Total Maximum Daily Load (TMDL) Study for Bacteria in Mill Pond Town Beach, Washington, NH

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NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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1 INTRODUCTION

1.1 Background

Section 303(d) of the Clean Water Act ("CWA") and the federal Water Quality Planning Regulations (40 CFR Part 130) require States to prepare a list (commonly called the 303(d) List) of all waters that are threatened or impaired by pollutants and are not expected to meet water quality standards even after implementation of technology-based controls for pollution such as secondary treatment for municipal wastewater treatment facilities. The 303(d) List is updated and issued for public comment every two years. The public comment period usually occurs in February or March of even numbered years with the final list submitted by April 1st to the United States Environmental Protection Agency (EPA) for approval. The most recent 303(d) list was submitted to EPA on March 31, 2006.

For all waters on the 303(d) List, Section 303(d) of the CWA also requires States to establish Total Maximum Daily Loads ("TMDLs") for the pollutants causing the impaired or threatened status. The total maximum daily load is the maximum daily load the waterbody can assimilate and still meet water quality standards. Water quality standards include numeric and narrative criteria that must be met to protect the uses of the surface water such as swimming, boating, aquatic life, and fish consumption. TMDL studies estimate required pollutant load reductions and map a course for stakeholders to follow that should lead to restoration of the impaired water and its uses. In general, the steps involved in the TMDL process include the following:

- Identification of the major sources of pollutant(s);
- Estimation of existing pollutant loadings from each major source;
- Calculation of the maximum load (i.e. the TMDL) that the surface water can assimilate and still meet water quality standards;
- Allocation of the maximum load among point and nonpoint sources;
- Calculation of the reduction in pollutant load needed to achieve water quality standards;
- Recommendations for implementing the TMDL so that water quality standards will ultimately be achieved;
- Opportunity for public comment prior to finalizing the TMDL;
- Submission of the final TMDL by the State to the U.S. Environmental Protection Agency ("EPA") for final approval.

1.2 Problem Statement and Purpose of Study

Mill Pond Town Beach (the "Beach") is a designated beach located in the town of East Washington on the southeast corner of Mill Pond next to the Mill Pond Dam (see Figure 1). Under RSA 485-A:8.I , "…designated beach areas shall contain not more than a geometric mean based on at least 3 samples obtained over a 60-day period of 47 Escherichia coli per 100

milliliters, or 88 Escherichia coli per 100 milliliters in any one sample; unless naturally occurring." According to New Hampshire's methodology for assessing the quality of surface waters (NHDES, 2005b), a designated beach is an area on a waterbody that is operated for bathing, swimming, or other primary water contact by any municipality, governmental subdivision, public or private corporation, partnership, association or educational institution, open to the public, members, guests, or students whether on a fee or free basis.

To facilitate tracking and assessing surface water quality, all surface waters in New Hampshire are assigned a unique identification number (called an Assessment Unit or AU number). The AU number assigned to the Beach swimming area is NHIMP700030204-05-02. As shown in Table 1, this AU is currently listed as impaired on the State's 2006 Section 303(d) list for primary contact recreation (i.e., swimming) due to violations of surface water quality standards for bacteria (*Escherichia coli* or *E. coli* for short). Waters with elevated bacteria levels can result in swimmer's itch and gastrointestinal illnesses if ingested. As such the Beach has been posted by the New Hampshire Department of Environmental Services ("NHDES") on several occasions in the past as being potentially unfit for swimming.

Table 1: Section 303(d) Listing for Mill Pond Beach

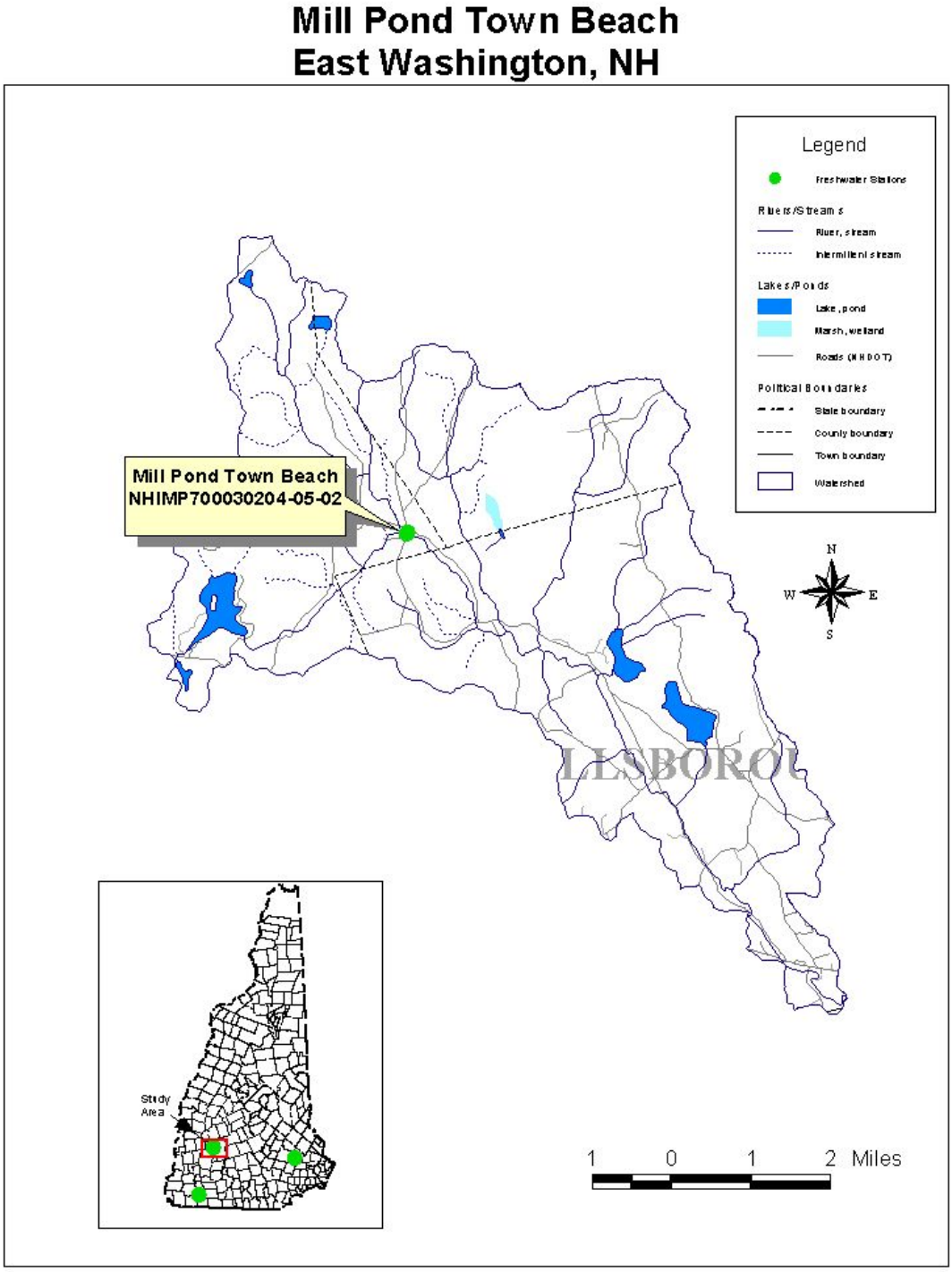
Assessment Unit ID	Name	Impaired Use	303(d) Impairment	Source(s)
NHIMP700030204-05-02	Mill Pond Beach	Primary contact recreation	*Escherichia coli*	Source Unknown

The purpose of this study is to:

1. Determine the primary sources of *E. coli* to the Beach;
2. Determine the TMDL for *E. coli* that will achieve water quality standards;
3. Allocate the TMDL between point and nonpoint sources;
4. Determine reductions in *E. coli* needed achieve the TMDL;
5. Provide a plan to guide implementation of the TMDL in a phased approach that will ultimately result in attainment of water quality standards and a beach with bacteria levels consistently acceptable for swimming.

Although bacteria is the focus of this study it is worth mentioning that all surface waters in New Hampshire (including the Beach), as well as in some New England States, are also listed as impaired for fish consumption due to mercury in fish tissue. Because of the levels of mercury found in fish tissue throughout New Hampshire's surface waters, a state-wide advisory was issued in the mid-1990's limiting the amount of fish one should eat. The sources of the mercury contamination in fish tissue are thought to be more regional (e.g., atmospheric deposition from upwind states) than local. In the future it is expected that a separate TMDL will be developed to address impairments due to mercury in all surface waters.

Figure 1: Mill Pond, Washington, NH



2 APPLICABLE WATER QUALITY STANDARDS AND TARGETS

2.1 Overview

Water Quality Standards determine the baseline water quality that all surface waters of the State must meet in order to protect their intended uses. They are the "yardstick" for identifying where water quality violations exist and for determining the effectiveness of regulatory pollution control and prevention programs. The standards are composed of three parts; classification, criteria, and antidegradation regulations, each of which are described below.

Classification of surface waters is accomplished by state legislation under the authority of RSA 485-A:9 and RSA 485-A:10. By definition, (RSA 485-A:2, XIV), "surface waters of the state means streams, lakes, ponds, and tidal waters within the jurisdiction of the state, including all streams, lakes, or ponds, bordering on the state, marshes, water courses and other bodies of water, natural or artificial."

All State surface waters are either classified as Class A or Class B, with the majority of waters being Class B. NHDES maintains a list which includes a narrative description of all the legislative classified waters. Designated uses for each classification may be found in State statute RSA 485-A:8 and are summarized below.

Classification	Designated Uses
Class A -	These are generally of the highest quality and are considered potentially usable for water supply after adequate treatment. Discharge of sewage or wastes is prohibited to waters of this classification.
Class B -	Of the second highest quality, these waters are considered acceptable for fishing, swimming and other recreational purposes, and, after adequate treatment, for use as water supplies.

According to New Hampshire’s assessment and listing methodology (NHDES, 2005) designated uses for New Hampshire surface waters include those shown in the following table.

Table 2: Designated Uses for New Hampshire Surface Waters

Designated Use	DES Definition	Applicability
Aquatic Life	Waters that provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms.	All surface waters
Fish Consumption	Waters that support fish free from contamination at levels that pose a human health risk to consumers.	All surface waters
Shellfish Consumption	Waters that support a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.	All tidal surface waters
Drinking Water Supply	Waters that with conventional treatment will be suitable for human intake and meet state/federal drinking water regulations.	All fresh surface waters
Primary Contact Recreation (i.e. swimming)	Waters suitable for recreational uses that require or are likely to result in full body contact and/or incidental ingestion of water.	All surface waters
Secondary Contact Recreation	Waters that support recreational uses that involve minor contact with the water.	All surface waters
Wildlife	Waters that provide suitable physical and chemical conditions in the water and the riparian corridor to support wildlife as well as aquatic life.	All surface waters

The second major component of the water quality standard is the "criteria." These include numeric or narrative criteria which define the water quality requirements for Class A or Class B waters. Criteria assigned to each classification are designed to protect the legislative designated uses for each classification. A waterbody that meets the criteria for it's assigned classification is considered to meet it's intended use. Water quality criteria for each classification may be found in RSA 485-A:8, I-V and in the State of New Hampshire Surface Water Quality Regulations (Env-Ws 1700). A copy of Env-Ws 1700 is available at http://www.des.state.nh.us/rules/env-ws1700.pdf.

The third component of water quality standards are antidegradation provisions which are designed to preserve and protect the existing beneficial uses of the State's surface waters and to limit the degradation allowed in receiving waters. Antidegradation regulations are included in Part Env-Ws 1708 of the New Hampshire Surface Water Quality Regulations. According to Env-Ws 1708.02, antidegradation applies to the following:

- All new or increased activity, including point and nonpoint source discharges of pollutants that would lower water quality or affect the existing or designated uses.

- A proposed increase in loadings to a waterbody when the proposal is associated with existing activities.
- An increase in flow alteration over an existing alteration.
- All hydrologic modifications, such as dam construction and water withdrawals.

2.2 Applicable Water Quality Standards

As mentioned in section 1.2, Mill Pond Town Beach is a designated beach. There are two designated uses for designated beaches that are relevant to bacteria pollution: primary contact recreation (e.g., swimming) and secondary contact recreation (e.g., boating). The Mill Pond Town Beach assessment unit is listed as impaired for primary contact recreation (i.e., swimming) due to violations of state water quality criteria for bacteria (*E. coli*). The Beach is a Class B surface water. Applicable water quality standards for the primary and secondary contact recreation are provided below.

> State Statute RSA 485-A:8,II: Designated beaches in Class B surface waters "shall contain not more than a geometric mean based on at least 3 samples obtained over a 60 day period of 47 *Escherichia coli* per 100 milliliters, or 88 *Escherichia coli* in any one sample; unless naturally occurring".

Though not currently listed as impaired for bacteria due to a lack of data, the remaining portion of Mill Pond which is not a designated beach, is also a Class B surface water. Applicable bacteria water quality standards for protecting primary contact recreation uses in such waters are less stringent than for designated beaches and are provided below:

> State Statute RSA 485-A:8,II: Class B surface waters that are not designated beaches "shall contain not more than either a geometric mean based on at least 3 samples obtained over a 60 day period of 126 *Escherichia coli* per 100 milliliters, or greater than 406 *Escherichia coli* in any one sample" unless naturally occurring.

In addition, the 2006 assessment and listing methodology (NHDES, 2005b) includes bacteria standards to protect secondary contact recreation (i.e., boating). These standards are five times higher than the bacteria criteria shown above for primary contact recreation.

The bacteria standards discussed above apply in the surface water. As indicated below, however, New Hampshire surface water quality regulations also specify that ambient bacteria criterion must also be met at the end of discharge pipe(s) from wastewater treatment facilities [Env-Ws 1703.06(b)]. Further, Env-Ws 1703.06 (c) requires that the bacteria concentration in the discharge pipe(s) from combined sewer overflows (i.e., pipes that convey a mixture of stormwater and untreated sewage during wet weather events), must not exceed 1000 *Escherichia coli* per 100 mL.

Env-Ws 1703.06 Bacteria

(b) Subject to (c) below, the bacteria criteria shall be applied at the end of a wastewater treatment facility's discharge pipe.

(c) For combined sewer overflows which discharge into non-tidal waters, a bacteria criteria of 1000 *Escherichia coli* per 100 milliliters shall be applied at the end of the combined sewer overflow's discharge pipe.

2.3 Targeted Water Quality Goals

The targeted water quality goal for this TMDL is for the bacteria concentrations in the Mill Pond Town Beach assessment unit to meet all the water quality standards for all the designated uses affected by bacteria pollution; that is, primary and secondary contact recreation. Of these two designated uses, the water quality standards for primary contact recreation are the most stringent. Therefore, the targeted goal for this TMDL is for the water quality at Mill Pond Town Beach to meet both aspects of the NHDES primary contact recreation bacteria water quality standard (geometric mean of 47 and single sample of 88 *E. coli* / 100 mL). The bacteria reductions needed to meet the primary contact recreation standard for designated beaches will ensure secondary contact recreation standards will be met.

These reductions should also help ensure that bacteria standards in the main part of Mill Pond are met due to the relatively small size of Mill Pond, its proximity to the Beach and the fact that the bacteria standards for Mill Pond are less stringent than for the Beach. Consequently, measures taken to achieve bacteria standards at the Beach should result in standards being met in the non-designated beach portion of Mill Pond as well.

3 BEACH WATER QUALITY CHARACTERIZATION

3.1 Watershed / Waterbody Description

Mill Pond is located in the upper portion of the North Branch River watershed (HUC 10 0107000302) which is approximately 34.2 square miles in size (see Figure 1). The drainage area to Mill Pond is approximately 10.8 square miles (6912 acres) but the pond itself is relatively small, measuring approximately 3.2 acres. Mill Pond is located in the southeast part of the Town of Washington. Beards Brook flows through Mill Pond from west to east and Woodward Brook enters the pond from the north (see Figure 2). Several unnamed tributaries also drain into Beards Brook. At the outlet of Mill Pond there is a small dam. Land use upstream of the pond is mostly rural and agricultural. Within approximately one mile upstream of the pond there are three small horse farms, one of which also has sheep, and a large dairy farm with corn crops, cows, goats, ducks, geese, emus and dogs (see Figures 2 and 3).

Figure 2: Schematic Showing Farms Just Upstream of Beach

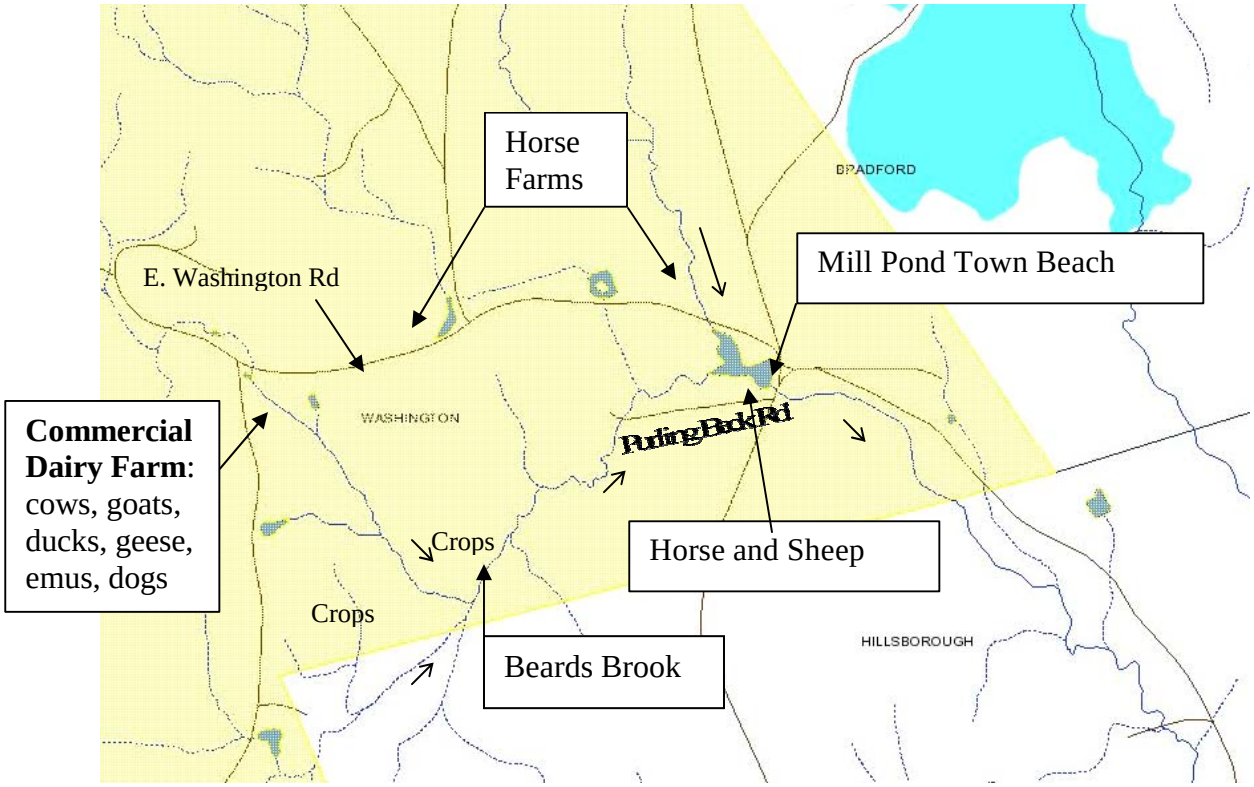
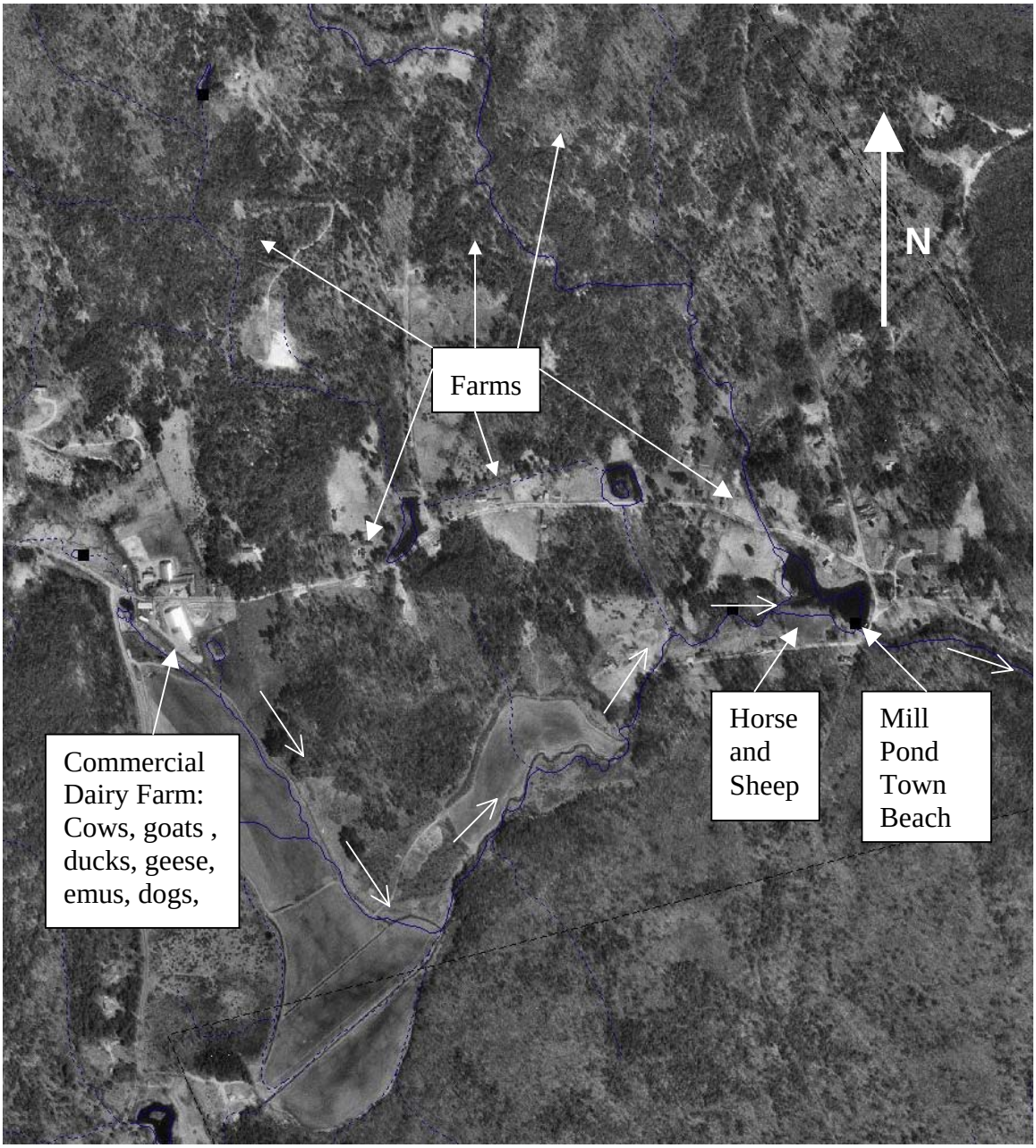


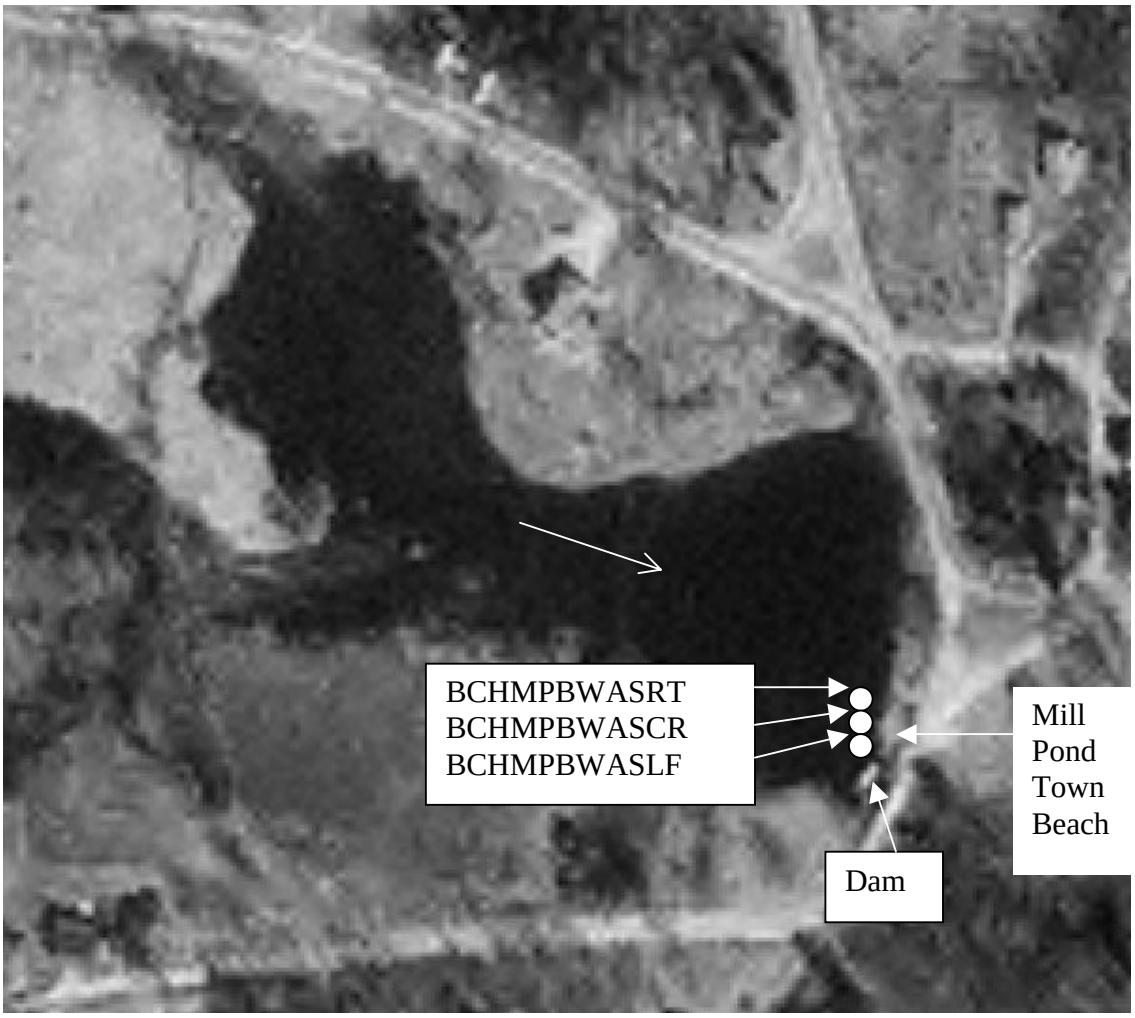
Figure 3: Aerial Photo Showing Land Use Just Upstream of Beach



The Mill Pond Town Beach is located in the southeast corner of the pond (see Figure 4). The footprint of sand at the beach area is relatively small measuring approximately 15 feet long and there is no roped off swim line. People who visit the beach generally recreate in the southern half of the pond. Given the small footprint of sand at the town beach the "swimming area" is estimated to be approximately 50 liner feet by 25 feet wide or approximately 1250

square feet. The average depth of the pond in this area is estimated at 3 feet deep. Thus, the total volume of water in the swimming area is approximately 3750 ft^3.

Figure 4: Aerial Photo of Mill Pond Beach with 2005 Sampling Stations



3.2 Bacteria Sampling for Compliance with Water Quality Standards

Data from the NHDES Public Beach Inspection Program was used to characterize the baseline concentration of bacteria in Mill Pond Town Beach and for determining compliance with water quality standards. From 1991 – 2004 the beach was sampled one to five times per year. In 2005, more intensive monitoring was conducted in support of the TMDL.

There are three designated beach monitoring stations at Mill Pond Town Beach swimming area (see Figure 4). Looking out from the Beach to the pond, Station

BCHMPBWASLF is located on the left side, station BCHMPBWASCR is in the center, and station BCHMPBWASRT is on the right side of the Beach swimming area.

The NHDES Public Beach Inspection Program monitored these stations in response to the potential health threats associated with water-borne pathogens. Samples are collected during the months of June through August to correspond with the season where bathers are most likely to use the beach.

In 2005 the NHDES Public Beach Inspection Program implemented a more detailed sampling plan at Mill Pond Town Beach to collect data in support of developing a TMDL. Prior data indicated that this beach has experienced chronic bacteria exceedances during the summer swimming months. These exceedances have resulted in the need for bacteria advisories to the public.

To calculate the water quality statistics for the receiving waters all of the *E.coli* measurements were compiled from the three stations at Mill Pond Town Beach from 1991 to 2005. All data used for these calculations passed the quality assurance protocols of the NHDES Public Beach Inspection Program. The data collected in 2005 also passed the quality assurance protocols detailed in the Quality Assurance Project Plan prepared for this study (NHDES, 2005a), a copy of which is included in Appendix A.

Before discussing results it is useful to first review how multiple samples taken on a given day are assessed to determine if a waterbody is impaired or attaining standards. The two components of the water quality standard for *E. coli* in freshwater beaches are the geometric mean ("geomean") and single sample measurements. On any given sampling day either two or three of the stations were sampled (e.g., the left, center and/or right side of the beach swimming area). In terms of determining compliance with water quality standards the maximum value of the samples collected on a given day are used. Thus the statistic "daily maximum" is used for purposes of water quality standards.

The geomean is calculated for a minimum of three samples collected within a sixty day period using the following formula:

$$\text{Geometric Mean} = (D1 \times D2 \times \ldots Dn)^{1/n}$$

where

D1, D2, etc. = the individual data points

n = the total number of data points used in the calculation.

As mentioned in section 2.2, the water quality standards for primary contact recreation in fresh water designated beaches are based on *E. coli* concentrations. The geometric mean criterion is 47 cts/100mL based on at least three samples over a sixty day period, and the maximum single sample criterion is 88 cts/100mL.

Table 3, Figure 5 and Figure 6, summarize the single sample daily maximum and geometric mean bacteria concentrations using all of the data collected by the NHDES Public Beach Inspection Program from 1991 through 2004. Of the data useable for assessment

purposes during this time period, there were thirteen violations of the single sample maximum criterion and five violations of the geometric mean criterion.

Table 3: Mill Pond Town Beach Bacteria Results 1991 – 2004

DATE	DES Public Beach Inspection Program Monitoring Stations			Statistics for Assessments	
	BCHMPBWASLF SINGLE SAMPLE	BCHMPBWASCR SINGLE SAMPLE	BCHMPBWASRT SINGLE SAMPLE	SINGLE SAMPLE DAILY MAX	GEOMETRIC MEAN
08/29/91	10		9	10	
07/14/92	50		59	59	
08/24/92	88		106	106	
07/08/93	90		82	90	
07/21/93	28		29	29	
07/12/94	200*		200*	200	
07/22/94			83	83	
08/11/94	7	20	5	20	69
07/07/95	27	18	24	27	
08/22/95	23		18	23	
07/19/96	138		145	145	
08/21/96	5		3	5	
07/01/98	200		200	200	
08/19/98	44		29	44	
07/06/99	200		200	200	
07/12/99	50		50	50	
08/09/99	8		19	19	57
07/11/00	184		200	200	
07/18/00	200		194	200	
08/01/00	130		180	180	
08/20/00	23		10	23	
08/29/00		8		8	67
07/12/01	91		101	101	
08/02/01	12		17	17	
07/08/02	20		19	20	
08/02/02	200		200	200	
08/07/02	27		25	27	48
07/10/03	50		60	60	
08/07/03	306		218	306	
08/13/03	84		94	94	120
07/22/04	13	10		13	
08/13/04	20		36	36	

Escherichia coli units in cts/ 100 ml
Highlighted cells are >88 for daily maximums or >47 for geometric means
* Value reported as >200 cts/ 100 ml

Figure 5: Single Sample *E. coli* Results, Mill Pond Town Beach 1991-2004

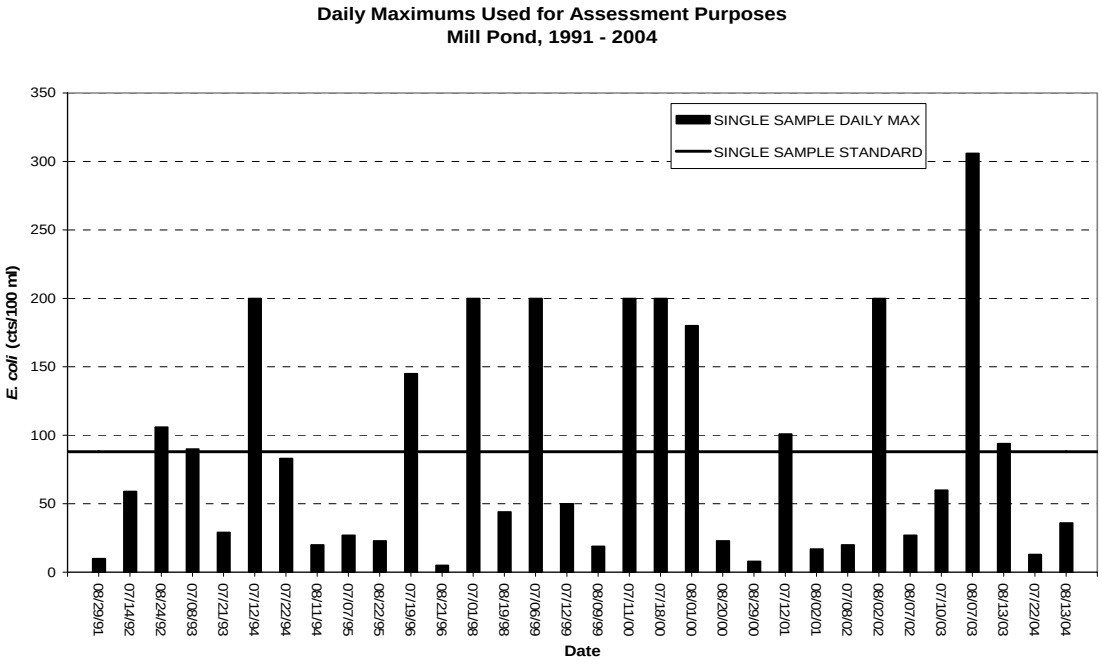
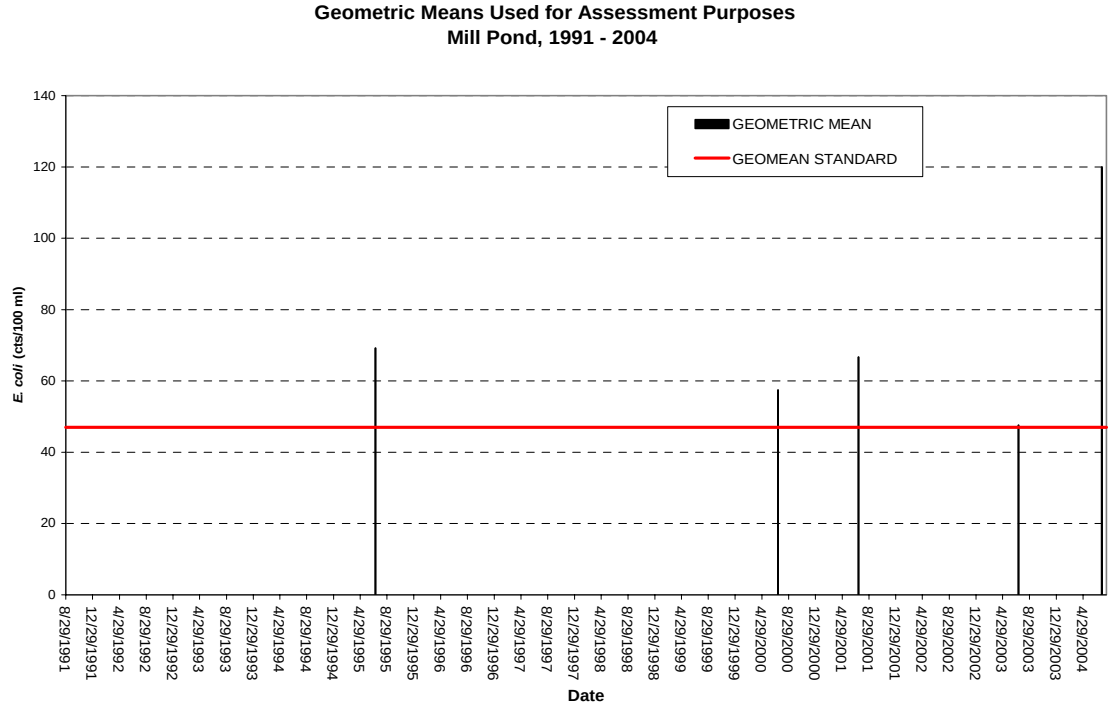


Figure 6: Geometric Mean *E. coli* Results, Mill Pond Town Beach 1991 – 2004



During 2005, the NHDES Public Beach Inspection Program conducted a more intensive sampling program at Mill Pond Town Beach to assist in the development of this TMDL. Table 4

depicts the single samples, daily maximums, and geometric mean results generated from the data collected in 2005. Figure 7 depicts the single sample daily maximums and Figure 8 shows the geometric mean values.

Table 4: 2005 Single Sample, Daily Maximum and Geometric Mean *E. coli* Results

DATE	DES Public Beach Inspection Program Monitoring Stations			
	BCHMPBWASLF SINGLE SAMPLE	BCHMPBWASRT SINGLE SAMPLE		GEOMETRIC MEAN
05/26/05	160	170	170	
06/14/05	170	268	268	
06/22/05	82	66	82	
06/29/05	400*	300	400	
07/01/05	200	170	200	
07/05/05	90	64	90	
07/15/05	79	56	79	
07/18/05	232	246	246	
07/21/05	110	95	110	157
07/26/05	20	22	22	
08/03/05	400*	400*	400	
08/11/05	8	6	8	112
08/18/05	120	130	130	101
08/23/05	30	32	32	93
08/30/05	296	394	394	93

Escherichia coli units in cts/ 100 ml
Highlighted cells are >88 for daily maximums or >47 for geometric means
* Value reported as >400 cts/ 100 ml

Figure 7: Single Sample *E. coli* Results Mill Pond Town Beach 2005

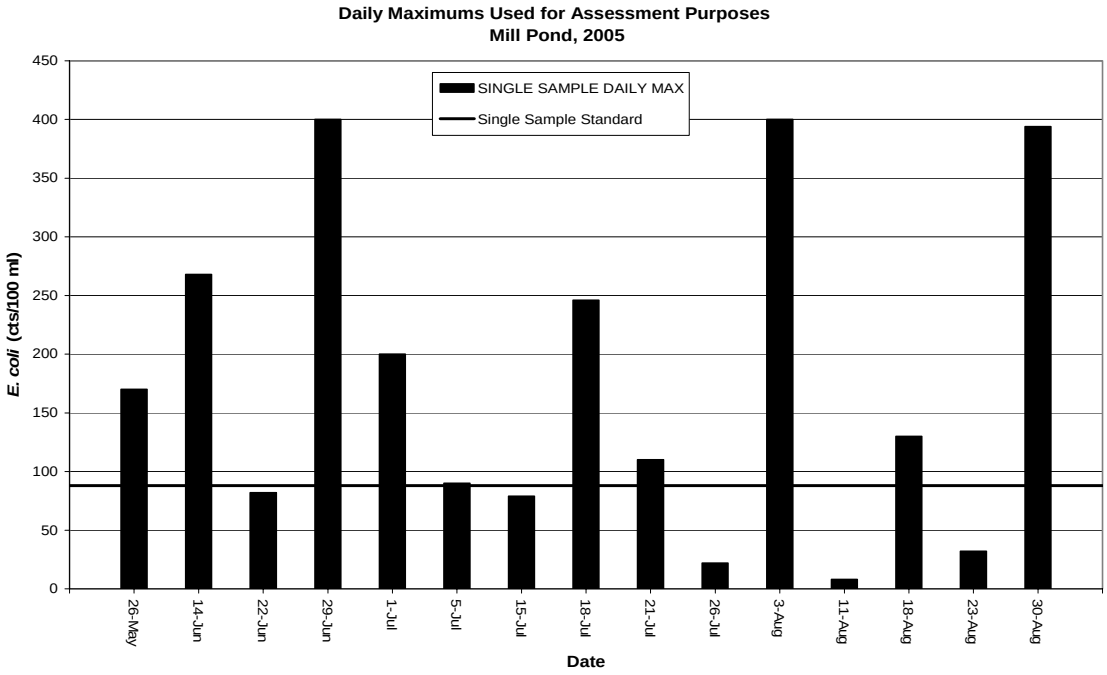
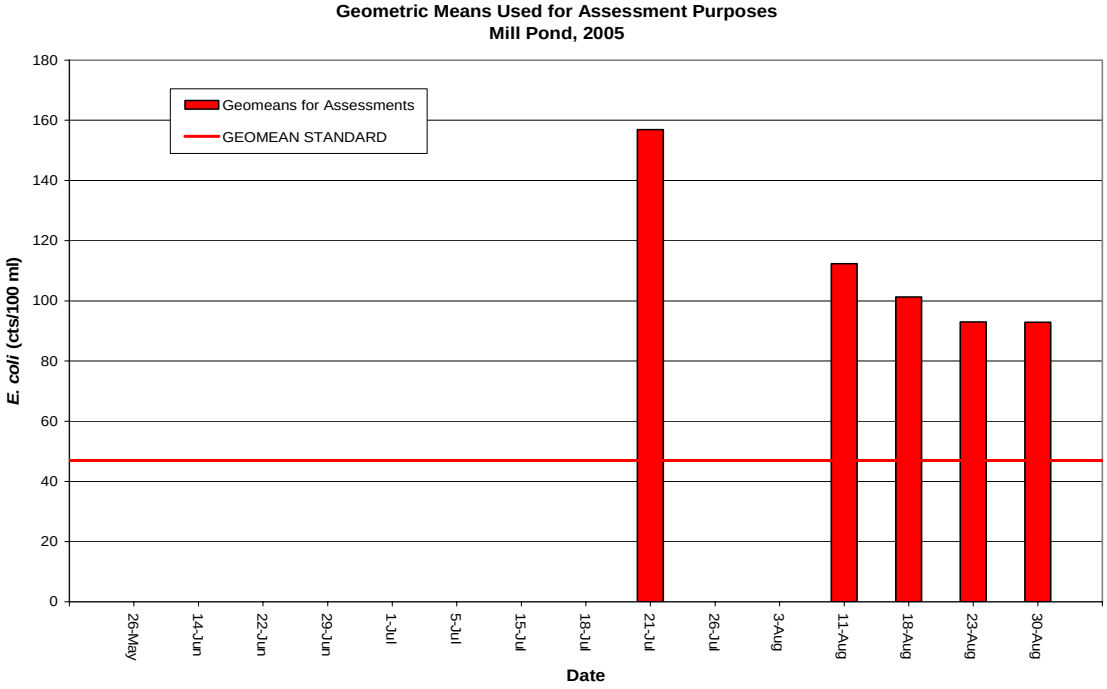


Figure 8: Geometric Mean *E. coli* Results Mill Pond Town Beach 2005



The results of *E.coli* monitoring at Mill Pond Town Beach presented above show that the bacteria levels at Mill Pond Town Beach violate the bacteria criteria established for primary contact recreation on numerous occasions. Consequently, in accordance with the New Hampshire's assessment and listing methodology (NHDES, 2005), Mill Pond Beach was listed as impaired for primary contact recreation on the 2006 303(d) List of impaired or threatened waters that require a TMDL.

To gain an understanding of how bacteria levels may vary with precipitation, the 2005 single sample results were compared to field observations at the Beach and precipitation data recorded at the National Weather Service station located at Keene airport. A wet event was defined as 0.25 inches or more of rainfall on the day of and previous 24 hours. If the field notes indicated significant rain but the Keene gauge indicated less than 0.25 inches, a value of 0.25 inches was assumed. As shown in Table 5, seven of the 2005 sampling dates were dry and eight were wet.

Table 5: *E coli* and Precipitation

Date	Maximum *E. coli* (cts /100 mL)	Keene National Weather Service Daily Rainfall Data			Field Notes Rain	Assumed amount of precipitation (inches)	Wet or Dry
		Rain Day of	Rain 1 Day Prior	1 Day Prior + Day of			
05/26/05	170	1.41	0.13	1.54	OVER 2 INCHES OF RAIN PRIOR 3 DAYS	1.54	Wet
06/14/05	268	0.19	0.00	0.19	HEAVY THUNDERSTORMS ON 6/13/05	0.25	Wet
06/22/05	82	0	0.00	0	RAINED OVERNITE	0.05	Dry
06/29/05	400	0.24	0.79	1.03	HEAVY RAINS NIGHT BEFORE	1.03	Wet
07/01/05	200	1.21	0.58	1.79		1.79	Wet
07/05/05	90	0	0.00	0		0	Dry
07/15/05	79	0	0.52	0.52	RAINED HEAVY YESTERDAY	0.52	Wet
07/18/05	246	0.07	0.02	0.09	RAINED LAST NIGHT/EARLY AM	0.25	Wet
07/21/05	110	0	0.01	0.01		0.01	Dry
07/26/05	22	0	0.00	0		0	Dry
08/03/05	400	0	0.00	0	RAIN HEAVY IN AM	0.25	Wet
08/11/05	8	0	0.00	0		0	Dry
08/18/05	130	0	0.00	0		0	Dry
08/23/05	32	0	0.00	0		0	Dry
08/30/05	394	0.12	0.01	0.13	CURRENTLY RAINING	0.25	Wet

Figure 9 shows a plot of *E. coli* concentration for the wet and dry samples and Figure 10 shows the same plot with precipitation expressed in inches of rain. As shown, *E. coli* concentrations appear to be significantly different under wet and dry conditions with wet weather conditions generally resulted in higher concentrations than dry weather conditions. The average *E. coli* concentration during dry conditions was 68 cts / 100 ml and 270 cts/100 mL under wet conditions. This suggests that violations are mainly due to bacteria conveyed by stormwater runoff to the Beards Brook, Woodard Brook, or their tributaries which then flows to Mill Pond or stormwater runoff which flows directly to Mill Pond and the Beach. As shown in Figure 10, *E. coli* concentrations almost always exceed the criterion of 88 cts / 100 ml when rainfall exceeds approximately 0.25 inches. Consequently, until efforts are implemented to reduce bacteria levels, it is recommended that the beach be closed when rainfall exceeds this amount.

Figure 9: 2005 *E. coli* vs Precipitation (Wet or Dry)

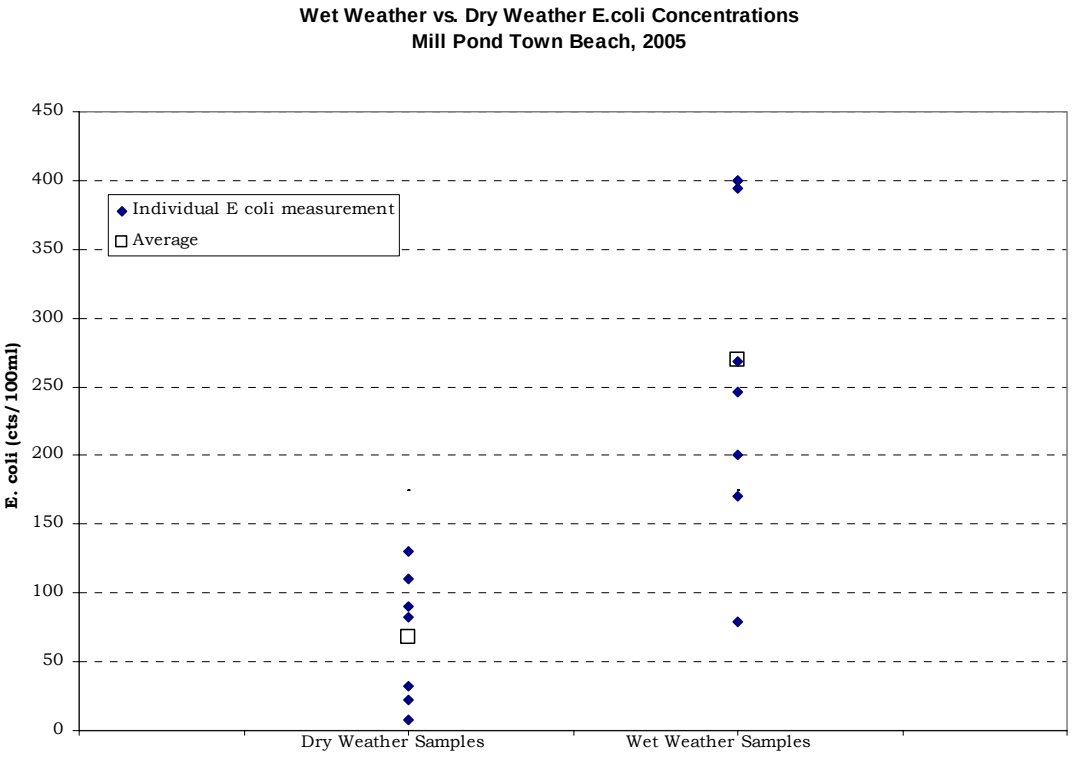
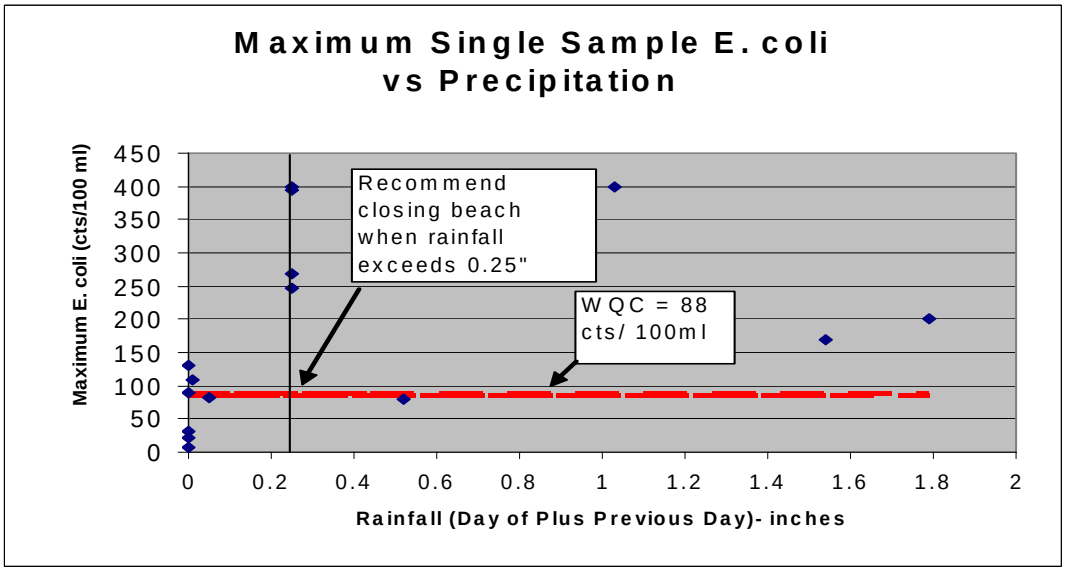


Figure 10: 2005 *E. coli* vs Precipitation (inches)



3.3 Microbial Source Tracking (i.e., Ribotyping) Results

To help determine the sources of bacteria to Mill Pond Town Beach a microbial source tracking technique called Ribotyping was conducted by the University of New Hampshire during the summer of 2005 (Jones 2006). Ribotyping is an analytical technique used to determine the source(s) of bacteria in a sample (i.e., human, waterfowl, pets, etc). It is based on the fact that each *E. coli* isolate produces a unique pattern (called a ribopattern) which can then compared to the pattern from a known source.

Two sources of known isolate patterns were used for this study for comparison purposes. One was the New Hampshire Regional Source Species database and the second was a local source species library that was developed by collecting scat samples from known animals in the vicinity of the beach and then producing the ribopatterns for those animals. The use of the local source species ribopatterns for comparison turned out to be a very valuable asset in this study resulting in higher than average identification rate (Jones, 2006). Since ribotyping involves a comparison analysis, a threshold similarity index is set in order to determine known isolates from unknown isolates. For this study the similarity index target was set at 90% similarity, however, 2 isolates that matched at 89% were included in the known isolates.

Jones (2006) monitored two of the same stations (BCHTWBTROLF and BCHTWBTROCR) that the NHDES Public Beach Inspection Program and TMDL Program had samples collected. A total of five samples were collected for ribotyping (Table 6). The samples were collected during both dry and wet weather (dry weather on 7/21, 8/18, and 9/21, wet weather on 8/3 and 8/30) with wet weather events defined as days with >0.25 inches of rain in the previous 24 hours. As shown in Table 6, the bacteria concentrations of the ribotyping samples were significantly higher during the wet weather events, which further supports the conclusion presented in previous section that stormwater runoff is a major source of bacteria to the Beach.

Table 6: Fecal coliform/E.coli Concentrations (cts/100ml) for Ribotyping Samples

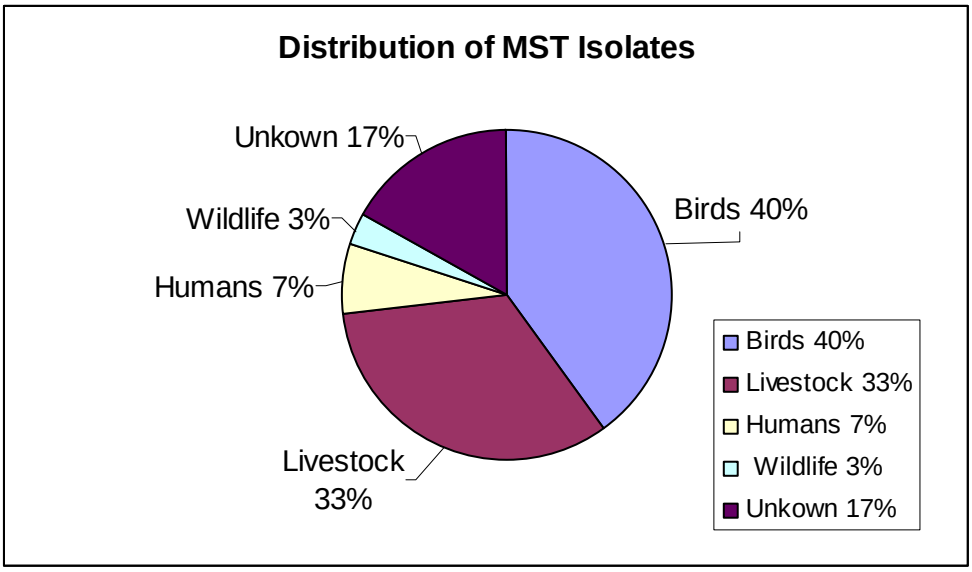
Site	7/21/05 (Dry)	8/3/05 (Wet)	8/18/05 (Dry)	8/30/05 (Wet)	9/21/05 (Dry)
BCHTWBTROLF	172/128	7200/6200			
BCHTWBTROCR	108/92		216/196	412/398	80/80

Likely sources of bacteria identified by the ribotyping analysis are shown in and Table 7 and Figure 11 . As shown, ribotyping identified source species for 83% of the *E.coli* isolates in the water samples. The remaining isolates (17%) could not be matched with certainty to patterns in the ribopattern database. Bacteria from 11 different species were identified at Mill Pond Town Beach swimming area. Of the identified isolates, birds constituted the largest portion (40%) followed by Livestock (33%), Human (7%) and Wild Animals (3%).

Table 7: Species Identified by Ribotyping of Mill Pond Town Beach Samples

Beach Location	Sample site designation	Sample Date	E.coli (cfu/100ml)	Total Isolates	Identified Isolates	Mixed Avian	Cow	Sheep	Horse	Goat	Mixed Wildlife	Human Wastewater	Human Septage
Washington	WASLF	7/21/05	128	5	3	2			1				
Washington	WASLF	8/3/05	6400	5	4	1	1		1			1	
Washington	WASRT	7/21/05	92	5	5		1	2	1		1		
Washington	WASRT	8/18/05	196	5	3	3							
Washington	WASRT	8/30/05	398	5	5	3				2			
Washington	WASRT	9/21/05	80	5	5	4							1

Figure 11: Distribution of Isolates Identified by Ribotyping



Results of the ribotyping study indicate that the majority of the bacteria at Mill Pond Town Beach is from birds and livestock. These findings are supported by visual observations by NHDES field staff of numerous waterfowl (ducks and geese) in two fenced in ponds at the commercial dairy farm off of E. Washington Road (see Figure 2). The ponds are located in close proximity to a tributary which drains to Beards Brook. In addition ducks have been observed in the Mill Pond itself. These findings are also supported by Table 8 which is a comparison of bacteria concentrations in scat (i.e., feces) from various sources. As shown, scat from geese is over 37 times more concentrated than the other sources tested. This implies that it would take less scat from geese to cause a violation of bacteria standards in surface waters as compared to other sources such as sheep, duck, horses, goats, etc.

Livestock are also prevalent in the watershed immediately upstream of the Beach; consequently it is not surprising that the ribotyping analysis found livestock to be the second highest source of bacteria to the Beach. As shown in Figure 2 and Figure 3, there are several

farms in the watershed including a large commercial dairy farm located approximately one mile upstream of Mill Pond. Horse and sheep have also been observed on the south side of Mill Pond just a few hundred feet upstream of the Beach. The horse has direct access to the pond and has been seen standing in the water at the edge of the Mill Pond.

Table 8: Comparison of *E. coli* Concentration in Various Scat Samples (Jones, 2006)

Sample	Species	Date	Location	E.coli Concentration (cfu/g wet wt.)
GE1	Geese	7/21/05	Troy	>222,000,000
GE2	Geese	7/21/05	Troy	>222,000,000
GE3	Geese	7/21/05	Nottingham	>222,000,000
ST1	Septage	9/6/05	Nottingham	789
SP1	Sheep	10/3/05	East Washington	5,888,889
HO1	Horse	10/3/05	East Washington	2,222,222
HO2	Horse	10/3/05	East Washington	1,556
DA1	Cow	10/3/05	East Washington	122,222
DU1	Duck	10/3/05	East Washington	4,444
GO1	Goat	10/3/05	East Washington	488,889

4 SOURCES OF BACTERIA

4.1 Existing Point Sources of Bacteria

Point source discharges include discernible, confined, and discrete conveyances such as the discharge from the effluent pipes of wastewater treatment plants or permitted combined sewer overflows (i.e., pipes that convey a mixture of stormwater and sewage during wet weather events). In addition, discrete stormwater discharges from municipal separate storm sewer systems (MS4) covered by the EPA National Pollutant Discharge Elimination System (NPDES) Phase II stormwater program regulations are considered point sources for this TMDL. All point source discharges must have a federal National Pollutant Discharge Elimination System (NPDES) discharge permit.

There are no wastewater treatment plant discharges or combined sewer overflows (CSOs) in the Mill Pond watershed. In addition, the town of Washington is not covered by the EPA Phase II NPDES stormwater program regulations for small municipal separate storm sewer systems (MS4). Consequently, it is concluded that there are no known existing point sources in the study area.

4.2 Existing Non-Point Sources of Bacteria

In general, non-point sources ("NPSs") of pollutants include all pollutant sources other than point sources. Compared to point sources, NPSs of pollution are diffuse and more difficult to quantify. Examples of NPSs are provided below.

- *Stormwater runoff not conveyed through MS4 systems*. Sources of bacteria in stormwater can include fecal matter deposited on the land by wildlife and domesticated animals (including pets and farm animals). During wet weather events, rainwater running over the land may come in contact with the fecal matter and convey it to the surface water. If stormwater runoff is a major source, elevated concentrations in the surface water will usually occur during or shortly after wet weather events.
- *Illicit connections of sewer pipes to storm drain systems.* In some communities, sewer pipes from residents or businesses have been found to be connected to storm drain pipes instead of sewer pipes. Consequently, instead of transporting the raw sewage to a facility where it can receive proper treatment (such as a wastewater treatment facility), the raw sewage is instead transported by the storm drain to the surface water. Such connections are illegal and can cause elevated bacteria concentrations in a surface water during wet and dry weather.
- *Failed septic systems.* Effluent from failed septic systems adjacent to or upstream of the surface water of interest can cause elevated ambient bacteria concentrations during wet and dry weather.
- *Direct deposition of fecal matter*. Deposition of fecal matter by animals, waterfowl and humans (i.e. babies with dirty diapers playing in the water) directly into or

upstream of the surface water of interest can cause elevated bacteria concentrations during wet or dry weather.

It is possible that all of the above NPSs could be contributing to bacteria levels recorded at the Beach. However, based on field reconnaissance and the results presented in the previous chapter, a best estimate of which bacteria sources are most important relative to the amount of bacteria they likely contribute is presented in Table 9. A simple ranking system of "High", "Medium", or "Low" was used to indicate the relative amount of bacteria the source is estimated to contribute. Major sources of bacteria were assigned a "High" rank. Bacteria sources that are believed to contribute little if any bacteria were assigned a "Low" rank and sources that contribute moderate amounts of bacteria were given a "Medium" rank. Such information is useful for guiding restoration efforts.

As shown in Table 9, bacteria from stormwater runoff and direct deposits of fecal matter at the Beach and Pond received the highest ranking as they are believed to be the major sources of bacteria to the Beach. Illicit connections and failed septic systems are not believed to be major sources of bacteria and were therefore given a low ranking. Direct deposition of bacteria from people recreating at the Beach (i.e. swimming) was also give a low ranking as no people were observed swimming at the beach on the days that samples were taken for this study.

Table 9: Ranking of Potential Sources of Bacteria

Bacteria Source	Ranking	Comments
Stormwater runoff (Non-MS4) and Non-human Direct Deposition to Surface Waters	High	As discussed in section 3.2. and 3.3, highest bacteria levels and most bacteria violations occur during wet weather. Consequently stormwater runoff is considered a major source of bacteria to the Pond and was assigned a High ranking. As discussed in section 3.3, ribotyping results indicate that birds (40%) and Livestock (33%) are the major sources of bacteria to the Beach. Reconnaissance of the watershed just upstream of Mill Pond revealed several potential areas that could contribute bacteria from birds and livestock to stormwater runoff and ultimately Mill Pond. In addition, and as discussed below, some bird and livestock were also observed to have direct access to Mill Pond and its tributaries. Consequently, direct deposition of fecal matter to surface waters by non-human sources was also assigned a High ranking. These sources are shown on Figure 2 and are discussed below: • Ducks have been observed in Mill Pond. • Horse and sheep have been observed on the south side of Mill Pond , and just a few hundred feet upstream of the Beach. The horse has direct access to the Pond and has been observed standing in the water at the edge of Mill Pond. • There is a large dairy farm approximately one mile upstream of Mill Pond with a tributary that flows through the middle of the farm and pasture land and eventually into Mill Pond. This dairy farm is home to cows, several varieties of geese and ducks, emu's, goats and dogs. Fecal matter from the birds and livestock has been seen deposited directly into the brook and/or on the land immediately adjacent to the brook. It is possible that other animals such as dogs may also contribute direct deposits to the Beach although none were observed on the days when sampling was conducted for this study. • Land application of composted cow manure on fields near the dairy farm and adjacent to one of the tributaries that flows into the Pond could also be a source of bacteria during wet weather events.
Illicit Connections And Failed Septic Systems	Low	The ribotyping results presented in section 3.3 indicate the presence of human wastewater and human septage which may be due to illicit connections and failed septic systems exist either immediately adjacent to the pond or in the upstream watershed. These sources were assigned a rank of "Low" since none were observed in the immediate vicinity of the Beach and the ribotyping results indicated human sources constituted only 7% of the known isolates, although it is possible a higher percentage may actually exist as 17% of the samples could not be identified. Further investigation in the watershed is needed to confirm the conclusion that these sources are not major contributors of bacteria to the Beach.
Direct Deposition by People Swimming	Low	People recreating in surface waters (i.e., babies with dirty diapers playing in the water or swimmers that haven't bathed properly) can also result in elevated bacteria levels. During this study no people were observed swimming at the Beach, consequently this source was assigned a Low ranking.

5 TMDL AND ALLOCATIONS

5.1 Definition of a TMDL

According to the 40 CFR Part 130.2, the TMDL for a waterbody is equal to the sum of the individual loads from point sources (i.e., waste load allocations or "WLAs"), and load allocations ("LAs") from nonpoint sources (including natural background conditions). Section 303(d) of the CWA also states that the TMDL must be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety ("MOS") which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

In equation form, a TMDL may be expressed as follows:

$$TMDL = WLA + LA + MOS$$

where:

WLA = Waste Load Allocation (i.e. loadings from point sources)

LA = Load Allocation (i.e., loadings from nonpoint sources including natural background)

MOS = Margin of Safety

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

5.2 TMDL Allocation and Percent Reduction

As mentioned in section 5.1, TMDLs can be expressed in terms of either mass per time, toxicity or other appropriate measure. To satisfy recent legal challenges on how TMDLs should be expressed, a TMDL in terms of the maximum allowable load per day, (i.e., billions of *E. coli* per day) is provided in Appendix C. As shown in Appendix C, the TMDL is a function of flow through the Beach swimming area. Although it is possible to express a TMDL in terms of a load per day, NHDES believes that the best way to express this TMDL is in terms of concentration (counts / 100 mL); reasons for this are provided below:

- The units are consistent with how bacteria water quality criteria are expressed;

- The units are consistent with how compliance with ambient bacteria water quality criteria will be determined;
- It is simpler and easier for the public to understand;
- Progress towards compliance is easier to measure and track than a TMDL expressed in *E. co*li /day which requires an estimate of flow as well as concentration; and
- Like the bacteria water quality criteria, a TMDL expressed in terms of concentration would be applicable during all times of the year.

Since concentrations are not directly additive, the TMDL equation presented in section 5.1 requires some adjustment to accommodate a TMDL expressed in terms of concentration. The revised equation is presented below.

TMDL = *E. coli* Water Quality Criterion $\geq$ WLA ($_{p1}$) $\geq$ LA ($_{n1}$) $\geq$ WLA ($_{p2}$) $\geq$ etc.

Where:

$\geq$ means greater than or equal to
WLA ($_{p1}$) = allowable concentration for point source category 1
LA ($_{n1}$) = allowable concentration from nonpoint source category 1
WLA ($_{p2}$) = allowable concentration from point source category 2 etc.

What this equation says is that if the receiving water is comprised of point and nonpoint sources, and if all point and nonpoint sources have bacteria concentrations that are less than or equal to the bacteria water quality criterion, then the concentration of bacteria in the receiving water will be less than or equal to the bacteria water quality criterion.

This equation implies a goal of meeting bacteria standards at the point of discharge for all sources. Although this may be the goal, it is not the intent of this TMDL to set permit limits for any point or nonpoint source discharge unless otherwise required by state law or regulation (see section 2.2). This is especially true for stormwater discharges covered by the EPA NPDES General Stormwater Permit program. The NPDES stormwater permits are Best Management Practices ("BMPs") based permits which require communities to develop and implement comprehensive stormwater management programs that include BMPs. New Hampshire and EPA believe that BMPs based permits that are part of a comprehensive stormwater management program, with specific emphasis given to pollutants causing or contributing to water quality problems, can be consistent with the WLAs established for stormwater discharges in TMDLs. Consequently, although end of pipe bacteria measurements can identify and help prioritize sources that require attention, compliance with this TMDL will be based on ambient water quality and not at the point of discharge (i.e., end of pipe).

As discussed in section 2.2 and 2.3, there are two bacteria water quality criterion applicable to this study; a single sample criterion equal to 88 *E. c*oli per 100 mL and a geometric mean equal to 47 *E. coli* per 100 mL. Since there are two criteria, two TMDLs are presented. The TMDL based on the single sample criterion is presented in Table 10 and the TMDL based on the geometric mean criterion is presented in Table 11. As previously discussed, the TMDL in both tables was set equal to the criterion and the point (WLA) and nonpoint (LA) sources were

set equal to a value less than or equal to the bacteria water quality criterion. For reasons discussed in section 5.3 below, the explicit MOS was set to zero.

Table 10: Single Sample TMDL Based on Concentration

Bacteria Source	WLA	LA	Explicit MOS	TMDL
	(counts *E. coli* / 100 ml)			
WWTF	0			
CSO	0			
Stormwater (MS4)	88			
Stormwater (Non-MS4)		88		
Non-Human Direct Discharges to Surface Waters		88		
Illicit Sewer Connections		0		
Failed Septic Systems		0		
People Recreating in the Water (i.e., Swimming)		88		
	88	**88**	**0**	**88**

Table 11: Geomean TMDL Based on Concentration

Bacteria Source	WLA	LA	Explicit MOS	TMDL
	(counts *E. coli* / 100 ml)			
WWTF	0			
CSO	0			
Stormwater (MS4)	47			
Stormwater (Non-MS4)		47		
Non-Human Direct Discharges to Surface Waters		47		
Illicit Sewer Connections		0		
Failed Septic Systems		0		
People Recreating in the Water (i.e., Swimming)		47		
	47	**47**	**0**	**47**

Sources were allocated a concentration of 0 counts/ 100 mL if

- there was no evidence that that the source currently exists and there is little likelihood that such a source will exist in the future, or
- the source exists but is illegal.

As discussed in section 4.1, there are no WWTFs or CSOs in the watershed and none are expected in the future; consequently, allocations for these point sources were set equal to zero. Although none of the communities in the watershed are currently covered by the EPA NPDES MS4 General Stormwater Permit program, an allocation was included for MS4 Stormwater in event the EPA stormwater permit program is expanded in the future to include communities such as Washington. Because there are no known illicit sewer connections to storm drains or failed septic systems (see section 4.1), and since illicit sewer connections and failed septic systems which violate bacteria standards are illegal, allocations for these nonpoint sources were set equal to zero. All other source categories were assigned an allocation equal to the bacteria water quality criterion. These include non-MS4 stormwater and non-human direct discharges to surface waters (such as waterfowl or livestock defecating directly in the surface water). In addition a nonpoint source allocation for people recreating in the surface waters was also included to account for the fact that people swimming at the Beach can also cause bacteria levels to rise. Examples include babies with dirty diapers playing in the water, or swimmers who have not bathed properly.

An approximation of the percent reduction needed to achieve each of the TMDLs is provided in Table 12. The upper detection limit of single samples was 400 cts/100 mL. On numerous occasions measurements exceeded this upper detection limit and were reported as ">400 cts/100mL." To determine the load reduction for the single sample TMDL a value 50% above the upper detection limit (i.e., 600 cts/100 mL) was used. Load reductions for the geometric mean TMDL were calculated based on the highest calculated geometric mean of 157 cts/100mL. As shown, bacteria concentrations must be reduced by approximately 85% to achieve the single sample TMDL and approximately 70% to achieve the TMDL based on the geometric mean criterion. These represent significant reductions which will be challenging to achieve.

Table 12: Percent Reduction in Bacteria Needed to Achieve TMDL

	Single Sample	Geomean
Maximum Measured Concentration (*E. coli* /100 ml)	600	157
TMDL (*E. coli* / 100 ml)	88	47
% Reduction Needed to Meet TMDL	85%	70%

5.3 Margin of Safety (MOS)

Setting an explicit margin of safety for this TMDL was not considered necessary because there is a sufficient margin of safety implicit in the methodology used to establish the TMDL. For example, setting all sources less than or equal to the bacteria criterion is conservative because it does not account for mixing or dilution in the receiving water. In addition, the methodology assumes no losses of bacteria due to settling or die-off, which are known to take place in surface waters.

5.4 Seasonal Considerations

As discussed in section 5.2, the bacteria water quality criterion are applicable at all times. Since the TMDLs are set equal to the bacteria criterion, they too are applicable at all times and are therefore protective of water quality under all conditions and seasons.

6 IMPLEMENTATION PLAN

6.1 Recommendations to Reduce Bacteria and Restore Mill Pond Town Beach

As discussed in the previous sections, bacteria levels at the Beach swimming area must be reduced by approximately 70% based on geometric mean concentrations and approximately 85% based on single sample values. Further, stormwater runoff and direct discharges of non-human fecal matter to the Beach swimming area or tributary surface waters are believed to be the primary sources of bacteria to the Beach. Finally, results of the ribotyping study indicate that birds, livestock and humans are responsible for approximately 40%, 33% and 7% respectively of the bacteria at the Beach.

Based on the above, the following activities are recommended to try to reduce bacteria to levels acceptable for swimming at Mill Pond Town Beach. Other measures may be necessary to completely restore the Beach. Reducing bacteria levels by over 70% will take a concerted effort by the Town and others to accomplish and should be implemented in phases with each phase followed by monitoring of the surface water to determine when bacteria levels are acceptable for swimming. As indicated below, many of the bacteria abatement measures include working with local farmers. To assist with this effort, NHDES will contact the New Hampshire Department of Agriculture who has many years of experience helping farmers.

Post Warning Sign and Close Beach When it Rains:

As discussed in section 3.2, the Beach frequently exceeds the geometric mean bacteria criterion which is a good indicator that bacteria levels will usually be high on any given day. Consequently, to protect potential swimmers it is recommended that the Town post the Beach with a sign warning them that the beach frequently has high bacteria levels and that they are swimming at their own risk. NHDES can assist with the Town with wording for the signs.

In addition, and as shown in Figure 9 and Figure 10, the bacteria criterion is almost always exceeded when rainfall exceeds approximately 0.25 inches. Consequently, it is recommended that the Town install a rain gauge and post signs closing the beach when rainfall exceeds 0.25 inches. Prior to reopening the Beach, it is recommended that the Town either sample the Beach to determine if bacteria standards are met, or wait a minimum of 3 consecutive days when rainfall is less than 0.25 inches. As measures are implemented to reduce bacteria levels, the rainfall threshold for closing the beach should rise resulting in fewer Beach closures. To determine new rainfall thresholds in the future, the Town will need to collect more bacteria samples and measure rainfall amounts on the days samples are collected.

Waterfowl Management:

Ducks have been observed in Mill Pond. It's also possible that geese visit the pond although none were observed by field staff. In addition, a wide variety of ducks and geese exist at the large dairy farm located approximately one mile upstream of Mill Pond (see Figure 2 and

Figure 3). The birds reside in a fenced-in area that includes two small ponds adjacent to an unnamed tributary that flows to Beards Brook and then Mill Pond. Bird droppings on the land can be easily transported by stormwater runoff from the land to the tributary and then Mill Pond.

It is believed that the dairy farm is the major source of waterfowl bacteria although some is also likely due to waterfowl in Mill Pond. It is recommended that measures be taken at the dairy farm to prevent bird droppings from entering tributaries to Mill Pond. One way to accomplish this is by locating the birds further away from the tributaries and providing vegetated buffers between the birds and surface waters. It may also be necessary to periodically collect and properly dispose of the bird droppings in a manner that will prevent stormwater from coming in contact with the droppings.

At Mill Pond, the Town should investigate and implement methods, as necessary, to minimize the number of waterfowl frequenting the pond and surrounding area. If bird droppings are found in the vicinity of the Beach they should be collected and disposed of properly. As previously mentioned, this does not appear to be a significant problem at the moment based on visual observations conducted for this study. However, this could change in the future and the Town should remain vigilant as just a few droppings from waterfowl deposited close to the Beach could cause bacteria violations.

Livestock Management:

Field reconnaissance conducted for this study identified several farms with livestock located relatively close and upstream of Mill Pond and the Beach (see Figure 2 and Figure 3). Others may exist further upstream in the watershed. A general description of the farms is provided below. In all cases it is recommended that the livestock be prevented from directly accessing Mill Pond or any of its tributaries. In addition, manure deposited on the land should be properly managed to minimize contact with stormwater runoff and transport to Mill Pond. Vegetated buffers should also be provided where possible to help filter runoff and reduce bacteria loads before entering surface waters.

The closest farm to the Beach is a small farm located on Purling Beck Road on the south side of Mill Pond and just a few hundred feet upstream from the Beach. One horse was observed at the farm as well as several sheep. The horse has direct access to the pond and was observed standing at its edge on one occasion.

Along the East Washington Road and Ayers Pond Road there are several small farms that keep cows and horses on their land. Bacteria from these farms may be transported to Mill Pond via Woodward Brook and an unnamed tributary to Beards Brook.

Finally, the large commercial dairy farm located approximately one mile upstream of Mill Pond has an assortment of animals including cows, goats, ducks, geese, emus and dogs. Flow from the farm is conveyed by an unnamed tributary which discharges to Beards Brook which then flows to Mill Pond. Piles of uncovered manure have been noticed at the farm. Corn fields and pastures, which likely contain manure, are also located just south of the farm. Many of the animals have direct access to surface waters that flow to Beards Brook.

Pet Management:

Although pets such as dogs were not specifically identified as a source of bacteria by the ribotyping study, they could be part of the 17% of the isolates which could not be identified. For this reason and the fact that pet waste is a relatively simple source to reduce or eliminate, it is recommended that the Town take steps to encourage people to clean up their dog's waste and to dispose of it properly. There are a variety of products available for parks and beaches that dispense plastic bags to dog owners and provide a container for proper disposal of the waste. To help ensure compliance, the Town may want to adopt a "pooper scooper" ordinance and make it mandatory for people to clean up after their pets.

Additional Investigations to Identify Human Sources of Bacteria:

Results from the ribotyping analysis of bacteria samples indicates the presence of human wastewater and human septage which suggests the possible existence of illicit connections and/or failed septic systems either immediately adjacent to the pond or in the upstream watershed. Preliminary field reconnaissance conducted for this study did not reveal any such sources. A sanitary survey should be conducted to determine the presence of any illicit connections or failed septic systems in the watershed. If illicit connections are found they should be eliminated and if failed septic systems are found they should be fixed. NHDES has staff experienced with detecting illicit connections and can provide technical assistance if requested.

6.2 Monitoring

Pending resources, the NHDES Public Beach Inspection Program plans to continue monitoring of the Mill Pond Town Beach in the future. As in the past, NHDES expects to sample the Beach at least twice each summer.

Although NHDES plans to monitor the Beach, local volunteers are encouraged to assist with sampling to obtain data on a more frequent basis. Prior to collecting samples, volunteers should review their sampling protocols with NHDES to ensure the data will be of high quality and useable for assessment decisions. If volunteers are interested in collecting samples, the Town of Washington should be approached to see if they would be willing to pay for laboratory analyses of the *E. coli* samples. In addition, NHDES will work with the volunteers to input their data into the NHDES Environmental Monitoring Databases (EMD). The majority of surface water monitoring data collected by NHDES is in the EMD and all data in the EMD is readily accessible to the public.

7 PUBLIC PARTICIPATION

7.1 Description of Public Participation Process

EPA regulations [40 CFR 130.7 (c) (ii)] require that calculations to establish TMDLs be subject to public review. The following is a description of the public participation process for this TMDL:

On August 16, 2006, a public notice (see Figure 12) announcing the availability of the draft TMDL for public review and comment was posted on the DES website (www.des.state.nh.us/wmb/TMDL/). On this date, nine copies of the draft report and three copies of the public notice were also delivered to Mr. Richard Cook , Selectman for the town of Washington, for distribution. Copies of the report were provided to each of the three Selectmen, the Conservation Commission, the Eckhardt Dairy Farm, the farm next to the pond on Purling Beck Road, and one to the homeowner at the end of Purling Beck Rd who is an abutter to the Eckhardt Dairy Farm. In addition, a copy was kept at the Town Hall, and, because of limited hours of operation at the Town Hall, a copy was also kept at the Town Highway Garage. The public notice was posted at three locations; the public bulletin boards at Town Hall, the Town Grange Hall and the Town Recycling Station. Written public comments were accepted from August 16, 2006 through September 15, 2006 (a period of 31 days).

Figure 12: Public Notice

NEW HAMPSHIRE DEPARTMENT OF
Environmental Services

Date: August 16, 2006
Subject: **PUBLIC NOTICE - Draft Mill Pond Town Beach TMDL Available for Public Comment**

PUBLIC COMMENT PERIOD August 16, 2006 - SEPTEMBER 15, 2006

Dear Interested Party or Stakeholder:

The Draft Total Maximum Daily Load (TMDL) Study for bacteria in the Mill Pond Town Beach in Washington, NH is now available for public review and comment on the New Hampshire Department of Environmental Services website at http://www.des.state.nh.us/wmb/tmdl/draft_tmdl.html. A copy of the report is also available for review at the Washington Town Hall and the Washington Highway Department.

The purpose of the TMDL is to establish allowable pollutant loads that will result in attainment of water quality standards for bacteria in Mill Pond.

Comments will be accepted until 4pm on September 15, 2006. Only written comments will be accepted. All comments must include the name of the TMDL, the date and contact information (your name, address, phone, e-mail, and organization).

Comments can be mailed to:

TMDL Program
NHDES Watershed Management Bureau
29 Hazen Drive, P.O. Box 95
Concord, NH 03301
Attention Margaret P. Foss, TMDL Coordinator

or sent by email to TMDL@des.state.nh.us.

For convenience, a form for submitting comments is available at www.des.state.nh.us/wmb/TMDL/commentform.htm; use of the form is optional.

If you have any questions about the report, please contact Margaret Foss, NHDES TMDL Coordinator at (603) 271-5448 or via email at mfoss@des.state.nh.us.

7.2 NHDES Response to Comments

DES received written comments on the draft report from two residents of the Town. The comments are summarized below. Each comment is followed by the DES response in italics.

1. Comment: Several farms along Ayers Pond Road have livestock (cows and horses) that have access to Woodward Brook, a tributary to Mill Pond. The livestock have been seen standing in Woodward Brook and there is concern that the animals may be contaminating the brook.

While preparing this report, DES was aware of several farms with livestock that had direct access to Mill Pond or its tributaries. Some are pointed out in the figures but it is acknowledged that others may exist. When implementation efforts commence, a more comprehensive assessment of farms in the watershed should be made, including those identified by the Commenter that are adjacent to Woodward Brook. As stated in the report, bacteria loadings to tributaries can have a significant effect on the water quality in the tributaries as well as in Mill Pond. Consequently, as stated in section 6.1, DES recommends that all livestock be prevented from directly accessing Mill Pond or any of its tributaries. In addition, DES recommends that manure deposited on the land should be properly managed to minimize contact with stormwater runoff and transport to Mill Pond and that vegetated buffers should be provided where possible to help filter runoff and reduce bacteria loads before entering surface waters.

2. Comment: There is no mention in the report of a failed septic system on the North side of the Pond which has had chronic septic problems for many years but is believed to have been fixed earlier this year.

DES was not aware of any specific failed septic systems at the time this report was prepared. However, as pointed out in the study, 7 percent of the bacteria isolates came from human sources (wastewater and/or septage) which suggests the possible existence of illicit connections and/or failed septic systems either in the vicinity of the pond or in the watershed. Since 17 percent of the isolates were of unknown origin, the actual amount attributable from humans may be higher than 7 percent. It's possible that some of the human isolates may have originated from the failed septic system mentioned by the Commenter. If this is true, and if the septic system has been fixed, its possible that future bacteria samples will show less bacteria, however violations of the bacteria standards for swimming will still likely occur as the majority of bacteria appears to be from waterfowl and livestock. In light of this comment, Section 6.1 (Additional Investigations to Identify Human Sources of Bacteria) has been reworded to recommend that a sanitary survey be conducted to determine the presence of any illicit connections or failed septic systems in the watershed. If illicit connections are found they should be eliminated and if failed septic systems are found they should be fixed. DES will assist with these efforts as resources permit.

3. Comment: Large flocks of wild geese and ducks, a couple of blue herrings and a pair of otters frequently visit the pond and we don't want the wildlife discouraged from using the pond.

Balancing human and wildlife needs is always a challenge. As stated in section 1.2 of the report, the focus of this study was to identify potential sources of bacteria and to develop a plan

that will hopefully reduce bacteria levels at Mill Pond Town Beach to levels considered acceptable for swimming. Since waterfowl appear to be a significant source of bacteria (40 percent of the isolates were from waterfowl) and since the reductions needed to achieve bacteria standards for swimming are so significant (70 to 85 percent), the report concludes that some degree of waterfowl management will be necessary to achieve the stated goal. However, as indicated in Section 6.1, DES recommends that the initial focus be on managing waterfowl (geese and ducks) located on farms upstream of the Mill Pond Town Beach rather than on management of wild flocks of geese and ducks that occasionally frequent the Pond. Farm waterfowl are easier to manage than wild flocks and are believed to be a significant source of bacteria to the Pond. Consequently, efforts to manage waterfowl bacteria should first focus on the farms rather than wild flocks of geese or ducks. Once bacteria control measures are implemented, the Pond should be resampled for bacteria to determine if standards are met and if additional measures are necessary to meet bacteria standards.

4. Comment: We are very concerned about the proposed housing development on Ayers Pond Road in East Washington. The site for the proposed project is on an eighteen acre parcel of steeply sloping land adjacent to the Woodward Brook on Ayres Pond road. The water shed from this site feeds directly into the Woodward Brook that feeds directly into the north west end of the Center Pond. We hope that DES will give important input and oversight on this proposed development project and its impact on the environment.

DES recognizes that development, if not properly managed, can be a threat to natural ecosystems. To minimize the impact of development on the environment, DES has several permitting programs in place. Examples are provided below. Depending on the specifics of the project, it's possible that the developer for the subject housing development will need to acquire most, if not all, of the permits/certifications mentioned below.

> *Site Specific Permit: The site specific (or alteration of terrain) permit program is intended to protect New Hampshire surface waters by controlling soil erosion and managing stormwater runoff from developed areas. A permit is required whenever a project proposes to disturb more than 100,000 square feet of terrain (50,000 sf if within the protected shoreland). The program applies to both earth moving operations, such as gravel pits, as well as industrial, commercial and residential developments.*
>
> *Wetlands Permit: Any project which results in the dredging or filling of wetlands must obtain a Wetlands Permit from the DES Wetlands Bureau. One objective of the program is no net loss of wetlands.*
>
> *Subsurface Permits: The DES Subsurface Systems Bureau reviews applications for the subdivision of land and the design of individual septic systems. In addition they perform on –site inspections of all septic systems installed in order to ensure strict compliance with the approved plans.*
>
> *Section 401 Water Quality Certifications (WQC). The DES Watershed Management Bureau implements the 401 WQC program. In general all activities that require a federal license or permit require a 401 Water Quality Certification (WQC). The WQC*

covers the construction and operation of the project and can include conditions to ensure that water quality standards are met. If a project involves dredging or filling of wetlands, a 401 WQC is required.

5. Comment: We are also very concerned about preserving the unique and fragile qualities that make East Washington a very special place. We feel that the farming that still goes on in our community is integral to the special qualities of this valley. The pond is a very popular spot for swimming, fishing, boating and just sitting and taking in the beautiful scenery. East Washington is a beautiful example of an old New Hampshire village, with several mill sites, most of the original historic homes and buildings intact and very little new construction to interfere with the historical experience of visiting this site. Our hope is that DES will work with all the farms in East Washington to come up with reasonable means to adjust our farming practices to improve the quality of the watershed from our properties."

DES, in conjunction with the Department of Agriculture, will do their best to work with the Town and local farmers to identify workable solutions that will reduce bacteria in Mill Pond to levels acceptable for swimming while preserving the unique character of the Town.

7.3 Summary of Substantive Changes Made to the Final Report

In addition to the changes noted in section 7.2 as well as minor formatting and grammatical changes, the following substantive changes were made to this report since the draft was issued for public notice.

Section 3.2: The discussion, tables and figures regarding the relationship of bacteria levels to wet and dry conditions were revised slightly. Table 5 was revised to show the dates which were presumed to be wet or dry based on a definition of 0.25 inches of rain on the day of or the previous 24 hours. A sentence was added to the discussion explaining that if the field notes indicated significant rain but the Keene gauge indicated less than 0.25 inches, a value of 0.25 inches was assumed. These changes resulted in minor changes to Figures 9 and 10. The most significant change to Figure 10 was the recommendation to close the beach when rainfall exceeded 0.25 inches as compared to 0.1 inches in the draft report.

Section 6.1: Based on the changes discussed above to Section 3.2, the recommended threshold to close the beach based on rainfall was revised from 0.1 inches in the draft report, to 0.25 inches.

8 REFERENCES

Jones, 2006. Freshwater Beach Total Maximum Daily Load Microbial Source Tracking Study. Dr. Stephen H. Jones. Jackson Estuarine Laboratory Center for Marine Biology, Department of Natural Resources, University of New Hampshire. February 2006.

NHDES, 2005a. 2005 Quality Assurance Project Plan for Three Fresh Water Beach Bacteria TMDL Studies in New Hampshire: Sand Dam Village Pond, Mill Pond, and Pawtuckaway State Park. New Hampshire Department of Environmental Services.

NHDES, 2005b: 2006 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology. November 2005. NHDES-R-WD-05-29. New Hampshire Department of Environmental Services.

9 APPENDICES