

**2017-2019 TRIENNIAL
SHELLFISH MANAGEMENT AREA UPDATE
FOR THE GREAT BAY, NEW HAMPSHIRE**

December 2020

New Hampshire Department of Environmental Services
Water Division
Watershed Management Bureau



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Introduction

The New Hampshire Department of Environmental Services (NHDES), under the authority granted by RSA 143:21 and 143:21-a, is responsible for classifying shellfish growing waters in the State of New Hampshire. The purpose of conducting shellfish water classifications is to determine if growing waters meet standards for human consumption of molluscan shellfish. The primary concern with the safety of shellfish growing waters is contamination from human sewage, which can contain a variety of disease-causing microorganisms. Shellfish pump large quantities of water through their bodies during normal feeding and respiration processes. During this time shellfish also concentrate microorganisms that may include pathogens, and a positive relationship between sewage pollution of shellfish growing areas and disease has been demonstrated many times (ISSC, 2017).

Though testing shellfish growing waters and/or shellfish meats for the pathogenic microorganisms themselves would seem to be the most direct method of determining whether or not growing waters are safe, several factors preclude this approach. Perhaps the most important is that the number of pathogens that may be in sewage is large, and laboratory methods that are practical, reliable and cost-effective are not available for all of the pathogens that may be present. Therefore, shellfish water classifications are based on evidence of human sewage contamination, which may include direct evidence (identification of actual pollution sources) or indirect evidence (elevated or highly variable indicator bacteria levels in the growing waters). If such evidence is found, then pathogens may be present, and the area is closed to harvesting. Areas may also be closed if contamination from animal waste or poisonous/toxic substances is found.

Under the authority granted by RSA 143:21 and 143:21-a, NHDES uses a set of guidelines and standards known as the National Shellfish Sanitation Program (NSSP) for classifying shellfish growing waters. These guidelines were collaboratively developed by state agencies, the commercial shellfish industry, and the federal government in order to provide uniform regulatory standards for the commercial shellfish industry. The NSSP is used by NHDES to classify all growing waters, whether used for commercial or recreational harvesting, because these standards provide a reliable methodology to protect public health. Furthermore, RSA 485-A:8 (V) states that “Those tidal waters used for growing or taking of shellfish for human consumption shall, in addition to the foregoing requirements, be in accordance with the criteria recommended under the National Shellfish Program Manual of Operation, United States Food and Drug Administration.”

The sanitary survey is the process by which the shellfish management areas are accurately classified. The sanitary survey includes an evaluation of the pollution sources that may affect the areas, an evaluation of the meteorological and hydrographic factors that may affect distribution of pollutants throughout the area, and an assessment of water quality. A sanitary survey for the Great Bay was originally published in December 2004 (Nash and Wood, 2004). Every 12 years a new sanitary survey must be completed. Field work for this effort was completed in 2016, and a new sanitary survey was published in 2017 (Nash 2017). The last triennial report for the Great Bay covered the 2011-2013 time period (Nash 2014).

The NSSP requires that in addition to an annual review of the classification of the area, the management area classification and the supporting data from the sanitary survey be reviewed at least every three years. This triennial re-evaluation shall include the following:

- A review of the water quality samples.
- Documentation of any new pollution sources and an evaluation of their effect on the management area.
- Reevaluation of all pollution sources, including the sources previously identified in the sanitary survey, as necessary to fully evaluate any changes in the sanitary conditions of the management area. The reevaluation may or may not include a site visit.
- A comprehensive report which analyzes the sanitary survey data and makes a determination that the existing management area classification is correct or needs to be revised.

If the triennial reevaluation determines that conditions have changed based on the information and data collected during the triennial review and that the management area classification is incorrect, immediate action shall be initiated to reclassify the area. If an emergency condition or situation is identified, then the management area will be immediately placed (within 24 hours) in the closed status.

The NSSP notes that work to complete a triennial reevaluation may include a number of activities, including:

- Inspection of wastewater treatment plants or collection of additional effluent samples to determine their impact on the management area.
- Hydrodynamic studies.
- Additional field work to determine the actual impact of pollution sources.
- Collection of additional water samples.

When a written triennial reevaluation report is not completed, the shellfish management area must be placed in the closed status.

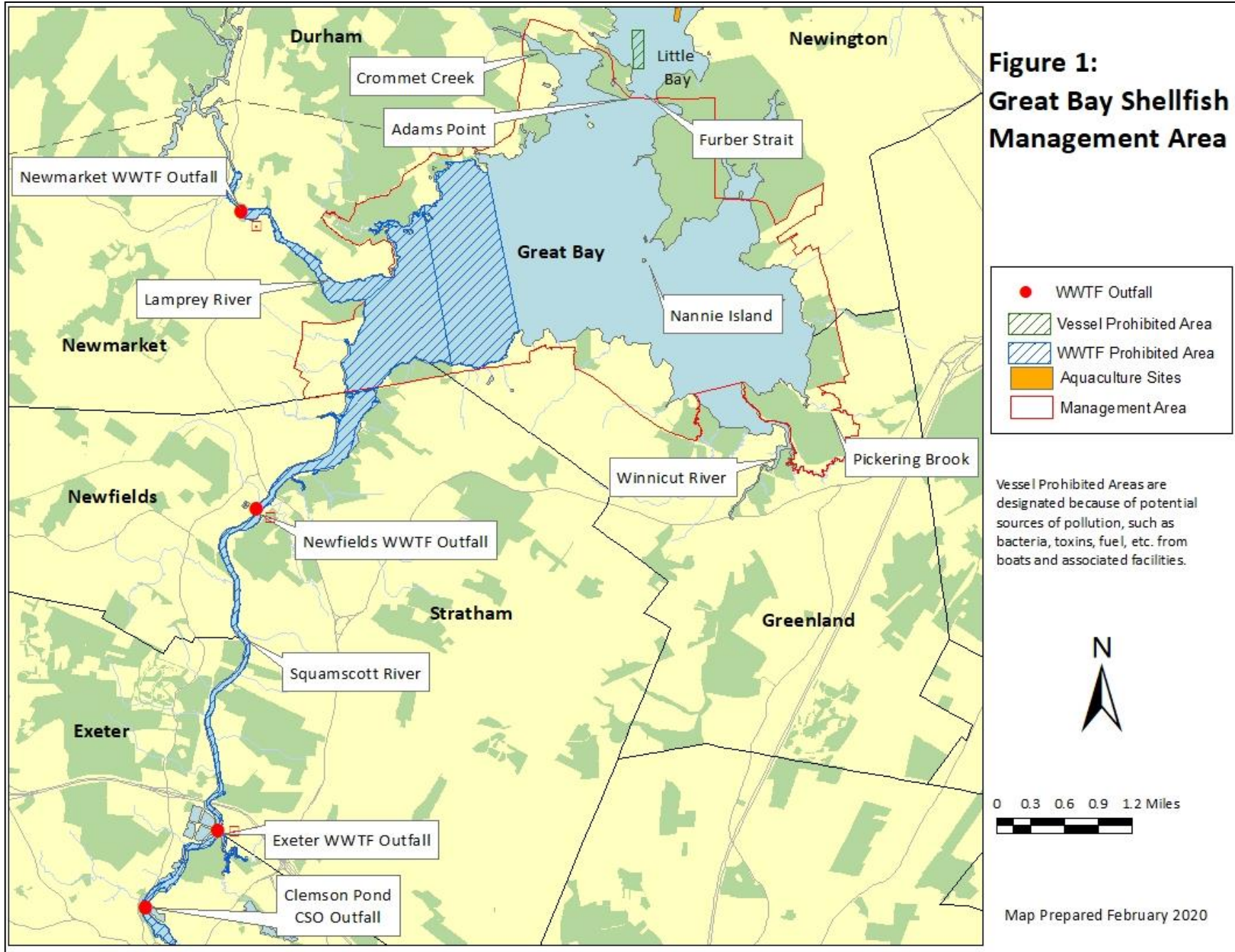
This document presents the data and analyses for the 2017-2019 Great Bay triennial report.

MANAGEMENT AREA

Great Bay, along with Little Bay and the Piscataqua River, are part of the Great Bay Estuary, which is the largest estuary in New Hampshire. The management area includes the waters of Great Bay, which begin just south of Furber Strait near Adams Point in Durham, New Hampshire, and portions of the Squamscott and Lamprey Rivers (Figure 1). Water depths in the Bay are relatively shallow, with deeper channels bordered by mudflats. More than half of Great Bay is exposed as mudflat at low tide. Great Bay has an average depth of 9 feet, with deeper channels of nearly 60 feet in some locations. At Furber Strait, the channel is 40 feet deep nearly the entire width of the strait. The main channel of the Bay stretches northeast from the mouths of the Lamprey and Squamscott Rivers toward Furber Strait. The Great Bay Shellfish Management Area includes approximately 4,339 acres of tidal waters, with approximately 38 miles of tidal shoreline.

Land surrounding Great Bay is lightly developed or undeveloped. Developed areas along the shoreline are primarily large lot, single-family residential, although there are some areas along the southern and southwestern shoreline with relatively higher densities of residential development. Sewage disposal for all developed properties is by septic systems/leach fields. Most of these denser developments, some of which are served by municipal sewer, lie just outside of the management area. Of the 214 properties in the Great Bay Management Area, 42 (20%) are conservation lands. Most of these are part of the Great Bay National Estuarine Reserve system or the Great Bay National Wildlife Sanctuary.

There is little commercial development around Great Bay, and the most prominent commercial property is the Portsmouth Country Club. Much of the eastern and western shorelines are permanently protected from development by the Great Bay National Estuarine Research Reserve or by the Great Bay National Wildlife Refuge. There are several parcels around the Bay that are used for agricultural production of hay, as well as one property operated as a horse riding farm that is not immediately adjacent to growing waters. There are currently no commercial shellfish aquaculture operations in Great Bay, due to restrictions on such commercial activities within the boundaries of the Great Bay National Estuarine Research Reserve.



Follow-up from Recent Reports

The most recent annual update for the Great Bay Management Area presented a number of recommendations to improve the classification of the area. These recommendations were developed from the results of previous recommendations presented in the original sanitary survey and subsequent annual/triennial updates. The italicized text describes how each recommendation has been addressed.

1. The location of the Exeter and Newmarket WWTF Prohibited area boundary should be reevaluated once construction of the new Exeter WWTF is complete. The re-evaluation should begin with a new characterization of pre-disinfection effluent fecal coliform levels, as well as male-specific coliphage concentration in influent, predisinfection effluent and final effluent.

Sampling of effluent from the new wastewater treatment facility in Newmarket, focusing on quantifying fecal coliform concentrations in predisinfection effluent, and quantifying male-specific coliphage concentration in raw influent, predisinfection effluent, and finished effluent, began in 2019. Sampling was conducted on 1/22/19, 2/5/19, 2/20/19, 3/6/19, 3/20/19, 4/1/19, 4/23/19, 6/3/19, 9/30/19 and 11/19/19. Sampling of the new Exeter facility will begin in 2020.

2. In concert with Recommendation #1, consider updating the hydrographic studies of the Exeter and Newmarket WWTFs, using new procedures recommended by the USFDA to delineate the steady state 1,000:1 zone of dilution around the outfalls. The updated hydrographic studies should be done after construction is complete.

Hydrographic studies were not pursued on these facilities in 2019. Effort on hydrographic studies in 2019 were focused on the Pease wastewater treatment facility in Portsmouth.

3. Continue with event-based sampling at the inflow and outflow of Clemson Pond in Exeter to better understand how/if CSO events actually impact water quality in the Squamscott River.

Event-based sampling at the outflow of Clemson Pond was conducted on 2/25/19, following discharge events on 2/21/19 involving diversion of raw sewage from a broken force main (26,750 gallons) plus an additional 20,120 gallons of combined sewer overflow discharge. The same area had a series of more significant discharges on 3/9/19 and 3/10/10, resulting in 700,000 gallons of raw sewage, plus an additional 420,170 gallons of combined sewer overflow discharge. The outflow of Clemson Pond was sampled 3/11/19, along with other sites, to evaluate the potential effect on water quality in Great Bay.

4. As time and resources allow, additional information on water quality impacts to Great Bay should be performed on some of the more significant fecal coliform sources, including the unnamed stream and cove just south of Fabyan Point, Pickering Brook and the Winnicut River. Ambient monitoring on the boundaries of these sources' Restricted areas will continue to confirm the adequacy of existing classifications, but the additional water quality impact information, particularly wet weather information, may reveal opportunities to reduce the size of the existing Restricted areas.

Ambient monitoring on the boundaries of these sources shows mostly low fecal coliform levels. GB84 showed one high fecal coliform sample after a 1.59-inch rainfall event (Great Bay conditional closure threshold is 1.5 inches), and high value later in the year that does not appear related to weather.

4-Day Rain Total (in)	Collection Date	GB4A	GB5	GB7C	GB16	GB81	GB82	GB83	GB84	GB85
0.59	1/9/19	13	1.8		<2					2
0.29	3/19/19	<2	4.5	<2	1.8	<2				1.8
0.00	3/21/19	7.8	<2	<2	<2					2
0.21	4/2/19	2	4.5	<2	<2	<2	2	2	6.1	2
1.59	5/1/19	13	4.5	22	11	6.8	13	17	49	13
1.10	6/10/19	2	2	13	2	23	4.5	4	<2	6.1
1.41	7/15/19	2	<2	33	7.8	<2				4.5
1.52	8/12/19	4.5	1.8	<2	<2	4.5	1.8	4	2	2
0.01	9/10/19	2	4	<2	2	<2	4.5	4.5	11	<2
0.68	10/9/19	2	<2	<2	2	1.8	7.8	7.8	1.8	4.5
0.07	11/6/19		7.8	7.8						4.5
0.78	11/25/19	23			17	7.8	17	14	130	
0.00	12/9/19	7.8	17	6.1	4.5	13	4	4.5	14	17

5. As time and resources allow, conduct water quality studies to assess impacts of rainfall events on Great Bay. These studies should focus on rainfall events in the range of one to two inches. Particular emphasis should be placed on such events in late fall and winter, when fecal coliform levels appear to persist longer than in other seasons.

There were nine rainfall events of 1 inch or more that were sampled in 2019:

Date	4-Day Cumulative Rainfall (inches)	Range of FC/100ml Observed
5/1/19	1.59	6.8 - 49
6/10/19	1.1	2 - 23
7/15/19	1.41	2 - 33
8/9/19	1.52	4.5 - 17
8/12/19	1.52	1.8 - 4.5
10/18/19	1.83	13 - 33
10/21/19	1.83	6.8 - 11
10/24/19	1.56	6.1 - 14
12/16/19	2.98	49 - 170

6. Conduct dry weather sampling at GBPS012, 049, 054, 061 and 062 to update the database. Consider doing wet weather sampling at these locations as well.

Sites GBPS061 and 062 were sampled in dry weather on 5/20/20, and both had FC=2/100ml. Site visits for inspection/sampling on GBPS049 and 054 were made on 7/13/20 in dry weather, but no flow could be located for sampling. All sites are slated for wet weather sampling when the proper sampling conditions occur.

7. After the Portsmouth WWTF upgrade is complete (anticipated 2020), perform work to evaluate its potential for affecting Great Bay water quality, and amend the Conditional Area Management Plan as appropriate.

Construction of the new facility was largely completed in December 2019. The facility will be fully online under its new NPDES permit by April 2020. Sampling of effluent by NHDES personnel is tentatively scheduled to begin April 2020.

Review of Water Quality Samples

Much of western Great Bay is classified as a Prohibited area (safety zone for the Newmarket, Newfields, and Exeter WWTFs). Much of eastern Great Bay is classified as Conditionally Approved with the exception of Restricted areas around the Winnicut River, Pickering Brook, and the cove just south of Fabyan Point. All of Crommet Creek is also classified as Restricted. These areas are sampled by boat for fecal coliform bacteria under the Systematic Random Sampling strategy (Table 2 and Figure 2).

Table 1: Great Bay Ambient Sampling Stations

Site	Latitude	Longitude	General Description	Rationale for Selection
GB4A	43°04'04" N	70°53'12" W	Located on the main channel of Great Bay, between Vols Island and Brackett Point	Document general water quality, possible impact of Exeter, Newfields, and Newmarket WWTFs; sited on Open/Closed line
GB5	43°04'07" N	70°51'48" W	Located just south of Nannie Island	Document general water quality
GB7C	43°05'38" N	70°52'33" W	Mouth of Crommet Creek, just west of Adams Point	Document general water quality, impact of Crommet Creek
GB16	43°03'38" N	70°51'09" W	Located in eastern Great Bay	Document general water quality.
GB81	43°03'59" N	70°53'57" W	In Great Bay, on the Prohibited/Safety zone line proposed by the Newmarket dye study	Document general water quality, possible impact of Exeter, Newfields, and Newmarket WWTFs; sited on proposed new Open/Closed line
GB82	43°03'09" N	70°50'58" W	In Great Bay, on the Restricted/Conditionally Approved line at Winnicut River mouth near Pierce Point	Document general water quality, impact of Winnicut River
GB83	43°03'28" N	70°50'22" W	In Great Bay, on the Restricted/ Conditionally Approved line near mouth of Pickering Brook (vicinity of Pierce Point)	Document general water quality, impact of Pickering Brook
GB84	43°04'02" N	70°50'19" W	In Great Bay, on the Restricted/ Conditionally Approved line near Fabyan Point	Document general water quality, impact of unnamed tributary south of Fabyan Point
GB85	43°05'02"N	70°51'57"W	In Great Bay near red navigational buoy #6	Document general water quality, use in openings and closures of the area when samples indicate that the sanitary quality differs from that of the rest of Great Bay

Per the NSSP guidelines for systematic random sampling, a monitoring schedule was established at the start of the year to ensure sample collection under a variety of environmental (seasonal, tidal, meteorological, etc.) conditions. Runs are scheduled to begin between 7 AM and 10 AM to randomize the tidal stage at which samples are collected. Sampling runs were rescheduled as a result of extenuating circumstances or when conditions were deemed unsafe. During this review period, several sampling runs needed to be rescheduled (Table 2). All samples were analyzed for fecal coliform MPN/100ml (5-tube method) by the New Hampshire Department of Health and Human Services/Public Health Laboratory.

Table 2: Systematic Random Sampling Schedule Modifications

Date Originally Scheduled	Actual Date Sampled	Justification
1/23/17	1/22/17	The run was rescheduled due to forecasted snow.
2/13/17	2/21/17	The run was rescheduled due to snow.
3/13/17	3/6/17	The run was rescheduled due to staff availability (ISSC biotoxin meeting in Washington DC).
5/8/17	5/23/17	The run was rescheduled to accommodate post rainfall sampling in Hampton/Seabrook and in Great Bay Estuary.
8/16/17	8/1/17	The run was rescheduled to accommodate prescheduled Vibrio resubmergence study sampling.
1/16/18	2/20/18	The run was rescheduled due to extensive ice cover.
3/5/18	3/26/18	The run was rescheduled due to ice conditions.
12/5/18	12/11/18	The run was rescheduled due to hazardous sampling conditions (wind and seas).
2/22/19	3/21/19	The run was rescheduled due to snow and ice.

Systematic random and open status samples collected from 2016–2019, and the relevant NSSP statistics are presented in Table 3. All routine monitoring stations, excluding GB83 and GB84, meet the NSSP criteria for Approved waters (geometric means not exceeding 14/100ml and the estimated 90th percentile statistic not exceeding 43/100ml). GB83 and GB84 do not meet NSSP criteria for Approved waters when samples collected during a closed status are included in the statistics (GB83 estimated 90th percentile of 45.7 and GB84 estimated 90th percentile of 58.6). An Approved classification would be inappropriate because all Great Bay ambient sites can be adversely affected by conditions such as heavy rainfall, poor wastewater treatment facility performance, and others. Thus, the highest classification that Great Bay can have is Conditionally Approved. When the conditions specified in the Great Bay Conditional Area Management Plan are applied to the data (i.e., exclusion of samples collected during times when the area was in the closed status), the routine monitoring stations meet NSSP criteria for Approved waters. This is discussed in greater detail in the “Conditional Area Data Review” section of this report.

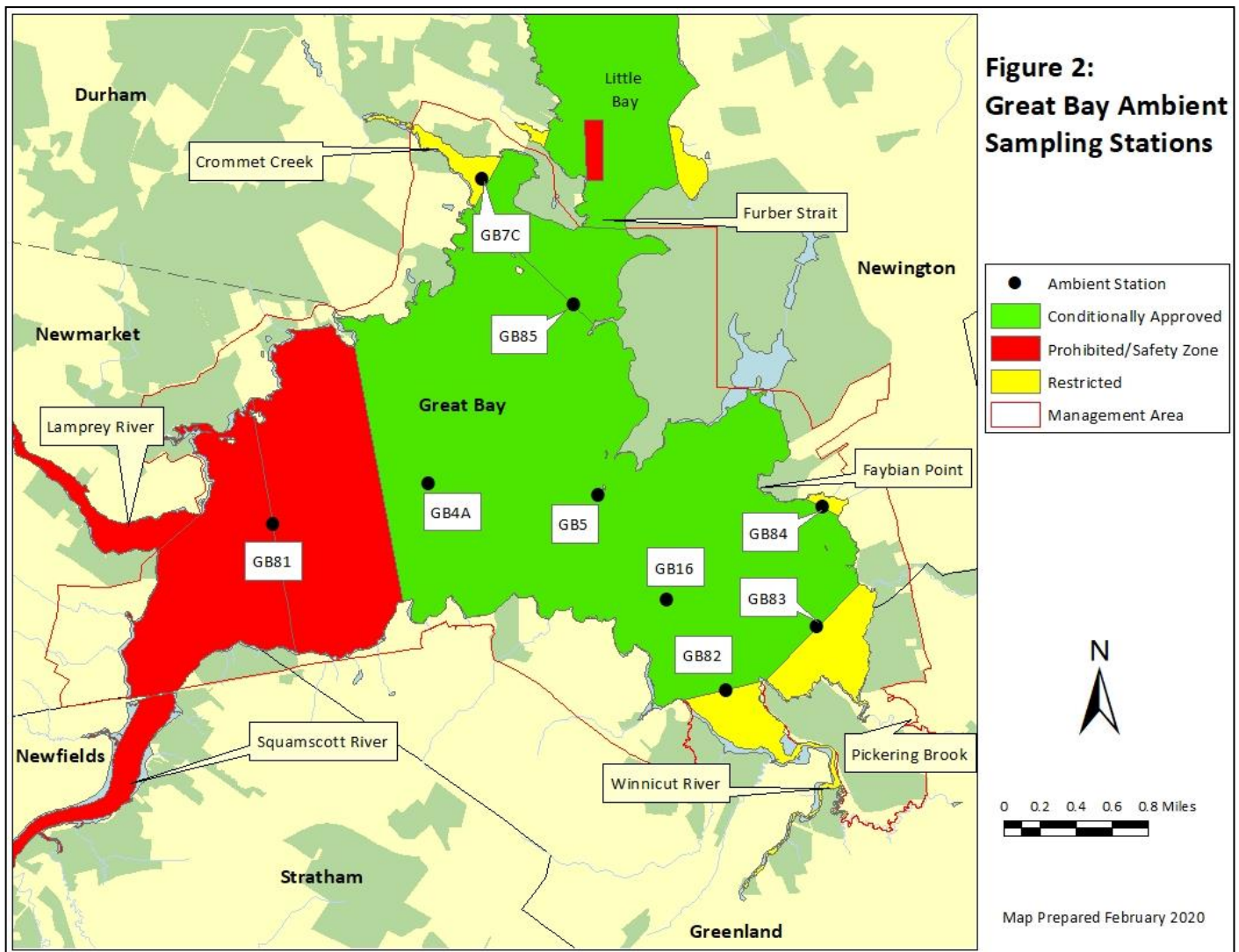


Table 3: 2016-2019 Fecal Coliform (per 100ml) Samples for Great Bay Sampling Stations

Fecal coliform (MPN/100ml) data for samples collected under the Systematic Random Sampling program. Samples over 43 MPN/100ml are in bold font. Samples collected during the Closed status are shaded.

4-Day Rain Total (in)	Collection Date	GB4A	GB5	GB7C	GB16	GB81	GB82	GB83	GB84	GB85
0	1/6/16	11	2							4.5
0	2/2/16	7.8	7.8	7.8	4.5	11				7.8
0	2/22/16	<2	<2		<2	2				<2
0	3/9/16	23	2	4.5	9.3	13	2	<2	4.5	11
0.31	4/6/16	6.8	4.5	<2	4	7.8	2	2	4.5	2
0.17	5/17/16	<2	2	<2	7.8	2	2	13	7.8	2
0.09	6/13/16	2	<2	<2	<2	2	2	2		<2
0.73	7/13/16	2	<2	<2	2	4.5	<2	<2	<2	4.5
0.62	8/17/16	23	13		2	13				2
0.23	9/12/16	2	2	2	2	2	2	13	4.5	2
1.28	10/10/16	2	<2	2	7.8	2	4.5	70	4.5	6.8
0	11/14/16	1.8	<2	2	<2	<2	<2	6.8	1.8	7.8
0.00	12/8/16	23	4	11	2	4.5	6.8	9.2	7.8	4.5
0.00	1/22/17	<2	2	<2	7.8	17	4.5	<2	2	7.8
0.00	2/21/17**			1.8						<2
0.00	3/6/17**									
0.00	4/3/17	4.5	79	2	11	6.8				17
0.34	5/23/17*	9.2	7.8	4.5	2	9.2	7.8	6.8	13	4.5
1.25	6/7/17	17	130	70	33	130	49	130	170	21
0.00	7/5/17	4.5	<2	2	<2	<2	<2	<2	<2	2
0.00	8/1/17	2	2	<2	<2	<2	2	<2	<2	<2
0.19	9/19/17	21	23	22	13	23	49	13	7.8	13
0.00	10/17/17	2	2	4.5	4.5	<2	4	33	49	2
2.42	11/1/17	79	70	350	140	130	49	350	920	46
0.15	11/15/17	6.8	4.5	7.8	<2	79	2	7.8	2	4.5
0.07	12/4/17	13	11	2	4	4.5	4.5	14	14	11
0.87	2/14/18	13	4.5		13					4
0.96	2/20/18	<2	<2	<2	<2					<2
0	3/26/18	2	<2	2	<2	<2	2	<2	<2	<2
0.09	4/2/18	13	4.5	<2	4.5	2	<2	4.5	<2	2
0.32	5/7/18	2	4.5	7.8	2	17	3.7	4.5	17	4.5
0	6/12/18	<2	2	2	2	<2	2	7.8	2	2
0.05	7/10/18	<2	<2	6.8	<2	4.5	2	<2	<2	<2
1.91	8/7/18	14	14	13	7.8	33	6.8	7.8	7.8	13
0.85	8/23/18	22	7.8	70	7.8	13	49	79	33	7.8
0	9/4/18	<2	13	4.5	7.8	6.8	4.5	4.5	7.8	4

0.74	10/3/18*	49	11	23	13	49	11	17	23	6.8
2.33	11/5/18	79	140	170	350	79	170	110	79	350
0	12/11/18*	6.8	4.5							7.8
0.46	12/19/2018	7.8	11							2
0.59	1/9/19	13	1.8		<2					2
0.29	3/19/2019*	<2	4.5	<2	1.8	<2				1.8
0.00	3/21/19	7.8	<2	<2	<2					2
0.21	4/2/19	2	4.5	<2	<2	<2	2	2	6.1	2
1.59	5/1/19	13	4.5	22	11	6.8	13	17	49	13
1.10	6/10/19	2	2	13	2	23	4.5	4	<2	6.1
1.41	7/15/19	2	<2	33	7.8	<2				4.5
1.52	8/12/19	4.5	1.8	<2	<2	4.5	1.8	4	2	2
0.01	9/10/19	2	4	<2	2	<2	4.5	4.5	11	<2
0.68	10/9/19	2	<2	<2	2	1.8	7.8	7.8	1.8	4.5
0.07	11/6/19		7.8	7.8						4.5
0.78	11/25/19	23			17	7.8	17	14	130	
0.00	12/9/19	7.8	17	6.1	4.5	13	4	4.5	14	17
	Count	50	50	43	47	43	37	37	36	51
	Geomean	5.8	4.9	5.5	4.6	6.7	5.1	8.2	8.2	4.8
	Est 90th	24.1	21.6	30.7	19.8	34.6	23.5	45.7	58.6	17.4
	Water Quality	A	A	A	A	A	A	R	R	A
	Classification	CA	CA	R	CA	P	R	R	R	CA

*per NSSP, two runs used to reopen a closed area may be used for stats annually.

**extensive ice cover

Statistics for the ambient sampling sites are calculated on an annual basis and are published in Annual Shellfish Management Area Updates. Table 4 presents these annual statistics for the Great Bay ambient station samples collected during Open Status only, and Table 5 presents the annual statistics for samples collected during the Open and Closed status.

Table 4: Summary of the Ambient Sampling Stations Yearly Statistics (Open Status Only)

Year	GB4A	GB5	GB7C	GB16	GB81	GB82	GB83	GB84	GB85
Geometric Mean									
2017	4.5	3.6	3.4	3.4	5.2	4.6	7.0	5.5	4.0
2018	4.8	4.0	3.7	3.5	5.4	4.3	7.4	5.4	4.0
2019	5.2	4.3	4.3	3.7	5.9	4.2	6.9	6.5	4.1
Estimated 90 th Percentile									
2017	14.6	12.7	9.2	8.7	21.5	15.5	34.7	19.6	10.7
2018	17.2	13.9	12.7	8.9	24.5	14.7	33.5	21.7	10.0
2019	18.4	15.1	16.5	10.3	27.0	14.6	29.0	33.8	10.6

Table 5: Summary of the Ambient Sampling Stations Yearly Statistics (Open and Closed Status)

Statistics highlighted in gray shading indicate exceedance of NSSP bacteriological criteria for approved waters.

Year	GB4A	GB5	GB7C	GB16	GB81	GB82	GB83	GB84	GB85
Geometric Mean									
2017	4.8	3.8	3.8	3.6	5.6	4.7	7.4	6.4	4.2
2018	5.4	4.6	4.7	4.3	6.1	5.2	8.6	6.7	4.5
2019	5.8	4.9	5.5	4.6	6.7	5.1	8.2	8.2	4.8
Estimated 90 th Percentile									
2017	17.4	14.9	14.8	11.5	25.3	17.2	43.2	32.9	12.2
2018	22.7	20.5	25.8	18.1	31.8	23.1	50.4	40.3	16.4
2019	24.1	21.6	30.7	19.8	34.6	23.5	45.7	58.6	17.4

Table 4 indicates that sites GB82, GB83 and GB85 exhibit relatively stable or improving water quality over the three-year period. All other ambient stations exhibit slightly worsening water quality over the triennial period, but statistics remain such that Great Bay can remain in a Conditionally Approved status. Site GB83, which is near the outlet of Pickering Brook, shows rather high variability. Site GB84 shows an increasing trend in variability, indicating that there may have been intermittent and unfavorable changes in water quality in that part of the Bay. Monitoring of these ambient sites and nearby pollution sources that may have a significant impact on these areas will continue.

Documentation and Evaluation of New Pollution Sources

Land Use Changes

During the 2017-2019 field seasons, NHDES Shellfish Program staff noted land use changes in the Great Bay Shellfish Management Area during both routine field work and annual drive-through surveys. In addition to the field investigations, NHDES staff examined the NHDES Wetlands and Subsurface Permit databases to find if any permits were given in the last three years to properties within the Great Bay Shellfish Management Area.

The drive-through surveys and permit database queries identified many property modifications (Table 6), none of which are anticipated to adversely affect water quality in the Atlantic Coast shellfish growing waters.

Table 6: Great Bay Management Area Property Modifications

TOWN	TAX MAP	TAX LOT	DESCRIPTION
Greenland	R-21	15	(2017): 80 Country Club Lane. Impact 9,022 sq. ft. of protected shoreland to regrade area and expand existing pond. No pollution sources previously identified by NHDES Shellfish on the property.
Greenland	R-14	14	(2017): 22 Bracketts Point Road. Permanently impact 546 square feet (sq. ft.) of estuarine and marine wetlands and 47 sq. ft. to the previously-developed 100-foot tidal buffer zone for the construction of a docking structure to include a 4 ft x 4 ft wooden landing, a 3 ft x 20 ft accessway, a 4 ft x 40 ft fixed wooden pier, a 3 ft x 40 ft aluminum ramp leading to a 10 ft x 24 ft float (overall structure length 128 ft) providing one (1) slip on approximately 2,640 ft of frontage along Great Bay. No pollution sources previously identified by NHDES Shellfish on the property.
Greenland	R13	13	(2017): 21 Strongs Landing. Temporarily impact approximately 105 square feet of previously-developed 100-foot tidal buffer zone to bury the existing over-head utility lines for a residential dwelling on Great Bay. No pollution sources previously identified by NHDES Shellfish on the property.
Greenland	R13	13	(2017): 21 Strongs Landing. Impact 836 square feet of protected shoreland in order to replace an existing deck in kind with new footings. No pollution sources previously identified by NHDES Shellfish on the property.
Greenland	R13	13	(2017): 21 Strongs Landing. Follow-up application in response to condition #4 in Emergency Authorization file 2017-01219. Impacted 61 square feet (SF) of protected shoreland in order for the burial of new underground electrical/cable/telephone utility lines servicing the existing residential structure. No pollution sources previously identified by NHDES Shellfish on the property.

Newington	50	2	(2017): 170 Fabyan Point Road. Construct a tidal docking structure consisting of a 6' x 20' permanent pier with batter piles, connecting to a 3' x 30' gangway, connecting to a 10' x 20' float, with float stops; overall structure length seaward of highest observable tide line 58', providing one slip on 180' of frontage on Great Bay. No pollution sources previously identified by NHDES Shellfish on the property.
Newington	----	----	(2017): Great Bay Estuary. Restore a degraded natural oyster reef at Nannie Island in Great Bay. Deploy a maximum of 500 cubic yards of shell as base layer, add live spat to base, working in one 5-acre area at Adam Point. Areas of live oysters and eelgrass will be avoided and shell will be placed in a thin veneer near the edges of the 2 habitats. No pollution sources previously identified by NHDES Shellfish on the property.
Newmarket	R1	27	(2017): 2 Lookout Place. Impact 2,280 square feet (SF) of protected shoreland in order to construct a new septic system leach bed, tank and lines and remove a shed. No pollution sources previously identified by NHDES Shellfish on the property.
Newmarket	R2	6	(2017): 131 Cushing Road. Impact 494 square feet of protected shoreland in order to remove the upper rear deck and install a 20 foot x 20 foot addition with a walkout basement. No pollution sources previously identified by NHDES Shellfish on the property.
Newmarket	R1	27	(2017): Lot 27 Lookout Place. Subsurface construction approval for septic system (2 bedrooms, 300 GPD) issued on 4/14/2017. No operational approval listed. No pollution sources previously identified by NHDES Shellfish on the property.
Greenland	R17	13-C	(2017): 26 Palm Drive. Subsurface construction approval for septic system (4 bedrooms, 600 GPD) issued on 06/16/2017. No operational approval listed. One pollution sources on this property (3-foot-wide concrete culvert).
Durham	20	3-2	(2018): 573 and 575 Bay Road. Subsurface subdivision approval for a septic system (1050 gpd) issued on 12/18/2018. No operational approval listed. Two pollution sources on property; an active foundation drain pipe (GBPS092) and an active PVC pipe (GBPS009).
Newmarket	R1	25	(2018): 7 Bayview Drive. Subsurface construction approval for a septic system (300 gpd) issued on 07/16/2018. No operational approval listed. No pollution sources on property.
Greenland	R14	32	(2018): 22 Osprey Cove. Shoreland PBN (Shoreland PBN accepted): Impact 1,560 square feet (ft) of protected shoreland in order to install stormwater improvements of existing home. One pollution source: intermittent stream running along eastern edge of property (GBPS094)
Greenland	R-13	8	(2018): 90 Depot Rd. Shoreland application (approved): Amend permit to read: Impact 20,565 square feet (SF) of protected shoreland in order to expand an existing residence

			with an addition, replacement garage, gravel pad and patio. No pollution sources previously identified by NHDES Shellfish on the property.
Newmarket	R1	25	(2018): 7 Bayview Dr. Shoreland application (approved): Impact 11,400 square feet (SF) of protected shoreland in order to construct a primary structure, septic system, and driveway. No pollution sources previously identified by NHDES Shellfish on the property.
Newmarket	R-2	36-4	(2018): 0 Cushing Rd. Standard dredge and fill application (approved): Impact a total of 7,437 square feet of tidal wetland and upland tidal buffer zone to stabilize 180 linear feet along an eroding shoreline with riprap slope protection and vegetated coir logs. Impacts include 4,943 square feet of temporary disturbance to the previously-developed upland tidal buffer zone for construction access and staging; 2,295 square feet of permanent impact to the previously-developed upland tidal buffer zone for installation of stone and vegetated coir logs; and 199 square feet of permanent impact seaward of the highest observable tide line for boulder toe-protection. One pollution source: 15 inch metal pipe outlet from man-made pond (GBPS034).
Newmarket	R-3	42A	(2018): 133 New Rd. Shoreland application (approved): Impact 12,397 square feet (SF) of protected shoreland in order to install a concrete pad for a solar array, underground electrical line, and construct a garage and gravel driveway. No pollution sources previously identified by NHDES Shellfish on the property.
Newmarket	R2	28-1/36/18	(2019): Bay Road. Expedited minimum (permit approved): Impact 527 square feet within the bed and banks of the tidal portion of Lubberland Creek to remove an abandoned farm crossing to eliminate a tidal stream restriction and to restore stream connectivity within Lubberland Creek and its associated 55-acre salt marsh. In addition, 316 square feet of salt marsh will be temporarily impacted for access. No pollution sources previously identified by NHDES Shellfish on the property.
Greenland	R14	4	(2019): 19 Birch Point. Standard dredge and fill application (more information received): **Pursuant to RSA 482-A:3, XIV. (a)(3), the applicant has requested an extension to 3/6/20 to respond to the Request for More Information.** Demolish a portion of the existing single family home and construct a building addition on the remaining portion of the home within the 100' tidal buffer zone. Stabilize an eroding slope along the Great Bay by constructing a boulder retaining wall to match what already exists on other portions of the property. The existing staircase and concrete patio adjacent to the proposed retaining wall will also be replaced. No pollution sources previously identified by NHDES Shellfish on the property.

Greenland	R-13	8	(2019): 90 Depot Road. Standard dredge and fill application (permit approved): Impact 1,475 square feet within the previously-developed 100-foot tidal buffer zone to place clean fill and regrade an area maintained as lawn. No pollution sources previously identified by NHDES Shellfish on the property.
Durham	20	3-2	(2019): 573 and 575 Bay Road. Standard dredge and fill application (permit approved): Temporarily impact 200 square feet within the previously developed upland tidal buffer zone to install a pump chamber and force main as part of an overall replacement of a residential septic system. Two pollution sources: 8 inch blue PVC in stone riprap (GBPS009) and a 6 inch pipe/foundation drain (GBPS092).
Durham	20	3-2	(2019): 573 and 575 Bay Road. Shoreland standard (permit approved): Impact 1,947 square feet of protected shoreland in order to replace and expand an existing septic system. Two pollution sources: 8 inch blue PVC in stone riprap (GBPS009) and a 6 inch pipe/foundation drain (GBPS092).

Re-Evaluation of Existing Pollution Sources

Exeter Wastewater Treatment Facility

The Town of Exeter nearly completed construction of a new wastewater treatment facility in 2019. Although construction will not be fully completed until 2020, the new 3.0 mgd facility (6.6 mgd peak flow) went online in summer 2019. The new WWTF utilizes an advanced activated sludge system (4-stage Bardenpho) that will substantially reduce effluent nitrogen, TSS, and BOD as compared to the old 3.0 mgd lagoon system. The disinfection system has been changed from chlorine to ultraviolet light. A significant change to the overall infrastructure is construction of a larger pump station with two larger force mains (capacity of 11 million gallons). The increased conveyance capacity is expected to reduce the frequency and volume of CSO discharges to Clemson Pond. The facility continues to discharge to the Squamscott River through a 40-foot diffuser with eight ports. CORMIX modeling by NHDES Wastewater Engineering Bureau determined a dilution factor of 25.2:1 for this multiport diffuser (H. Franz, personal communication). Cost of the new facility was \$53.5 million, including infrastructure upgrades.

The Exeter WWTF has a design flow of 3.0 mgd, and its Monthly Operations Reports (MORs) show that average monthly flows ranged as follows:

2017: 0.4 – 5.0 mgd
2018: 0.5 – 4.9 mgd
2019: 0.5 – 3.0 mgd

The most recent NPDES permit for the Exeter WWTF (NH0100871) expired March 2017. The facility is awaiting a new permit and expects issuance from EPA in 2020. The most recent compliance inspection report by the NHDES Wastewater Engineering Bureau (March 2019) shows no significant deficiencies regarding effluent bacteria concentrations, plant flow levels, or operation of the disinfection system.

A joint DES/U.S. Environmental Protection Agency (EPA) dye/dilution study of the Exeter wastewater treatment facility effluent's impact on the Squamscott River was conducted in April 2000 (Nash and Bridges, March 2004). The study simulated a hypothetical disinfection system failure at the plant and recommended boundaries for a Prohibited/Safety Zone and an adjacent Conditionally Approved area, using assumptions of WWTF flow of 2.6 mgd during injection (daily flow of 3.7 mgd for the day of study), effluent bacteria concentration of 300,000 FC/100ml, a four to six-hour plant failure notification time, and a worst-case scenario of a discharge beginning 1-1.5 hours prior to slack high tide. At four to five hours after injection, a leading edge was observed between the Rt. 108 crossing and the railroad bridge adjacent to Great Bay. In the following hour, the dye moved farther into Great Bay, near the mouth of the Lamprey River, although by this time the tidal stage had dropped such that all dye was confined in the channel, thus preventing dye migration onto adjacent flats. This study suggested that the southwest corner of Great Bay, near the mouth of the Squamscott River, could exhibit high bacteria levels within four to five hours of a WWTF failure occurring at slack high tide. The area affected within this time frame, including all of the Squamscott River to the head-of-tide dam, was classified as Prohibited/Safety Zone.

The National Shellfish Sanitation Program (ISSC, 2017) recommends that a Prohibited area around a WWTF outfall, for plants using chlorine disinfection, provide a minimum 1000:1 steady-state dilution to protect against viral contamination. Less dilution is permissible when WWTF viral removal efficiency is demonstrated. Data to examine the viral removal efficiency of the new Exeter facility will be collected starting in 2020. Although a hydrographic dye study for the Exeter facility was conducted in 2000, that

study utilized a slug injection of dye. New procedures recommended under the NSSP call for a 12.4 hour injection of dye, with mobile and fixed-station dye measurements over multiple days, in order to estimate steady-state dilution at various distances from the outfall. Such a study should be pursued for the Exeter facility, as time and available resources allow.

Table 7: Summary of Exeter WWTF Exceeding Reporting Thresholds for Bacteria and Effluent Flow, 2017-2019

Date	Parameter	Facility	Reporting Limit	Result	NHDES Response
2017					
4/3/17	Flow	Exeter	3 mgd	5 mgd	Determined no significant impact to harvest area per previous dye studies and available data.
8/18/17	Fecal Coliform	Exeter	43/100ml	92/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
2018					
4/17/18 - 4/19/18	Flow	Exeter	3 mgd	3.6 - 4.6 mgd	Determined no significant impact to harvest area per previous dye studies and available data.
9/19/18 – 9/20/18	Flow	Exeter	3 mgd	3.5 – 3.9 mgd	Determined no significant impact to harvest area per previous dye studies and available data.
11/7/18 – 11/21/18	Flow	Exeter	3 mgd	3.1 – 4.0 mgd	Determined no significant impact to harvest area per previous dye studies and available data.
11/28/18 – 12/5/18	Flow	Exeter	3 mgd	3.2 – 4.9 mgd	Determined no significant impact to harvest area per previous dye studies and available data.
7/28/18 – 7/29/18	Fecal Coliform	Exeter	43/100ml	82/100ml, 111/100ml	Determined sufficient dilution within outfall Prohibited zone.
8/3/18	Fecal Coliform	Exeter	43/100ml	58/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
8/12/18	Fecal Coliform	Exeter	43/100ml	48/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.

Date	Parameter	Facility	Reporting Limit	Result	NHDES Response
2019					
12/14/19	Flow	Exeter	3 mgd	4.2-5.3 mgd	Determined no significant impact to harvest area per previous dye studies and available data.
7/9/19	Fecal Coliform	Exeter	43/100ml	44/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
9/17/17	Fecal Coliform	Exeter	43/100ml	47/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.

Newfields Wastewater Treatment Facility

The Newfields Municipal Wastewater Treatment Facility (NPDES No. NH0101192) provides secondary treatment to wastewater from residents and businesses to a portion of the Town of Newfields. The treatment plant is designed for a flow of 0.12 MGD, and typically receives 0.045 mgd. Treated sewage is retained at the facility and batch-released at periodic intervals by the operator, 3-5 days per week depending on flow conditions. Chlorine is used for effluent disinfection. The outfall is located in the Squamscott River, just upstream of the Route 108 bridge. CORMIX modeling of dilution at the outfall, using the facility's design flow, indicates a dilution of >100:1. Because NHDES policy only allows for mixing zones with dilution of up to 100:1, a dilution of 100:1 is assumed for NPDES permitting (H. Franz, personal communication).

The most recent NPDES permit became effective on March 1, 2007 and expired on February 29, 2012. An application for renewal of the permit was received by EPA and is still under review. The most recent compliance inspection report by the NHDES Wastewater Engineering Bureau (December 2017) shows no significant deficiencies in regards to effluent bacteria concentrations, plant flow levels, or operation of the disinfection system. Review of the facility's Monthly Operations Reports shows the facility routinely achieves suitable disinfection (Table 8). Plant flows are not included in Table 8 because they do not show typical flow pattern during treatment, but rather, show flow values during periodic decants of treated/stored effluent.

A simple dye study/slug release of Rhodamine Wt was performed in May 2001 to develop information on available dilution around the outfall in the Squamscott River. The Newfields facility has such low flow in comparison to Exeter, that performance standards for the Great Bay Conditional Area Management Plan are not developed for this facility. The Prohibited/Safety Zone established for Exeter and for Newmarket WWTF is more than adequate to dilute any issues emanating from the Newfields WWTF.

Table 8: Summary of Newfields WWTF Exceeding Reporting Thresholds for Bacteria and Effluent Flow, 2017-2019

Date	Parameter	Facility	Reporting Limit	Result	NHDES Response
2017					
2/21/17	Fecal Coliform	Newfields	43/100ml	290.9/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
8/23/17	Fecal Coliform	Newfields	43/100ml	46.4/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
2018					
No exceedences of flow or fecal coliform reporting thresholds in 2018					
2019					
10/8/19	Fecal Coliform	Newfields	43/100ml	298.7 100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.

Newmarket Wastewater Treatment Facility

The Newmarket WWTF finished construction of a new facility in 2017. It has a similar flow design (0.85 mgd) as the old facility, but utilizes a four-stage Bardenpho treatment process (advanced activated sludge, to achieve nitrogen removal). Chlorine is still used for effluent disinfection, and the existing multiport diffuser outfall in the Lamprey River is still in use. The 65.6-foot long diffuser was constructed in 2002. It has 20 “T” shaped risers, each with two ports, for a total of 40 ports. CORMIX modelling, using the 0.85 mgd design flow, indicates a dilution factor of 55:1 (H. Franz, personal communication).

The Newmarket WWTF has a design flow of 0.85 mgd, and its Monthly Operations Reports (MORs) show that average monthly flows ranged as follows:

2017: 0.143 – 1.503 mgd
 2018: 0.185 – 2.203 mgd
 2019: 0.177 – 1.758 mgd

The most recent Newmarket WWTF NPDES permit (NH0100196) was signed by the U.S. Environmental Protection Agency on November 16, 2012, and became effective on the first day of the calendar month immediately following sixty days after signature. The most recent compliance inspection report by the DES Wastewater Engineering Bureau (April 2019) shows no significant deficiencies in regards to effluent bacteria concentrations, plant flow levels, or operation of the disinfection system. The inspection report does note repeat deficiencies regarding enterococci violations in five months of 2019, and a fecal coliform violation in one month of 2019 (September). The NPDES permit stipulates that not more than 10 percent of the daily fecal coliform samples can exceed a value of 43/100ml, but that 10 percent value was exceeded in September 2019. WWTF responded by cleaning the chlorine contact tank, increasing chlorine dosage, optimizing treatment processes.

A joint NHDES/EPA dye/dilution study of the Newmarket wastewater treatment facility effluent’s impact on the Lamprey River and Great Bay was conducted in November 2003, and again in April 2004 (Nash and Bridges, August 2004). The study simulated a hypothetical disinfection system failure at the plant and recommended boundaries for a Prohibited/Safety Zone, using assumptions of WWTF flow of 0.71 mgd during injection (daily flow of 1.16 mgd for the day of the study), effluent bacteria concentration of 500,000 FC/100ml, a four to six-hour plant failure notification time, and a worst-case scenario of a discharge beginning 1-1.5 hours prior to slack high tide. At four to five hours after injection, a leading edge developed, with somewhat diffuse concentrations in the channel of Great Bay and a well-defined and concentrated plume located at the mouth of the Lamprey River. At that point in time, the tide was at mid-ebb and tidal currents at their maximum. No significant dye concentrations were observed over the mudflats to the south, which were beginning to become exposed as the tide was falling. The study suggested that the southwest corner of Great Bay, near the mouth of the Lamprey River, could exhibit high bacteria levels within four to five hours of a WWTF failure occurring at slack high tide. The area affected within this time frame, including all of the Lamprey River to the head-of-tide dam, was classified as Prohibited/Safety Zone.

Table 9: Summary of Newmarket WWTF Exceeding Reporting Thresholds for Bacteria and Effluent Flow, 2017-2019

Date	Parameter	Facility	Reporting Limit	Result	NHDES Response
2017					
2/25/17	Flow	Newmarket	1 mgd	1.139 mgd	Determined no significant impact to harvest area per previous dye studies and available data.
4/3/17	Flow	Newmarket	1 mgd	1.133 mgd	Determined no significant impact to harvest area per previous dye studies and available data.
5/30/17	Fecal Coliform	Newmarket	43/100ml	51	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
7/1/17	Fecal Coliform	Newmarket	43/100ml	110	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
7/30/17	Fecal Coliform	Newmarket	43/100ml	66	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
9/30/17	Fecal Coliform	Newmarket	43/100ml	224	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
10/13/17	Fecal Coliform	Newmarket	43/100ml	116	Determined sufficient dilution within outfall

Date	Parameter	Facility	Reporting Limit	Result	NHDES Response
					Prohibited zone, and event lasted one day.
10/24/17	Fecal Coliform	Newmarket	43/100ml	60	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
2018					
4/17/18	Flow	Newmarket	1 mgd	1.051 mgd	Determined no significant impact to harvest area per previous dye studies and available data.
9/18/18	Flow	Newmarket	1 mgd	1.151	Determined no significant impact to harvest area per previous dye studies and available data.
11/3/18	Flow	Newmarket	1 mgd	1.28	Determined no significant impact to harvest area per previous dye studies and available data.
11/13/18	Flow	Newmarket	1 mgd	1.109	Determined no significant impact to harvest area per previous dye studies and available data.
11/27/18 – 11/29/18	Flow	Newmarket	1 mgd	1.009-2.203	Determined no significant impact to harvest area per previous dye studies and available data.
1/3/18	Fecal Coliform	Newmarket	43/100ml	96/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
3/8/18	Fecal Coliform	Newmarket	43/100ml	2320/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
5/1/18	Fecal Coliform	Newmarket	43/100ml	305/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
6/18/18 – 6/20/18	Fecal Coliform	Newmarket	43/100ml	44 – 96/100ml	Determined sufficient dilution within outfall Prohibited zone, and it was a two day event.
7/16/18	Fecal Coliform	Newmarket	43/100ml	58/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.

Date	Parameter	Facility	Reporting Limit	Result	NHDES Response
7/22/18	Fecal Coliform	Newmarket	43/100ml	210/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
8/2/18, 8/4/18	Fecal Coliform	Newmarket	43/100ml	44/100ml, 640/100ml	Determined sufficient dilution within outfall Prohibited zone, and it was a two day event
8/8/18	Fecal Coliform	Newmarket	43/100ml	56/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
8/11/18	Fecal Coliform	Newmarket	43/100ml	46/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
8/16/18 – 8/17/18	Fecal Coliform	Newmarket	43/100ml	52-53/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted two days.
8/29/18	Fecal Coliform	Newmarket	43/100ml	48/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
9/3/18	Fecal Coliform	Newmarket	43/100ml	54/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
9/22/18	Fecal Coliform	Newmarket	43/100ml	78/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
10/12/18	Fecal Coliform	Newmarket	43/100ml	1185/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
10/16/18, 10/18/18	Fecal Coliform	Newmarket	43/100ml	56/100ml, 51/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted two days.
11/7/18	Fecal Coliform	Newmarket	43/100ml	54/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
11/29/18 – 11/30/18	Fecal Coliform	Newmarket	43/100ml	180/100ml, 102/100ml	Determined sufficient dilution within outfall Prohibited zone, and it was a two day event.
12/3/18	Fecal Coliform	Newmarket	43/100ml	1720/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.

Date	Parameter	Facility	Reporting Limit	Result	NHDES Response
12/13/18	Fecal Coliform	Newmarket	43/100ml	66/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
12/19/18, 12/21/19	Fecal Coliform	Newmarket	43/100ml	200/100ml, 154/100ml	Determined sufficient dilution within outfall Prohibited zone, and event involved two days.
2019					
12/14/19	Flow	Newmarket	1 mgd	1.75 mgd	Determined no significant impact to harvest area per previous dye studies and available data.
1/2/19	Fecal Coliform	Newmarket	43/100ml	354/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
7/23/19	Fecal Coliform	Newmarket	43/100ml	70/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
9/4/19	Fecal Coliform	Newmarket	43/100ml	47/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
9/11/19	Fecal Coliform	Newmarket	43/100ml	44/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
9/17/19	Fecal Coliform	Newmarket	43/100ml	133/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
10/16/19	Fecal Coliform	Newmarket	43/100ml	80/100ml	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.

Prior to 2017, Newmarket had several instances of elevated fecal coliform, particularly in the summer. Several actions were taken to correct this situation, but none were particularly successful. There was hope that these issues would disappear with the construction of the new facility in 2017. Clearly, that did not occur, although the number of high fecal coliform readings did fall in 2019. As noted previously in this report, WWTF staff took a number of actions to bring down the bacteria level in the effluent.

Portsmouth Wastewater Treatment Facility

The Portsmouth WWTF is a primary treatment plant with chlorine disinfection. The facility is located on Peirce Island in downtown Portsmouth, and its outfall is located in the Lower Piscataqua River directly adjacent to the plant.

The Portsmouth WWTF has a design flow of 4.8 mgd, and its Monthly Operations Reports (MORs) show that average monthly flows ranged as follows:

2017: 2.190 – 14.487 mgd

2018: 2.441 – 15.207 mgd

2019: 2.11 – 17.99 mgd

The most recent NPDES permit (NH0100234) for the Portsmouth WWTF became effective on August 1, 2007 and expired on July 31, 2012. A new permit has not yet been issued. The most recent compliance inspection report by the NHDES Wastewater Engineering Bureau (June 2018) shows no significant deficiencies in regards to effluent bacteria concentrations or operation of the disinfection system. Review of the facility's Monthly Operations Reports shows the facility routinely meets its bacteria permit limit but frequently exceeds its design flow. Because the process of upgrading the Portsmouth WWTF to secondary treatment will involve a substantial amount of time and money, the City has been given interim permit limits by EPA. The new permit will not become active until the construction of a new secondary treatment plant is completed. Although the WWTF routinely exceeds its design flow of 4.8 mgd, the interim permit only requires that the City report effluent flow volumes. Therefore, as long as the City reports flow levels, it is in full compliance with their permit conditions for flow.

In December 2012, the U.S. Food and Drug Administration and NHDES conducted a hydrographic dye study of the Portsmouth municipal WWTF on Peirce Island (Ao et.al, 2017). The 2012 study includes a simulation of a hypothetical disinfection failure at the WWTF, using an effluent fecal coliform concentration assumption of 1,000,000 FC/100ml. This rather high assumption is based on repeated sampling of pre-disinfection effluent at the facility, and is much higher than an assumption that would be appropriate for a secondary treatment facility. The 2012 study indicates that for a disinfection failure occurring at slack low tide, insufficiently diluted effluent would extend into Little Bay, but not into Great Bay. However, insufficiently diluted dye was observed in some parts of Great Bay after subsequent flooding tides. Thus, disinfection system failures at the Portsmouth WWTF are included as part of the Great Bay Conditional Area Management Plan. When the facility is upgraded in 2020, pre-disinfection effluent sampling will be conducted to determine if a revision to the assumed 1,000,000 FC/100ml concentration is appropriate.

Table 10: Summary of Portsmouth WWTF Exceeding Reporting Thresholds for Bacteria and Effluent Flow, 2017-2019

Date	Parameter	Facility	Reporting Limit	Result	NHDES Response
2017					
Multiple dates in 2017	Flow	Portsmouth	4.8 mgd	4.853 – 14.487	Determined no significant impact to harvest area per previous dye studies and available data.
4/21/17	Fecal Coliform	Portsmouth	43/100ml	60	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
5/16/17	Fecal Coliform	Portsmouth	43/100ml	114	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
8/15/17	Fecal Coliform	Portsmouth	43/100ml	43.5	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
10/27/17	Fecal Coliform	Portsmouth	43/100ml	74	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
2018					
Multiple dates in 2018	Flow	Portsmouth	4.8 mgd	4.8 – 11.263	Determined no significant impact to harvest area per previous dye studies and available data.
11/12/18	Fecal Coliform	Portsmouth	43/100ml	248.1	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
2019					
Multiple dates in 2019	Flow	Portsmouth	4.8 mgd	4.8 – 17.99	Determined no significant impact to harvest area per previous dye studies and available data.
6/19/19	Fecal Coliform	Portsmouth	43/100ml	105	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
6/26/19	Fecal Coliform	Portsmouth	43/100ml	1119.9	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.

Date	Parameter	Facility	Reporting Limit	Result	NHDES Response
8/3/19	Fecal Coliform	Portsmouth	43/100ml	81.6	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
8/29/19	Fecal Coliform	Portsmouth	43/100ml	71.2	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.
12/31/19	Fecal Coliform	Portsmouth	43/100ml	101.7	Determined sufficient dilution within outfall Prohibited zone, and event lasted one day.

Wastewater Infrastructure

The Town of Exeter has a NPDES permit for the discharge of Combined Sewer Overflow (CSO) to Clemson Pond, which is a manmade waterbody on the banks of the Squamscott River. During heavy rainfall events, Clemson Pond can receive CSO discharges, typically from CSO structures on Water Street and on Spring Street. Water from Clemson Pond is discharged to the Squamscott River via two tide gates, which are located approximately 700 feet from the CSO inflow. Appendix 1 lists CSO discharges, as well as other sewage overflows, in 2017, 2018 and 2019. The Town of Exeter's construction of a new wastewater facility also includes new pump stations and sewer force mains with greater capacity. The town anticipates few, if any, CSO discharges once these new systems are built.

The City of Portsmouth reported eight sewage discharges in 2017, eight discharges in 2018, and seven discharges in 2019. Most of these were minor with respect to volume discharged (25 gallons or less). All discharges are listed in Appendix 1.

The Town of Newmarket reported no sewage overflow events in 2017, 2018 or 2019.

All instances of sewage release are listed in Appendix I.

Non-permitted Pollution Sources

For this review period, the evaluation of the significant actual and/or potential sources of pollution previously identified in the Great Bay Shellfish Management Area focused mainly on conducting site visits, and examining nearby ambient monitoring stations' sampling data. The results of this work did not prompt any changes in classification.

Four streams were identified during the original sanitary survey to be actual direct pollution sources. The initial sanitary survey and subsequent triennial reports describe the data used to delineate Restricted areas (Figure 2) around the streams, including:

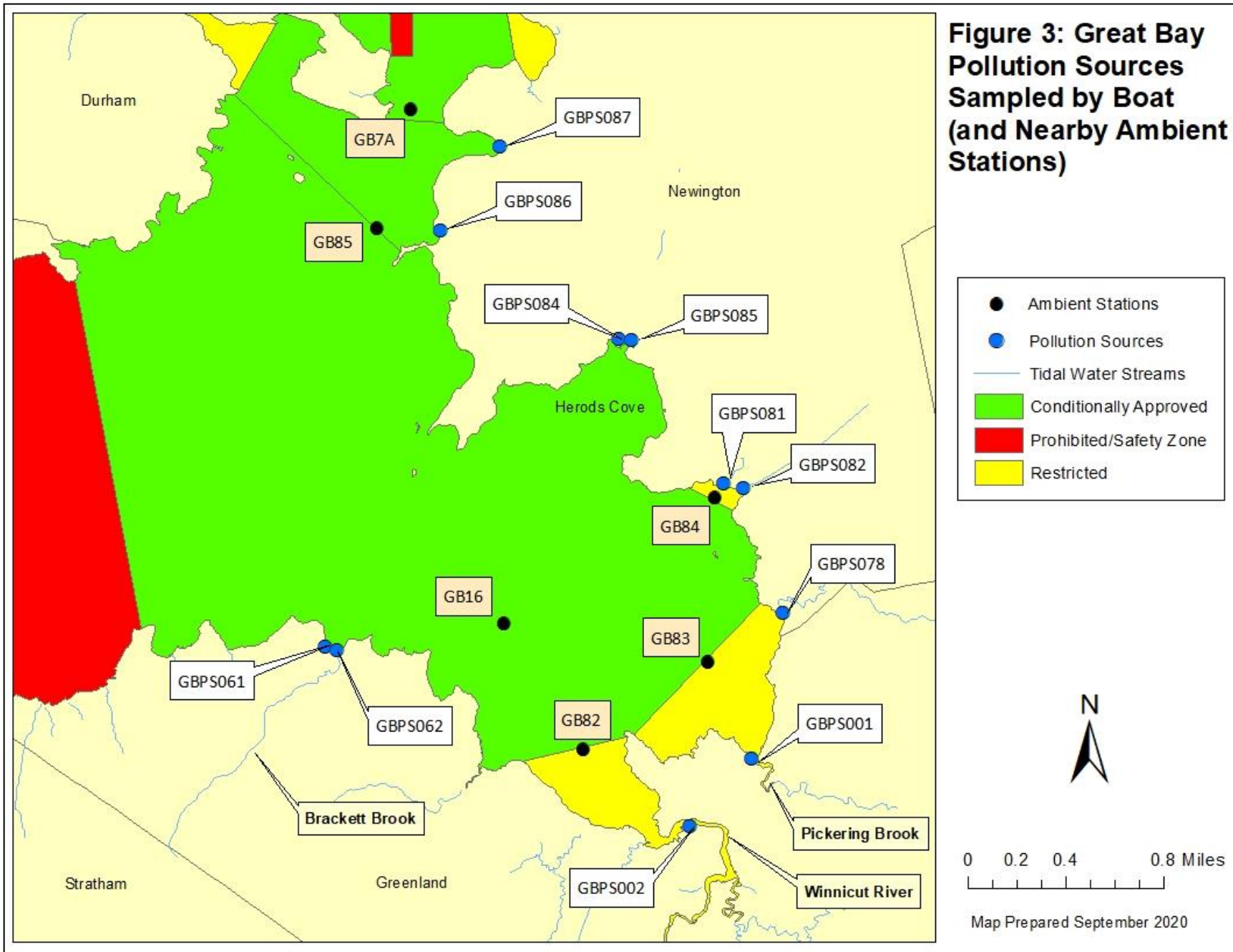
- The streams and cove just south of Fabyan Point (9.13 acres).
- All of Pickering Brook and the cove area north of Pierce Point (132.80 acres).
- All of the Winnicut River and the cove south of Pierce Point (123.50 acres).
- All of Crommet Creek to a point approximately 2500 feet downstream of the Bay Road bridge (40.58 acres).

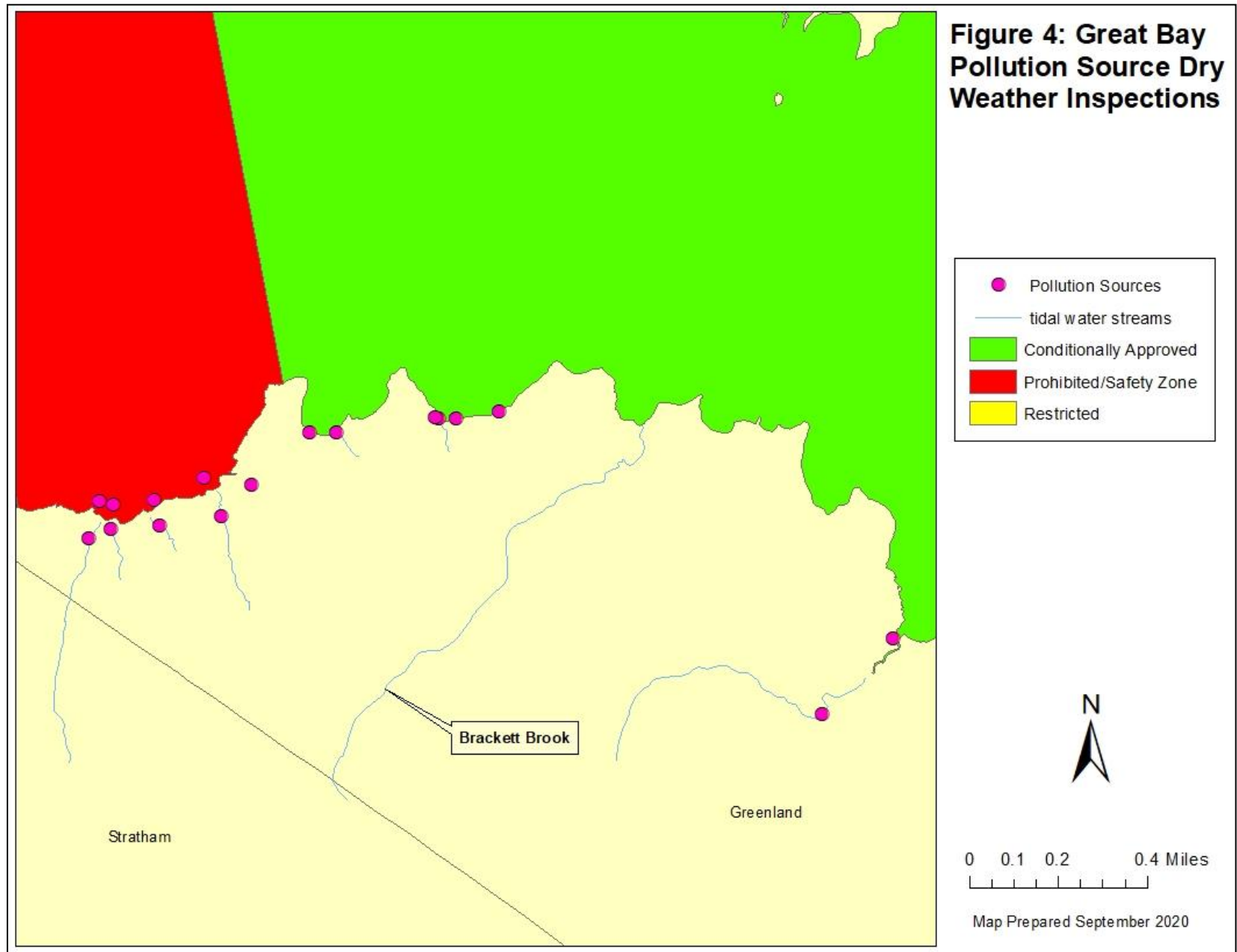
Pollution sources in the Conditionally Approved and Restricted areas of Great Bay were sampled during a dry weather boat run in May 2020. Previous triennial reports include recommendations for dry weather monitoring at these pollution source sites during the harvest season to develop more data under such conditions. During the site visits, it could not be determined if these sources were flowing due to the high tide at the time required to access these sites. However, many of these pollution sources are in close proximity to ambient monitoring stations. During this triennial period the ambient sites were sampled multiple times in dry and wet weather, and all meet Approved criteria as long as rainfall does not exceed 1.5 inches. Locations of these boat sites and the nearby ambient stations are illustrated in Figure 3, and pollution source sampling results are presented in Table 11.

Site visits of 14 pollution sources (**Figure 4**) that are near or have direct discharges to the Conditionally Approved waters of Great Bay were conducted in July of 2020. Many of these sources could not be located during the time of visit likely because lack of flow from severe drought conditions, and heavily wooded areas making it difficult to navigate the terrain. Most sources (GBPS66A, 066, 048, and 44A) exhibited an extremely low flow rate, and samples were not collected because only site investigations were being conducted at the time. Wet weather sampling of these sites is scheduled in the future when weather conditions are more favorable.

Table 11: Fecal Coliform Results from 2017-2020 Pollution Source Sampling

Station	Date	FC MPN/100ml
GBPS001	5/20/20	13
GBPS002	5/20/20	2
GBPS061	5/20/20	2
GBPS062	5/20/20	<2
GBPS078	5/20/20	6.8
GBPS081	5/20/20	4
GBPS082	5/20/20	22
GBPS084	5/20/20	49
GBPS085	5/20/20	79
GBPS086	5/20/20	2
GBPS087	5/20/20	<2





Boating Activities

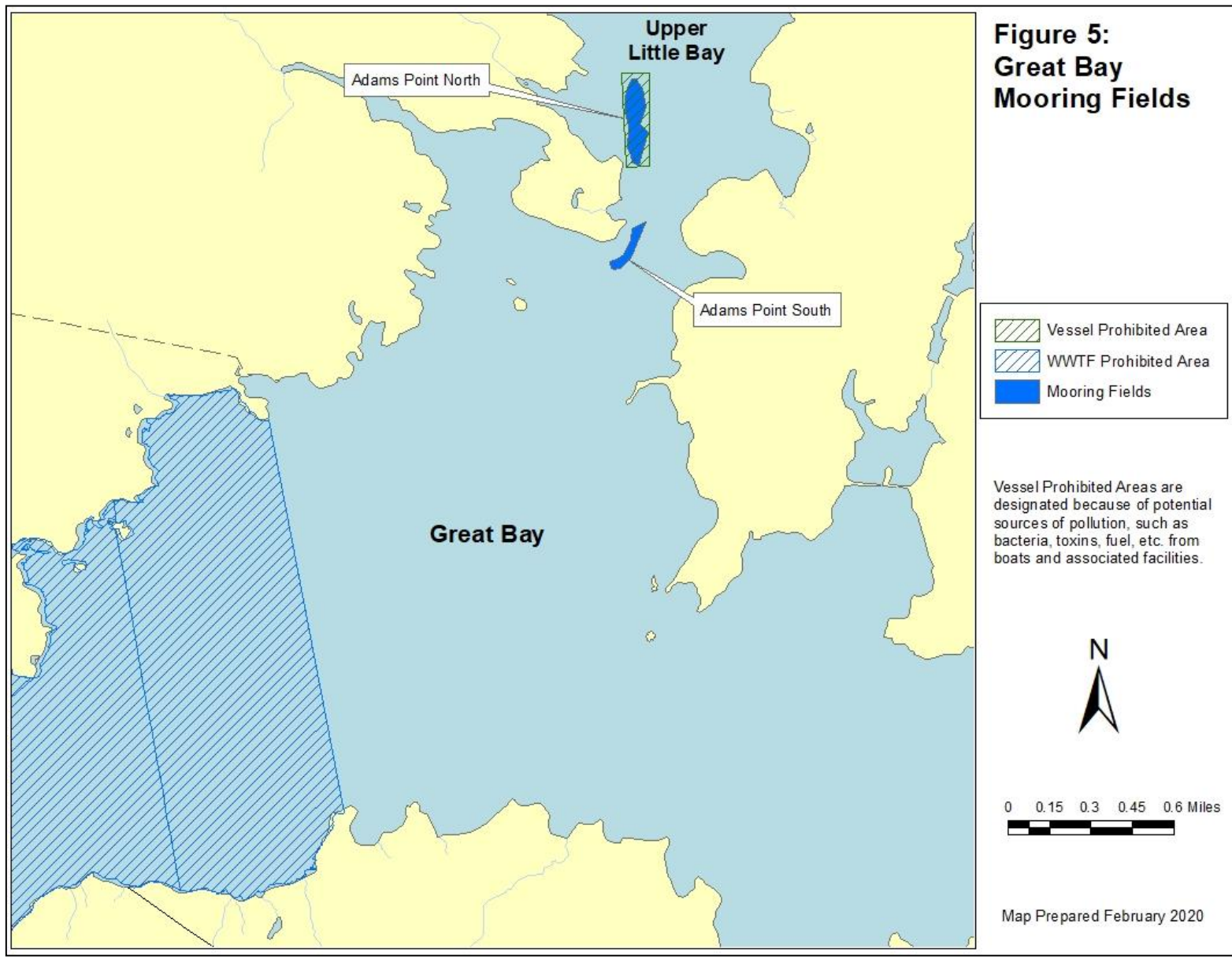
During the summer months, the northern portion of the growing area near Adams Point experiences increased recreational boating activity. Power boats and sailing vessels of various sizes begin to occupy moorings in mid-May, but recreational activity does not typically get underway in earnest until early June. By the end of September, boats are beginning to leave the water for the winter, and this process is typically complete by mid/late October. For the period of June through September each year, the discharge of sewage from these boats is considered to be a potential direct pollution source. There is currently one mooring field in the Great Bay Shellfish Management Area, and one mooring field north of Adam’s Point and just outside of the management area. Location and maximum occupancy figures for these areas are summarized in Table 12 and Figure 5.

The Adams Point South Mooring Field straddles the border between the Great Bay and Little Bay Shellfish Management Areas. This mooring field is of particular importance because it lies adjacent to one of only two major oyster beds in New Hampshire. If the potential risk of sewage discharge from the mooring field becomes a significant threat, a Prohibited area would need to be delineated around the mooring field. Such a reclassification would effectively exclude harvest from the oyster bed. To ensure that the risk of sewage contamination is minimal during the harvest season, regular counts/observations are made of the mooring fields during the boating season. The Adams Point South mooring field contained no boats during all of the boat counts performed in 2018 and 2019, and the maximum number of boats observed during all 2017 surveys was two; therefore, the mooring field does not currently pose a significant public health risk from sewage discharge.

In recent years, mooring fields have been less populated than in previous years. The Division of Ports and Harbors attributes this to the generally difficult economic conditions experienced by much of the country in recent years. However, when economic conditions improve, the demand for moorings may grow. Shellfish Program staff will continue to work with the New Hampshire Division of Ports and Harbors to see if new moorings can be located away from shellfish harvest areas. Shellfish Program staff will also continue to monitor existing mooring fields in case additional moorings are added in subsequent years or the number of vessels with sanitary facilities increases. If either of these situations occurs, the affected area will require further evaluation, which may result in a closure.

Table 12: Great Bay Mooring Fields

Area	Adjacent Avg. Mid-Tide Water Depth (ft)	Maximum Number of Slips or Moorings	Maximum Number of Boats Observed 2017-2019	Maximum Number of Boats with Facilities 2017-2019	Estimated Number of Boats Discharging (25% for mooring fields)	Comments
Adams Point South Mooring Field	20	16	2	2	0.5	<10 boats total
Adams Point North Mooring Field	18	56	13	12	3	None



Marine Biotoxins

The waters of the Gulf of Maine are prone to “blooms” of phytoplankton that can produce potent neurotoxins, and filter-feeding shellfish can accumulate concentrations of these toxins such that the shellfish themselves become a public health threat to consumers. For this reason, NHDES maintains monitoring programs focused on the phytoplankton and associated toxins causing Paralytic Shellfish Poisoning (PSP), Amnesic Shellfish Poisoning (ASP) and Diarrhetic Shellfish Poisoning (DSP). The biotoxin management program consists of weekly phytoplankton monitoring for harmful algal bloom species at four primary stations (Figure 6), and weekly sampling of blue mussel tissue for PSP toxin at two primary stations in Hampton Harbor and Isles of Shoals (Gosport Harbor). Harvest closures are initiated when PSP toxin levels exceed 80 µg PSP toxin/100g tissue.

Species of the genus *Alexandrium* can release toxins that cause Paralytic Shellfish Poisoning. When cell counts are greater than or equal to 15 cells/liter, and/or shellfish toxicity in Atlantic waters along the immediate shoreline (Hampton/Seabrook waters or Southern Maine waters) is at or near the 80µg/100g threshold, secondary phytoplankton sampling sites are activated. Species of the genus *Pseudo-nitzschia* can release toxins that cause Amnesic Shellfish Poisoning (ASP). When cell counts are greater than or equal to 2000 cells/liter, the phytoplankton are tested for ASP using Scotia toxin screening test kits. If the toxin screening test for ASP shows a positive result, then shellfish must be collected and analyzed for the presence of ASP toxin. Species of genus *Dinophysis* can release toxins that cause Diarrhetic Shellfish Poisoning (DSP). When cell counts are greater than or equal to 2000 cells/liter, shellfish tissue meats are collected to be tested for the presence of DSP toxin.

The 2017 season showed the typical pattern of low toxicity in early spring and rising toxicity in late spring. Little toxicity was observed through mid-May, but both the nearshore Hampton/Seabrook site and the offshore Star Island/Gosport Harbor site exhibited toxicity well above the NSSP mandatory closure threshold of 80ug/100g threshold on 5/31/17. All nearshore and offshore Atlantic waters were closed for the harvest of all species on 6/1/17. The nearshore Atlantic harvest closure was lifted on 7/7/17 after consecutive weeks of low toxicity, however, offshore toxicity continued to build. It was not until 7/5/17 that offshore toxicity was below the 80ug/100g threshold, and the offshore Atlantic closure was lifted on 7/21/17 after successive weeks of declining toxicity. No PSP closures were issued in Little Bay in 2017. Because there was no significant toxicity in Little Bay, no sampling was initiated in Great Bay.

The 2018 season showed very little PSP toxicity. Mussels at both the near-shore Hampton site and the off-shore Gosport site showed very low levels of toxicity (<44 µg/100g). Only on four sampling occasions in 2018 were toxicity levels slightly elevated, due to lab error or because the sample was lacking the NSSP recommended 100 grams of edible shellfish tissue (wet weight; samples with less than the minimum grams of edible tissue have an “adjusted” toxicity via calculation per NSSP procedures). Because of the low toxicity exhibited in Hampton Harbor and offshore, there were no secondary stations activated for sampling in Little Bay or Great Bay.

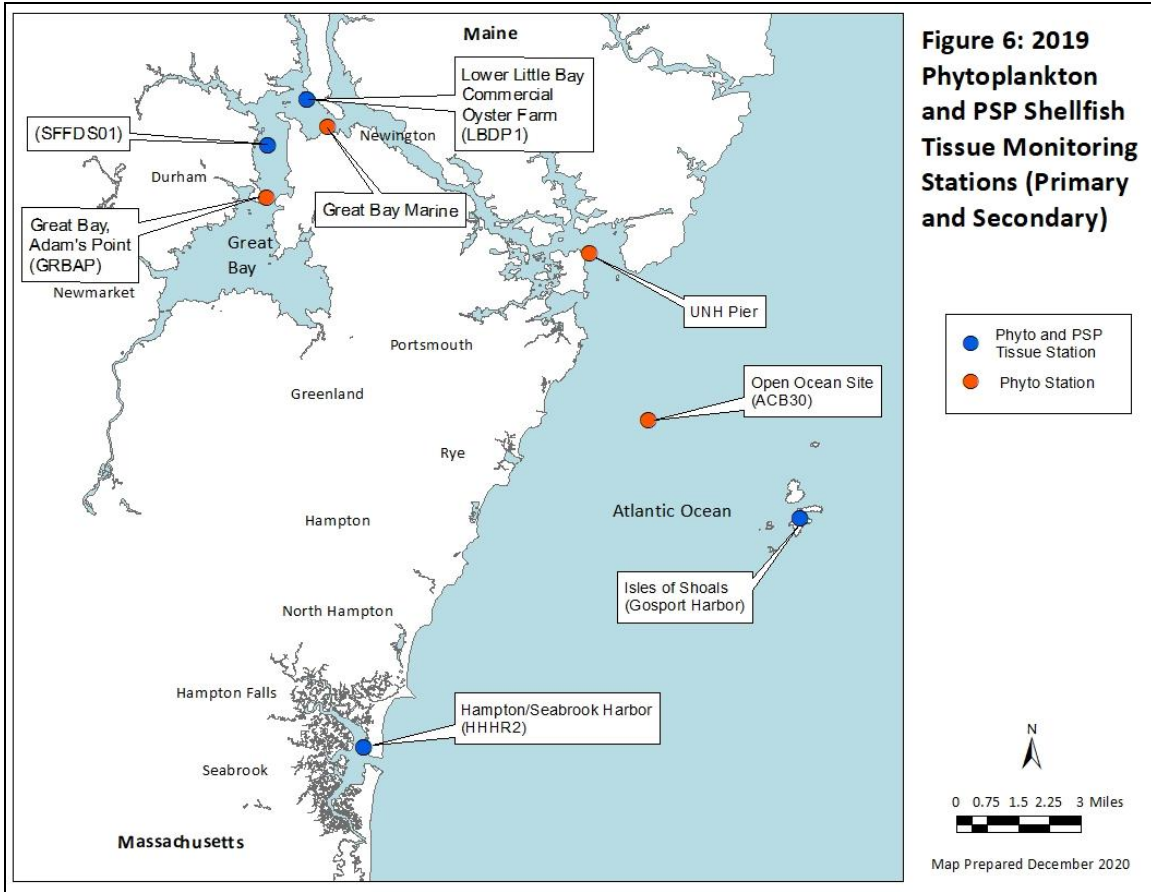
The 2019 season showed the typical pattern of low toxicity in early spring and rising toxicity in late spring. The offshore Isles of Shoals (Gosport Harbor) site and the nearshore Hampton/Seabrook Harbor site showed toxicity in early May 2019. All nearshore and offshore

Atlantic waters were closed for the harvest of all species on 5/9/2019, and Hampton/Seabrook was placed in the (seasonal) closed status on 6/1/2019. Offshore, toxicity remained above the NSSP mandatory 80ug/100g threshold, but numbers fluctuated from week to week. Weekly samples began to show declining toxicity, and after consecutive weeks of toxicity below the threshold, the nearshore and offshore Atlantic harvest closure was lifted on 8/8/19.

PSP and other harmful algal blooms do not typically cause shellfish toxicity in Little Bay, but it did occur in 2019. When high PSP toxicity levels are observed in the nearshore Atlantic area, secondary monitoring stations are initiated in Little Bay. Secondary sites start at the docks of Great Bay Marine in Lower Little Bay and move farther into the estuary at Great Bay Adams Point (Figure 6). Phytoplankton and PSP mussel tissue samples were collected from sites in Upper and Lower Little Bay. Slightly elevated toxicity and increasing *Alexandrium* cell counts prompted two precautionary closures in Little Bay in June, and triggered phytoplankton and PSP sampling at Great Bay Adam's Point (GRBAP). No high *Alexandrium* cell counts were observed at Adams Point, and no closures in Great Bay were necessary.

Alexandrium cell count data for all sites 2017-2019 are presented in Appendix III.

Pseudo-nitzschia (PN) phytoplankton concentrations and ASP Scotia screening kit results over the 2017-2019 time period indicate very low levels of ASP toxicity. There were 11 sampling events at Lower Little Bay sites in 2017 (Figure 6), but no screening tests needed for Great Bay, and PN concentrations were never over 2,000 cells per liter. Therefore, further sampling in Great Bay was not initiated. In 2018, there was little evidence of PN cell concentration and domoic acid at the primary sites, so supplemental sampling in Little Bay or Great Bay was not necessary. In 2019, there were 12 sampling events in Great Bay at Adams Point (GRBAP), but this supplemental collection was done primarily to assist with NHDES Beach Program cyanobacteria monitoring. All 12 samples showed low PN concentrations.



Discussion and Conclusions

After review of the relevant information collected over the past three years for the Great Bay Shellfish Management Area, it was determined that no changes need to be made to its current classification (Figure 2). This determination was based in part on the fact that there were no changes to the existing pollution sources and there were no new sources identified that would negatively affect the growing area.

Recommendations

1. The location of the Exeter and Newmarket WWTF Prohibited area boundary should be reevaluated once construction of the new Exeter WWTF is complete. The re-evaluation should begin with a new characterization of pre-disinfection effluent fecal coliform levels, as well as male-specific coliphage concentration in influent, pre-disinfection effluent, and final effluent.
2. In concert with Recommendation #1, consider updating the hydrographic studies of the Exeter and Newmarket WWTFs, using new procedures recommended by the USFDA to delineate the steady state 1,000:1 zone of dilution around the outfalls. The updated hydrographic studies should be done after construction is complete.
3. Continue with event-based sampling at the inflow and outflow of Clemson Pond in Exeter to better understand how/if CSO events actually impact water quality in the Squamscott River.
4. As time and resources allow, additional information on water quality impacts to Great Bay should be performed on some of the more significant fecal coliform sources, including the unnamed stream and cove just south of Fabyan Point, Pickering Brook, and the Winnicut River. Ambient monitoring on the boundaries of these sources' Restricted areas will continue to confirm the adequacy of existing classifications, but the additional water quality impact information, particularly wet weather information, may reveal opportunities to reduce the size of the existing Restricted areas.
 5. As time and resources allow, conduct water quality studies to assess impacts of rainfall events on Great Bay. These studies should focus on rainfall events in the range of one to two inches. Particular emphasis should be placed on such events in late fall and winter, when fecal coliform levels appear to persist longer than in other seasons.
 6. Conduct dry weather sampling at GBPS012, 049, 054, 061 and 062 to update the database. Consider doing wet weather sampling at these locations as well.
 7. After the Portsmouth WWTF upgrade is complete (anticipated 2020), perform work to evaluate its potential for affecting Great Bay water quality, and amend the Conditional Area Management Plan as appropriate.

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APPENDIX I
Wastewater Collection Infrastructure Discharges

EXETER (2017)

Town	Date	Gallons	Comments
Exeter	1/6/17	<60	<60-gallon discharge from a private sewer line.
Exeter	2/21/17	Minor	Minor leak in a private system.
Exeter	4/4/17	16,500	Town sewer line blocked for 33 minutes, discharge not near tidal waters.
Exeter	10/6/17	Up to 76,800	Failed check valve in a private system allowed town sewage to backflow and overflow the private system. Precautionary harvest closure implemented, and lifted a few days later after testing.

EXETER (2018)

Town	Date	Gallons	Comments
Exeter	4/16/18	393,780	CSO event caused by heavy rainfall.
Exeter	6/5/2018	Estimated 2,200 gallons	Break in the force main that enters the plant into the adjacent field. Plan to divert all the sewage into the CSO that drains into Clemson Pond. Potential public health risk for harvesting in any adjacent Approved or Conditionally Approved areas based on a previous dye study.
Exeter	8/3/18	12,760	CSO event caused by heavy rainfall.
Exeter	9/18/18	518,790	CSO event caused by heavy rainfall.
Exeter	11/2/18	10,920	CSO event caused by heavy rainfall.
Exeter	11/27/2018	1,1661,110 gallon CSO; separate 2,200 gallon sewage overflow	CSO event caused by heavy rainfall. 2,200-gallon sewage overflow from blocked sewer line.

EXETER (2019)

Town	Date	Gallons	Comments
Exeter	1/24/19	31,442	CSO event caused by heavy rainfall.
Exeter/	2/21/19	26,750 (sewage direct from broken line); 20,120 (CSO sewage diversion to Clemson Pond)	Break in the force main that enters the plant into the adjacent field. Intentional diversion pf 20,120 gallons into Clemson Pond to facilitate expeditious repair. Potential public health risk for harvesting in any adjacent Approved or Conditionally Approved areas based on a previous dye study.
Exeter	3/9/19	700,000 (sewage direct from broken line); 420,170 (CSO sewage diversion to Clemson Pond)	Break in the force main at the main pumping station, discharge to parking lot directly adjacent to Squamscott River. Intentional diversion pf 420,120 gallons into Clemson Pond to facilitate expeditious repair. Potential public health risk for harvesting in any adjacent Approved or Conditionally Approved areas based on a previous dye study.
Exeter	5/22/19	164,850	CSO event caused by heavy rainfall.
Exeter	7/9/19	180	CSO event caused by heavy rainfall.
Exeter	11/26/19	undetermined	Intermittent 10-20 gpm discharge from private system in tributary to Exeter River, upstream of tidal waters

PORTSMOUTH (2017)

Town	Date	Gallons	Comments
Portsmouth	1/6/17	n/a	Contractor at the WWTF construction site hit a sewer line. All discharge confined to the pit he was digging. Pump truck transferred sewage in the pit to the WWTF.
Portsmouth	2/3/17	30,000-50,000	Contractor at the WWTF construction site hit a 24-inch sewer line. Discharge occurred over 5.5hrs. Dilution values from 2012 dye study used to evaluate impact. No impact to Conditionally Approved waters in Little Bay. Only adjacent waters (Prohibited) would be impacted.
Portsmouth	2/17/17	minimal	Private system overflow from collapsed line. No discharge to surface waters (saturating ground and freezing in place).
Portsmouth	4/24/17	Unknown	2-hour overflow at Goosebay Drive, Pease Tradeport, caused by a combination of high industrial flows concurrent with one of two influent pumps being out of service.
Portsmouth	6/8/17	minimal	Blocked sewer line (private system) at Cumberland Farm. City crews pumped the system to stop the discharge until the private entity could address the problem. No discharge to surface water.
Portsmouth	6/16/17	minimal	Blocked sewer line affecting one residence. No discharge to surface water.
Portsmouth	10/13/17	3,600	Sewage discharge to a catch basin, from a local hotel that had internal plumbing issues in the building. Discharge lasted four hours before City crews learned of the discharge and stopped it. Discharge to Hodgson Brook, a tributary to North Mill Pond (Prohibited classification).
Portsmouth	11/29/17	unknown	Sewer line damaged by gas company resulted in discharge of unknown amount. If any sewage got to surface waters, it would have been to either North Mill Pond or South Mill Pond, both of which are

Town	Date	Gallons	Comments
			Prohibited for harvest.

PORTSMOUTH (2018)

Town	Date	Gallons	Comments
Portsmouth	2/17/18	Minimal	Minor sewage overflow from a private system. No discharge to tidal waters.
Portsmouth	3/4/18	1000	Sewer line break from a private system on Edmond Avenue. No discharge to surface waters.
Portsmouth	3/28/18	40	Sewer line blocked with grease, perhaps from a nearby food establishment. No discharge to surface waters.
Portsmouth	5/9/18	10	Sewer line blockage from a private system on Banfield Road. No discharge to surface waters.
Portsmouth	5/10/18	1100	Manhole discharge from Highliner Foods (grease blockage). No discharge to surface waters.
Portsmouth	6/27/18	Drip	Minor leak/drip of sewage from air relief valve under the bridge to Pierce Island. If minor discharge reached surface waters, it would have discharge into waters classified as Prohibited for shellfish harvest.
Portsmouth	7/21/18	Unknown	Punctured sewer line on Maplewood Avenue. No discharge to surface waters, sewage captured in a catch basin.
Portsmouth	9/18/18	Unknown	Sewage backup on Brewster Street during a CSO event. Does not pose a public health threat for harvesting in any adjacent Approved or Conditionally Approved areas, all of which were placed in the closed status for rainfall.

PORTSMOUTH (2019)

Town	Date	Estimated Gallons	Comments
Portsmouth	1/12/19	<25	Blocked grease trap overflow to catch basin at a food establishment; discharge froze on parking lot surface, no discharge to surface waters.
Portsmouth	3/19/19	15	Sewer line blocked with towels and debris from the same food establishment involved in the 1/12/19 incident. City will require cleaning schedule. No discharge to surface waters.
Portsmouth	4/25/19	20	Broken private sewer service line, discharge to Piscataqua River (classified as Prohibited).
Portsmouth	4/29/19	20	Sewer line blocked with towels and debris from the same food establishment involved in the 1/12/19 and 3/19/19 incidents. City enforcement action forthcoming. No discharge to surface waters appears unlikely.
Portsmouth	4/29/19	15	Broken sewer line. Discharge to two catch basins, but discharge to surface waters appears unlikely.
Portsmouth	10/19/19	<10	Sewer line overflow caused by tree roots. Line serves seasonal bathroom at softball field. Line will be rerouted. No discharge to surface waters.
Portsmouth	12/14/19	undetermined	Heavy rain caused surcharging lines and pump station overflows. Six locations discharged to North Mill Pond, and one discharged to Sagamore Creek. Both areas are classified as Prohibited. All nearby Approved or Conditionally Approved areas were placed in the closed status for rainfall.

APPENDIX II
Water Quality Data for Potential Sources of Pollution

Includes data collected during the 2017-2019 triennial review period. Some sites were revisited in 2020, and those data are also included here.

Station ID	Project ID	Pollution Source	Date	Fecal Coliform	Units
GBPS001	Dry	PERENNIAL STREAM	5/20/2020	13	MPN/100ML
GBPS002	Dry	PERENNIAL STREAM	5/20/2020	2	MPN/100ML
GBPS041	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS041A	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS042	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS042A	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS043	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS043A	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS044	Dry	PERENNIAL STREAM	7/17/2020		#/100ML
GBPS044A	Dry	PERENNIAL STREAM	7/17/2020		#/100ML
GBPS046	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS048	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS049	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS053	Dry	PIPE	7/17/2020		#/100ML
GBPS054	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS055	Dry	PIPE	7/17/2020		#/100ML
GBPS061	Dry	INTERMITTENT STREAM	5/20/2020	2	MPN/100ML
GBPS062	Dry	INTERMITTENT STREAM	5/20/2020	<2	MPN/100ML
GBPS066	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML
GBPS066A	Dry	TIDAL CREEK	7/17/2020		#/100ML
GBPS078	Dry	PERENNIAL STREAM	5/20/2020	6.8	MPN/100ML
GBPS081	Dry	SALTMARSH DITCH	5/20/2020	4	MPN/100ML
GBPS082	Dry	TIDAL CREEK	5/20/2020	22	MPN/100ML
GBPS084	Dry	ROAD CULVERT	5/20/2020	49	MPN/100ML
GBPS085	Dry	PIPE	5/20/2020	79	MPN/100ML
GBPS086	Dry	INTERMITTENT STREAM	5/20/2020	2	MPN/100ML
GBPS087	Dry	INTERMITTENT STREAM	5/20/2020	<2	MPN/100ML
GBPS094	Dry	INTERMITTENT STREAM	7/17/2020		#/100ML

APPENDIX III
Phytoplankton Monitoring Data
 (Table entries are Alexandrium cells per liter)

	Primary Stations				Little Bay Stations			
	Pisc. River	Hampton/Seabrook Harbor	Isles of Shoals (Gosport)	Open Ocean	Great Bay Marine	Lower Little Bay Comm. Oyster Farm	Upper Little Bay Comm. Oyster Farm	Adams Point
	UNH Pier	HHHR2	IOSSI2	ACB30	GB-MARINE	LBDP1	SFFDS01	GRBAP
5/5/2019								
5/6/2019	22.5							
5/7/2019								
5/8/2019		15						
5/9/2019								
5/10/2019								
5/11/2019								
5/12/2019								
5/13/2019	30				15			0
5/14/2019								
5/15/2019		285			45		30	
5/16/2019			637.5	128				
5/17/2019					0			
5/18/2019								
5/19/2019					15		30	
5/20/2019	82.5							
5/21/2019		23			15			
5/22/2019								
5/23/2019			353	150	22.5			
5/24/2019								
5/25/2019								
5/26/2019					22.5			
5/27/2019	75							
5/28/2019				240			127.5	
5/29/2019		150			67.5	67.5	60	7.5
5/30/2019								

	Primary Stations				Little Bay Stations			
	Pisc. River	Hampton/Seabrook Harbor	Isles of Shoals (Gosport)	Open Ocean	Great Bay Marine	Lower Little Bay Comm. Oyster Farm	Upper Little Bay Comm. Oyster Farm	Adams Point
	UNH Pier	HHR2	IOSSI2	ACB30	GB-MARINE	LBDP1	SFFDS01	GRBAP
5/31/2019					52.5			
6/1/2019								
6/2/2019					37.5	135	75, 90	22.5
6/3/2019	390	502.5						
6/4/2019			345	135	82.5	172.5		
6/5/2019								
6/6/2019					75	195	240	
6/7/2019								
6/8/2019								
6/9/2019					185.5	367.5	352.5	
6/10/2019	165							
6/11/2019		307.5						
6/12/2019			195	142	97.5	600	322.5	30
6/13/2019								
6/14/2019					7.5	217.5	172.5	52.5
6/15/2019								
6/16/2019								
6/17/2019	22.5		277.5	15		90		
6/18/2019		157.5						
6/19/2019					7.5	15		
6/20/2019								
6/21/2019								
6/22/2019								
6/23/2019								
6/24/2019	172.5							
6/25/2019		307.5						
6/26/2019			840	862.5	300	337.5		
6/27/2019								
6/28/2019								

	Primary Stations				Little Bay Stations			
	Pisc. River	Hampton/Seabrook Harbor	Isles of Shoals (Gosport)	Open Ocean	Great Bay Marine	Lower Little Bay Comm. Oyster Farm	Upper Little Bay Comm. Oyster Farm	Adams Point
	UNH Pier	HHR2	IOSSI2	ACB30	GB-MARINE	LBDP1	SFFDS01	GRBAP
6/29/2019								
6/30/2019								
7/1/2019	510				135	150	75	15
7/2/2019		1807.5	157.5	97.5				
7/3/2019					150	165/246.5	97.5	
7/4/2019								
7/5/2019						7.5		
7/6/2019								
7/7/2019								
7/8/2019	45		22.5	37.5		52.5	37.5	
7/9/2019								
7/10/2019		877.5			90	232.5	52.5	7.5
7/11/2019								
7/12/2019								
7/13/2019								
7/14/2019								
7/15/2019	157.5					67.5	30	
7/16/2019			90	30				
7/17/2019		217.5						
7/18/2019								
7/19/2019								
7/20/2019								
7/21/2019								
7/22/2019	37.5		7.5	90		15		
7/23/2019								
7/24/2019		30						
7/25/2019								
7/26/2019								
7/27/2019								

	Primary Stations				Little Bay Stations			
	Pisc. River	Hampton/Seabrook Harbor	Isles of Shoals (Gosport)	Open Ocean	Great Bay Marine	Lower Little Bay Comm. Oyster Farm	Upper Little Bay Comm. Oyster Farm	Adams Point
	UNH Pier	HHHR2	IOSSI2	ACB30	GB-MARINE	LBDP1	SFFDS01	GRBAP
7/28/2019								
7/29/2019	15		0	0		0		
7/30/2019		75						
7/31/2019								
8/1/2019								
8/2/2019								
8/3/2019								

APPENDIX IV

Conditional Area Management Plan for Great Bay Revision 15: January 2, 2020

DESCRIPTION OF CONDITIONALLY APPROVED AREA

The eastern two-thirds of the Great Bay growing area is classified as Conditionally Approved. This area is defined as the waterbody bounded to the west by a Prohibited line extending from the shore between Vols Island and Crommet Creek, to the shore just west of Bracketts Point, to the north by the boundary between Great Bay and Little Bay at Adams Point, and to the east by Prohibited boundaries near Fabyan Point, Pickering Brook, and the Winnicut River near Pierce Point.

FACTORS INDICATING SUITABILITY OF PORTIONS OF GREAT BAY AS CONDITIONALLY APPROVED

1. The major pollution sources with the capacity to adversely affect water quality in Great Bay are point source in origin, including the wastewater treatment facilities in Exeter and Newmarket and the Combined Sewer Overflow discharging to the Squamscott River via Clemson Pond in Exeter. Hydrographic studies have also demonstrated that the Portsmouth WWTF has the potential to adversely affect Great Bay water quality. The Conditionally Approved area is separated spatially from the wastewater treatment facility outfalls by a Prohibited/Safety Zone. National Pollutant Discharge Elimination System (NPDES) permit requirements for the facilities require the plant operators to immediately notify NHDES when discharges of improperly treated sewage occur, and experience to date has shown the plants do provide timely notification to NHDES. Prohibited zones are around other significant pollution sources adjacent to the Conditionally Approved area (Fabyan Point, Pickering Brook, Winnicut River, and Crommet Creek). There are no other significant point sources in the Conditionally Approved area.
2. The waters of Great Bay can be affected by nonpoint sources of pollution following heavy (>1.50 inches) rainfall events. Weather information is available in real-time from the Pease airport weather tower in Portsmouth, which is staffed 24 hours a day.
3. Great Bay exhibits a tidal range that indicates substantial exchange with coastal ocean waters.

POLLUTION EVENTS THAT MAY TRIGGER CONDITIONAL AREA CLOSURE

Newmarket Wastewater Treatment Facility (186 Main Street, Newmarket, NH 03857. Sean Grieg, Operator, 603/659-8810)

The following performance standards may be used to trigger a closure of the Conditionally Approved areas in Great Bay. Violation of any of the following shall trigger immediate notification of the NHDES Shellfish Program by the Town of Newmarket:

- **Effluent flow:** total daily flow shall not exceed a flow of 1.0 MGD.

- **Bacteriological quality of the effluent:** shall not exceed 43 fecal coliform/100ml after disinfection.
- **Bypasses:** any discharge of raw sewage or partially treated sewage from the WWTF or from any part of the sewage collection system. For the purposes of this performance standard, “partially treated sewage” means sewage/effluent that has been released to the environment before undergoing all aspects of treatment required by the most recent NPDES permit.
- Failure of the WWTF to complete its required effluent monitoring, such that the biological, physical and/or chemical quality of the effluent is unknown.

Exeter Wastewater Treatment Facility (10 Front Street, Exeter, NH 03833. Joshua Scotton, Operator, 603/773-6168).

The following performance standards may be used to trigger a closure of the Conditionally Approved areas in Great Bay. Violation of any of the following shall trigger immediate notification of the NHDES Shellfish Program by the Town of Exeter:

- **Effluent flow:** total daily flow shall not exceed the design flow of 3.0 MGD.
- **Bacteriological quality of the effluent:** shall not exceed 43 fecal coliform/100ml after disinfection.
- **Bypasses:** any discharge of raw sewage or partially treated sewage from the WWTF or from any part of the sewage collection system. For the purposes of this performance standard, “partially treated sewage” means sewage/effluent that has been released to the environment before undergoing all aspects of treatment required by the most recent NPDES permit.
- Failure of the WWTF to complete its required effluent monitoring, such that the biological, physical, and/or chemical quality of the effluent is unknown.

Portsmouth Wastewater Treatment Facility (Peirce Island, Portsmouth, New Hampshire 03801. Peter Conroy Operator, 603-957-8780)

The following performance standards may be used to trigger a closure of the Conditionally Approved areas in Great Bay. Exceedence of any of the following shall trigger immediate notification of the NHDES Shellfish Program by the City of Portsmouth:

- **Effluent flow:** total daily flow shall not exceed 4.8 mgd.
- **Bacteriological quality of the effluent:** shall not exceed 43 fecal coliform/100ml after disinfection. Notification of results over 43/100ml shall occur as soon as the laboratory test results are completed.
- **Bypasses:** any discharge of raw sewage or partially treated sewage from the WWTF or from any part of the sewage collection system. For the purposes of this performance standard, “partially treated sewage” means sewage/effluent that has been released to the environment before undergoing all aspects of treatment required by the most recent NPDES permit.
- Failure of the WWTF to complete its required effluent monitoring, such that the biological, physical, and/or chemical quality of the effluent is unknown.

Exeter Combined Sewer Overflows

- *Any discharge* of the CSOs may be used to trigger a closure of the Conditionally Approved areas in Great Bay. Dye dilution/dispersion studies of the Squamscott River indicate that discharges of 100,000 gallons per hour and FC concentrations of 500,000/100ml could adversely affect Great Bay's water quality. Discharges with lower rates but higher bacterial concentrations may also adversely affect Great Bay.

Meteorological or Hydrological Events

Rainfall events of more than 1.50 inches total precipitation shall trigger a closure of the Conditionally Approved areas in Great Bay. The 1.50-inch criterion is intended to generally apply to a 24-hour period; however, rainfall events that occur over a longer period of time may also warrant closure. Analysis of precipitation records from Portsmouth, NH, suggests that on average, such events will occur approximately 5-10 times per year. An analysis of the relationship between rainfall and bacteria levels is presented in the sanitary survey report.

For the purpose of this performance standard, rainfall data will be obtained from the meteorological observation station at the Pease International Tradeport Airport in Portsmouth, New Hampshire. Real-time checks of rainfall data are made via phone calls to the weather observation station at the airport tower. Data from other coastal New Hampshire weather stations (e.g., Seabrook) may also be used to institute a closure.

Closures will be instituted for precipitation events that fall primarily as rainfall. Precipitation that falls primarily as snow and/or ice will generally not trigger a closure, as these events do not produce the runoff that transports bacterial contamination to the growing waters. However, precipitation events that fall as a mix of rain and snow/ice, or snow/ice events that are immediately followed by a significant melting period, may trigger a closure. The potential for growing area contamination by such events will be evaluated by NHDES Shellfish Program staff on a case-by-case basis, and closure decisions will be made accordingly.

IMPLEMENTATION OF A CONDITIONALLY APPROVED AREA CLOSURE

Notification of Management Plan Violation

The Newmarket, Exeter, and Portsmouth WWTFs are responsible for immediately notifying NHDES in the event of a violation of the aforementioned performance standards. The response time between management plan violation and notification of NHDES can vary, depending on the sewage discharge. However, historical experience with these WWTFs indicates notification can be expected within four-to-six hours of the management plan violation. Notification time is shortened by the availability of a pager maintained by NHDES staff (Chris Nash, Shellfish Program Manager, or Brooke Dejadon, Shellfish Program Specialist, 222 International Drive, Suite 175, Pease Tradeport, Portsmouth, New Hampshire 03801). The Shellfish Program pager is to be used for notification (603/771-9826). The Shellfish Program also maintains a cell phone (603/568-6741) to be used by WWTF as needed (if direct contact with Shellfish staff is not made via cellphone, a page must be sent).

The Prohibited/no-harvest zone around each outfall is based in part on the time of travel notification time (response time) by each WWTF. WWTF response times will be reviewed annually to determine if a change in the size of the zone is warranted.

NHDES Shellfish Program staff are responsible for monitoring weather forecasts and conditions, and acquiring real-time rainfall data from the Pease Airport or other sources for the purposes of determining when a rainfall closure is necessary.

Implementation of Closure

Response time between management plan violation notification and legal closure by NHDES is relatively short for all facilities, typically within four to six hours. The short response times are aided by the automated alarm systems at the facilities and the fact that the NHDES Shellfish Program staff are on call (cellphone and pager) every day, 6am-9pm. Rainfall closures are also implemented quickly, as NHDES maintains direct contact with the Pease airport weather observation station. Notification of NHF&G (patrol agency) by NHDES typically occurs immediately following NHDES notification. Implementation of closure by NHF&G is often immediate as well, and typically occurs immediately after notification by NHDES. The following notification protocol is followed for each closure:

Initiation of Closure: Each week, the NHDES Shellfish Program calls the NHF&G Law Enforcement Division and sends a “Clam Hotline update” email to NHF&G Marine Fisheries Division/Durham, NHF&G Law Enforcement Division/Durham, and NHF&G Public Affairs Division in Concord. The email makes note of any management plan violations that have occurred, as well as any necessary closures. These emails typically outline the more common types of temporary closures, such as those occurring after rainfall events. For the more rare management plan violations that could involve prolonged closures (e.g., significant discharges of improperly treated waste from a WWTF), an informational email is sent not only to NHF&G Marine Fisheries Division/Durham, NHF&G Law Enforcement Division/Durham, and NHF&G Public Affairs Division in Concord, but also to the DHHS/Bureau of Food Protection, the DHHS Public Health Laboratory in Concord, and the NHDES Public Information Office in Concord.

F&G will enforce provisions of Fis 606.02(b) once NHDES has placed the area in the closed status.

Public Dissemination of Closure Information: NHF&G will serve as the lead agency to inform recreational harvesters and the general public of any closures and subsequent reopenings. Procedures to inform the public may include such vehicles as the Clam Hotline, press releases and website updates, and alerting the public during patrol activities. NHDES will assist with informing the general public via updates to the NH Coastal Atlas. DHHS will serve as the lead agency to inform the commercial shellfish industry of any closures and subsequent reopenings.

Enforcement of Closure

The New Hampshire Fish and Game Department is the agency responsible for patrolling waters closed for public health reasons. The frequency of patrols will be at the discretion of NH Fish and Game Department/Law Enforcement Division staff (Lt. Delayne Brown, Sgt. Jeremy Hawkes, Conservation Officer James Benvenuti, Conservation Officer Graham Courtney), NHF&G Region 3 Office, 225 Main Street, Durham, New Hampshire 03824, 603/868-1095).

REOPENING A CONDITIONALLY APPROVED AREA AFTER CLOSURE

Wastewater Treatment Plant/Collection System-Related Closures: Following closures triggered by discharges of raw or partially treated sewage from a wastewater treatment facility and/or any part of its sewage collection system, NHDES will be the lead agency for identifying necessary sampling locations and frequency needed to reopen the shellfish beds. At a minimum, water sampling will be conducted at monitoring sites GB4A, GB5 and GB16. If site access is limited by ice cover or other conditions, alternative shoreline sites will be used. Because access to shellfish tissue sampling sites can vary with tide stage, ice and daylight considerations, shellfish tissue sampling sites will be determined on a case-by-case basis. NHDES will be the lead agency in collecting water and shellfish tissue samples and will notify the DHHS lab of its intention to sample. All samples will be held on ice and will be delivered to the DHHS Laboratory in Concord by the collecting agency as soon as practical, but always within 24 hours of collection. Upon completion of the laboratory tests, DHHS laboratory personnel will promptly inform the NHDES Shellfish Program of the results. NHDES will then decide whether or not the sample results support a reopening of the area and will notify NHF&G/Law Enforcement Division of the decision. Sampling will continue until meat samples show a FC MPN of 230/100g or less (or a different baseline value established for a particular site) and confirmatory water samples show FC of 43/100ml or less. When sampling demonstrates that the area was in fact impacted by a significant sewage discharge, the area will remain closed for a period of at least three weeks, per U.S. FDA recommendations relating to the time required for viral pathogens to be purged from shellfish. Reopening may alternatively be driven by sampling of shellfish meats for male-specific coliphage, per NSSP guidelines (<50 pfu/100g tissue, or higher if documented background levels dictate). Reopening after the three-week closure will be done in concert with water and meat samples that show sufficiently low fecal coliform results.

Rainfall-Related Closure Periods: Because water quality impacts can vary among storms of the same size, NHDES may elect to conduct an initial round of sampling, involving water samples only, of the Conditionally Approved area in the day(s) following closures from rainfall events. The purpose of such sampling is to determine if the rainfall event did in fact cause bacterial contamination of the growing area, and therefore to determine if a closure was warranted. At a minimum, water sampling will be conducted at monitoring sites GB4A, GB5 and GB16. If site access is limited by ice cover or other conditions, alternative shoreline sites will be used. If these water samples show low fecal coliform levels (i.e., the samples indicate that there was no water quality impact from the storm to begin with), then the closure may be lifted with no additional sampling of waters or shellfish meats. If high FC levels are observed, then the area will remain in the closed status until post-rainfall meat samples show a FC MPN of 230/100g or less (or a different baseline value established for a particular site) and confirmatory water samples show FC of 43/100ml or less, or until 14 consecutive days with no storms >1.50 inches have elapsed and confirmatory water samples show FC of 43/100ml or less, whichever is less.

NHDES will be the lead agency in collecting samples from sites in the Conditionally Approved area and will notify the DHHS laboratory, as well as the NHF&G Law Enforcement Division of its intention to sample. All samples will be collected as soon as practical after the rainfall event has ended, will be held on ice, and will be delivered to the DHHS Laboratory in Concord, or an appropriate contracting laboratory, by the collecting agency within 24 hours of collection. Upon completion of the laboratory tests, DHHS laboratory personnel will promptly inform the NHDES Shellfish Program of the results. NHDES will then decide whether or not to close the area for harvesting and will notify NHF&G/Law Enforcement Division of the decision.

Notification of Reopening: NHDES will promptly rescind the closure after it is determined that the shellfish growing waters meet Nssp standards. Upon this determination, NHDES will email a reopening notice to the NHF&G Marine Fisheries Division/Durham, NHF&G Law Enforcement Division/Durham, and the NHF&G Public Affairs Division, as well as to the other individuals/organizations that received a closure notice. NHF&G will serve as the lead agency to inform recreational harvesters and the general public of any closures and subsequent reopenings. Procedures to inform the public may include such vehicles as the Clam Hotline and press releases. NHDES will assist with informing the general public via updates to the NH Coastal Atlas. DHHS will serve as the lead agency to inform the commercial shellfish industry of any closures and subsequent reopenings.

MANAGEMENT PLAN EVALUATION

This plan shall be evaluated once per year as part of the NHDES Shellfish Program's annual report.