Contract #07-04d

2011

Task 1A5: Baker Cove Track Down Survey and Abbreviated Watershed-Based Plan

Photo by ECCD staff

Prepared by the Eastern Connecticut Conservation District, Inc.

www.ConserveCT.org/eastern

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Cover Photograph: Lobster traps and dock on Jupiter Point, looking south over Baker Cove toward Bushy Point (photo by Sarah Lamagna, ECCD).

Acknowledgements

Creating a watershed-based plan, even one for a reasonably small watershed, like that contributing to Baker Cove, is not a small undertaking. It requires the work and perseverance of many individuals, who know well and care deeply about the watershed they are investigating. ECCD would like to thank the many people who shared their time, knowledge and experience to help create this watershed plan.

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Introduction

The Eastern Connecticut Conservation District (ECCD) conducted a track down survey of three local watersheds in Groton, Connecticut in order to identify potential sources of nonpoint source pollution that have degraded water quality in Baker Cove. Baker Cove (CT Waterbody Segment ID CT-E1_013), a 0.314 square mile estuary of Fisher Island Sound located between the City and Town of Groton, Connecticut, is listed in the 2008 and 2010 State of Connecticut Integrated Water Quality Reports as impaired for direct shellfish consumption (where permitted) due to elevated levels of fecal coliform bacteria. The report lists waterfowl, unspecified urban stormwater, marina/boating sanitary on-vessel discharges and residential districts as possible sources of the bacteria.

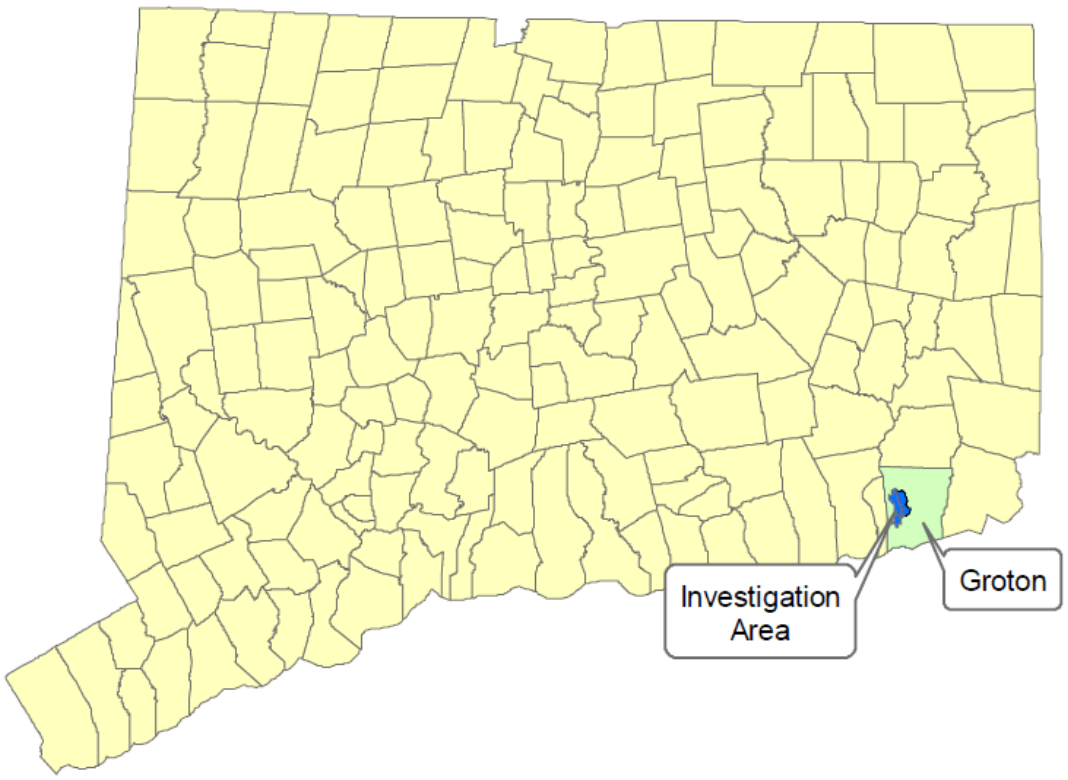


Figure 1: Location of investigation area in Groton, CT.

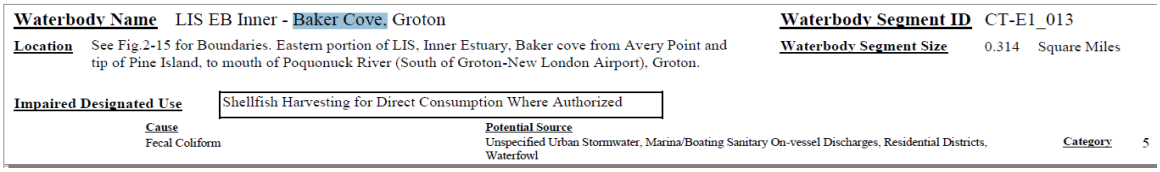
As part of the track down survey, ECCD staff and volunteers conducted stream walk surveys of tributaries to Baker Cove, including Birch Plain Creek and three unnamed perennial streams. The stream walks were conducted following the protocol established by the USDA Natural Resource Conservation Service (NRCS). The stream walks identified and documented "Areas of Concern," such as impaired buffers, eroded stream banks, and stormwater outfalls which are often indicators of conditions

contributing to degraded water quality in the receiving waterbody. ECCD consulted with CT Department of Agriculture Bureau of Aquaculture (DA/BA) staff regarding fecal coliform bacteria sampling in Baker Cove, and obtained and reviewed the results of that sampling for the period of 2000-2009. ECCD also obtained and reviewed the results of water quality sampling conducted by both the City and the Town as part of the Municipal Separate Storm Sewer System (MS-4) permit requirements of each municipality. ECCD reviewed Stormwater Management Plans (SWMP) submitted to DEEP by each municipality as part of their MS-4 permits. ECCD also interviewed local officials and area businesses, including marinas, golf courses and a local airport, to identify other potential causes of the observed degradation to Baker Cove.

Based on the information gathered, this abbreviated watershed based plan was written. The plan identifies possible sources of contaminants to Baker Cove and recommends management practices to address the documented areas of concern, with the goal of reducing NPS pollution contributions to Baker Cove.

Water Quality Status and Objective

Baker Cove has been included on the State of Connecticut Integrated Water Quality Report for a number of years, most recently in 2010, as impaired for direct shellfish consumption due to elevated levels of fecal coliform bacteria. The impairment has been attributed to multiple possible sources, including waterfowl, unspecified urban stormwater, marina/boating on-vessel sanitary discharges and unspecified contributions from residential districts.



Waterbody Name LIS EB Inner - Baker Cove, Groton **Waterbody Segment ID** CT-E1_013

Location See Fig.2-15 for Boundaries. Eastern portion of LIS, Inner Estuary, Baker cove from Avery Point and tip of Pine Island, to mouth of Poquonuck River (South of Groton-New London Airport), Groton. **Waterbody Segment Size** 0.314 Square Miles

Impaired Designated Use Shellfish Harvesting for Direct Consumption Where Authorized

Cause	Potential Source	Category
Fecal Coliform	Unspecified Urban Stormwater, Marina/Boating Sanitary On-vessel Discharges, Residential Districts, Waterfowl	5

Figure 2: 2010 CT Integrated Water Quality Report for Baker Cove.

The objective of this report is to identify potential sources of fecal coliform bacteria and other potential sources of water degradation, and to provide local watershed managers with recommendations and guidance to address these sources. The long term goal is to reduce the input of bacteria into Baker Cove, allowing the waterbody to be removed from the State of Connecticut Integrated Water Quality Report.

Background

Groton is located on the southeastern coast of Connecticut, on Fishers Island Sound, between the Thames and Mystic Rivers. It is comprised of two distinct political divisions, the City of Groton and the Town of Groton, which are divided in part by Birch Plain Creek. The Groton area was settled by Europeans in 1646 when settlers from the

Massachusetts Bay Colony founded the Pequot Plantation at the mouth of the Thames River, as part of New London. Groton separated from New London and was incorporated as an independent town in 1705. According to data from the Connecticut Economic Resource Center (CERC) town profile for 2007, the City and Town occupy approximately 31 square miles, have a combined population of 39,981 people, and a population density of 1277 people per square mile. Additional information about Groton can be found on the Town of Groton website (http://town.groton.ct.us/).

The US Census Bureau delineates Urban Area (UA) and Urban Cluster (UC) boundaries to encompass densely settled territory, which consists of:

- core census block groups or blocks that have a population density of at least 1,000 people per square mile and
- surrounding census blocks that have an overall density of at least 500 people per square mile

Connecticut municipalities that contain urbanized areas are subject to the Connecticut General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4). Both the City and Town of Groton contain UAs and must comply with the MS-4 permit program requirement.

Watershed Description

The study area is comprised of three local watersheds located in the City and Town of Groton, Connecticut (see Figure 3). These three watersheds are part of the Southeast Coastal Watershed – Eastern Complex, and drain into Baker Cove, a sub-estuary of Fisher Island Sound located west of the mouth of the Poquonnock River between Jupiter Point and Bushy Point. The area encompassed by the three local watersheds is 4.19 square miles (or 2681.6 acres). Birch Plain Creek and an unnamed perennial stream draining local watershed 2000-26 are the primary tributaries to Baker Cove.

Birch Plain Creek Watershed (2000-27): The Birch Plain Creek watershed is a 1.7 square mile local coastal watershed located in the Groton, CT. Birch Plain Creek and Baker Cove delineate a portion of the administrative boundary between the City and Town of Groton. Birch Plain Creek is an extremely fragmented urban stream. Its headwaters appear to originate north of Interstate Route 95; however, based on observations made during the streamwalk process, it appears that the construction of the highway has largely disconnected the stream from that area. As it flows through the watershed, Birch Plain Creek has been culverted under buildings, parking lots and roads in multiple areas as Groton has developed. Birch Plain Creek is tidally influenced from Thomas Road, north to Poquonnock Road.

Figure 3: Study Watersheds in City and Town of Groton, CT.

Within the Birch Plain Creek watershed, a perennial tributary identified as unnamed stream 1 for the purposes of this investigation drains a small pond on the north side of Poquonnock Road, near the Kolnaski Elementary School, and flows into Birch Plain Creek just west of Trails Corner. This stream was evaluated due to concerns expressed by local volunteers stemming from a prior investigation of chemical contamination at the unnamed pond. That investigation included Phase I and II and other environmental assessments conducted on the site in 2004 and 2009 by the engineering firm of Fuss & O'Neill at the request of the Town of Groton.

Watershed B (2000-26): Unnamed perennial stream 2 enters Baker Cove from the east at Thomas Road. This stream drains a 1.82 square mile watershed and has been labeled

Watershed B for the purposes of this investigation. This stream originates in a forested wetland at Wildcat Ledge, just north of Interstate Route 95, between exits 86 and 87. Like Birch Plain Creek, this stream is extremely fragmented. The portion of this stream designated as reach 2 is culverted under two shopping centers located on Route 1. In this reach, the stream forms the backbone of a storm drainage system for these two large parking areas (approximately 16.5 acres), with storm drains from the parking lots and the immediately adjacent roadway draining directly into the stream. As this stream approaches Baker Cove, it runs along the north side of the Groton-New London Airport. The last approximately 1300 feet of this section is tidally influenced.

Jupiter Point Watershed (2000-28): Unnamed stream 3 enters Baker Cove from the west, just north of the Elks Club Marina. This stream drains the eastern half of Jupiter Point and encompasses 0.18 square miles. This stream originates in the neighborhood south of Shennecossett Golf Course.

Land Use

The three local watersheds contributing to Baker Cove exhibit mixed land-use typical of Connecticut coastal urban areas (see Figure 4 below). Residential development is dense, especially along the shoreline and main thoroughfares, and includes a mix of single-family residences, and apartment and condominium complexes. A mixed commercial/industrial zone is located mid-watershed along the Poquonnock Road/ Route 1 corridor, and in the northern portion of the study area along the Bridge Street corridor. Transportation systems include cargo and commuter rail lines, interstate highways and local road systems. Two golf courses (Shennecossett Golf Course and Birch Plain Golf Course), two tree farms, and an airport (Groton-New London) contribute to a large block of open space. In addition, the City of Groton owns approximately 25 acres of land along the Birch Plain Creek stream corridor, including the 11.4 acre Birch Plain Creek Park. The Town of Groton owns approximately 237 acres of land along the Birch Plain Creek stream corridor north of Poquonnock Road.

Storm drain systems that were built as the watershed was developed typically discharge directly to the receiving water bodies without intermediary stormwater treatment. Approximately one-third of the watershed contributing to Baker Cove is sewered. Figure 5 below depicts areas in the City and the Town of Groton, within the investigation area, that have available sewer service. Although sewer service is available within those areas, there are properties that are not hooked up to the sanitary sewer system, but rather have on-site subsurface sewage disposal systems.

Land Cover

Scientific inquiry over the last twenty years regarding the relationship between land use and water quality has indicated that land development and use directly impacts the quality of surface and groundwater resources. Numerous studies, including those

conducted by Schueler (1994) and the CT DEEP (2008), among others, have established that the percentage of impervious cover in a watershed directly impacts stream quality (see Figure 6). Watersheds with less than 10% impervious cover tend to exhibit good stream quality, with a wide variety of plant and animal species present. Watersheds with 11-25% impervious cover tend to exhibit fair stream quality, with a reduction in the variety of species, and a trend towards species known to be tolerant of poorer quality water. Watersheds with greater than 25% impervious cover exhibit poor stream quality, with a high percent of pollution-tolerant species, and few or no pollution-intolerant species.

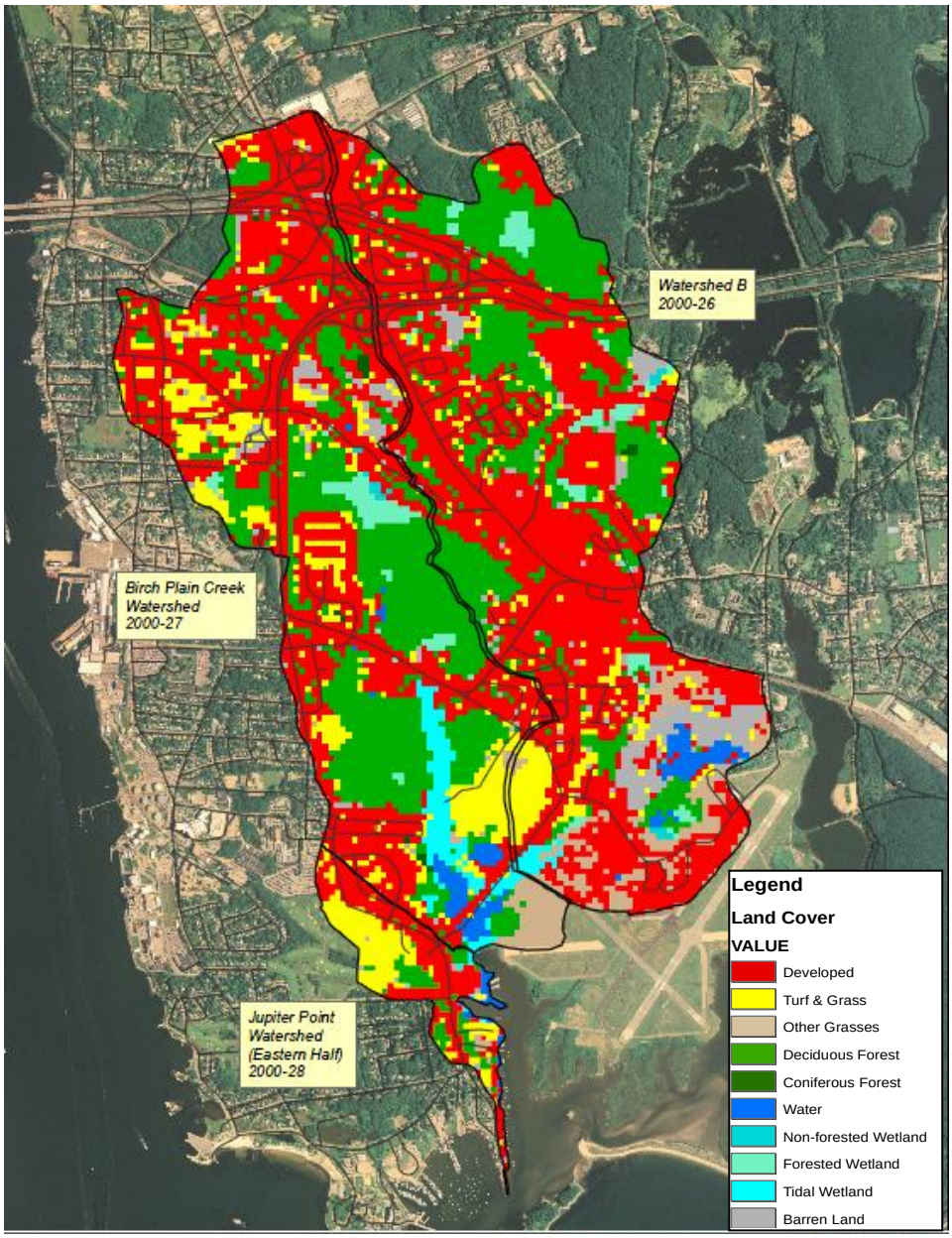
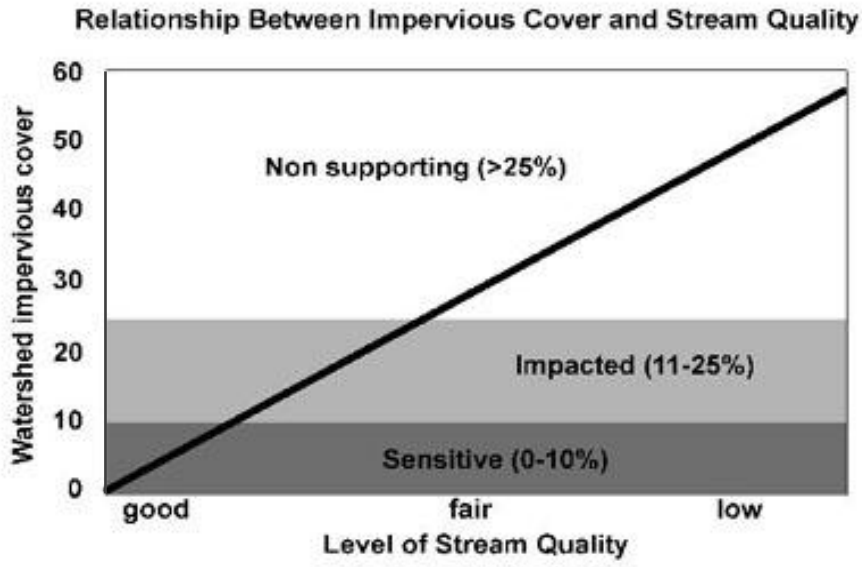


Figure 4: Land use/land cover for water quality investigation area.

Figure 5: Sewered Areas in the Study Watershed in the City and Town of Groton.



Source: Schueler, T. 1994. The Importance of Imperviousness. In: Watershed Protection Techniques 1(3):100-111.

Figure 6: Relationship between Impervious Cover and Stream Quality.

A review of the 2006 Center for Landuse Education and Research (CLEAR) land cover for the Baker Cove contributory watershed area indicates that the amount of impervious cover in the three subject watersheds well exceeds the recommended impervious cover of 10% or less, with an average of 50% impervious cover (see Table 1 below).

Based on the CLEAR land cover data, 45.6% of the Birch Plain Creek watershed is classified as impervious surfaces (paved roads, sidewalks, driveways and buildings). In Watershed B, 54.8% is classified as impervious and in the portion of the Jupiter Point watershed contributing to Baker Cove, 44.8% is impervious surfaces. The primary land cover classes in the study area as a whole are:

- Developed land (50.1%)
- Deciduous forest (25.4%)
- Turf grass (10.5 %).

CLEAR has conducted additional research on changes in land cover as part of its Connecticut's Changing Landscape project. The CLEAR Coastal Area Land Cover Analysis Project (CALCAP) provides insight into how and where development within Connecticut's coastal area and lower Connecticut River towns between 1985 and 2002 may be affecting Connecticut's most significant coastal ecological and recreational areas. The CALCAP study indicates that much of the Baker Cove watershed area has

transitioned across critical impervious surface thresholds (10% and 25% impervious cover) between 1985 and 2002.

Table 1: Percent land cover type for each watershed and for entire study area (Center for Landuse Education And Research 2006 landcover data).

Land Cover	% Birch Plain Creek Watershed	% Watershed B	% Jupiter Point Watershed	% Total Land Cover
Developed	45.6	54.8	44.8	50.1
Turf Grass	12.3	6.6	32.3	10.5
Other Grasses	2.4	4.5	1.7	3.4
Agriculture	0	0	0	0
Deciduous Forest	28.8	23.4	14.4	25.4
Coniferous Forest	0.3	0.1	0.0	0.2
Water	1.9	1.4	4.0	1.8
Non-forested Wetland	0.2	0.3	0.0	0.2
Forested Wetland	2.0	2.4	0.2	2.1
Tidal Wetland	3.6	0.5	1.2	2.0
Barren Land	2.8	6.0	1.4	4.3
Utilty ROWs	0	0	0	0

Shellfish Resource

Baker Cove, like other coastal Connecticut estuaries, supports such shellfish species as oysters and clams. The main source of nutrition for theses filter feeding organisms is phytoplankton, but if bacteria and other pathogens are present in the water as well, they will also be consumed. There is a human health concern if pathogen tainted shellfish are eaten, especially these species that are often consumed uncooked.

Baker Cove is closed to recreational shellfishing, however there are conditionally restricted relay beds located in the south end of the Cove. These beds are leased by the Department of Agriculture to licensed commercial fishermen who raise and harvest oysters. Because of the documented levels of fecal coliform bacteria, shellfish from the Baker Cove beds may not be directly harvested for market or consumption. Shellfish stock harvested from these beds are moved, or "relayed," to approved waters for natural cleansing prior to harvesting. The Baker Cove shellfish beds are tested by the Department of Agriculture Bureau of Aquaculture (DA/BA) five times per year, preferably within four days of a rainfall of greater than one-half inch (S. Kelly, personal communication).

Watershed Stakeholders

Watershed planning is a collaborative and participatory process. The ECCD consulted with numerous watershed stakeholders throughout the project to discuss the water quality problem and to gather information regarding possible sources of bacterial contamination and current management efforts. The stakeholders assisted with the

investigation of potential sources of nonpoint source pollution impacting the Baker Cove watershed. The stakeholders also participated in the development of Plan's implementation recommendations. The stakeholders and their roles in development of the watershed management plan are listed below in Table 2.

Table 2: Baker Cove Watershed Stakeholders	
Stakeholder	**Role**
CT DEEP	Provided water quality data from municipal and industrial stormwater general permits, fisheries information, mooring permits, Clean Boat and Clean Marina programs.
CT Dept. Agriculture - Bureau of Aquaculture	Provided water quality monitoring.
CT DOT – Groton-New London Airport	Provided information on Canada goose and stormwater management.
City of Groton – Engineering Department, Public Works, Harbor Management	Provided MS-4 water quality data, storm drain system maps, Stormwater Management Plan (SWMP), municipal maintenance practices, mooring permits.
Town of Groton – Planning Department, Parks & Recreation Department, Public Works	Provided MS-4 water quality data, sewer force main maps, Stormwater Management Plan (SWMP), municipal maintenance practices, Canada goose management.
Groton Shellfish Commission	Provided information on shellfish bed management, water quality monitoring.
Groton Utilities	Provided information on Canada goose management.
Ledge Light Health District	Provided information regarding public beach monitoring.
Birch Plain Golf Course	Provided information on Canada goose management.
Groton Open Space Association	Assisted with Watershed investigation, provided background information.
Avalonia Land Conservancy, Inc.	Assisted with Watershed investigation, provided background information.
Elks Club Marina	Provided information about boat maintenance practices.
University of Connecticut/CT SeaGrant (Syma Ebbin, Claudia Koerting)	Assisted with watershed investigation, provided technical information and water quality data.

Methodology

The Eastern Connecticut Conservation District (ECCD), with the assistance of municipal staff and local volunteers, conducted a track down survey of the three local watersheds to identify potential sources of NPS pollution to Baker Cove, with particular attention given to any possible sources bacterial contamination. Initially, the investigation

focused on Birch Plain Creek because it is the primary tributary to Baker Cove. As the investigation proceeded, it became apparent that tributaries from the watershed east of the Birch Plain Creek watershed (Watershed B), and the easterly portion of the Jupiter Point watershed also contributed significantly to Baker Cove, and needed to be evaluated as well. ECCD prepared and received approval of a Quality Assurance Project Plan (QAPP) for the use of the USDA/Natural Resource Conservation Service (NRCS) Streamwalk protocol for this investigation. Following this protocol, ECCD evaluated Birch Plain Creek and two unnamed tributaries for possible sources of the impairment. ECCD recruited and trained volunteers in the stream walk protocol. Volunteers then participated with ECCD staff in the survey process during the summer and fall of 2010.

NRCS staff delineated Birch Plain Creek into segments based on stream morphology using the Rosgen stream morphology method (1994). A copy of the Birch Plain Creek streamwalk map is included in Appendix A. Streamwalk data was entered onto forms developed by NRCS. These forms document specific conditions, identified as Areas of Concern (Aoc). There are seven condition assessment forms and one reach level assessment form, which summarizes reach characteristics. The seven Area of Concern forms are:

1. Erosion assessment
2. Fish barriers
3. Storm water outfalls
4. Modified channels
5. Degraded buffers
6. Trash/debris
7. Visual water conditions

For each Area of Concern identified, the appropriate form was filled out, and the area was photographed and geo-referenced using handheld GPS units. Once the stream walk was completed, the gathered data was compiled into a spreadsheet for evaluation.

Both the City and Town of Groton provided ECCD with their Small MS-4 Permit Stormwater Management Plans (SWMP). ECCD reviewed these plans looking for actions that might have an effect on the conditions in Baker Cove. ECCD also gathered and tabulated MS-4 and industrial storm water general permit program water quality data for each town, and water quality data acquired by the Connecticut Department of Agriculture Bureau of Aquaculture. ECCD also met with other watershed stakeholders, including marina managers, golf courses managers, and the Groton-New London Airport manager, about such issues as nutrient management, stormwater runoff management and management of resident Canada goose populations.

Utilizing the gathered data, ECCD prepared this management plan for the Baker Cove watershed following the US EPA's nine element model. ECCD identified areas of concern, and then made management recommendations for each to address possible

sources of contamination and to reduce bacteria and other contaminant loading to Baker Cove.

Results

Stream Walk Results:

ECCD staff and volunteers surveyed 6.3 miles of stream in the summer and fall of 2010. An Area of Concern sheet was filled out for each impact that was noted during the stream walks, as was a Reach Level Assessment sheet for each stream reach that was surveyed. The survey data was entered into a database. A summary of the Areas of Concern can be found in Appendix B. The Areas of Concern were imported into a geographic information system (GIS) data layer. This data layer was superimposed onto ortho-photogrammetric images of the study area to depict the locations of the Areas of Concern by type, stream reach and watershed. These images can be found in Appendix C. Table 3 (below) summarizes the number of Area of Concern sheets that were filled out for each impact type. A map depicting the location of documented Areas of Concern superimposed on land cover is located below (Figure 7). A review of the figure indicates that Areas of Concern cluster in areas of highest development (red). This association is supported by the findings by Schueler and others regarding the correlation between impervious cover and stream quality.

Table 3: Summary Table of Areas of Concern

Area of Concern Condition	Area of Concern Identifier	Description of Area of Concern	Number Identified
Erosion Assessment	ER	Stream bank erosion	3
Fish Barrier	FB	Dams, culverts or velocity barriers	14
Storm Water Outfall	SWO	Storm water pipe, leak-off or channel	38
Modified Channel	MC	Channelization, culvert, bank armoring, concrete channel	10
Degraded Riparian Buffer	DB	Minimal vegetation or width, invasive plants	16
Trash/Debris	TD	Trash/debris in stream or riparian area	7
Visual Water Conditions	VWC	Stained, green, turbid or milky water, odors, excessive plant or algae growth	12

Data review results:

ECCD gathered and summarized bacteria data from the City and the Town of Groton which was collected as part of the MS-4 permit required water sampling, and bacteria data that was collected by the Department of Agriculture Bureau of Aquaculture as part of shellfish bed monitoring. These data are tabulated in Appendix D. A summary of the data can be found in Table 4 below.

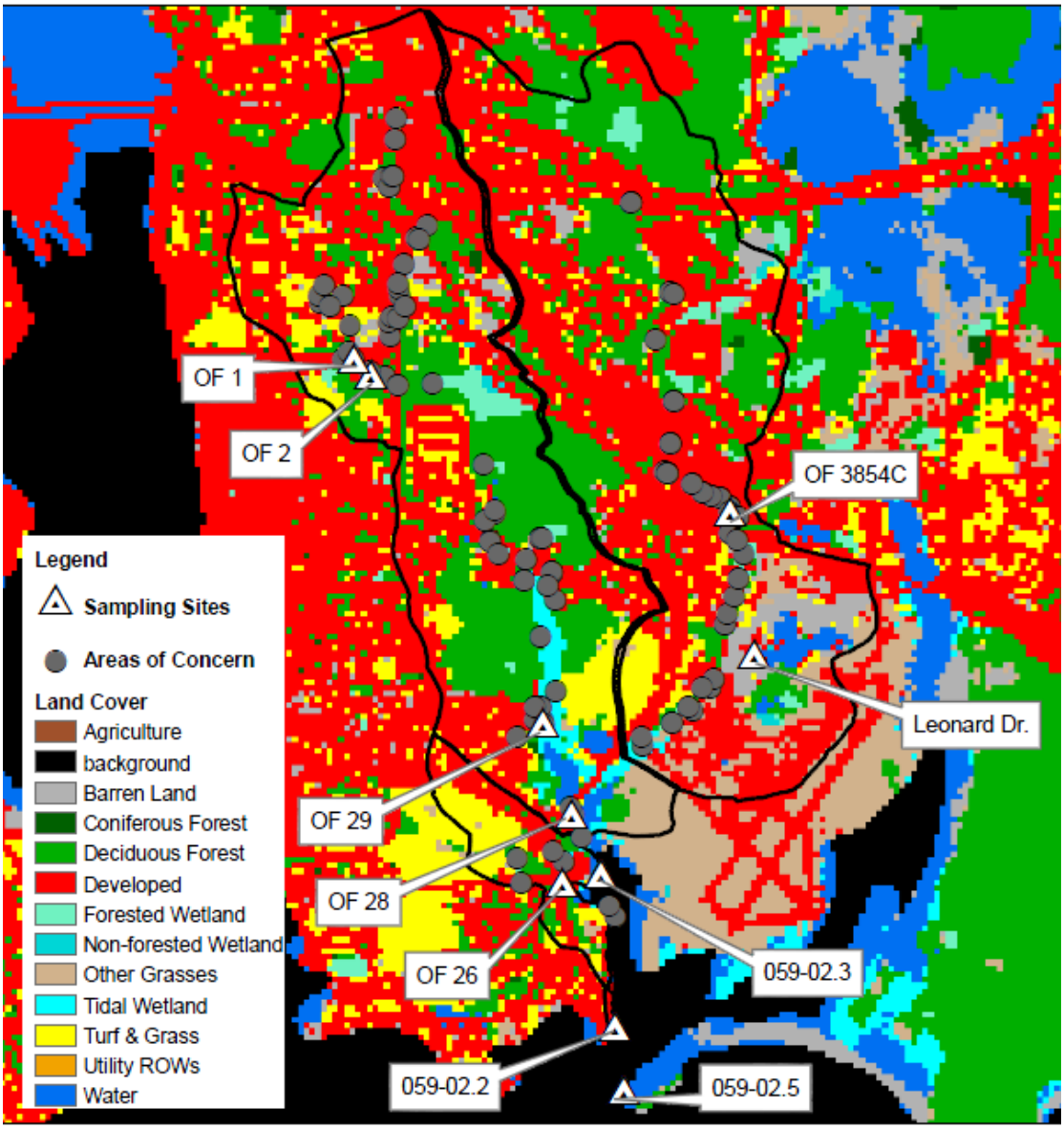


Figure 7: Streamwalk Areas of Concern and Bacteria Sampling Sites Relative to Land Cover.

The 2011 State of Connecticut Water Quality Standards describes specific limits for bacterial contamination, based on water quality classification and designated use. For fresh water recreational contact, *Escherichia coli* (E. coli) is the best indicator of health risk; whereas, for consumption of shellfish, fecal coliform bacteria is the best indicator. Escherichia coli and fecal coliform bacteria are used as indicators of possible bacterial contamination because they are commonly found in human and animal feces. Although they are generally not harmful themselves, they indicate the possible presence of disease-causing bacteria, viruses, and protozoans that also live in human and animal digestive systems. Their presence suggests that pathogenic microorganisms might also

be present and that swimming or eating shellfish might be a health risk. Sources of bacterial contamination to surface waters include wastewater treatment plants, on-site septic systems, domestic and wild animal feces, and storm runoff (US EPA).

For freshwater, the CT Water Quality Standard for *Escherichia coli* for recreational uses (other than swimming) is:

- Geometric Mean less than 126/100ml
- Single Sample Maximum 576/100ml

For saltwater, the standard for fecal coliform for the direct consumption of shellfish is:

- Geometric Mean less than 14/100ml
- 90% of Samples less than 31/100ml

A review of the bacteria data summary table below indicates several areas as bacterial "hot spots." Figure 7 above depicts the locations of the monitoring stations relative to stream walk-identified Areas of Concern and land use. These locations include stormwater outfalls 26 and 29, which drain residential neighborhoods on Shennecossett Road and Madison Place in the City of Groton, and which both failed in 2008; the stormwater outfall at Groton Airport Business Park on Leonard Drive, which failed from 2006 to 2008; the stormwater outfall behind the Big Y shopping plaza on Route 1, which failed from 2004 to 2008; stormwater discharges B and D at the Groton-New London Airport, which failed in 1997; and DA/BA shellfish monitoring station 059-02.3, adjacent to the Elks Club Marina, which had four exceedances between 2000 and 2004.

Table 4: Summary of bacteria data reported by the City and Town of Groton MS-4 programsand Department of Agriculture Bureau of Aquaculture.

Fresh Water Sampling Sites				
Sample Location	**Receiving Water**	**Year**	**E. coli Single Sample**	**E. coli Geomean**
30 Poquonnock Rd & Rainville Ave, City of Groton	Birch Plain Creek	2005	10	-
Outfall 1 – Highway Garage City of Groton	Birch Plain Creek	2008	*BDL	-
Outfall 26, Shennecossett Rd, City of Groton	Birch Plain Creek	2008	**800**	-
Outfall 28 - Thomas Rd, City of Groton	Birch Plain Creek	2008	**850**	-
Outfall 29 - Madison Place, City of Groton	Birch Plain Creek	2008	300	-
Leonard Drive @ Groton Airport Business Park, Town of Groton	Unnamed Stream 2	2004	100	-
Leonard Drive @ Groton Airport Business Park, Town of Groton	Unnamed Stream 2	2005	10	-
Leonard Drive @ Groton Airport Business Park, Town of Groton	Unnamed Stream 2	2006	**1,700**	-
Leonard Drive @ Groton Airport Business Park, Town of Groton	Unnamed Stream 2	2007	**3,250**	-
Leonard Drive @ Groton Airport Business Park, Town of Groton	Unnamed Stream 2	2008	**4400**	-
Route 1 - behind Big Y (outfall 3854C),Town of Groton	Unnamed Stream 2	2004	**800**	-

Sample Location	Receiving Water	Year	Fecal Coliform Single Sample	Fecal Coliform Geomean
Route 1 - behind Big Y (outfall 3854C), Town of Groton	Unnamed Stream 2	2005	**5,200**	-
Route 1 - behind Big Y (outfall 3854C), Town of Groton	Unnamed Stream 2	2006	**720**	-
Route 1 - behind Big Y (outfall 3854C), Town of Groton	Unnamed Stream 2	2007	**3,300**	-
Route 1 - behind Big Y (outfall 3854C), Town of Groton	Unnamed Stream 2	2008	**4000**	-
Salt Water Sampling Sites				
Sample Location	**Receiving Water**	**Year**	**Fecal Coliform Single Sample**	**Fecal Coliform Geomean**
Groton-New London Airport – Discharge B	Baker Cove	96-97	**2,400**	-
Groton-New London Airport – Discharge C	Baker Cove	96-97	20	-
Groton-New London Airport – Discharge D	Baker Cove	96-97	**4,800**	-
Baker Cove - Station 059-02.2	Baker Cove	2000	-	**14.5**
Baker Cove - Station 059-02.2	Baker Cove	2001	-	5.7
Baker Cove - Station 059-02.2	Baker Cove	2002	-	5
Baker Cove - Station 059-02.2	Baker Cove	2003	-	12
Baker Cove - Station 059-02.2	Baker Cove	2004	-	7.3
Baker Cove - Station 059-02.2	Baker Cove	2005	-	3.3
Baker Cove - Station 059-02.2	Baker Cove	2006	-	3.3
Baker Cove - Station 059-02.2	Baker Cove	2007	-	1.8
Baker Cove - Station 059-02.2	Baker Cove	2008	-	4.7
Baker Cove - Station 059-02.2	Baker Cove	2009	-	2.7
Baker Cove- Station 059-02.3	Baker Cove	2000	-	**14.3**
Baker Cove- Station 059-02.3	Baker Cove	2001	-	**14**
Baker Cove- Station 059-02.3	Baker Cove	2002	-	11.4
Baker Cove- Station 059-02.3	Baker Cove	2003	-	**20.4**
Baker Cove- Station 059-02.3	Baker Cove	2004	-	**16.1**
Baker Cove- Station 059-02.3	Baker Cove	2005	-	11.7
Baker Cove- Station 059-02.3	Baker Cove	2006	-	7.5
Baker Cove- Station 059-02.3	Baker Cove	2007	-	7.4
Baker Cove- Station 059-02.3	Baker Cove	2008	-	7.3
Baker Cove- Station 059-02.3	Baker Cove	2009	-	1
Baker Cove- Station 059-02.5	Baker Cove	2000	-	5.9
Baker Cove- Station 059-02.5	Baker Cove	2001	-	4.6
Baker Cove- Station 059-02.5	Baker Cove	2002	-	2
Baker Cove- Station 059-02.5	Baker Cove	2003	-	8.1
Baker Cove- Station 059-02.5	Baker Cove	2004	-	12.7
Baker Cove- Station 059-02.5	Baker Cove	2005	-	3.4
Baker Cove- Station 059-02.5	Baker Cove	2006	-	3.8
Baker Cove- Station 059-02.5	Baker Cove	2007	-	1.7
Baker Cove- Station 059-02.5	Baker Cove	2008	-	1.8
Baker Cove- Station 059-02.5	Baker Cove	2009	-	4.2

*BDL – below detection

Bold figures exceed CT water quality standards for bacteria

EPA Nine-Element Baker Cove Abbreviated Watershed-based Plan

The Connecticut Department of Energy and Environmental Protection (DEEP) through funding from the US Environmental Protection Agency (US EPA) Clean Water Act Section 319 Nonpoint Source (NPS) grant program, contracted with the Eastern Connecticut Conservation District (ECCD) to conduct a track down survey of the Baker Cove watershed to identify possible sources of fecal coliform bacteria that has contaminated Baker Cove, and to prepare a watershed-based plan identifying the pollutant sources and providing recommendations to reduce NPS pollution to Baker Cove.

Nonpoint source pollution (NPS) is natural or man-made pollution that comes from multiple sources, and which is carried in snowmelt and storm runoff into waterbodies. NPS can include fertilizers, herbicides and insecticides; oil, grease and toxic chemicals; sediment; salt; bacteria; nutrients; and atmospheric deposition (US EPA). Because the sources can occur anywhere in a watershed, NPS is best addressed utilizing a watershed approach. A watershed approach looks at all land types and land uses within a watershed, and considers all activities taking place within the watershed that may affect watershed health. The watershed approach involves the engagement of multiple watershed partners, ensuring the participation of these stakeholders in effecting the solution. Because the pollutants in the Baker Cove watershed are widespread and multi-sourced, restoration of water quality requires participation from multiple organizations and agencies within both the City and Town of Groton, and may require infrastructure improvements as well as behavioral changes.

A. Identification of Pollutant Causes and Sources

The Eastern Connecticut Conservation District (ECCD) and volunteers conducted a track down survey in the three local watersheds in Groton, Connecticut in the summer and fall of 2010 to identify potential sources of nonpoint source pollution that have degraded water quality in Baker Cove. Baker Cove is listed in the 2008 and 2010 State of Connecticut Integrated Water Quality Reports as being impaired for the direct shellfish consumption use due to elevated levels of fecal coliform bacteria. ECCD also reviewed water quality data from the CT Department of Agriculture Bureau of Aquaculture (DA/BA) and from the Groton City and Town MS-4 programs.

While the primary purpose of the Baker Cove track down survey was to identify possible sources of indicator bacteria that affect shellfish harvesting for direct consumption, the survey also documented other conditions that may contribute NPS pollution to Baker Cove. Possible sources of indicator bacteria and other NPS contaminants to Baker Cove are tabulated below. The locations of the occurrences are correlated to recommended management measures in Table 8, and are depicted on maps found in Appendix D.

Table 5: Possible Sources of Bacterial and Other Contaminants to Baker Cove		
Possible Source	**Location**	**Number of Occurrences**
Urban Sources/Pets	Watershed wide	50% impervious surface, est. 231 licensed dogs
Storm Water Outfalls	Multiple locations	38
Dry weather storm drain flow	Poquonnock Road	1
Sewer/Septic Systems	Watershed wide	No known failures
Degraded Riparian Buffer	Multiple locations	16
Marinas/Private Water Craft	Baker Cove	2 marinas, multiple private crafts
Geese/Waterfowl	Baker Cove, Golf Courses, and Airport	>28 geese, 10 swans
Trash/Debris	Multiple locations	7
Erosion	Multiple locations	3
Modified Channel	Multiple locations	10

Likely Sources of Fecal Coliform Bacteria and Nonpoint Source Pollution (NPS) in the Baker Cove Watershed

Urban Sources/Pets

Figure 8: Dumpsters at Kinnesbrook Condominiums

Impervious surfaces have been linked to degraded water quality. Land cover analysis of the Baker Cove watershed indicates that approximately 51% of the project area is impervious surface (buildings, roads, parking lots). There are numerous urban clusters within the Baker Cove watershed that coincide with these areas of high impervious cover, including apartments, condominium complexes, commercial and industrial areas along the main corridors, including Bridge Street, Meridian Street, Shennecossett Road, and Poquonnock Road/Route 1. The high percentage of impervious cover in these urban clusters reduces the opportunity for rainfall to infiltrate into the ground. Instead, water is channeled into the storm drain system, along with a myriad of pollutants picked up from the ground surface. Dumpsters associated with residential, commercial and industrial

operations can be notorious breeding grounds for bacteria. The dumpster in Figure 8, located at the Kinnesbrook Condominium complex, is located on a concrete pad which is graded to a storm drain in the parking area that drains to Birch Plain Creek, approximately twenty-five feet away.

Pet waste was observed in many areas including Washington Park and Kinnesbrook Condominiums. A feral cat area was noted adjacent to a wetland behind the Big Y shopping plaza on Route 1 (Figure 9). Although the number of cats in the colony is not known, encouragement of a large cat population could contribute to bacteria loading to waterways leading to Baker Cove.

Figure 9: Feral Cat Area

According to the Town Clerk's Office, which licenses dogs in both the City and Town, 2074 dogs were registered in 2010-2011. An average-sized dog can produce approximately 0.75 pounds of waste a day. According to the US EPA, one gram of dog waste can contain 23 million fecal coliform bacteria colonies. The Baker Cove watershed comprises approximately 11% of Groton. Assuming an even distribution of dogs throughout the City/Town, the Baker Cove watershed contains an estimated 231 dogs. This amount of dogs can produce 173 pounds of waste a day, containing a staggering 1.8 x 106 million fecal coliform bacteria colonies (http://doodycalls.com/resources_pet_waste_virginia_water_quality.asp).

Stormwater Systems/Untreated Runoff

Thirty-eight stormwater outfalls were identified in the stream walk surveys of the three local watersheds contributing to Baker Cove, including seven outfalls that were located on Birch Plain Creek, in the area of tidal influence. All of these outfalls discharged untreated stormwater directly into the receiving streams. Due to the primarily urban nature of development in the survey area, these outfalls can contribute multiple pollutants to Baker Cove, including bacteria, nutrients from pets and lawn care products, trash and debris, and oils, greases and other chemicals from vehicles.

Figure 10: Storm drain over unnamed stream 2 in a shopping plaza on Rt 1.

There are multiple areas throughout the watershed where stormwater discharges have severe impacts on the tributaries to Baker Cove. Outfalls to Birch Plain Creek from Madison Place exhibited large sediment deltas and associated trash. Reach 2 of unnamed stream 2, which originates at Wildcat Ledge in

local watershed 2000-26, is culverted under two shopping plaza parking lots on Route 1, and functions as the stormwater conduit for those parking areas. Multiple storm drains open directly over the stream channel, allowing untreated runoff from the extensive parking area to discharge directly into the buried stream (Figure 10).

Lake George, located in Washington Park in the City of Groton, is the headwater for the west branch of Birch Plain Creek. Lake George is also the receiving waterbody for stormwater runoff from the surrounding area, including roads, businesses and apartment and condominium complexes. Lake George is a grassy wetland through which numerous channels have been excavated, which convey water quickly into Birch Plain Creek. The riparian vegetation along the easterly limit of Lake George has been removed and replaced with asphalt armoring (Figure 11).

Figure 11: Extensive asphalt leak-off into Lake George from Meridian St.

Dry Weather Storm Drain Flow

During the stream walks, several storm drains on Poquonnock Road were observed to have dry weather flow. The City has enacted an Illicit Discharge Detection and Elimination (IDDE) program as part of its MS-4 permit. The City engineer informed ECCD that numerous homes have, in the past, been allowed to discharge sump pumps and footing drains to the storm drain system. Presumably, these residences are still connected to the storm drain system, and are contributing flow during dry periods. Dry weather flow in storm drain systems may perpetuate continuous bacteria loading. Research indicates that bio-films (the slime layer that forms in gutters and storm drain pipes) may contribute to bacteria loading by providing a protected environment with the necessary nutrients and moisture for bacteria to grow (Skinner, Guzman and Kappeler, 2010).

Sewer/Septic Systems

According to sanitary sewer coverage maps from both the City and the Town of Groton, approximately one-third of the project area has available sewer service. However, not all structures within the sewer service area are connected to the sewer mains. The Town conducts annual sewer line inspections. Individual onsite subsurface sewage treatment systems, or septic systems, are subject to

Figure 12: Sewer manhole in wetlands near Tower Road

maintenance by the property owners.

During the stream walk surveys, ECCD staff and volunteers noted two sewer manholes located in a wetland area associated with unnamed stream 2 (Figure 12), east of the Tower Road railroad crossing. Sewer leaks and overflows, especially after flood events, which can be common in coastal areas, can contribute to bacterial contamination of nearby surface and ground waters. ECCD staff and volunteers also identified a sewer manhole near the City Highway garage with a broken concrete collar.

Degraded Riparian Buffers

Sixteen instances of degraded riparian buffers were noted during the stream walks. The types of degraded riparian buffers included minimal buffer width (seven instances), minimal riparian vegetation (ten instances) and presence of invasive species (twelve instances). In one instance (the west branch of Birch Plain Creek by the Highway garage and Washington Park), the noted degraded buffer condition was reach-wide. In several areas, landowners had cleared and/or maintained lawn to the edges of the various waterbodies (Figure 13). In several areas the riparian buffer was degraded by invasive plants. For example, along the edge of Birch Plain Creek just north of Thomas Road, the buffer was heavily dominated by Phragmites (Figure 14).

Figure 13: Lack of riparian buffer along Baker Cove.

Riparian buffers of minimal width and minimal vegetation reduce the capacity of the vegetative buffer to slow surface run-off of stormwater, and absorb any nutrients or contaminants contained in the run-off. Invasive plant species often out-compete native plants and reduce the habitat benefits that native plants provide for native biota.

Figure 14: Phragmites growing among salt marsh grasses in Birch Plain

Municipal Inland Wetland Commissions have the authority to review and regulate certain activities within pre-determined distances of wetlands, waterways, and waterbodies. These areas are referred to as the upland review areas (URA). The Town of Groton Inland Wetland Regulations specify a URA of 150 feet for Birch Plain Creek, and 100 feet for other waterbodies. The City of Groton Inland Wetland Regulations specify a URA of 200 feet from all wetlands and watercourses.

The 2002 Coastal Riparian Buffers Analysis conducted by CLEAR indicates that the Baker Cove watershed is in the top twenty-five coastal zone watersheds for relative rate of loss of natural riparian vegetation for the period of 1985 – 2002 (see http://clear.uconn.edu/projects/riparian_buffer/ for more information), indicating that greater municipal protection of vegetative riparian zones through land use regulation may be necessary to protect water quality.

Marinas/Private Water Craft

There are two marinas located in Baker Cove. The first is owned and operated by the Elks Club (Figure 15). Discussion with the manager of the Elks Club Marina indicated that the majority of the crafts are small and do not have on-board toilets. The marina also does not have facilities to conduct maintenance or repairs. The second marina is Chapman's Boat Yard, which according to CT DEEP personnel, is in the process of upgrading its facility.

Figure 15: Elks Club Marina in Baker Cove.

A number of private watercraft are also moored along the shore of Jupiter Point, including several commercial fishing boats (Figure 16).

Baker Cove is located in the Groton/Guilford No Discharge Zone, which was designated in 2006 (Figure 17). No Discharge areas prohibit the discharge of treated and untreated boat sewage within three miles of the shore. Numerous pumpout facilities, at which onboard waste tanks can be emptied, are available to boat owners in the Groton area, including the Mystic Pumpout Boat, Mystic Shipyard, LLC., Noank Shipyard, Noank Village Boatyard, Pine Island Marina, Shennecossett Yacht Club, and Spicer's Noank Marina.

Figure 16: Lobster boat moored along Jupiter Point.

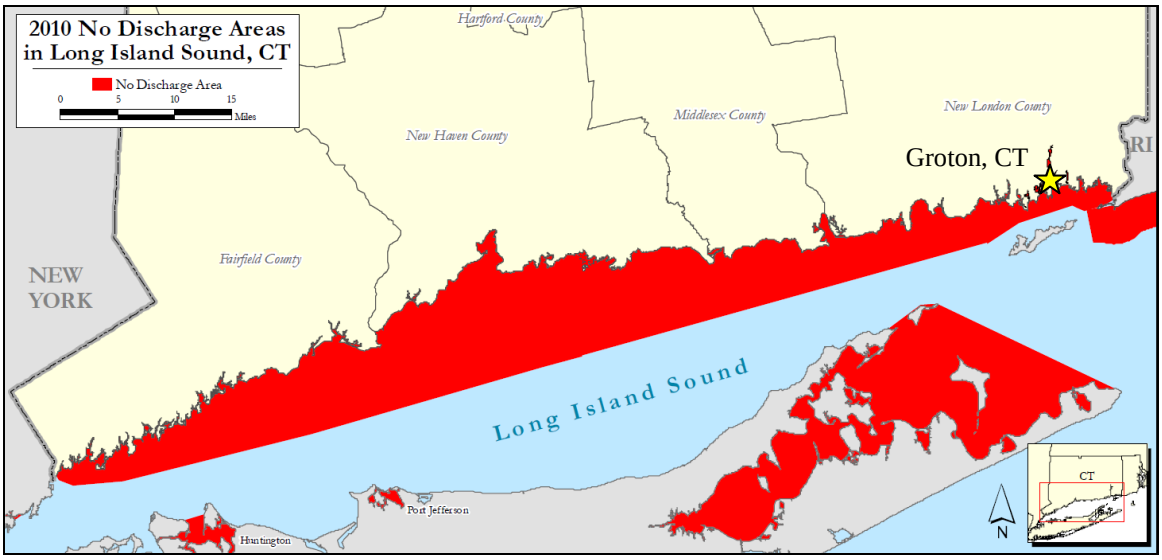


Figure 17: 2010 No Discharge Areas in Long Island Sound (CT DEP).

Wildlife

Due to the high level of development of the Baker Cove watershed, terrestrial wildlife species were not considered a significant source of fecal coliform bacteria. However, several non-migrating Canada geese were noted in Baker Cove during the investigation (Figure 18). An adult Canada goose can deposit 1 – 2 pounds of feces per day, which contain fecal bacteria and nutrients that contribute to water quality degradation.

During this watershed investigation by ECCD, the Groton/New London Airport concurrently contracted with the Louis Berger Group to conduct an Aviation Hazard Assessment. Wildlife Biologist Jason Ringler documented 25 goslings at the airport during a June 21, 2011 site visit. In addition, three of the geese he observed were tagged. Two of the geese were tagged in 2003 and the third goose was tagged in 2004. Mute swans, another introduced waterfowl species, are also known to frequent the cove. Mr. Ringler reported a pair at the airport that fledged 8 cygnets.

The nuisance waterfowl problem is not only a potential threat to water quality, but also a threat to aviation safety. The Canada geese are known to frequent Birch Plain and Shennecossett Golf Courses, the Groton-New London Airport and the lawn at the Elks Club. The same flock of resident geese is reported to also frequent the Groton Reservoir and the lower reaches of the Poquonnock River located outside the Baker Cove watershed.

Min Huang of the CT DEEP Wildlife Division was consulted for advice on managing nuisance goose populations. He reported that hunting opportunities and natural predation of the Canada goose flocks are limited due to the urban nature of the watershed, and a coordinated management strategy in the region is necessary to reduce the flock size.

Figure 18: Geese foraging along shore of Baker Cove.

At this time, watershed stakeholders that are experiencing issues with resident geese are independently addressing the issue. Shennecossett Golf Course, an Audubon International Golf Course of Distinction, routinely uses a trained border collie to discourage geese at their facility. Birch Plain Golf Course staff discharge fireworks from a golf cart during the nesting season to discourage the geese from selecting nesting sites on their course, with an expectation that the geese will learn to associate golf carts with the noise Groton-New London Airport uses a variety of methods to manage the flock size. These methods include acoustic measures and lethal take. Groton Utilities also practices various flock management strategies including hazing, barrier fencing, decoys, fox urine and grass height management. No one reported using special grass species selected to discourage geese foraging.

The effect of the disjointed effort to control the nuisance goose population is that the flock rotates from one location to the next, but the overall result is no decrease in flock size. A regional management approach to reduce the flock size and discourage repopulation of the area in the future with habitat management is necessary.

Trash/Debris

Seven instances of trash and debris were observed during the stream walks. Bicycles, plastic crates and other items were noted in Birch Plain Creek north of Thomas Road (Figure 19). Windblown and waterborne debris, such as plastic bags, plastic beverage bottles and paper products, were noted along reach 1 of unnamed steam 2. A large pile of yard waste was deposited along the edge of a wetland associated with unnamed stream 2, adjacent to the Big Y shopping plaza on Route 1 (Figure 20). This yard waste pile included grass clippings, leaves and branches, and other plant materials. It

Figure 19: Bicycle discarded in Birch Plain Creek.

was not clear if this waste was associated with a nearby apartment complex or with maintenance at the shopping plaza.

Figure 20: Large yard waste pile at edge of wetland associated with unnamed stream 2.

While trash and debris do not directly contribute to bacterial contamination of Baker Cove, it has the capacity to introduce a number of other pollutants into Baker Cove via the various watershed streams. Decomposition of the yard waste releases nutrients, including nitrogen from the plant tissues, into the streams. Influx of these organic materials can cause algal blooms and the subsequent depletion of dissolved oxygen in the streams as the algae dies and is decomposed, degrading habitat quality for in-stream biota.

Erosion

Three instances of bank erosion were noted during the stream walks. All three areas of bank erosion were associated with a lack of vegetated riparian buffer. Stream bank erosion delivers sediment to the stream, and ultimately to the receiving waterbody, along with any nutrients or contaminants that may be adsorbed to the eroded sediments.

Figure 21: Stream bank erosion along Birch Plain Creek near Meridian Street.

The first documented area represented a 250 foot stretch of eroded stream bank near Meridian Street (Figure 21). A second area was located along reach 1 of unnamed stream 2, in close proximity to a storm drain outfall from the vicinity of H Street and was likely caused by high velocities during storm events. The third area was associated with surface run-off from a stockpile yard near the City Highway facility.

Modified Channel

Ten instances of modified channels were noted during the stream walks. In most instances, the modifications involved stream culverts under roads. In several instances, the modified channel involved the channelization of the stream under highways (Routes 1, 95 and 349), and buildings and parking areas (Bridge Street, Washington Park, and Route 1 shopping centers). Figure 22 depicts a gap in a local motel where Birch Plain Creek is channeled underground between the two segments of the building.

Approximately 5475 feet, or 16% of the 33,500 feet of stream surveyed throughout the Baker Cove watershed was channelized. Channelization and other hydro-modifications can contribute to NPS by disconnecting streams from their flood plains, which reduces the attenuation of storm flow and the bio-retention of pollutants by flood plain vegetation. Channelization also increases storm flow velocities and can result in channel scouring and bank erosion, further degrading water quality and in-stream habitat.

Figure 22: Birch Plain Creek is culverted under this motel on Bridge Street.

Visual Water Conditions

Twelve instances of visual water conditions were noted. The entirety of the west branch of Birch Plain Creek was observed to have a cloudy appearance. This may have been caused by a high level of suspended solids in the water column, possibly by high clay content in the soil. The east branch of Birch Plain Creek exhibited high amounts of iron bacteria, with the rusty red bacteria floc completely covering the substrate in many areas (Figure 23). "Oily" deposits associated with iron bacteria were also noted on the water surface in many areas. This condition extended from RT 95 to Meridian Street.

Figure 23: Iron bacteria in east branch of Birch Plain Creek.

Potential Sources of Habitat Degradation
Fish Passage Barrier

While fish barriers do not contribute to nonpoint source pollution, they do inhibit the passage of fish up and downstream, and result in degradation of habitat. In coastal areas this can be especially critical for fish species such as trout, alewife and herring that require access to inland spawning habitats. Fourteen fish barriers were noted during the stream walks, including a stone dam at Trails Pond (an impoundment of Birch

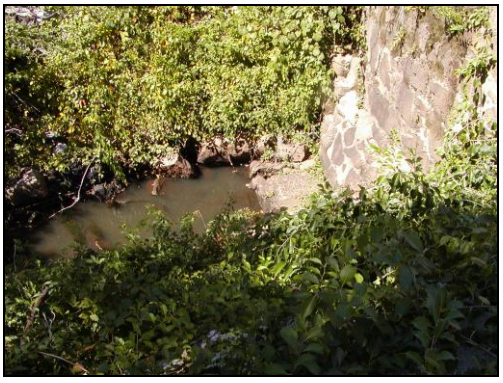


Figure 24: Trails Pond dam.

Plain Creek) north of Poquonnock Road (Figure 24) and numerous culverts throughout the watershed that acted as velocity or habitat barriers.

B. Pollutant Load Reduction Estimates

To estimate loads and load reductions, EPA recommends the use of models which have been developed for these purposes. ECCD has found that, due to the lack of available data, there were no models that provide quantitative estimates of loading or load reductions for fecal coliform bacteria that were suitable for this watershed based plan. CT DEEP is in the process of developing a statewide total maximum daily load (TMDL) for bacteria, which will be available to calculate necessary reductions in bacteria loading in future versions of this plan. ECCD has utilized qualitative estimates to predict load reductions. The estimated bacteria load reduction table below utilizes a high-medium-low gradient to predict potential bacterial load reductions for the listed management measures.

Table 6: Estimated Bacteria Load Reduction of Potential Management Measures

Source	Management Measures	Potential Bacterial Load Reductions	Other Pollutants	Number of Occurrences
Urban Sources/Pets	Public and Municipal Good Housekeeping Practices	high	Sediment, nutrients, metals, other chemicals	50% impervious cover, est. 231 dogs licensed
Storm Water Outfalls	Water quality retrofits	high	NPS, thermal pollution, sediments	38
Dry weather storm drain flow	Disconnection of house drains	moderate		1
Sewer/Septic Systems	Sewer inspections Homeowner education	Moderate Moderate	Nutrients, household chemicals, pharmaceuticals,	No known failures
Degraded Riparian Buffer	Buffer restoration	low	Sediment, nutrients	16
Marinas/Private Water Craft	Public Education, Participation in Clean Marina and Vessel programs	Moderate to low	Boat maintenance waste	2 marinas, multiple private crafts
Geese/Waterfowl	Public education, flock mgnt	Low		>28 geese, 10 swans
Trash/Debris	Public education, town ordinances and enforcement	Low	Multiple	7
Erosion	Vegetative buffer restoration	Moderate to low	Sediment, nutrients	3
Modified Channel	Properly sized culverts, reconnect to flood plains	Low	Sediment, thermal pollution	10

C. Watershed Best Management Practices

Nonpoint sources of pollution are inherently diverse. In a highly urbanized area such as Groton, Connecticut, it is challenging to identify and remediate any one source of nonpoint source pollution. All possible sources throughout the watershed must be evaluated for potential pollutant reduction. Table 5 identifies possible sources of nonpoint source pollution. Table 7 provides management strategies for each management measure and ties each strategy to stream walk areas of concern, where possible. The table further identifies the entity most appropriate for implementing the strategy, and provides a cost estimate for the implementation. The management strategies recommended in Table 7 are described in more detail below.

Urban Sources/Pets Best Management Practices –

- *Storm drain stenciling*: Storm drain stenciling alerts residents that catch basins drain to Baker Cove and that discharging materials to storm drains can be detrimental to water quality. Storm drain stenciling should be conducted in unison with a public education campaign (informational brochures, newspaper article) to alert residents of the purpose for and benefits of the storm drain stenciling. According to the Stormwater Management Plan for the City of Groton storm drains were stamped between 2004 and 2006. No stencils were noted during the 2010 stream walks.

- *Street sweeping*: Street sweeping removes accumulated sediment and other pollutants from roadsides and gutters, preventing these pollutants from entering the storm drain system. On average, one kilogram of street dirt can contain up to 3 million colony forming units (CFU) of fecal coliform bacteria (Zariello, Breault and Weiskel 2002). Street sweeping should be conducted at least twice a year to prevent the accumulation of sediments. High traffic areas and areas prone to accumulation of sediments should be evaluated for additional sweeping, as necessary. Roads and parking lots in areas associated with high bacteria levels as identified by water sampling (eg. MS-4, Stormwater General Permits) should be evaluated for additional maintenance. The Stormwater Management Plan for the Town of Groton specifies biannual street sweeping as part of its Pollution Prevention/Good Housekeeping control measure. Additionally, the City and Town should explore methods, including incentive programs or regulatory revisions, to encourage commercial property owners to conduct regular sweeping of large lots.

- *Catch basin clean-out*: Catch basin sumps require regular clean-outs to prevent the build-up of sediments and other pollutants conveyed by stormwater. Without regular maintenance, catch basins can fill with sediment, decreasing their functionality. Biofilms in catch basins can be vectors for bacterial growth, providing a source of bacteria to the receiving waterbody (Ferguson 2006). Both the City and the Town conduct regular catch basin inspections and conduct

cleanings as needed. Catch basins associated with high bacteria levels as identified by water sampling (eg. MS-4, SGP) should be evaluated for additional maintenance.

- *Pet waste management:* Pet waste can be a significant contributor to fecal coliform bacteria. In urban areas, where many pet owners regularly walk their dogs in public areas, such as sidewalks and municipal parks, it is important to encourage owners to clean-up after their pets. As previously discussed, one gram of dog feces can contain as much as 23 million fecal coliform bacteria. Public outreach campaigns, including distribution of flyers with dog licenses, sign posting and availability of dog bag dispensers and trash bins at popular dog walking areas can encourage a change in public behavior.

- *Trash/dumpster good housekeeping*: Dumpster and dumpster areas can be vectors for fecal coliform bacteria, especially if they regularly contain human or animal waste. Additionally, poorly managed trash receptacles can be magnets for urban wildlife such as raccoons which raid the dumpsters and may defecate nearby. Property owners should be encouraged to adopt good housekeeping practices including keeping dumpsters and trash bins secure, regularly disinfecting dumpsters or trash bins and areas, and responding quickly to spills. Municipalities, in conjunction with the local health district, should reach out to businesses and residents that regularly use dumpsters to promote good housekeeping practices.

<u>Storm Water Management/Outfalls Retrofits</u> –

- *Replace/retrofit storm drain sumps*: Storm drains throughout the watershed can be replaced or retrofitted to provide pollutant treatment. The replacement of existing storm drain units with units containing hydrodynamic separators, bio-skirts, or trash hoods will provide water quality treatment that is currently lacking. Each storm drain should be evaluated and replaced accordingly as part of regular municipal maintenance. Storm drains in areas associated with high bacteria levels (Shennecossett Road, Thomas Road, Leonard Drive, Big Y shopping plaza) should be evaluated and fitted with catch basin inserts designed to treat a variety of pollutants including bacteria.

- *Direct surface runoff to bio-retention unit*: Where possible and feasible, surface runoff should be directed to bio-retention units to provide treatment. Bio-retention units capture stormwater and allow it to infiltrate slowly into the ground. Micro-organisms in the soil provide pollutant treatment. Specific plan recommendations include:

    - Stormwater tree filter installation – Nathan Hale and Paul Revere Roads. Stormwater tree filters have been proven to be effective in removing numerous pollutants from stormwater runoff. Expected average

pollutant removal rates include >83% of total suspended solids (TSS); >50% nitrogen; >60% phosphorus; 35-95% heavy metals; and >85% bacteria (from Green Street Systems, LLC.).

- Rain garden installation – Nathan Hale and Paul Revere Roads. Rain gardens are a proven technology for capturing and infiltrating storm runoff. Pollutant removal rates are comparable to rates listed for tree filters.

- Infiltration basin or grass swale at D, G and H Streets – Currently leak-offs direct storm flow from D, G and H Streets, in the Town of Groton, directly into unnamed stream 2. It is recommended that the cul de sacs at the ends of each street be regraded and storm flow be directed to infiltration structures to provide treatment prior to entering the stream.

- Lake George/Washington Park stormwater wetland retrofit – Lake George, a grassy wetland in the City of Groton, is currently the receiving waterbody for the storm drain system in the surrounding neighbor. The Lake is currently ditched to allow for quick conveyance of stormwater to the west branch of Birch Plain Creek. The potential exists for Lake George to be retrofitted by the City as a stormwater wetland to allow retention, infiltration and treatment of stormwater prior to being discharged to Birch Plain Creek.

- Stormwater retention basin repair or retrofit at Electric Boat property, Poquonnock Road - The stormwater retention basin at the south end of the 3.85 acre Electric Boat parking lot appeared to be in a state of disrepair at the time of the watershed investigation. As the detention basin discharges directly into Birch Plain Creek, it should be repaired or retrofitted to provide treatment of pollutants.

- Incentives for LID implementation on commercial properties - Land-use departments in both the City and Town of Groton should investigate the creation of incentives for commercial property owners, especially in the highly developed commercial corridors adjacent to water quality "hot spots," to install low impact development (LID) technologies to manage stormwater runoff and associated pollutants. The land use departments should also evaluate land use regulations to identify and remove any barriers to LID implementation by applicants.

- Stormwater retrofit at Big Y and Benny's shopping plazas on Route 1 – The watershed investigation found that unnamed stream 2 has been culverted under these two shopping centers, and appears to form the backbone of the storm drain system through both. Storm drains in the Big Y shopping center open directly over the buried stream, allowing the

input of untreated runoff into the stream. The MS-4 sampling site at the outlet to the buried portion of the stream had the highest indicator bacteria levels in the watershed, ranging from 720 to 5200 cfu of E coli. It is recommended that these storm drains to be closed and stormwater be directed to a bio-retention swale prior to being discharged back into the culverted stream.

Illicit Storm Drain Connection Elimination –

- *Illicit discharge detection and elimination (IDDE)* - IDDE is a key component of the MS-4 permits of both the City and the Town. Municipal staff should continue to conduct storm drain surveys as part of their regular maintenance routine to identify residences and/or businesses that are illicitly discharging sump and footing drains to the storm drain system. The discharges should be disconnected from the storm drain system to eliminate dry weather storm drain flow, which can be promote bacteria growth.

Sewer/Septic Systems Inspections and BMPs –

- *Sewer force main inspection and maintenance* - The Town of Groton should continue its practice of annual inspections of the effluent force mains to assure the system is in good repair, and make repairs where need.

- *Homeowner septic system Best Management Practices (BMP)* – Ledge Light Health District should conduct regular outreach and education programs to encourage homeowners with septic systems to engage in best management practices, including regular inspections and/or pumping of their holding tanks in accordance with the manufacturer or installer's recommendations (usually every two years). The City and Town and Ledge Light Health District should consider developing a database of septic system pumpouts/problems, and should investigate sources of funding (such as STEAP or USDA Rural Home grants) to assist homeowners with septic repairs.

Riparian Buffer Restoration –

- *Lake George/Washington Park* - The asphalt bank armoring along the east side of Lake George should be removed and replaced with appropriate riparian vegetation. This project could be done in conjunction with the stormwater retrofit of Lake George. Because this is a high profile site, this project should be conducted in conjunction with a public outreach campaign, to educate and inform the public on the value of riparian buffers. Outreach could include newspaper articles about the project, information on the City website, and permanent post-installation educational signage.

- *Riparian buffer restoration/Invasive plant removal* – Numerous opportunities exist for the restoration of riparian buffers along Baker Cove and its tributaries. These opportunities include removal of invasive species such as Phragmites,

porcelainberry, bittersweet, multiflora rose, and other plants, and re-establishment of native riparian buffer vegetation to minimum widths of 15 feet.

Locations of areas with degraded riparian buffers noted during the watershed investigation include:

- Multiple private residences along Baker Cove
- Elks Club Marina, Shennecosett Road
- Multiple private property owners along Birch Plain Creek
- Birch Plain Golf Course (Hole 10)
- Electric Boat parking lot, Poquonnock Road
- Unused Amtrak railroad spur paralleling Thomas Road
- Birch Plain Creek south of Bridge Street

The municipalities should investigate methods to encourage these private property owners to restore riparian buffers, including:

- Outreach and education via educational brochures, newspaper articles, municipal websites or presentations about the benefits of riparian buffers, and how to recognize and eradicate invasive species.
- Funding assistance through grant opportunities such as the CL&P Small Community Environmental Grant Program, NRSC Wildlife Habitat Incentive Program (WHIP) or others to engage in targeted restoration projects, especially in areas of bacteria "hot spots."
- Adoption or revision of municipal zoning regulation requirements on riparian buffer width, including buffer widths along targeted watercourses, and when "substantial" improvements are made to an existing developed site.
- Enforcement of existing land use regulations or evaluation of barriers to enforcement.

<u>Marinas/Private Water Craft BMPs</u> –

- *Boat owner BMPs* – The harbor management Commission, Shellfish Commission or others should conduct a targeted outreach campaign to boat owners on Baker Cove regarding best management practices for boat maintenance and repair. This could take the form of educational brochures, workshops or presentations.

- *Use of boat pump-out facilities* - Local boat pump-out programs and facilities should be promoted by Harbor Management, Shellfish Commission and others, including publication of pumpout boat and facilities phone numbers or marine channel numbers to local and visiting boaters.

- *Clean Marina/Clean Boat Programs* – Marinas should be encouraged to participate in the CT DEEP Clean Marina and Clean Boat programs, as applicable.

Geese/Waterfowl Management –

- *Stakeholder coordination* – Watershed stakeholders, particularly those impacted by the flock of resident Canada geese, should coordinate to conduct a goose reduction strategy. The management strategy should address reducing the flock size through a goose roundup, altering the habitat, and continued hazing during the breeding season. Stakeholders should include, at a minimum, representatives from: Groton Utilities, CT DOT/Groton-New London Airport, Shennecossett Golf Course, Birch Plain Golf Course, Elks Club Marina, CT DEEP – Wildlife Division staff, US Fish & Wildlife Service staff, City and Town planning staff.

- *Flock Reduction* - The resident Canada geese should be managed to reduce the flock size. To garner public support, watershed residents should be educated about the potential water quality issues associated with waterfowl, as well as the airport hazards associated with large bird strikes. According to US Fish & Wildlife Service staff, both the City of Groton and the Groton/New London Airport already have depredation permits for resident geese.

- *Habitat alteration* - Habitat management may include planting riparian buffers that discourage geese and replanting grassy areas with grass species known to be unpalatable to Canada geese, if it doesn't interfere with foraging of native species.

Trash/Debris Reduction –

- *Organize and conduct stream cleanups* – Local organizations and/or businesses, with assistance from the municipalities, should be encouraged to sponsor and/or lead stream clean-ups. Areas to be targeted should include:

    - Wooded area behind 538 Poquonnock Road (adjacent to the small pond on the former King property)
    - Birch Plain Creek north of Thomas Road
    - Unnamed Stream 2 along the unused Amtrak spur line

- *Post and enforce no littering* – Existing no littering signs should be regularly inspected and maintained. The City should consider placing no littering signs along Madison Place, due to the amount of trash found in Birch Plain Creek near the Madison Place storm drain outfalls.

- *Municipal Enforcement* – The appropriate municipal authorities should work with property owners to remedy instances of trash/debris and yard waste (including leaves, branches and grass clippings) observed in wetlands and/or watercourses during the watershed investigation.

Stream Bank Erosion Mitigation –

- *Meridian Street* –The riparian vegetation at this site should be re-established to mitigate stream bank erosion of Birch Plain Creek. As this is private property, the Town may consider contacting the owner if it adopts the recommendations listed in riparian buffer restoration section above. The property owner should be encouraged to allow stream bank vegetation to re-establish in order to stabilize the streambank.

- *City of Groton municipal stockpile yard* –This site should be re-graded to prevent surface run-off to Birch Plain Creek. The site should also be evaluated for erosion and sedimentation control of the various stockpiled materials.

- *Unnamed stream 2, west of H Street* - Erosion of unnamed steam 2 appeared to be associated with a stormwater outfall from the vicinity of H Street. The stormwater pipe should be evaluated to determine if it is properly sized for the amount of flow it conveys. The site should also be evaluated to determine if the outfall can be redesigned to discharge into the adjacent wooded area, which would allow the storm flow to infiltrate.

Table 7: Recommended Management Strategies for Specific Areas of Concern, with Cost Estimates						
AoC Definitions: SWO = Stormwater Outfall DG = Degraded Riparian Buffer TD = Trash and Debris ER = Streambank Erosion MC = Modified Stream Channel						
Management Measure	**Reach, AoC Number**	**Location**	**Strategy**	**Priority**	**Responsible Entity**	**Probable Cost**
Urban Sources/ Pet BMPS	Watershed Wide		Conduct good maintenance practices including biannual street sweeping and catch basin sump clean-out	High	City of Groton, Town of Groton DPWs & State of Connecticut Highway Department	Sweeping: ($25-$45 mile/yr/pass) Cleanouts: ($250-$1000 per unit)
			Storm Drain Stenciling	Med	Town of Groton, City of Groton, Volunteers	$1500 Approx. 600 drains @ $2.50/drain
	West Branch Birch Plain Creek (BPC), Reach 4a, general	Washington Park, Meridian Street	Encourage park users to dispose of trash, pet waste in proper waste receptacles	Low to Med	City of Groton	Signs, posts and hardware @$20/unit, as necessary Waste Receptacles - $99-$699 per unit
	BPC Reach 4, general	Kinnesbrook Condominiums, Meridian Street	Encourage pet owners to manage pet waste	High	Condominium association	$200 (100 educational brochures @$2/pc)
	BPC Reach 4, general		Maintain dumpsters and dumpster area	High	Condominium association, City via Enforcement	Included in waste mgnt and grounds keeping services
	BPC Reach 4, general		Adopt organic lawn care methods	Med	Condominium association	Comparable to current lawn service fees

Management Measure	Reach, AoC Number	Location	Strategy	Priority	Responsible Entity	Probable Cost
Urban Sources/ Pet BMPS	BPC, Reach 3, general	Electric Boat Parking lot, Poquonnock Road	Conduct good maintenance practices including biannual street sweeping and catch basin sump clean-out	Med	Electric Boat (parking lot)	Sweeping: ($25-$45 mile/yr/pass) Cleanouts: ($250-$1000 per unit)
	BPC, Reach 1, SWO 07, SWO 08	Avery Heights - Nathan Hale Road Paul Revere Road Madison Place	Post No Dumping or No Littering signs at storm drain outlets to Birch Plain Creek	Med	City of Groton	$40 (2 signs, posts and hardware @$20/unit)
Stormwater Management/ Outfall Retrofits	Watershed-wide		Review, update and implement recommendations of Small MS-4 Stormwater Management Plans	High	City of Groton Town of Groton	Staff time/salaries
	West Branch BPC, Reach 4a	Washington Park, Meridian Street	Retrofit Lake George to provide water quality treatment	High	City of Groton	$100,000-$200,00 (2.7 ac @ $39,000-$82,000/ac – may be less since much infrastructure already exists)
	West Branch BPC, Reach 4a, SWO 18, SWO 19, SWO 20, SWO 21		Replace/retrofit storm drain sumps to provide secondary treatment	High	City of Groton	$100-$40,000 per unit
	BPC, Reach 4, general	Kinnesbrook Condominiums, Meridian Street	Replace/retrofit storm drain sumps to provide secondary treatment	High	Property Owner/Condo Association	$100-$40,000 per unit
	BPC, Reach 4, general	Kinnesbrook Condominiums, Meridian Street	Install bio-retention areas to treat surface run-off	Med	Condominium association	$15,000- $30,000 (3 ac. @ $5000-$10,000 per impervious acre drained)
	BPC, Reach 3; Unnamed Stream 1, Reach 1	Poquonnock Road	Replace/retrofit storm drain sumps to provide secondary treatment	High	City of Groton	$100-$40,000 per unit

Management Measure	Reach, AoC Number	Location	Strategy	Priority	Responsible Entity	Probable Cost
Stormwater Management/ Outfall Retrofits	BPC, Reach 3; Unnamed Stream 1, Reach 1; Unnamed Stream 2, Reaches 1 and 2	Poquonnock Road/Route 1	Encourage or provide incentives for business owners to install LIDs	Med	Town of Groton – Office of Planning & Developmental Services	Determined on an individual basis
	BPC, Reach 3, SWO 11	Electric Boat Parking lot, Poquonnock Road	Disconnect storm drains and direct surface run-off to retention basin at rear of parking lot	Med	Electric Boat	$18,500 - $37,000 (3.7 ac. @ $5000-$10,000 per impervious acre drained)
	BPC, Reach 3, SWO 09		Repair stormwater bio-retention basin at south end of parking lot	Med	Electric Boat	$19,000-$38,500 (3.85 acres @$5000-$10,000 per acre of treated area – may be less since much infrastructure is in place)
	BPC, Reach 1, SWO 07, SWO 08	Avery Heights - Nathan Hale and Paul Revere Roads, Madison Place	Replace/retrofit storm drain sumps to provide secondary treatment	High	City of Groton	$100-$40,000 per unit
	BPC, Reach 1		Install tree filter units at storm drains to treat stormwater	Med	City of Groton	$67,500 ($7500/unit x 9 units)
			Install Rain Gardens between buildings to treat surface runoff	High	Property owner/ management company	$2,100-$16,000 each (4-6 rain gardens @ $3-$15/sf of rain garden surface area)
	Unnamed Stream 2, Reach 1, SWO 27-30	D Street, G Street, H Street	Re-grade cul de sacs to collect storm water and direct to a secondary treatment area	High	Town of Groton	$11,000 - $23,000 each (2.25 acre @ $5000-$10,000 per impervious acre drained)
	Unnamed Stream 2, Reaches 1 and 2	Route 1 Corridor	Replace/retrofit storm drain sumps to provide secondary treatment	High	State of Connecticut	$100-$40,000 per unit

Management Measure	Reach, AoC Number	Location	Strategy	Priority	Responsible Entity	Probable Cost
Stormwater Management/ Outfall Retrofits	Unnamed Stream 2, Reach 2	Rt 1 Shopping Plaza, North	Replace/retrofit storm drain sumps to provide secondary treatment	High	Property owner	$100-$40,000 per unit
	Unnamed Stream 2, Reach 2	Rt 1 Shopping Plaza, South	Replace/retrofit storm drain sumps to provide secondary treatment	High	Property owner	$100-$40,000 per unit
	Unnamed Stream 2, Reach 2, SWO 38-40	Rt 1 Shopping Plaza, North	Disconnect storm drains that open directly over stream in RT 1 shopping plaza	High	Property owner, with assistance from local, state or other agencies	Dependent on method chosen to close storm drains
	Unnamed Stream 2, Reach 2, SWO 33-37	Rt 1 Shopping Plaza, South	Disconnect storm drains that open directly over stream in RT 1 shopping plaza	High	Property owner, with assistance from local, state or other agencies	Dependent on method chosen to close storm drains
	Unnamed Stream 2, Reach 2	RT 1 shopping plazas	Install bio-retention swales to treat stormwater from parking lots before it enters storm drain system	High	Property owner, with assistance from local, state or other agencies	$45,500-$91,000 (9.1 acres@$5000-$10,000 per acre of treated area)
	BPC, Reach 4, SWO 25	Bridge Street	Replace/retrofit storm drain sumps to provide secondary treatment	High	Town of Groton	$100-$40,000 per unit
Illict Stormdrain Connections	BPC, Reach 3	Poquonnock Road from Rainville Ave or Old Farm Road	Identify residences hooked up to storm drain system and disconnect	Low	City of Groton, property owners	Cost determined on individual basis
Sewer Inspections/ Septic System BMPs	Watershed-wide		Conduct municipal sewer line inspections and repair any leaks	Med	City and Town of Groton	Municipal staff salaries
			Conduct education program for homeowners on septic system BMPs	Med	Ledge Light health District	Educational brochures @$2/pc

Management Measure	Reach, AoC Number	Location	Strategy	Priority	Responsible Entity	Probable Cost
Riparian Buffer Restoration	West Branch BPC, Reach 4a, Vicinity of SWO 21	Washington Park, Meridian Street	Remove asphalt armoring from edge of Lake George along Meridian Street and revegetate 380 linear feet of 15 ft wide buffer	High	City of Groton	Asphalt removal: $2000-$3000 Buffer: $100- $600 (0.13 acres @ $500 - $4500 per acre)
	West Branch BPC, Reach 4a, Vicinity of SWO 21		Revegetate 950 linear feet of 15 ft wide buffer along shore of Lake George	High	City of Groton	$200-$1500 (0.33 acres @ $500 - $4500 per acre)
	BPC, Reach 3, DG 07	Electric Boat parking lot Poquonnock Road	Remove invasive species and revegetate 500 linear ft of 15 ft wide buffer	Med	Electric Boat	$100-$800 (0.0.17 acres @ $500 - $4500 per acre)
	BPC, Reaches 1, 2 and 3, Reach-wide	Birch Plain Creek	Remove invasive species (phragmites) on 8.7 acres of tidal marsh associated with Birch Plain Creek	Low	Town and City of Groton, abutting property owners	$6730 (Spraying: 8.7 acres @ $492/acre Mowing: 8.7 acres @ $692/acre, $430 fees)
	Unnamed Stream 2, Reach 1, DG 18-20	Train tracks parallel to Poquonnock Road	Remove invasive species and revegetate 2000 linear feet of 15 ft wide buffer	Low	Property owner (Amtrak)	$350-$3000 (0.69 acres @ $500 - $4500 per acre)
	Baker Cove, DG 01	Baker Cove (multiple private residences)	Revegetate 15 ft wide buffer along 280 linear feet of Baker Cove	Med	Property owners	$100-$400 (0.1 acres @ $500 - $4500 per acre)
	Baker Cove	Elks Club Marina, Shennecossett Rd.	Revegetate 15 ft wide buffer along 1500 linear feet of Baker Cove	Med	Property owner (Elks Club Marina)	$250-$2500 (0.52 acres @ $500 - $4500 per acre)
	BPC, Reach 1, DG 03	Birch Plain Golf Course	Revegetate riparian buffer to maximum width practicable along 200 linear feet of Birch Plain Creek	Med	Property owner	$125-$1125 (0.25 acres @ $500 - $4500 per acre)

Management Measure	Reach, AoC Number	Location	Strategy	Priority	Responsible Entity	Probable Cost
Riparian Buffer Restoration	Unnamed pond/ Unnamed Stream 1, Reach 1, DG 10	Poquonnock Road	Remove fly ash deposits on southeast shore of pond, revegetate 35 ft wide buffer along 100 feet of shoreline	Low	Town of Groton	Fly Ash Removal: TBD by professional engineer Buffer: $200-$1500 (0.33 acres @ $500 - $4500 per acre)
	Unnamed Stream 1, Reach 1, DG 08	Poquonnock Road	Remove invasive species (Phragmites) on 0.3 acres of tidal marsh associated with Unnamed Stream 1	Med	Town of Groton	$650 (Spraying: 0.3 acres @ $492/acre Mowing: 0.3 acres @ $692/acre, $450 fees)
	Unnamed Stream 2, Reach 1, DG 20	Along railroad tracks north of Tower Road	Revegetate 100 feet of 15 ft wide riparian buffer	Low	Property owner (Amtrak)	$100-$200 (0.03 acres @ $500 - $4500 per acre)
	BPC, Reach 4, DG 15	Behind Knights Inn on Bridge St	Remove invasive species (Phragmites) on 1.4 acres on Birch Plain Creek	Med	Property Owner	$2100 (Spraying: 1.4 acres @ $492/acre Mowing: 1.4 acres @ $692/acre, $450 fees)
Marina/Private Watercraft BMPs	Baker Cove - General	Jupiter Point	Encourage boat owner BMPs including use of boat pumpout program, DEEP Clean Boat program	High	City of Groton, Harbor Management Commission, Shellfish Commission	$200 (100 educational brochures @$2/pc)
	Baker Cove	Elks Club Marina	Encourage boat owner BMPs and Clean Marina Certification, if warranted	Medium	Property owner	$200 (100 educational brochures @$2/pc)
Geese/Waterfowl Management	Baker Cove	Groton-New London Airport	Coordinated Canada goose flock control: Installation of non-preferred turf grasses, flock reduction, hazing	Low to medium	CT DOT	Dependent on flock control method and level of participation by each entity
	Unnamed Stream 3	Shennecossett GC			City of Groton	
	BPC, Reach 1	Birch Plain GC			Property owner	

Management Measure	Reach, AoC Number	Location	Strategy	Priority	Responsible Entity	Probable Cost
Trash/Debris Reduction	BPC Reach 4, Vicinity of MC 08	Kinnesbrook Condominiums, Meridian Street	Remove yard waste/leaves from stream bed	High	Condominium association, City via Enforcement	$250 - $1,000
	BPC, Reach 1, TD 02	Birch Plain Creek north of Thomas Rd	Organize and conduct river clean-up.	Low	City of Groton	Volunteer time
			Post and enforce no littering.	Low	City of Groton	$20 (1 sign, post and hardware @ $20 per unit)
	Unnamed Stream 1, Reach 1, TD 04	538 Poquonnock Road	Remove trash and debris in woods behind stores	Med	Property owner, Town Enforcement	$250-$1,000
	Unnamed Stream 2, Reach 1, TD 05, TD 06	Unnamed stream 2 along Railroad between Thomas Rd and RT 1	Organize and conduct river clean-up.	Low	Property Owner (Amtrak)	Volunteer time
			Post and enforce no littering.	Low	Property Owner (Amtrak), Town of Groton (enforcement)	$20 (1 sign, post and hardware @ $20 per unit)
	Unnamed Stream 2, Reach 2, TD 09	Wetland associated with Unnamed stream 2, adjacent to Big Y shopping plaza	Remove yard waste from edge of wetland	Low	Property owner, Town via enforcement	$250 - $1000
Stream Bank Erosion Mitigation	BPC, Reach 4, ER 01	Meridian Street (private residence)	Revegetate 250 linear feet of 15 ft wide buffer	Med	Property owner	$100-$400 (0.09 acres @ $500 - $4500 per acre)
	BPC Reach 4a, ER 03	City DPW Stockyard	Re-grade site to prevent surface run-off to stream	Med	City of Groton	$1000-$2500
	Unnamed Stream 2, Reach 1, ER 02	Along Railroad between Thomas Rd and RT 1	Redesign outfall to discharge in wooded area near stream	Low	Property owner (Amtrak)	$1500

D. Financial and Technical Assistance Needed

Reasonable financial estimates for each management practice have been provided in table 7 above, however costs associated with the development and implementation of each proposed measure will need to be estimated individually as management strategies are undertaken. Financial assistance in the form of grants is available from multiple sources, including federal, state, and local sources, including but not limited to Community Development grants, Clean Water Act §319 grants, Long Island Sound program grants, National Fish and Wildlife Fund grants, and environmental and professional organizations grants. Funds may also be available in the form of donations and in-kind services provided by local businesses and environmental organizations. Numerous grant applications are strengthened by the availability of cost matches and in-kind services. A sampling of funding opportunities is listed in Table 8.

Table 8: Potential Funding Sources

Funding Source	Award Amount	Contact Information
CT DEEP CWA §319 Grant Program		Stan Zaremba (860) 424-3730
http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325588&depNav_GID=1654		
CT DEEP Clean Water Fund		Susan Hawkins (860) 424-3325
http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325578&depNav_GID=1654		
CT DEEP Long Island Sound License Plate Program	$25,000.	Kate Brown (860) 424-3034
http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323782&depNav_GID=1635		
CT OPM Small Town Economic Assistance Program (STEAP)		Barbara Rua (860) 418-6303
http://www.ct.gov/opm/cwp/view.asp?a=2965&q=382970&opmNav_GID=1793		
US EPA Healthy Communities Grant Program		Jennifer Padula (617) 918-1698
http://www.epa.gov/region1/eco/uep/hcgp.html		
NOAA Coastal Management Programs		
http://coastalmanagement.noaa.gov/funding/welcome.html		
US EPA Five Star Restoration Grant Program	$20,000 average	Myra Price (202) 566-1225
http://www.epa.gov/owow/wetlands/restore/5star		
NFWF Long Island Sound Futures Fund		Lynn Dwyer lynn.dwyer@nfwf.org
http://www.nfwf.org/AM/Template.cfm?Section=Charter_Programs_List&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=60&ContentID=19108		
NRCS Wetlands Reserve Program (WRP)		Javier Cruz (860) 887-3604
http://www.ct.nrcs.usda.gov/programs/whip/whip.html		
NRCS Environmental Quality Incentives Program (EQIP)	$300,000 over a six year period	Javier Cruz (860) 887-3604
http://www.ct.nrcs.usda.gov/programs/eqip/eqip.html		
Wildlife Habitat Incentive Program (WHIP)		Javier Cruz (860) 887-3604
http://www.ct.nrcs.usda.gov/programs/whip/whip.html		
Rivers Alliance of CT Watershed Assistance Small Grants Program	$5000, 40% non-federal funding match req't	Rivers Alliance of CT (860) 361-9349
http://www.riversalliance.org/watershedassistancegrantrfp.cfm		
Corporate Wetlands Restoration Partnership (CWRP)		
http://ctcwrp.com/home		
CLP Environmental Community Grant Program	$1500	Patricia Baxa
http://www.nu.com/environmental/grant.asp		

Technical assistance may be provided by organizations such as the US Department of Agriculture/Natural Resource Conservation Service, CT DEEP, the Eastern Connecticut Conservation District, US Fish & Wildlife Service, and others, depending on the nature of the implementation.

E. Education/Outreach Component

The objective of the education/outreach component of this plan is to raise public awareness of the water quality issues associated with Baker Cove, in order to create an educated public that understands both the issues of nonpoint source pollution and its effects on water quality, and also, actions that can be taken to address the problem. By successfully educating the public, this plan should lead to behavioral change that should result in reduction of NPS to Baker Cove.

Table 9: Outreach & Education Topics and Partners

Outreach Topic	Potential Outreach Partner
Water quality issues in Long Island Sound	CT DEEP Office of Long Island Sound Programs (OLISP), Long Island Sound Study (LISS)
Commercial & Recreational Shellfishing	Dept of Agriculture/Bureau of Aquaculture, Groton Shellfish Commission
The benefits of vegetated riparian buffers	CT SeaGrant
Invasive plant species identification and control	CT Invasive Plant Work Group (CIPWG), Invasive Plant Atlas of New England (IPANE)
Pet waste management	City/Town of Groton, Ledge Light Health District
Boat maintenance BMPs	CT DEEP, Harbor Master
Clean Marina and Clean Boat programs	CT DEEP
Boat Pumpout Program	CT DEEP Boat Pumpout Program
Understanding Non-point Source (NPS) Pollution	CT NEMO
Low impact development (LID)	NEMO
Septic System BMPs for Homeowners	Ledge Light Health District

Outreach/education efforts should focus on addressing sources of fecal coliform bacteria and other NPS pollution in the watershed, and providing solutions that citizens can apply to reduce pollutant loading to Baker Cove. Target groups should include, but not be limited to, watershed residents, pet owners, businesses, municipal staff and land use boards, the boating community, shellfishing community, and schools.

Outreach can be provided via vehicles such as news media (such The Day, the Groton Patch), websites (such as CT DEEP, City/Town of Groton, ECCD), blogs, list-servs, social media outlets, targeted workshops and presentations.

Watershed stakeholders should define outreach roles and provide education and outreach to watershed residents, business owners, land-use decision makers and others on the following issues in order to ensure success of this watershed plan.

F. Implementation Schedule

2012:

- Review and revise Small MS-4 Stormwater Management Plans; implement SWMP recommendations
- Convene stakeholders to create watershed management team to oversee implementation of the Baker Cove Watershed Plan
- Conduct good municipal housekeeping practices including biannual street sweeping and sump clean-out on all private and public roads and parking areas in watershed
- Install signs and dispensers and distribute educational literature to encourage dog walkers to clean up dog waste
- Conduct good housekeeping at Kinnesbrook Condominium on dumpsters and dumpster areas
- Develop conceptual designs of retrofits and other stormwater management implementations for education and outreach to town staff and consultants, land use commissioners and citizenry to build support and consensus on next step actions
- Facilitate meetings/workshops promoting revisions to town/city land use regulations to incorporate LID design practice. Encourage NEMO program and others to reach out to town/city staff to make presentations to land use commissioners.
- Remove debris from storm drain outfall at Kinnesbrook Condominiums
- Remove trash and debris in flood plain behind stores on Poquonnock Road
- Disconnect storm drains that open directly over unnamed stream 2 in the Route 1 shopping plazas
- Install bioretention swales to treat stormwater from parking lots at Route 1 shopping plazas
- Post “No Littering” or “No Dumping” signs at the storm drain outlets on Nathan Hale and Paul Revere Roads and at Thomas Road bridge
- Install rain gardens or infiltration trenches between buildings at Branford Manor to treat surface runoff
- Conduct watershed wide education program for homeowners with septic systems
- Promote boat owner best management and good housekeeping practices
- Encourage Elks Club Marina to obtain Clean Marina Certification

- Organize and conduct river/stream clean-ups

2013:

- Stencil all storm drains in watershed
- Adopt organic lawn care practices at Kinnesbrook Condominiums
- Repair stormwater retention basin in Electric Boat parking lot on Poquonnock Road for enhanced water quality treatment
- Encourage or provide incentives for business owners on Poquonnock Road and Route 1 to install LIDs
- Replace/retrofit storm drain sumps at shopping plazas on Route 1
- Identify and disconnect residences with sump pumps/footing drains connected to the storm drain system
- Conduct watershed wide municipal sewer line inspections and repair any any leaks
- Revegetate riparian buffer along Birch Plain Creek (Birch Plain Creek Golf Course)
- Revegetate riparian buffer at private residence on Meridian Street
- Re-grade City of Groton DPW stockyard to prevent surface run-off to Birch Plain Creek
- Develop Plan of Work and progress report card

2014:

- Install bio-retention areas to treat surface run-off at Kinnesbrook Condominiums
- Install stormwater tree filter units at Avery Heights
- Install infiltration basin at base of asphalt leak-off at Branford Manor
- Remove leak-offs at 591 Poquonnock Road and install infiltration structure
- Remove leak-offs at D, G and N Streets and install infiltration structures
- Replace/retrofit storm drain sumps on Route 1
- Remove invasive plants and revegetate riparian buffer at Electric Boat parking lot on Poquonnock Avenue
- Begin phragmites removal in Birch Plain Creek (Reaches 1-3)
- Begin phragmites removal on unnamed stream 2 between Poquonnock Road and Groton-New London airport
- Begin phragmites removal on unnamed stream 1, Poquonnock Road
- Begin phragmites removal on Birch Plain Creek south of Bridge Street
- Revegetate riparian buffer along Baker Cove (Jupiter Point)
- Revegetate riparian buffer along Baker Cove (Elks Club Marina)
- Review available water quality data, evaluate progress of implementations

2015:

- Install bio-retention areas to treat surface run-off at Kinnesbrook Condominiums
- Replace/retrofit storm drain sumps in Washington Park
- Replace/retrofit storm drain sumps at Kinnesbrook Condominiums
- Disconnect storm drains at Electric Boat parking lot on Poquonnock Road and direct all water to detention basin
- Replace/retrofit storm drain sumps on Poquonnock Road

- Continue phragmites removal in Birch Plain Creek (Reaches 1-3)
- Continue phragmites removal on unnamed stream 2 between Poquonnock Road and Groton-New London airport
- Continue phragmites removal on unnamed stream 1, Poquonnock Road
- Continue phragmites removal on Birch Plain Creek south of Bridge Street
- Install riparian buffer along stream in area between Poquonnock Road and Groton-New London Airport
- Investigate and pursue regulatory requirements associated with removal of fly-ash deposits on the shore of the small lake on Poquonnock Road
- Evaluate Plan goals and recommendations as implementations progress and revise as necessary

2016:

- Install stormwater retrofit at Lake George to provide water quality treatment
- Replace/retrofit storm drain sumps on Bridge Street
- Remove asphalt armoring on east side of Lake George, restore riparian buffer
- Continue phragmites removal in Birch Plain Creek (Reaches 1-3)
- Continue phragmites removal on unnamed stream 2 between Poquonnock Road and Groton-New London airport
- Continue phragmites removal on unnamed stream 1, Poquonnock Road
- Continue phragmites removal on Birch Plain Creek south of Bridge Street
- Remove flyash deposits along shore of small lake on Poquonnock Road and revegetate riparian buffer
- Daylight Birch Plain Creek from Poquonnock Road to the Trails Pond dam

G. Measurable Milestones

Implementation of the recommended management strategies is scheduled over a 5 year period. A reduction of nonpoint source pollutants, including indicator bacteria, should be noted after implementation of year 1 and 2 recommendations, which target municipal best management practices and home and business owner education. Stormwater pollutant reductions should continue over years 3, 4 and 5 as stormwater retrofits are installed. Successful implementation should yield measurable reductions in the levels of indicator bacteria at the stormwater and shellfish bed sampling sites, with the goal of reducing the level of indicator bacteria for the direct consumption of shellfish to below the standard set by the State of Connecticut Water Quality Standards (http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325618) and possibly re-opening the shellfish beds in Baker Cove for recreational shellfishing.

Described below are interim milestones that may be used to measure the progress that the watershed stakeholders are making toward meeting the watershed goals.

Management Objective 1: Build public awareness of NPS, including sources of nonpoint source pollution and management practices through outreach and education	
Actions/Milestones:	• Identify target audiences • Gather existing educational materials • Create new educational materials as needed • Distribute materials to residential and urban watershed residents • Conduct workshops focusing on non-point source issues
BMPs:	Urban Bacteria/NPS Sources
Responsible Parties:	ECCD, CT DEEP, Municipalities
Anticipated Products:	Educational materials/workshops
Evaluation:	# educational materials distributed, # workshops conducted
Timeline:	1-2 yrs.

Management Objective 2: Promote good housekeeping practices among municipalities and property owners	
Actions/Milestones:	• Review municipal housekeeping practices (GHP) • Adopt revised GHPs in priority areas as established by WBP • Distribute information regarding GHPs in priority areas as established by WBP
BMPs:	Urban Bacteria/NPS Sources
Responsible Parties:	Municipalities/DPW, stakeholders
Timeline:	1-3 yrs.
Anticipated Products:	Revised municipal and property owner maintenance practices
Evaluation:	Adoption of improved GHPs, # educational brochures distributed, reduction in measured bacteria levels
Timeline:	1-2 yrs.

Management Objective 3: Address pollution from illicit discharges, sewer leaks, and/or failing septic systems	
Actions/Milestones:	• Implement Illicit Discharge Detection and Elimination (IDDE) program • Work with Health District sanitarians to evaluate the residential septic systems in the priority areas as defined by the WBP • Identify potential funding sources for septic repairs • Work with property owners to repair failing systems • Provide educational materials to property owners about septic system BMPs • Conduct regular inspections of sewer force mains • Make force main repairs as necessary

BMPs:	Sewer Inspections/Septic System BMPs
Responsible Parties:	Municipalities, Sewer Authority, Ledge Light Health District, property owners
Anticipated Products:	Elimination of illicit discharges, repaired septic systems, repaired sewer lines
Evaluation:	# illicit discharges detected and eliminated, # failing systems repaired, # educational brochures distributed, # ft sewer force main inspected/repaired
Timeline:	2-4 yrs.

Management Objective 4: Implement structural measures to reduce bacteria and other NPS loading	
Actions/Milestones:	• Review and prioritize implementation sites • Select sites, contact landowners (if private property) to determine level of interest and cooperation • Identify and obtain funding • Develop construction design for BMP implementation • Obtain necessary permits • Construct structural measures • Design and conduct pre- and post-construction monitoring program to assess practice effectiveness
BMPs:	Stormwater management
Responsible Parties:	Municipalities, ECCD, private land owners
Anticipated Products:	Prioritized list of implementation sites, BMP design plans, water monitoring data
Evaluation:	# structural measures installed, measured reduction in NPS/bacteria
Timeline:	2-5 yrs.

Management Objective 5: Establish riparian buffers	
Actions/Milestones:	• Evaluate and identify priority areas for buffer establishment or invasive species removal • Select sites, contact landowners (if private property) to determine level of interest and cooperation • Identify and obtain funding • Develop site design • Conduct buffer planting or invasive species removal • Conduct pre- and post-planting water quality monitoring
BMPs:	Riparian buffer restoration
Responsible Parties:	Municipalities, ECCD, private land owners
Anticipated Products:	List of priority areas, construction design, photo-documentation, water quality data

Evaluation:	# acres or stream feet of area restored, reduction in NPS/bacteria
Timeline:	2-5 yrs.

Management Objective 6: Implement on-going water quality monitoring program, especially in bacteria "hot spots"	
Actions/Milestones:	• Identify locations for monitoring, based on bacteria "hot spots" • Design water quality monitoring program • Obtain funding for training and equipment • Recruit and train volunteers • Conduct site monitoring • Report water quality results
BMPs:	Additional data necessary to narrow down sources of bacteria and other NPS
Responsible Parties:	ECCD, CT DEP, Municipalities, Groton Shellfish Commission
Anticipated Products:	Water quality data, summary report
Evaluation:	# sites monitored, data submitted to appropriate agencies
Timeline:	2-5 yrs., ongoing thereafter

Management Objective 7: Review and strengthen land use regulations pertaining to water quality	
Actions/Milestones:	• Form regulation review team • Review existing land use regulations, municipal ordinances, etc. • Review sample/model regulations pertaining to water quality • Work with land use staff and boards to develop revised regulations • Adopt new regulations
BMPs:	
Responsible Parties:	Municipalities, ECCD, NEMO, CT DEEP, SECCOG
Anticipated Products:	Proposed regulation amendments, revised regulations
Evaluation:	Adoption of regulation amendments that effectively address water quality issues
Timeline:	1-2 yrs.

H. Monitoring and Assessment Component

Indicator bacteria monitoring in Baker Cove by the Connecticut Department of Agriculture Bureau of Aquaculture is ongoing as part of shellfish bed management. Stormwater monitoring of stormwater outfalls that are received by tributaries to Baker

Cove by the City and Town of Groton as part of their MS-4 permit requirements will also be ongoing. Water quality data collection should be coordinated with the implementation of management measures to determine the implementation effectiveness. Communication must be ongoing between the stakeholder groups and monitoring managers to assure that the monitoring design, as well as data collection and analysis, meets the needs of the Plan objectives. The stakeholders should be ready to revise monitoring plans if the goals and objectives of the watershed plan are not being met. Monitoring results should be compared to the established State water quality standards for direct consumption of shellfish to determine if indicator bacteria levels are being reduced by implementations.

The Groton Shellfish Commission, recognizing the contributions of tributaries to pollutant loading to the coves and embayments of Groton, are in the process of developing a water quality monitoring program of all tributaries to Long Island Sound. Development of this monitoring program should be supported by all the watershed stakeholders. The results of the Shellfish Commission's water quality monitoring should be shared with stakeholders as a component of evaluating the effectiveness of the watershed strategy implementation as well.

I. Implementation Effectiveness

Since no total maximum daily load (TMDL) for indicator bacteria has been established for Baker Cove, a specific reduction in bacteria loading cannot be quantified. However, it is valid to say that the effectiveness of the implementation may be measured by a reduction in measured colonies of indicator bacteria in Baker Cove, and a reduction in the number of exceedences of water quality standards for indicator bacteria. Further, since the shellfish beds are currently designated restricted-relay and therefore accessible only to commercial operations, an additional measure of effectiveness would be the opening of the beds to the general public for shellfish harvesting for direct consumption.

Next Steps

Following acceptance of the Baker Cove Abbreviated Watershed-based Plan by the CT DEEP, this Plan should be distributed to all the watershed stakeholders for implementation. The plan should also be made available for review by the general public via posting on the CT DEEP, ECCD and City and Town of Groton municipal websites.

In order to ensure the success of the Baker Cove Abbreviated Watershed-based Plan, it is recommended that the stakeholders form a watershed management team and meet periodically to review the progress of the implementation strategies outline in this Plan.

The team should develop a work plan based on the plan recommendations, and should devise a process to determine steps to take to implement the plan strategies.

The team should develop and maintain an evaluation process, such as a watershed progress report card, to document completion of Plan recommendations and other activities within the watershed, in order to demonstrate progress towards water quality improvements.

The management team should review and revise the Plan as implementations are completed and as new technology and information becomes available. The management team should solicit input from local, state and federal agencies as appropriate.

The management team should consider initiating additional water quality investigation to further narrow down sources of indicator bacteria at the hot spots identified in this watershed plan, including outfalls at Shennecossett Road, Thomas Road, the Big Y shopping plaza, and Leonard Drive.

Closing

Addressing Baker Cove's water quality issues will be a long term effort. The Eastern Connecticut Conservation District intends to remain an active participant and central point of contact as implementations recommended by this Watershed Based Plan are undertaken.

Any comments or questions regarding this plan should be directed to the Eastern Connecticut Conservation District:

Judy Rondeau
Natural Resources Specialist
judy.rondeau@comcast.net
238 West Town Street
Norwich, CT 06360
(860) 887-4163 ext. 401

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Appendices:

- **A.** Birch Plain Creek Stream Walk Map
- **B.** Area of Concern Summary
- **C.** Area of Concern Reach Maps
- **D.** Water Sampling Data

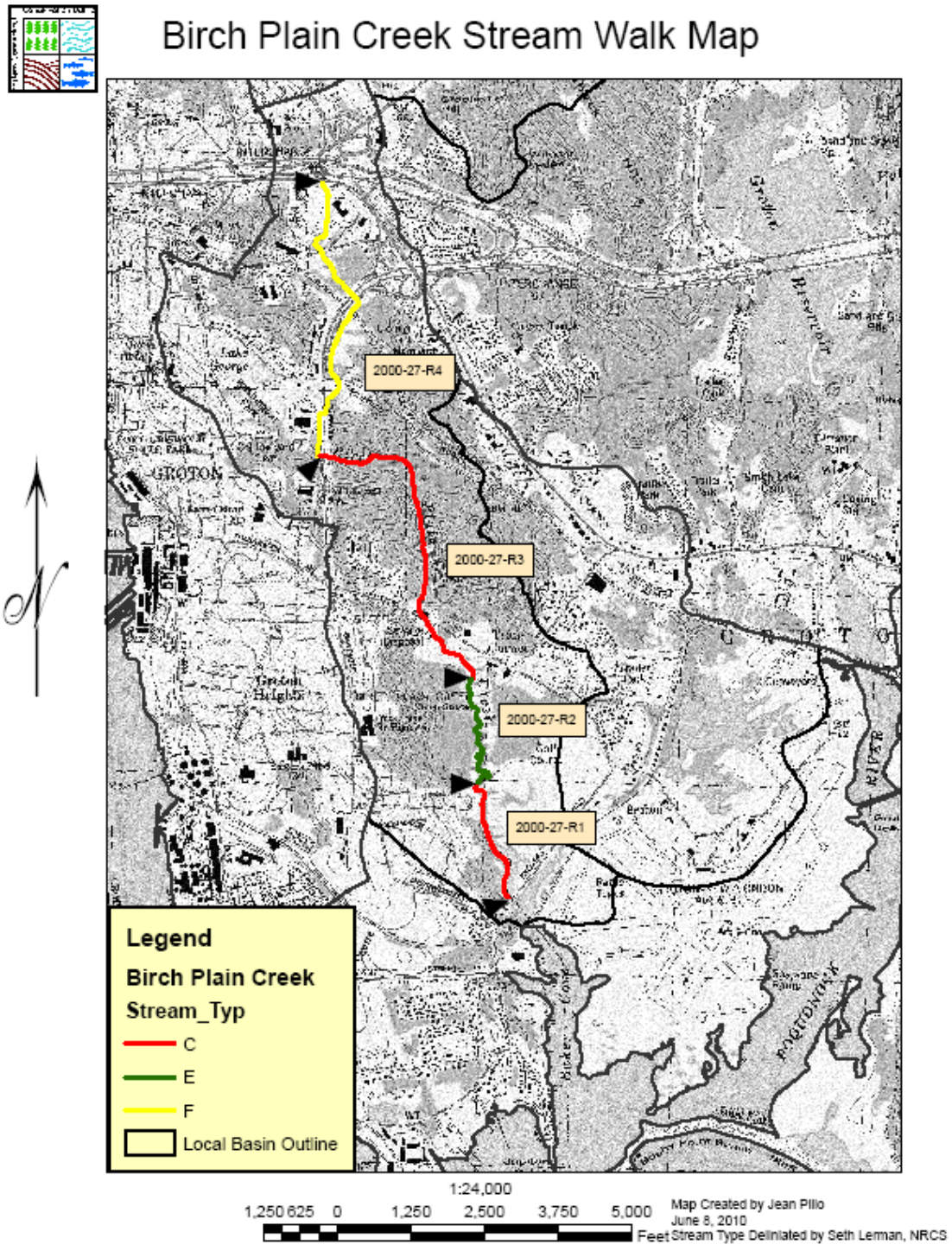


Figure 9: Birch Plain Creek Watershed with Streamwalk Segments and Stream Segment Types, as defined by NRCS.

Appendix B
Area of Concern Summary

Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
DG 01	degraded buffer	216	41.325357	-72.055592	7/20/2010	Baker Cove	Shennecossett Rd/ Jupiter Pt	several lawns to water
DG 02	degraded buffer	227	41.335487	-72.060173	8/20/2010	2000-27-R1	start of reach 2	
DG 03	degraded buffer	229	41.336149	-72.059239	8/20/2010	2000-27-R1	BPC Reach 1	east bank - hole 10 birch Plain GC - no buffer vegetation
DG 04	degraded buffer	230	41.338825	-72.060179	8/20/2010	2000-27-R2	BPC R2 end of navigable channel	phragmites marsh pinches out channel
DG 05	degraded buffer	231	41.334936	-72.060216	8/20/2010	2000-27-R2	BPC R2 west bank near brick buildings	porcelain berry and trash
DG 06	degraded buffer	238	41.341504	-72.061185	8/20/2010	2000-27-R3	EB commuter lot Poquonnock. Rd	begin phragmites marsh
DG 07	degraded buffer	245	41.343438	-72.063333	9/20/2010	2000-27-R3		degraded buffer at parking lot, min width, invasive plants
DG 08	degraded buffer	249	41.341901	-72.059432	9/20/2010	2000-27-Unnamed Stream 1- R1	near hotel	culvert from pond under Poquonnock Rd
DG 09	degraded buffer	251	41.341814	-72.059447	9/20/2010	2000-27-Unnamed Stream 1- R1	near hotel	unnamed trib south side of Poquonnock Rd
DG 10	degraded buffer	252	41.343522	-72.060160	9/20/2010	2000-27-Unnamed Stream 1- R1	SE corner of pond	uncontained fly ash deposit by pond, 20x20' , exposed slag, empty blue metal 55 gal drum
DG 11	degraded buffer	257	41.344709	-72.063012	9/20/2010	2000-27-R3	north of Poquonnock Rd, west of Trails Pond	house +/- 500 ft to west of waypoint, lawn cleared to within 50 ft+/- of edge of pond
DG 12	degraded buffer	260	41.347057	-72.063681	9/20/2010	2000-27-R3	north of Poquonnock Rd, on town owned land	phragmites patch north of pond

Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
DG 13	degraded buffer	4	41.354097	-72.069062	11/23/2010	2000-27-R4	Meridian Rd	private residence on Meridian across from condos
DG 14	degraded buffer	6	41.355175	-72.068968	11/23/2010	2000-27-R4	Meridian Rd	by Meridian at Kinnesbrook Condos
DG 15	degraded buffer	14	41.360414	-72.069581	11/23/2010	2000-27-R4	Bridge St - Knights Inn	end of culvert under road and inn property, into phragmites marsh
DG 16	degraded buffer	64	41.328039	-72.058801	12/13/2010	2000-28, Stream 3, Reach 1	north end elks club property	stream from Shennecossett GC
DG 17	degraded buffer	65	41.329208	-72.057666	12/13/2010	2000-28, Stream 3, Reach 1	RR tracks, 100 ft north of stream outlet	stream outlet into Baker Cove
DG 18	degraded buffer	66	41.333526	-72.053750	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks, near runway B	phragmites stand
DG 19	degraded buffer	67	41.334641	-72.051870	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks opposite airport, opposite tree farm on Thomas Rd	trash
DG 20	degraded buffer	68	41.335428	-72.050820	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks opposite airport, behind car rental business on Thomas Road	trash, degraded buffer, trench from yard to stream
DG 21	degraded buffer	70	41.336310	-72.049407	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks north of Tower Road	sewer manhole in middle of wetlands, secondary stream on east side of RR tracks, goes under Tower Rd via double 12" culvert, runs along fence line at airport and then goes under tracks to merge with mainstem of stream
DG 22	degraded buffer	72	41.336699	-72.049194	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks north of Tower Road	2nd sewer manhole near Site 3 sign
DG 23	degraded buffer	80	41.343755	-72.048103	12/13/2010	2000-26, Stream 1, Reach 1	Amtrak RR tracks	downstream side of box culvert under Amtrak RR tracks, upstream side is channelized, banks are riprapped

Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
DG 24	degraded buffer	101	41.355279	-72.051791	12/13/2010	2000-26, Stream 2, Reach 3	stream at power lines at bottom of apt complex	~100 foot wide phrag marsh under utility ROW
DG 25	degraded buffer	104	41.328211	-72.061809	12/13/2010	2000-28, Stream 3, Reach 1	Shennecossett Golf Course, Tee for Hole 8	stream approx 30 ft edge of green, makes 90 turn at RR tracks
ER 01	erosion	4	41.354097	-72.069062	11/23/2010	2000-27-R4	Meridian Rd	private residence on Meridian across from condos
ER 02	erosion	73	41.339334	-72.048481	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks north of Tower Road, south of N Street	bank erosion, culvert - 24" CP
ER 03	erosion	274	41.352434	-72.072580	10/4/2010	2000-27, BPC, Reach 4a	Hwy Dept Stockpile Yard	eroded stream bank from runoff from stockpile yard
FB 01	fish barrier	80	41.343755	-72.048103	12/13/2010	2000-26, Stream 2, Reach 1	Amtrak RR tracks	downstream side of box culvert under Amtrak RR tracks, upstream side is channelized, banks are riprapped
FB 02	fish barrier	81	41.344752	-72.048092	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, south side of Rt 1	Town MS-4 sampling site (permit #55), outlet of culvert under shopping center, 2 stormwater outfalls, three leakoffs (2 asphalt, 1 dirt)
FB 03	fish barrier	89	41.346592	-72.052054	12/13/2010	2000-26, Stream 2, Reach 2	Poquonnock Road near RT 1	2 catch basins at the edge of Poquonnock Road (east side)
FB 04	fish barrier	90	41.346672	-72.052223	12/13/2010	2000-26, Stream 2, Reach 2	Avery Park, Poquonnock Road	brook through Avery Park flowing SE along south side of Rt 1), near intersection with brook from north

Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
FB 05	fish barrier	91	41.348031	-72.051840	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, north side of Rt 1	cb in parking lot in shopping center north of RT 1, culverted stream
FB 06	fish barrier	92	41.350078	-72.051587	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, north side of Rt 1	beginning of 36-48" CP culvert of stream under shopping center, near Post Office
FB 07	fish barrier	94	41.359607	-72.054218	12/13/2010	2000-26, Stream 2, Reach 3	stream at RT 95	box culvert under RT 95, two large asphalt leakoffs
FB 08	fish barrier	255	41.344404	-72.063649	9/20/2010	2000-27-R3	north of Poquonnock Rd and EB remediation site	dam spillway
FB 09	fish barrier	265	41.350964	-72.066905	9/20/2010	2000-27-R3	north of Poquonnock Rd, on town owned land	debris dam - natural? Or man-made?
MC 01	modified channel	240	41.343384	-72.063340	8/20/2010	2000-27-R3	EB commuter lot Poquonnock Rd	stream daylights at Poq Rd from culvert across street
MC 02	modified channel	249	41.341901	-72.059432	9/20/2010	2000-27-Unnamed Stream 1- R1	near hotel	culvert from pond under Poquonnock Rd
MC 03	modified channel	266	41.350943	-72.069104	9/20/2010	2000-27-R3	east of Rt 349, on town owned land	8' CMP under Rt 349, and storm drain outlet from rt 349
MC 04	modified channel	267	41.569256	-72.147987	9/20/2010	2000-27-R3	east of Rt 349, on town owned land	conc culvert of old Birch Plain Creek under Rt 349
MC 05	modified channel	269	41.351335	-72.069929	10/4/2010	2000-27-R4a	Rt 349	5 ft CMP under Rt 349
MC 06	modified channel	273	41.352189	-72.071928	10/4/2010	2000-27-R4a	dirt road to stockpile area	dirt road crossing 30" RCP
MC 07	modified channel	276	41.353771	-72.072114	10/4/2010	2000-27-R4a	athletic field Washington Park	begin stream culvert under athletic fields

Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
MC 08	modified channel	1	41.353283	-72.069554	11/23/2010	2000-27-R4	Rt 349 (east side)	culvert under rt 349
MC 09	modified channel	8	41.355522	-72.069032	11/23/2010	2000-27-R4	Kinnesbrook Condos	stream culverted
MC 10	modified channel	11	41.357975	-72.067891	11/23/2010	2000-27-R4	RR tracks near Rt 349	stream culverted under RR thru box culvert - south end
MC 11	modified channel	12	41.357888	-72.067675	11/23/2010	2000-27-R4	RR tracks near Rt 349	stream culverted under RR thru box culvert - north end
MC 12	modified channel	13	41.358601	-72.067153	11/23/2010	2000-27-R4	Rt 349 (east side)	5 ft CMP under Rt 349
MC 13	modified channel	14	41.360414	-72.069581	11/23/2010	2000-27-R4	Bridge St - Knights Inn	end of culvert under road and inn property, into phragmites marsh
MC 14	modified channel	15	41.360916	-72.069948	11/23/2010	2000-27-R4	Bridge St	headwall at north end of culvert under Bridge Street
MC 15	modified channel	18	41.362711	-72.069184	11/23/2010	2000-27-R4	Bridge St	headwall between Pfizer and roller rink
MC 16	modified channel	71	41.335209	-72.050539	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks south of Tower Road (Behind airport)	14" CCP culvert under tracks for stream described above, noticed turtle egg cases at upstream end of culvert
MC 17	modified channel	80	41.343755	-72.048103	12/13/2010	2000-26, Stream 2, Reach 1	Amtrak RR tracks	downstream side of box culvert under Amtrak RR tracks, upstream side is channelized, banks are riprapped
MC 18	modified channel	81	41.344752	-72.048092	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, south side of Rt 1	Town MS-4 sampling site (permit #55), outlet of culvert under shopping center, 2 stormwater outfalls, three leakoffs (2 asphalt, 1 dirt)
MC 19	modified channel	84	41.345010	-72.048112	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot,south side of Rt 1	double catch basin over buried stream

Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
MC 20	modified channel	85	41.345369	-72.048688	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot,south side of Rt 1	double catch basin over buried stream
MC 21	modified channel	86	41.345519	-72.049260	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot,south side of Rt 1	double catch basin over buried stream
MC 22	modified channel	87	41.345690	-72.049808	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot,south side of Rt 1	double catch basin over buried stream
MC 23	modified channel	88	41.346086	-72.050474	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot,south side of Rt 1	double catch basin over buried stream
MC 24	modified channel	89	41.346592	-72.052054	12/13/2010	2000-26, Stream 2, Reach 2	Poquonnock Road near RT 1	2 catch basins at the edge of Poquonnock Road (east side)
MC 25	modified channel	91	41.348031	-72.051840	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, north side of Rt 1	cb in parking lot in shopping center north of RT 1, culverted stream
MC 26	modified channel	92	41.350078	-72.051587	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, north side of Rt 2	beginning of 36-48" CP culvert of stream under shopping center, near Post Office
MC 27	modified channel	94	41.359607	-72.054218	12/13/2010	2000-26, Stream 2, Reach 3	stream at RT 95	box culvert under RT 95, two large asphalt leakoffs
MC 28	modified channel	105	41.326987	-72.061553	12/13/2010	2000-28, Stream 3, Reach 1	Plant Street	stream crossing under Plant Street
SWO 01	storm water outfall	215	41.325916	-72.055960	7/20/2010	Baker Cove	cul de sac by boat launch	stormdrain outlet
SWO 02	storm water outfall	222	41.330287	-72.058163	7/20/2010	Baker Cove	Thomas Road	15" storm pipe from road

Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
SWO 03	storm water outfall	225	41.330583	-72.058354	8/20/2010	2000-27-R1	Thomas Road @ bridge	path to water/leakoff
SWO 04	storm water outfall	228	41.335443	-72.060210	8/20/2010	2000-27-R1	right bank, at base of Nathan Hale and Paul Revere Roads	associated sediment delta and trash
SWO 05	storm water outfall	232	41.334738	-72.060046	8/20/2010	2000-27-R2	BPC Reach 2 west bank	trash and sediment delta near outfall
SWO 06	storm water outfall	233	41.334040	-72.061747	8/20/2010	2000-27-R1	BPC R1 - Groton Commons (?) Apts	large leak-off behind Groton Commons
SWO 07	storm water outfall	234	41.334813	-72.060603	8/20/2010	2000-27-R1	Nathan Hale drive	24" storm pipe to BPC - 100 ft from outfall
SWO 08	storm water outfall	236	41.335414	-72.060585	8/20/2010	2000-27-R1	Paul Revere Road	storm drain to BPC +/_ 65 ft
SWO 09	storm water outfall	237	41.341513	-72.061196	8/20/2010	2000-27-R3	EB commuter lot Poq. Rd	outlet of stormwater detention basin
SWO 10	storm water outfall	241	41.340554	-72.059241	8/20/2010	2000-27-R3		leakoff at back of church parking lot
SWO 11	storm water outfall	243	41.342769	-72.062830	9/20/2010	2000-27-R3	opposite bus kiosk	10" conc pipe left bank no erosion evident
SWO 12	storm water outfall	248	41.342551	-72.061081	9/20/2010	2000-27-Unnamed Stream 1- R1	Poquonnock Rd	Storm drain outlet to phragmites marsh from Eurostar parking lot
SWO 13	storm water outfall	250	41.341281	-72.059707	9/20/2010	2000-27-Unnamed Stream 1- R1		leak-off back corner day care parking lot
SWO 14	storm water outfall	266	41.350943	-72.069104	9/20/2010	2000-27-R3	east of Rt 349, on town owned land	8' CMP under Rt 349, and storm drain outlet from rt 349
SWO 15	storm water outfall	268	41.351569	-72.070885	10/4/2010	2000-27-R4a	highway garage	location of 3000 gal SW separator, storm outfall to stream
SWO 16	storm water outfall	272	41.352199	-72.072628	10/4/2010	2000-27-R4a	cul de sac near stockpile area	stormwater leakoff

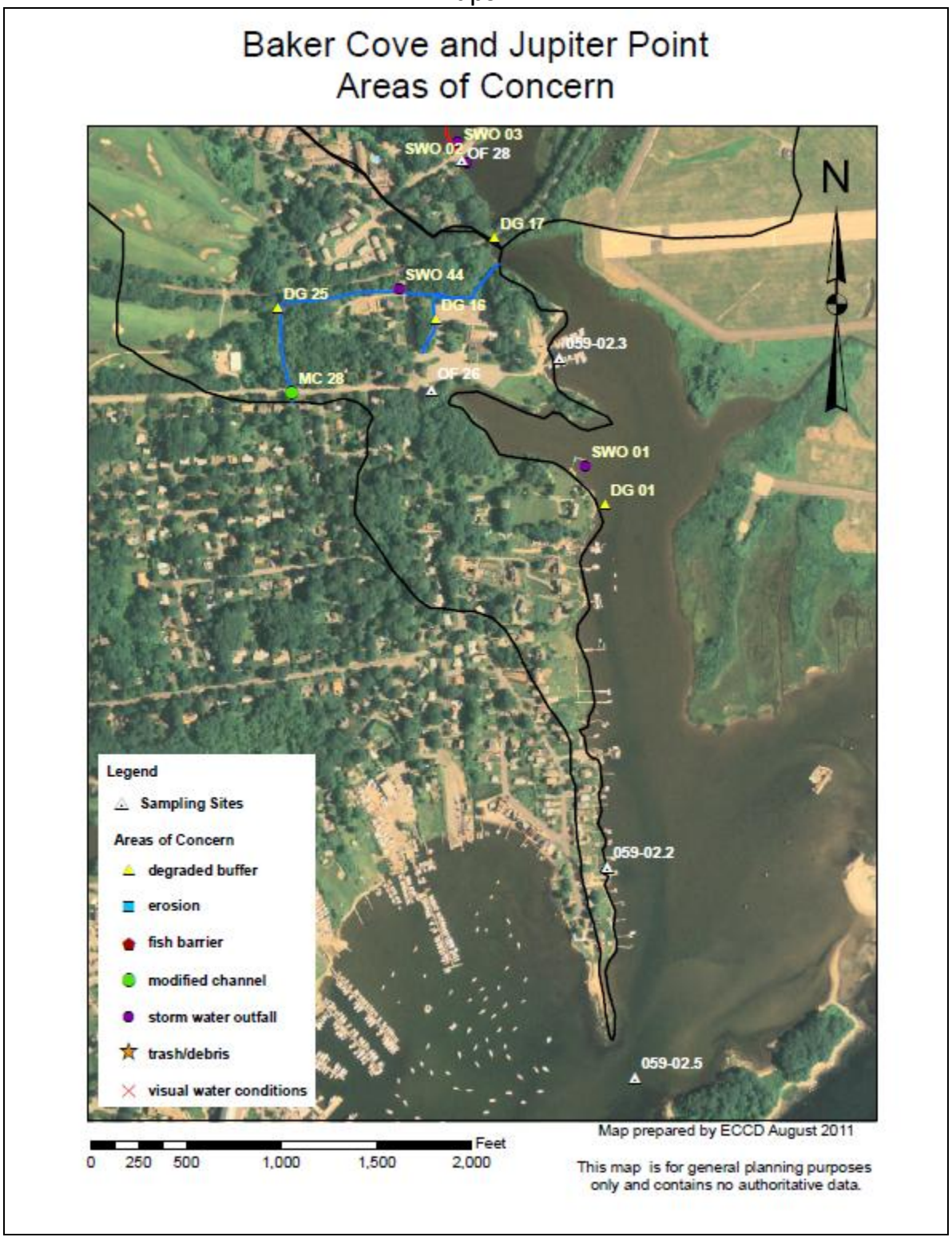
Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
SWO 17	storm water outfall	275	41.352555	-72.072222	10/4/2010	2000-27-R4a	stockpile area	dirt leak off to stream
SWO 18	storm water outfall	278	41.354930	-72.074046	10/4/2010	2000-27-R4a	Washington Park	drain pipe from volleyball court to left most drainage ditch
SWO 19	storm water outfall	279	41.355265	-72.074115	10/4/2010	2000-27-R4a	Washington Park	24" cmp culvert exiting from under baseball field
SWO 20	storm water outfall	280	41.355733	-72.073776	10/4/2010	2000-27-R4a	Washington Park	20" RCP from cb in parking lot
SWO 21	storm water outfall	281	41.355288	-72.072571	10/4/2010	2000-27-R4a	Washington Park	storm drain outfall on Meridian Rd
SWO 22	storm water outfall	2	41.353957	-72.069678	11/23/2010	2000-27-R4	Rt 349 (east side)	north of culvert
SWO 23	storm water outfall	3	41.354244	-72.069488	11/23/2010	2000-27-R4	Rt 349 (east side)	leak off north of storm outfall
SWO 24	storm water outfall	10	41.356764	-72.068683	11/23/2010	2000-27-R4	Kinnesbrook Condos	flared end
SWO 25	storm water outfall	16	41.360978	-72.069415	11/23/2010	2000-27-R4	Bridge St	16" RCP from street drain
SWO 26	storm water outfall	17	41.360967	-72.069306	11/23/2010	2000-27-R4	Bridge St	flared end, end of culvert
SWO 27	storm water outfall	73	41.339334	-72.048481	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks north of Tower Road, south of N Street	bank erosion, culvert - 24" CP
SWO 28	storm water outfall	74	41.339809	-72.048286	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks north of Tower Road, at end of N Street	asphalt leak off, with freestanding 12" CP
SWO 29	storm water outfall	75	41.340648	-72.047856	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks north of Tower Road, at end of G Street	asphalt leakoff
SWO 30	storm water outfall	76	41.341511	-72.047560	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks north of Tower Road, at end of D Street	eroded dirt leakoff, 10-12" CP (not visible in photo)

Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
SWO 31	storm water outfall	78	41.342663	-72.047249	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks north of track divergence, on west track	36" CMP under RR tracks from triangular area between tracks, for storm flow, area in question not wetland, and dry day of survey
SWO 32	storm water outfall	81	41.344752	-72.048092	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, south side of Rt 1	Town MS-4 sampling site (permit #55), outlet of culvert under shopping center, 2 stormwater outfalls, three leakoffs (2 asphalt, 1 dirt)
SWO 33	storm water outfall	84	41.345010	-72.048112	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, south side of Rt 1	double catch basin over buried stream
SWO 34	storm water outfall	85	41.345369	-72.048688	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, south side of Rt 1	double catch basin over buried stream
SWO 35	storm water outfall	86	41.345519	-72.049260	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, south side of Rt 1	double catch basin over buried stream
SWO 36	storm water outfall	87	41.345690	-72.049808	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, south side of Rt 1	double catch basin over buried stream
SWO 37	storm water outfall	88	41.346086	-72.050474	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, south side of Rt 1	double catch basin over buried stream
SWO 38	storm water outfall	89	41.346592	-72.052054	12/13/2010	2000-26, Stream 2, Reach 2	Poquonnock Road near RT 1	2 catch basins at the edge of Poquonnock Road (east side)
SWO 39	storm water outfall	91	41.348031	-72.051840	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, north side of Rt 1	cb in parking lot in shopping center north of RT 1, culverted stream
SWO 40	storm water outfall	92	41.350078	-72.051587	12/13/2010	2000-26, Stream 2, Reach 2	shopping center parking lot, north side of Rt 2	beginning of 36-48" CP culvert of stream under shopping center, near Post Office

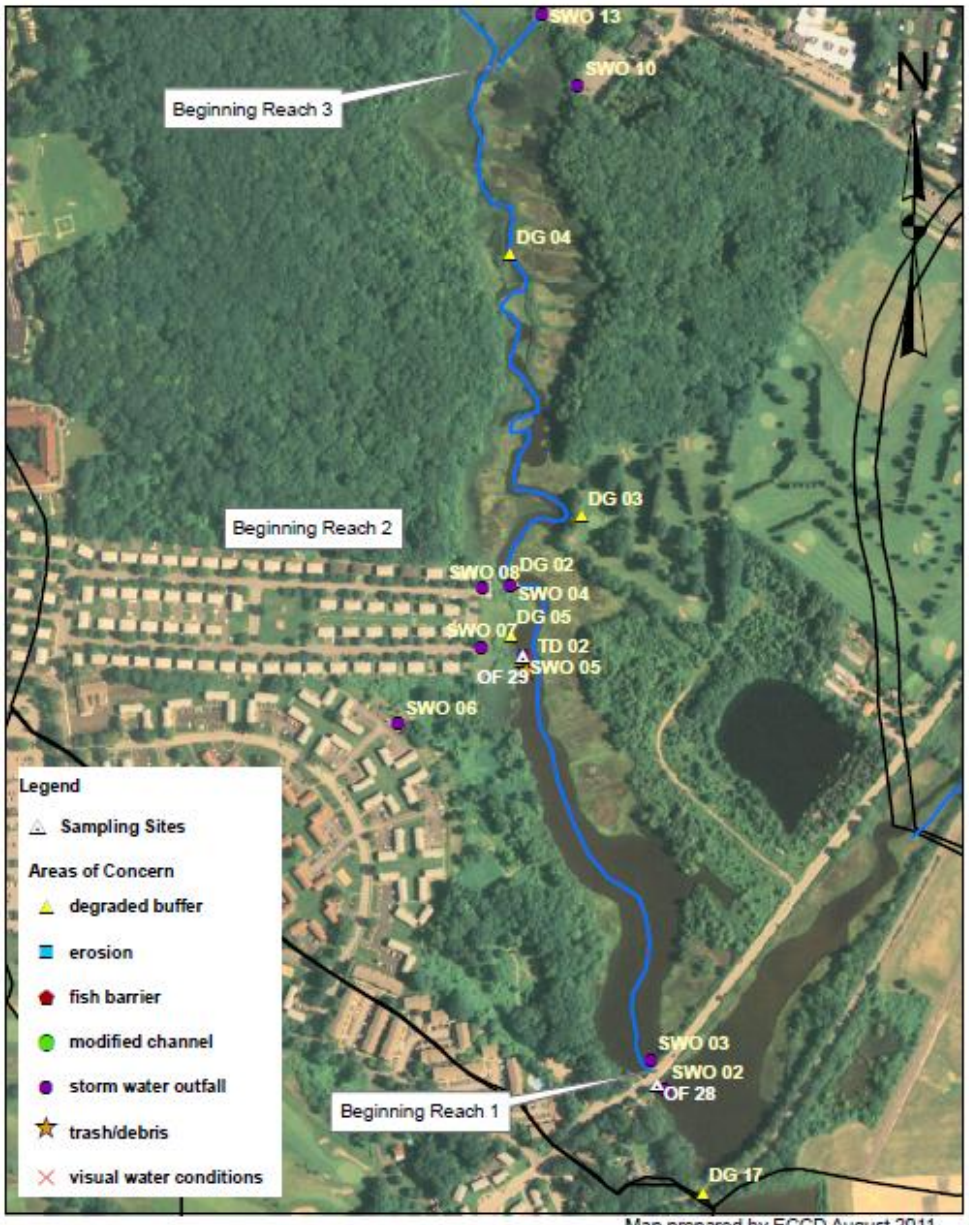
Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
SWO 41	storm water outfall	93	41.353010	-72.052716	12/13/2010	2000-26, Stream 2, Reach 3	Drozdyk Drive	box culvert under Drozdyk Drive & riprap swale to level spreader from subdivision on Long Hill
SWO 42	storm water outfall	94	41.359607	-72.054218	12/13/2010	2000-26, Stream 2, Reach 3	stream at RT 95	box culvert under RT 95, two large asphalt leakoffs
SWO 43	storm water outfall	102	41.355220	-72.051563	12/13/2010	2000-26, Stream 2, Reach 3	apt complex between clubhouse and playground	manholes for vortex V2b stormwater treatment system
SWO 44	storm water outfall	103	41.328491	-72.059480	12/13/2010	2000-28, Stream 3, Reach 1	Shennecossett Road	stream from Shennie GC @ dbl 3' culvert under Shennecossett Road, footing drain from house on right bank, 12" culvert entering from left bank
TD 01	trash/debris	223	41.333923	-72.053801	7/20/2010	Baker Cove	Baker Cove	trash along tidal stream (going toward Tower Rd) at edge of airport
TD 02	trash/debris	226	41.334592	-72.060004	8/20/2010	2000-27-R1	BPC @ break between Reach 1/Reach 2	trash near brick houses, street light visible
TD 03	trash/debris	252	41.343522	-72.060160	9/20/2010	2000-27-Unnamed Stream 1- R1	SE corner of pond	uncontained fly ash deposit by pond, 20x20' , exposed slag, empty blue metal 55 gal drum
TD 04	trash/debris	253	41.343492	-72.060022	9/20/2010	2000-27-Unnamed Stream 1- R1	SE corner of pond	homeless village behind strip mall
TD 05	trash/debris	67	41.334641	-72.051870	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks opposite airport, opposite tree farm on Thomas Rd	trash
TD 06	trash/debris	68	41.335428	-72.050820	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks opposite airport, behind car rental business on Thomas Road	trash, degraded buffer, trench from yard to stream
TD 07	trash/debris	79	41.343400	-72.047644	12/13/2010	2000-26, Stream 2, Reach 1	RR tracks north of track divergence, on west track	trash, shopping carts

Area of Concern Number	Area of Concern Type	GPS Number	Latitude	Longitude	Date Acquired	Watershed/ Stream/ Reach	Location	Description
TD 08	trash/debris	82	41.344587	-72.047837	12/13/2010	2000-26, Stream 2, Reach 2	next to shopping center south side of RT 1, behind apt complex at end of lawn	feral cat village - cat houses, food dishes, trash, and ~6 shopping carts in wetland associated with stream
TD 09	trash/debris	83	41.344436	-72.047544	12/13/2010	2000-26, Stream 2, Reach 2	next to shopping center south side of RT 1, behind apt complex at end of lawn	large debris pile of lawn/yard waste in wetland associated with stream
VWC 01	visual water conditions	258	41.344929	-72.063012	9/20/2010	2000-27-R3	north of Poquonnock Rd, on town owned land	iron stained stream through Trails Pond
VWC 02	visual water conditions	277	41.354687	-72.073405	10/4/2010	2000-27-R4a	Washington Park	outlet to Lake George, algae, iron bacteria/floc
VWC 03	visual water conditions	4	41.354097	-72.069062	11/23/2010	2000-27-R4	Meridian Rd	private residence on Meridian across from condos
VWC 04	visual water conditions	5	41.354758	-72.068637	11/23/2010	2000-27-R4	Meridian Rd	at culvert under Meridian Rd
VWC 05	visual water conditions	9	41.355851	-72.069041	11/23/2010	2000-27-R4	Kinnesbrook Condos	iron bacteria on substrate
VWC 06	visual water conditions	12	41.357888	-72.067675	11/23/2010	2000-27-R4	RR tracks near Rt 349	stream culverted under RR thru box culvert - north end
VWC 07	visual water conditions	19	41.363755	-72.069070	11/23/2010	2000-27-R4	Bridge St	split in stream north of headwall, at RT 12 off ramp, stream splits east-west, and is likely culverted under off ramp, Rt 12 and RT 95
VWC 08	visual water conditions	69	41.336300	-72.049948	12/13/2010	2000-26, Stream 2, Reach 1	stream crossing at Tower Road	stream crossing/bridge, foam noted upstream

Appendix C
Area of Concern Reach
Maps

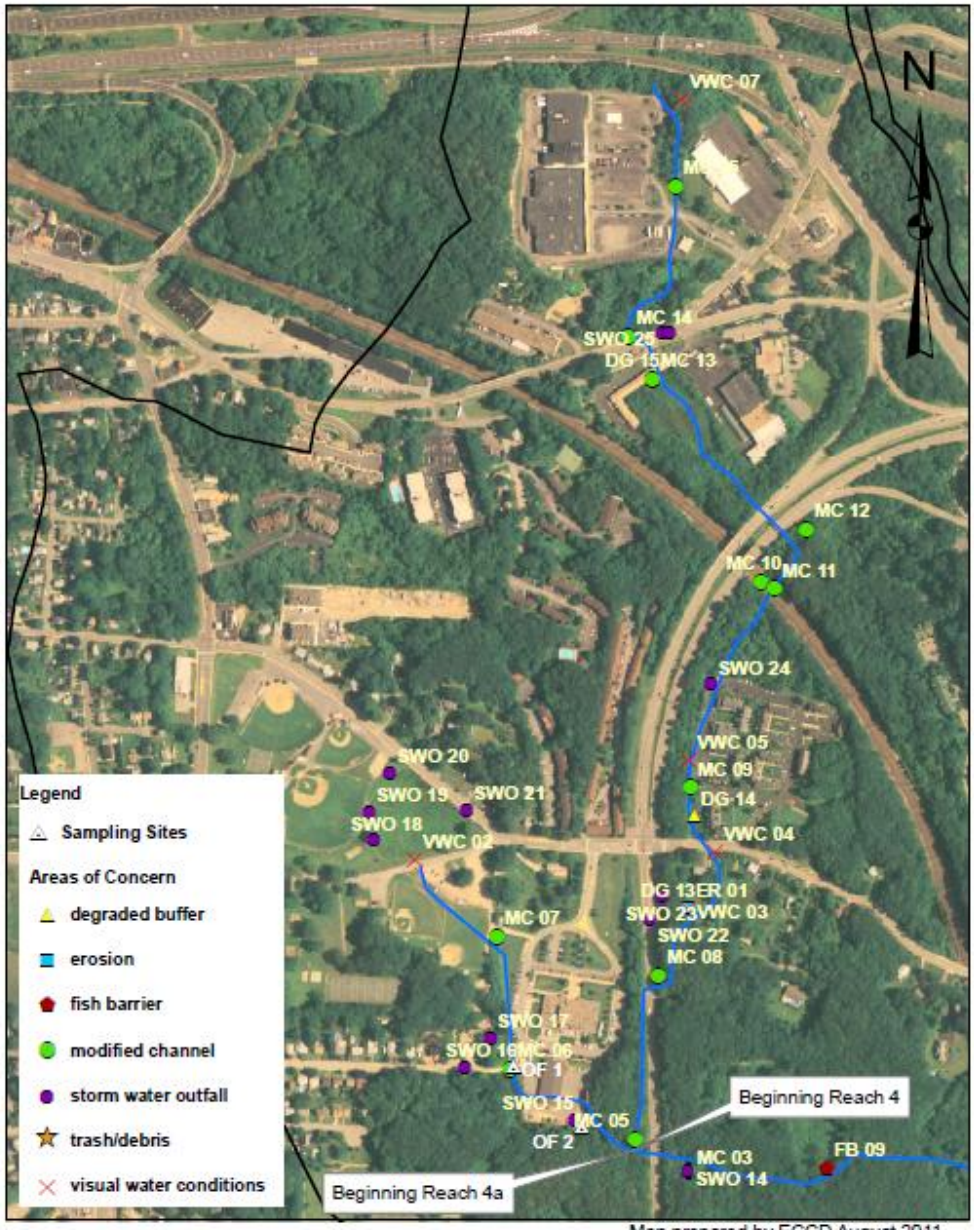


Birch Plain Creek Reaches 1 & 2
Areas of Concern

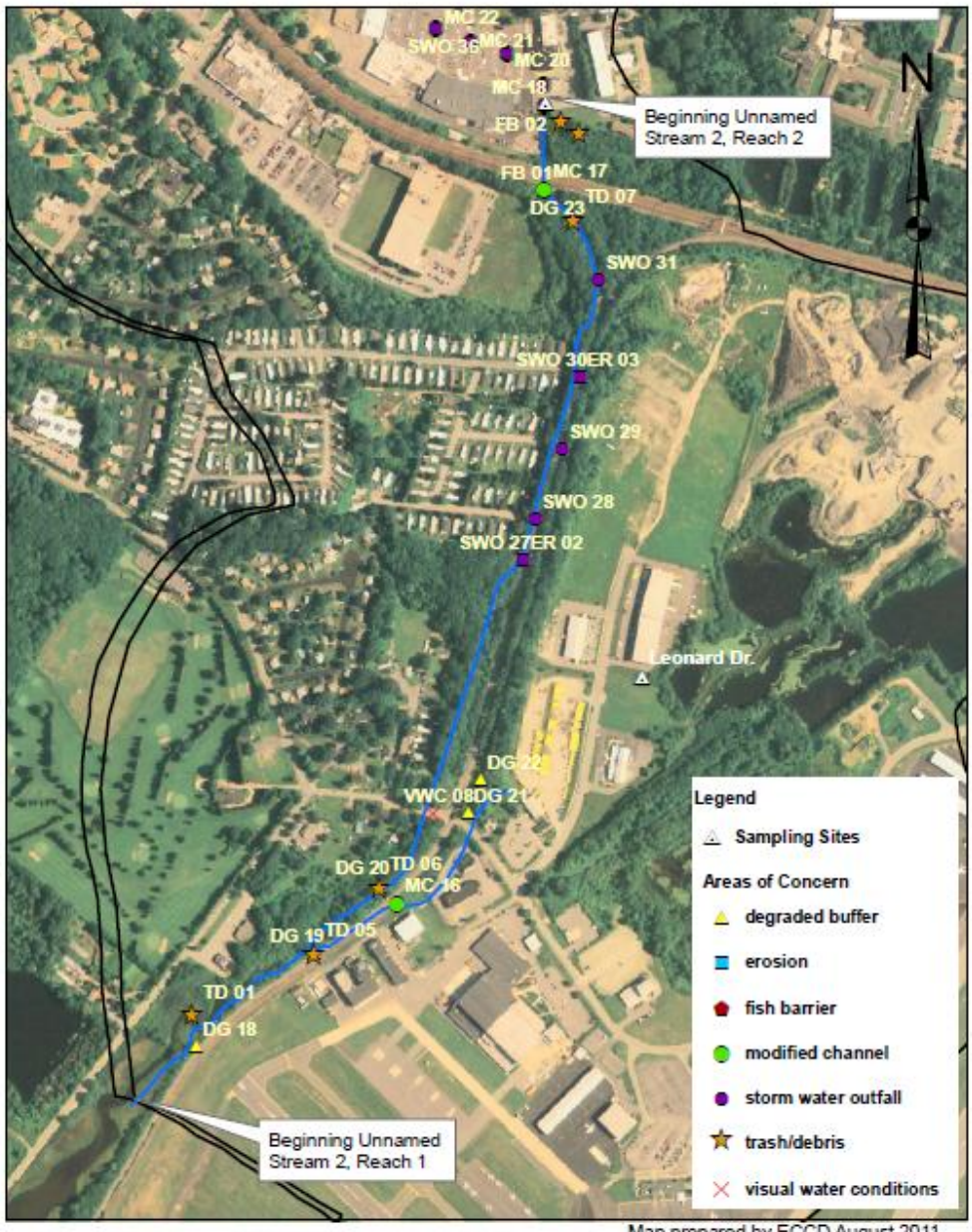


Birch Plain Creek Reach 3 and Unnamed Stream 1 Areas of Concern

Birch Plain Creek Reaches 4 & 4a
Areas of Concern



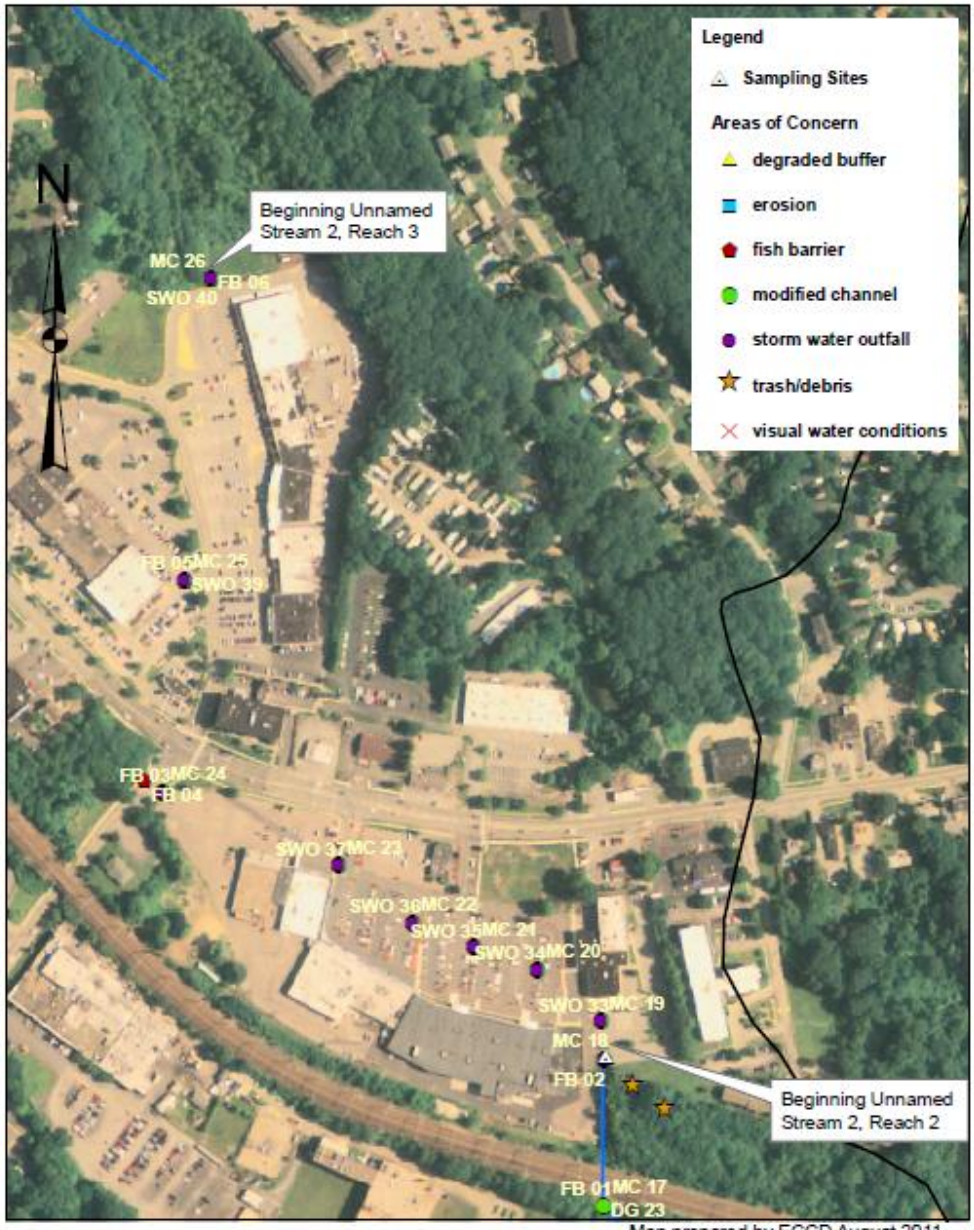
Watershed B Unnamed Stream 2 Reach 1
Areas of Concern



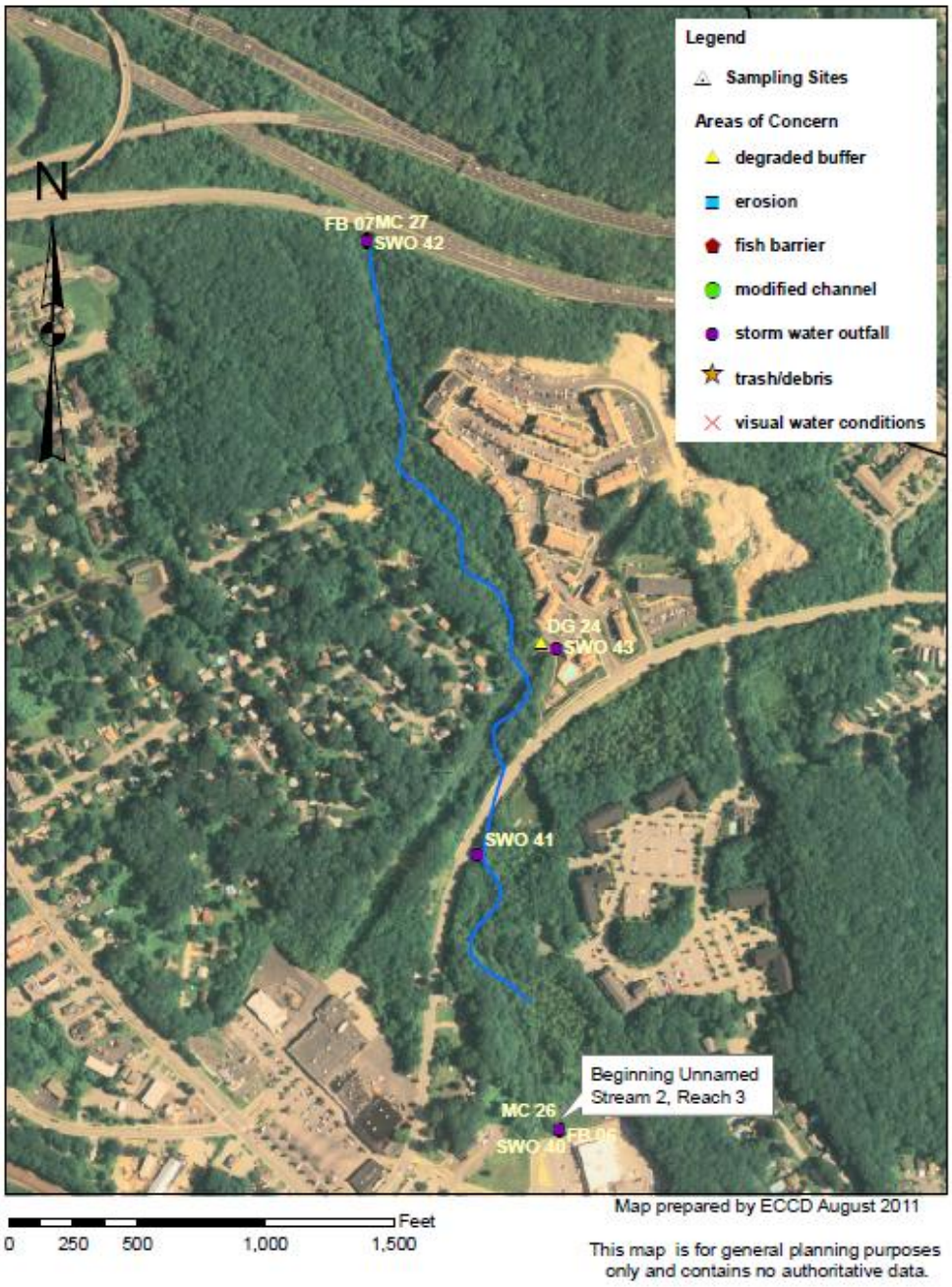
Map prepared by ECCD August 2011

This map is for general planning purposes only and contains no authoritative data.

Watershed B Unnamed Stream 2 Reach 2
Areas of Concern



Watershed B Unnamed Stream 2 Reach 3
Areas of Concern



Appendix D
Water Quality Data

Summary of indicator bacteria data reported by the City and Town of Groton MS-4 programs. Data has variously been reported to CT DEEP as either fecal coliform or E. coli.

Source	Data Type	Location	Date	Fecal Coliform /100 ml	E. coli /100 ml
City of Groton	MS-4	OF 1 - Highway Dept	09/14/01	40	
City of Groton	MS-4	OF 1 - Highway Dept	08/29/02	3	
City of Groton	MS-4	OF 1 - Highway Dept	1/28/08		*BDL
City of Groton	MS-4	OF 2 - Highway Dept	11/10/00	927	
City of Groton	MS-4	OF 2 - Highway Dept	08/29/02	3	
City of Groton	MS-4	#30 Poquonnock Rd & Rainville Ave	11/10/05		10
City of Groton	MS-4	OF 26 – Pump Station Shennocossett Rd	1/28/08		800
City of Groton	MS-4	Thomas Rd	1/28/08		850
City of Groton	MS-4	Madison Place	1/28/08		300
Groton, Town of	MS-4	Leonard Drive @ Groton Airport Business Park	09/29/05		100
Groton, Town of	MS-4	Leonard Drive @ Groton Airport Business Park	11/30/05		10
Groton, Town of	MS-4	Leonard Drive @ Groton Airport Business Park	12/01/06		1,700
Groton, Town of	MS-4	Leonard Drive @ Groton Airport Business Park	06/04/08		3,250
Groton, Town of	MS-4	Leonard Drive @ Groton Airport Business Park	06/04/08		4400
Groton, Town of	MS-4	behind Big Y on Route 1	09/29/05		800
Groton, Town of	MS-4	behind Big Y on Route 1	11/30/05		5,200
Groton, Town of	MS-4	behind Big Y on Route 1	12/01/06		720
Groton, Town of	MS-4	behind Big Y on Route 1	06/04/08		3,300
Groton, Town of	MS-4	behind Big Y on Route 1	06/04/08		4000

Source	Data Type	Location	Date	Fecal Coliform /100 ml	E. coli /100 ml
Wyman Gordon Investment Castings	MS-4	Location A	09/13/97	42	
Wyman-Gordon	MS-4	Location A	04/17/98	360	
Wyman-Gordon	MS-4	Location A	10/14/98	10	
Wyman-Gordon	MS-4	site A	05/18/00	120	
Wyman Gordon Investment Castings	MS-4	Location C	09/13/97	10	
Wyman-Gordon	MS-4	Location C	10/14/98	1,298	
Wyman-Gordon	MS-4	site C	05/18/00	60	
Wyman Gordon Investment Castings	MS-4	Location E	09/13/97	10	
Wyman-Gordon	MS-4	Location E	04/17/98	31	
Wyman-Gordon	MS-4	Location E	10/14/98	10	
Wyman-Gordon	MS-4	site E	05/18/00	190	
Wyman-Gordon Investment	MS-4	WG-338D-location 1-manhole	09/26/02	7	
Vancom-Connecticut	MS-4	Outfall #1	09/12/96	330	
VanCom/LaidLaw -Ct	MS-4	Outfall 1	08/13/97	10,000	
	MS-4				
Laidlaw Transit	MS-4	oil/h20 sep pipe	07/22/98	260	
Laidlaw Transit	MS-4	oil/h20 sep pipe	02/14/00	10	
Laidlaw Transit	MS-4	oil/h20 sep pipe	03/13/01	10	
Laidlaw Transit	MS-4	oil/h20 sep pipe	03/27/02	10	
Groton/New London Airport	MS-4	Discharge A	09/29/97	10	
Groton/New London Airport	MS-4	Discharge B	09/29/97	2,400	
Groton/New London Airport	MS-4	Discharge C	09/29/97	20	
Groton/New London Airport	MS-4	Discharge D	09/29/97	4,800	
Groton/New London Airport	MS-4	Discharge J	09/29/97	110	

*BDL – Below Detection Level (>50/100 ml)

Summary of bacteria data reported by the CT Department of Agriculture Bureau of Aquaculture. (**Bold** number in geomean column indicates geomean exceeded limit.)

Date	Station #	Fecal Coliform/100 ml	Geomean cfu/100 ml
4/13/2000	059-02.2	8.6	
5/10/2000	059-02.2	29	
8/29/2000	059-02.2	5.8	
9/11/2000	059-02.2	51	
10/10/2000	059-02.2	8.6	**14.5**
6/5/2001	059-02.2	8.7	
7/17/2001	059-02.2	8.6	
9/18/2001	059-02.2	5.8	
10/31/2001	059-02.2	8.6	
11/14/2001	059-02.2	1.6	5.7
2/20/2002	059-02.2	1.7	
3/4/2002	059-02.2	8.6	
4/24/2002	059-02.2	8.6	
8/21/2002	059-02.2	8.6	
10/21/2002	059-02.2	1.6	
10/29/2002	059-02.2	8.7	5.0
5/13/2003	059-02.2	1.7	
6/10/2003	059-02.2	50	
7/9/2003	059-02.2	36	
10/20/2003	059-02.2	1.6	
10/28/2003	059-02.2	51	12.0
1/21/2004	059-02.2	1.7	
4/28/2004	059-02.2	14	
5/5/2004	059-02.2	10	
6/2/2004	059-02.2	1.7	
7/19/2004	059-02.2	51	7.3
5/10/2005	059-02.2	1	
6/6/2005	059-02.2	1	
11/15/2005	059-02.2	42	
12/6/2005	059-02.2	1	
12/12/2005	059-02.2	9	3.3
1/9/2006	059-02.2	2	
6/21/2006	059-02.2	32	
10/16/2006	059-02.2	1	
11/20/2006	059-02.2	3	
12/12/2006	059-02.2	2	3.3

Date	Station #	Fecal Coliform/100 ml	Geomean cfu/100 ml
5/29/2007	059-02.2	1	
1/30/2007	059-02.2	1	
1/2/2007	059-02.2	20	
1/16/2007	059-02.2	1	
3/14/2007	059-02.2	1	1.8
6/16/2008	059-02.2	81	
6/11/2008	059-02.2	2	
6/30/2008	059-02.2	7	
5/14/2008	059-02.2	1	
2/19/2008	059-02.2	2	4.7
2/9/2009	059-02.2	6	
12/21/2009	059-02.2	2	
12/28/2009	059-02.2	2	
11/4/2009	059-02.2	6	
12/7/2009	059-02.2	1	2.7
3/6/2000	059-02.3	8.6	
3/27/2000	059-02.3	8.6	
4/13/2000	059-02.3	8.6	
5/10/2000	059-02.3	110	
8/29/2000	059-02.3	8.6	**14.3**
1/31/2001	059-02.3	51	
2/7/2001	059-02.3	1.6	
2/20/2001	059-02.3	8.6	
3/19/2001	059-02.3	1.6	
5/9/2001	059-02.3	1.6	
6/12/2001	059-02.3	110	
9/18/2001	059-02.3	22	
9/25/2001	059-02.3	258	
10/15/2001	059-02.3	18	**14.0**
1/22/2002	059-02.3	8.6	
2/20/2002	059-02.3	3.6	
3/4/2002	059-02.3	8.6	
4/22/2002	059-02.3	41	
10/21/2002	059-02.3	5.8	
10/29/2002	059-02.3	29	11.1
1/6/2003	059-02.3	5.8	
4/1/2003	059-02.3	29	
5/13/2003	059-02.3	36	
7/9/2003	059-02.3	109	

Date	Station #	Fecal Coliform/100 ml	Geomean cfu/100 ml
7/22/2003	059-02.3	11	
10/20/2003	059-02.3	10	**20.4**
1/7/2004	059-02.3	11	
1/13/2004	059-02.3	10	
1/21/2004	059-02.3	10	
3/8/2004	059-02.3	10	
3/15/2004	059-02.3	10	
3/22/2004	059-02.3	10	
5/5/2004	059-02.3	36	
5/19/2004	059-02.3	36	
7/19/2004	059-02.3	51	**16.1**
1/4/2005	059-02.3	2	
2/16/2005	059-02.3	1	
8/30/2005	059-02.3	171	
9/19/2005	059-02.3	17	
11/15/2005	059-02.3	38	11.7
1/9/2006	059-02.3	2	
2/28/2006	059-02.3	36	
10/16/2006	059-02.3	4	
11/20/2006	059-02.3	5	
12/12/2006	059-02.3	16	7.5
5/29/2007	059-02.3	1	
1/30/2007	059-02.3	1	
1/2/2007	059-02.3	800	
1/16/2007	059-02.3	28	
3/14/2007	059-02.3	1	7.4
6/11/2008	059-02.3	1	
2/19/2008	059-02.3	2	
11/24/2008	059-02.3	8	
12/9/2008	059-02.3	26	
12/15/2008	059-02.3	50	7.3
2/9/2009	059-02.3	1	
12/21/2009	059-02.3	1	
12/28/2009	059-02.3	1	
11/4/2009	059-02.3	1	
12/7/2009	059-02.3	1	1.0

Date	Station #	Fecal Coliform/100 ml	Geomean cfu/100 ml
3/6/2000	059-02.5	1.6	
4/13/2000	059-02.5	1.7	
5/3/2000	059-02.5	1.6	
5/10/2000	059-02.5	28	
5/15/2000	059-02.5	5.8	
9/6/2000	059-02.5	11	
9/11/2000	059-02.5	51	
10/18/2000	059-02.5	8.6	
11/13/2000	059-02.5	1.7	
11/28/2000	059-02.5	8.6	5.9
6/4/2001	059-02.5	14	
6/13/2001	059-02.5	8.1	
6/25/2001	059-02.5	8.6	
7/17/2001	059-02.5	1.7	
9/12/2001	059-02.5	3.6	
10/29/2001	059-02.5	1.6	4.6
2/20/2002	059-02.5	1.6	
4/24/2002	059-02.5	1.6	
5/8/2002	059-02.5	5.8	
5/22/2002	059-02.5	1.7	
7/22/2002	059-02.5	1.7	
7/30/2002	059-02.5	1.6	
8/21/2002	059-02.5	3.6	
10/15/2002	059-02.5	1.6	
11/5/2002	059-02.5	1.6	
12/4/2002	059-02.5	1.7	2.0
4/30/2003	059-02.5	1.6	
6/10/2003	059-02.5	51	
7/9/2003	059-02.5	28	
8/25/2003	059-02.5	10	
10/20/2003	059-02.5	1.7	
10/28/2003	059-02.5	36	
11/24/2003	059-02.5	1.6	8.1
1/21/2004	059-02.5	3.6	
4/28/2004	059-02.5	18	
5/5/2004	059-02.5	11	
6/2/2004	059-02.5	5.8	
7/19/2004	059-02.5	51	
8/16/2004	059-02.5	51	
8/18/2004	059-02.5	10	

Date	Station #	Fecal Coliform/100 ml	Geomean cfu/100 ml
8/30/2004	059-02.5	8.1	
11/15/2004	059-02.5	10	12.7
5/17/2005	059-02.5	1	
6/1/2005	059-02.5	6	
6/6/2005	059-02.5	3	
11/21/2005	059-02.5	12	
11/28/2005	059-02.5	1	
12/1/2005	059-02.5	7	3.4
6/21/2006	059-02.5	23	
7/24/2006	059-02.5	1	
11/7/2006	059-02.5	2	
11/15/2006	059-02.5	6	
11/20/2006	059-02.5	3	3.8
6/13/2007	059-02.5	8	
7/9/2007	059-02.5	1	
7/11/2007	059-02.5	1	
8/27/2007	059-02.5	1	
11/28/2007	059-02.5	2	1.7
4/16/2008	059-02.5	1	
5/5/2008	059-02.5	1	
5/14/2008	059-02.5	1	
6/11/2008	059-02.5	6	
6/16/2008	059-02.5	3	
6/30/2008	059-02.5	1	
7/1/2008	059-02.5	7	
9/22/2008	059-02.5	1	
9/24/2008	059-02.5	2	1.8
5/6/2009	059-02.5	1	
5/18/2009	059-02.5	16	
5/19/2009	059-02.5	5	
6/2/2009	059-02.5	2	
6/3/2009	059-02.5	2	
6/16/2009	059-02.5	9	
8/3/2009	059-02.5	8	4.2