/9/2012	6/12/2012	7/10/2012	9/6/2012
MAIN STEM					ZONE 2 TRIBS				
CNR-02					**CNR-10**				
Fresh/Salt	F	F	F	F	Fresh/Salt	F	F	S	S
DO	10.3/93	10.3/93	**6.51/--**	**5.99/--**	DO	9.09/81.5	7.31/73.1	**4.5/54.5**	**5.53/61.2**
CNR-01-3					**CNR-09**				
Fresh/Salt	F	F	S	S	Fresh/Salt	S	S	S	S
DO	10.3/93.0	9.18/96.54	10.41/--	9.86/--	DO	10.29/96.7	16.87/143	7.34/101.6	7.22/79.5
CNR-01-1					**CNR-08**				
Fresh/Salt	F	B	S	F	Fresh/Salt	F	B	S	S
DO	11.86/106.3	9.67/101.2	10.75/--	NR/98.2	DO	11.54/103.7	8.71/90.78	7.83/--	**6.08/--**
CNR-01-2					**CNR-07**				
Fresh/Salt	**B**	S	S	S	Fresh/Salt	B	B	S	S
DO	11.57/103.6	**6.29/71.3**	7.81/108.6	**5.43/58.0**	DO	8.71/80.0	**2.95/29.2**	**2.97/45.3**	**1.6/22.9**

CNR-01					***CNR-06***				
Fresh/Salt	*S*	*S*	*S*	*S*	*Fresh/Salt*	*F*	*B*	*Dry*	*B*
DO	*10.79/97.9*	*8.55/95.5*	*7.3/100.7*	***5.94/75.7***	*DO*	*5.0/45.3*	***0.16/1.48***	*NS*	***0.57/6.5***
YK-A1					***ZONE 1 LOCATIONS***				
Fresh/Salt	*S*	*S*	*S*	*S*	***CNR-19***				
DO	*10.83/98.7*	***5.49/63.3***	*8.11/103.8*	***6.36/80.1***	*Fresh/Salt*	*F*	*F*	*F*	*F*
YK-A2					*DO*	*10.3/98.2*	*8.25/88.6*	*7.08/--*	***6.88/--***
Fresh/Salt	*S*	*S*	*S*	*S*	***CNR-05***				
DO	*10.8/98.9*	*7.01/85.5*	*8.43/105.1*	*7.66/95*	*Fresh/Salt*	*F*	*F*	*F*	*F*
YK-A3					*DO*	*10.6/95.3*	*8.29/82*	*9.22/--*	***5.23/--***
Fresh/Salt	*S*		*S*		***CNR-05-D***				
DO	*11.0/--*	*NS*	*8.24/103.5*	*NS*	*Fresh/Salt*	*F*	*F*	*F*	*F*
ZONE 2 TRIBS					*DO*	*10.3/92.9*	*NS*	*8.56/--*	*NS*
CNR-15					***CNR-03***				
Fresh/Salt	*F*	*F*	*F*	*F*	*Fresh/Salt*	*F*	*F*	*F*	*F*
DO	*9.9/90.8*	*8.41/84.38*	*7.55/--*	***5.82/--***	*DO*	*10.89/99.5*	*9.12/93.6*	*7.85/--*	*NS*

CNR-13					***CNR-04***				
Fresh/Salt	*F*	*F*	*F*	*F*	*Fresh/Salt*	*F*	*F*	*F*	*F*
DO	*11.70/104.5*	*8.51/85.1*	*9.35/--*	*7.8/--*	*DO*	*11.02/98.8*	*8.18/83.3*	*9.30/--*	*NS*
CNR-12									
Fresh/Salt	*F*	*F*	*Dry*	*Dry*					
DO	*10.38/91*	***6.96/68.3***	*NS*	*NS*					
CNR-11									
Fresh/Salt	*F*	*F*	*F*	*F*					
DO	*10.89/97.4*	*8.54/85.69*	*7.4/--*	***4.76/--***					

Notes: 1. *DO is listed as "X/Y" with "X" = concentration in mg/L. "Y" is %.*
2. *"--" = Parameter Not Measured. NS = No Sample Collected.*
3. *F = Fresh, S = Salt, B = Brackish.*
4. *Highlighted values are below the applicable DO Criteria*

Bacteria Test Results

As described earlier, there are historical data showing elevated bacteria concentrations in the CNR. The bacteria data from the four 2012 sampling events are summarized in Table 3-5. *The data from May and July have also been summarized in two graphs (*Figures 3-5 and 3-6*) to provide a graphic depiction of the bacteria concentrations in the main stem and tributary samples from below Route 1 to the ocean. May sampling occurred at the end of a rain storm and the other sampling events occurred either during dry periods or at least 24 hours after rain had ended.*

Table 3-5: Bacteria Data – 2012 Cape Neddick River (Frick et. al, 2013)

		ENTEROCOCCI			
Sample	*Fresh/*	*(MPN/100ml)*			
Designation	*Salt*	***5/9/2012***	***6/12/2012***	***7/10/2012***	***9/6/2012***
MAIN STEM					
CNR-19	*F*	*52*	*20*	*41*	*20*
CNR-02	*F*	***545***	*20*	*10*	*20*
CNR-01-3	*S*	***259***	*20*	*20*	*20*
CNR-01-1	*S*	***341***	*20*	*41*	*20*
CNR-01-2	*S*	***397***	*10*	*<10*	*<10*
CNR-01	*S*	***443***	*20*	*10*	*<10*
YK-A1	*S*	***563***	*10*	*<10*	*<10*
YK-A2	*S*	***657***	*<10*	*<10*	*<10*
YK-A3	*S*	***146***	*NA*	*<10*	*NA*
ZONE 2 TRIBUTARIES					
CNR-15	*F*	***63***	*52*	*31*	***410***
CNR-13	*F*	***228***	***63***	***96***	*41*
CNR-12	*F*	***423***	*20*	*Dry*	*dry*
CNR-11	*F*	***888***	*41*	***74***	***193***
CNR-10	*S*	***130***	*41*	***115***	*74*
CNR-09	*S*	***473***	*<10*	*10*	*<10*
CNR-08	*S*	*52*	*10*	*10*	*10*
CNR-07	*S*	***181***	*<10*	*10*	*10*
CNR-06	*S*	***504***	***>24196***	*Dry*	***510***
ZONE 1 TRIBUTARIES					
CNR-05	*F*	***181***	*20*	*20*	***195***
CNR-05-D	*F*	***95***	*NS*	***62***	*NS*

Notes: "<10" = No Enterococci Detected above detection limit of 10 MPN/100ml, 2. USEPA Bacteria criteria for recreational waters = 104 MPN/100ml for salt wate,r & 61 MPN/100ml for fresh water (for an individual sample), 3. Maine Class SB criteria for Enterococci = 54 MPN/100ml (individual sample), 4. BOLD values exceed USEPA &/or Class SB Criteria

The 2012 data provide additional information about the nature of bacterial concentrations in the CNR as summarized below.

The 2012 data show that there are significantly higher bacteria concentrations in all sampling locations immediately after a rain storm (i.e., May 2012) compared to times when there has been no recent precipitation (i.e., June and July 2012).

The September 2012 samples were collected more than 24 hours after a rain event, however the samples from the main stem of the river had low bacteria concentrations. This suggests that the bacteria concentrations in the main tidal portion of the river, which has been identified as impaired by the MEDEP, can drop to low concentrations rapidly (within a few tidal cycles) after the end of the rain event.

- *Sample location YK-A3 was located directly over the YSD outfall and samples were collected at low tide from the visible upwelling above the outfall. Wave action on the beach prevented sampling over the outfall in June and September. However, the July sample had no detectable Enterococci and the May sample had a lower Enterococci concentration than the nearby locations in the CNR. Collectively, these data do not implicate the YSD treatment plant outfall as a significant contributor to the Enterococci concentrations in the CNR.*
- *Sample location CNR-06, which flows out of the marsh behind the Cape Neddick Beach, consistently shows elevated bacteria concentrations. The June sample, which was collected from a very small flow, had extremely high concentrations, which may have been due to entrained sediment in the sample. Despite the elevated bacteria concentrations at CNR-06, the small flow from this marsh does not appear to routinely raise main stem concentrations during dry conditions.*
- *Several sampling sites were located in the upper portion of the watershed (Zone 1). Samples from site CNR-19, located downstream of the Chase's Pond Dam, had low bacteria concentrations during all sampling events. Samples from site CNR-05, located on the northern upstream tributary, had elevated concentrations of bacteria during the wet sampling event in May and also in the September event, which was preceded by rain. Concentrations at CNR-05 were low in dry events during June and July. These data suggest the runoff from land uses in this upper portion of this tributary does elevate bacteria concentrations. In the September sampling, the bacteria concentrations observed at CNR-05 did not persist downstream to CNR-02.*
- Figure 3-5 *shows that during the July sampling, tributaries with small flows such as CNR-11 and CNR-10, do not raise the bacteria concentrations in the main stem of the*

river, despite the presence of elevated bacteria in the tributaries. CNR-13, with higher flows, appear to have a measureable impact on the main stem, though the main stem concentrations remain below the criteria.

- *Data from June and September also suggest that the impact from the tributaries on the main stem bacteria concentrations is limited and the main stem remains below the bacteria criteria.*
- Figure 3-6 *shows that during the May (wet) sampling event, there is an increasing trend of bacteria concentrations in the main stem and suggests that the input from the tributaries contributes to this trend.*
- Figure 3-6 *also shows a marked increase in the trend of bacteria concentrations downstream of the Shore Road Bridge, suggesting that CNR-09 could be a significant contributor to bacteria load in the river after rain events.*

Figure 3-5: July 2012 Bacteria Concentrations Lower Cape Neddick River (Frick et. al, 2013)

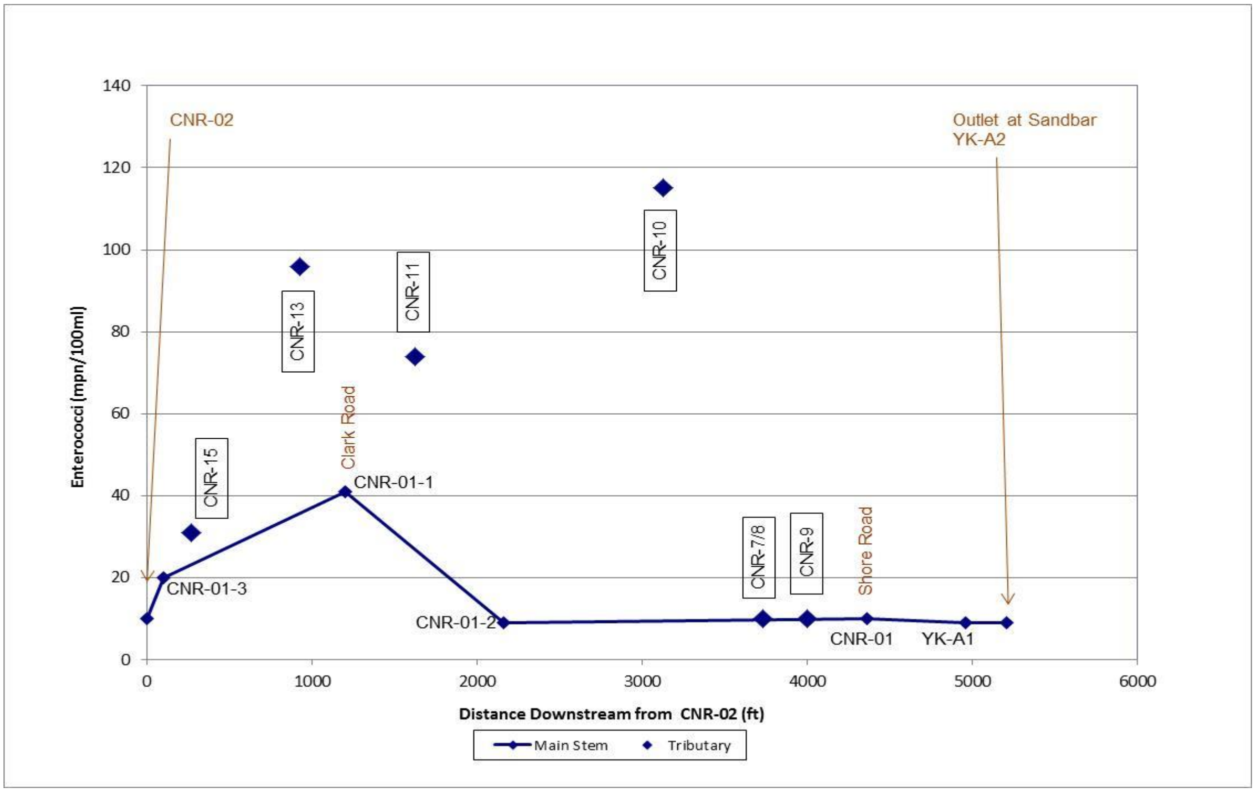
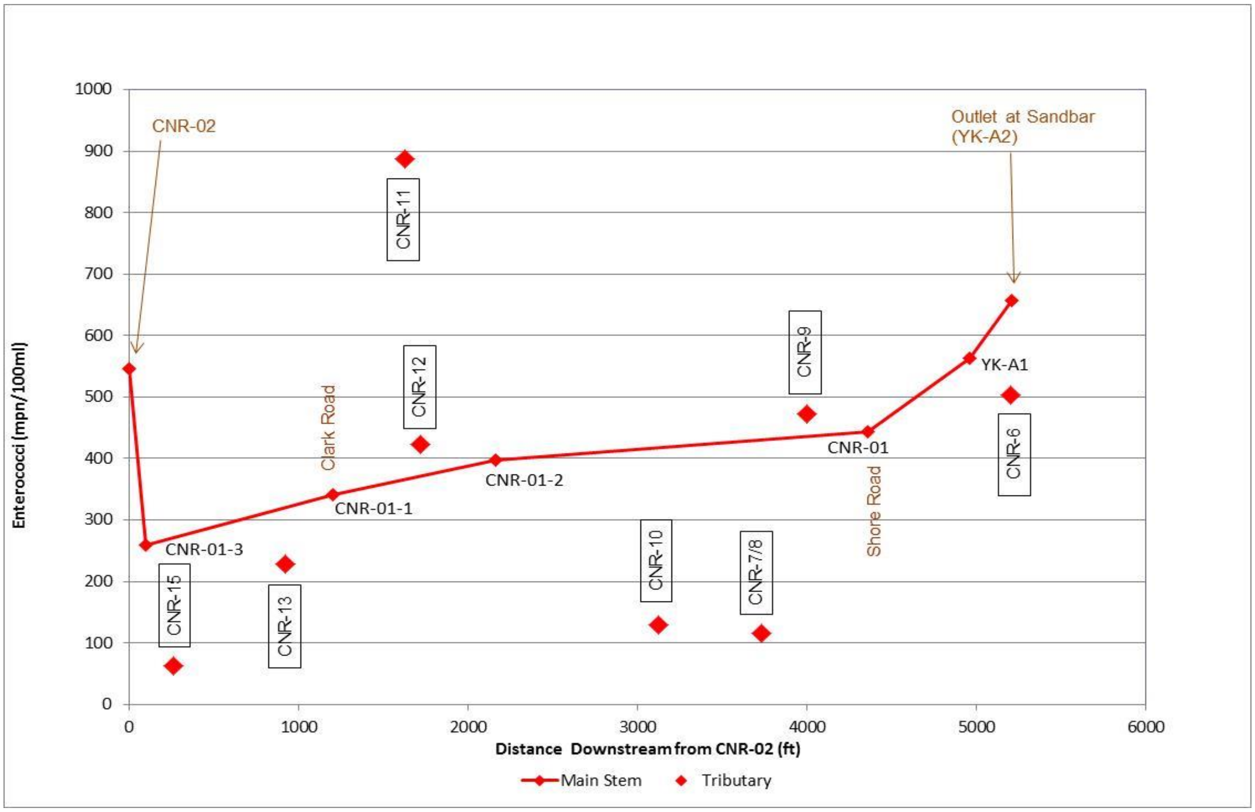


Figure 3-6: May 2012 Bacteria Concentrations Lower Cape Neddick River



3.2.10 Summary of 2012 Bacteria Data

The 2012 bacteria sampling was intended to augment the historical database and provide additional information to clarify the impacts of the tributaries on the CNR Estuary, which has been designated as impaired by the MEDEP.

The 2012 data clearly show that the primary condition when bacteria concentrations are elevated above the criteria in the main stem of the river is during the approximately 24-hour period immediately following a rain event. The 2012 sampling data, along with historical data and an assessment of potential flow volume from each subwatershed, have also been used to identify priority subwatersheds where mitigation measures can be focused to improve water quality both in the tributaries and the main stem of the river.

3.2.11 2013 Canine Detection

In July 2013, the Town of York sponsored and assisted FB Environmental and Environmental Canine Services in a day of canine detection of human sources of bacteria to York's beaches. Two trained canines (each with a different detection limit) were used alongside traditional bacteria tests to better determine where human sources of bacteria were present in the surface waters of the Cape Neddick River, Short Sands beach and Long Sands beach. Five sample stations were tested along the Cape Neddick River, along with a walking survey along portions of Cape Neddick Beach. The canines alerted to the presence of human sources of bacteria at four out of the five sites. Two of the positive-alert sites (CNR-06 and CNR-09) also had high bacteria counts, indicating they were the highest priority sites for follow up on (FBE, 2013) (Table 3-6)

In addition to providing valuable data on areas where human sources of bacteria were likely to be present in the Cape Neddick River, the canine survey energized pollution reduction efforts in York by providing an effective yet economical method for searching for wastewater leaks in surface waters.

Table 3-6: Enterococci and Canine Detection Results in the Cape Neddick River Watershed (FBE, 2013)

Site Name	Description	Enterococci (colonies/100 mL)	Dog Response (Sable/Logan)	Comments
CNR6B	Culvert to River	2755	No/Yes	White "sewage fungus present" toilet paper present in marsh
CN1	Right side of house from beach	--	No/Yes	
CN2	To the right of house	--	No/Yes	
CNR11	River Road	1483	No/No	
CNR9	Lois Lane and 1A	287	No/Yes	
Gray cells indicate an exceedance of the water quality standard (104 colonies/100mL). Blue cells indicate a positive response via canine detection from one dog only.				

3.3 2013 Shoreland Survey – **Element A**

3.3.1 Watershed Survey in 2013

A Cape Neddick River watershed survey was conducted on December 3, 2013 by trained technical staff from FB Environmental. Surveyors documented sources of bacteria and other pollutants throughout the watershed using cameras and standardized forms. This survey focused on examining sites within the Cape Neddick River Watershed that are potential sources of nutrients and bacteria to the river. Problems were identified and documented, solutions were recommended, and the costs of improvements were estimated.

Overall, 18 sites were documented during the watershed survey. Impact levels were assigned to each site based on site area, number of pollutants, and transportation (direct or limited flow to the river). Some key conclusions of the survey are presented in Section 5.2.

3.3.2 Conclusions from 2013 Watershed Survey

Stakeholder concerns in the Cape Neddick River watershed have evolved since the formation of the Cape Neddick River Association and the initial work completed throughout the watershed. Bacteria have become the primary pollutant of concern. This current focus on bacteria is driven by the intensive use of the swimming beaches in the tidal portion of the Cape Neddick River and the waterfront homes near the mouth of the river. The additional ten years of bacteria data collected by Maine Healthy Beaches program shows that bacteria at the beaches likely derives from upstream, watershed-based sources. Efforts to reduce stormwater runoff will reduce pollutant inputs to the river, including bacteria. Erosion is still considered an important, if secondary, pollutant. Reducing the speed and intensity of runoff from parking lots, roads, and lawns will reduce erosion, and therefore, bacteria pollution in the Cape Neddick River.

4. Threats to Water Quality

4.1 Nonpoint Sources of Pollution – **Element A**

4.1.1 Stormwater

Overall, bacteria concentrations are generally higher under wet weather conditions than under dry weather conditions. As rain water moves over the land and into a waterbody, it will carry bacteria from various sources (i.e. pet waste, dumpsters) as well as other pollutants (nutrients from lawn fertilizers and sediment). Stormwater runoff then flows untreated into a storm drain system or directly into a river, wetland, or coastal waterbody leading to increased bacteria concentrations after a rain event. In coastal areas and other low-lying areas with a relatively high water table, it is possible that the impact of stormwater runoff is even greater as malfunctioning septic system leach fields may become inundated with water during a period of heavy rain.

4.1.2 Septic Systems

Septic systems are significant potential source of pollution to the Cape Neddick River. The entire watershed relies on septic systems for waste disposal. There is currently little documentation of these systems including the specific location and maintenance history. In the 2013 Canine Detection study conducted by FB Environmental, two tributary sites (CNR-06 and CNR-09) and two locations on Cape Neddick Beach were identified as having high counts of bacteria and the presence of human sources of bacteria. Watershed homes are not connected to a municipal sewer system in this area indicating that failing septic systems are a potential contributor of bacteria to the Cape Neddick River.

4.1.3 Agriculture

Agriculture is an important potential source of pollution to many of Maine's lakes and rivers. Though some farms are present in the watershed, bacteria modeling results indicate that agriculture is not a major contributor of bacteria to the Cape Neddick River.

4.1.4 Pet waste

Pet waste is another potential source of pollution to the Cape Neddick River. Though there are restrictions for pets on York's public beaches, there are many locations throughout the watershed that allow pets. According to the bacteria modeling results in Section 5, pets are the second largest contributor to bacterial pollution after humans. In the 2013 Canine Detection study conducted by FB Environmental, Site CNR-11 had high bacteria concentrations but did not have any indication of the presence of human sources of bacteria, indicating other sources such as pet waste are likely.

4.1.5 Wildlife

Wildlife is also a potential source of pollution to the Cape Neddick River. According to the bacteria modeling results in Section 5, wildlife is likely a major contributor to bacteria in the watershed. As indicated above, the 2013 Canine Detection study by FB Environmental found that some sites on the river had high bacteria concentrations but did not have human sources of bacteria present. It is common in the lower portions of the watershed for geese to congregate along the shoreline of the Cape Neddick River. This large geese population is likely an important potential source of bacteria in the River.

4.2 Point Sources – **Element A**

There are no known point sources in the Cape Neddick River watershed. A review of the Maine Pollutant Discharge Elimination System (MPDES) permits found no permitted discharges (http://www.epa.gov/region1/npdes/me.html).

The York Sewer District has a Maine Pollutant Discharge Elimination System permit, number ME0101222, dated May 26, 2006. This permit discharges to the Atlantic Ocean rather than to the watershed. The monthly average concentration for fecal coliform discharges is 15 counts per 100 mL, with a daily maximum of 50 counts per 100 mL, and minimum monitoring frequency of three times per week. There are additional permit limits for arsenic, mercury, and whole effluent toxicity, each with monitoring requirements. In theory, it is possible for a portion of discharges to the Atlantic Ocean to be present in the tidal portion of the Cape Neddick River on an incoming tide. Given the disinfection, regular monitoring, and dilution by the Atlantic Ocean, it is unlikely that this point of discharge is a significant source of bacteria to the river or estuary. However, it is possible that the sewer pipes which convey wastewater from service areas to the treatment plant, if leaking or overflowing, could be a source of bacteria. For the purposes of this report, leaks of this kind are considered nonpoint sources.

See: http://www.epa.gov/region1/npdes/permits/finalme0101222permit.pdf

5. Linking Pollutant Sources to Water Quality

5.1 Estimation of Pollutant Loads – **Element A**

Estimates of fecal coliform loads and sources in the Cape Neddick River watershed were determined using the Bacteria Source Load Calculator (BSLC), developed by the Center for TMDL and Watershed Studies at Virginia Polytechnic Institute. 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. Results are displayed by source (i.e. land use) in cfu’s, or "colony forming units", per year. In the Cape Neddick River watershed, yearly bacterial loads from all sources totaled 592,699 x 10^9 per year. Land use data and additional model inputs gathered for the Cape Neddick River 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 inputs are approximate and should be viewed only as carefully researched estimations.

5.1.1 Inputs to Bacteria Source Load Calculator

The BSLC requires several inputs, including land use, population, wildlife, and pet waste parameters.

Land Use - Land use in the Cape Neddick River watershed was determined through GIS analysis of the Maine Land Cover Data layer (MELCD). This layer is derived from Landsat Thematic Mapper Imagery from 1999-2001, and refined for the State of Maine using 2004 SPOT 5 panchoromatic imagery (MEGIS, 2014). For modeling purposes, MELCD land use categories were grouped for data entry according to BSLC categories (Table5-1).

Table 5-1: Land uses in Maine GIS data (MELCD) and Assignment to Bacteria Modeling Categories

MELCD Grid Code	*acres*	**BSLC Land Use Categories**	*acres*
Deciduous Forest	333.1	Forest	4712.9
Evergreen Forest	1536.4		
Mixed Forest	2250.1		
Scrub-Shrub	85.9		
Forested Wetland	205.3		
Wetlands (PSS/PEM)	46.5		
Clear Cut	7.2		
Light Partial Cut	15.1		
Heavy Partial Cut	144.6		
Forest Regeneration	88.8		
Low-Intensity Development	124.9	Residential 1	325.4
Developed Open Space	200.5		
Medium-Intensity Development	85.0	Residential 2	85.0
High-Intensity Development	34.6	Residential 3	206.9
Roads	172.3		
Cultivated Lands	3.2	Cropland	3.2
Pasture / Hay	131.1	Pasture	131.1
Grassland / Herbaceous	0.0		
Unconsolidated Shore	13.8	Unassigned (no analogous category)	203.3
Open Water	186.0		
Bare Land	3.4		
Total	**5667.9**	**Total**	**5667.9**

Livestock - Livestock estimates are based on the 2013 watershed survey as well as past watershed observations and documented sources. Four horses were observed at a property in York during the 2013 survey.

Wildlife- Wildlife populations in general are difficult and time consuming to estimate. It is not feasible to calculate exact wildlife population figures for the purposes of this model. Therefore, default wildlife population densities provided within BSLC were used, with midpoint selected if a range of densities was indicated in the model. The population densities were multiplied by the habitat area for that species, as defined by the model and calculated in GIS. These estimates are based on available habitat areas and density data for each species. Below summarizes wildlife populations (Table 5-2).

Table 5-2: Summary of Wildlife Population Density, Habitat, and Overall Population Estimates

Wildlife Type	**Habitat Assumptions**	**Pop. Density** (animal/ha of habitat)	**Source**	**Watershed Estimate**
Deer	Entire Watershed	0.12	MapTech (2000)	**275**
Raccoon	Low density on forests not in high density area; high density on forest within 183m of a permanent water source or 0.8km of cropland	0.04 to 0.12 **Mean Density: 0.08**	Virginia Department of Game and Inland Fisheries (personal communication, 2004)	**105**
Geese	91-m buffer around streams and impoundments	0.13 – off season 0.27 – peak season	Moyer and Hyer (2003)	**104 – off season 216 – peak season**
Wild Turkey	Entire watershed except urban and farmstead	0.025	Brannan et al. (2002)	**57**

Wastewater - Human pollutant source contributions are based on two types of houses: sewered and non-sewered. Houses connected to a sewer system do not contribute to nonpoint source pollution like those with failing or poorly maintained septic systems. For this reason, the number and age of unsewered homes is needed to calculate an accurate bacteria load estimate. The relative ages of unsewered homes in the watershed are used to calculate the number of failing septic systems by using a known septic failure rate equation. House totals are also used within

BSLC to calculate human and pet populations for the watershed. Numbers used for the Cape Neddick River watershed assume that zero straight pipes exist within the watershed.

To estimate total unsewered houses within the Cape Neddick River watershed, the York parcel data layer and 2010 U.S. Census data were utilized. There are 1,044 parcels located within the Cape Neddick River Watershed, and 100% of the watershed is on private septic systems. The BSLC considers age of homes, with older homes being more susceptible to failure. The US Census provides information on age of homes, and the data for the Town of York was used, as the entire watershed is located in York (Table 5-3).

Table 5-3: Age of Homes (Based on US Census data for York, Maine)

Category	**Homes in Age Category**	**Watershed Home Totals**
Pre 1966	34%	350
1966 to 1985	45%	469
Post 1985	22%	226

Pet Waste - Bacteria loading from pets is a function of population and is calculated by the model based on the above census data.

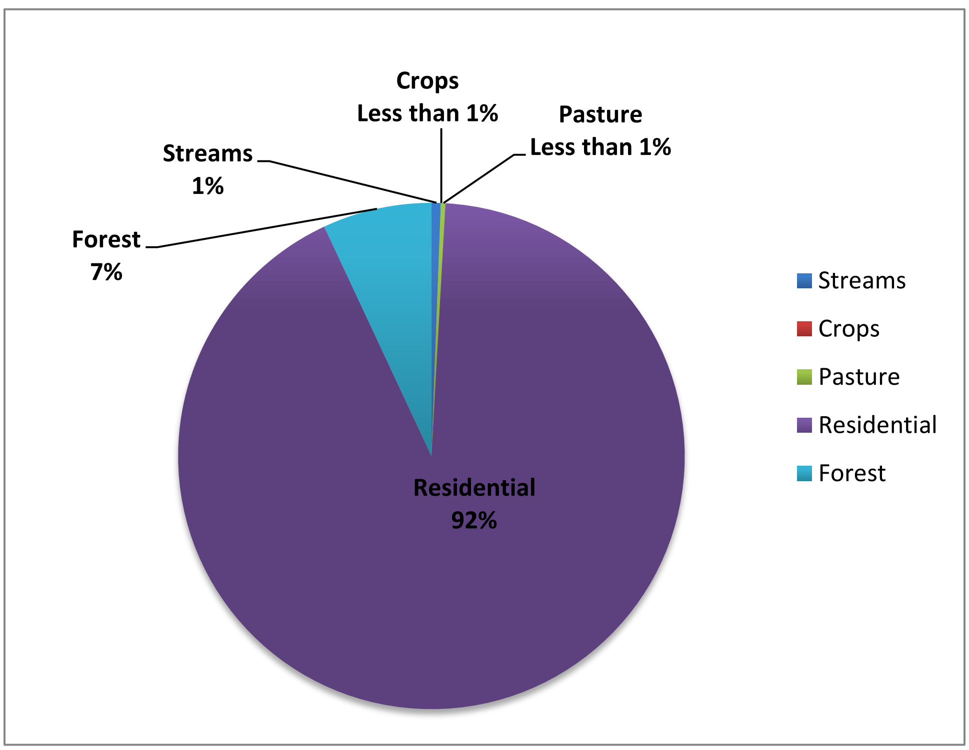
5.1.2 Bacteria Modeling Results

Table 5-4 displays bacteria load estimates by land use in the Cape Neddick River watershed. Bacteria load production is also listed by source below. Humans are the largest contributor of bacteria within the watershed and produce over half the total load to the Cape Neddick River. This is also reflected in the land use breakdown as residential development accounts for over 92% of the total yearly bacteria load (Figure 5-1).

Table 5-4: Annual Bacteria Load Estimates by Land Use and Source Category.

Land Use Category	**Annual Load (fecal coliform cfu/year)**	**Percent Contribution**
Streams	3.51E+12	0.59%
Crops	2.68E+10	0.00%
Pasture	1.71E+12	0.29%
Residential	5.46E+14	92.2%
Forest	4.12E+13	6.96%
Source Category	**Production Breakdown**	**Percent Contribution**
Agriculture	6.14E+11	0.10%
Wildlife	5.08E+13	8.57%
Humans	3.70E+14	62.4%
Pets	1.72E+14	29.0%

Figure 5-1: Bacteria Source Contributions by Land Use in the Cape Neddick River watershed



5.2 Identification of Critical Areas – **Element C**

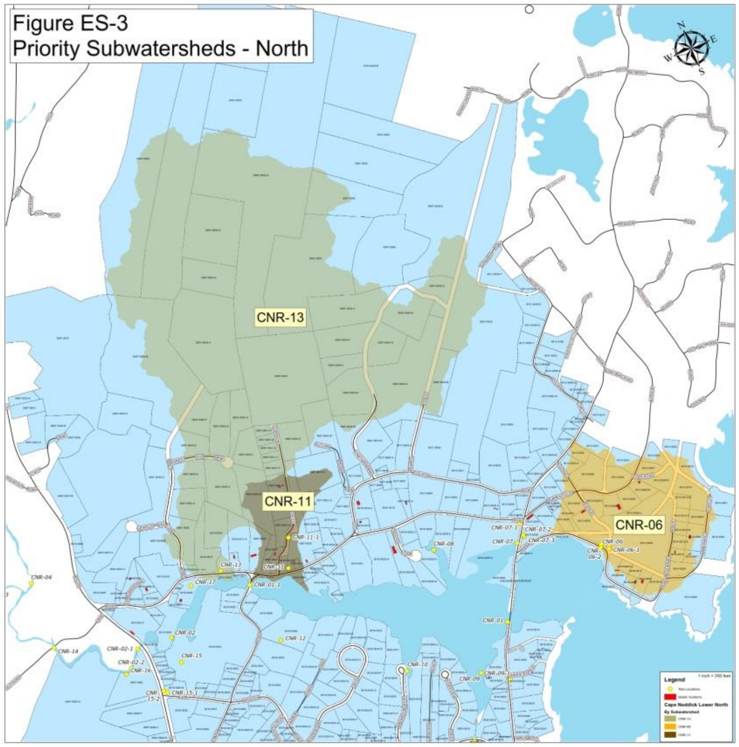
To help prioritize and target management efforts within the Cape Neddick River watershed, critical areas have been identified based on the results of the 2012 monitoring project and the 2013 watershed survey. Cape Neddick River watershed critical areas are identified below and presented based on their potential impact on the River. It is recommended that management measures be applied to these areas first. Overall, the lower portion of the watershed near the mouth of the Cape Neddick River is estimated to be contributing the largest bacteria load to the river. Sources of bacteria in this area include residential septic systems. Many residential properties in this area have inadequate buffers between private yards and the river. The upper portion of the watershed isare also estimated to be contributing a large bacteria load to the river. Sources from this area are thought to be predominately from wildlife and other forest sources.

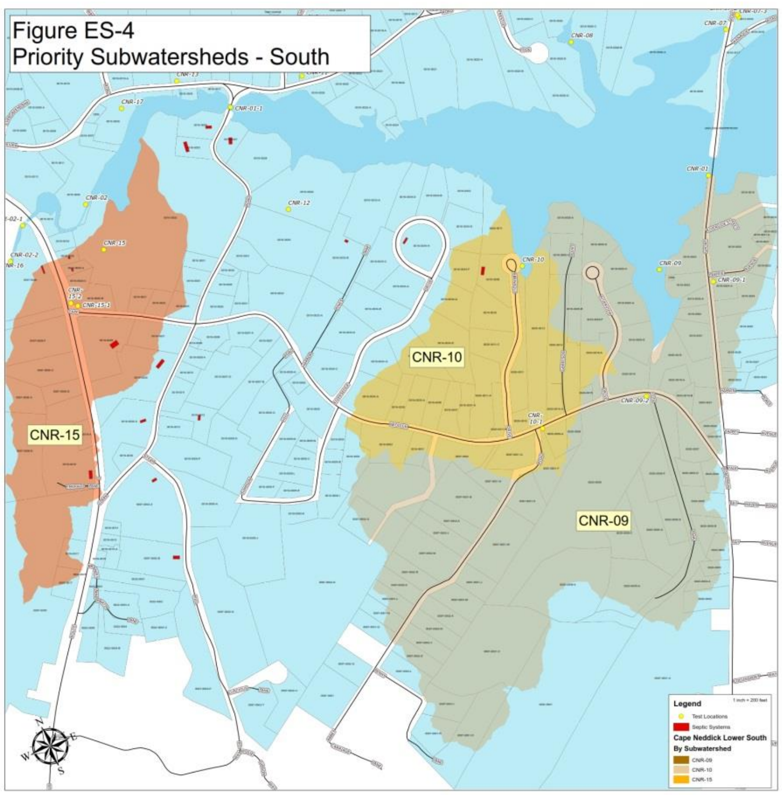
5.2.1 2012 Summer Field Investigation

Six priority subwatersheds were selected based on historical water quality data and the results of the 2012 monitoring program. Based on water quality data, sub-watershed information including age and number of homes, land use, and an i*nspection of Figures ES-5 and ES-6* (Figure 5-2) *the following observations* could be made*:*

- *CNR-09 potentially generates the overall largest bacteria load and the largest bacteria load from residential sources (i.e., failing septic systems and pet waste).*
- *CNR-13 potentially generates the second largest bacteria load but the majority of it is from forest sources (i.e., wildlife).*
- *CNR-06, CNR-10, and CNR-15 potentially generate similar bacteria loads, the majority of which are from residential sources.*
- *CNR-11 potentially generates the overall smallest bacteria load.*
- *Humans (i.e., failing septic systems) are potentially the largest source of bacteria loading to the estuary.*
- *Pets are potentially a significant contributor to overall bacteria loading to the estuary.*

Figure 5-2: Priority Sub-Watersheds in the Cape Neddick River Watershed (Frick et al, 2013)

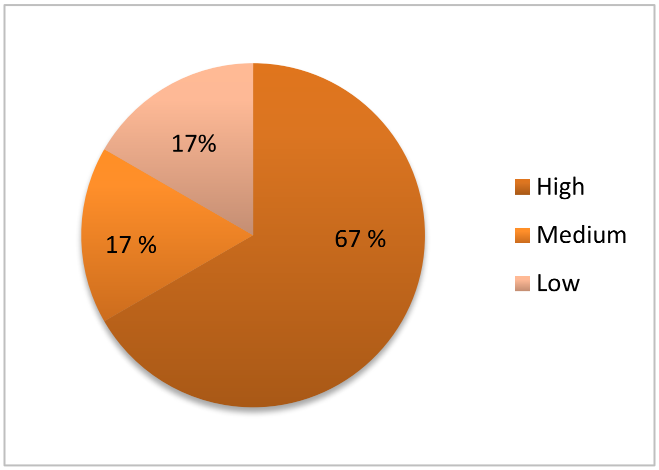




5.2.2 2013 Watershed Survey

Figure 5-2 presents site impact levels documented in the watershed. High Impact sites account for 66.7 % of total 18 documented sites. Both medium and low impact sites account for 16.7 % each. Many of these sites lie in previously prioritized sub-watershed CNR-09 (Figure 5-2).

Figure 5-3: Impact Level of Sites in the 2013 Watershed Survey.



Nine of the identified sites were found in residential areas and accounted for half of total documented sites. Most of these sites had buffer and shading issues with direct impact to the river. Twenty-two percent of documented sites were found in commercial areas and were mainly related to toxics and impervious surfaces. Road sites account for twenty-seven percent of sites, while municipal areas account for the least amount of sites at five percent of total documented sites. Most road sites were related to impervious surfaces and stormwater drainage. Figure 5-1 presents sites by land use type. Twelve of the eighteen described sites were identified to be of high impact, and was the overall majority. There were three sites described for both medium and low impact (Table 5-5).

Figure 5-4: Land Use at Sites Observed During the 2013 Stormwater Survey

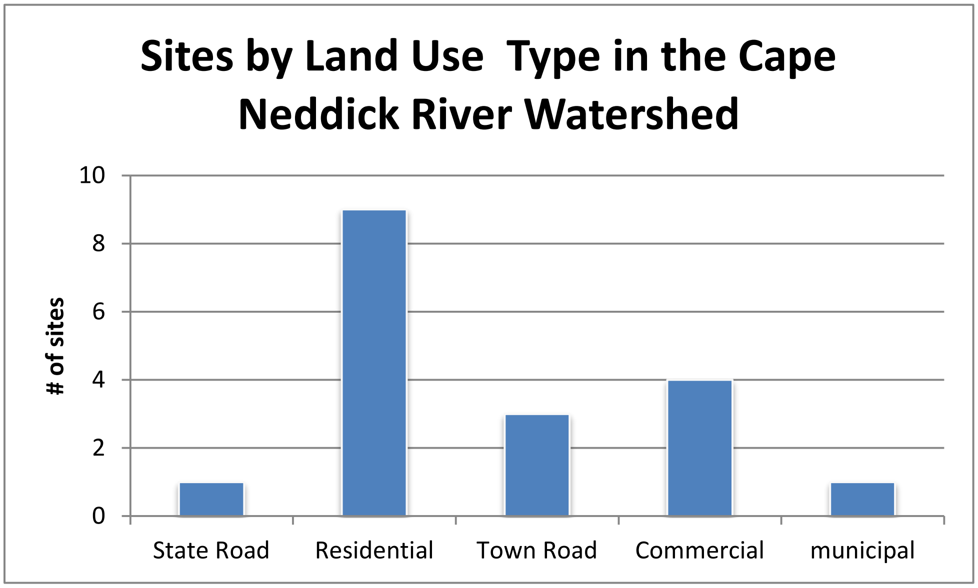


Table 5-5: Breakdown of Sites by Land Use and Impact from the 2013 Stormwater Survey

LAND USE	HIGH IMPACT	MEDIUM IMPACT	LOW IMPACT	TOTAL
STATE ROAD	1	0	0	1
RESIDENTIAL	6	2	1	9
TOWN ROAD	1	0	2	3
MUNICIPAL	1	0	0	1
COMMERICAL	3	1	0	4
TOTAL	12	3	3	18

Recommendations were made for fixing each site, and the associated cost of labor and materials was estimated (Figure 5-4). Cost is an important factor in planning for restoration and the associated costs of BMP application. "Low" costs sites were estimated to cost less than $500. 22% of sites were rated low cost. An estimated cost between $500 and $2,500 was rated as "Medium." 50% of sites were rated medium cost (Figure 5-4). If the estimated cost was greater than $2,500, a "High" rating was assigned. 28% of sites were rated high cost. Appendix A has a detailed summary of the watershed survey.

Figure 5-5: Erosion Site Cost Rating from the 2013 Stormwater Survey

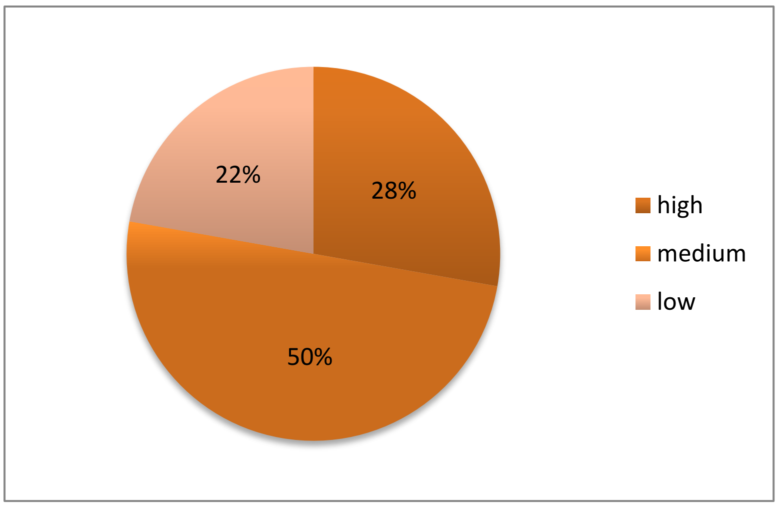
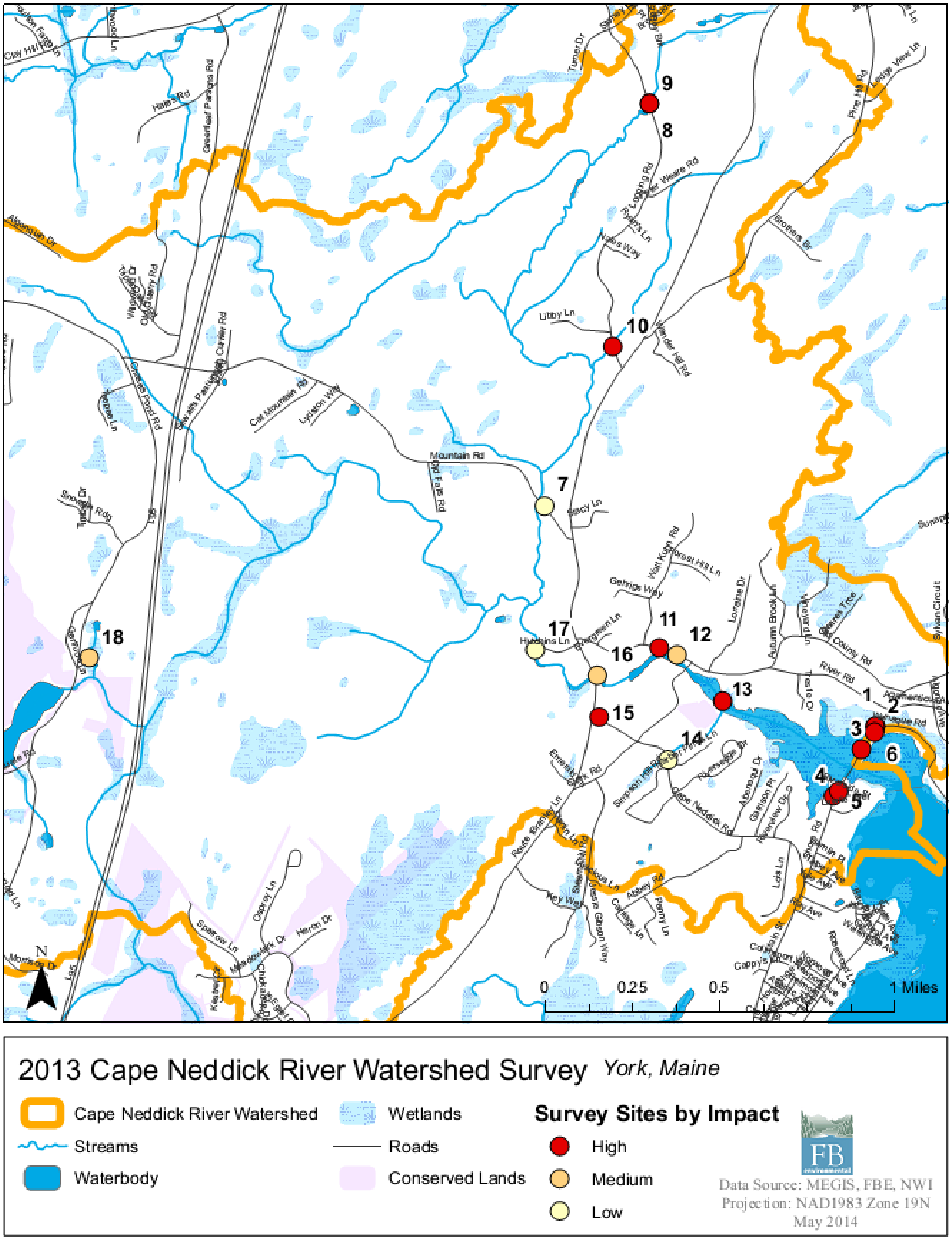


Table 5-6: Identified Critical Areas in the Cape Neddick River Watershed from the 2013 Stormwater Survey

NPS Pollution Critical Areas *Cape Neddick River Watershed Survey Results December 3, 2013*				
Site ID	***Site Type***	***Issues***	***Location UTM***	***Impact***
1	Town Road	Soil Erosion/Sediment, Toxics, Temperature, Crossing	369676 4783230	High
2	Municipal	Bacteria	369676 4783230	High
3	Residential	Soil Erosion/Sediment, Bacteria, Nutrients, Toxics, Buffer	369612 4783124	High
4	Commercial	Soil Erosion/Sediment, Bacteria, Toxics, Buffer Channel	369484 4782907	High
5	Commercial	Soil Erosion/Sediment, Bacteria, Nutrients, Toxics, Buffer	369508 4782931	High
6	Residential	Soil Erosion/Sediment, Bacteria, Buffer	369672 4783203	High
7	Town Road	Buffer	368152 4784247	Low
8	Residential	Soil Erosion/Sediment, Bacteria, Nutrients, Toxics, Temperature, Buffer	368637 4786103	High
9	Residential	Soil Erosion/Sediment, Bacteria, Nutrients, Toxics, Temperature, Buffer	368637 4786103	High
10	Commercial	Soil Erosion/Sediment, Toxics, Channel, Buffer	368467 4784982	High
11	Residential	Soil Erosion/Sediment, Bacteria, Nutrients, Toxics, Buffer	368680 4783592	High
12	Residential	Soil Erosion, Bacteria, Buffer	368763 4783559	Medium
13	Residential	Soil Erosion/Sediment, Bacteria, Nutrients, Buffer	n/a	High
14	Residential	Buffer	368721 4783075	Low
15	State Road	Buffer, Channel	368403 4783273	High
16	Commercial	Toxics, Temperature, Buffer	368395 4783465	Medium
17	Town Road	Bacteria, Nutrients, Buffer	368109 4783582	Low

18	Residential	Soil Erosion/Sediment, Bacteria, Nutrients, Buffer	366054 4783546	Medium

Figure 5-6: Identified Critical Areas in the Cape Neddick River Watershed (a description of each site is located in Table 5-6 and Appendix A)



6. Watershed Goals and Objectives

6.1 Management Objectives

The primary management objectives are to ensure that the Cape Neddick River meets applicable water quality standards as assessed by Maine DEP and the Maine Healthy Beaches Program. A special emphasis is placed on clean water in the tidal portion of the Cape Neddick River, due to the high usage for swimming, boating, and other forms of recreation in the summer and fall.

6.2 Load Reduction Targets – **Element B**

Load reductions are calculated based on observed bacteria concentrations in the Cape Neddick River. Bacterial (enterococci) data collected by the Town of York and Maine Healthy Beaches were used for every sample station with ten or more samples taken over multiple years (primarily 2007-2012). The sample stations which meet the above criteria provide very good coverage of virtually all major tributaries near their confluence with the tidal portion of the Cape Neddick River, which includes recreational waters in the estuary and at the beaches. Load reductions range from 54% to 94% across sample locations (Table 6-1).

To calculate the estimated % reduction necessary to achieve the enterococci safety level (as established by Maine Healthy Beaches, based on EPA guidance) in the Cape Neddick River:

Percent Enterococci reduction =
((Enterococci measured value – Enterococci standard) /Enterococci measured value) x 100

Table 6-1: Load Reduction Targets for Enterococci in the Cape Neddick River Watershed using Geometric Mean Data from all Sampling Locations

Site	Number of Samples	Years Sampled	Enterococci Geometric Mean (mpn)	Enterococci Geometric Standard	Percent Reduction
CNR-01	28	2007-2012	45	35	22%
CNR-02	20	2007-2012	129	35	73%
CNR-03	22	2007-2012	72	35	51%
CNR-04	13	2007-2012	141	35	75%
CNR-05	15	2007-2012	171	35	79%
CNR-06	14	2007-2012	247	35	86%
CNR-07	11	2007-2012	55	35	37%
CNR-08	10	2007-2012	88	35	60%
CNR-09	15	2007-2012	139	35	75%
CNR-10	13	2007-2012	142	35	75%
CNR-11	14	2007-2012	561	35	94%
CNR-13	14	2007-2012	144	35	76%
CNR-14	18	2007-2012	278	35	87%
CNR-15	11	2007-2012	199	35	82%
YK-02	178	2003-2013	31	35	75%

7. Management Strategies

7.1 Existing Management Strategies

Efforts to identify pollution sources and ensure clean water in the Cape Neddick River have been ongoing for many years.

- Regular, ongoing bacteria monitoring at Cape Neddick Beach by Maine Healthy Beaches from 2003 to present.
- 2012 Cape Neddick River Watershed-Based Management Plan (includes 2012 bacteria monitoring results)
- Bacteria sampling 2007-2011 by the Town of York Community Development Department.
- Cape Neddick River Shoreline Reconnaissance Survey in 2011.

- The Town's Supplemental Plumbing Ordinance requires septic tanks to be pumped periodically. With respect to the Cape Neddick River, active enforcement is being initiated in 3 stages based on the area within the watershed, as follows:
    - First Priority Area / Chases Pond Watershed. On October 15, 2010, letters were mailed to over 50 property owners with septic systems in the Watershed Protection Overlay District. About half complied with the request to either pump or to provide documentation of pumping within the past 3 years.
- The Town of York passed a septic system inspection and maintenance ordinance in 2010, which requires septic system pump-outs every 3 to 5 years.
- Bacteria Source Tracking using canine detection and laboratory analysis by FB Environmental in 2013 (FBE 2013).
- Ongoing acquisition of town-owned property and streams in cooperation into "Conservation Land" to minimize development thereby reducing contaminated stormwater runoff.

7.2 Additional Strategies Needed to Achieve Goals – **Element C**

The primary concern in the Cape Neddick River watershed is bacteria, with general pollutants from stormwater runoff being an additional concern. In general, bacteria can be addressed in the following ways in this watershed:

- Reduce the volume and intensity of stormwater runoff (see paragraphs below), since runoff is one of the primary transportation mechanisms bringing bacterial pollution to surface waters.
- Continue developing a municipal program (ordinance, enforcement, and education) that ensures all septic systems are properly maintained over the entire service life of these systems.
- Continue to municipal ordinance development and enforcement aimed at proper management of pet waste.
- Develop a public outreach program focused on reducing pet waste within the watershed.
- Conduct wildlife management efforts to reduce nuisance populations, if needed. For example, high concentrations of geese can be discouraged from congregating near water if vegetated buffers interfere with the geese's ability to see the water from land.
- Extend sewer services throughout the Cape Neddick River watershed.

7.2.1 Treating Stormwater Runoff

Stormwater runoff is also a significant water quality concern in the Cape Neddick River as high concentrations of bacteria have been documented during and after storm events. 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.

Best Management Practices (BMPs) are any structural or non-structural practice developed 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, or more involved such as installing sediment detention basins to capture and filter sediments before they enter the water. Often, a variety of BMPs may be needed to adequately treat NPS pollution. The following list provides general examples of many different BMPs that can be applied to the NPS problems identified in the watershed Cape Neddick River watershed:

Erosion on Roads and Driveways

- Install permeable pavement to allow water infiltration where feasible.
- Add new surface material to stabilize roadways.
- Install runoff diverters (broad-based dip, rubber razor, waterbar).
- Use detention basins at ditch turnouts to retain water between runoff events, and remove suspended sediments and adsorbed pollutants.
- Remove excess winter sand.
- Reshape/vegetate road shoulder.
- Reshape or crown roads to reduce water on surface.
- Pave dirt roads.
- Stabilize eroding ditches with grass, stone, check dams, or reshaping to reduce erosion.

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.

- Replace mowed lawn areas with naturalized vegetation where feasible.
- Mulch bare soil with straw, wood fiber, or chips, etc., over a seeded area to protect the bed from erosion and drying.

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.
- Install/retrofit culverts to provide improved fish passage and remove barriers.

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

- Revegetate 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.
- 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.

7.2.2 Sewer Expansion

Currently, the CNR Watershed is entirely without sewer. The capacity of the YSD treatment plant and its proximity to the neighborhoods on the south side of the lower CNR make it a potentially feasible alternative to septic systems for sewage disposal. The feasibility of sewering *the south side neighborhoods was previously evaluated in a Sewerage Feasibility Study prepared for the YSD in 1994 (Anderson-Livingston Engineers, Inc., 1994). The study evaluated two alternatives for extending sewer into an area encompassing Main Street, Shore Road, and Route 1A and associated side roads up to Clark Road. The rationale for conducting the study was that small house lots were created in many areas which have marginal soils to support septic systems. Additionally, there were existing problems with the septic system that served the Cape Neddick Lobster Pound and the lack of a system at the Cape Neddick Campground. The feasibility study recommended an alternative that included one main pump station and several smaller package pump stations. Wastewater flows were estimated based on providing sewer service to all existing structures and then available house lots. The total estimated flow for the study area was 74,300 GPD average flow, well within the excess capacity currently experienced at the YSD treatment plant.*

More recently, engineering plans were prepared in 2006 for a sewer extension on Main Street and Shore Road up to Riverside Street at the Cape Neddick Campground. The project was put out to bid in 2007. The low bid was $1,617,729 (including alternatives) which translated to an average cost per household of $24,000, not including connection costs and an Impact Fee of $2,500. The YSD reviewed the plans and determined that plan modifications could reduce the average cost per household to $18,000, not including Impact Fee, connection costs, and the cost of pumps for residences not connected to a gravity line. The YSD was able to secure a low interest loan for the project from the State Revolving Loan Fund (SRF). At a public hearing on the project, the majority of affected homeowners were decidedly against the project and the project was shelved. However, the feasibility of expanding the sewer to the CNR Watershed should continue to be investigated as it will greatly reduce bacteria inputs from malfunctioning septic systems throughout the watershed.

7.3 Load Reduction Estimates – **Element B**

It is difficult to predict 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.

Given that bacteria and pathogens are the primary pollutants of concern, BMPs that focus on source reduction and infiltration of stormwater are most effective. Source removal, such as repairing broken sewer or septic system pipes, removal of pet waste, and elimination of sewer/stormwater cross connections, are considered to result in close to 100% load reduction on a site-specific basis. Table 7-1 provides removal efficiencies for stormwater-related bacteria sources.

The secondary pollutant, sediment, is dealt with primarily through stabilizing bare soil and improving the landscape to reduce the speed and intensity of runoff water. **Table 7-1** provides load reduction estimates for the suite of contaminants associated with erosion and sedimentation.

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

Table 7-1: Structural BMP Expected Pollutant Removal Efficiency

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

8. Plan Implementation

8.1 Plan Oversight

The primary entity responsible for implementing the plan is the Town of York. However, the work and oversight of the plan will involve a committee of stakeholders, including representatives from the town of York (including Conservation Commissions, Select Board, and Public Works Departments), the York Sewer and Water Districts, The Cape Neddick River Association, Maine DOT, and Maine DEP.

8.2 Action Plan – <u>**Elements C, D, and F**</u>

The Town of York will work toward improving and implementing an Action Plan to reduce bacteria to the Cape Neddick River which consists of action items within seven major categories (Table 8-1):

1. Watershed Planning
2. Reducing Impervious Cover and Treating Stormwater Runoff
3. Increasing Buffers on the Cape Neddick River
4. Improving Wastewater Removal
5. Addressing Animal Waste
6. Protecting and Conserving Undeveloped Land
7. Continuing Water Quality Assessment

This Action Plan was developed to follow-up on objectives developed through a series of meetings of the Cape Neddick River Steering Committee in October 2013 and January 2014. Committee participants included local town officials, watershed landowners, and members of the Cape Neddick River Association. 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 of the seven categories. The implementation of this Action Plan is expected to be completed in ten years. As indicated in the Action Plan, the plan should be re-visited every three years to assess progress and determine the feasibility and applicability of the remaining action items.

8.2.1 Financial Support and Technical Assistance

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

Federal Clean Water Act, Section 319 Nonpoint Source Implementation Grants

Section 319 Grants are available to assist projects that promote restoration and protection of water quality through reducing and managing nonpoint source pollution. These grants are made possible by federal funds provided to ME DEP by the USEPA under Section 319 of the Clean Water Act.

Clean Water Finance Agency, Clean Water State Revolving Fund Loans

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

<u>Small Community Grant Program (SCG)</u>

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.

Table 8-1: Action Plan for the Cape Neddick River Watershed Based Management Plan

WATERSHED PLANNING																		
Action Items	***Priority** (number of votes at public meeting)	**Responsible Party**							**Funding Source**								**Approximate Cost**	**Schedule**
		Town of York	CNRA	YCC	YCSWD	Land Trusts	Schools	Land-owners	ME DEP 319	Other Federal	Other State	Town of York	Private	Volunteer				
Develop/Implement a comprehensive education and outreach plan for residents in the CNR watershed	20	x	x	x	x	x	x	x	x		x	x	x	x			$24,000	2015
Conduct a revised build-out analysis of the watershed to assess the impact of future development	19	x	x		x	x		x			x	x	x				$20,000	2016-2018
Research potential zoning changes to limit development in shoreland zone and to encourage LID	6	x			x						x	x	x				$5,000	2014-2016
Develop an Open Space Plan for the Town	6	x	x	x	x	x		x			x	x	x	x			$20,000	2015-2017
Form the CNR Watershed Committee	4	x	x	x	x	x		x	x			x		x			$12,000	Beginning 2014
Develop a plan to measure progress such as revisiting Action Plan every three years	4	x	x	x	x				x		x	x		x			$12,000	2017. 202, and 2023
Conduct workshops with the Town of York Select Board on importance of current and future water quality issues	2	x	x	x	x				x		x	x	x	x			$10,000	Beginning 2014

Action item discussed at CNRW meeting
*Meeting attendees voted to prioritize action items on 1/28/2014
CNRA = Cape Neddick River Association
YCC = York Conservation Commission
YCSWD = York County Soil and Water District

REDUCING IMPERVIOUS COVER AND TREATING STORMWATER RUNOFF																
Action Items	***Priority** (number of votes at public meeting)	**Responsible Party**							**Funding Source**						**Approximate Cost**	**Schedule**
		Town of York	CNRA	YCC	YCSWD	Land Trusts	Schools	Land-owners	ME DEP 319	Other Federal	Other State	Town of York	Private	Volunteer		
Develop/Implement a comprehensive public outreach campaign focusing on stormwater runoff	25	x	x	x	x		x	x	x		x	x		x	$20,000	2015-2017
Develop a comprehensive stormwater mitigation plan	12	x	x		x					x	x	x	x	x	$75,000	2018-2020
Encourage commercial, municipal, and residential installations of stormwater prevention practices (e.g. rain gardens, rain barrels)	10	x	x		x		x	x	x		x	x	x	x	$80,000	Immediately and ongoing
Recognize/award businesses using IC reduction practices	8	x	x	x					x			x	x	x	$4,000	2018
Inventory all impervious areas (including % lawn area) throughout the watershed to ensure the overall IC impacts are understood	6	x	x		x						x	x	x	x	$5,000	2018-2020
Evaluate stream crossings to identify locations for stormwater retrofits	6	x	x		x						x	x	x	x	$12,000	2016-2018
Conduct LID workshops for municipal staff including DPW	1	x			x				x			x	x		$12,000	Beginning 2015
Research stormwater ordinance options	1	x	x	x	x						x	x	x	x	$5,000	2015
Work with Town Planning Department to hold pre and post-development seminars for developers	1	x	x		x				x			x	x	x	$12,000	2018-2020
Work with ME DOT to incorporate and encourage LID into their designs	1	x			x				x			x	x		$5,000	Beginning 2015
Develop a stormwater ordinance	1	x	x	x	x						x	x			$20,000	2020-2022

INCREASING BUFFERS ALONG THE CAPE NEDDICK RIVER

Action Items	***Priority** (number of votes at public meeting)	**Responsible Party**							**Funding Source**						**Approximate Cost**	**Schedule**
		Town of York	CNRA	YCC	YCSWD	Land Trusts	Schools	Land-owners	ME DEP 319	Other Federal	Other State	Town of York	Private	Volunteer		
Develop an incentive program for voluntary buffer increases	15	x	x					x	x			x	x	x	$8,000	Beginning 2015
Research/use geese deterrent options	14	x	x	x								x	x	x	$20,000	2015
Provide technical assistance to landowners landscaping in the shoreland zone	13	x	x		x			x	x		x	x	x	x	$10,000	Beginning 2015
Encourage installation of vegetated buffers along shoreline properties	10	x	x		x		x	x	x		x	x	x	x	$40,000	Immediately and ongoing
Encourage stricter enforcement of riparian zoning laws	4	x	x									x			$6,000	Beginning 2018
Provide educational workshops to local landscapers	4	x	x		x				x			x	x	x	$10,000	Beginning 2015
Provide educational materials on keeping geese off of properties as one benefit of a developed buffer	2	x	x	x	x				x			x	x	x	$4,000	2015-2017
Work with local nurseries to get discounts for plants for buffer plantings	2		x					x	x			x	x	x	$0	Beginning 2015
Develop a shoreland buffer brochure illustrating the types and benefits of buffers available	1	x	x		x			x	x			x	x	x	$4,000	2015-2017
Hold residential socials with a garden theme in shoreland neighborhoods	1	x	x		x			x	x			x	x	x	$10,000	2016-2018

IMPROVING WASTEWATER REMOVAL																
Action Items	***Priority** (number of votes at public meeting)	**Responsible Party**							**Funding Source**						**Approximate Cost)**	**Schedule**
		Town of York	CNRA	YCC	YCSWD	Land Trusts	Schools	Land-owners	ME DEP 319	Other Federal	Other State	Town of York	Private	Volunteer		
Develop a program to handle seasonal use properties. Weekly rental would have to be licensed and approved by the BOS annually.	18	x	x								x	x	x	x	$100,000	2018-2022
Evaluate sewer expansion potential particularly into the lower portion of the watershed	14	x	x								x	x			< $50,000	Beginning 2016
Establish a mechanism to track septic system maintenance/replacement history	12	x			x				x		x	x	x	x	$6,000	By 2016
Continue to encourage enforcement for pumping violations	8	x										x			$4,000	Immediately and ongoing
Continue public outreach to inform residents about the relationship between septic systems and water quality	6	x	x	x	x				x		x	x	x	x	$8,000	Beginning 2014
Seek funding through the Small Community Grants Program to help replace septic systems that have been shown to pollute the Cape Neddick River	4	x	x					x			x	x	x		$4,000	Beginning 2017
Research potential for a "Septic Inspector/Surveyor" to find failing septic systems in the watershed	3	x	x		x				x			x	x		$1,000	2015
Review the current septic system ordinance	1	x	x		x				x			x	x	x	$8,000	2014-2016
Research/Use aerial photography as a method to identify septic break-outs	1	x	x	x							x	x	x		$2,000-$100,000	2018-2020

ADDRESSING ANIMAL WASTE																	
Action Items		**Responsible Party**							**Funding Source**							**Approximate Cost**	**Schedule**
	***Priority** (number of votes at public meeting)	Town of York	CNRA	YCC	YCSWD	Land Trusts	Schools	Land-owners	ME DEP 319	Other Federal	Other State	Town of York	Private	Volunteer			
Increase the width of buffers along shoreland properties to discourage geese	26	x	x	x	x			x	x		x	x	x	x		$40,000	Beginning 2014
Promote pet waste management (e.g. create a dog park; post pet waste bags in shoreland zone)	19	x	x	x	x			x	x			x	x	x		$12,000	2020-2022
Develop a public education campaign addressing pet waste management	13	x		x	x		x		x			x	x	x		$8,000	2017
Investigate areas throughout the watershed where animals congregate (e.g. geese)	6	x	x		x							x	x	x		$2,500	2015-2017
Ensure the Town of York Animal Control Ordinance is enforced	5	x										x				$2,000	2015

PROTECTING AND CONSERVING UNDEVELOPED LAND

Action Items	***Priority** (number of votes at public meeting)	**Responsible Party**							**Funding Source**						**Approximate Cost**	**Schedule**
		Town of York	CNRA	YCC	YCSWD	Land Trusts	Schools	Land-owners	ME DEP 319	Other Federal	Other State	Town of York	Private	Volunteer		
Develop a watershed-scale Open Space Plan	20	x				x						x	x	x	$20,000	By 2020
Use conservation or open space subdivisions to reduce numbers of lots in shoreland zones	19	x	x		x			x				x		x	NA	Beginning 2018
Coordinate with local land trusts to acquire land to protect riparian areas	18	x	x			x		x			x	x	x	x	NA	Beginning 2015
Encourage "green infrastructure" to reduce municipal costs	5	x										x		x	NA	Beginning 2015
Develop an Open Space Committee	3	x	x	x	x	x		x				x		x	$8,000	By 2016

CONTINUING WATER QUALITY ASSESSMENT																
Action Items	***Priority** (number of votes at public meeting)	**Responsible Party**							**Funding Source**						**Approximate Cost**	**Schedule**
		Town of York	CNRA	YCC	YCSWD	Land Trusts	Schools	Land-owners	MEDEP 319	Other Federal	Other State	Town of York	Private	Volunteer		
Continue water quality monitoring throughout the CNR watershed	21	x	x		x					x	x	x	x	x	$30,000	Beginning 2014
Evaluate existing data and monitoring program to determine future focused monitoring (e.g. bracket sampling)	18	x	x	x	x					x	x	x	x	x	$6,000	2015-2016
Flow monitoring-especially at Chase's Pond dam	14	x	x	x	x					x	x	x	x	x	$20,000	2018-2020
Develop a stormwater monitoring program (e.g. wet-dry weather sampling)	12	x	x		x					x	x	x	x	x	$30,000	Beginning 2016
Conduct baseline sediment and macroinvertebrate study	7	x			x						x	x	x		$20,000	2020-2022
Utilize canine detection to determine "hotspots" of human sources of bacteria in the watershed	6	x	x									x	x		$10,000	Beginning 2014
Explore funding options to increase volunteer monitoring programs	2	x	x				x	x	x		x	x	x	x	$4,000	2015
Develop a town web page to link water quality data to town water quality management initiatives	1	x	x		x				x			x	x	x	$6,000	By 2016

8.3 Indicators to Measure Progress – **Element G**

Indicators provide an ongoing measure of progress in implementing the watershed based plan. Monitoring, as outlined below, is an essential indicator of progress. In addition, the following programmatic, social, and environmental indicators will be used to measure progress of the Cape Neddick River Watershed Based Management Plan.

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 meetings held by the Cape Neddick River Watershed Steering Committee.
- Number of water quality samples taken.
- Number of septic systems inspected and/or pumped out.
- Number of houses that eliminate septic systems and hook up to sewer.
- Amount of funding secured for plan implementation.
- Number of BMPs installed.
- Number of hydrologically connected impervious acres disconnected from streams or estuaries.
- Number of acres of preserved open space.
-
- Feet of shore line permanently protected.

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 people and range of organizations participating in the Cape Neddick River Watershed Coalition.
- Number of landowners who participate in shoreland buffer neighborhood meetings and demonstration projects.
- Number of homeowners who participate in residential stormwater educational programs.
- Number of people who participate in river cleanup days.
- Number of requests for information (from the town and the coalition).
- Amount of town and stakeholders' website hits (track webpage).

- Number of volunteer hours to support Maine Healthy Beaches, Cape Neddick River Association, York Conservation Commission, and other activities focused on protecting the Cape Neddick River.

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 samples meeting water quality standards.
- Number (or absence) of beach advisories per season.
- Number of acres of improved riparian habitat.

8.4 Educational Component – Element E

The educational component of this plan will engage a broad base of stakeholders, enhance public understanding, and encourage community participation in ensuring clean, safe water in the Cape Neddick River and beach. Education efforts will consist of these elements:

1. **Establish and maintain Cape Neddick River Watershed Steering Committee.** While the primary goal of the coalition is to support active management using coordinated resources, a secondary benefit of the coalition will be the education of key community members.
2. **A web page focused on protecting the Cape Neddick River.** The site will provide a description of watershed protection efforts, coalition members, and copies of reports.
3. **Two press releases per year.** One press release early in the beach going season to describe the monitoring and management efforts of the coalition, and one after the season ends will report on stream and beach water quality based on sampling.
4. **Continued outreach on cleaning up pet waste.** York has taken several steps to ensure pets are responsibly managed. An ordinance prohibits dogs, ponies, and horses from York beaches and in the River Estuary between 8:00 am and 6:00 pm from May 20th – September 20th. Pet clean up stations have been installed in various locations, and there is a part-time animal control officer. Annual maintenance and enforcement of these efforts and resources is part of the educational component of this watershed management plan.
5. **Establish stormwater demonstration sites.** Portions of the lower watershed are densely developed and have a relatively high percentage of impervious cover or are lacking vegetated buffers. Hydrologically disconnecting sections of impervious cover from streams and the estuary is an important step toward reducing the impact of polluted stormwater, and signage at demonstration sites will promote this theme, and encourage river friendly shoreline practices.

8.5 Monitoring Plan – **Element I**

The monitoring plan for the Cape Neddick River will build on the experience and resources established over the past years. The core monitoring activities will consist of these elements:

1. **Enterococci beach sampling through Maine Healthy Beaches.** This core sampling element has all the advantages of an established sampling program, including close proximity to recreational users.
2. **Enterococci sampling at major freshwater tributaries.** A minimum of four sample days throughout the swimming season at 6-8 selected sites, covering the major tributaries. This core freshwater tributary sampling effort provides a baseline screening effort to help prioritize more targeted sampling, as well as maintains a lookout for year-to-year trends.
3. **Focused source tracking sampling on highest priority areas**. The location and frequency of this sampling will be as determined by core sampling under points 1 and 2. A typical targeted sampling effort would consist of enterococci samples at four to eight sites over three to six dates over a season. Supplemental testing using canine detection methods, optical brighteners, surfactants, dye studies, or other source tracking techniques may be added as opportunities allow.
4. **Septic system inspections and pump-outs under York's Septic Ordinance.** Integrating the septic system ordinance provisions into the monitoring plan will provide a key bridge between water quality efforts and the municipal code enforcement. The exact scope of this effort will depend to a large degree on municipal authority and resources, but the goal is to inform enforcement efforts with bacterial sampling, and vice versa.
5. **Periodic compilation, analysis, and reporting of bacteria and enforcement results.** Each winter or spring, data will be sought from Maine Healthy Beaches, the Cape Neddick River Association, the York Sewer and Water Districts, York Code Enforcement Office, Maine DMR, and Maine DEP. Besides promoting valuable collaboration, this component of the monitoring plan will regularly bring together new data and experience from the past seasons. Analysis and a brief written report will focus on lessons learned, trends, and what areas to prioritize for future sampling.

8.6 Evaluation Plan – **Element H**

There are several criteria in place to measure the success of this watershed based plan (Section 8.3(. The central criteria are those assessed by ME DEP in determining whether the Cape Neddick River meets its water quality classification. Failure to meet water quality criteria results in a formal listing as impaired under the Clean Water Act, reported biennially to the US EPA as part of the Integrated Water Quality Monitoring and Assessment Report. Specifically, the primary freshwater criteria for aquatic life use are measured by three types of numeric data collected by Maine DEP, dissolved oxygen, benthic macroinvertebrates, and periphyton (algae).

See: http://www.maine.gov/dep/water/monitoring/305b/index.htm

In addition, the Maine Department of Marine Resources has well-defined water quality standards based on bacteria tests (fecal coliform) that apply to the tidal portion of the Cape Neddick River. Success in the Cape Neddick River watershed will consist of evaluation of tidal waters. Though potential clam harvesting areas exist in the Cape Neddick River, the location of the York Waste Water Treatment Facility discharge prevents these areas from ever opening for harvesting

See: http://www.maine.gov/dmr/rm/public_health/closures/closedarea.htm

Finally, Maine Healthy Beaches program conducts regular bacteria (enteroccoci) tests which determine whether a beach advisory should be posted. Success in managing the Cape Neddick River can be measured by regular beach testing which shows no advisories are needed.

See: http://www.mainehealthybeaches.org/index.html

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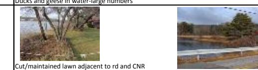
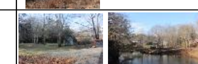
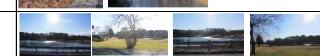
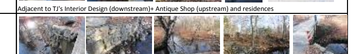
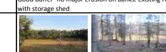
10. Appendix A: 2013 Stormwater Survey Results

2013 Cape Neddick River Watershed Stormwater Survey

Site	Date	Surveyor	affected water body	Landowner contacted?	photos	Location	Easting	Northing	Area	Land Use	Issues	Recommendations	size/amount	pollutants	transport to stream	Impact rating	Cost	Comments
1	12/3/2013	WB, LC	CNR	No		NW corner @ Shore Rd Crossing	369676	4783230		town road	Soil Erosion/Sediment: road should/ditch erosion- water over shoulder onto road; Toxics: Roadway runoff; Temperature: drainage from roadway; Culvert/Crossing: crossing should be larger	Soil Erosion/Sediment/Culverts: enlarge crossing, build up road/add surface material; Temperature: stormwater controls	Medium	Multiple	Direct flow	High	High	
2	12/3/2013	WB, LC	CNR	No		Ponded water body inland of shore land crossing				marsh-waterfowl gathering area	Bacteria: waterfowl/ wildlife gathering area	Nutrients/Bacteria: wildlife management	Large	Single	Direct flow	High	Medium	Ducks and geese in water-large numbers
3	12/3/2013	WB, LC	CNR	No		House on Shore Rd, NW edge of bridge	369612	4783124	80x200 ft	residential	Soil Erosion/Sediment: Bare soil/fields; Bacteria: Pet waste?, waterfowl/wildlife gathering area onto lawn; Nutrients: manicured lawn cut low; Toxics: manicured lawns; Other Buffer Issues: poor/degraded buffer	Soil Erosion/Sediment/Culverts: Plant/improve buffer; Nutrients: remove pet waste?, wildlife management-add buffer	Small/Medium	Multiple	Direct flow	High	Low	 Cut/maintained lawn adjacent to rd and CNR
4	12/3/2013	WB, LC	CNR	No		Harborside Restaurant/Lobster pound	369484	4782907	200x200 ft	Commercial, Recreational (boat Launch)	Soil Erosion/Sediment: bare soil/fields, road surface erosion (boat access); Bacteria: waterfowl/wildlife gathering area-no buffer; Toxics: drainage from high use parking lot (boat launch), dumpster runoff-did not access but w/ in 20ft of stream with no buffer; Other Buffer Issues: buffer not wide enough, poor degraded buffer; Stream Channel: storm drains directly to channel, excessive build up of sediment from parking lot/boat launch	Soil Erosion/Sediment/Culverts: install turnout on shore rd to prevent runoff, reshape ditch, install runoff diverter (water bars on boat launch), plant/improve buffer; Toxics: clean up garbage/dumpster area-move away from river; Nutrients/Bacteria: wildlife management-buffer to prevent geese	Large	Multiple	Direct flow	High	Medium/High	 Restaurant is over the water on piles-other areas have no buffer-launch area erosion is moderate, potential bird gathering area. Harborside Restaurant/ Cape Neddick Lobster pound
5	12/3/2013	WB, LC	CNR	No		Campground at riverside sty.	369508	4782931		Commercial-Campground	Soil Erosion/Sediment: bare soils/fields; Bacteria: pet waste?, potential waterfowl/wildlife gathering area; Nutrients: pet waste?; Toxics: manicured lawns, heavy vehicle traffic (RV all year), dumpster runoff-didn't see but must be one on property	Soil Erosion/Sediment: plant/improve buffer; Toxics: buffers, improve stormwater controls, low impact turf care; Nutrients/Bacteria: remove pet waste if needed, wildlife management if needed.	Large	Multiple	Direct flow	High	Medium/High	
6	12/3/2013	WB, LC	CNR	No		House NE corner of Shore Rd crossing	369672	4783203	100x100	Residential	Soil Erosion/Sediment: bare soils/fields; Bacteria: potential septic system problems-property directly adjacent to CNR beach-where is septic-no room. Other Buffer Issues: buffer not wide enough, poor degraded buffer-buffer non existent	Soil Erosion Sediment/Culverts: plant and improve buffer.	Medium	Multiple	Direct flow	High	Medium	 Look up dog results for potential septic failure
7	12/3/2013	WB, LC	CNR	No		Mountain Rd ditch	368152	4784247	100x25	Town Road	Other Buffer Issues: concentrated flow path of stormwater through buffer	Toxics: improve stormwater controls	Small	Single	Limited	Low	Medium/Low	 Cutting in shore land zone, direct flow path of stormwater to stream-maybe rock-lined instead?
8	12/3/2013	WB, LC	CNR/Tributary	Spoke to homeowner on SW side of road		Logging Rd-north crossing	368637	4786103		Residential/Agriculture? (did not observe but fences and barn)	Soil Erosion/Sediment: fields; Bacteria: Livestock-horse paddocks and fenced area adjacent; Toxics: manicured lawns; Temperature: lack of stream shading, drainage from pong/dammed area; Other Buffer Issues: buffer not wide enough	Soil Erosion/Sediment: plant/improve buffer; Nutrients/Bacteria: Ag waste management(if needed); Temperature: Establish buffer	Medium/Large	Multiple	Direct flow	High	Medium/Low	 Stream flows through cut lawn (well maintained- no buffer- grass cut to banks ~ 25ft) on NE side of rd before entering culvert. On SW side of road-large pond area with livestock fence (no livestock observed) with minimal buffer
9	12/3/2013	WB, LC	Ditch to Stream	No		Ditching and ponds on Logging Rd- south of site #8	368637	4786103		Residential	Soil Erosion/Sediment: bare soil/fields; Bacteria: Pet waste?; Nutrients: very green lawn-fertilizer?; Toxics: manicured lawns; Temperature: lack of stream shading; Other Buffer Issues: buffer not wide enough, poor degraded buffer-buffer non-existent	Soil Erosion/Sediment: Plant/Improve buffer; Other: investigate source of flow/water	Medium/Large	Multiple	Limited	Medium/High	Medium	 Unusual ditching through property, ponded areas in front of yard, flowing water moves into rd ditch and directly to stream on NE side of Logging Rd. Ditches dug on W side of property-lawns surrounding (very green) with no buffer what so ever. Garden (raised bed)adjacent. Investigate source of flow-unknown
10	12/2/2013	WB, LC		No		Crossing S of Libby Ln on Logging rd- Freeman Signs/ Eldridge Brothers Fly Shop	368467	4784982		Commercial/Residential	Soil Erosion/Sediment: Bare soil/fields, unstable culvert inlet/outlet on upstream side; Toxics: Heavy vehicle traffic; Other Buffer Issues: buffer not wide enough; Stream Channel: channel straightened along roadway	Soil Erosion/Sediment: Clean out culvert, stabilize banks; Temperature: extend/improve buffer; Other: investigate sources in storage yard	Small/Medium	Multiple	Limited	Medium/High	Medium	 Large equipment storage yard located adjacent to stream did not access- heavy equipment/trash/storage containers observed.
11	12/3/2013	WB, LC	CNR	No		River Rd- mailbox #57- home adjacent lawns	368680	4783592		Residential	Soil Erosion/Sediment: bare soils/fields; Bacteria: potential waterfowl/wildlife gathering area-minimal buffer, ducks in water; Nutrients: Pet waste?; Toxics: manicured lawns; Other Buffer issues: buffer not wide enough	Soil Erosion/Sediment: plant/improve buffer	Medium	Single/Multiple	Direct flow	Medium/High	Low/Medium	
12	12/3/2013	WB, LC	CNR	No		Open grassy area on River Road-small building	368763	4783559		Residential	Soil Erosion/Sediment: bare soils/fields- runoff from rd-slight; Bacteria: waterfowl/ wildlife gathering area (potential); Other Buffer Issues: poor/degraded buffer	Soil Erosion / Sediment: plant/improve buffer, control runoff from river road	Small/Medium	Single	Direct flow	Medium/Low	Low	
13	12/3/2013	WB, LC	CNR	No		Multiple house on River Rd + opposite side (various access rds)				Residential	Soil Erosion/Sediment: fields; Bacteria: Pet waste?, waterfowl / wildlife gathering area (many geese on lawns during survey); Other Buffer Issues: buffer not wide enough, poor/degraded buffer-buffer non-existent in some areas	Soil Erosion/Sediment: plant/improve buffer; Toxics: low impact turf care (if necessary); Nutrients/Bacteria: low impact fertilizer (in necessary), wildlife management	Large	Multiple	Direct flow	High	Medium/High	 Multiple homes on both sides of the CNR have large, well manicured lawns with geese. Lawns slope to river and have minimal to NO buffer. Direct flow to river over lawn surface- bacteria and nutrients!
14	12/3/2013	WB, LC		No		North of intersection of Cape Neddick Rd and Harbor Pines Ln	368721	4783075		Residential	Other Buffer Issues: buffer not wide enough, poor/degraded buffer	Soil Erosion/Sediment: plant/improve buffer	Small/Medium	Single	Limited	Low	Low	 No flow downstream of Rd- intermittent
15	12/3/2013	WB, LC	Tributary to CNR	No		Intersection of Rt 1 and Cape Neddick Rd, Tributary to CNR- from wetland drainage?	368403	4783273		State Road/Town Road, Residential?	Other Buffer Issues: Poor/degraded buffer between house; Stream Channel: bank/channel down cutting/incision, severe streamabank erosion/failure, excessive trash, excessive build up of sediment	Stream Channel/Culverts: bank stabilization, restore channel; Other: Investigate origin of culvert and pipe from house	Large	Multiple	Direct flow	High	Medium/High	 Investigate origin of culvert and pipe from house, tributary from unknown origin-wetland? Culvert (dry) comes out of bank near Cape Neddick Rd (unknown). White PVC pipe from adjacent house (see photo)-drain? Laundry?
16	12/3/2013	WB, LC		No		Rt. 1 river crossing	368395	4783465		Commercial	Temperature: Lack of stream shading; Toxics: manicured lawns; Other Buffer Issues: poor/degraded buffer	Soil Erosion/Sediment: plant/improve buffer; Temperature: establish buffer	Large	Single/Multiple	Direct flow	Medium	Medium/Low	 Adjacent to TJ's Interior Design (downstream)+ Antique Shop (upstream) and residences
17	12/3/2013	WB, LC	Tributary to CNR	No		Hutchins Ln	368109	4783582	20x20	Town Road/Residential	Bacteria: Storage shed; Nutrients: green lawn; Other Buffer Issues: Poor degraded buffer	Soil Erosion/Sediment: plant/Improve Buffer; Toxics: clean up storage shed/ potential sources	Small	Single	Limited	Low	Low	 Good buffer- no major erosion on banks. Existing rip-rap ditches appear to be working properly. House adjacent with storage shed
18	12/3/2013	WB, LC	CNR	No		Chase Pond Rd- hobby farm			100x100	Residential	Soil Erosion/Sediment: fields, livestock access to stream bank; Bacteria: livestock; Nutrients: Livestock/improper manure storage?; Other Buffer Issues: poor/degraded buffer	Soil Erosion/Sediment: fence out livestock from stream, plant/improve buffer	Medium	Multiple	Limited	Medium	Medium/Low	 Small ponding area, flow directly to CNR south of Chase Pond Outlet