

Rhode Island Department of Environmental Management

Office of Water Resources – Shellfish Program

2017 Shellfish Program Classification Report



GA1

Upper Narragansett Bay 2017 Annual Update

A twelve (12) year sanitary survey of the Upper Narragansett Bay Growing Area 1 was conducted in 2009. A triennial update was completed in 2015. There was a total of seventy-seven (77) actual or potential sources identified during this shoreline survey, excluding marinas. A total of twenty-eight of the seventy-seven sources were not actively flowing at the time of the shoreline survey with the remaining forty-nine having flows warranting sampling. In 2012 follow-up sampling was done of thirteen (13) sources of actual or potential pollution that were identified in the 2009 shoreline survey report. Each of these sources had results that were equal to or exceeded the recommended follow-up threshold of 240 MPN outlined in the shellfish programs standard operating procedures when sampled in 2009 for the triennial update. Sources that had results greater than 240 cfu/100ml in 2012 were investigated and only two had flows and thus sampled. Of those four sources, none of the results exceeded 2400 cfu/100ml requiring follow-up sampling. However, two (2) sources 1-202 and 1-207 originally exhibited elevated bacteria counts in 2009 (above 2400) and were resampled for the 2014 annual review. Results from 2014 were 3 cfu/100ml and NF respectively. Given the low bacteria concentrations of these sources, there was no follow-up sampling during 2015 or 2016.

The 2017 annual shoreline survey occurred on 8/31/2017 with four (4) sources (1-7, 1-202, 1-206, and 1-207) revisited and sampled (if there was flow present) that had previously elevated bacteria levels. One (1) (2017-1-007) of the four (4) sources did not have flow. Three (3) of the original four (4) sources had flow and were sampled at the time of the survey. In addition, one (1) new source 1-211, was actively flowing and sampled at the time of the shoreline survey. The four sources that were sampled had bacteria counts below 2,400 cfu/100ml, which does not warrant follow-up sampling.

The Upper Narragansett Bay Growing Area 1 was reclassified in May 2017, due to improvements in water quality after the Narragansett Bay Commission (NBC) completed Phase I and II of the CSO project which capture combined sewage in a tunnel for pump back and treatment at the Fields Point WWTF. The "Conditionally Approved" "Area B" was reclassified to "Approved" after additional wet weather monitoring showed significant improvements in bacteria levels and met NSSP criteria for Approved Shellfish Growing Areas. The Growing Area 1 conditionally approved subarea "Conimicut Triangle" was merged with Growing Area 1 conditionally approved subarea "A." Wet weather sampling and data analysis showed improvements in water quality to both conditionally approved subareas after the NBC WWTF completed of Phase I and II of the NBC CSO project, which allowed for the merge of the two subareas. The rainfall closure threshold was also increased in the conditionally approved "Area A" from 0.8 to 1.2 inches. Refer to the revised Conditional Area Management Plan (CAMP), Addendum # 3 dated July 2017 for the analysis of wet weather sampling and the rationale for reclassification of Area "B" and the revised rain criteria for Area "A".

Table 1-1Summary of 2017 Results for Growing Area 1 Upper Narragansett Bay*Highlighted sources >240 CFU/100ml.

Source ID	Date Visited	Lat	Long	Description	Receiving waters classification	Act/Pot	Dir/Ind	2009 Results MPN FC/100ml	2012 Results mTEC cfu/100ml	2014 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
1-7	8/31/2017	41.6997	-71.2918	4" Black flexible pipe 200' S Beach Rd	Conditionally Approved	Р	D	93			NF	0
1-202	8/31/2017	41.67096	-71.3743	24" RCP. Broken and overgrown.	Approved	А	D	24001	0	3	21	trickle
1-207	8/31/2017	41.67632	-71.3741	GW STREAM	Approved	А	D	4300	12	NF	450	trickle
1-206	8/31/2017	41.67457	-71.3739	6" metal pipe in stone wall at 164 Beacon Ave, Warwick. Lots of vegetation.	Approved	A	D	2			1150	0.0003
1-211	8/31/2017	41.67169	-71.3742	2" PVC on top of ground in vegetation. Heavy flow at time of survey. 42 Broadview Ave, Warwick.	Approved	А	D				1.9	0.0044

IS = In stream sample NS = Not sampled NF = No flow CNL = Could not loca

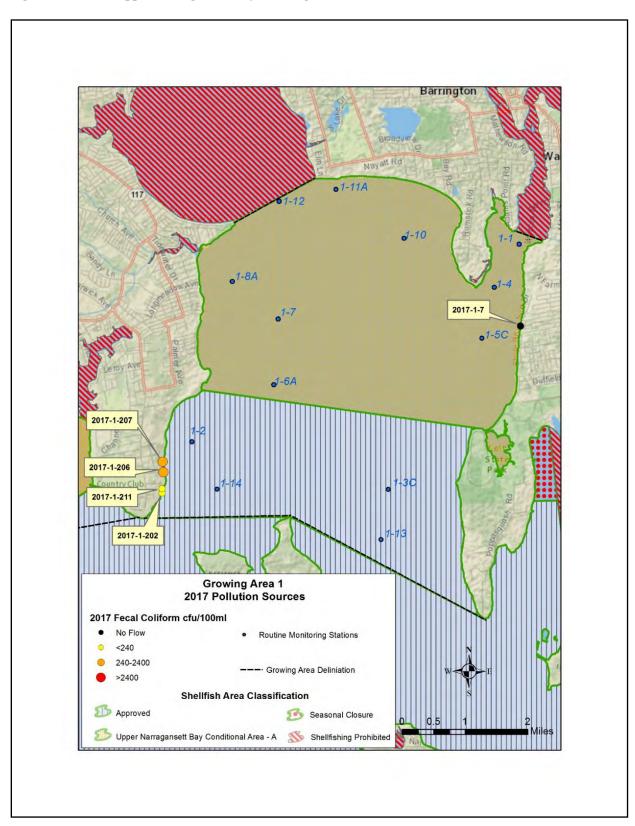


Figure 1-1 2017 Upper Narragansett Bay Growing Area 1 Pollution Sources

Table 1-2 Source 2017-1-202

Source 1-202 is a 24" broken RCP pipe located in approved waters. During the 2009 shoreline survey bacteria results from 1-202 were extremely elevated at 24001 FC/100ml. This source has been sampled multiple times since 2009 with results significantly lower than 24001 FC/100ml, as shown in the table below. Due to the consistently low (< 22 cfu/100ml) bacteria load of this source since 2012, there is no impact to the growing area waters.

Source ID	Date Visited	Description	Act/ Pot	Dir/ Ind	2009 Results MPN FC/100ml	2012 Results mTEC cfu/100ml	2014 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volum etric Flow (cfs)
1-202	8/31/2017	24" RCP. Broken and overgrown	А	D	24001	NF	3	21	Trickle

Figure 1-2 Source 2017-1-206

Source 1-206 is a 6-inch metal pipe within a stone wall. The source had dense overgrowth of Japanese Knotweed. This source had an elevated bacteria count (1150 cfu/100ml), however, the volumetric flow is very low therefore it is not impacting the growing area.

Source ID	Date Visited	Description	Act/Pot	Dir/Ind	2009 Results MPN FC/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
1-206	8/31/2017	6" metal pipe in stone wall at 164 Beacon Ave, Warwick. Lots of vegetation.	A	D	2	1150	0.0003



Figure 1-3 Source 2017-1-207

Source 1-207 is a ground water stream, which was flowing in multiple locations across a large rock outcropping and percolating through the cobble beach below. The bacteria level was elevated at this source (450 cfu/100ml) but it had a trickling flow that faded into the cobble beach before the high tide line, therefore it is not impacting the growing area waters.

Source ID	Date Visited	Description	Act/Pot Dir/Ind		2009 Results MPN FC/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)	
1-207	8/31/2017	GW STREAM	А	D	4300	450	trickle	



Marinas and Mooring Fields

The Upper Narragansett Bay Growing Area 1 does not contain any marinas. During sanitary surveys moorings are to be noted, moorings in Smith Cove and north of Bristol town beach were evaluated during the survey and determined to have no impact on the classification of waters within the Upper Bay.

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with

DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of Upper Narragansett Bay due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

Waste Water Treatment Facilities

There are no WWTF discharges directly to these growing area waters. A total of four (4) waste water treatment facilities (WWTF) up-Bay from this Growing Area that have been evaluated for their potential to indirectly impact Growing Area 1. The East Providence WWTF, the Narragansett Bay Commission Fields Point WWTF and the Narragansett Bay Commission Bucklin Point WWTF that discharge to the tidal Providence River and the Warren WWTF that discharges to the tidal Warren River. As explained further below, GA1 is not influenced by these WWTFs with the exception of the Conditional Area "A" which has criteria established based on the influence of untreated or partially combined sewer overflows

The EPA PLUMES model was used to evaluate the potential impacts from these WWTFs based on the extremely rare potential for a total loss of disinfection. The resulting impact zones are within waters classified as prohibited (i.e. the Providence River and Warren River) and do not extend into the waters of Growing Area 1. The PLUMES analysis and the resultant sizing of the prohibited closed safety zones are available for review in the program's permanent files. A review of each of these facility's performance records indicate that these plants consistently operate within their permitted limits reporting only minor infrequent exceedances. These plants are required to identify and eliminate sources of excessive infiltration and inflow, are not permitted to and have not bypassed full treatment. All of these facilities except Warren, currently provide advanced wastewater treatment. The Warren WWTF is currently being upgraded to advanced treatment which will be completed by January 1, 2020.

Portions of the collection systems to the NBC Fields Point and Bucklin Point facilities are combined sewers (i.e. were designed to collect wastewater and stormwater). When the capacity of either advanced treatment system is exceeded, both facilities have the potential to bypass flows to wet weather treatment (primary treatment and disinfection of combined sewage) and at the Bucklin Point combined sewage can also be discharged immediately upstream of the WWTF (at the North Diversion Structure). Conditional criteria were established several decades ago for Growing Area 1 – Upper Narragansett Bay based on the volume bypassed at these facilities which remains in place today despite changes in the volume of combined sewage that receives partial treatment and the increases in effective treatment of the bypassed flows. In January 2015, Phase I and II of the NBC CSO project was completed which captures combined sewage

in a storage tunnel and then is pumped back for full treatment at the Fields Point WWTF. This has nearly eliminated the bypasses at this facility and greatly reduced combined sewer overflows from this system to the extent that measurable improvements in water quality are indicated in the waters of GA1 during these wet weather conditions. Ongoing review and analysis of current treatment scenarios and conditions as a result of these improvements may allow an amendment to the existing closure triggers and will be further evaluated in 2018. Until completed the historic closure triggers as detailed in the current GA1 CAMP will be and have been adhered to. The conditionally approved area was closed well within all specified time lines and conditions as detailed in the area's CAMP.

WWTF function and performance standards of these two NBC plants reviewed annually within the Conditional Area Management Plan (CAMP) of Growing Area 1 and procedures for closing GA1 under various treatment scenarios is detailed within that document and is maintained in the shellfish programs permanent files. Records of the closures due to these by-passes of partially treated sewage are within the program's permanent records and are available for review. The CAMP was reviewed for this annual update and closures and management of this growing area were in compliance with the criteria as currently established.

GA1 Annual Statistical Analysis

HIGHLIGHTS

- * Sampled 16X under a variety of conditions during 2017 season.
- * Sampled 10X with all of Area A open during 2017 season.
- * Cold weather (February) and frequent rain (May) prevented sampling with all areas 'open' during February and May 2017.
- * Statistics represent most recent data 10/19/2016 TO 12/1/2017 (n=15) for Area A stations.
- * Improvements in water quality resulted in a change in classification of the southern portion of the Upper Bay (formerly known as Area B) from 'Conditionally Approved' to 'Approved' on May 27, 2017.
- * Improvements in water quality also resulted in an increase in the closure rainfall threshold in UpperBayAreaA from 0.8" to 1.2".
- * The conditionally area known as the Conimicut Triangle (station 1-12) was merged with Upper Bay Area A with a rainfall closure threshold increase to 1.2".Statistics for stations 1-2, 1-3C, 1-13 and 1-14 in the southern part of the Upper Bay (former Conditional Area B) calculated with the blended procedure recommended by NSSP guidance for the transition from 'Conditionally Approved' to 'Approved' waters.
- * Statistics for stations 1-2, 1-3C, 1-13 and 1-14 represent recent data collected from 1/8/2016 to 5/8/2017 when the area was in the open status (n=16 or 17) and from 6/7/2017 to 12/1/2017 (n=13 or 14).
- * All conditionally approved areas in compliance when open.
- * All approved areas in compliance.
- * All samples were analyzed by mTEC method.
- * Data run 1/9/2018.

COMMENTARY

Upper Narragansett Bay (Growing Area 1) was sampled sixteen (16) times during 2016 under a variety of conditions, with ten (10) of those occurring when all areas withinGA1 whereopen. The additionalsix(6) targeted samples were collected to characterize fecal coliform concentration under a variety of wet weather conditions and to confirm the proper classification of the area.

Improved water quality due to the completion of Phases I and II of the NBC CSO project in the Providence area resulted in a change in the classification of the southern portion of the UpperBay(Area B)from 'ConditionallyApproved' to 'Approved' in May2017. Subsequents ampling of the four stations (1-2,1-3C,1-13,1-14) in the southern portion of the Upper Bay will follow the systematic random sampling protocol recommended by the NSSP for 'Approved' areas.

Water quality improvements also resulted in elimination of the former Conimicut Triangle conditional area. This area was merged with Upper Bay Area A, and the closure rainfall threshold for Area A was increased from 0.8" to 1.2".

RECOMMENDATIONS

- * All 'Conditionally Approved' stations in compliance and conformance when open.
- * All 'Approved' stations in compliance.
- * Continue additional wet weather sampling to track fecal coliform concentration response to rain and completed construction of the CSO project capturing and pumping back combined sewage and stormwater to the plant for treatment.
- * Focusmonitoringonupperlevelrainevents(>2.0") atdays4and5to compliment data set on recovery time.
- * Modifymanagementclosurecriteriaofautomaticre-openingfollowingrain events>3.0" from ten days to sample in compliance with approved criteria and 2 days for depuration. Details to be included in CAMPre-assessment. See additional response to rainfall discussion this document.

RIDEM SHELLFISH GROWING AREA MONITORING: GA1

Upper Bay Area A when open (10/19/2016 to 12/1/2017; all mTEC) Recent 15 when open:

			FECAL-GEO)
Station Name	Status	N	MEAN	%>CRITICAL 31
GA1-1	CA	15	2.8	0.0
GA1-4	CA	15	2.8	0.0
GA1-5C	CA	15	2.4	0.0
GA1-6A	CA	15	2.4	0.0
GA1-7	CA	15	2.6	0.0
GA1-8A	CA	15	6.7	0.0
GA1-10	CA	15	2.7	0.0
GA1-11A	CA	15	3.7	0.0
GA1-12	CA	15	3.4	0.0

Upper Bay (1/8/2016 to 12/1/2017; all mTEC)

Area B, transition to 'APPROVED' status. Statistics calculated on recent 30 samples. Per ISSC guidance, statistics include blend of samples (n=9) collected after May 27, 2017 change to approved status and samples (n=21) collected when station was 'open' prior to May 27, 2017.

			FECAL-GEC)	
Station Name	Status	N	MEAN	90 th Percentile (<31)	Weather
GA1-2 dry	А	30	2.6	6.5	13 wet, 17
GA1-3C dry	A	30	2.7	6.5	13 wet, 17
GA1-13 dry	А	30	2.5	6.1	14 wet, 16
GA1-14 dry	А	30	2.5	7.1	14 wet, 16

Response to rainfall in Area A.

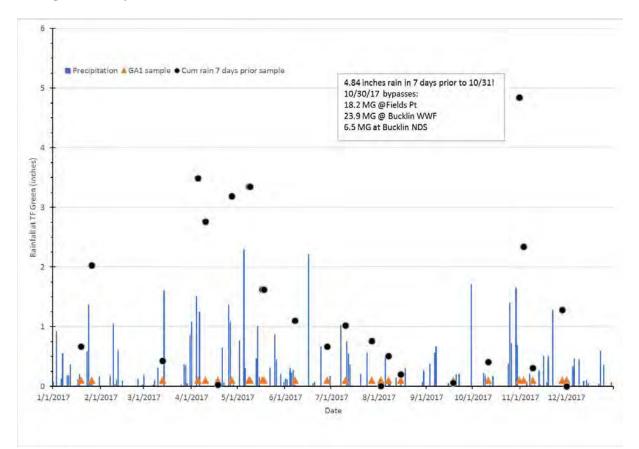
We have sampled at least one station in the Upper Bay (GA1 Area A & B) within 7 days of 1" or greater rainfall 26 times since January 2010 (Phase 1 upgrade start). Rainfall events included 10 events at 1.0-1.5", 5 events at 1.5-2.0", 4 events at 2.0-2.5", and 1 storm at 2.5-3.0" of rain. 2017 was a relatively wet year, with 49.0" of rain reported at TF Green (compared to a long-term mean of 48.05") and 2017 was the first above long-term average rainfall year since 2011 and 7 of the 26 greater than 1" rain events sampled since 2010 were sampled during 2017. Fecal coliform results for these greater than 1" rain samples are listed below:

Rain	Days									•	
(inches)	after	Date	1	10	11A	12	4	5C	6A	7	8A
1.42	5	03/09/10	2	2	9	2	4	2	2	4	2
1.34	6	07/05/12	2	2	4	2	2	4	2	9	2
1.09	2	08/07/12	2	2	2	2	4	2	2	2	2
1.03	1	04/22/15	7	40	34	28	10	16	42	22	90
1.03	2	04/23/15	6	2	2	34	4	2	2	2	2
1.03	3	04/24/15	4	4	18	8	2	2	2	4	2
1.27	2	06/23/15	6	22	20	4	4	8	2	5	2
1.27	3	06/24/15	16	2	2	10	9	6	2	2	4
1.27	4	06/25/15	4	4	4	4	12	4	2	10	4
2.07	2	06/30/15	14	2	2	6	10	4	2	2	8
1.55	1	03/16/16		2		7				4	2
1.55	1	03/17/16	38	2	12	11	31	6	4	2	2
1.50	3	06/02/16							2		
1.70	4	07/27/16							2		
1.06	1	09/02/16	2	2	2	8	2	2	2	4	6
1.09	4	10/05/16							2		
1.13	2	11/17/16	2	2	2	20	6	2	2	2	2
1.58	3	12/02/16	12	24	13	10	12	4	2	5	2
1.95	1.5	01/26/17	5	25	46	22	2	4	6	2	36
2.45	1	04/27/17	46	22	11	140	18	6	26	120	200
2.96	1.5	05/08/17	90	134	96	240	96	40	48	165	58
2.96	2.5	05/09/17	33	20	18	84	46	16	48	33	27
1.01	2.5	07/10/17	2	2	2	10	2	2	2	2	2
1.19	4	10/04/17				2					
2.34	1	10/31/17	160	1300	1360	1500	400	760	220	240	92
2.36	5	11/03/17	20	90	48	50	16	36	34	31	33

Fecal coliform results in Upper Narragansett Bay "Area A" during rain events greater than 1-inch.

Elevated fecal coliform after ~2.4+" of rain is evident (examples: 5/8/17, 10/31/17). The 10/31/17 samples were unusually high. These samples were collected 1 day after 2.34" rain, but there were a series of rain storms prior to that date with a total of 4.84" of rain cumulative in the 7 days prior to the sample and more than 48 million gallons (MG) in bypass volume, including 6.5 MG at Bucklin NDS, that likely contributed to the elevated fecal coliform.

Precipitation events at TF Green rain gauge in relation to sampling events of the Upper Narragansett Bay "Area."

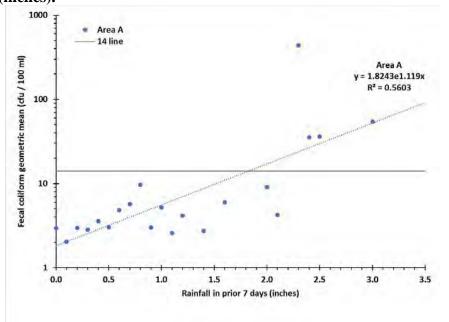


Even with the high proportion of wet weather (<0.5" rain in prior 7 days) samples in the 2017 recent 30 data set, most stations in the Upper Bay would meet criteria if the area was managed as 'Approved'. Results of the recent 30 samples (Figure 1-10) show that all upper Bay stations would meet the geometric mean criteria and most stations meet the variability criteria. Stations 7 and 8A (north of Rocky Point on NW side of upper Bay) were just slightly above the variability criteria of 31. Stations 10, 11A and 12 in the region close to the Providence River from Conimicut Point east to Barrington Beach on the northern side of the upper Bay exceeded the variability criteria. This suggests that the current classification with Area A classified as 'Conditionally Approved' and closing at 1.2" of rain is protective of public health. Evaluation of recent data for Area B, classified as 'Approved' since 2017 indicate that the 'Approved' classification is appropriate for Area B.

Upper Narragansett Bay routine monitoring station variability results from the most recent 30 samples (as of 1/18/2018).

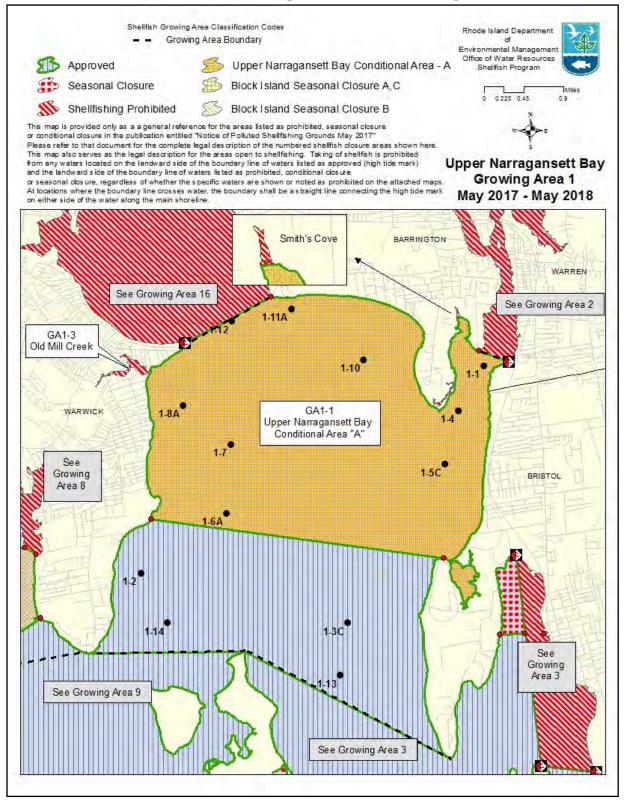
Recent 30	Recent 30 samples, all weather, data 6/8/16 to 21/1/17										
			#wet/#dr								
Area	Station 1-	n	У	GeoMean	90th %tile						
Area A	1	30	18/12	4.5	23.7						
Area A	10	30	18/12	5.6	44.6						
Area A	11A	30	18/12	5.9	40.9						
Area A	• 12	30	17/13	9.4	87.7						
Area A	4	30	18/12	4.6	25.6						
Area A	5C	30	18/12	3.8	20.7						
Area A	6A	30	19/11	4.3	22.2						
Area A	7	30	18/12	4.5	32.6						
Area A	8A	30	18/12	5.2	33.7						
Area B	2	30	19/11	3.7	13.5						
Area B	3C	30	17/13	4.1	19.9						
Area B	13	30	17/13	3.6	17.3						
Area B	14	30	19/11	3.6	15.2						

A regression analysis was completed to quantify fecal coliform concentration response to rainfall in Area A. Rainfall within the 7 days prior to sample collection was grouped into 0.1" bins and the geometric mean fecal coliform response was calculated from all samples in that bin (Figure 1-11). Data are from January 2010 (Phase 1 start) through December 2017. On average, Area A is predicted to cross the 14 cfu/100 ml fecal coliform threshold at a rainfall of ~1.8". The mean rain-fecal response curve (Figure, below) indicate that the current 'Conditionally Approved' classification of Area A with a rainfall closure of 1.2" is protective of public health.



Fecal coliform in Upper Narragansett Bay "Area A" in relation to rain fall amounts (inches).

2017-2018 classification map and routine monitoring stations.



Growing Area 2 Barrington, Palmer and Warren Rivers 2017 Annual Update

All waters of the Barrington, Palmer and Warren Rivers, Growing Area 2 area currently prohibited to shellfishing. The area was sampled four times in 2016 during dry weather conditions. Sampling occurred twice in 2017 with both during wet weather conditions. Results from existing sampling indicate that based on the most recent 15 samples during all weather, 8 out of 14 stations are in compliance and during dry weather only 9 out of 14 are in compliance.

A bi-state monitoring effort of the lower Palmer River watershed in Massachusetts, was begun in 2012 and three dry weather surveys of the entire Palmer River watershed were conducted in 2012 and 2013. More recent sampling led by RIDEM and MADEP has targeted specific areas with elevated bacteria concentrations. This included several canoe trips on the lower Palmer River below Shad Factory Pond and targeted sampling along both the main stem lower Palmer River, Torrey Creek, and Rocky Run. In 2015, multiple samples were taken at different tides at eight stations in this target area. While these monitoring efforts have helped to identify specific reaches of the river and its tributaries associated with elevated bacteria levels, they have not been helpful in identifying specific sources. In December 2015, EPA coordinated a meeting between MADEP, RIDEM, EPA, and MA office of NRCS to update organizations on the project and to plan next steps to identify bacteria sources. The discussion of 2016 filed work focused on identifying agriculturally-related source areas of nutrients and bacteria to help target the NWQI (National Water Quality Initiative) outreach efforts. In the Upper reaches of this growing area extensive study and focus has been initiated, and further work by RIDEM in cooperation with EPA and NRCS still needs to be done to address the impacts noted in the bi-state TMDLs with regards to non-point discharges and agricultural BMPs.

Major accomplishments through the above-mentioned efforts have resulted in completion of several agricultural BMPs having been implemented in the upstream watershed. These mitigation efforts should reduce bacteria loadings to the watershed and result in improved water quality. Efforts will be made to sample the growing area more frequently this season to document these results with the goal of re-classifying some of this growing area.

Growing Area 2 is within the receiving waters of the Warren Waste Water Treatment Facility; the analysis to determine the necessary dilution zone for compliance with the NSSP MO is contained in the program's permanent files. EPA's PLUMES model was utilized in determining the extent of impacts of the WWTF discharge in the event of an upset in treatment at the plant should it occur. All impacted waters are classified as Prohibited within this growing area. Performance records of plant treatment quality and records of any unusual events at the plant that would cause a discharge of partially treated sewage are maintained by the department's operations and maintenance division and reported immediately to shellfish staff should such an unlikely event occur. There were no reports of permit violations warranting re-evaluation of the prohibited zone. Treatment plant upgrades to reduce Total Nitrogen loads is estimated for completion by January 1, 2020.

In addition to the Warren WWTF there are numerous marinas and mooring fields located within the confines of GA-2, mostly concentrated in the lower reaches of the Warren and Barrington Rivers. As you travel north beyond the bridges of Route 103 water depths and access heights

limits the accessibility of larger vessels in the Palmar River and the large shallower coves of the Barrington River. Numerous day use vessels are docked or moored along the riparian shorelines of both rivers. The potential impacts from the existing commercial docks and marinas has been evaluated and waters adjacent to these facilities are within the closed prohibited zones providing adequate protection in the case of any discharges associated with marine vessels. Details of this analysis can be found in the program document entitled "Evaluation of Waters Adjacent to Marinas – Marine Dilution Analysis Background June 2017."

Annual Statistical Analysis

HIGHLIGHTS

- * Sampled 2X during 2017
- * Statistics represent recent 15 combined wet and dry weather data 5/25/2012 to 9/25/2017,7 wet weather and 8 dry weather samples. Samples analyzed by mTEC=14 and MPN=1 sample
- * Area is currently classified as 'Prohibited'
- * Statistics also calculated for recent 15 samples collected during dry weather (<0.5" rain in prior 7 days) only during (8/25/2008 to 9/13/2016) for informational purposes; 8 mTEC and 7 MPN.
- * Data run 12/26/2017.

COMMENTARY

The Barrington, Palmer and Warren Rivers (Growing Area 2) were sampled twice during 2017. Both samplingrunswere conducted during wetweather (greater than 0.5" rainfall in 7 days prior to sampling). The stations in the Barrington River (stations 1-5) and the Palmer River (stations 6-8) were downgraded from conditionally approved to prohibited 15 years ago due to declining water quality. ATMDL study of the area was completed in 2002, with a recommendation to monitor shellfish growing waters to track changes in water quality. Results of sampling since 2003 indicate that many stations in the area are out of compliance during wet weather. Up-river stations (1 and 1A in the Barrington River and stations 7, 6 and 6A in the Palmer River) are also out of compliance during dry weather. TMDL work in RI and MA portions of the watershed continue in an effort to improve water quality. Given current water quality and the unpredictable fecal coliform response after rainfall, the area is properly classified.

RECOMMENDATIONS

- * Maintain closure of the Barrington River and Hundred Acre Cove.
- * Maintain closure of the Palmer River.
- * Complete six (6) systematic random sampling trips per year to support TMDL efforts and to track water quality changes.

RIDEM SHELLFISH GROWING AREA MONITORING: GA2

(5/25/2012 to 9/	/25/2017; 1	4 mTEC, 1	mpn; 7 wet and	8 dry weather)
			FECAL-GEO	
Station Name	<u>Status</u>	N	MEAN	<u>%>CRITICAL 32</u>
GA2-1	Р	15	17.1	20.0
GA2-1A	Р	15	5.9	13.3
GA2-2	Р	15	5.0	6.7
GA2-3	Р	15	5.7	6.7
GA2-4	Р	15	3.4	0.0
GA2-5	Р	15	3.8	6.7
GA2-6	Р	15	30.4	53.3
GA2-6A	Р	15	103.6	80.0
GA2-7	Р	15	6.7	20.0
GA2-7A	Р	15	5.3	13.3
GA2-8	Р	15	3.9	0.0
GA2-9	Р	15	3.3	0.0
GA2-10	Р	15	2.5	6.7
GA2-13	Р	15	3.3	6.7

Recent 15 all weather (5/25/2012 to 9/25/2017; 14 mTEC, 1 mpn; 7 wet and 8 dry weath

Recent 15 dry weather (<0.5" rain prior 7 days) only

(8/25/2008 to 9/13/2016; 8 mTEC, 7 mpn)

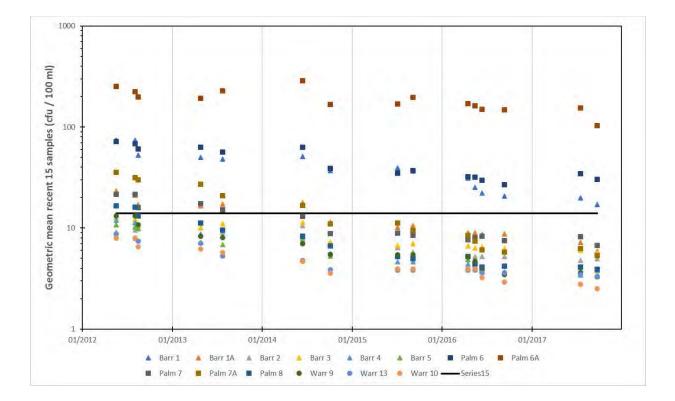
			FECAL-GEO	
Station Name	<u>Status</u>	N	MEAN	<u>%>CRITICAL 38</u>
GA2-1	Р	15	19.2	40.0
GA2-1A	Р	15	6.1	20.0
GA2-2	Р	15	4.3	6.7
GA2-3	Р	15	5.0	6.7
GA2-4	Р	15	4.4	0.0
GA2-5	Р	15	5.2	6.7
GA2-6	Р	15	21.9	26.7
GA2-6A	Р	15	121.7	86.7
GA2-7	Р	15	6.0	6.7
GA2-7A	Р	15	9.2	20.0
GA2-8	Р	15	7.9	0.0
GA2-9	Р	15	4.7	6.7
GA2-10	Р	15	3.5	6.7
GA2-13	Р	15	5.5	6.7

Summary of GA2 data 2008 to 2018

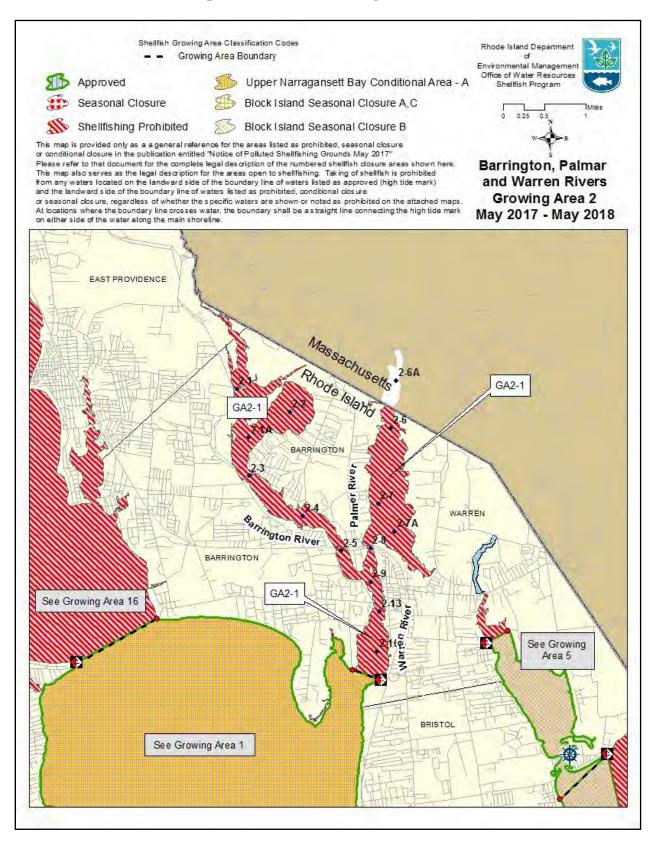
Brief analysis of GA2 fecal coliform suggests that fecal concentration may be improving, but levels still above compliance levels at most Palmer stations and up-river Barrington stations. Table of fecal coliform geometric mean (cfu/ 100 ml) calculated by station and year (2-4 samples per year) in GA2 2008-2017. Change from MPN to MTEC occurred during summer 2012.

	-		1	1	0.		
			BARRINGT	ON			
Year	1		1A	2	3	4	5
2008		34.1	13.6	2.9	8.8	11.9	15.0
2009		41.6	37.8	35.1	30.7	19.5	20.2
2010		114.1	27.0	33.4	17.9	15.7	11.6
2011		104.5	18.7	4.4	7.6	9.4	9.7
2012		28.1	9.4	5.4	5.8	4.1	2.4
2013		9.8	5.7	2.0	4.5	2.0	2.8
2014		5.7	3.5	11.0	4.9	2.0	4.5
2015		167.6	16.7	13.7	25.3	8.0	14.7
2016		12.6	6.3	2.4	3.3	2.6	2.8
2017		14.8	3.5	4.9	5.1	6.9	3.7
			PALMER				
Year	6A		6	7	7A	8	
2008		300.0	33.4	15.4	16.8	20.7	
2009	1	123.7	205.6	81.4	309.6	43.6	
2010	1	373.5	444.7	19.3	44.2	20.2	
2011	1	307.4	29.3	7.8	15.6	12.0	
2012	1	142.3	30.0	14.7	11.3	3.7	
2013		219.1	26.5	3.7	2.8	2.0	
2014	1	24.0	15.5	4.5	4.9	4.0	
2015		1106.3	309.8	14.1	15.4	7.5	
2016	1	73.2	9.8	3.9	2.0	4.6	
2017		56.6	46.0	13.4	12.2	3.2	
			WARREN				
Year	9		13	10			
2008		20.0	10.7	6.8			
2009		29.3	50.1	40.3			
2010		6.5	5.6	3.0			
2011		13.3	5.0	7.5			
2012		3.5	3.1	2.9			
2013		2.8	2.8	2.0			
2014		3.5	2.8	2.8			
2015		7.9	8.2	8.1			
2016		2.0	3.0	2.0			
2017	L	6.0	2.8	2.0			
2017	1	6.0	2.8	2.0	1.0		

Plot (below) shows the fecal coliform geometric mean of recent 15 samples for each station in GA2 during 2008-2017. Limited sampling indicated that there may be a declining fecal coliform concentration trend at many stations. Up-river Palmer River stations (6, 6A,7 square symbols) and the upper Barrington River (station 1, 1A) continue to have fecal coliform abundance far above compliance levels. Warren River (circle symbols) and lower Barrington River (triangle symbols) and lower Palmer River (squares) stations meet geometric mean compliance for recent 15 (marina and WWTF closures remain). Stations 1, 1A, 6, 6A, 7, 7A also exceed on variability criteria (data not shown).



2017-2018 classification map and routine monitoring stations.



Growing Area 3 East Middle Bay 2017 Annual Update

A 12-year sanitary shoreline survey of the East Middle Bay Growing Area 3 was conducted in 2010 and a Triennial Update was performed in 2016. A total of sixty-one (61) actual or potential sources were identified during the 2016 shoreline survey, excluding marinas. Forty-five (45) of the sources were not actively flowing at the time of the survey with the remaining sixteen (16) having flows warranting sampling. Of the sixteen (16) sources sampled, eight (8) sources exceeded the 240 MPN/100ml threshold and six (6) of those eight (8) sources were located in approved waters, which required a follow-up sampling in 2016. Only one of the sources was actively flowing when resampled (2016-3-039) and remained with levels above 240 MPN/100ml but had a significantly decreased Fecal coliform (FC) result from the 2010 sampling.

During the 2017 annual shoreline survey a total of eight (8) sources were visited and of those one (1) source did not have any flow and one (1) was not found. The remaining six (6) sources had bacteria levels < 2,400 cfu/100 ml, which did not require any follow-up sampling. Two (2) of the sources (3-201 and 3-209) had bacteria levels above 240 cfu/100 ml, which will require a follow-up sampling during the 2018 shoreline survey. Source 3-201 if it were discharging to the bay it would be into prohibited waters, however both sources with elevated bacteria levels were not discharging into the bay, the sources ending and dissipating into the bach above the high tide line, and thus not impacting the growing area.

Table 1-1 Summary of 2017 Results for Growing Area 3 East Middle Bay

*Highlighted sources >240 CFU/100 ml.

Source ID	Date visited	Lat	Long	Description	Receiving Waters Classification	Act/ Pot	Dir/ Ind	2010 Results MPN FC/100ml	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
2017-3- 018	9/5/2017	41.676523	- 71.278998	18" RCP outfall in rip rap wall from storm drain. Rubber sleeve attached over pipe.	Prohibited	Р	D	23000	Prohibited - not sampled	NF	0
2017-3- 005	9/5/2017	41.671609	- 71.279752	36" diameter RCP storm drain from under condo building	Prohibited	А	D	15000	Prohibited - not sampled	CNL	
2017-3- 201	10/2/2017	41.573334	71.288054	Stream at R/R trestle Burma (Defense Drive) Road. In 2017, stream was not flowing into receiving waters. Ended ~50' from shore in a "pond" on beach. Possibly seeping underneath sand.	Prohibited	А	D	4600	0	1000	0
2017-3- 060	12/18/2017	41.638267	-71.28085	Stream draining saltwater marsh on south side of Hog Island	Approved	А	D	2400	0	100	0.189
2017-3- 301	12/18/2017	41.58155	-71.32109	24" diameter RCP 50 yards north of #301	Approved	А	D	2400	0	<100	0.315
2017-3- 301IS	12/18/2017	41.58155	-71.32109	In-Stream	Approved	А	D			100	
2017-3- 039	9/5/2017	41.66195	-71.29524	Stream draining wetland	Approved	А	D		500	100	0.085
2017-3- 209	10/2/2017	41.59298	-71.28131	Stream from upland pond. In 2017, stream ended ~50' from shore.	Approved	А	D		0	800	1.214
2017-3- 209IS	10/2/2017			In-stream taken at shore closest to stream	Approved	А	D			99	
2017-3- 300	12/18/2017	41.58139	-71.32201	Stream just north of pier 48" RCP	Approved	А	D		0	30	1.518
2017-3- 300IS	12/18/2017	41.58139	-71.32201	In-Stream	Approved	А	D		0	<100	1.518

IS = In stream sample NS = Not sampled NF = No flow CNL = Could not locate

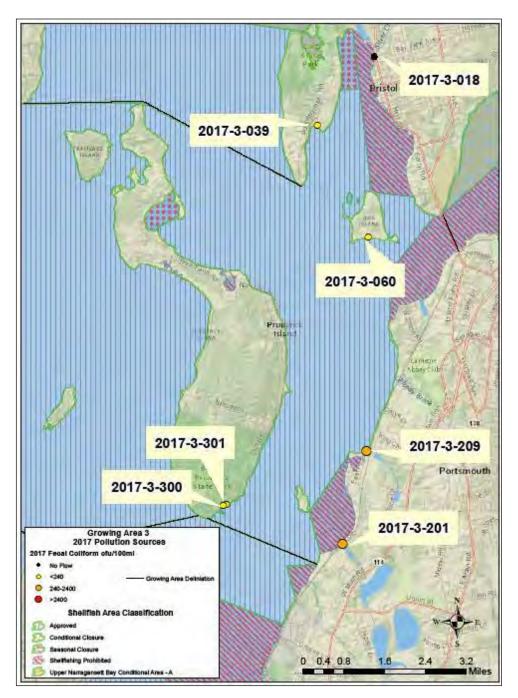


Figure 1-1 2017 East Middle Bay Growing Area 3 Pollution Sources.

Figure 1-4 Source 2017-3-201

Source 3-201 is a stream that drains from the Lawton Valley Reservoir into Prohibited shellfishing waters. However, during the 2017 sampling the stream flowed into a pond on the beach approximately 50 feet from the shoreline. The source is not discharging into the receiving waters; thus, it is not directly impacting the shellfish growing area.

Source ID	Date visited	Description	Act/Pot	Dir/Ind	2010 Results MPN FC/100ml	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
2017- 3-201	10/2/2017	Stream at R/R trestle Burma (Defense Drive) Road. In 2017, stream was not flowing into receiving waters. Ended ~50' from shore in a "pond" on beach. Possibly seeping underneath sand.	A	D	4600	0	1000	0



Figure 1-5 Source 2017-3-209

Source 3-209 is a stream that drains the upland Melville Pond next to the New England Boat Works in Portsmouth. During the 2017 survey the stream ended approximately 50 feet from the shoreline in a basin on the beach. The source is not discharging into the receiving waters; thus, it is not directly impacting the growing area.

Source ID	Date visited	Description	Act/Pot	Dir/Ind	2010 Results MPN FC/100ml	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
2017- 3-209	10/2/2017	Stream at R/R trestle Burma (Defense Drive) Road. In 2017, stream was not flowing into receiving waters. Ended ~50' from shore in a "pond" on beach. Possibly seeping underneath sand.	A	D		0	800	1.214



Marinas and Mooring Fields

There are several recreational and commercial boating areas that have the potential to negatively impact the ambient waters of East Middle Bay. There are currently four (4) pump-out facilities located within the area of Bristol Harbor: Bristol Marina Boat, Stone Harbor Marina, Rockwell Town Pier, and the Bristol Town pump-out boat. For additional information refer to the 2017

RIDEM Pump-out Facilitates Report which evaluates the area's compliance with Rhode Island's "No Discharge" policies.

To account for illicit discharges, dilution calculations were completed for all marinas and destination mooring fields in the growing area. For details on these calculated dilution areas and the rationale for assumptions made to complete these calculations, refer to the RIDEM Office of Water Resources Shellfish Program document entitled *Marina Dilution Analysis Background* (June 2017). Eight (8) of the marinas are located within the prohibited waters of Bristol Harbor, in which the closure area is more than adequate to meet the fecal coliform level in the event of an accidental discharge from an occupied vessel. The two (2) remaining marinas within Bristol Harbor are within the seasonally closed area in the western part of the harbor, this additional seasonal closure provides adequate dilution for the summer boating season. Finally, the two remaining marinas within East Middle Bay are within prohibited waters again with ample area for dilution. In addition to the slip counts for the identified marinas the numerous moorings located within Bristol harbor were included in the dilution calculations.

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of East Middle Bay due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

The shoreline survey for 2017 indicates that Growing Area 3 is properly classified and that all pollution sources have accurate dilution zones established and no additional closure areas are warranted. A seasonal closure in the northwest portion of Bristol Harbor is due to the numerous slips and moorings associated with the Bristol Marina and Yacht Club that occupy this area of Bristol Harbor only during the summer boating season.

Wastewater Treatment Facilities

The most significant point source discharge into this growing area is from the Bristol wastewater treatment facility located in Bristol Harbor discharging to Walker Cove. Routine monitoring station 3-8 is located at this discharge location, and the sample is taken within the discharge plume. EPA's PLUMES model was utilized in determining the extent of impacts of the Bristol WWTF discharge in the event of an upset in treatment at the plant should it occur. Any impacted waters are classified as Prohibited. Performance records of plant treatment quality and records of any unusual events at the plant that would cause a discharge of partially treated sewage are maintained by the department's operations and maintenance division and reported immediately to shellfish staff should such an unlikely event occur. There were no reports of permit violations warranting re-evaluation of the prohibited zone. The facility is permitted to discharge a maximum flow of 3.79 MGD (million gallons/day) of treated effluent. The average daily flow for 2017 was 2.8 MGD, which is within the permit limits. However, daily maximum violations have occurred during wet weather events. In 2016, Bristol completed upgrades to the facility's disinfection system in order to address these FC violations. Additional upgrades are expected to be completed in 2018.

The Bristol WWTF and associated infrastructure has experienced several sanitary sewer overflows due to wet weather conditions and infiltration overloads throughout the facilities catchment area. These overflows and treatment interruptions are documented in the shellfish program's permanent files and associated emergency closures and re-opening records relating to each event are filed chronologically. RIDEM shellfish program evaluated each incident of permit violation or SSO and appropriately closed impacted shellfish waters in accordance with the guidance contained within the NSSP Model Ordinance. Shellfish waters did not reopen to harvest until waters returned to pre-event conditions and sufficient time had elapsed for shellfish to self-depurate. In the case of a discharge of raw untreated sewage, MSC was used to ensure viral loads had dissipated in shellfish prior to re-opening in addition to FC levels in the shellfish waters returning to approved conditions or for a minimum of 21 days.

Annual Statistical Analysis

HIGHLIGHTS

- * Sampled 6X during 2017.
- * Statistics represent recent 30 combined wet and dry weather data 12/2/2012 to 9/25/2017 for approved stations
- * Statistics represent recent 15 combined wet and dry weather data when the area was open 2/22/2013 to 9/25/2017 for conditionally approved stations.
- * All approved and conditionally/seasonally approved stations in compliance and conformance.
 - * All samples analyzed by mTEC method (90^{th} percentile criteria = 31 cfu / 100 ml)
 - * Data run 12/22/2017.

COMMENTARY

East Middle Bay (Growing Area 3) was sampled 6 times during 2016, in compliance with systematic random sampling monitoring requirements for approved areas. The 2017 statistical evaluation includes the most recent 30 samples collected during both wet and dry weather (21 wet, 9 dry weather) since 12/2/2012. Two stations in GA3 (3-7 and 3-12) are classified as seasonally approved. The statistical analysis for these stations includes the most recent 15 samples collected when the area was open. Samples included those collected during both wet and dry weather (12 wet and 3 dry weather) since 2/22/2013.

Elevated fecal coliform levels have resulted in a shell fishing closure in a small tidal creek, Nag's Creek, located on the north side of Prudence Island. The DEM Department of Water Resources collaborates with the Narragansett Bay Estuary Program to conduct field sampling at five tidal creek stations to assess the bacterial water quality in tidal creeks on Prudence Island. 2017 evaluation of Prudence Island data has indicated that fecal coliform levels at most stations exceed NSSP criteria and that the Nag's Creek is correctly classified as prohibited for the direct harvest and consumption of shell fish. A second Prudence Island tidal creek, Jenny's Creek, transits the island and discharges on the south side of the island. It is managed as a Shell fish Management Area and is closed to shell fish harvest except for the harvest of bay scallops by dip netting in season.

Results of the 2017 statistical evaluation indicate that all approved and seasonally approved stations in Growing Area 3 are in compliance and that the areais properly classified.

RECOMMENDATIONS

- * No action recommended based on 2017 monitoring results.
- * Continue collaboration with Narragansett Bay Estuary Program to sample Nag'sCreekand Jenny'sCreeksixtimesperyear.

RIDEM SHELLFISH GROWING AREA MONITORING: GA3

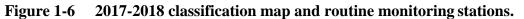
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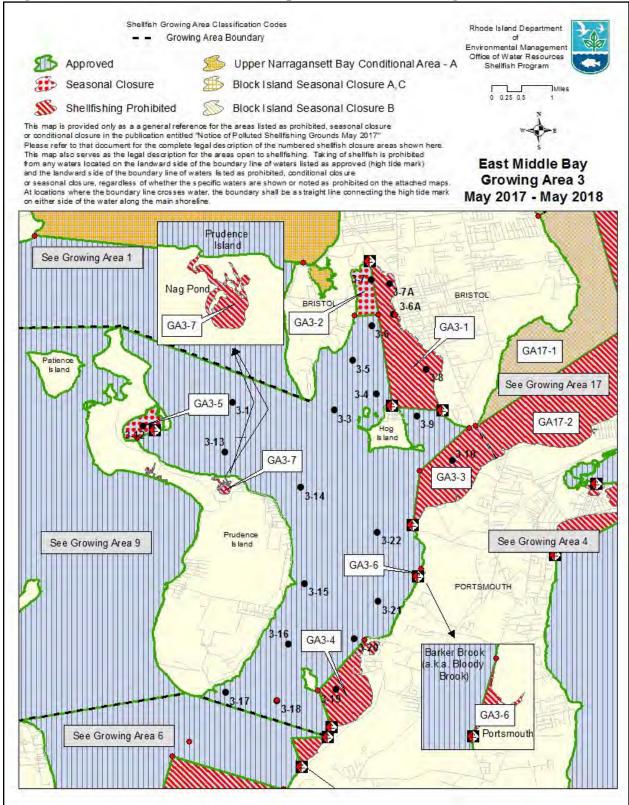
	0,2010 00 11	FECAL-GEO						
Station Name	<u>Status</u>	\underline{N}	MEAN	90 th Percentile (<31)				
GA3-1	А	30	3.1	12.9				
GA3-3	А	30	2.6	5.6				
GA3-4	А	30	2.4	4.0				
GA3-5	А	30	2.2	4.0				
GA3-6	А	30	2.7	8.5				
GA3-6A	Р	30	3.1	12.0				
GA3-7	SA	30	2.7	10.0				
GA3-7A	Р	30	3.9	24.1				
GA3-8	Р	30	5.7	52.8				
GA3-9	А	30	2.3	3.9				
GA3-10	Р	30	2.2	3.4				
GA3-12	SA	30	2.4	4.2				
GA3-13	А	30	2.4	5.5				
GA3-14	А	30	2.6	6.4				
GA3-15	А	30	2.2	3.7				
GA3-16	А	30	2.3	3.7				
GA3-17	А	30	2.4	4.3				
GA3-18	А	30	2.4	4.9				
GA3-19	Р	30	2.4	5.2				
GA3-20	А	30	2.2	3.5				
GA3-21	А	30	2.4	4.2				
GA3-22	А	30	2.2	3.8				

(12/2/2012 or 6/26/2013 to 11/30/2017; all mTEC, 21 wet and 9 dry weather) FECAL-GEO

Seasonally Approved stations, recent 15 when open (2/22/2013 to 5/18/2017, all mTEC, 12 wet and 3 dry weather)

		1	FECAL-GEO	
Station Name	Status	N	MEAN	%>CRITICAL 31
GA3-7	SA	15	2.5	0.0
GA3-12	SA	15	2.6	0.0





Growing Area 4 Sakonnet River 2017 Annual Update

A twelve (12) year sanitary shoreline survey of Growing Area 4 the Sakonnet River was conducted in 2013 and a triennial update was performed in 2016. There was a total of one hundred and sixty-seven (167) actual or potential sources identified during the 2013 shoreline survey, excluding marinas. One-hundred and eight (108) of the sources were not actively flowing at the time of the shoreline survey with the remaining fifty-nine (59) having flows warranting sampling. Fourteen (14) of the sources from the 2013 survey had results greater than 240 cfu/100ml and of those sources five (5) were located in prohibited areas of the growing area. The remaining eight (8) sources did not have bacteria counts exceeding 2400 cfu/100ml, which would warrant follow-up sampling. One source (4-702) resulted in an elevated bacteria concentration (> 2400 cfu/100ml) requiring a follow-up sampling in 2014. However, at the time of the follow-up visit there was no flow coming from the pipe.

The 2016 triennial shoreline survey re-evaluated twenty-seven sources within the growing area and identified any new pollution sources. Six (6) of the twenty-seven (27) sources were located within the "Prohibited" sections of the growing area and were not resampled in the 2016 triennial update. Twenty-one (21) sources were revisited and sampled plus an additional three new sources. For the 2017 annual update a total of eleven (11) sources were revisited and sampled if feasible. Six (6) of the sources had no flow and one (1) did not exist anymore. Two (2) sources had Fecal coliform levels > 2400 cfu/100ml and two sources had Fecal coliform levels > 240 cfu/100ml. Two (2) of the sources (2017-4-540E and 2017-4-540W) were stagnant water that had pooled onto the beach so were not impacting the growing area. One (1) of the sources (2017-4-710) had a bacteria count of 1100 cfu/100ml and a trickling flow, however, upon a follow-up sampling, the bacteria count dropped to 100 cfu/100ml with a volumetric flow of 1.53 cfs and an instream result of 31 cfu/100ml. Source 2017-4-540 had an elevated bacteria count (5500 cfu/100ml) during the first sampling with a flow rate of 2.55 cfs and upon resampling the bacteria count decreased to 1090 cfu/100ml but the flow rate increased to 15.69 cfs. A third sampling of source 4-540 was conducted 5/8/2018 and the bacteria count was 91 cfu/100ml at the source and 24 and 2 cfu/100ml at the south and north instream samples, respectively. This source is an intermittent stream with varying flows throughout the year. Installation of new culverts in the connector road was performed during the spring of 2018 with the intention of improving drainage within the saltmarsh and Maidford River. Dredging and expansion of the channel was included in the proposed action for Sachuest Point Restoration. All of these improvements will most likely affect the consistency of flow at sources 4-540 and 4-550. potentially impacting bacteria counts. A second follow-up visit in 2018 upon the completion of the Sachuest Point Restoration, the outflow at 4-540 was again pooled on the beach and not reaching the receiving waters. This source is an intermittent stream which should be followedup during the annual shoreline survey.

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural

lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of the Sakonnet River due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

Table 1-1 Summary of 2017 Results for Growing Area 4 Sakonnet River

*Highlighted sources >240 CFU/100ml.

Source ID	Date Visited	Lat.	Long.	Description	Receiving waters classification	2013 Results mTEC cfu/100ml	2014 Results mTEC cfu/100ml	2015 Results mTEC cfu/100ml	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
2017-4- 104	11/2/2017	41.6186	-71.2405	36" RCP storm drain at end of ROW/ steel pipe underneath	Prohibited	440				124	0.0044
2017-4- 540	10/2/2017 Follow-up: 5/8/2018	41.4908	-71.2475	Stream from uplands wetland. Not flowing through culvert. Culvert filled with sand. Stream diverges away through bird sanctuary and empties into wetland/pond near 3rd Beach boat ramp.	Approved	0	NF	NF	NF	5500 Follow-up: 91	2.55 Follow-up: 12.75
2017-4- 540E	11/2/2017 Follow-up: 5/8/2018	41.4908	-71.2475	Stagnant water in culvert after rainfall. East side of culvert. Water cloudy.	Approved					1640 Follow-up: 2	Stagnant
2017-4- 540W	11/2/2017 Follow-up: 5/8/2018	41.4908	-71.2475	Stagnant water in culvert after rainfall. West side of culvert. Full of debris and floating grey sediment.	Approved					3300 Follow-up: 24	Stagnant
2017-4- 550	5/8/2018	41.48569 5	-71.243522	Beach side of the culvert- discharging into receiving waters	Approved					100	Couldn't measure
2017-4- 550W	5/8/2018	41.48520 3	-71.243811	Marsh side of the culvert.	Prohibited					100	
2017-4- 550IS	5/8/2018	41.48581 7	-71.243433	15' in front of culvert	Approved					2	
2017-4- 619	9/5/2017	41.6248	-71.2134	12" diameter CMP storm drain, Grinnells Beach Tiverton	Approved	NF	NF	NF	NF	0	NF

Source ID	Date Visited	Lat.	Long.	Description	Receiving waters classification	2013 Results mTEC cfu/100ml	2014 Results mTEC cfu/100ml	2015 Results mTEC cfu/100ml	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
2017-4- 621	9/5/2017	41.6235	-71.2118	Stormflow from under wall from rusted remains of 18" diameter CMP	Approved	NF	NF	NF	NF	0	NF
2017-4- 708	9/5/2017	41.6165	-71.2006	ASSF from road water breaks out at shoreline	Approved	NF	NF	NF	NF	0	NF
2017-4- 1007	10/2/2017	41.5176	-71.2027	Groundwater outfall from upland marsh. Seeps under rocks onto sand from Phragmites- overgrown marsh.	Approved	107			NF	99	0.3542
2017-4- 1007IS	10/2/2017			In-stream	Approved					99	
2017-4- 1008	10/2/2017	41.5407	-71.2047	Small stream along south side of Town Road	Approved	NF	45	NF	NF	0	NF
2017-4- 013	9/5/2017	41.6199	-71.24	24" diameter RCP at corner of Park Ave	Prohibited	8000	410	NF		0	NF
2017-4- 702	9/5/2017	41.6094	-71.2029	4" diameter PVC pipe from yard. Likely no longer exists - lots of construction just done at house which is now	Approved	8000			NF	0	CNL
2017-4- 107	9/5/2017	41.6172	-71.2405	24" diameter RCP storm drain at end of ROW corner Atlantic/Tallman	Prohibited	2220	67	NF		0	NF
2017-4- 710	9/5/2017 Follow-up: 5/8/2018	41.6124	-71.1959	White Wine Brook at road crossing 24" diameter CMP	Approved	1500	6600	NF	320	1100 Follow-up: 100	Trickle Follow-up: 1.53

Source ID	Date Visited	Lat.	Long.	Description	Receiving waters classification	2013 Results mTEC cfu/100ml	2014 Results mTEC cfu/100ml	2015 Results mTEC cfu/100ml	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
2017-4- 710IS	5/8/2018	41.61215 5	-71.197694	Instream	Approved					31	
2017-4- 711	5/8/2018	41.61926 0	-71.203288	Sin and Flesh Brook on north side of bridge at Highland St.	Prohibited					91	8.5
2017-4- 711	5/8/2018	41.61779 5	-71.204433	Instream of Sin and Flesh Brook at bridge south of The Gut.	Prohibited					360	

IS = In stream sample NS = Not sampled NF = No flow CNL = Could not locate

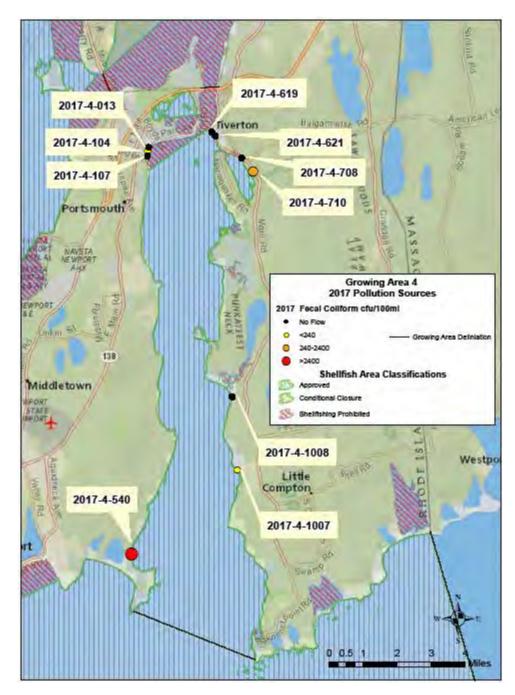


Figure 1-1 2017 Sakonnet River Growing Area 4 Pollution Sources

Figure 1-2 Source 2017-4-540

Source 4-540 is a stream, which is part of the Maidford River and flows through upland wetlands and drains across Third Beach into the Sakonnet River in Newport. The initial bacteria result required follow-up sampling, which occurred on 11/2/2017 which resulted in a lower bacteria count of 1090 cfu/100ml but a higher volumetric flow of 15.69 cfs. An additional follow-up was conducted on 5/8/2018 and the stream outlet was reaching the receiving waters with a volumetric

flow rate of 8.5 cfs and a FC of 91 cfu/100ml. Instream samples were collected 50 feet north and south of the outlet with FC of 2 cfu/100ml and 24 cfu/100ml respectively. During an additional follow-up in 2018 the source was not reaching the receiving waters or high tide line, thus this source is intermittent and not impacting the growing area.

Source ID	Date Visited	Description	2013 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
2017-4- 540	10/2/2017 1 st Follow-up: 11/2/2017 2 nd Follow-up: 5/8/2018	Stream from uplands wetland. Not flowing through culvert. Culvert filled with sand. Stream diverges away through bird sanctuary and empties into wetland/pond near 3rd Beach boat ramp.	0	10/12/17 – 5500 11/2/17 – 1090 5/8/2018 – 91 (IS-S = 24, IS-N = 2)	2.55 1 st Follow-up: 15.69 2 nd Follow- up: 8.5



Figure 1-3 Source 2017-4-540E

Source 4-540E is located on the east side of source 4-540. During the 2017 survey the water was stagnant within the culvert with a slight cloudiness. This source is pooling onto the beach and not draining into the Sakonnet River, thus it is not impacting the growing area. A follow-up should be performed during the 2018 annual shoreline survey.

Source ID	Date Visited	Description		2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
2017-4- 540E	11/2/2017	Stagnant water in culvert after rainfall. East side of culvert. Water cloudy.	NA	1640	Stagnant





Figure 1-4 Source 2017-4-540W

Source 4-540W is located on the west side of source 4-540W. During the 2017 survey the water was stagnant within the culvert with debris and floating grey sediment. The bacteria count was elevated at 3300 cfu/100ml, which requires a follow-up during the 2018 annual shoreline survey. Because the water is not discharging into the Sakonnet River but rather pooling on the beach it is not impacting the growing area.

Source ID	Date Visited	Description	2013 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
2017-4- 540W	11/2/2017	Stagnant water in culvert after rainfall. West side of culvert. Full of debris and floating grey sediment.		3300	Stagnant



Figure 1-5 Source 2017-4-710

Source 4-710 is White Wine Brook, which drains through a 24-inch CMP into Nanaquaket Pond in Tiverton. The source had an elevated bacteria count at 1100 cfu/100ml but the volumetric flow was a trickle at the CMP, which is located within a dense phragmites stand and must travel over 100 feet before reaching the receiving waters. A follow-up sampling was conducted on 5/8/2018 with a result of 100 cfu/100ml and an instream of 31 cfu/100ml. This source should be followed-up during the 2018 annual review, however, the instream results indicate that the travel distance from the CMP to the receiving waters is sufficient to filter and dilute bacteria levels before reaching open shellfishing waters.

Source ID	Date Visited	Description	2013 Results mTEC cfu/100ml	2014 Results mTEC cfu/100ml	2015 Results mTEC cfu/100ml	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volume tric Flow (cfs)
2017-4- 710	9/5/2017	White Wine Brook at road crossing 24" diameter	1500	6600	NF	320	9/5/17 -1100 5/8/18 – 100 (IS = 31)	trickle



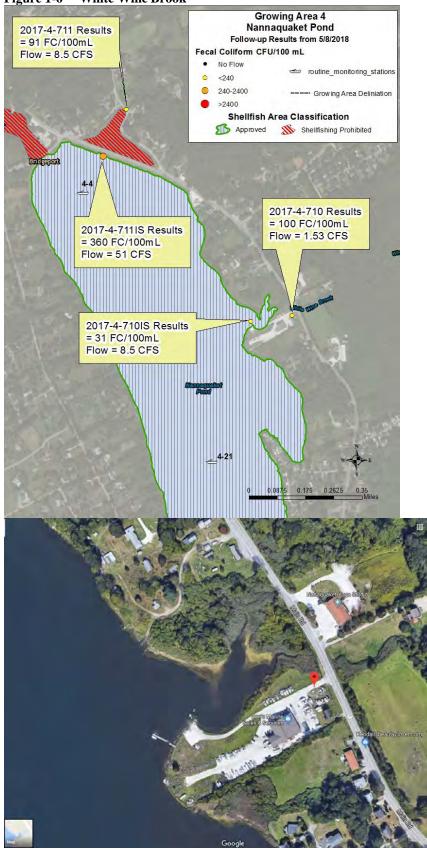


Figure 1-6 White Wine Brook

Marinas

The Sakonnet River growing area has several marinas and mooring fields as detailed in the shellfish program's document entitled "Evaluation of Waters Adjacent to Marinas – Marine Dilution Analysis Background June 2017". Waters adjacent to these marinas have either a year-round prohibited area or a seasonal closure to be protective of shellfish waters should an accidental discharge from a vessel occur. All waters in Rhode Island are designated as No Discharge Zones which prohibits the discharge of any sewage from any vessel within any waters of the state. Information regarding the enforcement and inspection procedures for vessels operating in RI waters can be found on our website by following this link:

http://www.dem.ri.gov/programs/water/shellfish/marine-pumpouts.php

Annual Statistical Analysis

HIGHLIGHTS

- * Sampled 6X during 2017.
- * Statisticsrepresentrecent30samplescollected3/18/2013to11/1/207during wet (n=17) and dry (n=13) weather for approved stations; all samples analyzed by mTEC method.
- * Statistics represent recent 15 samples collected 4/19/2012 to 11/1/2017 when seasonally approved station 4-11 (Sakonnet Harbor) was in the open status; 14 samplesmTEC and 1 sampleMPN method.
- * All approved and seasonally approved stations were in compliance and conformance.
- * Data run 12/22/2017.

COMMENTARY

The SakonnetRiver(GrowingArea4) was sampled sixtimes during 2017 which meets minimum systematic random sampling requirements for approved areas. The statistical evaluation of approved areas includes the most recent 30 samples collected since 3/18/2013 during both wet (n=17) and dry (n=13) weather conditions. All approved stations are in program compliance and properly classified.

While incompliance, then orthernend of Nannaquaket Pond (station 4-4) had an apparent increase in the frequency of elevated fecal coliform observations. The 201790th percentile variability criteria calculated for station 4-4 was 27.5 cfu/100 ml which is edging towards the variability criteria of 31 cfu/100 ml for approved waters. Four of the recent 30 observations at this station were elevated, and all four of these observations occurred following greater than 1" of rain in the 7 days prior to sampling. This station (4-4) is subject to freshwater input from nearby Sin and Flesh Brook which may be a source of elevated fecal coliform following rain.

Classification of station 4-11 in Sakonnet Harbor was upgraded from prohibited to seasonally approved in 2016 due to improvements in water quality. Sampling was completed at this station when the area was both seasonally open and during closed periods, with a sample collected approximately 6 weeks prior to seasonal reopening. Analysis of 2017 data indicated that seasonally approved station 4-11 was in compliance during the open season and that the area is properly classified.

RECOMMENDATIONS

- * Maintain Sakonnet Harbor (station 4-11) seasonal closure.
- * Investigate sources of recent increase in fecal coliform concentration at the northern end of Nannaquaket Pond (near station 4-4) during wet weather.

RIDEM SHELLFISH GROWING AREA MONITORING: GA4

Recent 30, all weather

(3/18/2013 to 11/1/2017; all mTEC, 17 wet and 13 dry weather)

			FECAL-GEC)
Station Name	Status	N	MEAN	90 th Percentile (<31)
GA4-1	Р	30	2.2	3.4
GA4-2	А	30	2.4	4.0
GA4-3	А	30	2.5	4.4
GA4-4	А	30	4.6	<mark>27.5</mark>
GA4-5	А	30	2.4	4.1
GA4-6	А	30	2.1	2.8
GA4-7	А	30	2.1	2.7
GA4-8	А	30	2.2	3.2
GA4-9	А	30	2.3	4.3
GA4-10	А	30	2.4	5.4
GA4-11	SA	30	2.7	6.8
GA4-12	А	30	2.3	4.2
GA4-13	А	30	2.3	4.4
GA4-14	А	30	3.1	10.8
GA4-15	А	30	2.3	3.9
GA4-16	А	30	2.1	3.5
GA4-17	А	30	2.1	2.9
GA4-18	А	30	2.3	3.5
GA4-19	Р	30	2.4	4.5
GA4-20	Р	30	2.6	4.9
GA4-21	А	30	3.4	11.0

PEGAL CEO

Recent 15, when OPEN (4/19/2012 to 11/1/2017; 14 mTEC, 1 mpn, 9 wet and 6 dry weather)

			FECAL-GEO)
Station Name	Status	N	MEAN	%>CRITICAL 32
GA4-11	SA	15	2.8	0.0

Figure 1-7 2017-2018 North Sakonnet River classification map and routine monitoring stations.

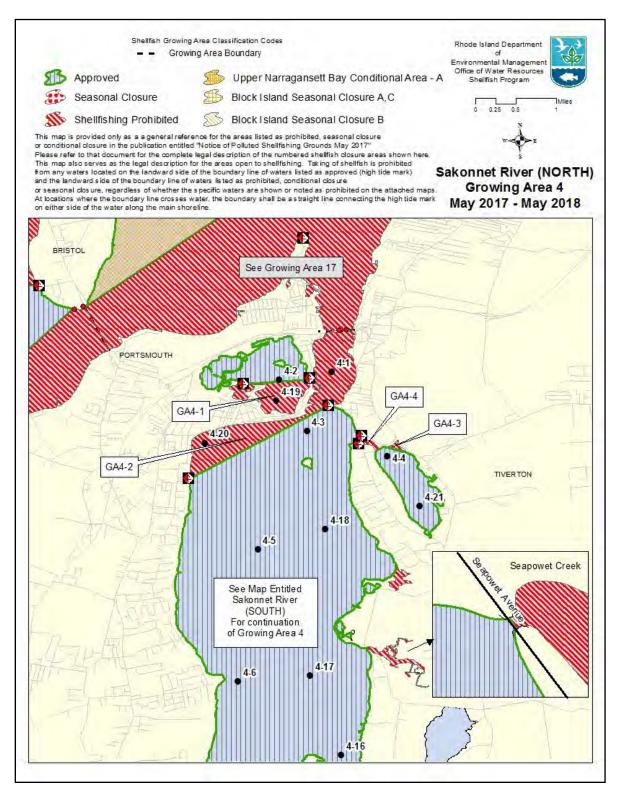
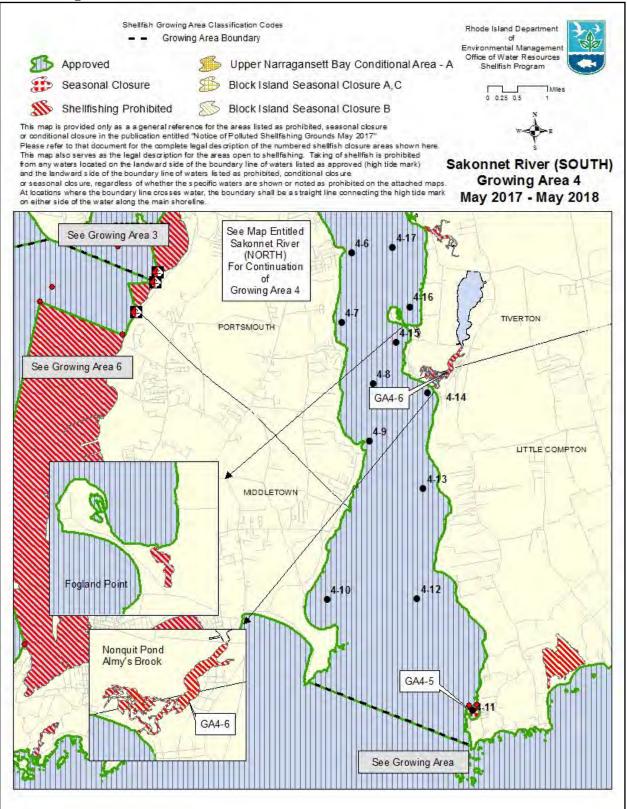


Figure 1-8 2017-2018 South Sakonnet River classification map and routine monitoring stations



Kickemuit River

Growing Area 5 Triennial Re-Evaluation For Calendar Year 2017



Kickemuit River as seen from the Warren Bike Path. Photo Courtesy of Kenneth C. Zirkel

Rhode Island Department of Environmental Management Office of Water Resources Shellfish Program



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1.0 Introduction

The Kickemuit River growing area is classified as Conditionally Approved with a precipitation closure trigger of 0.5" necessitating a minimum seven-day closure. A 12-year shoreline survey of the Kickemuit River was conducted during the summer of 2008 by staff from RIDEM's Office of Water Resources Shellfish Program. The survey involved a shoreline reconnaissance of the study area to locate and catalog pollution sources and collect bacteriological samples from all sources actively flowing into the survey area.

This 2017 shoreline survey was conducted as a triennial re-evaluation of this growing area. As such, the survey involved review of previous shoreline surveys including bacteriological sampling of actual pollution sources noted in previous surveys that were found to be equal to or greater than 240 FC/100ml and identification of any new sources of pollution if applicable. These previously identified pollution sources were re-evaluated to determine their bacteriological impacts on the Kickemuit River.

Pipes, groundwater seeps, tributaries, inland inter-tidal, and freshwater discharges that were potential or actual sources of pollution were re-sampled. Marinas and mooring fields were investigated for potential impacts to the growing area. Sources that may contain poisonous or deleterious substances were also considered as part of this triennial update.

2.0 Description of Growing Area

Growing Area 5 consists of approximately 643 acres (RIDEM GIS) tidally influenced estuarine waters. The Kickemuit River is bordered by the towns of Bristol and Warren, Rhode Island. The Kickemuit River originates in Massachusetts as a freshwater river crossing over the state border and continuing to a retaining dam at Rt. 103, Child Street in Warren. From that point south, the river continues as a tidally influenced, brackish inlet which terminates in Mount Hope Bay. The growing area (GA5) is the tidally influenced portion of the river and includes a portion of Mount Hope Bay north and west of a line from the extension of Sunrise Drive in Bristol to the Rhode Island Department of Environmental Management range marker located approximately midway on the shoreline of Touisset Point in Warren (See figure 2-1).

The area is divided into one prohibited shellfishing area encompassing routine monitoring station 5-8 at the northern boundary of the tidal waters and one seasonal marina closure on the Touisset shoreline. The remaining portion of the growing area is operated on a conditionally approved basis, closed for seven (7) days in the event of 0.5 inches of rainfall or greater. The precipitation that initiates these shellfishing closures can be in the form of rain and/or snowmelt. All precipitation totals are based on the total accumulation during any consecutive 24-hour period (24 hr. total) as recorded at the NOAA Taunton weather station.

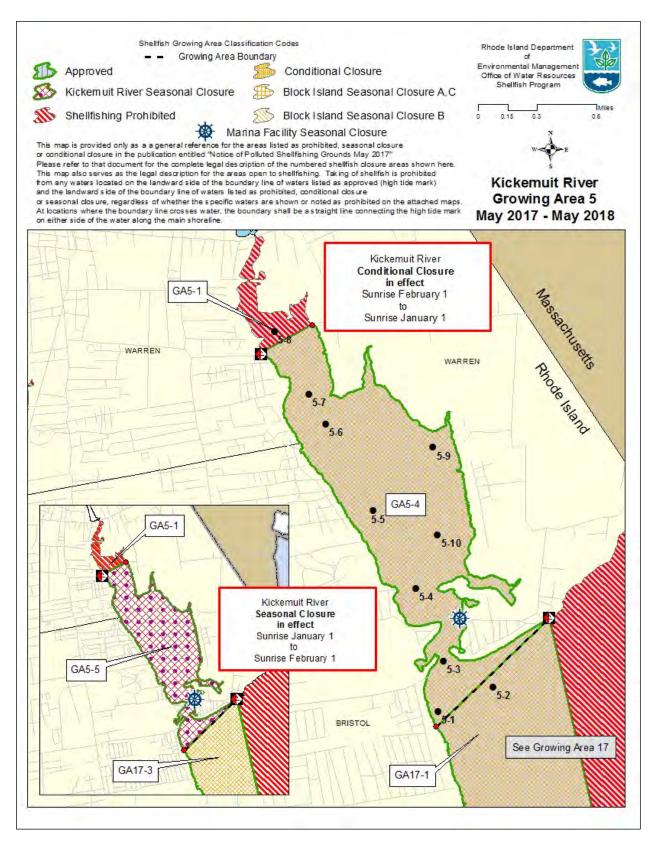
In addition to the seasonal marina closure in Touisset, routine sampling and statistical analysis of results taken of the growing area indicate that there are exceedances of the shellfishing approved water quality criteria during the month of January. It is not known the reasons behind this elevated condition of these waters but to ensure that the classification remains protective of public health, a seasonal closure of all waters of this growing area are closed for the entire month, beginning at sunrise on January first and continuing until sunrise February first annually. This seasonal closure shall remain effective annually until such time as routine sampling indicates the closure is no longer needed and waters meet the approved classification when open

regardless of seasonality. Further investigation as to the potential source of this anomaly are ongoing within the office of water resources (TMDL and Shellfish Programs) with emphasis on tracking BMPs within the water shed and identification and remediation of potential bacteria sources.

The following information describes the physical geography of this growing area:

Area of Shellfishing Prohibited Kickemuit River	44.5 acres
Area of Remaining Conditional Areas (Seasonal closure)	563.3 acres
Longest reach	2.6 miles
Widest reach	0.7 miles
Deepest point	16 feet

Figure 2-1 Kickemuit River Growing Area 5



3.0 Pollution Source Survey

Katherine Rodrigue and Anna Gerber-Williams, Marine Biologists of the RIDEM Office of Water Resources Shellfish Program, coordinated and conducted shoreline sampling of the Kickemuit River. The subsequent review of the findings and report were compiled by Katherine Rodrigue. The sampling took place on October 17 and November 2 of 2017. The most recent 12-yr shoreline sanitary survey was conducted in 2008. This update was also completed for the companion conditionally approved growing area of the adjacent waters of Mount Hope Bay which is presented in a separate section within this report.

This shoreline survey was conducted as a triennial re-evaluation of this growing area. As such, the survey involved review of previous shoreline surveys and sampling of actual pollution sources with bacteriological results greater than 240 FC/100ml as well as identification of any new sources of pollution if applicable (Figure 3-1). There were seven sources identified from previous surveys that required follow-up sampling. The results are presented in Table 3-1.

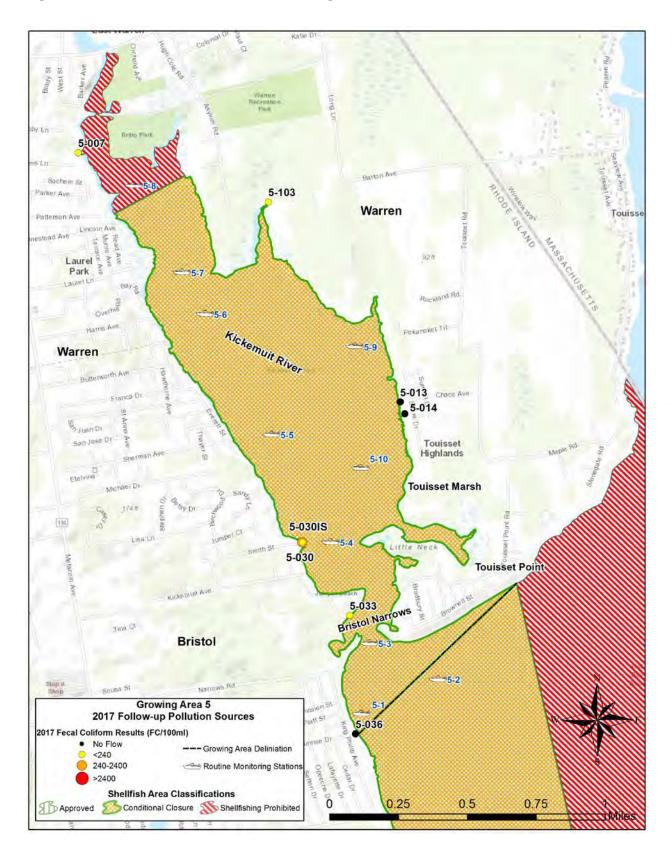


Figure 3-1 2017 Kickemuit River Growing Area 4 Pollution Sources

Table 3-1Summary of 2017 Results

*Highlighted sources >240 CFU/100ml. NF= No flow

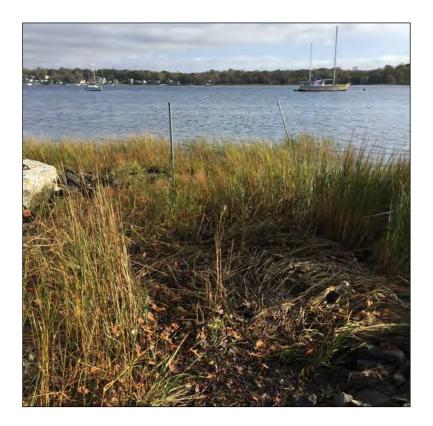
Source ID	Survey Date	Latitude	Longitude	Description	Receiving waters classification	Actual/ Potential	Direct/ Indirect	Max FC Result	Max FC Year	2017 FC Result	2017 Volumetric Flow (cfs)
5-013	10/17/2017	41.71089	-71.242	Groundwater stream at end of ROW	Conditionally Approved/ Seasonal closure	A	D	1670	2012	NF	0
5-014	10/17/2017	41.71026	-71.24168	Seepage from under concrete retaining wall	Conditionally Approved/ Seasonal closure	А	D	110000	2008	NF	0
5-103	10/17/2017	41.72144	-71.25122	Stream through salt marsh. In 2017, sampled upstream at source (storm drain)	Conditionally Approved/ Seasonal closure	A	D	11000	2008	<100	trickle
5-036	10/17/2017	41.69340	-71.24520	36" RCP at end of ROW sample taken from upstream basin	Conditionally Approved/ Seasonal closure	A	D	930	2008	NF	0
5-007	10/17/2017	41.72406	-71.26457	Small stream from damned pond at cow farm	Prohibited	А	D	430	2008	<100	0.05
5-030	11/2/2017	41.70351	-71.24890	18" CMP at end of Smith St. No detectable flow going into marsh, but might be slowly seeping into receiving waters.	Conditionally Approved/ Seasonal closure	А	D	2900	2017	<100	trickle
5-030IS	11/2/2017	41.70351	-71.24890	In stream	Conditionally Approved/ Seasonal closure					546	
5-033	10/17/2017	41.69963	-71.24560	Stream north of Narrows Road	Conditionally Approved/ Seasonal closure	A	D	430	2008	<100	trickle

Of the seven sources surveyed, three had no flow at the time of sampling. Four of the sources sampled had low FC results of less than 100 CFU/100ml. The remaining source, 5-030, was initially sampled on 10/17/2017 and had a high FC result of 2900 CFU/100ml, although the flow was only a slight trickle and the area the pipe discharges to was filled with debris. Because of the high bacteriological results, it was resampled on 11/2/2017 and an in-stream sample was taken just downstream of where the source discharges into the receiving waters. The results of the source were <100 and again the source was barely flowing and still surrounded with debris. Despite this, the in-stream sample was higher at 546 CFU/100ml. However, this source is only ~500 feet from routine monitoring station 5/4, which is in compliance (Table 6-1). In addition, the sampling conducted on 11/2/2017 was in wet weather, 3 days after a 2.63" rain event (Tables 3-2 and 3-3). This may explain why the in-stream sample was high, it should be noted however that the entire growing area was closed at the time of sampling due to its conditional classification. Therefore, no reclassification of the growing area is recommended at this time, but this source and the in-stream sample will be resurveyed as part of the 2018 Annual Review and evaluated during dry weather open conditions.



Figure 3-2 Source 2017-5-030

Figure 3-3 Source 2017-5-030 receiving waters



5/10/2019

The following rainfall data was observed at the NOAA weather station at Taunton Municipal Airport in Taunton, MA. Highlighted rows indicate days in which surveying was conducted, with yellow representing dry weather days and blue representing wet weather days.

Day	Total Precipitation (inches)	Max Temp. (°F)	Min Temp. (°F)
1	0	67	36
2	0	70	34
3	0	69	39
4	0	75	39
5	0	81	63
6	0	79	50
7	0	78	51
8	0.18	74	69
9	0.17	73	65
10	0	80	51
11	0	71	50
12	0	62	34
13	0	66	32
14	0.11	67	52
15	0	71	60
16	0.01	69	42
17	0	58	34
18	0	73	38
19	0	71	38
20	0	71	42
21	0	74	36
22	0	80	41
23	0	74	51
24	0.05	75	66
25	1.8	71	59
26	0.46	65	48
27	0	63	37
28	0	68	35
29	1.56	66	58
30	1.07	66	51
31	0	61	33

Table 3-2October 2017 rainfall at Taunton station

Day	Total Precipitation (inches)	Max Temp. (°F)	Min Temp. (°F)	
1	0	58	29	
2	0	72	42	
3	0	74	47	
4	0	57	34	
5	0.03	63	37	
6	0.01	67	52	
7	0.1	53	40	
8	0.08	46	28	
9	0	54	23	
10	0.03	50	24	
11	0	39	17	
12	0	48	18	
13	0.32	45	26	
14	0.01	45	38	
15	0	47	26	
16	0.42	51	29	
17	0	46	24	
18	0.09	56	20	
19	0.43	63	38	
20	0	43	34	
21	0	58	27	
22	1.53	55	38	
23	0	44	26	
24	0	49	23	
25	0	57	27	
26	0	50	37	
27	0	48	22	
28	0	51	17	
29	0	63	34	
30	0	47	21	

Table 3-3November 2017 rainfall at Taunton station

4.0 Mooring Fields and Marinas

Mooring fields and the single marina were evaluated for impacts during the sanitary survey. The small community dock in Touisset has a seasonal closure to be protective during the months of summer usage. Details of these evaluations can be reviewed in the program's document "Evaluation of Waters Adjacent to Marinas" contained in the program's permanent files.

5.0 **Poisonous and Deleterious Substances**

Poisonous and deleterious substances are contaminants that can include metals, organic chemical compounds (such as pesticides, PAHs, and PCBS) and natural toxins that when released into the environment can cause degradation of habitat and harmful effects on organisms. These compounds can enter waters through runoff, industrial discharges, fossil fuel and waste burning, mining and ore processing, toxin-releasing organisms such as phytoplankton, and agriculture (Kimbrough et al. 2008).

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the conditionally approved waters of the Kickemuit River due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

6.0 Wastewater Treatment Facilities (WWTF)

There are currently no wastewater treatment facilities that discharge directly to this growing area. This conditionally approved growing area is managed as a precipitation based growing area as outlined in the area's Conditional Area Management Plan (CAMP). As is the case of all areas that may have sewer systems or infrastructure within their watersheds a notification of any sewage overflow that may impact these waters could require an emergency closure. Such was the case when the town of Bristol's sewage pump station had an overflow that discharged into these waters. The River was closed immediately to the harvest of shellfish and remained closed until such time as the waters returned to approved status and sufficient time had elapsed for shellfish to self-cleanse in accordance with the model ordinance guidance. Records of this closure and subsequent actions are maintained in the programs central files.

A review of Onsite Wastewater Treatment System (OWTS) complaints and failures was conducted as part of the 2017 shoreline survey. There are currently no open complaints within 200ft of the Kickemuit River growing area. In February 2017, DEM investigated a complaint at 82 King Philip Ave in Bristol (on the western shoreline just south of Bristol Narrows) in which over time, the structure settled and the septic connection at the foundation separated from the discharge line, causing a chronic failure. The system was immediately reconnected to the septic system and a new septic pump installed as a short-term solution. The property has since been connected to the public sewer system and is no longer dependent on a OWTS.

In January 2018, a break in a sewer line caused by work on a water main in the same vicinity resulted in 265,000 gallons of untreated sewage to enter a stream and discharge into the conditionally approved Mt. Hope Bay (GA17) receiving waters just south of the Kickemuit River growing area (Figure 6-1). The discharge occurred from January 5 until January 24 when town officials were made aware of the issue. DEM was notified immediately and the necessary repairs to the sewer line were made on January 25. The Kickemuit River growing area was closed throughout the overflow event due to its seasonal January closure. An extension to the closure was made until February 15 (resulting in a full 21-day closure from the end of the SSO event on January 24). The RI Department of Health verified that no shellfish product from these waters entered the market

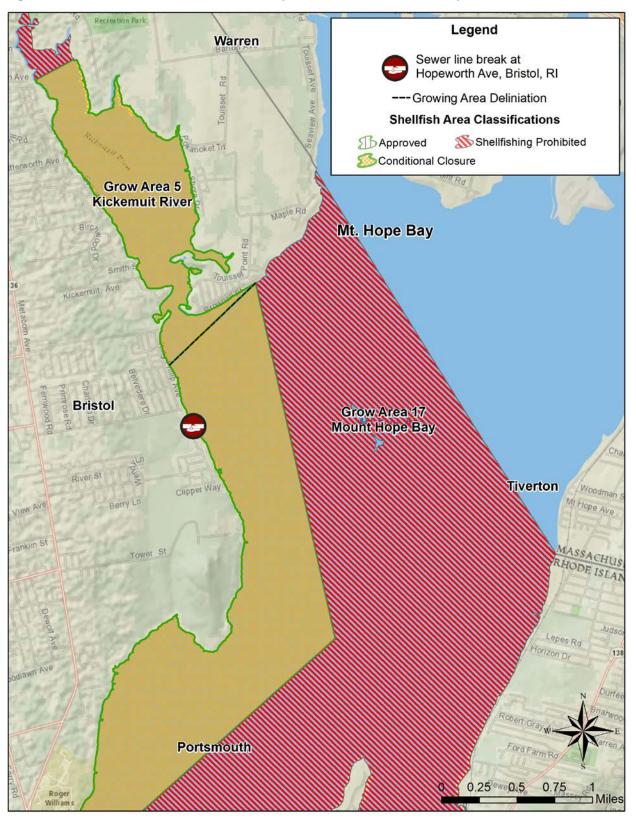


Figure 6-1 Location of Bristol Sanitary Sewer Overflow January 2018

7.0 Water Quality Studies

The Shellfish Growing Area Monitoring program is part of the state of Rhode Island's agreement with the United States Food and Drug Administration's National Shellfish Sanitation Program (NSSP). The purpose of this program is to maintain national health standards by regulating the interstate shellfish industry. As part of this agreement, the state of Rhode Island is required to conduct continuous bacteriological monitoring of the shellfish harvesting waters of the state in order to maintain certification of these waters for shellfish harvesting for direct human consumption.

Growing Area 5 is a conditionally approved area, closed for 7 days following a 0.5" rainfall or greater within a 24-hour period. Water quality monitoring is conducted on a monthly sampling regime during dry weather conditions when the conditionally approved portions of the growing area are open to shellfish harvesting.

All samples are collected at a depth of 1-2 feet below the water's surface using 4-ounce Nalgene bottles. The samples are then stored in a portable cooler at a temperature of approximately 4° Celsius. Upon completion of the monitoring run, samples are transported to the RIDOH laboratories in Providence for analysis. The mTEC method as described in Standard Methods for the Examination of Water and Wastewater (APHA 1999) is used to analyze the samples. The data is compiled and reviewed according to NSSP requirements stating that at least the most recent 15 data sets be used. Table 6-1 demonstrates the areas ability to conform to NSSP statistical criteria. Figures 2-1 and 3-1 show the locations of these monitoring stations within the Kickemuit River Growing Area 5.

The re-classification of this area and the CAMP for this growing area was originally drafted in 1995 and subsequently updated in 1997. The initial 1995 management criteria following precipitation events of greater than 0.25" (24 hours) established a closure of this conditionally approved area until results of bacteriological sampling demonstrated that all stations within the conditional boundaries met the approved growing area criteria. During the summer and fall of 1995 sampling was completed that allowed an adjustment to this closure period by raising the precipitation criteria from 0.25" to 0.5" and allowing an automatic re-opening after seven days instead of closing the area until further notice. Also, at that time the Taunton WWTF was permitted to discharge unchlorinated effluent between December and March annually. This permitted practice mandated a seasonal closure of the entire area coinciding with this lack of disinfection. By October of 1995 the Taunton WWTF had agreed to practice disinfection throughout the year which allowed RIDEM to revert to the modified management plan based on the increased precipitation criteria (0.5" – 7 days) and eliminate the seasonal closure.

In January of 1997 the operating procedures for both the Kickemuit River and Mt Hope Bay conditionally approved growing areas was again re-drafted and included a caveat that precipitation events greater than 1.0" (24 hours) would require that the areas remain closed until bacteriological sampling demonstrated that all stations within the conditionally approved areas met the approved classification.

RIDEM shellfish program began a wet weather sampling strategy for investigating the recovery time for precipitation events greater than 1.0" to ascertain the ability to amend the CAMP closure criteria and eliminate the closed till further notice stipulation for these higher volume precipitation events. In addition to this historic analysis more recent results indicate that the current seven-day closure (3-4 days for recovery and 2 days for cleansing) is still valid. The following graphs represent this analysis.

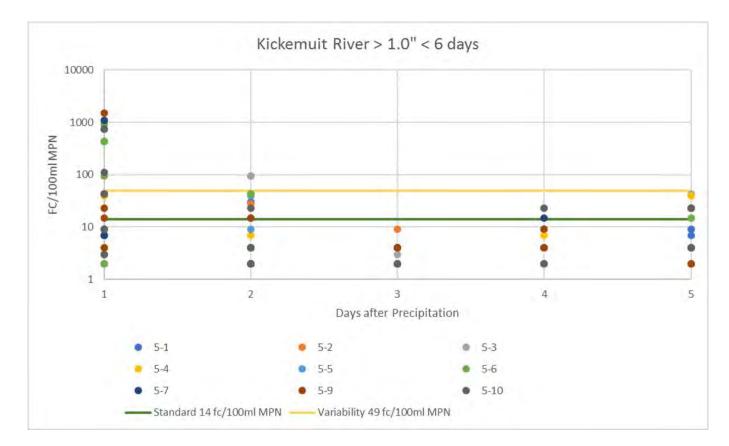


Figure 7-1 Historic Analysis (1985 – 1995)

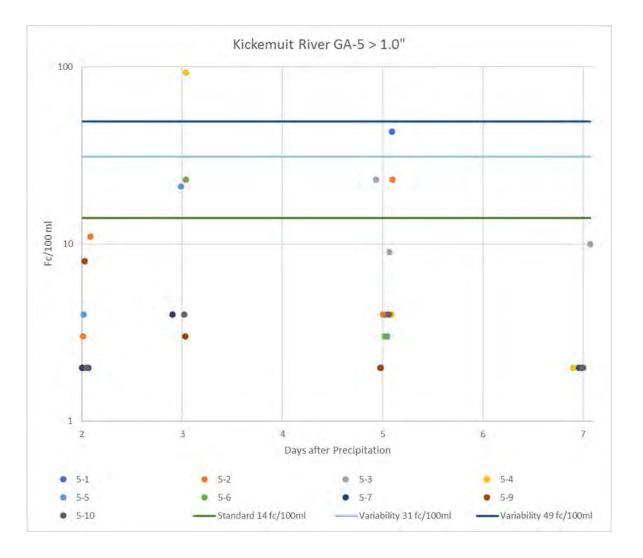


Figure 7-2 Recent Analysis (2003 - 2016)

The current CAMP for the conditionally managed Kickemuit River Growing Area will be updated to reflect these current management conditions and operational procedures. The existing CAMP although outdated was reviewed for this annual review and all management criteria for closures (as amended) were adhered to. Records of these closures can be found in the program's Conditional Area Closure Log excel file and within the program's permanent records and is available for review.

RIDEM Shellfish Growing Area Monitoring Results

RIDEM SHELLFISH GROWING AREA MONITORING: GA5

Recent 15 dry weather; note that there are no January data in the recent 15 observations. (7/27/2016 or 8/19/2016 to 12/19/2017; all mTEC)

			FECAL-GEO	
Station Name	Status	N	MEAN	%>CRITICAL 31
GA5-1	CA/SA	15	2.8	0.0
GA5-2	CA/SA	15	3.3	0.0
GA5-3	CA/SA	15	4.1	0.0
GA5-4	CA/SA	15	2.4	0.0
GA5-5	CA/SA	15	3.3	0.0
GA5-6	CA/SA	15	3.0	0.0
GA5-7	CA/SA	15	3.8	0.0
GA5-8	Р	15	4.4	6.7
GA5-9	CA/SA	15	2.9	0.0
GA5-10	CA/SA	15	3.8	0.0

HIGHLIGHTS

* Sampled 10X during 2017.

- * Statistics represent recent 15 dry-weather samples collected 7/2/2016 or 8/19/2016 to 12/19/2017 when the Kickemuit conditional area was open.
- * All samples analyzed by the mTEC method.
- * All conditionally approved stations are in compliance and program conformance.
- * Data run 1/9/2018.

COMMENTARY

The conditionally approved Kickemuit River (Growing Area 5) was sampled ten (10) times during 2017. All samples were collected during dry weather when the area was open for shellfish harvest. The Kickemuit has historically (since the 1980s) shown an increase in fecal **coliform during winter months**. A January seasonal closure was instituted for the Kickemuit River in 2016 due to elevated January fecal coliform readings which would result in exceedance of the NSSP fecal coliform variability criteria. Accordingly, January 2017 data are not included in the statistical analysis of recent 15 samples. All conditionally approved / seasonally approved (January closure) stations in the growing area are in program compliance. The area is properly classified.

RECOMMENDATIONS

- * Maintain January seasonal closure of the Kickemuit River growing area.
- * When practical, continue to sample Kickemuit during all months to track changes in winter water quality.

8.0 Conclusions and Recommendations

This triennial update included follow-up surveying of previously identified pollution sources with the potential to have an adverse bacteriological effect on the growing area waters. This review and additional sampling and follow-up results do not indicate that these sources are currently causing adverse effects to the receiving water quality. The results of the routine water quality monitoring further support this finding. The Kickemuit River growing area is properly classified and no changes are recommended. Major pollution sources (with any previous sampling results >2400 CFU/100ml) will be resurveyed during the 2018 Annual Review. The next 12-year sanitary shoreline survey is scheduled for 2020.

9.0 References

American Public Health Association. 1999. Standard Methods for the Examination of Water and Wastewater, 20th ed. 1999. American Public Health Association, American Water Works Association, Water Pollution Control Federation. Washington D.C.

Kimbrough, K. L., W. E. Johnson, G. G. Lauenstein, J. D. Christensen and D. A. Apeti. 2008. An Assessment of Two Decades of Contaminant Monitoring in the Nation's Coastal Zone. Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 74. 105 pp

RIDEM. May 2017. Notice of Polluted Shellfishing Grounds. Rhode Island Department of Environmental Management, Office of Water Resources, Shellfish Section. Providence, Rhode Island.

RIDEM. March 2018. State of Rhode Island 303(d) List of Impaired Waters. Rhode Island Department of Environmental Management, Office of Water Resources, Total Maximum Daily Load Program. Providence, Rhode Island.

GIS map data provided by: RIDEM, ESRI (Environmental Systems Research Institute), National Geographic

Growing Area 6 East Passage 2017 Annual Update

A twelve (12) year sanitary shoreline survey of the East Passage Growing Area 6 was conducted in 2015 which identified seventy-two (72) actual or potential sources. Fifty-four (54) of the sources were not actively flowing at the time of the shoreline survey with the remaining eighteen (18) having flows warranting sampling. In 2015 six (6) sources had bacteria counts greater than 2,400 cfu/100ml warranting follow-up sampling, however three (3) of those sources discharge to a prohibited classification and were not re-sampled as part of the 2016 annual update. None of the three (3) sources requiring a follow-up exhibited a flow in 2016. The sources (6-001 and 6-003), which resulted in a closure of the area in Cranston Cove (GA6-5 closure) were re-inspected in 2016. The inspection of these two (2) sources during 2016 showed no flow, however 2016 was a dry year and potential impacts during more normal weather patterns prevented the reopening of the area.

In 2017 on October 3^{rd} , a follow-up visit was made to ten (10) of the eighteen (18) sources that were measured during the 2015 twelve (12) year sanitary shoreline survey. The 2017 annual follow-ups were determined by bacteria sample results > 2400 cfu/100ml from the 2015 survey requiring a site visit during 2017 (see table 1-1 for full list of results). Of the ten (10) sources visited during the 2017 shoreline survey, eight (8) of them had no flow. The two (2) sources (2017-6-001 and 2017-6-500) with flow had bacterial levels < 2,400 cfu/100ml, which did not require additional follow-up sampling. Source 2017-6-001 has had historically elevated bacteria levels (higher than 2017 sample results) and has a small closure around the source, thus there is enough dilution area for the source before reaching approved growing waters.

There are thirty-five (35) marinas with more than 1700 slips and moorings located within the waters of the East Passage growing area. All waters surrounding the marina proper are classified as prohibited with sufficient dilution in adjoining water to be protective of shellfish harvest. Calculations to determine adequacy of this closure zone are contained in the program's permanent files in the report entitled "Evaluation of Waters Adjacent to Marinas: Marina Dilution Analysis Background, June 2017, RIDEM" and is available for review. Mooring areas were noted and where adjacent to existing marinas such as in Newport and Jamestown harbors are included in the boat counts. Individual moorings were evaluated for their potential to impact approved shellfish waters.

Table 1-1 Summary of 2017 Results for Growing area 6 East Passage

*Highlighted sources >240 CFU/100ml.

Source ID	Date Visited	Lat.	Long.	Description	Receiving waters classification	2006 Results FC/100ml	2015 Results mTEC cfu/100ml	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
6-001	10/3/2017	41.54162	-71.36502	Stream north of Wright Lane	Prohibited	460	800		454	0.113
6-002	10/3/2017	41.54274	-71.36365	Small stream thru woods	Approved	11000	0	NS	0	NF
6-003	10/3/2017	41.54297	-71.36346	Stream thru woods	Approved	110000	2700	NF	0	NF
6-102	NA	41.53825	-71.36486	Small stream over rocks from uplands	Approved	93	1100	NS	NS	
6-103	NA	41.53822	-71.36488	Small stream maybe split of source #102 south of #102	Approved	230	800	NS	NS	
6-106	NA	41.53295	-71.36284	Very small stream from upland woods heavy iron bacteria	Approved	43	1430	NS	NS	
6-107	10/3/2017	41.53127	-71.36239	Small stream thru woods	Approved	23000	662	NS	0	NF
6-108	10/3/2017	41.53097	-71.36234	Groundwater/ very small stream from uplands	Approved	12000	0	NS	0	NF
6-109	NA	41.52988	-71.36212	Groundwater seepage fades out above tide line	Approved	0	685	NS	NS	
6-110	NA	41.52929	-71.36191	Stream from uplands also heavy sepage along embankment	Approved	43	92	NS	NS	
6-209	10/3/2017	41.51197	-71.36557	Outfall from retention pond at base of Newport Bridge can't	Approved	0	2600	NF	0	NF
6-210	10/3/2017	41.51173	-71.36533	Stone headwall w/ standing water most likely from retention	Approved	11000	8000	NF	0	NF
6-301	10/3/2017	41.49587	-71.36665	24" diameter CMP storm drain at corner of concrete seawall	Prohibited	0	7700	Prohibited	0	NF
6-310	NA	41.48998	-71.36372	4" dia PVC pipe in seawall norht of Grumbles Point	Prohibited	3	3	NS	NS	

Source ID	Date Visited	Lat.	Long.	Description	Receiving waters classification	2006 Results FC/100ml	2015 Results mTEC cfu/100ml	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
6-311	NA	41.49025	-71.36373	8" dia clay/iron pipe put in water took sample from drip	Prohibited	4	2120	NS	NS	
6-500	10/3/2017	41.48854	-71.36303	24" diameter RCP before broken seawall	Prohibited		2400	Prohibited	99	0.136
6-505	10/3/2017	41.49372	-71.36636	"Unknown source" for original description. Upon surveying, only visible potantial source was an old broken iron pipe, half buried in sand. No evidence of recent flows.	Prohibited		4600	Prohibited	0	NF
6-606	NA	41.52806	-71.36167	Multiple GW seep	Approved	0	1720	NS	NS	
6-700	NA	41.52828	-71.36181	GW seep from rocks	Approved		93	NS	NS	
6-800	NA	41.56642	-71.363046	4" PVC pipe in retaining wall	Approved		93	NS	NS	
6-850	NA	41.56528	-71.362929	GW Seep @ brick abutment north of Broad st	Approved	300	300	NS	NS	
6-852	NA	41.56724	-71.363026	Large stream north of Broad st	Approved		560	NS	NS	
6-900	NA	41.57132	-71.364976	4" PVC @ top of embankment	Approved		10	NS	NS	

IS = In stream sample NS = Not sampled NF = No flow CNL = Could Not Locate

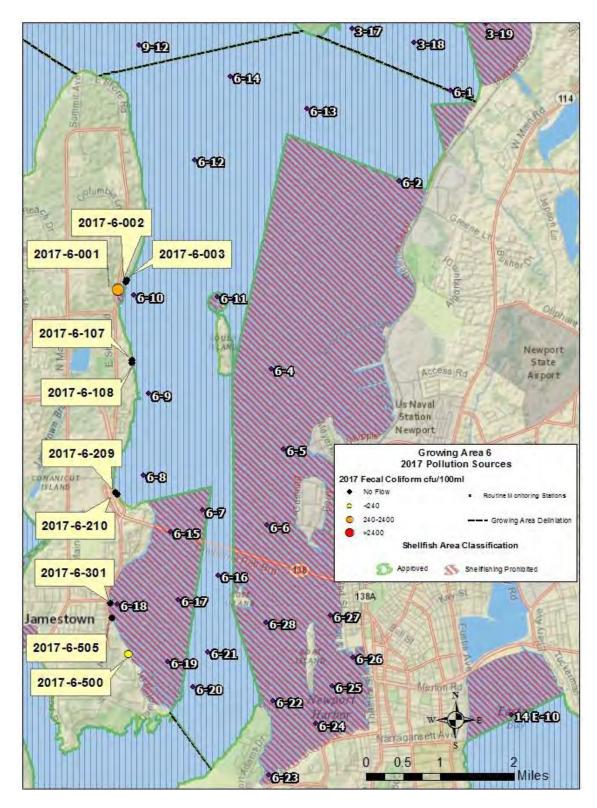


Figure 1-1 2017 East Passage Growing Area 6 Pollution Sources.

Figure 1-2 Source 2017-6-001

Source 6-001 is a stream that flows through a thick Phragmites stand before draining across a cobble beach into the bay in Jamestown. The bacteria level was elevated at this source; however, the flow rate was low at 0.113 cfs. A closure (GA6-5 as described in the RIDEM, Annual Notice of Polluted Shellfishing Grounds, May 2017)) was placed around this source as a result of the findings during the 2015 12-year sanitary shoreline survey and has remined in place since the closure was instated. The 2015 bacteria results were much higher than results from sampling in 2017 and thus the calculated closure area provides sufficient dilution water for the source.

Source ID	Date Visited	Lat.	Long.	Description	2015 Results mTEC cfu/100ml	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
6-001	10/3/2017	41.542	-71.365	Stream north of Wright Lane	800	Not sampled	454	0.113





In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of the East Passage due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

Annual Statistical Analysis

HIGHLIGHTS

- * Sam pled 6X during 2017.
- * Statistics represent recent 30 samples collected during wet (n= 13) and dry (n= 17) conditions during 3/ 5/ 2013 to 10/ 4/ 2017.
- * All samples analyzed by the mTEC method.
- * All approved s ta t ions are in compliance.
- * Data run 12/22/2017.

COMMENTARY

The East Passage (Growing Area 6) was sampled s ix times during 2017, complying with minimum systematic random sampling criteria. The recent 30 samples used in the evaluation were collected during both wet (n=13) and dry (n=17) weather conditions. Results of the 2017 statistical evaluation indicate that all approved s ta t ions are in program compliance and that the area is properly classified.

RECOMMENDATIONS

* No actions required based on 2017 ambient monitoring results.

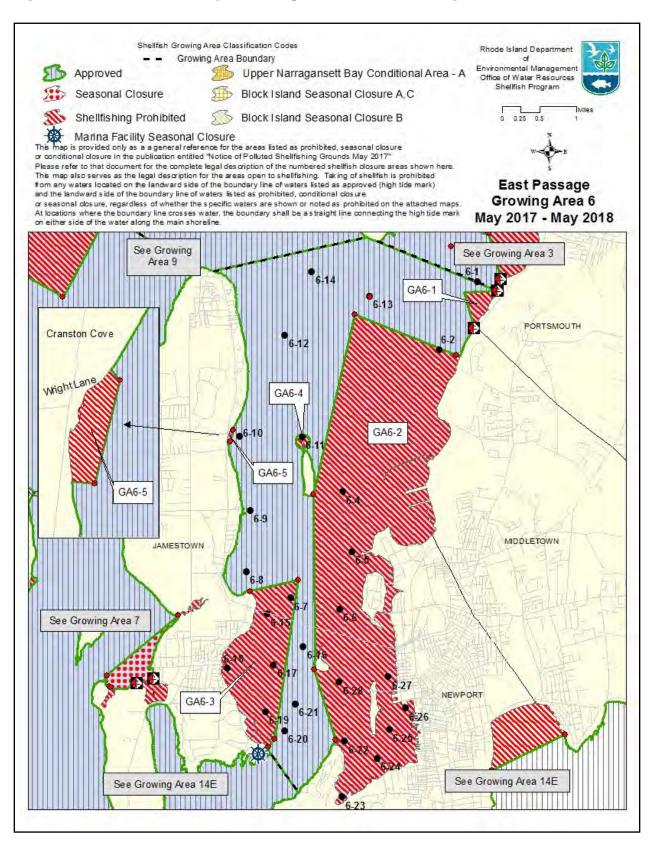
RIDEM SHELLFISH GROWING AREA MONITORING: GA6

Recent 30 all weather.

(7/27/2016 or 8/19/2016 to 12/19/2017; all mTEC, 13 wet and 17 dry weather)

			FECAL-GEC)
Station Name		<u>N</u>	MEAN	<u>90th Percentile (<31)</u>
GA6-1	A	30	2.1	2.6
GA6-2	Р	30	2.1	2.7
GA6-4	Ρ	30	2.0	2.0
GA6-5	Р	30	2.1	2.9
GA6-6	Р	30	2.2	3.5
GA6-7	Р	30	2.0	2.4
GA6-8	А	30	2.1	2.7
GA6-9	А	30	2.0	2.4
GA6-10	А	30	2.1	2.6
GA6-11	Р	30	2.0	2.4
GA6-12	А	30	2.1	2.8
GA6-13	А	30	2.1	3.1
GA6-14	А	30	2.0	2.0
GA6-15	Р	30	2.0	2.4
GA6-16	А	30	2.2	3.2
GA6-17	Р	30	2.0	2.0
GA6-18	Р	30	2.0	2.0
GA6-19	Р	30	2.1	2.7
GA6-20	А	30	2.1	2.6
GA6-21	А	30	2.2	3.0
GA6-22	Р	30	2.4	5.4
GA6-23	Р	30	2.2	3.0
GA6-24	Р	30	3.4	13.8
GA6-25	Р	30	4.3	22.0
GA6-26	Ρ	30	5.3	20.0
GA6-27	Ρ	30	2.6	6.8
GA6-28	Р	30	2.1	2.6

Figure 1-4 2017-2018 classification map and routine monitoring stations.



Growing Area 7 West Passage 2017 Annual Update

A twelve (12) year sanitary shoreline survey of the West Passage Growing Area 7 was conducted in 2016. A total of 110 sources were identified during the shoreline survey, excluding marinas. A total of sixty-seven (67) of the 110 sources were not actively flowing at the time of the shoreline survey with the remaining forty-three (43) having flows warranting sampling. All sources in which flow was observed were sampled.

During the 2017 annual update a total of ten (10) sources were visited. Of the ten (10) sources, three (3) did not have flow, two (2) no longer existed or could not be located, and five (5) had flow. All of the sample results were < 2,400 cfu/100ml, which does not warrant immediate follow-up sampling. One (1) source (7-803) had bacteria counts above 240 cfu/100ml and should be re-sampled during the 2018 annual survey. Source 7-306 was noted to have septic odors during the 2016 survey, however during the 2017 survey there were no septic odors coming from the area and the sample results were <100 cfu/100ml with a trickle flow. After a review of OWTS complaints from the area there were no issues listed in that vicinity. A follow-up of the source should be conducted during 2018.

Growing Area 7 is presently comprised of sections classified as approved, seasonally approved and prohibited for shellfishing (Figure 1-7). Six (6) distinct areas of this growing area are prohibited to shellfishing: Wickford Cove (GA7-2), Bissel Cove (GA7-3), a portion of the upper West Passage abutting the Quonset Point area (GA7-1), the area around the docks at the University of Rhode Island's Bay Campus (GA7-4), and Sheffield Cove and Fox Hill Pond (GA7-7 and GA7-8) in Jamestown. There are two seasonally closed areas: one in outer Wickford Harbor including Fishing Cove (GA7-6), and the other in the Dutch Harbor-West Ferry(GA7-5) area of Jamestown.

Table 1-1Summary of 2017 Results for Growing area 7 West Passage

*Highlighted sources >240 CFU/100ml.

Source ID	Date Visited	Lat	Long	Description	Discharging waters classification	Act/Pot	Dir/Ind	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
2017-7-109	10/18/2017	41.5268	-71.4166	Flow thru upland vegetation. No stream flowing, no signs of recent flow. One area seemed to be carved out possibly by water, but completely dry.	Approved	Ρ	D	0	0	NF
2017-7-118	10/18/2017	41.51451667	-71.41587	2" PVC pipe	Approved	Α	D	0	<100	0.0002
2017-7-800	10/3/2017	41.49273	-71.38282	Outlet from tidal marsh. In 2017, no flow into receiving waters. Ground too soft to access tidal pond	Prohibited	A	D	96	0	NF
2017-7-804	10/3/2017	41.49798	-71.3844	Stream from upland thru rock over wall. In 2017, could not find a wall at location. No flow or evidence of recent flows.	Prohibited	A	D	0	0	NF
2017-7-306	10/18/2017	41.47162	-71.42158	Extensive length of Groundwater seepage with septic odors. Slow trickle and multiple seeps ~50ft along rocks.	Approved	A	D	8000	<100	trickle
2017-7-803	10/3/2017	41.49274	-71.38057	10" CPP from upland wetland	Prohibited	А	D	280	1000	0.0118
2017-7- 1004A	10/3/2017	41.527303	-71.39137	Rusty drainpipe at shoreline access under bridge. In 2017, could not find. Maybe buried.	Approved	Р	D	0	0	DNE
2017-7-102	10/18/2017	41.53618	-71.41897	Outlet from upland tidal pond - fades into sand above high tide	Approved	А	D	1.9	<100	1.9318
2017-7-14B	10/18/2017	41.560943	-71.43655	Outlet of Duck Cove	Approved	Р	D		100	204
2017-7-14G	10/18/2017	41.554895	-71.42805	2 x 4" PVC under dock. In 2017, could not find. Likely no longer exists.	Approved	Р	D		0	DNE

IS = In stream sample NS = Not sampled NF = No flow CNL = Could not locate

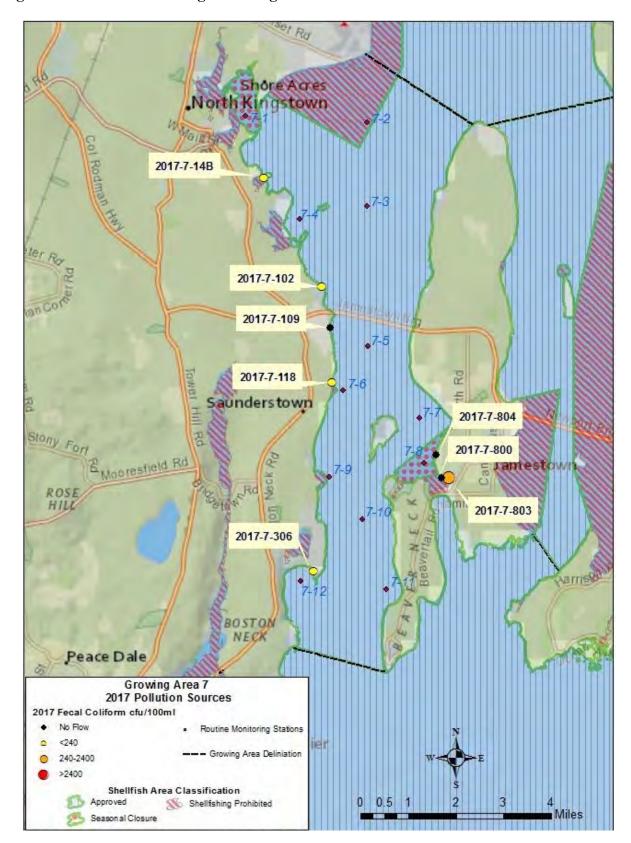


Figure 1-1 2017 West Passage Growing Area 7 Pollution Sources.

Figure 1-2 Source 2017-7-803

Source 7-803 is a 10" CPP draining an upland wetland into the prohibited waters of Sheffield Cove. The bacteria count was elevated at 1000 cfu/100ml, however the volumetric flow was low (0.018 cfs). Because this source is discharging into waters that are currently classified as prohibited, there is sufficient dilution area so as to be protective of the approved portion of the West Passage receiving waters.

The Town of Jamestown has undertaken a stormwater abatement project in the upland watershed of Sheffield Cove to install BMPs (infiltration basin and grass swales) that are designed to capture and treat stormwater flows prior to their entering these receiving waters. Until such time that these BMPs are completed and sampling of stormwater reflects reductions in bacteria loadings, Sheffield Cove will remain classified as prohibited and closed to the harvest of shellfish.

	Source ID	Date Visited	Description	Act/Pot	Dir/Ind	2016 Results mTEC cfu/100ml	2017 Results mTEC cfu/100ml	2017 Volumetric Flow (cfs)
-	2017-7-803	10/3/2017	10" CPP from upland wetland	А	D	280	1000	0.0118



In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural

toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of the West Passage due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

The West Passage growing area has several marinas and mooring areas that were evaluated for this annual update. The waters proper to marinas such as those located in Wickford Harbor, Quonset and Dutch Harbor on Jamestown are prohibited either annually or seasonally and the dilution calculations for these closure areas are detailed in the program's document entitled "Evaluation of Waters Adjacent to Marinas - Marina Dilution Analysis Background, June 2017 and is available for review. Moorings associated with these identified marinas were included in the slip count. Other moorings were evaluated for their potential as a source of pollution to the growing area. No additional closures due to the presence of boats is warranted.

Annual Statistical Analysis

HIGHLIGHTS

- * Sampled 7X during 2017.
- * For approved stations, statistics represent recent 30 samples collected during wet (n = 18) and dry (n = 12) conditions during 2/26/2013 or 4/15/2013 to 11/28/2017.
- * For seasonally approved stations 7-1 and 7-8, statistics represent recent 15 samples collected 2/26/2013 to 11/28/2017 when these seasonally approved stations were open.
- * All approved stations are in compliance.
- * All seasonally approved stations are in compliance.
- * All samples analyzed by the mTEC method.
- * Data run 12/22/2017.

COMMENTARY

The West Passage (Growing Area 7) was sampled seven times during 2017. The recent 30 samples used in the 2017 statistical evaluation of approved stations were collected during both wet (n=18) and dry (n=12) weather conditions. Statistics for seasonally approved stations 7-1 and 7-8 were calculated for the recent 15 samples when the station was in the open status.

Results of the 2017 statistical evaluation indicate that all approved stations are in program compliance. The area is properly classified.

RECOMMENDATIONS

* No actions required based on 2017 ambient monitoring results.

RIDEM SHELLFISH GROWING AREA MONITORING: GA7

Recent 30 all weather.

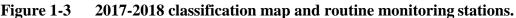
(2/26/2013 or 4/15/2013 to 11/28/2017; all mTEC, 18 wet and 12 dry weather)

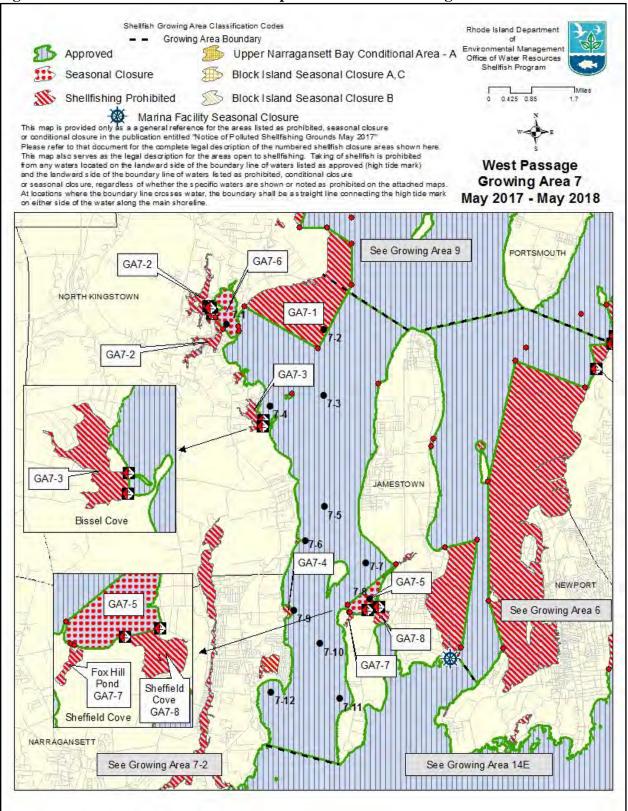
			FECAL-GEO)
Station Name	Status	N	MEAN	<u>90th Percentile (<31)</u>
GA7-1	SA	30	3.9	16.1
GA7-2	Р	30	2.0	2.4
GA7-3	А	30	2.1	2.7
GA7-4	А	30	3.0	7.6
GA7-5	А	30	2.1	3.1
GA7-6	А	30	2.0	2.4
GA7-7	А	30	2.0	2.4
GA7-8	SA	30	2.2	3.4
GA7-9	Р	30	2.0	2.0
GA7-10	А	30	2.1	2.7
GA7-11	А	30	2.0	2.4
GA7-12	А	30	2.1	2.9

Recent 15, when OPEN

(2/26/13 or 4/15/2013 to 11/1/2017; all mTEC, 10 wet and 5 dry weather) FECAL-GEO <u>Station Name Status N MEAN %>CRITICAL 31</u>

	10	= 1		,,, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
GA7-1	SA	15	2.5	0.0
GA7-8	SA	15	2.1	0.0





Growing Area 7-2 Narrow (Pettaquamscutt) River 2017 Annual Update

All waters of the Narrow River, Growing Area 7-2 are currently prohibited to shellfishing. The area was sampled Ten (10) times during 2017 under a variety of conditions in support of potential re-classification. The following map shows the sampling station locations and the current classification of this growing area. Results from the statistical evaluation of all stations exceed shellfish standards during wet weather conditions and all of the stations north of Mettatuxet (7-2-17S, 7-2-19S and 7-2-21S) do not meet shellfish standards during dry weather. However, we are seeing some improvements to water quality at station 7-2-22S (south of the Sprague Bridge) that indicates initial support of a conditionally approved area with a closure criteria during wet weather of less than 0.5" of rain. Continued monitoring of wet weather conditions must be conducted to determine whether station 7-2-22S would reliably stay within compliance under 0.5" of rain, the establishment of recovery times associated with this management criteria and an evaluation of the program's logistical ability to support monitoring of this area if an upgrade to conditionally approved classification is warranted

Records indicate that there are two marinas located within the waters of this growing area. Both marinas have limited capacity in that the waters of the river are fairly shallow, which limits the length of boat capable of navigating to these marinas. However, the waters of the entire river are currently classified as prohibited which includes the marina proper and further provide more than ample dilution to be protective of shellfishing in adjacent approved waters at the confluence of the river with open waters of Rhode Island Sound approximately a mile and a half to the southeast. Refer to the report entitled RIDEM "Evaluation of Waters Adjacent to Marinas: Marina Dilution Analysis Background, June 2017" which is located in the program's permanent files for further details and the relative dilution calculations.

<u>HIGHLIGHTS</u>

- * Sampled 10X during 2017.
- * Shellfishing is prohibited in growing area 7-2. Statistics were calculated for informational purposes of tracking water quality changes.
- * Statistics represent recent 30 samples collected during wet (n= 11) and dry (n= 19) weather 11/14/2014 to 12/11/2017.
- * Statistics also calculated under dry weather (less than 0.5" rain in prior 7 days) only conditions for recent 15 samples collected 6/29/2016 to 12/11/2017.
- * All samples analyzed by the Mtec method.
- * Data run 12/22/2017.

COMMENTARY

The Pettaquamscutt River (Growing Area 7-2) was sampled 10 times from shore-access stations during 2017. The area is classified as prohibited to shellfishing so there is no minimum sampling requirement. The 2017 statistical evaluation for the Pettaquamscutt River includes the most recent 15 samples. The area has been closed to shellfish harvest for direct human consumption since 1985 due to unpredictable and elevated fecal coliform levels. A TMDL was completed for the area in 2002, with recommendations for monitoring to follow long-term changes in water quality.

There are no NSSP guidelines for statistical evaluation of prohibited areas. Summary

statistics for this growing area were calculated to track changes in water quality, not for compliance. Based on the recent 30 samples, all stations in the Narrow River exceeded criteria for approved waters. Under a conditionally approved management scenario of a 7-day closure following >0.5" rain, all stations north of Mettatuxet (stations 7-2-17S, 7-2-19S and 7-2-21S) exceed fecal coliform criteria. Under this conditionally approved scenario, station 22S, south of Sprague Bridge near the connection of the Narrow River with Block Island Sound would meet water quality criteria for conditionally approved areas. Future monitoring along with a current shoreline survey would be required to ascertain whether these recent improvements in lower Narrow River water quality are predictable and long-term enough to support a change in classification of some portion of the lower most portion of the Narrow River GA-7-2.

RECOMMENDATIONS

- * Continue monthly shore-based sampling under all weather conditions to track water quality and to support TMDL efforts in the watershed.
- * No other action recommended.

RIDEM SHELLFISH GROWING AREA MONITORING: GA7-2

Recent 30 all weather

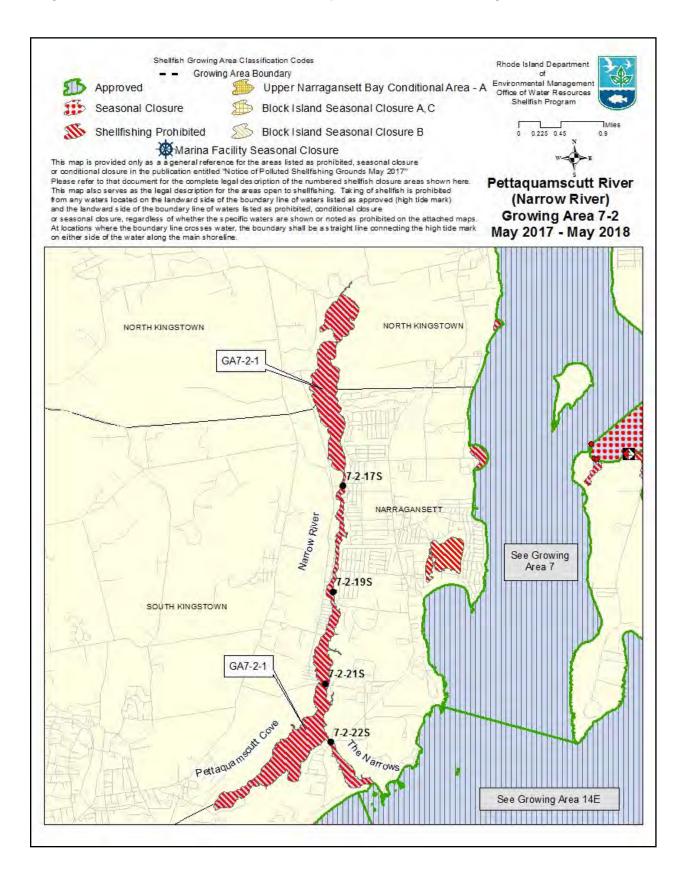
(11/14/2012 to 12/11/2017; all mTEC, 11 wet and 19 dry weather)

			r <i>ecal-geu</i>	·
Station Name	Status	N	MEAN	90 th Percentile (<31)
GA7-2-17S	Ρ	30	13.7	86.6
GA7-2-19S	Р	30	29.5	246.5
GA7-2-21S	Р	30	18.0	122.4
GA7-2-22S	Р	30	11.1	70.2

Recent 15 dry weather(<0.5" rain in previous 7 days) only. (6/29/2016 to 12/11/2017; all mTEC, 15 dry weather)

			FECAL-GEO	
Station Name	Status	N	MEAN	%>CRITICAL 31
GA7-2-17S	Ρ	15	8.3	20.0
GA7-2-19S	Р	15	15.9	40.0
GA7-2-21S	Р	15	12.3	40.0
GA7-2-22S	Р	15	6.9	6.7

Figure 1-1 2017-2018 classification map and routine monitoring stations.



Growing Area 8

12 Year Sanitary Shoreline Survey

Calendar Year 2017



Warwick Cove, Warwick, RI Photo courtesy of Brewer Greenwich Bay Marina

> **Rhode Island Department of Environmental Management**

> > **Office of Water Resources**

Shellfish Program



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Acronyms and Terms

FDA: Food and Drug Administration

ISSC: Interstate Shellfish Sanitation Conference

MPN: Most Probable Number

NSSP: National Shellfish Sanitation Program

<u>RIDEM</u>: Rhode Island Department of Environmental Management

SGAM: Shellfish Growing Area Monitoring

SSCA: State Shellfish Control Authority

NOAA: National Oceanographic and Atmospheric Administration

1.0 Introduction

A shoreline survey of Greenwich Bay was conducted in the summer and fall of 2017 by staff from RIDEM's Office of Water Resources Shellfish Program with assistance from staff of the TMDL program. The survey involved a shoreline reconnaissance of the study area to locate and catalog pollution sources and collect bacteriological samples from all sources actively flowing into the survey area. The shoreline was divided into seven survey areas with teams assigned to each area. The respective teams surveyed as much of their areas as possible within a two-day sampling effort in July. Any remaining areas were surveyed by Shellfish Program staff in the fall. All locations within the growing area were surveyed regardless of their classification.

The primary objective of the shoreline survey was to identify and characterize any new sources of pollution impacting the growing area, to reevaluate point and non-point sources identified during previous surveys, and to update information regarding the sampling of previously identified sources.

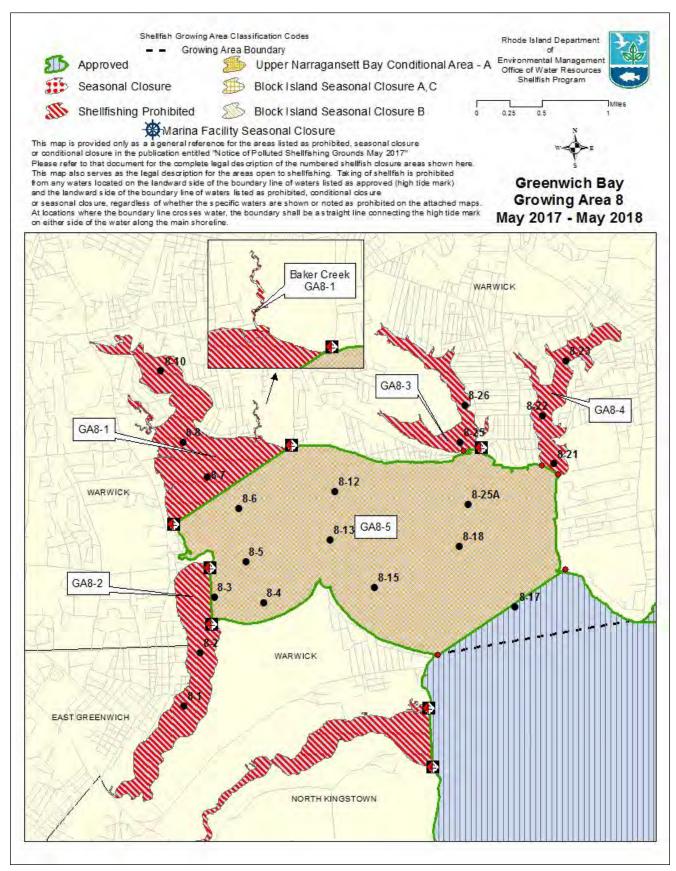
2.0 Description of the Growing Area

Greenwich Bay is an estuary—a semi-enclosed inlet of the sea in which seawater is diluted with fresh water. It contains five protected coves with five square miles of shallow water and is impacted by a 26-square-mile watershed. Greenwich Bay has provided people with food, shelter, transportation, trade, and recreational opportunities for centuries.

The survey area encompasses all of the shoreline north and west of a line from Sandy Point in Warwick to the southernmost tip of Warwick Point on Warwick Neck. The study area is located within the towns of Warwick and East Greenwich.

Growing Area 8 is presently comprised of sections classified as approved, conditionally approved and prohibited for shellfishing (Figure 2-1). Four distinct areas of this growing area are classified as prohibited to shellfishing: Greenwich Cove (GA8-2), Apponaug Cove (GA8-1), Buttonwoods and Brushneck Coves (GA8-3), and Warwick Cove (GA8-4). In previous years a seasonal (December) closure of the bay was warranted based on sampling results, however, this anomaly of non-compliance during the month of December has filtered out of the statistical database along with more recent monitoring data supporting the conditionally approved classification allows for this seasonal closure to no longer be warranted.

Figure 2-1 Growing Area 8 – Greenwich Bay



2.1 Location

Greenwich Bay proper is located in the City of Warwick. The westerly half of Greenwich Cove has a shoreline in the town of East Greenwich whereas all of Apponaug Cove, Brushneck Cove, Buttonwoods Cove, and Warwick Cove are located in the City of Warwick. Greenwich Bay is in the northwest corner of Narragansett Bay, north of what is referred to as the West Middle Bay, Growing Area 9.

2.2 Description of the Area

2.2.1 Physical Description

The Greenwich Bay watershed includes parts of the City of Warwick and the Towns of East Greenwich and West Warwick in central Rhode Island. The watershed area is about 26 square miles and can be characterized as urban/residential, with high to medium density residential land-use covering almost one-third of the total land area. Greenwich Bay is home to three licensed bathing beaches: Goddard Park, Oakland Beach, and City Park. There are also numerous marinas and mooring fields along the shorelines.

Greenwich Bay is approximately 3000 acres of shallow water and includes five protected coves used by fisherman and recreational boaters to harbor their vessels. The bay's weighted mean average depth is approximately 7 ½ feet with the deepest area approximately 37 feet deep at the eastern opening to Narragansett Bay (Figure 2-2). There are numerous fresh water brooks and streams that discharge to the various coves. The largest freshwater inputs into Greenwich Bay are Hardig Brook into Apponaug Cove with a daily average flow of 8.6 mgd (million gallons per day), and Maskerchugg River into Greenwich Cove with an average daily flow of 8.02 mgd. This makes up approximately 60 percent of the total freshwater inputs to the bay. There are several other smaller tributaries with a combined flow of 4.3 mgd in addition to groundwater (4.8 mgd) and atmospheric inputs (1.8 mgd) providing fresh water to this estuary (Greenwich Bay Special Area Management Plan (SAMP) May 10, 2005).

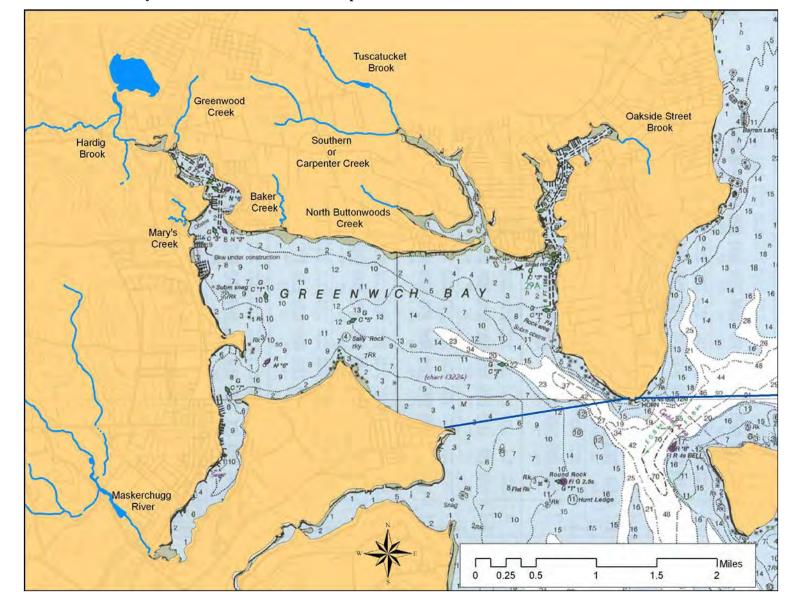


Figure 2-2Greenwich Bay Nautical Chart and Freshwater Inputs

2.2.2 Latest Survey

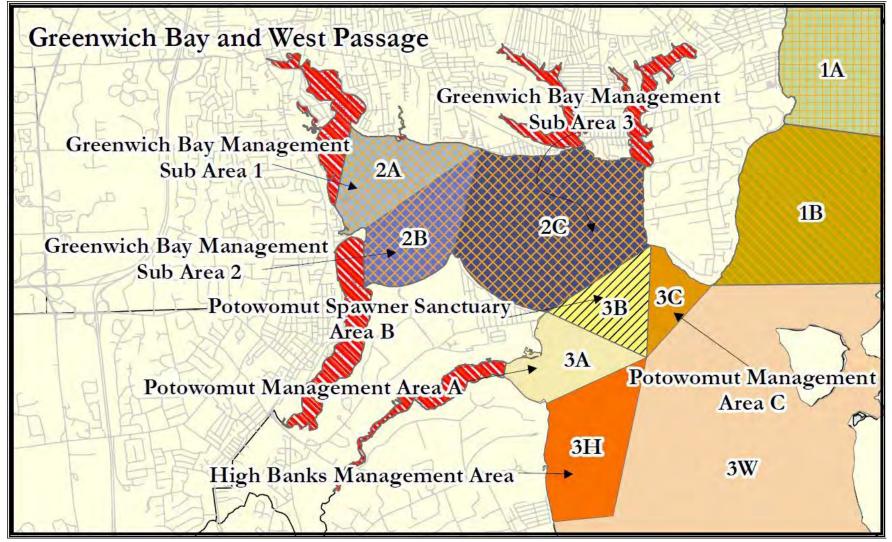
The US Food and Drug Administration and RIDEM's Office of Water Resources personnel conducted an extensive shoreline survey in 2005 to assess the relative importance of pollution sources impacting bay water quality and to develop recommendations for the classification and management of the bay.

2.2.3 Previous Classification Maps

Greenwich Bay was closed for shellfish harvesting in December 1992 due to heavy precipitation. This closure remained in effect until a reclassification study could be conducted. This reclassification study was completed in April and June of 1993 in two near-term periods representing comparatively 'wet' and 'dry' weather conditions. The results of the study supported the classification of Greenwich Bay as "Conditionally Approved," requiring a management plan be developed. This management plan went into effect in June of 1994 requiring the closure of the conditionally approved area in the event of a 0.5 inches or greater rainfall (or snowmelt) event within a 24-hour period, any emergencies at sewage treatment plants that would result in pollution of the conditional area, discovery of wastewater treatment system failures or illegal overflows during dry weather which may adversely affect the area, a significant toxic spill, or a toxic algal bloom. The reopening of conditional areas occurs 7 days following the termination of the discrete closure event. In the event of an extraordinary pollution event, the area will reopen when sample results demonstrate that the area is free of pollution or toxins and sufficient time has elapsed to allow shellfish to natural depurate.

In addition to the conditionally approved status, a shellfish management area has been established within Greenwich Bay regulated by RIDEM's Division of Marine Fisheries. The management plan regulates commercial harvesting of shellfish in the Greenwich Bay conditionally approved areas, and further divides the conditionally approved portion of the growing area into 3 sub-areas (Figure 2-3). For sub-areas 1 and 2 (comprising the western side of the conditional area and also referred to as tagging areas 2A and 2B respectively), commercial harvest is currently limited to the hours of 8 am to noon on Mondays, Wednesdays and Fridays from January 3rd through the last Friday in April 2018. There are additional restrictions for December 2017 in which harvest can only occur on specific days during the month (Dec.13, 15, 18, 20, 22, 26, 27, and 29). In sub-area 3 (comprising the eastern side of the conditional area and referred to as tagging area 2C), commercial boat harvest is open daily. During all times, recreational shore digging is allowed during open conditions. A small section at the mouth of Greenwich Bay is managed as the Potowomut Spawner Sanctuary (tagging area 3B), and is open only for the harvest of bay scallops by dip-netting from a boat during the open season. At all times regardless of management rules, water quality conditions supersede any harvest restrictions, and no harvest is allowed by anyone if the area is closed based on growing area water quality status.

Figure 2-3Greenwich Bay Harvest Area Tagging Map



Note: This graphic depicts only the limits of management and harvest area designations, refer to the current (May 2017 -2018) Notice of Polluted Shellfish Grounds document for the current shellfish growing area classifications (Figure 2-1).

2.2.4 Current Classification Map

The most recent (May 2017-May 2018 and revised annually) RIDEM document entitled <u>Notice</u> <u>of Polluted Shellfishing Grounds</u> documents four prohibited shellfish areas in Greenwich Bay, and one conditionally approved area. The legal descriptions of these closure areas are described below and shown in Figure 2-1.

Shellfishing Prohibited

Greenwich Bay – Apponaug Cove and Baker Creek Closure GA8-1

All waters of Greenwich Bay in the area of Apponaug Cove including all waters of Bakers Creek north and west of a line from the Rhode Island Department of Environmental Management range marker located on the NECO Pole #6 at the end of Neptune Street in Chepiwanoxet to the Rhode Island Department of Environmental Management range marker located at the extension of Capron Farm Drive in Nausauket including Apponaug Cove, the northwest corner of Greenwich Bay and Mary's Pond and Thatch Cove (so called) south of Arnold's Neck.

Brush Neck and Buttonwoods Coves Closure GA8-3

All waters of Brush Neck Cove and Buttonwoods Cove north of a line from the easternmost point of Buttonwoods Neck in Buttonwoods, to the Rhode Island Department of Environmental Management range marker on Pole #35 at the western extension of Strand Avenue at Oakland Beach.

Greenwich Cove Closure GA8-2

Greenwich Cove westerly and southerly of a line from the Department of Environmental Management range marker located on the northerly point of Long Point to the Rhode Island Department of Environmental Management range marker located on the southerly point of Chepiwanoxet.

Old Warwick Cove Closure GA8-4

Old Warwick Cove, north of a line from the southeastern most riprap jetty at the entrance to Warwick Cove, located at the southeastern end of Oakland Beach to the southern (landward) end of Dorr's Dock on Warwick Neck.

Conditional Closures

Greenwich Bay Closure GA8-5

The waters of Greenwich Bay, north and west of a line from the eastern extremity of Sandy Point in Warwick to the flag pole located at the Warwick Country Club on Warwick Neck, excluding Apponaug Cove and all tributaries north and west of a line from the Rhode Island Department of Environmental Management range marker located at the end of Neptune Street in Chepiwanoxet to the Rhode Island Department of Environmental Management range marker located at the extension of Capron Farm Drive in Nausauket, including Apponaug Cove, the northwest corner of Greenwich Bay and Mary's Pond and Thatch Cove (so called) south of Arnold's Neck, excluding all waters of Bakers Creek and those waters of Brush Neck and Buttonwoods Cove north of a line from the easternmost point of Buttonwoods Neck to the western extension of Strand Avenue at Oakland Beach, excluding Greenwich Cove westerly and southerly of a line from the Rhode Island Department of Environmental Management range marker located on Long Point to the Rhode Island Department of Environmental Management range marker on the southerly point of Chepiwanoxet and excluding Old Warwick Cove north of a line from the southeastern riprap jetty at the entrance to Warwick Cove located at the southeastern end of Oakland Beach to the southern (landward) end of the Dock located at the westerly extension of Randall Avenue on the so called Dorr's Landing on Warwick Neck. This conditionally closed area is shown in Figure 2-1.

3.0 Pollution Source Survey

3.1 Personnel

Katherine Rodrigue, Marine Biologist for the RIDEM Office of Water Resources Shellfish Section, coordinated and conducted a shoreline reconnaissance of Greenwich Bay with the assistance of other RIDEM Office of Water Resources Shellfish and TMDL staff members. Teams of surveyors were organized and assigned to each section of the bay to inspect the entire shoreline.

3.2 Survey Procedures

In early July 2017, a planning meeting was arranged in which staff from RIDEM discussed the logistics necessary to meet and complete the requirements of a 12-year sanitary shoreline survey for the Greenwich Bay growing area. The shoreline of Greenwich Bay and its five coves were divided into seven distinct areas (Figure 3-1) and teams of two were assigned to each area to be surveyed over two days. Sampling had already been initiated by Katherine Rodrigue on June 5th and 6th as part of the annual Program Element Evaluation Review conducted by FDA staff. Over these two days, the Goddard Park/Potowomut section was surveyed. In addition, a portion of Brushneck cove was surveyed on July 6th, prior to the main survey days. The remaining 6 areas were assigned to teams for the July survey. All necessary survey materials were provided to each team, including aerial maps created using ArcMap GIS software that displayed the locations of all previously identified sources. An example of one of these maps has been included here as Figure 3-2. Each team assigned to an area was given the appropriate map; pre-filled field sheets

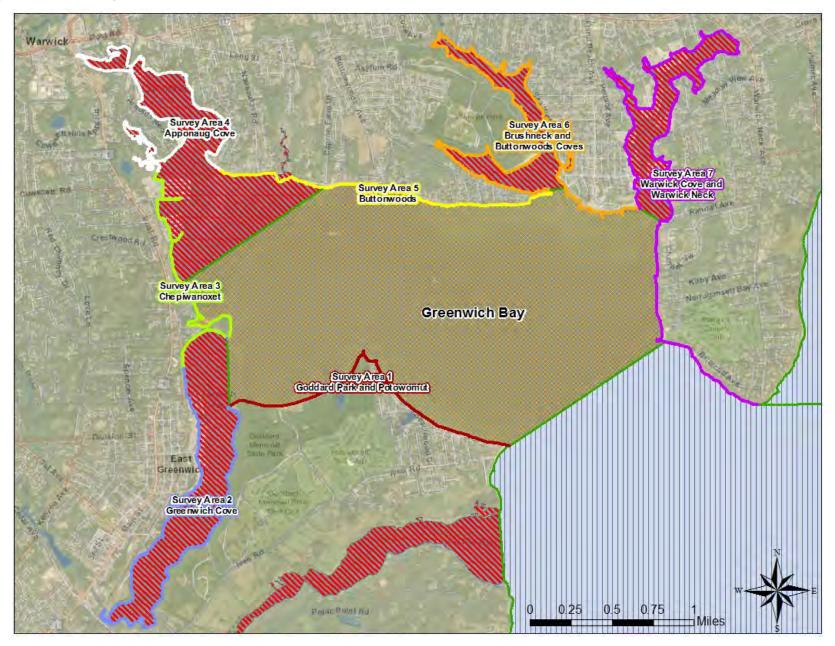
including source IDs, descriptions, and geographic coordinates; information on public access points and street maps for parking; and extra field sheets and laboratory sample submission chain of title forms. In addition, each team was equipped with a GPS-enabled digital camera or their personal cell phone, a means for measuring flows such as a bucket or float, coolers, extra sample bottles, and first-aid kits. One team was assigned to the areas that are more densely populated with marinas and used a 16-foot aluminum Jon boat in order to locate sources under docks and along bulk-heads. Those teams tasked with surveying marina areas were also provided with marina survey field sheets to make note of number of slips, type and number of pumpouts, occupancy and boat types and lengths and the general state of the marina facilities.

Due to favorable tidal conditions and staff availability, July 19th and 20th were chosen as the primary survey dates. However, due to a 0.76" rain event on 7/11 and second rain event of 0.54" on 7/12, a 7-day closure was enacted, and the conditional area of Greenwich Bay was closed to shellfishing until noon on 7/20. After deliberation with other RIDEM staff, it was decided that the best course of action would be to continue with the shoreline survey on 7/19 and 7/20, given that it was 6 days after the rain event and bay waters had returned to approved conditions. Water sampling at the routine monitoring stations was completed on 7/19. Because of intensely hot weather and the difficulty of accessing some of the shoreline in Greenwich Bay, some areas could not be completed over the primary two-day survey. Therefore, follow-up sampling was completed by RIDEM Shellfish section staff throughout the fall of 2017 in September, October, and December.

Special attention was given to all types of pipes, drainage ditches, culverts, and streams in order to classify them as a direct (discharges directly to the growing area), indirect (does not discharge directly to the receiving waters, but may contribute to pollution in the growing area), actual (discharging at the time of the survey), or potential (not actively discharging at the time of the survey, but considered a possible source of pollution). Bacteriological samples were collected in sterile, 125 mL (or 500 mL if MSB analysis was also required) Nalgene bottles from all sources that were actively flowing at the time of the field study. Samples were stored in a portable cooler and transported to the Rhode Island Department of Health Laboratory at the end of each field day. The mTEC membrane filtration method, as described in Standard Methods for the Examination of Water and Wastewater (APHA, 1999), was used for analysis for both shoreline and routine station (bay run) samples.

In addition to routine bacteriological sampling for fecal coliform concentrations, all samples which were analyzed for Male-Specific Bacteriophage (MSB) during the previous 12-year shoreline survey and had a result greater than 50 plaque-forming units per 100ml were resampled for MSB. This was to help determine whether the fecal source is human or non-human., as highest densities of coliphage are typically found in treated and untreated human wastewater effluent. From past studies, RIDEM has determined that in general, MSB levels greater than 50 PFU/100ml indicate that there is a higher likelihood that the bacteria sources in these samples are human in nature. Thus, this level was used to direct follow-up sampling in Greenwich Bay.

Figure 3-1 Survey Area Delineation



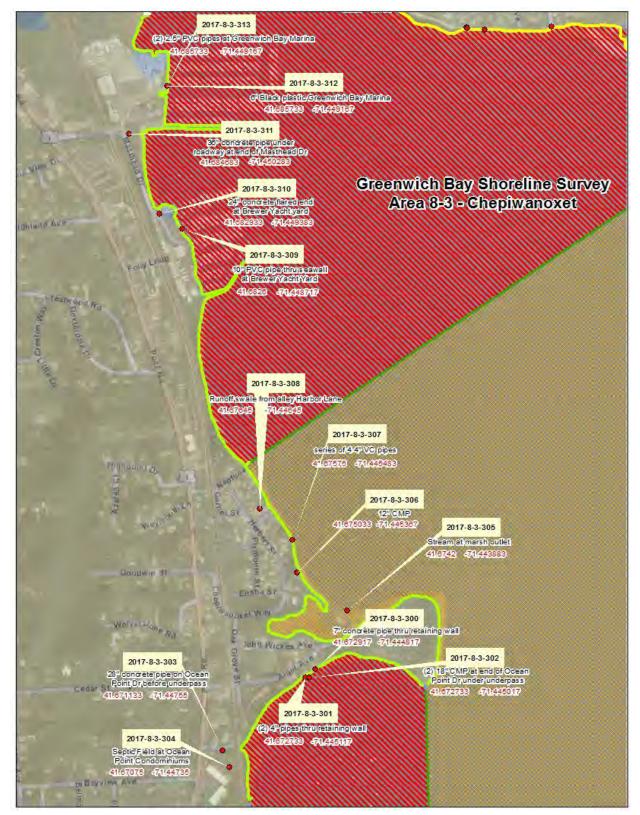


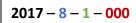
Figure 3-2 Area 3 Chepiwanoxet Source Identification Aerial Map

3.3 Summary of Sources and Locations

3.3.1 Locations of Major Sources

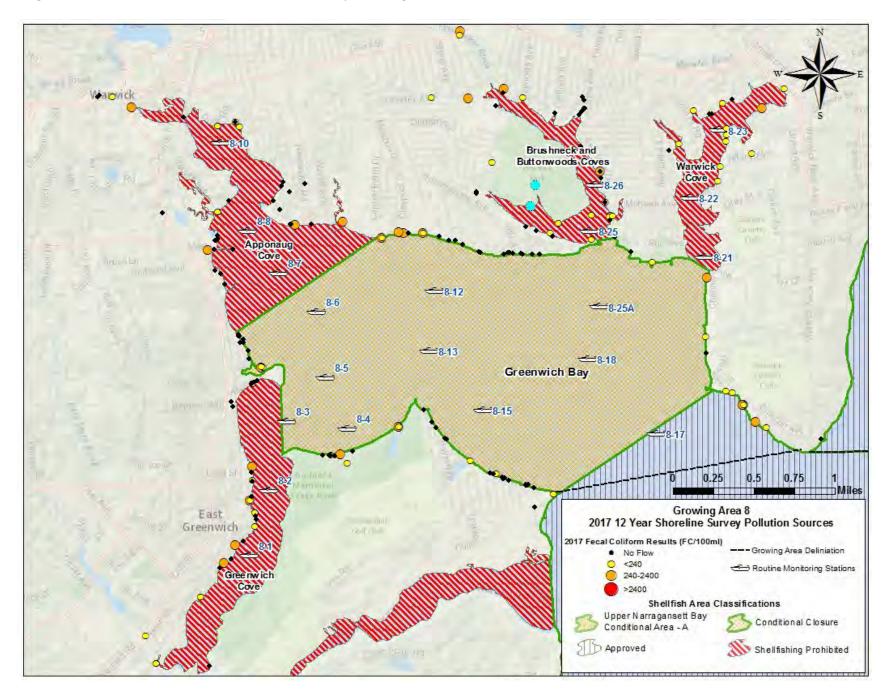
There were 206 actual or potential sources of pollution identified during the shoreline survey in 2017, with 84 of these sources flowing at the time of sampling. All sources in which flow was observed were sampled. Figure 3-3 is a map depicting the location of all identified actual and potential sources of pollution within Greenwich Bay. Details of each source are listed in Table 3-1.

The sample ID for each source is coded to indicate the area in which the source was located as follows:



Year - Growing Area - Survey Area - Source ID

Survey Area 1:Goddard Park and PotowomutSurvey Area 2:Greenwich CoveSurvey Area 3:ChepiwanoxetSurvey Area 4:Apponaug CoveSurvey Area 5:ButtonwoodsSurvey Area 6:Buttonwoods and Brushneck CovesSurvey Area 7:Warwick Cove and Warwick Neck



Station ID	Latitude	Longitude	Description	Receiving Water Classification	Survey Date	Direct/ Indirect	2005 FC Results (MPN/100ml)	2017 Fecal Coliform Results (CFU/100ml)	Volumetric Flow (ft³/s)	Male-specific Bacteriophage Results (PFU/100ml)
2017-8- 1-100	41.66587	-71.41902	18" Concrete pipe / Beach area	Conditionally Approved	6/6/2017	D	8	152	0.265625	NA
2017-8- 1-102	41.66562	-71.43372	Twin 24" concrete pipe in seawall	Conditionally Approved	6/5/2017	D	NOT SAMPLED	200	4.9048E-05	NA
2017-8- 1-103	41.66645	-71.43445	Twin 24" concrete pipe in seawall with grates	Conditionally Approved	6/5/2017	D	NOT SAMPLED	1040	7.5138E-06	NA
2017-8- 1-105	41.66638	-71.43565	6" PVC pipe in retaining seawall at snack bar/bath house 36" below top of seawall	Conditionally Approved	6/5/2017	D	NOT SAMPLED	78	Slow drip	NA
2017-8- 1-109	41.66890	-71.42750	Marsh drainage stream	Conditionally Approved	6/5/2017	D	NOT SAMPLED	300	1.25	NA
2017-8- 1-109A	41.66890	-71.42750	IS east of stream	Conditionally Approved	6/5/2017	NA	165	2	NA	NA
2017-8- 1-109B	41.66890	-71.42750	IS west of stream	Conditionally Approved	6/5/2017	NA	27	24	NA	NA
2017-8- 1-113	41.66472	-71.41587	21" round hole in seawall under wooden steps	Conditionally Approved	6/6/2017	D	11	96	0.425	NA
2017-8- 1-114	41.66287	-71.40900	Marsh drainage no flow, stagnant.	Conditionally Approved	6/6/2017	D	8	92	NA	NA
2017-8- 1-114A	41.66287	-71.40900	Flow from marsh under sand to beach	Conditionally Approved	6/6/2017	D	NOT SAMPLED	36	0.0563125	NA
2017-8- 2-200	41.64777	-71.45647	12" broken pipe Old Forge Rd. in 2017, no flow from pipe. Water seeping around pipe.	Prohibited	10/16/2017	D	1	99	0.01770833	NA
2017-8- 2-200IS	41.64777	-71.45647	In-stream downflow from 8-2- 200	Prohibited	10/16/2017	NA	NOT SAMPLED	99	NA	NA
2017-8- 2-201	41.64777	-71.45647	River just upstream of flow out of pipe source ID 200	Prohibited	10/16/2017	D	27	99	4.25	NA
2017-8- 2-201A	41.64777	-71.45647	small stream/seep near upstream sample at Old Forge Rd. Lots of iron oxidizing bacteria	Prohibited	10/16/2017	D	NOT SAMPLED	99	trickle	NA

Table 3-1Bacteriological Results of Sources Actively Flowing in 2017

Station ID	Latitude	Longitude	Description	Receiving Water Classification	Survey Date	Direct/ Indirect	2005 FC Results (MPN/100ml)	2017 Fecal Coliform Results (CFU/100ml)	Volumetric Flow (ft³/s)	Male-specific Bacteriophage Results (PFU/100ml)
2017-8- 2-202	41.65020	-71.45773	Maskerchaug River Rt 1 east of bridge	Prohibited	10/17/2017	I	27	99	10.2	NA
2017-8- 2-203	41.65368	-71.45122	36" concrete drain adjacent south of 115 Rocky Hollow Rd	Prohibited	7/19/2017	D	NOT SAMPLED	126	2	NA
2017-8- 2-205	41.65677	-71.44838	24" concrete pipe north of EG town ramp south of WWTP bottom of access road to ramp	Prohibited	7/19/2017	D	2	360	Trickle	NA
2017-8- 2-208	41.65835	-71.44702	30" concrete pipe at bottom of steps at playground north of WWTP	Prohibited	7/19/2017	D	170	1180	0.0668403	1200
2017-8- 2-209	41.65997	-71.44472	27" concrete pipe adjacent north of ramp at Greenwich Bay marina parking lot Water St	Prohibited	7/19/2017	D	NOT SAMPLED	48	0.00147144	NA
2017-8- 2-212N	41.66125	-71.44475	1 of 2 17" concrete pipes under deck north side of Harbourside Restaurant (N pipe). Water was a milky color and some odor present.	Prohibited	7/19/2017	D	315	80	0.00117598	7
2017-8- 2-212S	41.66125	-71.44475	2 of 2 17" concrete pipes under deck north side of Harbourside Restaurant (S pipe)	Prohibited	7/19/2017	D	315	22	0.0141259	1.9
2017-8- 2-213	41.66230	-71.44527	30" concrete pipe under south end of 20 Water St deck. Visited at low tide and water was still up to and slightly flooding pipe. Difficult to tell flow due to angle, but looked to be only a slight trickle.	Prohibited	12/12/2017	D	NOT SAMPLED	1200	0.00706293	NA
2017-8- 2-213IS	41.66230	-71.44527	In stream	Prohibited	12/12/2017	NA	NOT SAMPLED	200	NA	NA
2017-8- 2-215	41.66410	-71.44500	38" CMP in concrete bulkhead at bottom of Division St	Prohibited	7/19/2017	D	3250	200	0.00706293	2
2017-8- 2-218	41.66538	-71.44498	30" concrete pipe south side of Norton's Marina at marine railway	Prohibited	7/19/2017	D	2850	280	0.0668403	1.9
2017-8- 3-302	41.67273	-71.44502	(2) 18" CMP at end of Ocean Point Dr under underpass	Prohibited	7/20/2017	D	4350	220	0.903125	NA

Station ID	Latitude	Longitude	Description	Receiving Water Classification	Survey Date	Direct/ Indirect	2005 FC Results (MPN/100ml)	2017 Fecal Coliform Results (CFU/100ml)	Volumetric Flow (ft³/s)	Male-specific Bacteriophage Results (PFU/100ml)
2017-8- 3-305	41.67420	-71.44388	Stream at marsh outlet	Conditionally Approved	7/20/2017	D	7	340	1.2	NA
2017-8- 3-305 ISE	41.67422	-71.44372	In-stream east of marsh stream	Conditionally Approved	7/20/2017	NA	NOT SAMPLED	25	NA	NA
2017-8- 3-305 ISW	41.67429	-71.44397	in-stream west of marsh stream	Conditionally Approved	7/20/2017	NA	NOT SAMPLED	22	NA	NA
2017-8- 3-311	41.68468	-71.45028	36" concrete pipe under roadway at end of Masthead Dr	Prohibited	9/13/2017	D	100	400	Little or no flow	NA
2017-8- 4-400	41.69747	-71.45938	Hardig Brook at Rt 1	Prohibited	10/16/2017	А	75	1200	19.615	NA
2017-8- 4-405	41.69580	-71.44908	15" concrete pipe at 66 Dory. Seems to have collapsed and is now a seep.	Prohibited	12/12/2017	D	NOT SAMPLED	99	0.10625	NA
2017-8- 4-405IS	41.69580	-71.44908	In stream	Prohibited	12/12/2017	NA	NOT SAMPLED	99	NA	NA
2017-8- 4-406	41.69613	-71.44700	stream could not find source	Prohibited	10/16/2017	D	2700	100	1.275	NA
2017-8- 4-408	41.69577	-71.44650	Mill Brook upstream 500 ft	Prohibited	10/16/2017	D	10	200	0.88541667	NA
2017-8- 4-409	41.69842	-71.46173	Gorton Pond Tributary upstream 400 ft	Prohibited	10/16/2017	D	135	99	34	NA
2017-8- 4-418	41.69747	-71.45938	Mary's Creek - ~100' upstream	Prohibited	1/18/2018	D	NOT SAMPLED	100	12.75	NA
2017-8- 4-418A	41.69747	-71.45938	Mary's Creek Outlet	Prohibited	1/18/2018	D	NOT SAMPLED	<100	8.5	NA
2017-8- 4-418- ISN	41.69747	-71.45938	In-stream north	Prohibited	1/18/2018	NA	NOT SAMPLED	<100	NA	NA
2017-8- 4-418-ISS	41.69747	-71.45938	In-stream south	Prohibited	1/18/2018	NA	NOT SAMPLED	100	NA	NA
2017-8- 5-504	41.68697	-71.43985	4' wide concrete canal draining upstream wetlands	Prohibited	7/19/2017	D	575	1120	0.094444444	NA
2017-8- 5-506	41.68723	-71.43413	Bakers Creek	Prohibited	7/19/2017	D	455	300	6.375	NA

Station ID	Latitude	Longitude	Description	Receiving Water Classification	Survey Date	Direct/ Indirect	2005 FC Results (MPN/100ml)	2017 Fecal Coliform Results (CFU/100ml)	Volumetric Flow (ft³/s)	Male-specific Bacteriophage Results (PFU/100ml)
2017-8- 5-507	41.68577	-71.42952	Small creek draining wetland area	Conditionally Approved	12/12/2017	D	90	400	0.35416667	NA
2017-8- 5-507IS	41.68577	-71.42952	In stream	Conditionally Approved	12/12/2017	NA	NOT SAMPLED	99	NA	NA
2017-8- 5-508	41.68625	-71.42687	15" CMP conveying creek draining upstream wetland	Conditionally Approved	7/19/2017	D	55	1000	0.202380952	NA
2017-8- 5-510	41.68622	-71.42458	Area of groundwater seepage. No odors.	Conditionally Approved	12/12/2017	D	NOT SAMPLED	99	0.01180556	NA
2017-8- 5-510IS	41.68622	-71.42458	In stream	Conditionally Approved	12/12/2017	NA	NOT SAMPLED	700	NA	NA
2017-8- 5-527	41.68630	-71.42748	Small groundwater seep at base of stairs of 360 Claypool Dr. right-of-way	Conditionally Approved	7/19/2017	D	NOT SAMPLED	320	Trickle	NA
2017-8- 6-602	41.69048	-71.41113	Stream upstream of culvert under bike path at Warwick City Park	Prohibited	7/19/2017	D	3000	420	0.15454545	NA
2017-8- 6-604	41.69822	-71.41915	Stream at head of Brushneck cove	Prohibited	7/19/2017	D	140	1100	Not measured	NA
2017-8- 6-605	41.70428	-71.42013	Tuscatucket Brook at Rt. 117 stone culvert	Prohibited	7/19/2017	D	6	1080	4.17630058	NA
2017-8- 6-606	41.70392	-71.42018	36" concrete flared end adjacent to Tuscatucket Brook, oily smell, brown slime on surfaces	Prohibited	7/19/2017	D	0.99	42	Trickle	NA
2017-8- 6-650	41.68357	-71.39717	Seep at Oakland Beach parking lot west side	Conditionally Approved	7/6/2017	D	0.99	1.9	0.12891667	NA
2017-8- 6-653	41.68773	-71.40197	Stream flowing through concrete culvert	Prohibited	7/6/2017	D	28	1.9	3.774	NA
2017-8- 6-653A	41.68765	-71.40234	in-stream South	Prohibited	7/6/2017	NA	NOT SAMPLED	4	NA	NA
2017-8- 6-653B	41.68783	-71.40223	in-stream North	Prohibited	7/6/2017	NA	NOT SAMPLED	18	NA	NA
2017-8- 6-657	41.69175	-71.40340	Seepage under source #656	Prohibited	7/19/2017	D	55	1180	Little or no flow	NA

Station ID	Latitude	Longitude	Description	Receiving Water Classification	Survey Date	Direct/ Indirect	2005 FC Results (MPN/100ml)	2017 Fecal Coliform Results (CFU/100ml)	Volumetric Flow (ft³/s)	Male-specific Bacteriophage Results (PFU/100ml)
2017-8- 6-669	41.69833	-71.41262	Stream	Prohibited	10/17/2017	D	830	182	Trickle	NA
2017-8- 6-672	41.69912	-71.41493	36" concrete pipe at end of Shand Ave	Prohibited	10/17/2017	D	7	1270	0.09287037	NA
2017-8- 6-674	41.68895	-71.40277	approximately 4 tidal seeps draining from marsh	Prohibited	7/6/2017	D	NOT SAMPLED	11	Trickle	NA
2017-8- 6-676	41.69833	-71.42361	24" CMP at White ave. Enters stream SW of Tuscatucket Brook, into head of Brushneck Cove.	Prohibited	7/19/2017	D	NOT SAMPLED	1.9	0.14071684	NA
2017-8- 6-677	41.68861	-71.41167	Instream at center of City Park	Prohibited	7/20/2017	NA	NOT SAMPLED	400	NA	NA
2017-8- 6-693	41.68564	-71.40449	In-stream sample at beach at end of buttonwoods	Prohibited	7/20/2017	NA	NOT SAMPLED	14	NA	NA
2017-8- 6-694	41.68618	-71.40941	in-stream sample off dock midway in Buttonwoods Cove	Prohibited	7/20/2017	NA	NOT SAMPLED	22	NA	NA
2017-8- 6-697	41.69253	-71.41638	Stream behind school	Prohibited	7/20/2017	D	NOT SAMPLED	88	0.085	NA
2017-8- 6-698	41.68778	-71.40449	Instream at center of City Park beach	Prohibited	7/19/2017	NA	NOT SAMPLED	40	NA	NA
2017-8- 6-699	41.68710	-71.40841	Instream on east side of City Park beach	Prohibited	7/19/2017	NA	NOT SAMPLED	60	NA	NA
2017-8- 7-700	41.67192	-71.38768	10" concrete pipe in seawall draining golf course pond	Approved	7/19/2017	D	129	4	0.01	NA
2017-8- 7-700A	41.67207	-71.38841	Seep from drain in green	Approved	7/19/2017	D	NOT SAMPLED	9	seep (flow very low)	NA
2017-8- 7-701	41.67085	-71.38640	16" concrete grey house with tennis court and swimming pool	Approved	7/19/2017	D	170	400	0.005	NA
2017-8- 7-702	41.67085	-71.38637	24" CMP 5 feet east of #701	Approved	7/19/2017	D	2200	1180	trickle	NA
2017-8- 7-703	41.66933	-71.38487	10" concrete pipe behind bamboo vegetation	Approved	7/19/2017	D	115	920	0.028	NA
2017-8- 7-704	41.66877	-71.38360	seep	Approved	7/19/2017	D	NOT SAMPLED	104	trickle	NA

Station ID	Latitude	Longitude	Description	Receiving Water Classification	Survey Date	Direct/ Indirect	2005 FC Results (MPN/100ml)	2017 Fecal Coliform Results (CFU/100ml)	Volumetric Flow (ft³/s)	Male-specific Bacteriophage Results (PFU/100ml)
2017-8- 7-706	41.67693	-71.39080	16" concrete located at road	Conditionally Approved	7/19/2017	D	0.99	100	0.007	NA
2017-8- 7-708	41.68220	-71.39063	wetland drainage	Conditionally Approved	7/19/2017	D	430	1180	0.25	NA
2017-8- 7-709	41.69087	-71.38938	10" concrete pipe	Prohibited	7/20/2017	D	2000	52	0.002	NA
2017-8- 7-710	41.69213	-71.38905	10" concrete pipe end of Tiffany ave on north side	Prohibited	7/20/2017	D	0.99	5	0.004	NA
2017-8- 7-711	41.69438	-71.38837	12" CMP	Prohibited	7/20/2017	D	0.99	47	drip	NA
2017-8- 7-711A	41.69556	-71.38826	Flow from wetland area at end of Sayles Ave	Prohibited	7/20/2017	D	NOT SAMPLED	1.9	0.05	NA
2017-8- 7-711B	41.69333	-71.38530	24-36 inch concrete pipe	Prohibited	7/20/2017	D	NOT SAMPLED	176	0.05	NA
2017-8- 7-711C	41.69734	-71.38408	8" concrete pipe. Drains catch basin at end of Guild Ave	Prohibited	7/20/2017	D	NOT SAMPLED	700	trickle	NA
2017-8- 7-711D	41.69906	-71.38140	(2) Flared concrete outfall. Drains stormwater off of Warwick Neck Ave and Samuel Gorton Ave. Only one pipe flowing during survey in 2017	Prohibited	7/20/2017	D	NOT SAMPLED	6	0.05	NA
2017-8- 7-712	41.69500	-71.38833	Wetland draining north east end of cove	Prohibited	7/20/2017	D	NOT SAMPLED	1.9	stagnant	NA
2017-8- 7-714	41.69780	-71.38880	12" Concrete in bulkhead just west of travel lift	Prohibited	7/20/2017	D	0.99	160	0.01	NA
2017-8- 7-717	41.69713	-71.39225	Cove / salt marsh	Prohibited	7/20/2017	D	86	4	NA	NA
2017-8- 7-718	41.69417	-71.39403	Cove / salt marsh	Prohibited	7/20/2017	D	1	13	NA	NA
2017-8- 7-720	41.67083	-71.38633	Stream above pond at Camelot Farms	Approved	7/19/2017	I	84	900	0.01	NA
2017-8- 7-721	41.67083	-71.38633	Stream below pond at Camelot Farms	Approved	7/20/2017	I	180	160	0.01	NA

3.3.2 Detailed Description of Major Sources

No sources exceeded the 2400 CFU/100ml benchmark requiring follow-up sampling. However, 27 of the sources flowing during the 2017 shoreline survey had bacteriological results that exceeded the 240 CFU/100ml benchmark warranting triennial follow-up investigations. These sources are highlighted in yellow in the Table 3-1. The following is a discussion of each of the sources that exceeded 240 CFU/100ml, broken down by survey area. Four samples were tested for MSB and one of these results (source 2017-8-2-208) had a MSB level exceeding 50 PFU/100ml (1200 pfu/100ml), suggesting wastewater effluent of anthropogenic origin. This source discharges to waters located in the prohibited area of Apponaug Cove. The trigger level of 50 PFU/100ml has been determined through past studies by RIDEM to be a level that suggests a higher likelihood that the source of bacteria is from human origins.

The following table from the document entitled; Occurrence of Male-Specific Bacteriophage in Feral and Domestic Animal Wastes, Human Feces, and Human-Associated Wastewaters (Calci et al 1999) indicates the range of MSBs found in various human-associated wastewaters.

	No. of	MSB density ^a						
Waste type	samples	By qualitative enrichment method (%)	nt By quantitative direct-plating Range method (%)		Mean MSB ^b			
Human feces	13	1 (8)	0.0(0)	<1.0-6.25	<1			
Residential lift station	22	<u> </u>	2 (9)	$<50.0-2.5 \times 10^{4}$	1.3×10^{3}			
Sewage plant effluent	14	_	11 (79)	$<100-2.1 \times 10^{5}$	3.0×10^{4}			
Septage	17	11 (65)	10 (59)	$<10-1.0 \times 10^{6}$	1.0×10^{5}			
In-line sewage	11	<u> </u>	11 (100)	4.5×10^{3} - 8.7×10^{5}	2.3×10^{5}			
Sewage plant influent	14	—	14 (100)	$8.5\times10^{4}3.4\times10^{6}$	$5.2 imes 10^5$			

Table 3-2 Densities of MSB in human-associated wastewaters

Additionally, the following statement was excerpted from this document:

"Calculations demonstrate that MSB inputs from animal sources are insignificant compared with those from wastewater effluents. To equal the MSB levels discharged by a wastewater treatment plant averaging 1 MGD (1012 PFU/day) would require the daily fecal contribution of more than 60,000 horses, 100,000 hogs, 180,000 landfill-associated seagulls, or 550,000 dairy cows. A plant serving a relatively small community of about 10,000 would discharge this volume of wastewater. It is apparent from the number of inputs that animals are not a significant source of MSB compared to wastewater treatment plants servicing even relatively small communities which discharge treated wastes into the aquatic environment. We found that MSB recovered from waters or shellfish, excluding those from the most-rural coastal areas, can be presumed to be of anthropogenic origin. As such, MSB may be a reliable indicator of enteric viral pathogens in environmental waters and molluscan shellfish.

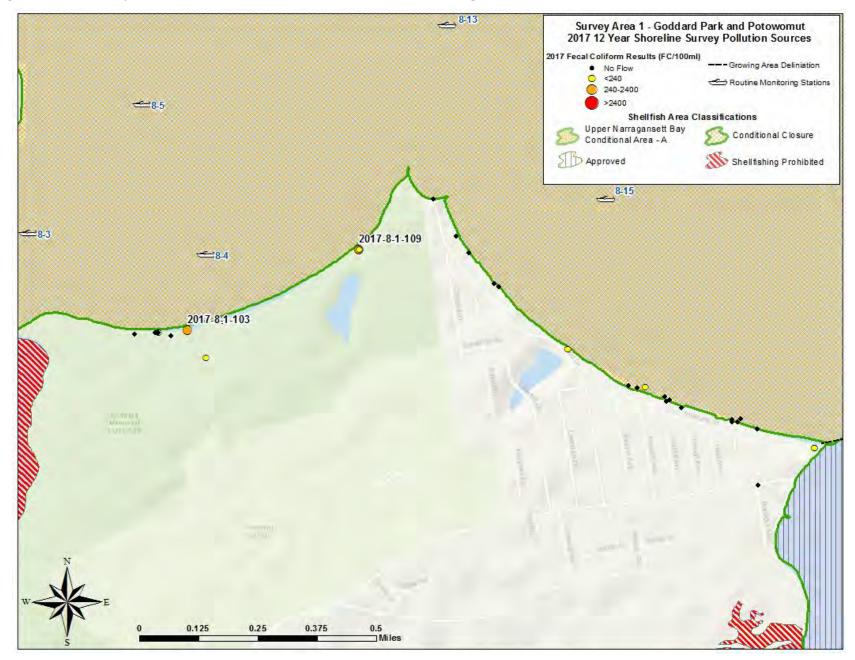


Figure 3-4 Survey Area 1 – Goddard Park and Potowomut - Sources exceeding 240 CFU/100ml

Survey Area 1 – Goddard Park and Potowomut

There were two sources in this survey area exceeding 240 CFU/100ml, both located along the beach of Goddard Park. These sources are listed in the following Table 3-3.

Station ID	Description	Survey Date	Direct/ Indirect	Fecal Coliform Results		Volumetric Flow (ft ³ /s)	Male-specific Bacteriophage
				2005 (MPN/100ml)	2017 (CFU/100ml)		(PFU/100ml)
2017-8-1-	Twin 24"	6/5/2017	D				
103	concrete						
	pipe in			<mark>NOT SAMPLED</mark>	1040	7.5138E-06	NA
	seawall with						
	grates						
2017-8-1-	Marsh	6/5/2017	D	165			
109	drainage			IS at mouth = 27	300	1.25	NA
	stream						
2017-8-1-	IS east of	6/5/2017	NA	NIA	n	NIA	NIA
109A	stream			NA	2	NA	NA
2017-8-1-	IS west of	6/5/2017	NA	NA	24	NA	NA
109B	stream			INA	24	NA	INA

 Table 3-3
 Major Sources in Survey Area 1 – Goddard Park and Potowomut

The first source, 2017-8-1-103, had FC results at 1040 CFU/100ml, well above the 240 CFU/100ml trigger level. This source is stormwater drainage from the Goddard Park beach parking lot. Upstream inputs to the stormwater come from the parking lot where runoff collects and various wildlife and seagull activity contribute to fecal inputs. It is discharging into conditionally approved waters, however it had an extremely low volumetric flow rate of 0.0000075 ft³/s (just a slow drip at the time of the survey), which amounts to only 0.65 ft³/day. Thus, no reclassification is recommended at this time based on this source, however, it should be resurveyed during the 2020 Triennial evaluation.



Figure 3-5 Source 2017-8-1-103

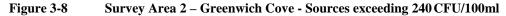
The second source, 2017-8-1-109, is a stream that drains an upland marshy area into the receiving waters of Greenwich Bay. It had a relatively high flow rate of 1.25 ft³/s or 108,000 ft³/day, resulting in a FC load of $9.16E^9$ FC/day. However, two in-stream samples were taken just East and West of the outlet of the stream, and both had low FC results (2 and 24 CFU/100ml respectively). Thus, it does not seem that this stream significantly impacts the receiving waters. This source will also be resurveyed in 2020.

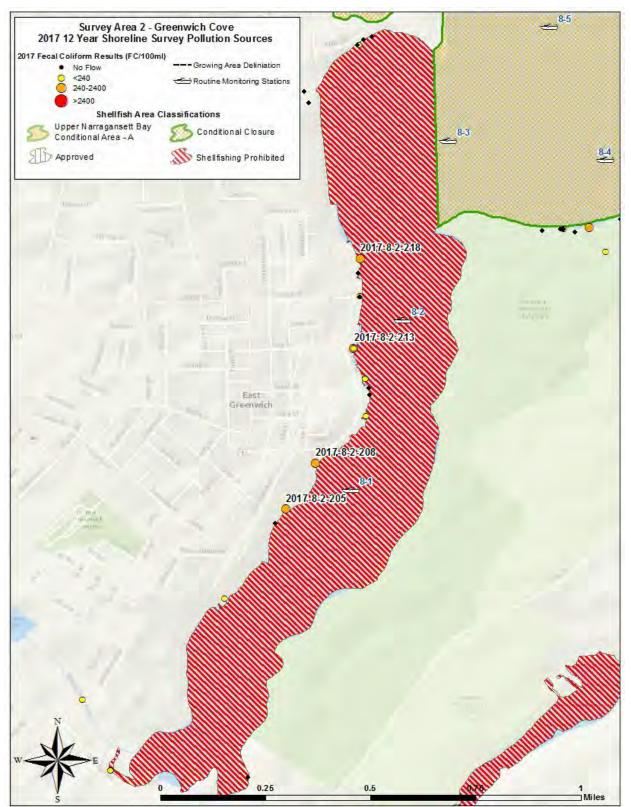
Figure 3-6 Source 2017-8-1-109



Figure 3-7 Source 2018-8-1-109 at beach end







Survey Area 2 – Greenwich Cove

Station ID	Description	Survey Date	Direct/ Indirect	Fecal Colifo	orm Results	Volumetric Flow (ft ³ /s)	Male-specific Bacteriophage
		Date		2005 (MPN/100ml)	2017 (CFU/100ml)		(PFU/100ml)
2017-8- 2-205	24" concrete pipe north of EG town ramp, south of WWTP, bottom of access road to ramp	7/19/2017	D	2	360	Trickle	NA
2017-8- 2-208	30" concrete pipe at bottom of steps at playground north of WWTP	7/19/2017	D	170	1180	0.0668403	1200
2017-8- 2-213	30" concrete pipe under south end of 20 Water St deck. Visited at low tide and water was still up to and slightly flooding pipe. Difficult to tell flow due to angle, but looked to be only a slight trickle.	12/12/2017	D	NOT SAMPLED	1200	0.0070629	NA
2017-8- 2-218	30" concrete pipe south side of Norton's Marina at marine railway	7/19/2017	D	2850	280	0.0668403	<2

Table 3-4Major Sources in Survey Area 2 – Greenwich Cove

There were four samples within Greenwich Cove with FC levels above 240 CFU/100ml, however all had very low flow rates at the time of sampling. Source 2017-8-2-213 was originally surveyed on 7/19/2017 and had a result of >1600 CFU/100ml. It was resampled on 12/12/2017 and had a lower result of 1200 CFU/100ml and was still only flowing at a trickle. One source (2017-8-2-208) was tested for Male-Specific Bacteriophage with a result of 1200 PFU/100ml, suggesting anthropogenic sources of bacteria being discharged from this pipe. RIPDES staff have been made aware of this source and will notify East Greenwich town officials for follow-up to ensure compliance with their MS4 Municipal Stormwater permit. Because this area is already classified as Prohibited to shellfishing due to the high volume of marinas and mooring fields as well as the closed safety zone for the East Greenwich WWTF, no reclassification is recommended based on the shoreline pollution sources analyzed during this survey. Follow-up sampling will be completed during the 2020 Triennial Evaluation. Photos of these sources are provided on the following page.

Figure 3-9 Source 2017-8-2-205



Figure 3-10 Source 2017-8-2-208



Figure 3-11 Source 2017-8-2-213



Figure 3-12 Source 2017-8-2-218



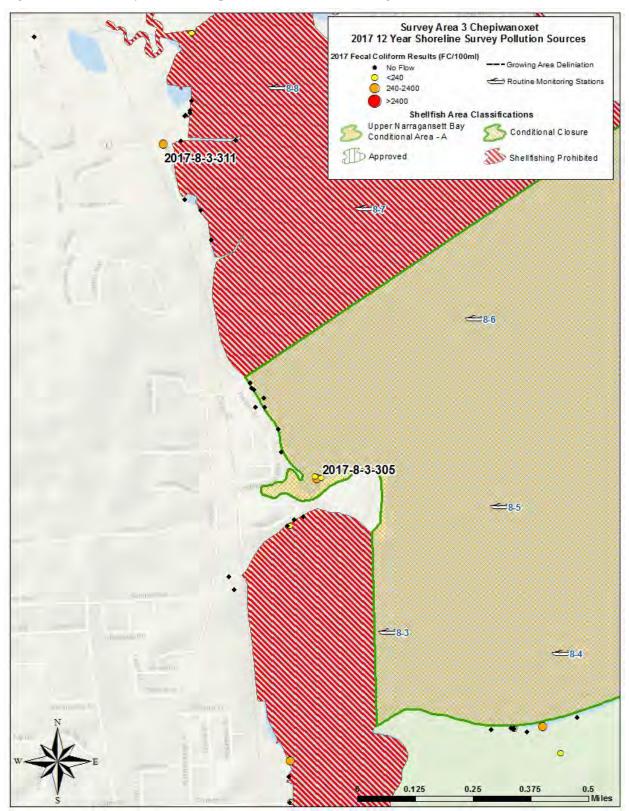


Figure 3-13 Survey Area 3 – Chepiwanoxet - Sources exceeding 240 CFU/100ml

Survey Area 3 - Chepiwanoxet

Station ID	Description	Survey Date	Direct/ Indirect	Fecal Coliform Results		Volumetric Flow	Male-specific Bacteriophage
				2005 (MPN/100ml)	2017 (CFU/100ml)	(ft³/s)	(PFU/100ml)
2017-8-3- 305	Stream at marsh outlet	7/20/2017	D	7	340	1.2	NA
2017-8-3- 305 ISE	In-stream east of marsh stream	7/20/2017	NA	NOT SAMPLED	25	NA	NA
2017-8-3- 305 ISW	in-stream west of marsh stream	7/20/2017	NA	NOT SAMPLED	22	NA	NA
2017-8-3- 311	36" concrete pipe under roadway at end of Masthead Dr	9/13/2017	D	100	400	Little or no flow	NA

Table 3-5Major Sources in Survey Area 3 - Chepiwanoxet

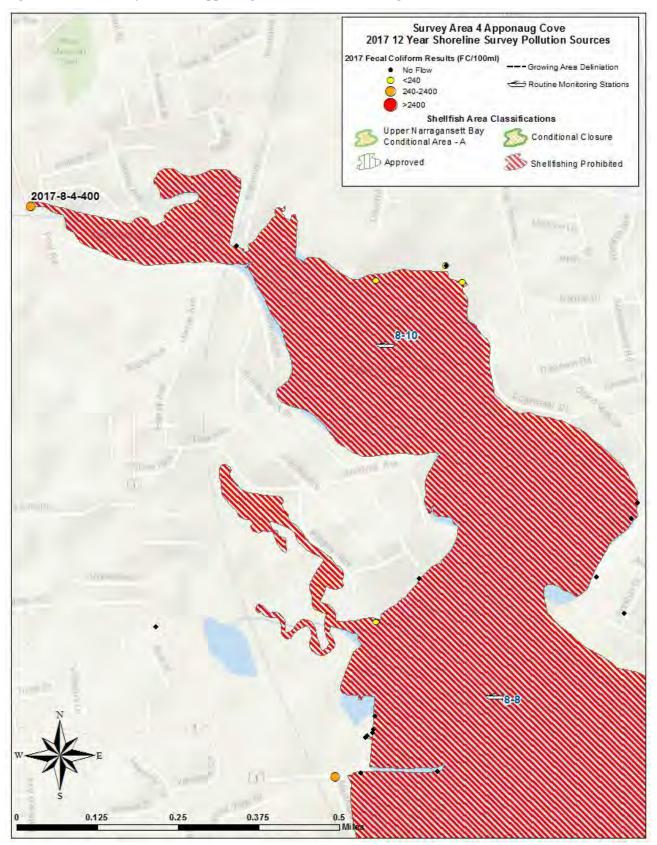
There were two sources in the Chepiwanoxet survey area in which bacteriological results exceeded 240 CFU/100ml (Figures 3-14 and 3-15). 2017-8-3-305 is a stream from a marshy area and had FC results of 340 CFU/100ml with a volumetric flow rate of 1.2 ft³/s. However, two instream samples were taken just East and West of the end of the stream and both results were fairly low (25 and 22 CFU/100ml respectively). Thus, it does not appear that this stream is impacting the bacteriological levels of the receiving waters. Source 2017-8-3-311 had FC results of 400 CFU/100ml, also above the 240 CFU/100ml threshold. However, the pipe had lots of sediment in it and the flow was so slight that it was not able to be measured. Therefore, it does not seem that this source would be a significant contributor to bacterial pollution to Greenwich Bay. However, both sources should be resurveyed during the 2020 Triennial Evaluation.

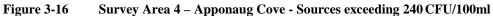
Figure 3-14 Source 2017-8-3-305



Figure 3-15 Source 2017-8-3-311







Survey Area 4 – Apponaug Cove

Station ID	Description	Survey Date	Direct/ Indirect	Fecal Colifo	rm Results	Volumetric Flow (ft ³ /s)	Male-specific Bacteriophage
				2005 (MPN/100ml)	2017 (CFU/100ml)		(PFU/100ml)
2017-8- 4-400	Hardig Brook	10/16/2017	D	75	1200	19.615	NA

 Table 3-6
 Major Sources in Survey Area 4 – Apponaug Cove

Table 3-7Routine Monitoring Results in Apponaug Cove

Station	Date	Fecal Coliform Results (CFU/100ml)	Weather
8-6	10/11/2017	2	Dry
8-7	10/11/2017	2	Dry
8-8	10/11/2017	2	Dry
8-10	10/11/2017	30	Dry

There was one major bacteriological source in the Apponaug Cove survey area. Source 2017-8-4-400 is the outlet of Hardig Brook into the upper part of the cove. This is one of the major freshwater tributaries that enters Greenwich Bay at the most inland section of Apponaug Cove. It had a fairly high fecal coliform level at 1200 CFU/100ml and a strong volumetric flow of 19.6 ft³/s. Many ducks and winter water fowl were present at the time of sampling. At this FC and flow level, 1.45E8 ft³ of water is required for proper dilution, which is approximately 6.4E7 ft³ more than is provided by the current prohibited area. This would result in moving the line outward approximately 800-1000ft. Below are the calculations for the dilution area required:

FC=1200 CFU/100ml Vol. flow = $19.6 \text{ ft}^3/\text{s}$

 $19.6 \text{ ft}^3/\text{s} = 1,693,440 \text{ ft}^3/\text{day} = 12.67 \text{ mg/day}$

$$12.67 \frac{\text{mg}}{\text{d}} * \frac{1200\text{CFU}}{100\text{ml}} = \frac{15,204\text{mg} * \text{CFU}}{\text{d}} * \frac{1}{100\text{ml}} * \frac{3.785\text{E9}\text{ml}}{\text{mg}} = 5.75\text{E11}\frac{\text{CFU}}{\text{d}}$$

Or 5.75E11 FC/day

With this daily FC load, the dilution water required can be calculated as follows:

$$\frac{5.75E11 \text{ FC}}{x \text{ ft}^3} = \frac{14\text{FC}}{100ml} * \frac{283(100ml)}{\text{ft}^3}$$
$$x = \frac{5.75E11\text{FC}}{14 * 283} = 1.45E8 \text{ ft}^3$$

Assuming two separate depths within Apponaug Cove, a "shallow area" of 3 feet in the upper reaches and a "deep area" of 8 feet in the lower outer section of the prohibited area (see Figure 3-17). The split in the cove depths was based on reviewing the depths on the NOAA Nautical Chart 13221 and using best judgement. Using ArcMap, the acreage of each section was calculated and the volume of each section was calculated and added together for an approximate volume of the entire prohibited area.

	Area (ft ²⁾	Volume (ft ³)= Area * Depth
New extended prohibited strip	3.21E+06	<i>3.21E+06</i> * <i>8</i> = 2.57E+07
Extra extended strip	8.67E+05	<i>8.67E+05</i> * 7 = 6.07E+06
	1.26E+06	<i>1.26E+06</i> * 7 = 8.84E+06
Upper Apponaug	6.12E+06	6.12E+06 * 3 = 1.83E+07
Lower Apponaug	1.08E+07	<i>1.08E+07 * 8 =</i> 8.61E+07
Total Volume		1.45E+08

- The area of Apponaug Cove that is currently prohibited: **8.12E+07** ft³
- The area required to appropriately dilute the Hardig Brook source: **1.45E+08 ft**³

To determine whether the current prohibited area is sufficient enough for diluting the source the current volume and the required volume were subtracted to determine the difference, as shown below:

1.45E+08 ft³ - 8.12E+07 ft³ = 6.4E+07 ft³

An extended dilution area is required based on these calculations with a FC load of 1200 CFU/100ml and a volumetric flow of 19.615 (ft^3/s).

However, past dry-weather data for Hardig Brook has shown much lower FC concentrations: the last 12-year survey in 2005 had results of less than 100 FC/100ml and a very low flow of only 0.063 ft³/s and the 2005 Greenwich Bay TMDL showed an average dry-weather FC concentration of 291 FC/100ml and an average flow of 6.0 ft³/s. In addition, routine monitoring was completed 5 days before this shoreline source was surveyed (Table 3-7). The results for Apponaug Cove suggest that Hardig Brook dilutes quickly from the most inland station (station 8-10, results = 30 CFU/100ml) to just inside and outside of the prohibited area (station 8-7 and 8-6 respectively, results = 2 CFU/100ml). Finally, routine monitoring station 8-7, which is approximately 800 feet from the prohibited area line, met the standards for the FC geometric mean (3.8 FC/100ml) and % of samples>31 FC/100ml (6.7%) (Table 5-1). This suggests that adequate dilution and/or tidal flow is occurring for this pollution source. No reclassification is recommended. Follow-up sampling should be done in the next annual or triennial survey.

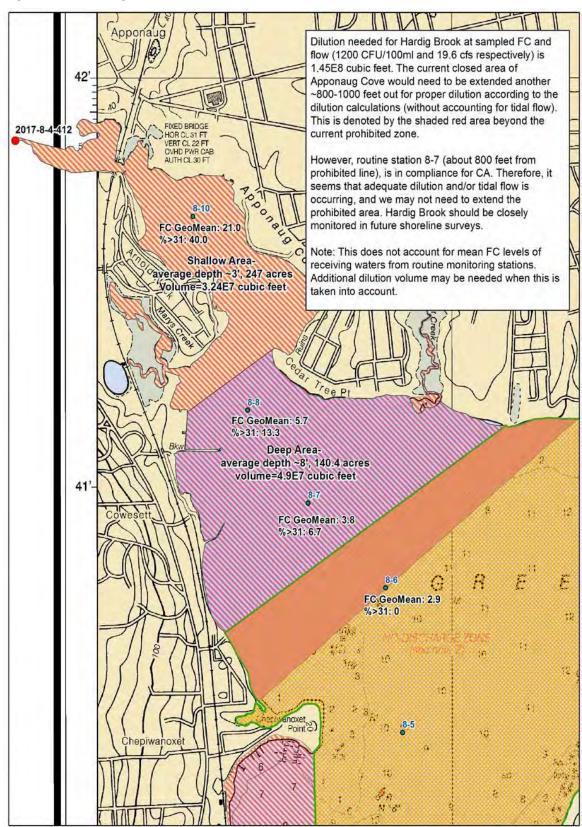


Figure 3-17 Hardig Brook

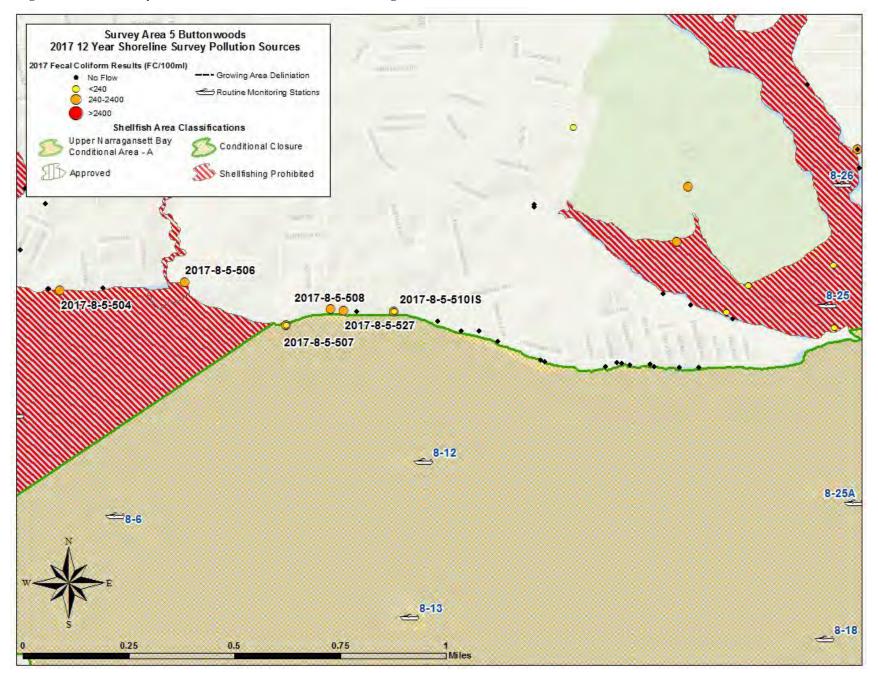
Figure 3-18Source 8-4-400 – receiving water



Figure 3-19 Source 8-4-400



Figure 3-20 Survey Area 5 – Buttonwoods - Sources exceeding 240 CFU/100ml



Survey Area 5 – Buttonwoods

Station ID	Description	Survey Date	Direct/ Indirect	Fecal Colifo	rm Results	Volumetric Flow (ft ³ /s)	Male-specific Bacteriophage
		Date	manect	2005 (MPN/100ml)	2017 (CFU/100ml)	11000 (11 / 3)	(PFU/100ml)
2017-8-5- 504	4' wide concrete canal draining upstream wetlands	7/19/2017	D	575	1120	0.094444444	NA
2017-8-5- 506	Bakers Creek	7/19/2017	D	455	300	6.375	NA
2017-8-5- 507	Small creek draining wetland area	12/12/2017	D	90	400	0.35416667	NA
2017-8-5- 507IS	In stream	12/12/2017	NA	NOT SAMPLED	<100	NA	NA
2017-8-5- 508	15" CMP conveying creek draining upstream wetland	7/19/2017	D	55	1000	0.202380952	NA
2017-8-5- 510	Area of groundwater seepage. No odors.	12/12/2017	D	NOT SAMPLED	<100	0.01180556	NA
2017-8-5- 510IS	In stream	12/12/2017	NA	NOT SAMPLED	700	NA	NA
2017-8-5- 527	Small groundwater seep at base of stairs of 360 Claypool Dr. right-of-way	7/19/2017	D	NOT SAMPLED	320	Trickle	NA

 Table 3-8
 Major Sources in Survey Area 5 – Buttonwoods

There were five sources in the Buttonwoods area that exceeded the 240CFU/100ml criteria (Figure 3-17, Table 3-7). The first is a concrete canal draining a wetland area, source 2017-8-5-504. With a flow rate of 0.094 ft3/s and a FC level of 1120 CFU/100ml, a dilution volume of 6.53E5 ft3 or a radius of 455 feet from shore is required to provide proper dilution, which is more than adequately provided by the current prohibited area surrounding the source.

Source 2017-8-5-506 (Baker's Creek) also discharges into the prohibited area of Apponaug Cove. The FC level and flow that was observed during the survey would require a radius from shore of ~1200ft, which is provided by the current closure area. In addition, the two closest monitoring stations meet the criteria for conditionally closed areas (station 8-7 which is ~2200ft SW from Baker's Creek and within the prohibited area, and station 8-6 which is ~2400ft south within the conditionally approved area) (Table 5-1). However, this source has shown high variability in flow and FC results from past shoreline surveys. This could be due in part to the lower rate of sewer connections in the past: a significant number of properties around Baker's Creek have connected to the sewer system over the last ten years, with a connection rate in this area of approximately 71% in 2007 and 86.5% in 2017 (Warwick Sewer Authority). This source should be sampled in dry weather conditions as part of the next annual review to ensure that water quality from this source is improving.

Source 8-5-507 is a stream draining a wetland area and had a bacteriological result of 400 CFU/100ml and a flow of 0.35 ft³/s. However, an in-stream sample of this source had a FC result of less than 100 CFU/100ml (due to laboratory testing limitations, the results could not be

determined more precisely) and so this source does not seem to be negatively impacting the receiving waters. Source 8-5-510 was well below the FC criteria, however an in-stream sample had a result of 700 CFU/100ml. Despite this, the closest routine monitoring station to Buttonwoods (8-12, ~1800 feet offshore) is in compliance (Table 5-1).

Finally, source 8-5-527 had a bacteriological result of 320 CFU/100ml, however it was only a slight trickle at the time of sampling. Due to the intermittent nature of these pollution sources and the results of the routine monitoring stations, no reclassification of the receiving waters is recommended. However, these sources will be resampled during the 2020 Triennial Review or 2018 Annual Review.

Figure 3-17 Source 8-5-504



Figure 3-22 Source 8-5-506 – Baker's Creek

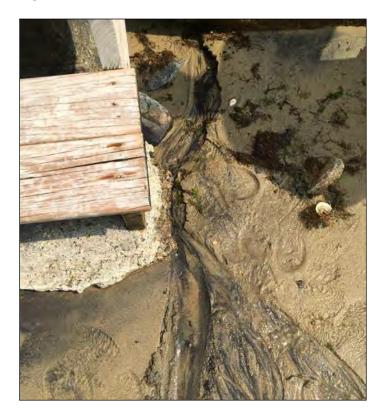


Figure 3-23 Source 8-5-507

Figure 3-24 Source 8-5-510



Figure 3-25 Source 8-5-527



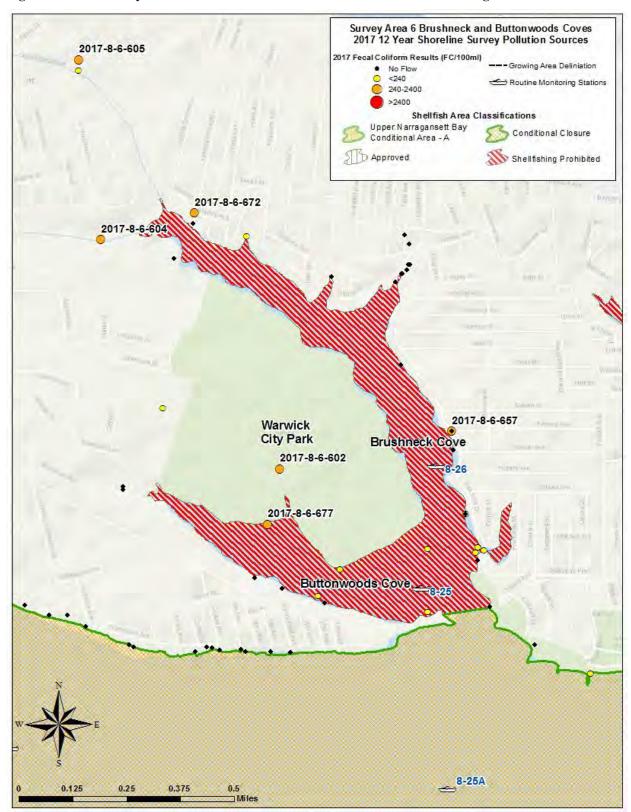


Figure 3-26 Survey Area 6 – Brushneck/Buttonwoods Coves - Sources exceeding 240 CFU/100ml

Survey Area 6 – Brushneck and Buttonwoods Coves

Station ID	Description	Survey Date	Direct/ Indirect	Fecal Colifo	rm Results	Volumetric Flow (ft³/s)	Male-specific Bacteriophage	
				2005 (MPN/100ml)	2017 (CFU/100ml)		(PFU/100ml)	
2017-8- 6-602	Stream upstream of culvert under bike path at Warwick City Park	7/19/2017	D	3000	420	0.15454545	NA	
2017-8- 6-604	Southern Creek at head of Brushneck cove	7/19/2017	D	140	1100	Not measured*	NA	
2017-8- 6-605	Tuscatucket Brook at Rt. 117 stone culvert	7/19/2017	D	6	1080	4.17630058	NA	
2017-8- 6-657	Seepage under source #656	7/19/2017	D	55	1180	Little or no flow	NA	
2017-8- 6-672	36" concrete pipe at end of Shand Ave	10/17/2017	D	7	1270	0.09287037	NA	
2017-8- 6-677	Instream at center of City Park	7/20/2017	NA	NOT SAMPLED	400	NA	NA	

 Table 3-8
 Major Sources in Survey Area 6 – Brushneck and Buttonwoods Coves

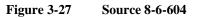
Table 3-9Routine Monitoring Results in Brushneck Cove	Table 3-9	Routine Monitoring	Results in	Brushneck Cove
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Station	Date	Fecal Coliform Results (CFU/100ml)	Weather
8-26	7/19/2017	140	Wet
8-25	7/19/2017	27	Wet
8-25A	7/19/2017	7	Wet

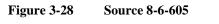
Six samples in Brushneck and Buttonwoods Coves exceeded 240 CFU/100ml. Two of the sources are major tributaries entering the northernmost corner of Brushneck cove. All sources discharge to prohibited classified waters. Source 8-6-604 (Figure 3-22) is Southern Creek and had a bacteriological result of 1100 CFU/100ml. Unfortunately, the flow was not measured at the time of the survey, but a past study estimates the yearly flow as 1001 million gallons, which is about 4.2 ft³/s (RI Coastal Resource Management Council, 2005). The second major tributary is Tuscatucket Brook (Source 8-6-605, Figure 3-23), which had similar results: 1080 CFU/100ml and 4.18 ft³/s. The remaining point sources had varying bacteriological results ranging from 420 to 1270 CFU/100ml, however all had very low flow rates. During the 2005 12-year survey, most of these samples had low bacteriological results (excluding source 8-6-602). Also, during the 2017 survey, these samples were taken during wet weather (6 days after a 1.65" rain event over a 3-day timespan) when the conditional area waters were closed. Finally, routine monitoring shows that dilution is occurring. On the primary sampling day (7/19/2017), the routine stations within these coves were sampled (Table 3-10). The most inland station (8-26, Figure 3-25) was high at 140 CFU/100ml, however further south at station 8-25, results were much lower (27 CFU/100ml) and the station just outside the coves in the conditionally approved waters was low (7 CFU/100ml). In addition, stations 8-25 and 8-25A are in compliance overall (Table 5-1).

Because of these considerations, it does not seem that these sources are adversely affecting the conditionally approved area outside the cove. The current prohibited area allows for adequate dilution of these sources. No reclassification is recommended and these sources will be resampled in 2020 during the next Triennial Review.









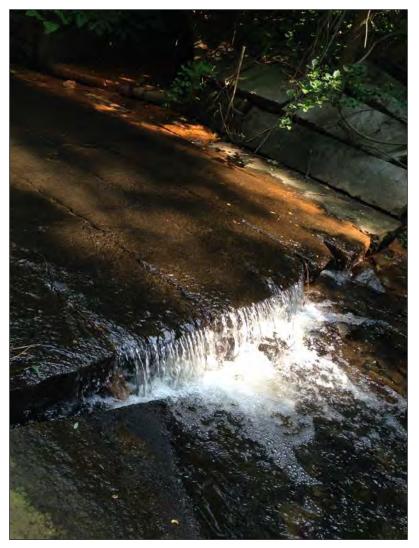








Figure 3-18 Source 8-6-677

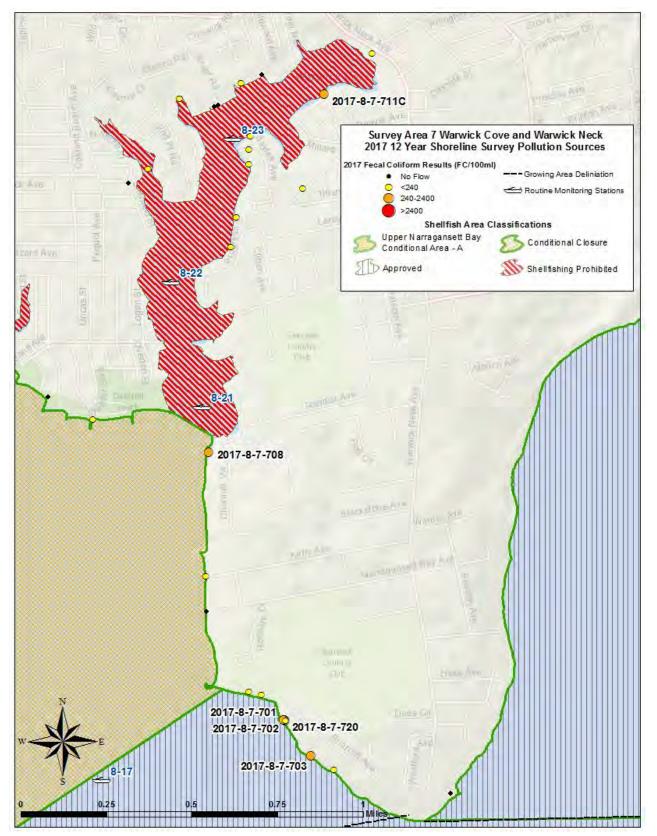


Figure 3-19 Survey Area 7 – Warwick Cove/Warwick Neck - Sources exceeding 240 CFU/100ml

Survey Area 7 – Warwick Cove and Warwick Neck

Station ID	Description	Survey Date	Direct/ Indirect	Fecal Colifo	rm Results	Volumetric Flow (ft ³ /s)	Male-specific Bacteriophage
				2005 (MPN/100ml)	2017 (CFU/100ml)		(PFU/100ml)
2017-8- 7-701	16" concrete pipe. grey house with tennis court and swimming pool	7/19/2017	D	170	400	0.005	NA
2017-8- 7-702	24" CMP 5 feet east of #701	7/19/2017	D	2200	1180	trickle	NA
2017-8- 7-703	10" concrete pipe behind bamboo vegetation	7/19/2017	D	115	920	0.028	NA
2017-8- 7-708	wetland drainage	7/19/2017	D	430	1180	0.25	NA
2017-8- 7-711C	8" concrete pipe. Drains catch basin at end of Guild Ave	7/20/2017	D	NOT SAMPLED	700	trickle	NA
2017-8- 7-720	Stream above pond at Camelot Farms	7/19/2017	I	84	900	0.01	NA

 Table 3-10
 Major Sources in Survey Area 7 – Warwick Cove and Warwick Neck

Table 3-11Source 8-7-708 Past FC Results

Source ID	2005 Fecal Coliform Results (CFU/100ml)	2005 Vol. Flow (cfs)	*2006 Fecal Coliform Results (CFU/100ml)	2006 Vol. Flow (cfs)	*2008 Fecal Coliform Results (CFU/100ml)	2008 Vol. Flow (cfs)	2011 Fecal Coliform Results (CFU/100ml)	2011 Vol. Flow (cfs)
8-7-708	430	0.053	46	0.74	93	Not available	430	0.035

*Sample taken during wet weather closed conditions

The final survey area in Greenwich Bay is Warwick Cove and Warwick Neck. There were six sources exceeding 240 CFU/100ml. One source (2017-8-7-711C), discharges into the upper portion of the prohibited area of Warwick Cove. This source was only trickling and is therefore more than adequately diluted by the current closure.

Four sources discharge into the approved section of the growing area: 8-7-701, 8-7-702, 8-7-703, and 8-7-720. They had bacterial concentrations ranging from 400 to 1180 CFU/100ml, however all had very low flow rates with the highest being source 8-7-703 with a flow of only 0.028 cfs. The receiving waters get deep very quickly, as a channel runs along the shoreline of Warwick Neck with a low tide depth ranging from 20-40 feet (NOAA Chart 13224). Because these sources all had very low flow rates and the receiving waters fairly deep, there is a suitable volume of water to allow for adequate dilution and these sources do not seem to be impacting the growing area.

Finally, source 8-7-708 discharges into the conditionally approved portion of the growing area. In 2017, this source had elevated fecal levels at 1180 CFU/100ml and a relatively low flow of 0.25 cfs. However, this source was sampled during wet weather when the conditionally approved portion of the growing area was closed to shellfishing. In addition, past sampling in has shown lower fecal coliform levels for this source (Table 3-10). Because of these considerations, it does not seem that this source is impacting the growing area, however it should be resampled during dry weather as part of the next annual or triennial evaluation.

3.4 Identification and Evaluation of Pollution Sources

3.4.1 Domestic Wastes

Sources of domestic wastes that may convey fecal coliform bacteria to the growing area include dry wells, cesspools, illicit connections, on-site wastewater treatment systems (OWTS) and wastewater treatment facility discharges. The method of transport of pollutants from on-site wastewater treatment facilities is normally through the groundwater, either to the growing area itself or to a tributary that ultimately drains to the growing area. Although less common, fecal coliform bacteria can also be transported via surface seepage or by illegal pipes.

The Greenwich Bay watershed is evolving from a watershed that once relied upon OWTS to one in which the majority of sewage is handled by municipal sewers and treatment facilities (Greenwich Bay TMDL, RIDEM 2005). Today, most of the existing residential and commercial occupants in the growing area's watershed have sewers available to them (Figure 3-32). However, there are currently no mandatory tie-in requirements set forth by the Town of East Greenwich or the City of Warwick. Despite this, most of the neighborhoods surrounding Greenwich Bay have tied into the sewers (Figure 3-32). The watershed is unique in that most of the abutting lands are serviced by sewers that ultimately discharge outside of the watershed of Greenwich Bay. The City of Warwick operates a treatment plant that releases treated effluent to the main stem of the Pawtuxet River, which ultimately discharges to the Providence River, outside of this watershed. The Town of East Greenwich operates a sewage treatment facility that discharges to Greenwich Cove at routine monitoring station 8-1 (Figure 3-36).

A review of Onsite Wastewater Treatment Systems (OWTS) complaints and failures was conducted. There are currently no open OWTS complaints within close proximity of the Greenwich Bay growing area. The closest open complaint is approximately 1800 feet from the shore of prohibited waters, and thus is not a threat to the quality of the growing area.

3.4.1.1 East Greenwich Wastewater Treatment Facility Performance

The East Greenwich WWTF is a modern "Rotating Biological Contactors" secondary treatment plant that was converted to UV disinfection in February of 2004. Additional construction was completed in 2006 to meet a seasonal Total Nitrogen limit of 5 mg/l. The plant has a design flow of 1.7 MGD and serves approximately 6,000 customers. The plant currently has a RIPDES permitted discharge (RI0100030) that discharges into Greenwich Cove.

The facility is permitted to discharge a maximum daily load of 1.70 MGD (million gallons/day) of treated effluent. The average flow for 2017 was 0.88 MGD, well within the permit limits. Only one violation was reported in 2017. After installation of a new UV system control panel, a daily max Enterococci of 300 MPN was reported, just over the permitted daily max of 276 MPN. The UV control panel needed "tweaking" which resolved the issue. The facility did not install any new treatment processes. The only upgrade in 2017 was the new UV system control panel. They are currently replacing their RBC (Rotating Biological Contactors) units and rehabbing their secondary clarifiers. Plant operators report any permit violations or failure events to RIDEM's Office of Operations and Maintenance (or DLE after hours) which is then conveyed directly to the shellfish program for any necessary actions according to the CAMP..

A dye study was completed in Greenwich Cove in 1986 to determine the travel time and dilution of effluent from the wastewater treatment facility. The flow rate of the effluent from the plant was 0.8-1.05 mgd. Results of the study concluded that it takes approximately 14.5 hours for the effluent from the plant to exit Greenwich Cove (Turner 1986). This portion of the growing area is classified as prohibited, and so it takes that amount of time for the discharge from the plant to enter the conditionally approved section of the bay. In addition, prior to reaching the current defined edge of the prohibited area, the effluent is diluted by a factor of 1700, meeting the NSSP requirements that a dilution ratio of 1000:1 be reached within the prohibited zone.

The flow rate of effluent has not changed significantly since the completion of the dye study (2017 average flow of 0.88 mgd and past years' flows generally between 0.8 and 1.0 mgd), and therefore, these dilution values would still apply. However, significant improvements have been made to the plant over the years, such as the installation of RBCs in 1989 and a UV disinfection system in 2004, which ultimately reduce viral loads and more efficiently eliminate pathogens.

Finally, in the event of a wastewater treatment facility failure, the plant operator is required to inform DEM immediately so that appropriate action can be taken. This allows shellfish staff to close the conditionally approved area within 12 hours (within the 14.5-hour travel time of the effluent) and reopen when conditions have returned to normal. Per NSSP requirements if an extended failure to treat event outside these design parameters should occur at the plant, the conditionally approved area would be closed for 21 days or until shellfish samples collected after 7 days are tested and show male-specific coliphage levels below 50 PFU/100 grams.

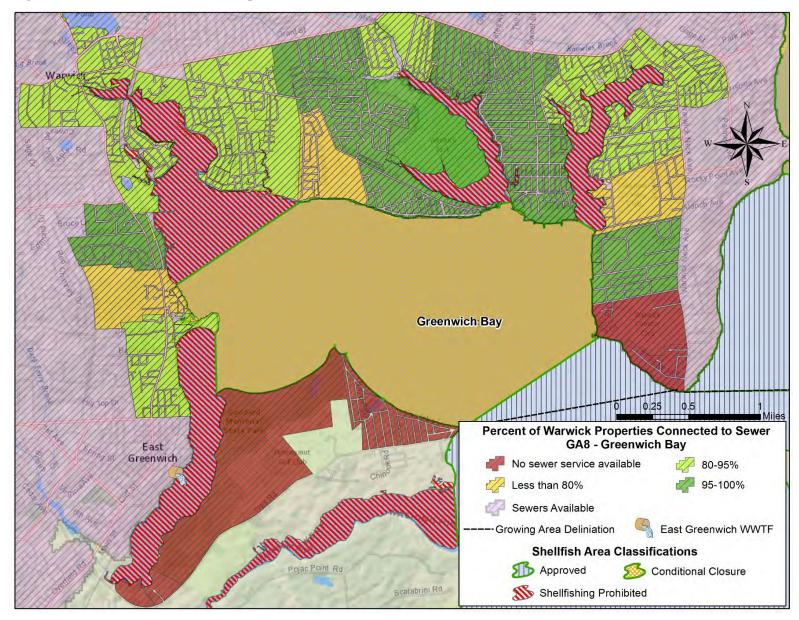


Figure 3-20 Percent of Warwick Properties Connected to Sewer

3.4.2 Stormwater

Stormwater has been documented to be a significant source of bacterial contamination especially in highly developed urban areas such as the watershed to Greenwich Bay. Because of the effects of stormwater on the watershed, the Greenwich Bay growing area is open on a conditional basis. After a precipitation event of greater than 0.5" within a 24-hr period, the conditionally approved portion of Greenwich Bay is closed for 7 days. Subsequent rain events exceeding the 0.5" criteria would require the closure to be extended an additional seven days from the end of the latest precipitation event.

3.4.3 Marinas

There are numerous recreational boating facilities within Greenwich Bay. All waters surrounding the marina proper are located within areas classified as prohibited to shellfishing due to the negative impacts these facilities could have on water quality. As of 2017, there are 33 marinas within the growing area. These marinas range from small private boat clubs with only a handful of slips, to large facilities housing hundreds of boats. The potential impacts from the existing commercial docks and marinas has been evaluated and waters adjacent to these facilities are within the closed prohibited zones providing adequate protection in the case of any discharges associated with marine vessels. Details of this analysis can be found in the program document entitled "Evaluation of Waters Adjacent to Marinas – Marine Dilution Analysis Background June 2017."

There are currently ten fixed pump-out locations and two floating pump-out boats in the Greenwich Bay area to service the boating public. Apponaug Harbor Marina, Brewer's Cowesett, East Greenwich Yacht Club, Harbor Light Marina, and Warwick Cove Marina in Greenwich Bay are considered some of the most vital since they reported pumping at least 140,000 gallons of sewage in 2017

3.4.4 Agricultural Waste

The Greenwich Bay watershed is comprised of primarily residential/commercial/industrial development. According to the Greenwich Bay TMDL, only 16.7% or approximately 1630 acres of the watershed is considered agricultural land use (RIDEM 2005). There is a small farm of cows on Warwick Neck (Figure 3-33), along with several horse stables located throughout the watershed and a small pen of goats and sheep in the Camelot Farms neighborhood. There has been no observance of a direct channel from any of these agricultural uses to the waters of the bay. Proper manure management on these farms is essential to preventing contaminated runoff from reaching the bay waters. At this time, there is no indication that this is a significant source of bacterial contamination to Greenwich Bay.



3.4.5 Wildlife

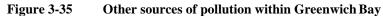
Wildlife inputs of bacteria may be a significant source within the Greenwich Bay area. It is common knowledge that numerous waterfowl use the bay as a resting area, especially during the winter months. This was noted on several occasions during the shoreline survey and routine monitoring runs. Figure 3-28 is an example of winter ducks and geese in Mary's Creek, which discharges to Apponaug Cove.

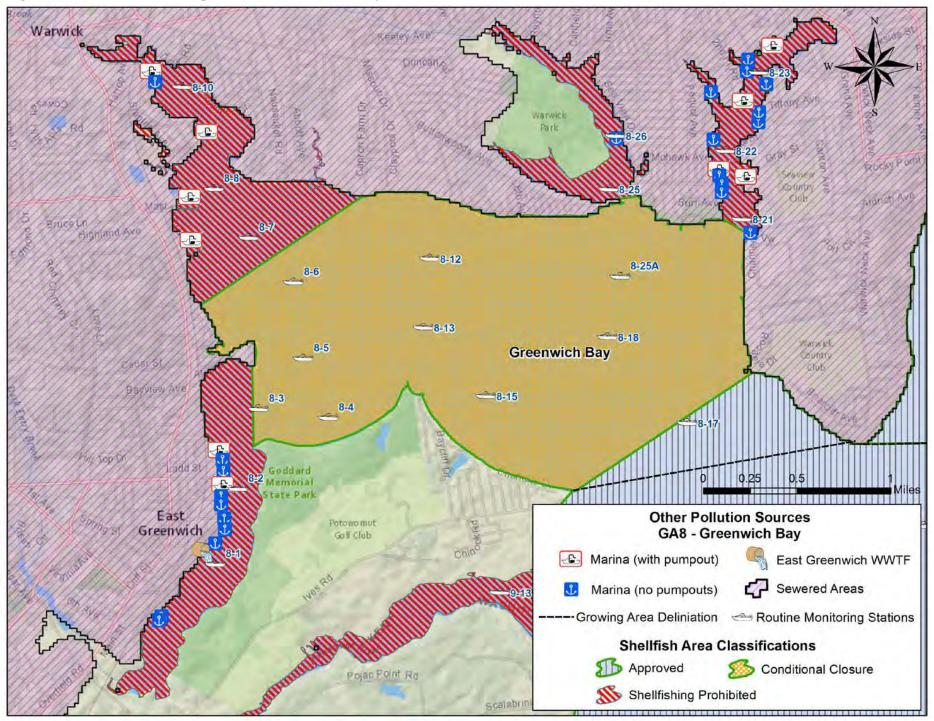


Figure 3-22 Water Fowl in Mary's Creek in January 2018

3.4.6 Industrial Wastes

The Rhode Island Pollution Discharge Elimination System Program (RIPDES) is responsible for permitting all industrial and municipal waste discharges to waterbodies of the state. The RIPDES Program has only one documented industrial waste permit for growing area 8 issued to the East Greenwich Wastewater Treatment plant which discharges into Greenwich Cove (Figure 3-34). Routine monitoring station 8-1 is located directly in the plume of the treated effluent from the plant.





3.4.7 Poisonous and Deleterious Substances

Poisonous and deleterious substances are contaminants that can include metals, organic chemical compounds (such as pesticides, PAHs, and PCBS) and natural toxins that when released into the environment can cause degradation of habitat and harmful effects on organisms. These compounds can enter waters through runoff, industrial discharges, fossil fuel and waste burning, mining and ore processing, toxin-releasing organisms such as phytoplankton, and agriculture (Kimbrough et al. 2008).

A long-term study of contaminants in waters throughout the country is being done by NOAA National Status and Trends called the Mussel Watch Program (Kimbrough et al. 2008). Findings were published in 2008 assessing contaminants in shellfish tissues over two decades of monitoring. A variety of metals and organic chemical compounds were analyzed for the study. Monitoring was completed in Rhode Island at four stations using mussels as the surrogate species. Of the four stations, the closest is Patience Island (station NBPI) which is approximately 1.5 miles southeast of the growing area. Of all metals and organic chemical compounds analyzed, none were above the FDA action levels outlined in the 2007 NSSP Guide for the Control of Molluscan Shellfish. In addition, almost all contaminants were considered to be at low levels when compared nationally, with many showing a decreasing trend. Table 3-12 shows the Mussel Watch Program monitoring results for RI (Kimbrough et al. 2008).

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the conditionally approved waters of Greenwich Bay due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

APPENDIX 2: RESULTS BY STATE RHODE ISLAND (RI)



Regional (r) ^{Mussels} (M)	Status (s) National Status	Trend (t) National Trend	Site	Latitude	Longitude	General Location	Location
Medium	Medium	▼ Decreasing	NBDI	41.6048	-71.3052	Narragansett Bay	Dyer Island
 High 	High	Increasing	NBPI	41.6523	-71.3567	Narragansett Bay	Patience Island
Zebra Mussels (Z	(M)		NBDU	41.5013	-71.3928	Narragansett Bay	Dutch Island
Medium	,		BIBI	41.1982	-71.5922	Block Island Sound	Block Island

High

Oysters (O)

- Medium
- 🗕 High

Concentrations derived from 2004-2005 data.

Markers represent the Regional Species Characterization (r), National Characterization (s) and National Trends maps (t).

METALS (ppm)

Site	Spec	AS	r	s	t	CD	r	s	t	CU	r	s	t	HG	r	s	t	NI	r	S	t	PB	r	s	t	SN	r	S	t	ZN	r	s	t
NBDI	М	9.9				0.94				9.7				0.12				1.1				2.9	•	•		0.16				132			
NBPI	М	8				0.4				10				0.06				0				0.82				0				48			۷
NBDU	М	13	•	•		1				8.4			۲	0.12				1.8				2				0				117			
BIBI	М	11		•	۲	1.3				8.9				0.12				1.8				1.4				0				150	•		

ORGANICS (ppb)

Sites	Spec	Butyltins	r	s	t	Chlordanes	r	s	t	DDTs	r	s	t	Dieldrins	r	s	t	PAHs	r	s	t	PCBs	r	s	t
NBDI	М	50		•		8			۲	26				6.4		•		1540	•	•		239	•		
NBPI	м	12			۲	6.1			۲	27			۲	20	•	•	۲					141	•		
NBDU	м	14			۲	4.5			۲	14				4.6		•		520				102			
BIBI	м	13				1.8			۲	4.3			۲	0.87			۲	285				24			

4.0 Hydrographic and Meteorological Characteristics

4.1 Tides

Tides in Rhode Island are semi-diurnal (having a cycle of approximately one-half of a tidal day or 12.84 hours) characterized by two similar high waters and two similar low waters each tidal day. The tidal current is said to be semi-diurnal when there are two flood and two ebb periods each day. A semi diurnal constituent has two maxima and two minima each constituent day.

The shoreline survey was scheduled to coincide with ebb and/or low tide, which is the most opportune time for observing stormwater outfalls that may otherwise be hidden by tidal water. Additionally, pollution effects such as runoff are generally more pronounced during low tide. Sampling of streams and pipes during low tides should represent actual stream flows rather than the retreating tidal waters that they may receive.

4.2 Rainfall

In Rhode Island there are normally no seasonal patterns in the frequency and amounts of precipitation during the year, however two major storm patterns exist. Storms that occur between October and May are primarily extra-tropical cyclones. The most famous are the "nor-easters:" low-pressure systems that typically develop off the North and South Carolina coasts and move northeast along the Atlantic seaboard, occasionally colliding with colder and drier air (from Canada) in the New England region. This results in the development of heavy rain and/or snow. These storms are more widespread in their range. The second type of storm, occurring between June and October, are primarily tropical cyclones. The biggest storms are hurricanes, which directly affected Rhode Island 9 times during the last 350 years (RI Emergency Management Agency). In the summer, most precipitation results from thunderstorms and smaller convective systems. These typically produce short-duration high-intensity precipitation events and are more localized than nor-easters.

Growing area response to these precipitation events varies according to storm duration, storm intensity, and watershed characteristics such as land use, vegetative cover, and soil characteristics. Changes in land use and vegetative cover are typically accompanied by increases in impervious areas. Of particular concern for the growing area is the close proximity of impervious surfaces to stream channels. This allows for the rapid and efficient transport of runoff of concomitant pollutants, including fecal coliform bacteria, to river and stream channels that ultimately drain to the growing area.

The RI Shellfish Program criteria for wet weather conditions require a minimum of 0.5-inches of precipitation has occured within a 24 hour period and for 7 days after. Therefore, wet and dry weather conditions for this survey are based on those criteria.

The 2017 shoreline survey dates for Greenwich Bay were June 5 and 6; July 6, 19, and 20; September 13, October 16 and 17; December 12, and January 18 of 2018.

The following rainfall data was observed at the NOAA weather station at TF Green State Airport in Warwick, RI. Highlighted rows indicate days in which surveying was conducted, with yellow representing dry weather days and blue representing wet weather days.

Day	Total Precipitation (inches)	Average Temp. (°F)	Max Temp. (°F)	Min Temp. (°F)
1	0.13	65	78	56
2	0.11	63	73	50
3	0	59	70	48
4	0.3	62	73	50
5	0.22	57	60	53
6	0.27	52	53	49
7	0.02	57	72	49
8	0	58	69	47
9	0.01	65	80	54
10	0	72	84	59
11	0	76	89	63
12	0	81	95	66
13	0.01	83	95	72
14	0	76	82	57
15	0	62	69	52
16	2.21	63	70	60
17	0.01	66	75	63
18	0.01	71	81	65
19	0.05	73	80	68
20	0.07	74	83	65
21	0	74	85	63
22	0	72	85	60
23	0	74	86	67
24	0.66	76	87	67
25	0	73	85	64
26	0	70	79	60
27	0.01	67	76	58
28	0	67	78	55
29	0	69	79	63
30	0.17	74	84	67

Table 4-1June 2017 Rainfall Data

Day	Total Precipitation (inches)	Average Temp. (°F)	Max Temp. (°F)	Min Temp. (°F)
1	0	74	83	70
2	0	78	90	69
3	0	79	88	67
4	0	75	85	63
5	0	73	84	63
6	0	69	79	59
7	1.02	68	72	64
8	0	72	86	63
9	0	74	83	64
10	0.01	74	85	63
11	0.75	75	86	69
12	0.54	76	86	69
13	0.36	70	81	59
14	0.01	62	68	60
15	0	69	78	63
16	0	75	86	65
17	0	74	80	65
18	0	76	83	70
19	0	79	90	73
20	0.2	82	93	70
21	0	81	90	71
22	0	78	84	70
23	0	74	77	65
24	0.56	62	66	58
25	0	60	66	58
26	0	66	79	54
27	0.01	67	75	60
28	0	74	82	68
29	0	69	72	59
30	0	68	82	57
31	0	69	81	57

Table 4-2July 2017 Rainfall Data

Day	Total Precipitation (inches)	Average Temp. (°F)	Max Temp. (°F)	Min Temp. (°F)
1	0	62	70	52
2	0.01	59	71	46
3	0.37	60	68	53
4	0	67	81	58
5	0	72	84	64
6	0.56	73	79	64
7	0.67	67	76	58
8	0	64	76	54
9	0	64	73	54
10	0	64	75	54
11	0	66	79	54
12	0	68	85	56
13	0	70	81	57
14	0.01	74	83	68
15	0.05	74	82	66
16	0	70	81	62
17	0	69	80	64
18	0	69	74	66
19	0.07	67	69	65
20	0.2	68	73	66
21	0	71	75	66
22	0.2	62	66	58
23	0	68	82	62
24	0	71	86	60
25	0	72	84	63
26	0	72	82	66
27	0	72	84	65
28	0	75	81	57
29	0	60	69	50
30	1.71	55	62	49

Table 4-3September 2017 Rainfall Data

Day	Total Precipitation (inches)	Average Temp. (°F)	Max Temp. (°F)	Min Temp. (°F)
1	0	55	68	44
2	0	58	72	46
3	0	57	67	47
4	0	59	76	47
5	0	70	84	63
6	0	71	81	58
7	0	66	75	59
8	0.22	71	74	69
9	0.19	72	75	69
10	0	74	82	59
11	0	65	74	56
12	0.02	58	63	45
13	0	53	67	42
14	0.17	61	68	56
15	0	65	72	60
16	0	63	71	44
17	0	48	59	38
18	0	56	74	45
19	0	59	73	45
20	0	62	72	52
21	0	60	73	45
22	0	61	78	49
23	0	58	72	49
24	0.38	68	73	65
25	1.4	67	69	60
26	0.72	60	65	49
27	0	53	63	43
28	0	53	67	42
29	1.65	62	66	59
30	0.69	60	66	49
31	0	53	61	38

Table 4-4October 2017 Rainfall Data

Day	Total Precipitation (inches)	Average Temp. (°F)	Max Temp. (°F)	Min Temp. (°F)
1	0.04	47	54	37
2	0	40	47	27
3	0	38	46	29
4	0	41	49	33
5	0.33	43	59	31
6	0.46	53	60	35
7	0	39	48	31
8	0	35	41	30
9	0.45	35	36	32
10	0	33	39	30
11	0	35	40	31
12	0.08	39	49	32
13	0	28	34	20
14	0.1	24	30	17
15	0.05	19	26	11
16	0	26	33	19
17	0	25	31	11
18	0.01	29	38	24
19	0	42	53	37
20	0	43	50	30
21	0	32	39	24
22	0.04	29	33	26
23	0.59	33	55	30
24	0	40	43	32
25	0.36	35	37	28
26	0	27	28	17
27	0	18	24	12
28	0	12	14	7
29	0	9	18	5
30	0.06	13	20	7
31	0	13	16	4

Table 4-5December 2017 Rainfall Data

Day	Total Precipitation (inches)	Snow	Average Temp. (°F)	Max Temp. (°F)	Min Temp. (°F)
1	0	0	6	14	1
2	0	0	11	20	3
3	0	0	20	31	12
4	1.02	14.1	25	32	22
5	0	0	18	24	7
6	0	0	8	13	3
7	0	0	6	19	-3
8	0.03	0.3	24	36	20
9	0	0	35	42	29
10	0	0	30	37	18
11	0	0	38	51	27
12	1.88	0	50	62	41
13	1.46	0	52	63	22
14	0	0	22	26	16
15	0	0.1	18	23	15
16	0	0	26	36	20
17	0.17	1.1	34	36	33
18	0	0	29	34	20
19	0	0	27	37	21
20	0	0	38	51	27
21	0	0	40	51	30
22	0.06	0	37	40	33
23	1.45	0	44	57	38
24	0	0	40	44	25
25	0	0	26	32	20
26	0	0	26	37	19
27	0	0	36	53	23
28	0.12	0	49	52	40
29	0	0.1	39	42	30
30	0.24	5.4	27	33	22
31	0	0	27	32	14

Table 4-6January 2018 Rainfall Data

Based on the NOAA data at TF Green Airport, the survey dates of July 19 and September 13 were considered wet weather. The remaining survey dates were conducted in dry weather.

4.3 Climate/Winds

4.3.1 Climate

Rhode Island's climate may be summarized as having an equitable distribution of precipitation throughout the four seasons and large ranges of temperature, both daily and annually, as well as variability in the same season year-to-year and considerable diversity of the weather over short periods of time. These varying conditions are greatly influenced across the state by the nearness to Narragansett Bay or the Atlantic Ocean and by elevation and nature of the local terrain. Day to day variety is the norm with no particular regular or persistent rhythm to the changes in weather other than a tendency to a roughly twice-weekly alternation from fair weather to cloudy or stormy weather.

Weather averages in Rhode Island are not very useful for important planning purposes due to the large variety of weather patterns. However, the following averages can be used for general understanding of the areas climate.

The mean annual temperature ranges from 48° F to 51 ° F with the higher mean temperature more representative of the areas of Narragansett Bay. The average daily minimum temperature in January and February is 25 ° F in coastal sections.

Precipitation is evenly distributed throughout the year, with annual averages of 42 to 46 inches and the southeastern bay area tending towards 40 inches. Average yearly snowfall along the shoreline is about 20 inches, however the region is known to have years in which snowfall totals can be significantly less than average as a result of milder winters. Total precipitation averages around 3 to 3.5 inches per month regardless of season, but with the lesser amounts typically in the period between May and July.

4.3.2 Winds

Literature could not be found that links bacterial contamination to wind direction. However, two predominate wind directions can be observed dependent on season. In the spring and summer months when the temperature of the land is warmer than that of the ocean, sea breezes occur that transfer air over the ocean landward under the warmer, lighter air over the land. Consequently, in Rhode Island, the most common spring and summer wind flow direction is south to southwest. When the southwesterly breeze is prevalent, winds travel in a northeast direction towards the upper portions of the growing area. Sustained winds in this direction may detain polluted waters in upper portions of Greenwich Bay. In the fall and winter, the opposite tends to occur. Cold, dense air over the land surface creates a north/northwesterly wind direction. During the winter, sustained northwest winds may detain polluted waters in the lower portion of Greenwich Bay along the Potowomut shoreline and in Greenwich Cove. Furthermore, wave action as a result of wind velocity may also stir sediments that have bacteria in them.

4.4 River Discharges

As mentioned previously in this report, the largest freshwater inputs into Greenwich Bay are Hardig Brook into Apponaug Cove with a daily average flow of 8.6 mgd (million gallons per day), and Maskerchugg River into Greenwich Cove with an average daily flow of 8.02 mgd. This makes up approximately 60 percent of the total freshwater inputs to the bay. There are several other smaller tributaries with a combined flow of 4.3 mgd in addition to groundwater (4.8 mgd) and atmospheric inputs (1.8 mgd) providing fresh water to this estuary (Greenwich Bay Special Area Management Plan, 2005).

The more easily quantified pollutants that are transported to the growing area travel via surface water sources such as rivers, streams, stormwater outfalls and swales. Groundwater influences, although more difficult to quantify, cannot be understated.

5.0 Water Quality Studies

5.1 Overview

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA), and managed by the National Shellfish Sanitation Program (NSSP). The purpose of these programs is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain an industry standard. As part of this agreement, the state of Rhode Island is required to conduct continuous bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain certification.

Water samples are collected at twenty (20) monitoring stations throughout the growing area (Figure 2-1). Twelve of these stations are in prohibited areas, while the other eight are in the conditionally approved portion of the growing area.

Samples are collected 1-2 feet below the water surface (using 4-ounce sterile Nalgene bottles) or other pre-sterilize bottles provided by RIDOH, after which they are stored in a cooler packed with ice. They are then transported to the Rhode Island Department of Health Laboratories for analysis. In July of 2012, the RIDOH converted from the MPN multi-tube fermentation process to the mTEC membrane filtration method, as described in *Standard Methods for the Examination of Water and Wastewater* (APHA, 1999). The protocol for collecting and storing samples is the same as for the MPN 3 tube method, however, the mTEC method allows for an extended holding period of 30 hours versus 6 hours. This method is now used for analyzing all shellfish water samples. The data is compiled and reviewed according to NSSP requirements stating that at least the 15 most recent data sets be used for conditionally approved areas when they are in the open status. A summary report is written and recommendations regarding the classification of the growing area are made on a yearly basis. The 2017 report is incorporated into this report in the following section. Routine monitoring data is also part of this report and is shown in Table 5-1.

5.2 RIDEM Shellfish Program Monitoring

5.2.1 2017 Annual Report of Statistical Evaluations and Comments

GROWING AREA 8 – GREENWICH BAY

HIGHLIGHTS

- * Sampled 11X during 2017.
- * The previously-enacted seasonal (December) closure of Greenwich Bay ended in 2017.
- * Statistics represent recent 15 samples collected between 10/19/2016 to 12/21/2017 when the growing area was open. This included two December 2017 samples.
- * All conditionally approved stations are in compliance.
- * All samples analyzed by the MTEC method.
- * Data run 12/22/2017.

COMMENTARY

Greenwich Bay (GA8) was sampled eleven (11) times during 2017. Following NSSP guidance, evaluation of this conditionally approved growing area was based on the most recent 15 samples collected when the area was open for shellfish harvest. Prior to 2017, a seasonal December shellfishing closure of this growing area was required because of elevated fecal coliform observations during December. Recent data indicated improving December water quality, and the December closure was lifted for 2017. Accordingly, the 2017 statistical evaluation was based on the recent 15 samples, which included two samples collected during December 2017.

The 2017 statistical evaluation showed that all conditionally approved stations in Greenwich Bay (GA8) were in compliance. 'Sentinel stations' in prohibited areas of Greenwich Cove (station 8-3), Apponaug Cove (station 8-7) and Buttonwoods Cove (station 8-25) that are adjacent to open areas also met criteria for conditionally approved waters. The area is in program compliance and is properly classified.

RECOMMENDATIONS

- * Maintain Greenwich Bay conditionally approved year-round (no December closure).
- * Continue to sample prohibited areas in Greenwich, Apponaug, Buttonwood, Brushneck and Warwick Coves in support of TMDL work in the watershed.

5.2.2 Routine Monitoring Station Statistical Analysis

Table 5-1 Monitoring Results Reported 12/22/2017

P = Prohibited, CA= Conditionally Approved

Recent 15 when area was open (all dry weather, 10/19/2016 to 12/21/2017; all mTEC)

			FECAL-GEO)
<u>Station Name</u>	Status	N	MEAN	%>CRITICAL 31
GA8-1	Р	15	3.8	6.7
GA8-2	Р	15	5.6	13.3
GA8-3	Р	15	4.7	6.7
GA8-4	CA	15	2.7	0.0
GA8-5	CA	15	2.3	0.0
GA8-6	CA	15	2.9	0.0
GA8-7	Р	15	3.8	6.7
GA8-8	Р	15	5.7	13.3
GA8-10	Р	15	21.0	40.0
GA8-12	CA	15	2.7	0.0
GA8-13	CA	15	2.3	0.0
GA8-15	CA	15	2.9	6.7
GA8-17	CA	15	2.1	0.0
GA8-18	CA	15	2.4	0.0
GA8-21	Р	15	5.0	13.3
GA8-22	Р	15	8.2	20.0
GA8-23	Р	15	14.0	33.3
GA8-25 *	Р	15	5.6	6.7
GA8-25A	CA	15	3.5	6.7
GA8-26 *	Р	15	11.2	26.7

* Data period is 5/19/2016 to 12/21/2017 for stations 8-25 and 8-26 only. These stations are located in shallow coves which prevents sample collection if a sampling trip coincides with low tide.

5.2.3 Sampling Plan and Justification

Growing Area 8 is a conditionally approved growing area, impacted by precipitation events and also containing a discharge from a sewage treatment facility. Therefore, the RIDEM Shellfish Program monitors Growing Area 8 in accordance with the guidelines set forth in the Greenwich Bay Conditional Area Management Plan (CAMP) established in January 1996. Although the document is outdated it is still valid due to the positive improvements within the watershed to deal with stormwater impacts as recommended in the TMDL, reduction of OWTS and improvements to the WWTF. This document is currently being rewritten in response to the 2017 FDA PEER evaluation recommendations. The CAMP for Greenwich Bay Growing Area 8 was re-evaluated during this survey and the monitoring and management actions were in compliance with the management plan as currently written and going forward.

Water quality monitoring stations within the growing area are sampled twelve times per year during periods when the conditionally – approved area is open for harvesting. The NSSP Manual of Operations Guidelines allows the program to statistically evaluate the condition of the area utilizing the most recent fifteen – twenty-five (N=15-25) dry weather samples. In 2017, the most recent 15 dry weather samples collected for areas classified as conditional were incorporated into the statistical evaluation. This represents the samples taken between 1/28/2016 and 12/21/2017. The geomean and %> Critical 31 CFU values are used for statistical evaluation.

5.3 RIDEM TMDL Studies

A Pathogen/Bacteria TMDL (Total Maximum Daily Load) has been completed and approved for the Greenwich Bay and surrounding waters. The TMDL aims to restore Greenwich Bay waters by identifying necessary pollutant reductions, locating pollution sources, and outlining an implementation strategy to abate fecal coliform sources such that water quality standards can ultimately be attained during all weather conditions.

The TMDL recommends implementation activities that will focus on storm water and wastewater management in order to achieve water quality standards. The document recognizes the ongoing efforts to ensure adequate treatment of wastewater by the surrounding communities through their planned sewer extensions, and the proper operation and maintenance of septic systems. Achieving water quality standards will also require that both the amount of storm water and the bacteria concentrations in that storm water reaching Greenwich Bay be reduced. The TMDL makes recommendations on prioritization of outfalls that have been identified both in this report and the TMDL itself that either have high bacteria counts or discharge stormwater from large developed drainage areas. The TMDL also recommends pollution prevention efforts to discourage residents from feeding birds, encourage residents to pick up after their pets, and ensure that boats comply with the *No Discharge* requirements of Rhode Island marine waters.

5.4 Wastewater Treatment Facilities

The East Greenwich Wastewater Treatment Facility is the largest single point source of contamination to the Greenwich Bay estuary. Routine monitoring station GA8-1 is located at the outfall from the plant in the prohibited area of Greenwich Cove. Fecal coliform bacteria geomean of the routine station for the most recent 15 samples was 3.8 CFU/100ml, well below the 14 MPN criteria. In addition, the %>Critical 31 was only 6.7%. Overall the plant was found to be operating in good operating condition.

6.0 Interpretation of Data

6.1 Effects of Meteorological and Hydrographic Conditions on Bacterial Loading

Stormwater has been documented to be a significant source of bacterial contamination to the bay and its coves, as evidenced by both this survey and the results of wet weather monitoring conducted as part of the Greenwich Bay TMDL. As documented in the TMDL, critical conditions in the Greenwich Bay watershed occur after wet weather events, with high values occurring in all seasons. The current seven-day closure requirement following 0.5" of precipitation (rainfall or snow melt) is protective of the growing area.

6.2 Recommendations

6.2.1 Monitoring Schedule

The current monitoring schedule is adequate for maintaining correct classification.

6.2.2 Comments

Water quality statistical evaluations indicate that the area conforms to the NSSP requirements as a conditionally approved growing area during dry weather periods. There are no recommendations for change in classification at this time.

6.2.3 Legal Description

Based on regular RIDEM Shellfish Program monitoring data and the data acquired during this 12-year shoreline survey, it is recommended that the existing legal description of the growing area be maintained as currently described in the May 2018 Notice of Polluted Shellfish Grounds.

Prohibited shellfish closure areas are described below:

GA 8-1 Greenwich Bay – Apponaug Cove and Baker Creek

All waters of Greenwich Bay in the area of Apponaug Cove including all waters of Bakers Creek north and west of a line from the Rhode Island Department of Environmental Management range marker located on the NECO Pole #6 at the end of Neptune Street in Chepiwanoxet to the Rhode Island Department of Environmental Management range marker located at the extension of Capron Farm Drive in Nausauket including Apponaug Cove, the northwest corner of Greenwich Bay and Mary's Pond and Thatch Cove (so called) south of Arnold's Neck.

GA 8-3 Brush Neck and Buttonwoods Coves

All waters of Brush Neck Cove and Buttonwoods Cove north of a line from the easternmost point of Buttonwoods Neck in Buttonwoods, to the Rhode Island Department of Environmental Management range marker on Pole #35 at the western extension of Strand Avenue at Oakland Beach.

GA 8-2 Greenwich Cove

Greenwich Cove westerly and southerly of a line from the Department of Environmental Management range marker located on the northerly point of Long Point to the Rhode Island Department of Environmental Management range marker located on the southerly point of Chepiwanoxet.

GA 8-4 Old Warwick Cove

Old Warwick Cove, north of a line from the southeastern most riprap jetty at the entrance to Warwick Cove, located at the southeastern end of Oakland Beach to the southern (landward) end of Dorr's Dock on Warwick Neck.

Conditionally Approved Waters

GA 8 -5 Greenwich Bay

The waters of Greenwich Bay, north and west of a line from the eastern extremity of Sandy Point in Warwick to the flag pole located at the Warwick Country Club on Warwick Neck, excluding Apponaug Cove and all tributaries north and west of a line from the Rhode Island Department of Environmental Management range marker located at the end of Neptune Street in Chepiwanoxet to the Rhode Island Department of Environmental Management range marker located at the extension of Capron Farm Drive in Nausauket, including Apponaug Cove, the northwest corner of Greenwich Bay and Mary's Pond and Thatch Cove (so called) south of Arnold's Neck, excluding all waters of Bakers Creek and those waters of Brush Neck and Buttonwoods Cove north of a line from the easternmost point of Buttonwoods Neck to the western extension of Strand Avenue at Oakland Beach, excluding Greenwich Cove westerly and southerly of a line from the Rhode Island Department of Environmental Management range marker located on Long Point to the Rhode Island Department of Environmental Management range marker on the southerly point of Chepiwanoxet and excluding Old Warwick Cove north of a line from the southeastern riprap jetty at the entrance to Warwick Cove located at the southeastern end of Oakland Beach to the southern (landward) end of the Dock located at the westerly extension of Randall Avenue on the so called Dorr's Landing on Warwick Neck. This conditionally approved area is shown in Figure 2-1.

7.0 References

Occurrence of Male-Specific Bacteriophage in Feral and Domestic Animal Wastes, Human Feces, and Human-Associated Wastewaters. KEVIN R. CALCI,1,2* WILLIAM BURKHARDT III,1 WILLIAM D. WATKINS,2 AND SCOTT R. RIPPEY3U.S. Public Health Service, Food and Drug Administration, Dauphin Island, Alabama 36528,1 U.S. Public Health Service, Food and Drug Administration, D.C. 20204,3 and Department of Microbiology, University of Rhode Island, Kingston, Rhode Island 028812Received 8 June 1998/Accepted 17 September 1998

Greenwich Bay Total Maximum Daily Load, RIDEM 2005, Office of Water Resources

Rhode Island No Discharge and Pumpout Facility Evaluation Report, Draft Report 2005, Rhode Island Department of Environmental Management, Office of Water Resources

Growing Area 9 West Middle Bay 2017 Annual Update

A triennial re-evaluation shoreline survey of West Middle Bay was performed in 2016. A total of five (5) pollution sources were visited and all of them had flow. Three (3) of the sources had bacteria levels above 240 cfu/100ml (source 9-011 at 480 cfu/100ml, source 9-210 at 400 cfu/100ml, and source 9-500-IS at 280 cfu/100ml).

During the 2017 annual update two (2) sources were re-visited (9-201 and 9-011) and sampled. In-stream samples were collected at both sources Source 9-011 had a elevated bacteria count at 909 cfu/100ml and a flow rate of 17.44 cfs. In stream samples taken adjacent to the source indicate a reduction due to dilution in the receiving waters. Source 9-201 had a bacteria count of 200 cfu/100ml and flow rate of 0.708 cfs with an in-stream value of <100 cfu/100ml. A follow-up of source 9-011 should be conducted during the 2018 annual update for the West Middle Bay.

Table 1-1 Summary of 2017 Results for Growing area 9 West Middle Bay

*Highlighted sources >240 CFU/100ml.

Source ID	Date Visited	Lat	Long	Description	Receiving waters classification	2016 Results mTEC CFU/100ml	2017 Results mTEC CFU/100ml	2017 Volumetric Flow (cfs)	2017 Follow- up Results	2017 Follow-up Volumetric Flow (cfs)
2017-9- 201	10/4/2017	41.61019	-71.41324	Small stream draining upland tidal marsh/wetland	Prohibited	400	200	0.7083		
2017-9- 201IS	10/4/2017	41.61019	-71.41324	In stream	Prohibited	4	<100			
2017-9- 011	10/4/2017	41.64204	-71.40855	Tibbets Creek at Quidnessett Country Club	Approved	480	909	17.4359	100	4.25
2017-9- 011N	10/4/2017	41.642716	-71.407003	Tibbets Creek IS North	Approved	2	300		38	
2017-9- 011S	10/4/2017	41.641363	-71.407003	Tibbets Creek IS South	Approved	4	<100		122	

IS = In stream sample NS = Not sampled NF = No flow CNL = Could not locate

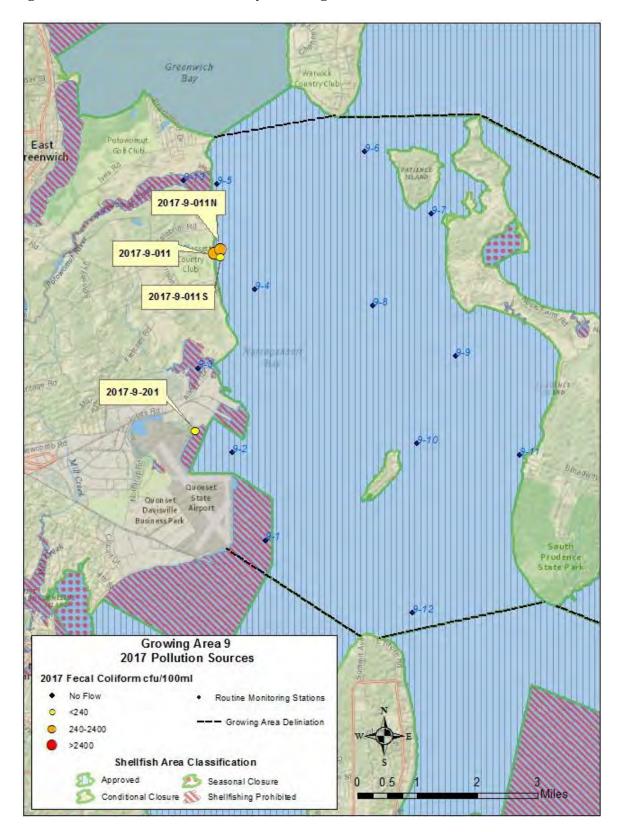


Figure 1-1 2017 West Middle Bay Growing Area 9 Pollution Sources.

Figure 1-2 Source 2017-9-011

Source 9-011 is a Tibbets Creek, which runs through the Quidnessett Country Club before discharging into West Middle Bay in North Kingstown. Fecal coliform was slightly elevated at this source at 909 cfu/100ml and a flow of 17.44 cfs. However, the sources in-stream results were much lower (9-011N = 300 cfu/100ml and 9-011S < 100 cfu/100ml) due to the travel time across a sandy beach where the water percolates through the sand before reaching the bay. Thus, this source is determined to not be causing adverse impacts to the surrounding shellfishing waters. It will be re-sampled as part of the 2018 annual review.





In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of the West Middle Bay due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

HIGHLIGHTS

- * Sampled 7X during 2017.
- * Statistics represent combined wet (n=19) and dry (n=11) weather data collected between 4/15/2013 or 7/30/2013 to 10/31/2017 or 11/3/2017.
- * All approved stations in compliance.
- * All samples analyzed by the Mtec method.
- * Data run 12/26/2017.

COMMENTARY

The WestMiddleBay(GrowingArea9) wassampled seven(7) times during 2017, exceeding the minimum systematic random sampling guidelines for approved areas. Statistics were calculated from the most recent 30 samples which were collected under both wet (n=19) and dry (n=11) weather conditions.

ThePotowomutRiver(stations9-13and9-5)haselevatedfecalcoliformlevels during wet weather. Station 9-13 near the freshwater end of the Potowomut Riverwasestablished in 2007 to evaluate whether that area of wassuitable for approved harvest of shellfish. The 2017 statistical evaluation indicated that the freshwater end of the Potowomut River (station 9-13) exceeds the 90th percentile variability criteria and that shellfish harvest should remain prohibited for that region. Station 9-5 at the mouth of the Potowomut River continues to meet criteria for approved waters, and should remain approved for shellfish harvest.

The 2017 statistical review indicated that all approved stations in the growing area were in program compliance. The area is properly classified.

RECOMMENDATIONS

- * Maintain closure of upper Potowomut River.
- * Continue to monitor Potowomut River (stations 9-13 and 9-5) to follow changes in water quality.
- * No other actions recommended based on ambient monitoring results.

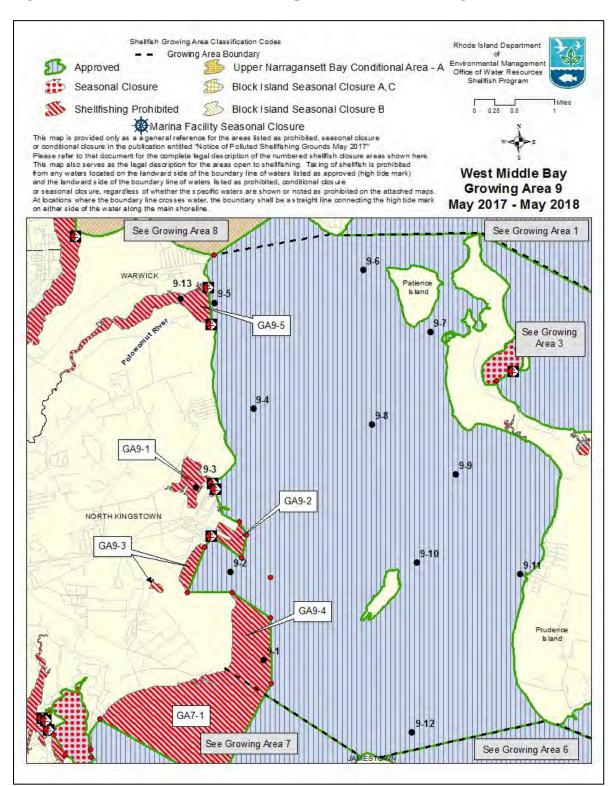
RIDEM SHELLFISH GROWING AREA MONITORING: GA9

Recent 30 all weather.

(4/15/2013 or 7/30/2013 to 10/31/2017 or 11/3/2017; all mTEC, 19 wet and 11 dry weather)

Station Name	Status	N	FECAL-GEO MEAN	90 th Percentile (<31)
GA9-1	P	30	2.0	<u>2.4</u>
GA9-2	А	30	2.1	2.6
GA9-3	Р	30	3.5	11.9
GA9-4	А	30	2.5	6.0
GA9-5	А	30	3.7	16.5
GA9-6	А	30	2.4	4.8
GA9-7	А	30	2.3	3.8
GA9-8	А	30	2.1	2.6
GA9-9	А	30	2.0	2.0
GA9-10	А	30	2.3	4.1
GA9-11	А	30	2.0	2.0
GA9-12	А	30	2.1	2.6
GA9-13	Р	30	6.4	38.9

Figure 1-4 2017-2018 classification map and routine monitoring stations.



Point Judith and Potter Ponds

Growing Area 10 Triennial Re-Evaluation Year



Point Judith Pond, Narragansett, RI Photo courtesy of The Narragansett Bay Estuary Program

Rhode Island Department of Environmental Management Office of Water Resources Shellfish Program



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1.0 Introduction

A triennial re-evaluation shoreline survey of Point Judith Pond and Potters Pond was conducted in order to comply with National Shellfish Sanitation Program (NSSP) requirements for shellfish growing area classification. The primary objective of this shoreline survey is to identify and characterize sources of pollution affecting the area and re-evaluate point and non-point sources previously identified during prior surveys. This triennial update of Area 10 (Figure 2-1) was conducted in 2017. The survey involved follow-up sampling of previously identified sources from the 2014 triennial survey and the 2011 12-year sanitary shoreline survey that resulted in fecal colliform counts exceeding 240 MPN / 100ml. These sources were evaluated to determine the bacteriological impact into the growing area.

2.0 Description of Growing Area

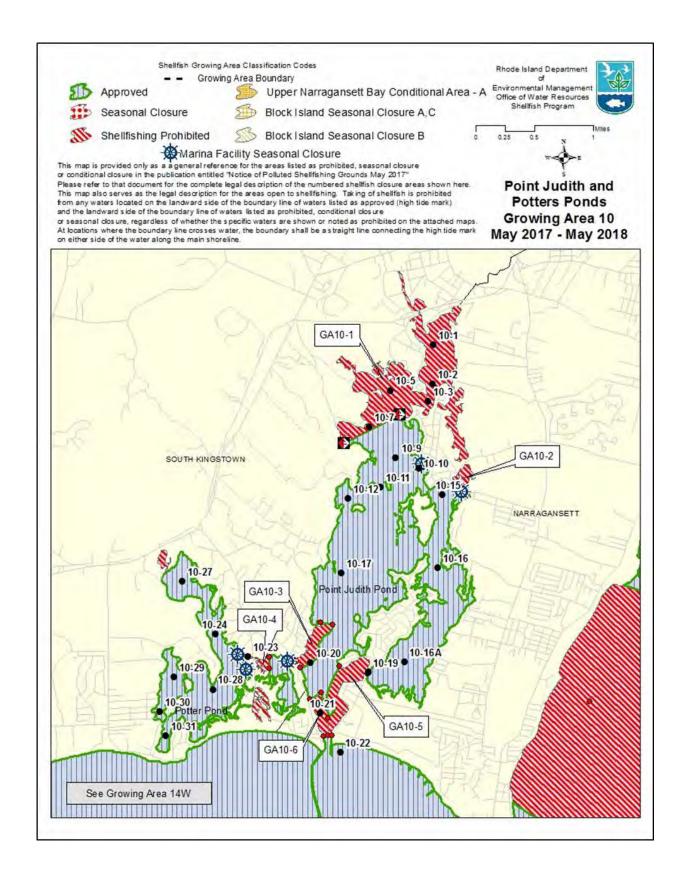
Growing area 10 is located within the southern coastal Salt Pond Region and consists of shallow coastal lagoons that are productive marine embayments separated from the ocean (Figure 1-1). Point Judith and Potter Ponds are the easternmost waterbodies in Rhode Island's Salt Pond Region, respectively, and are located just west of Narragansett Bay and immediately north of Block Island Sound.

Point Judith Pond occupies approximately 1,530-acres and is located in the towns of Narragansett and South Kingstown, Rhode Island (Figure 1-1). Potter Pond occupies approximately 330-acres and is located entirely within the town of South Kingstown (CRMC, 1999) (Figure 1-1). An outline of the physical characteristics of the ponds is listed in Table 1.

The southern end of the Point Judith Pond consists of a constructed breachway that is protected by the breakwaters of the Harbor of Refuge. The breachway was constructed from 1902-1910 and is the main source of marine waters entering the ponds.

The principal motivation for building the breachway was easy boat access between the ponds and the ocean. The seasonal breachway between Potter Pond and the ocean was allowed to fill in and a manmade channel was dredged connecting Potter Pond to Point Judith Pond through Gooseberry Hole. This connection still exists today and is the only surface water connection between the two ponds.

Figure 2-1 Current Classification Map



3.0 Pollution Source Survey

The 2017 shoreline survey of Point Judith and Potter Ponds was conducted as a triennial re-evaluation of this growing area. As such, the survey involved review of previous shoreline surveys and sampling of actual pollution sources with bacteriological results greater than 240 FC/100ml as well as identification of any new sources of pollution if applicable (Figure 3-1). There were thirty-one (31) sources identified from previous surveys that required follow-up sampling. Twenty-three (23) of the sources were visited during the 2017 triennial survey. Eight (8) of the sources were not visited because they were located in areas of the ponds in which shellfishing is currently prohibited. Eleven (11) of the fourteen (14) sources located within approved waters had flow warranting sampling. After conducting follow-up sampling on sources with elevated bacteria concentrations one (1) source (2017-10-62) remained elevated and has the potential to impact the growing area. The results are presented in Table 3-1.

Initial sampling on 10/30/2017 occurred during wet weather conditions with rainfall amounts in nearby Kingston at the NOAA weather station measuring 3.44" of rain between 10/29/2017 and 10/30/2017. The excess amount of rainfall was noticeable in the bacteria results with many of the sources having elevated fecal coliform results. Follow-up sampling for all of the elevated sources occurred during dry weather conditions and exhibited greatly reduced fecal coliform counts.

Special attention was given to all types of pipes, drainage ditches, culverts, and streams in order to classify them as a direct (discharges directly to the growing area), indirect (does not discharge directly to the growing area but may contribute to pollution), actual (discharging at the time of the survey), or potential (not actively discharging at the time of the survey but considered a possible source of pollution). Bacteriological samples were collected in sterile, four-ounce (125mL) Nalgene bottles from all sources that were actively flowing at the time of the field study. Samples were stored in a portable cooler and transported to the Rhode Island Department of Health Laboratory at the end of each field day. The mTEC membrane filtration method, as described in *Standard Methods for the Examination of Water and Wastewater* (APHA, 1999), was used for analysis for both shoreline and routine station (bay run) samples

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters Point Judith or Potters Pond due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

Survey Personnel

Anna Gerber-Williams and Katherine Rodrigue, Biologists in the RIDEM Office of Water Resources, coordinated the shoreline reconnaissance of the Point Judith Pond and Potter Pond with the assistance of other staff members at RIDEM. Sampling was completed in October and November of 2017 with some additional follow-up sampling in December of 2017.

Figure 3-1 2017 Point Judith and Potter Ponds Growing Area 10 Pollution Sources.

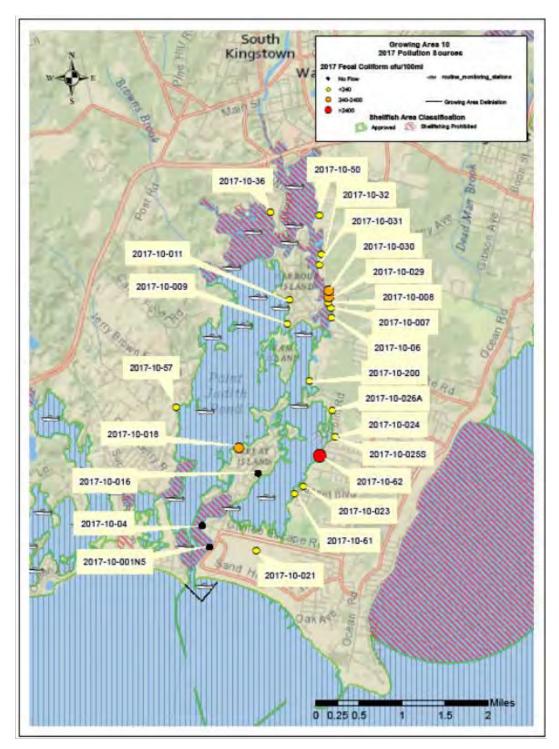


Table 3-1Summary of 2017 Results for Growing area 10 Point Judith and Potter Ponds.

*Highlighted sources >240 CFU/100ml.

Source ID	Date Visited	Lat.	Long.	Description	Discharging waters classification	2011 Results MPN/100ml	2012 Results CFU/100ml	2014 Results CFU/100ml	2016 Results CFU/100ml	2017 Results CFU/100ml	2017 Volumetric Flow (cfs)	2017 follow-up Results
10-04	11/15/2017	41.38188	-71.51197	Storm water outfall in Galilee	Prohibited					DNE		
10-06	12/13/2017	41.4081	-71.4903	Stream entering Champlin Cove	Prohibited	4300				<100	0.14	
10-016	10/31/2017	41.38846	-71.50263	Outlet from Teal Pond at wier	Approved					DNE		
10-36	12/13/2017	41.42132	-71.50055	Stream entering Billington Cove	Prohibited	4300				<100	Trickle	
10-53	Didn't visit	41.42272	-71.5037	CPP draining salt marsh	Prohibited	750						
10-57	11/15/2017	41.39683	-71.5164	Stream draining cove	Approved	1100	NS	NS	NS	<100	1.42	
10-57IS	11/15/2017			In-stream of 10-57	Approved					<100		
10-61	10/30/2017	41.38588	-71.49653	Storm water outfall at end of Sunset Blvd	Approved					1000	0.02	<100
10-61IS	12/1/2017			In-stream of 10-61	Approved							<100
10- 001N5	10/30/2017	41.379196	-71.510704	10" diameter PVC in bulkhead	Prohibited	930				0	NF	
10-007	12/13/2017	41.409283	-71.490417	Stream entering Champlin Cove, Narragansett	Prohibited	1500				<100	0.28	
10-008	12/13/2017	41.409917	-71.490883	Stream entering Champlin Cove, Narragansett	Prohibited	1100				<100	Slow trickle	
10-009	12/12/2017	41.407323	-71.497736	Cove outlet- west of Isle Pt. Rd, Narragansett	Approved	930				<100	low flow	
10-011	10/31/2017	41.410233	-71.497317	RCP outfall-near Cedar Island Rd, Harbour Island, Narragansett	Approved	4300	NF	NF	NF	100	0.21	
10-021	12/1/2017	41.378767	-71.502967	18" CMP, Galilee salt marsh outlet (west), Narragansett	Approved	430				<100	1.55	

Source ID	Date Visited	Lat.	Long.	Description	Discharging waters classification	2011 Results MPN/100ml	2012 Results CFU/100ml	2014 Results CFU/100ml	2016 Results CFU/100ml	2017 Results CFU/100ml	2017 Volumetric Flow (cfs)	2017 follow-up Results
10-023	10/30/2017	41.3868	-71.495033	Stream bisecting Sunset Shore Dr, Narragansett	Approved	1100	NS	NS	NS	4700	0.96	100
10-024	10/30/2017	41.393083	-71.489633	Flared end RCP outfall, cove east of Rye Point, Narragansett	Approved	430	NS	232	NF	4000	0.12	<100
10-025	10/30/2017	41.393083	-71.489633	Two PVC pipes, cove east of Rye Point, Narragansett	Approved	24000	1500 Trickle	NF	NF	DNE		
10-025S	10/30/2017	41.393048	-71.489743	In stream in front of flared end	Approved	1100				10000		<100
10-026A	10/30/2017	41.39645	-71.49015	Rye Cove in stream sample	Approved	NS	930	NS	NS	7000	0.10	100
10- 26AIS	10/30/2017			In-stream of 10- 026A	Approved					<100		<100
10-029	10/31/2017	41.4107	-71.49075	Stream entering Long Cove, Narragansett	Prohibited	750				818	0.01	
10-030	10/31/2017	41.411433	-71.49075	Stream entering Long Cove, Narragansett	Prohibited	430				1000	0.09	
10-031	12/13/2017	41.414717	-71.49235	Stream entering Long Cove, Narragansett	Prohibited	460				<100	0.05	
10-200	10/30/2017	41.400088	-71.494024	Culvert draining pond at kenyon Farm	Approved	4600	750	250	NF	2400	5.67	<100
10-200IS	10/30/2017			In-stream of 10- 200	Approved							<100
10-301	Didn't visit	41.418276	-71.493044	Middle of upper Long Cove	Prohibited	460						
10-32	12/13/2017	41.416017	-71.491967	Stream entering Long Cove, Narragansett	Prohibited	430				<100	0.05	
10-34	Didn't visit	41.417367	-71.491617	Stream entering Long Cove, Narragansett	Prohibited	2400						
10-39	Didn't visit	41.414383	-71.512617	Smelt Brook, SK	Prohibited	1100						

Source ID	Date Visited	Lat.	Long.	Description	Discharging waters classification	2011 Results MPN/100ml	2012 Results CFU/100ml	2014 Results CFU/100ml	2016 Results CFU/100ml	2017 Results CFU/100ml	2017 Volumetric Flow (cfs)	2017 follow-up Results
10-43A	Didn't visit	41.428961	-71.499572	Saugatucket River	Prohibited	2300						
10-51	Didn't visit	41.418933	-71.491467	Stream entering Long Cove, Narragansett	Prohibited	930						
10-62	10/30/2017	41.390733	-71.49225	RCP flared end outfall, Pond View Ave, Narragansett.	Approved	46000	4600	615	NF	2900	0.21	41000
10-62IS	10/30/2017	41.390733	-71.49225	In-stream of 10-62	Approved							23000

IS = In stream sample NS = Not sampled NF = No flow CNL = Could not locate

Figure 3-2 Source # 2017-10-018 (and 018 IS)





Source 2017-10-018 is a storm drain outfall on Great Island and was first visited on 10/30/2017 and found to have a slow trickle with a small pool of water below the pipe. There was evidence of previous water draining across the beach into Point Judith Pond. The sample results were 300 CFU/100ml requiring a follow-up sampling because it is located within approved waters. The second visit occurred on 12/12/2017 and the drain pipe was covered with sand and there was no flow. It appeared to have had a small water flow coming from the pipe and across the sand possibly from high tide water receding. A sample was taken from the shoreline in front of the pipe to determine if there was any seepage occurring. The results came back at <100 CFU/100ml. After both visits during dry weather it is most likely that the little water dripping from the pipe during the first visit is a result of flooding during high tide thus not causing water quality issues in the adjacent receiving waters.

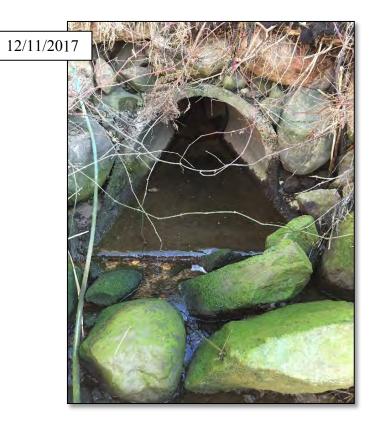
Figure 3-3 Source # 2017-10-023



Source 2017-10-023 is a stream running under Sunset Shore Drive and is thickly overgrown with vines. The stream drains a large upland wetland located on the East side of the road and eventually drains into Point Judith Pond. The sampling results were 4700 CFU/100ml with a flow of 0.96 cfs. A follow-up sample was taken and the results were 100 CFU/100ml. The previous sampling occurred in 2011 with a result of 1100fc/MPN. It is a remote, seasonally occupied area with few houses near the headwaters, which means that this cause of the high bacteria levels is most likely due to wildlife.







Source 10-024 is a storm drain at the end of Carver Lane. Bacterial levels were elevated, 4000 CFU/100ml, during the first sampling (10/30/2017) with a flow of 0.12 CFS. The follow-up sampling (12/11/2017) results were <100 CFU/100ml with less flow (0.085 CFS). The higher bacteria levels during the first sampling is most likely due to the wet weather conditions that occurred on the day of sampling. The follow-up sampling occurred on a dry weather day with less flow, which is more indicative of the normal conditions. Property owners are dumping landscape debris and lawn clippings around the edges of the outfall.

Figure 3-5 Source # 2017-10-025S



Source 10-025S is the in-stream sample in the receiving waters of the previous source (10-024) and was first sampled on 10/30/2017 during a windy wet weather day (3.44" in previous 24-hours) with an elevated bacterial level of 10,000 CFU/100ml. The follow-up sampling (12/11/2017) results were much lower (<100 CFU/100ml) along with less flow (1.94 CFS initial and 0.085 CFS follow-up). Because of the improved bacteria results upon the follow-up visit, this source does not impact the receiving waters. However, due to the initial elevated sampling results this source will be followed-up on during the 2018 annual shoreline survey.

Figure 3-6 Source # 2017-10-26A



Source 10-26A is a stream that drains into Rye Cove. It was first sampled on 10/30/2017 during wet weather conditions (3.44" in the previous 24-hours) with elevated bacterial levels of 7000 CFU/100ml upstream before the stream enters the marsh and 1,124 feet from the in-stream results near the mouth of the stream at <100 CFU/100ml. Follow-up sampling results on 12/11/17 were lower at 100 CFU/100ml and in-stream results remained <100 CFU/100ml. Bacterial counts were much lower during the follow-up sampling. The distance traveled from the stream source drastically diluted bacterial levels in both in-stream samples near the receiving waters confirming that this source is not of concern to the nearby shellfishing waters.

Figure 3-7 Source # 2017-10-61





Source 10-61 is a stormwater outfall at the end of Sunset Blvd., which is located within waters open to shellfish harvesting. The source is so densely overgrown with Phragmites that is was not possible to sample directly at the outfall and thus was sampled near the receiving waters. The first sampling on 10/30/2017 had elevated bacteria levels at 1,000 CFU/100ml. A follow-up sampling was conducted on 12/1/2017 and the outfall was accessible and sampled along with an in-stream sample near the receiving waters and both results were <100 CFU/100ml.



Source 10-62 is a storm drain outfall at the end of Pond View Avenue, which is located within waters open to shellfish harvesting. Initial sampling of source 10-62 occurred on 10/30/2017, which was a rainy day with rainfall amounts in nearby Kingston at the NOAA weather station measuring 3.44" of rain. The resulting bacteria level was 2,900 CFU/100ml with a flow rate of 0.2125 cfs. The follow-up sampling occurred on 12/11/2017, which was a clear and dry day with recent snow precipitation within the previous 48 hours totaling 2.3" from the NOAA weather station in Kingston. There was some snow melt (approximately 2" of snow, which would be around 0.2" melt water) that occurred on the day of the second sampling (12/11/2017) due to temperatures reaching above freezing (43° F). The bacteria level was much higher at 41,000 CFU/100ml but with slightly less flow (0.106 cfs). The initial sampling event occurred during wet weather conditions, which could be one reason for the higher bacteria levels measured. The second sampling event occurred during a recent snowfall followed by snow melt event, which would contribute to additional runoff at the outfall and also lead to higher bacteria levels. Rainfall of > 0.50" and snow melt events > 0.2" are a somewhat common occurrence within the area, thus this source may be contributing excess bacteria into Bluff Hill Cove during any rainfall or snow melt event.

The closest ambient monitoring station to this source is 10-16, which is approximately 2,549 feet NW of the outfall. Upon review of the last few years of routine monitoring results including 2017, this station has been in significant compliance (see table below). Station 10-16A approximately 3,070 feet SW of the source is also in compliance. Fecal coliform levels at both stations in Bluff Hill Cove have met the 14 CFU/100ml geometric mean standard from 2000 through 2017. The variability component of the southerly station has had results that approach the unacceptable criteria but have showed significant improvement in 2017 (25.8 down to 14.5).

The 10-62 source has had elevated bacteria levels in the past with the highest measurement in 2011 at 46,000 MPN/100ml. There was an increase in fecal coliform levels that occurred at the routine monitoring stations back in 2012, which may have been influenced by the source 10-62. Over the past six years, there has been an increase in fecal coliform from the annual mean of 4.3 CFU/100ml (2015) to 6.2 CFU/100ml (2016) and 9.2 CFU/100ml in 2017, which can be seen in

in the table below. However, the fecal coliform levels have remained within compliance during the aforementioned years.

The geo-mean and variability percentiles at ambient monitoring stations 10-16 and 10-16A from 2012 to 2017 are shown in the following table. The RI Department of Health (RIDOH) Water Microbiology Laboratory changed their bacteria analysis methods mid 2012 from MPN (variability criteria of 49) to MTEC (variability criteria of 31). In 2012 and 2013 during the blending period of the mixed methods some of the Point Judith samples were analyzed using the MPN method, thus stations 10-16 and 10-16A meet the variability criteria between 2012 and 2017 as we transitioned to all samples being analyzed using the mTEC method which was completed in 2013.

RIDEM Shellfish Growing Area Monitoring Results								
Year	Station Name	Status	Ν	Fecal-Geo Mean	90th Percentiles (<31)			
2012	GA10-16	А	29	3.5	11.7			
2012	GA10-16A	А	30	7.6	38.3			
2013	GA10-16	А	29	3.2	9.9			
2013	GA10-16A	А	30	7.2	35.5			
2014	GA10-16	А	29	3.1	7.9			
2014	GA10-16A	А	30	6.2	29.2			
2015	GA10-16	А	29	2.7	6.5			
2015	GA10-16A	А	30	6.2	29.6			
2016	GA10-16	А	30	3	7.7			
2016	GA10-16A	А	30	5.3	25.8			
2017	GA10-16	А	30	2.8	7.1			
2017	GA10-16A	А	30	4.4	14.4			

Fecal coliform results from the routine monitoring stations 10-16, 10-16A and 10-19 were compared to historic precipitation events at the nearby NOAA weather station located in Kingston, RI to determine whether spikes in bacteria levels were correlated with rainfall events. Sampling results with elevated bacteria levels occurred either on or near precipitation events (within 72 hours). However, the amount of rainfall did not positively influence the bacteria concentration. For example, the highest bacteria levels at 10-16, 10-16A and 10-19 measured in 2012 occurred during 0.01" of rainfall within the previous 24 hours with bacteria levels at 9 MPN/100ml, 240 MPN/100ml and 23 MPN/100ml respectively. The second sampling event in 2012 occurred during 1.0" of rainfall during the previous 24 hours and bacteria levels were less than half of the previous results at stations 10-16 (2 MPN/100ml) and 10-16A (39 MPN/100ml), and at station 10-19 over 10 times the previous results (240 MPN/100ml). It is common throughout the routine monitoring results at these three stations for unpredictable bacteria concentrations in relation to precipitation amounts. However, bacteria levels at the routine monitoring stations of 10-16, 10-16A and 10-19 have remained in compliance and have not exceeded 34 CFU/100ml since 2012.

Upon review of the unpredictable variability in the source bacteria levels it has been determined that an area of Bluff Hill Cove should be re-classified to prohibited to be protective of shellfish harvest during all weather conditions. An in-depth analysis of the sources in the area and a dilution calculation was preformed to determine the volume of water needed to reduce the bacteria levels to approved standards for variability (31 CFU/100ml) as these are definitively wet weather sources that only impact these waters during precipitation events. Using the FDA provided dilution analysis spreadsheet the following input/output data was developed:

olumetric Dilution Analysis	X
Do calculations for @ Discharge C Marina Enter and report values in: @ Standard U.S. Units C Metric Units Enter Flow Rate of the Discharge: .071 ft²/sec (cfs) <-> be sure to check the units	0
Enter the Fecal Coliform concentration in the discharge: 41000 FC/100 mL Suggested Options	
Load = 6134.40 ft ³ /day x 1.16E+07 FC/ft ³ = 7.12E+10 FC/day	
Calculate the Volume needed for Dilution	
Enter the Target Value for Fecal Coliform Concentration in receiving water (typically the applicable NSSP Geometric Mean oriterion): 31 FC/100 mL	
/olume needed = Load ÷ Target Concentration	
/olume needed = 7.12E+10 FC/day + 8773 FC/ft ³ = 8.11E+06 ft ³	
Calculate the Area needed for Dilution	
Enter the average water depth in the waters suspected to be impacted: 3 ft	
Area needed = Dilution Volume ÷ Water Depth	
Area needed = 8.11E+06 ft ³ ÷ 3 ft = 2.70E+06	
Select output units^ Desired shape for closure area is:	
Corde C Semi-Orde C Rectande	
The radius of the semi-circle for this closure should be 1312.13 ft 👻	

As a result, the following re-classification of waters within the Bluff Hill Cove area is recommended to be implemented with the issuance of the 2018-2019 annual notice of polluted shellfishing grounds. Notice has also been made to the town as part of their requirements to meet the EPA mandated MS4 Stormwater Management Program that they conduct investigative study of the sources that may be contributing to these elevated bacteria results within their storm drain systems. The area will remain closed to shellfishing until the bacteria sources have been identified and addressed and follow up sampling indicates they are no longer impacting the growing area. Additional back up discussion and analysis of closure and subsequent correspondence to town officials is contained in the programs growing area file.

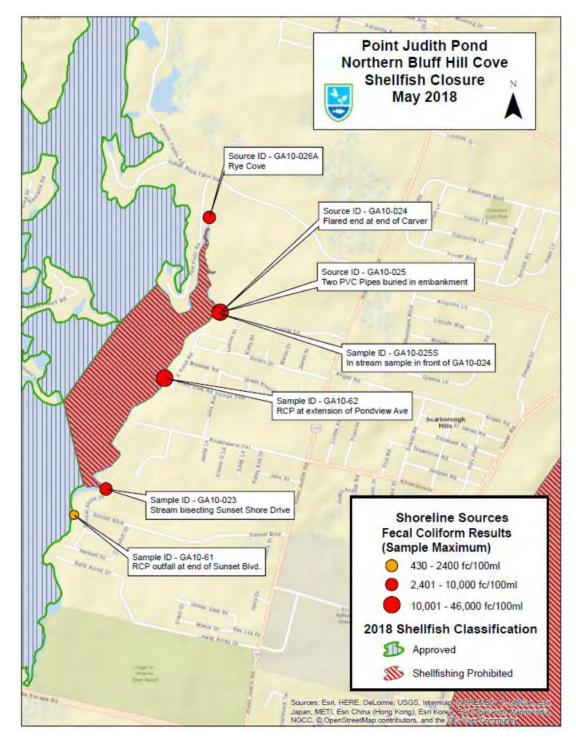
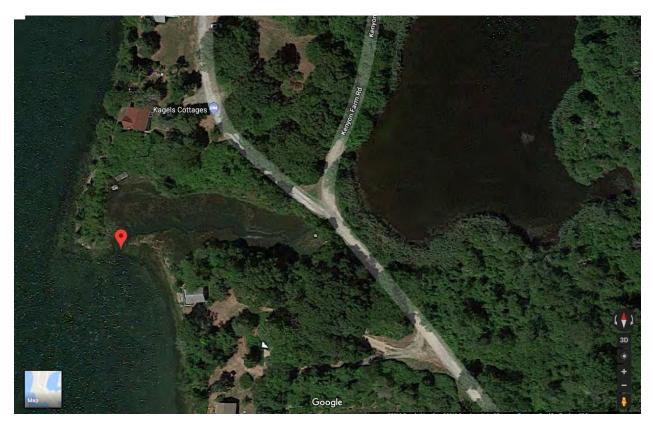


Figure 3-9 Proposed 2018 closure Bluff Hill Cove

Figure 3-10 Source # 2017-10-200



Source 2017-10-200 is a culvert draining a pond at Kenyon Farm. The initial sampling occurred on 10/30/2017 during wet weather conditions and bacteria results were elevated at 2400 cfu/100ml. Upon follow-up sampling on 11/15/2017, during dry weather conditions, both the culvert outfall and instream results were <100 cfu/100ml.

4.0 Mooring Fields and Marinas

There are numerous recreational boating facilities within the growing area that have the potential to have negative impacts upon water quality, and for those marinas that do have that potential an area protective of shellfish waters has been established for the marina proper and the adjacent waters. As of 2017 there are four pumpout facilities servicing the numerous marinas, two at the head of Point Judith Pond at Ram Point and the other two at the connector channel between the two ponds. Both ponds are within the states no-discharge zone, making the discharge of marine sanitation devices illegal.

The Port of Galilee in the Town of Narragansett is the major commercial fishing center in Rhode Island. The port is located on the eastern side of Point Judith Pond immediately north of the breachway. There are also commercial fishing boats harbored in Snug Harbor immediately south of High Point in South Kingstown. The areas immediately surround these ports are closed to shellfishing. The potential impacts from the existing commercial docks and marinas has been evaluated and waters adjacent to these facilities are within the closed prohibited zones providing adequate protection in the case of any discharges associated with marine vessels. Details of this analysis can be found in the program document entitled "Evaluation of Waters Adjacent to Marinas – Marine Dilution Analysis Background June 2017."

5.0 Wastewater Treatment Facilities (WWTF)

There are no wastewater treatment facilities that discharge directly into either Point Judith Pond or Potters Pond. There are six (6) RIPDES permitted discharges into the harbor area in Galilee. They are all water release pipes associated with fish processing and distribution plants and discharge into waters that are currently classified as prohibited providing sufficient dilution prior to mixing with adjacent approved shellfish waters.

6.0 Water Quality Studies

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA), and managed by the National Shellfish Sanitation Program (NSSP). The purpose of these programs is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain an industry standard. As part of this agreement, the state of Rhode Island is required to conduct continuous bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain certification.

Water samples are collected at monitoring stations throughout the growing area (Figure1-1). Samples are collected 1-2 feet below the water surface using sterile 125 ml (4 ounce) Nalgene bottles and stored on ice at 40 C. They are transported to the Rhode Island Department of Health Laboratories for analysis. The results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. A summary report is written and recommendations regarding the classification of the growing area are made on a yearly basis. The 2017 report is incorporated into this report in the following sections.

7.0 Annual Statistical Analysis

GROWING AREA 10 – PT. JUDITH AND POTTER POND

HIGHLIGHTS

- * Sampled 6X during 2017.
- * Statistics represent recent 30 samples collected during both wet (n= 13) and dry (n= 17) weather during 5/7/2013 to 9/28/2017.
 - * All approved stations in compliance.
 - * All samples analyzed by the MTEC method.
 - * Data run 12/26/2017.

COMMENTARY

Point Judith and Potter Pond (Growing Area 10) was sampled six (6) times during 2017, complying with the minimum systematic random sampling monitoring requirements for approved areas. The recent 30 samples included in the 2017 evaluation were representative of both wet (n= 13) and dry (n= 17) weather.

Results of the statistical evaluation demonstrated that all approved stations in this growing area were in program compliance. A 2017 review of fecal coliform data indicated that the area of Upper Point Judith Pond classified as prohibited (north of the closure line near station 10-7) is adversely affected by wet weather. A TMDL study of the area was completed in 2008 and monitoring in the prohibited section of Upper Point Judith Pond will continue six time per year to track changes in water quality. The area is correctly classified.

RECOMMENDATIONS

* No other actions recommended based on 2017 ambient monitoring results.

* Reclassify to prohibited an area in Bluff Hill Cove to be protective of shoreline sources.

RIDEM SHELLFISH GROWING AREA MONITORING: GA10

Recent 30 all weather.

(4/15/2013 or 7/30/2013 to 10/31/2017 or 11/3/2017; all mTEC, 19 wet and 11 dry weather) FECAL-GEO

FECAL-GEU					
Station Name	Status	Ν	MEAN	V	90th Percentile (<31)
GA10-1	Р	30	23.5	218.3	
GA10-2	Р	30	21.2	262.7	
GA10-3	Р	30	14.5	151.1	
GA10-5	Р	30	7.6	50.2	
GA10-7	Р	30	5.5	32.5	
GA10-9	А	30	4.3	17.7	
GA10-10	А	30	3.6	15.6	
GA10-11	А	30	3.5	12.6	
GA10-12	А	30	3.3	9.2	
GA10-15	А	30	4.1	17.3	
GA10-16	А	30	2.8	17.1	
GA10-16A	А	30	4.4	14.4	
GA10-17	А	30	3.2	10.6	
GA10-19	Р	30	5.0	18.4	
GA10-20	Р	30	3.5	9.4	
GA10-21	Р	30	4.2	16.1	
GA10-22	А	30	2.6	5.3	
GA10-23	Р	30	2.9	7.3	
GA10-24	А	30	4.8	16.4	
GA10-27	А	30	3.1	7.4	
GA10-28	А	30	2.5	6.0	
GA10-29	А	30	2.5	4.8	
GA10-30	А	30	3.1	9.5	
GA10-31	А	30	2.8	6.0	

GA10 analysis – for discussion:

Several approved stations in Mid-Upper Point Judith Pond (10-9, 10-10, 10-11, 10-17), in Champlin and Bluff Hill Coves (10-15, 10-16 and 10-16A) and one station (10-24) in Potter Pond have had 90th percentile variability criteria that are inching upwards during recent years (Table, below). Several stations (notably 10-9, 10-15 and 10-16A) had 2016 90th percentile values approaching the 31 cfu/100 ml criteria (Table). Fecal coliform observations made in 2017 were generally lower than those made in 2016 and this lowered the 90th percentile variability criteria (Table). These stations currently have variability criteria in the teens and bear careful monitoring because of the abundant aquaculture in the area. A few more elevated FC observations in GA10 were made during wet weather which likely contributed to the recent increase in variability criteria.

Station Status	2016 GeoM	oon ((2017	GeoM	ean (90th
		Call (5	/0til /0)	UCUM	can (90th
%) Mid-Upper Pond					
GA10-9	А	5.2	(28.2)	4.3	(17.7)
GA10-10	А	3.8	(17.1)	3.6	(15.6)
GA10-11	А	4.2	(16.9)	3.5	(12.6)
GA10-17	А	3.2	(9.1)	3.2	(10.6)
Champlin + Bluff Hi	ll Cove				
GA10-15	А	4.6	(21.1)	4.1	(17.3)
GA10-16	А	3.0	(7.7)	2.8	(17.1)
GA10-16A	А	5.3	(25.8)	4.4	(14.4)
Potter Pond					
GA10-24	А	5.1	(17.0)	4.8	(16.4)

8.0 References

NOAA. December 2017. *Nautical Chart 13219*. National Oceanic and Atmospheric Association, National Ocean Service, Office of Coast Survey. Silver Spring, Maryland.

GIS map data provided by: RIDEM, ESRI (Environmental Systems Research Institute), National Geographic

Ninigret and Green Hill Ponds Growing Area 11 NG 2017 Annual Update

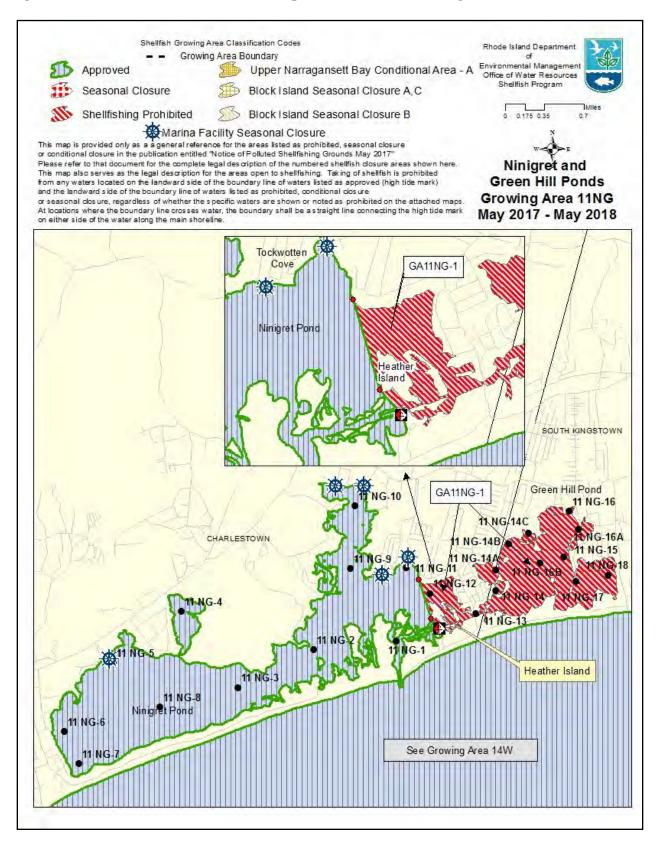
A shoreline survey of the Ninigret and Green Hill Ponds Growing Area 11 NG was conducted in 2012. The shoreline survey identified a total of ten (10) actual or potential sources, five (5) in each pond excluding marinas. The five (5) sources that are in Green Hill Pond discharge or potentially discharge into waters that are currently classifies as Prohibited. Of the five (5) sources discharging or potentially discharging into Ninigret Pond, four (4) of them do so into waters that are approved for shellfishing, and the fifth source discharges into the prohibited waters of the pond. All sources in which flow was observed were sampled with no sources within the open areas exceeding the 2400 MPN fecal coliform standard threshold for follow-up sampling. The two major sources identified in the Office of Water Resource's TMDL report; Teal Brook and Factory Pond Brook discharge into the prohibited portion of Green Hill Pond and therefore did not warrant follow-up sampling for this annual review. A triennial survey of Ninigret and Green Hill Ponds was completed in 2015 in which no sources were sampled due to low bacteria counts in previous surveys. In 2017 no shoreline survey sources were visited because bacteria counts were low in previous years.

There are twelve (12) marinas identified within this growing area, three (3) in Greenhill Pond and nine (9) in Ninigret. As all of Green Hill Pond waters are classified as prohibited there is sufficient protective dilution around these small "marinas" to be protective of shellfishing. In Ninigret Pond two of the nine marinas are within waters classifies as prohibited and dilution areas are protective of these waters. The other five (5) marinas in Ninigret Pond are in waters that are approved but also have a seasonal marina closure associated with the facility. Dilution calculations for these marinas may be found in the document entitled RIDEM Marina Dilution Analysis – June 2017 and in the electronic excel file 2017 Marina Calcs VIMS FDA located in the program's permanent files. There is at least one pump out facility located at the Ocean House Marine in Ninigret Pond. A triennial update of Ninigret and Greenhill Pond will be performed in 2018.

The watershed to Ninigret and Greenhill Ponds consists of mainly residential homes with very little commercial and no industrial land developments. In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of Ninigret or Green Hill Ponds due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

Figure 1-1 2017-2018 classification map and routine monitoring stations.



The following are the highlights and results of the annual statistical evaluations with recommendations on classifications. The 2017-2018 classification map is also included below.

GROWING AREA 11NG - NINIGRET AND GREEN HILL POND

<u>HIGHLIGHTS</u>

- * Sampled 6X during 2017.
- * Statistics represent recent 30 samples collected under both wet (n=9) and dry (n=17) weather conditions during 5/7/2013 to 9/28/2017.
- * All approved stations in compliance.
- * All samples analyzed by the mTEC method.
- * Data run 12/27/2017.

COMMENTARY

Ninigret Pond and Green Hill Pond (Growing Area 11NG) were sampled six (6) times during 2017, consistent with the minimum systematic random sampling monitoring requirements for approved areas. Sample results are representative of the recent 30 samples collected during both wet (n=9) and dry (n=17) weather conditions. The results of the 2017 statistical evaluation demonstrate that all approved stations are in program compliance.

Shellfishing is prohibited in Green Hill Pond due to elevated fecal coliform concentrations. A TMDL study of Green Hill Pond was completed in 2006. The TMDL identified freshwater streams in the north-northeast side of Green Hill Pond and groundwater as sources of fecal coliform. 2017 ambient monitoring results are consistent with this, with elevated fecal coliform levels exceeding NSSP standards for shellfish harvest at stations along the northern side of Green Hill Pond. Stations on the south side of Green Hill Pond displayed lower but highly variable (90th percentile statistic just below NSSP threshold) fecal coliform levels. A new station (station 11NG-19, located in the southwestern corner of Green Hill Pond) was added in 2017 to monitor water quality in the region of the pond. Future monitoring will continue in Green Hill Pond to support TMDL efforts in the watershed and to track changes in water quality. Ninigret and Green Hill Pond (GA 11NG) is properly classified.

RECOMMENDATIONS

- * No action recommended based on 2017 ambient monitoring results.
- * Continue sampling in shellfishing-prohibited Green Hill Pond to support TMDL study and to track changes in fecal coliform concentration.

RIDEM SHELLFISH GROWING AREA MONITORING: GA11NG

Recent 30 all weather.

(12/4/2012 or 5/28/2013 to 11/8/2017; all mTEC, 9 wet and 21 dry weather)

			FECAL-GEO	
Station Name	<u>Status</u>	<u>N</u>	MEAN	<u>90th Percentile (<31)</u>
GA11NG-1	A	30	2.6	5.5
GA11NG-2	A	30	2.3	4.7
GA11NG-3	А	30	2.3	4.6
GA11NG-4	А	30	3.7	14.5
GA11NG-5	А	30	2.5	5.0
GA11NG-6	А	30	2.2	3.7
GA11NG-7	А	30	3.0	10.4
GA11NG-8	А	30	2.3	4.0
GA11NG-9	А	30	3.4	12.6
GA11NG-10	А	30	3.6	16.1
GA11NG-11	А	30	3.0	8.1
GA11NG-12	Ρ	30	4.6	15.6
GA11NG-13	Р	30	4.8	20.7
GA11NG-14	Р	30	7.3	53.5
GA11NG-14A	Ρ	30	7.7	42.2
GA11NG-14B	Ρ	30	4.3	21.0
GA11NG-14C	Ρ	30	25.4	238.0
GA11NG-15	Р	30	3.8	15.0
GA11NG-16	Ρ	30	16.3	177.0
GA11NG-16A	Ρ	30	8.0	57.0
GA11NG-16B	Р	30	5.1	23.6
GA11NG-17	Ρ	30	4.2	16.6
GA11NG-18	Ρ	30	3.5	11.4
GA11NG-19	Р	2	6.9**	9.0**

** new station added in 2017; number of observations is low (n= 2) and insufficient data to calculate representative statistics for compliance.

Quonochontaug and Winnapaug Ponds Growing Area 11 QW 2017 Annual Update

A shoreline survey of Quonochontaug and Winnapaug Ponds Growing Area 11QW was conducted in 2012 and a triennial update was completed in 2015. This shoreline survey identified a total of twenty-six (26) actual or potential sources, seventeen (17) in Quonochontaug Pond and nine (9) in Winnapaug Pond excluding marinas.

Of the twenty-six (26) identified sources from 2012, ten (10) either had no flows or surveyors were unable to locate the source that had been identified in previous surveys. Sixteen (16) sources had flows of which only one had elevated bacteria counts greater than 2400 CFU/100ml requiring follow-up sampling for the 2016 annual update. One (1) source required follow-up sampling for the 2017 annual update. A triennial update of Quonochontaug and Winnapaug Ponds will be performed in 2018.

Source W40 is a small stream that originates from a swale that is adjacent to a stormwater detention basin opposite Misquamicut State Beach. Results were 3400 CFUs/100ml in 2012. This source was reinvestigated in 2013. At numerous times the basin which has become silted in and overgrown with phragmites has been inspected. Super storm Sandy wreaked havoc with the drainage system in this area and cleanup work had not been completed. It is still unknown what the status of this basin and drainage system is. An extensive discussion of this area and potential associated sources can be found in the program's permanent file and discussed in detail in previous surveys. Monitoring of the recently added station (GA11QW- 36) just offshore of this source continues and is in program compliance.

Source ID	Lat	Long	Description	Act/Pot	Dir/Ind	2012 FC Results MPN/100ml	2017 FC Result cfu/100ml	2017 Volumetric Flow (cfs)
11QW- 40	41.3258	-71.8023	Stream from swale along detention basin Misquamicutt Beach	A	D	3400	100	0.159375

There are two marinas identified, one in each pond. The Weekapaug Yacht club, which is located in a small cove is not considered a marina by NSSP definition and actual inspection since there are no docks that can support 10 or more boats. The seasonal docks here service a local small day sailing school that operates only in the summer. The facility has on land sanitary service and the boats used here do not have MSDs. The Weekapaug Fire District has a series of docks located along the Weekapaug Breachway in Quonochontaug Pond. There is a seasonal marina closure associated with these docks and the dilution analysis contained in the document entitled "RIDEM Marina Dilution Analysis – June 2017" indicates that there is sufficient dilution to be protective during the operational season for any potential discharge from these boats.

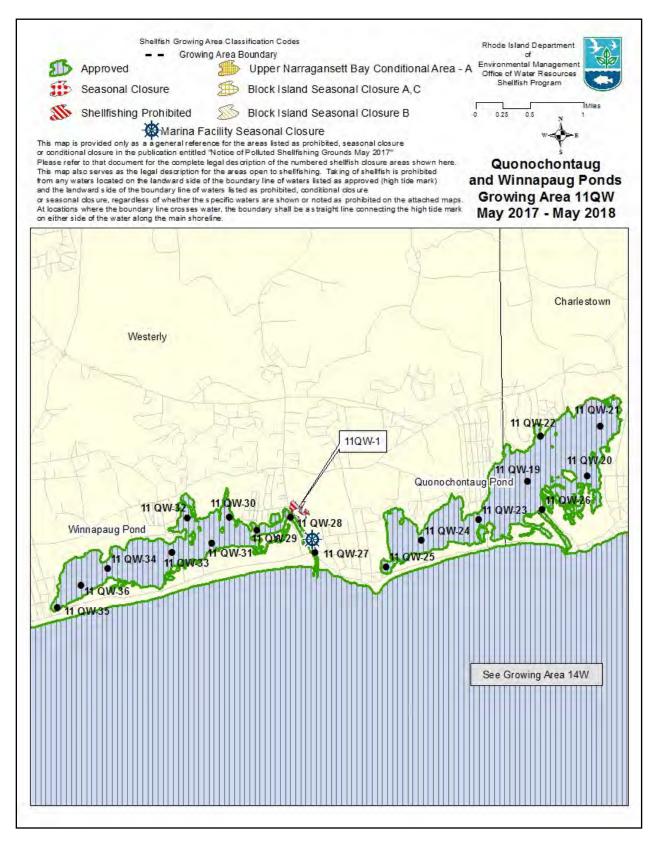
In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or

deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of Quonochontaug or Winnapaug Ponds due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

The following are the highlights and results of the annual statistical evaluations with recommendations on classifications. The 2017-2018 classification map is also included below.

Figure 1-1 2017-2018 classification map and routine monitoring stations.

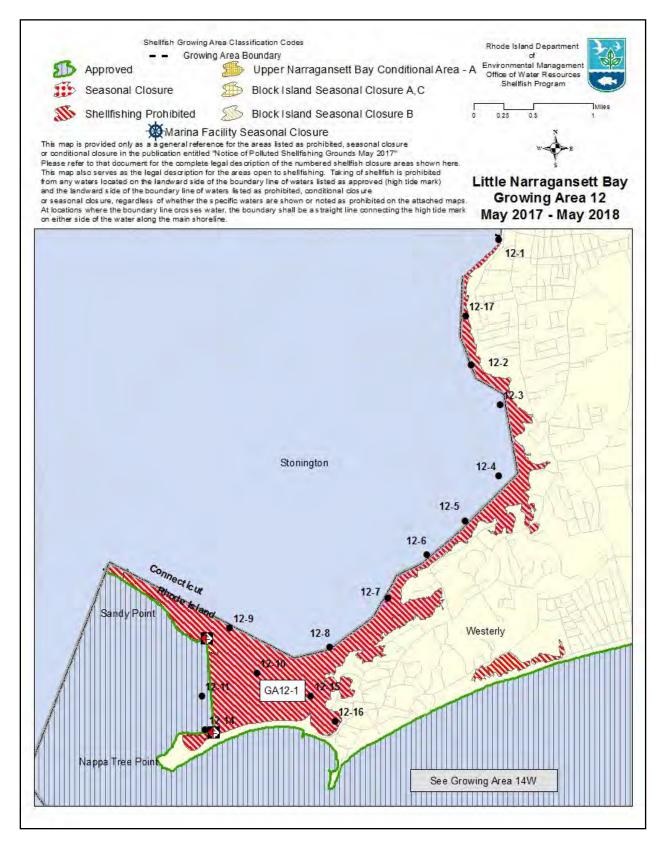


Growing Area 12 Pawcatuck River – Little Narragansett Bay 2017 Annual Update

All waters of the Little Narragansett Bay, Growing Area 12 are currently prohibited to shellfishing. A TMDL study of Little Narragansett Bay was approved by EPA in December of 2010. The recommended implementation activities for the study area focus on stormwater, wastewater, and waterfowl management. As part of that ongoing effort sampling has been conducted in the past several years by TMDL staff in partnership with the Save the Bay Pond Watchers. This has allowed for more frequent sampling as a Save the Bay boat is readily available in the Westerly area, along with the additional manpower to operate the boat and facilitate TMDL staff sampling, which has resulted in sampling of this growing area five times per year for the past several years. This current data is more representative of the conditions in the bay versus historic sampling that had been sporadic due to limited resources and the prohibited classification as a low priority to sample.

In addition to closures due to unacceptable water quality as a result of the highly urbanized areas adjacent to the river there are a dozen or so commercial marinas and mooring fields within these prohibited waters. All waters of Little Narragansett Bay within and adjacent to these marinas are currently classified as prohibited. By calculation there is sufficient dilution within these prohibited waters to be protective of shellfish harvesting. These calculations and marina details can be found in the document entitled "Marina Dilution Analysis – June 2017" and within the electronic excel file 2017 Marina Calcs CIMS_FDA located in the programs permanent files.

Figure 1 2017-2018 classification map and routine monitoring stations.



HIGHLIGHTS

- * Sampled 6X during 2017.
- * The area is classified as prohibited, with the exception of sentinel station 12-11 which is located on the line between approved and prohibited waters.
- * For approved station 12-11, statistics represent recent 30 samples collected under both wet (n= 10) and dry (n= 20) weather conditions during 7/16/2012 to 10/31/2017.
- * Statistics for prohibited stations calculated for information purposes only, not for compliance.
- * Approved station 12-11 is in compliance.
- * All samples analyzed by the mTEC method.
- * Data run 12/27/2017.

COMMENTARY

Little Narragansett Bay (Growing Area 12) was sampled six (6) times during 2017 through a cooperative partnership between DEM Office of Water Resources and Save the Bay. The area is classified as prohibited, so there is no minimum sampling requirement. For more than ~20 years the area has been closed to shellfish harvest for direct human consumption due to elevated and unpredictable fecal coliform levels during wet weather. A TMDL study of the area was completed in 2010, with a focus on improving stormwater and wastewater management and reducing waterfowl impacts in the Pawcatuck River watershed.

The 2017 review indicated that there are signs of improving fecal coliform water quality in the central region of Little Narragansett Bay. Stations 12-9, 12-10, 12-11, 12-14 and 12-15 all met the criteria for approved waters based on the recent 30 samples collected between 7/16/2012 and 10/31/2017. Ten (10) of these 30 samples were collected during wet weather, including several sets of samples collected less than seven days after storms of greater than 1" rainfall. While water quality appears to be improving, fecal coliform levels still exceed criteria during some wet weather conditions. This unpredictable response indicates that the area is currently properly classified as prohibited for shellfish harvest.

RECOMMENDATIONS

- * Continue cooperative sampling effort with Save the Bay to monitor changing water quality and to support TMDL work in the watershed.
- * No other actions recommended.

RIDEM SHELLFISH GROWING AREA MONITORING: GA12

(7/16/2012 to 1	0/31/2017;	all mTEC, 10) wet and 20 d FECAL-GEO	• •
Station Name	<u>Status</u>	N	MEAN	90 th Percentile (<31)
GA12-1	Р	30	196.5	616.6
GA12-2	Р	30	118.9	501.1
GA12-3	Р	30	116.2	578.1
GA12-4	Р	30	39.0	247.2
GA12-5	Р	30	33.0	251.4
GA12-6	Р	30	16.1	187.5
GA12-7	Р	30	12.2	97.8
GA12-8	Р	30	9.6	62.8
GA12-9	Р	30	3.9	23.7
GA12-10	Р	30	4.7	22.6
GA12-11	А	30	3.5	18.7
GA12-14	Р	30	3.9	17.4
GA12-15	Р	30	5.5	26.5
GA12-16	Р	30	11.1	92.1
GA12-17	Р	30	64.3	239.0

Recent 30 all weather.

RIDEM SHELLFISH GROWING AREA MONITORING: GA12

Recent 15 dry weather only.

(8/14/2013 to 9/26/2017; all mTEC, all dry weath	ier)
	000

			FECAL-GEO	
Station Name	<u>Status</u>	N	MEAN	%>CRITICAL 31
GA12-1	Р	15	160.9	100.0
GA12-2	Р	15	85.1	93.3
GA12-3	Р	15	88.7	93.3
GA12-4	Р	15	22.8	20.0
GA12-5	Р	15	19.0	33.3
GA12-6	Р	15	8.7	20.0
GA12-7	Р	15	6.2	13.3
GA12-8	Р	15	4.7	6.7
GA12-9	Р	15	2.2	0.0
GA12-10	Р	15	2.5	0.0
GA12-11	А	15	2.3	0.0
GA12-14	Р	15	2.5	0.0
GA12-15	Р	15	3.5	0.0
GA12-16	Р	15	6.7	20.0
GA12-17	Р	15	49.9	73.3

Block Island Growing Area 13 2017 Annual Update

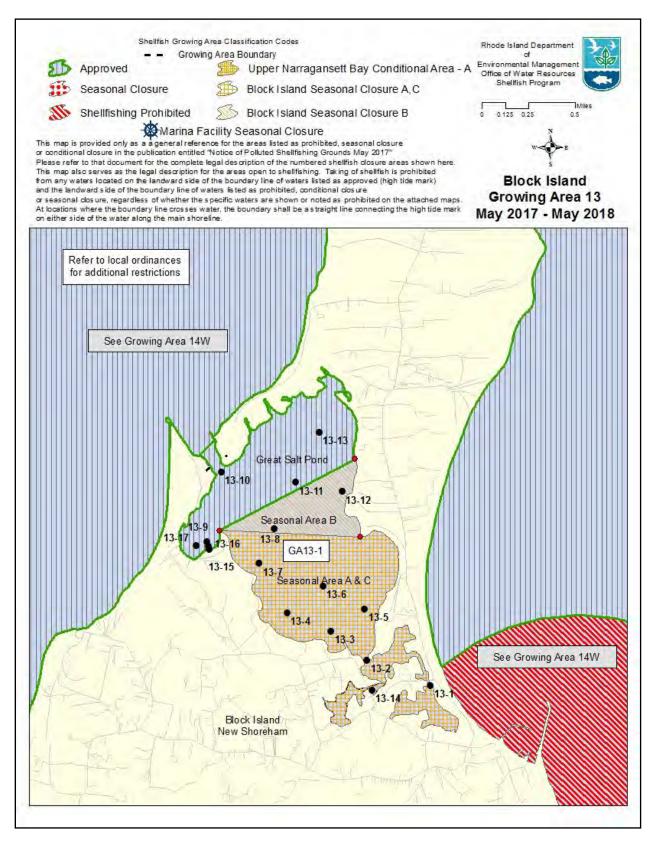
A complete sanitary shoreline survey of the Block Island Growing Area 13 was conducted in 2006. A triennial update was completed in 2015. In 2016 three sources were re-sampled as part of the annual update. Although the bacteria levels from the 2016 sampling were elevated the sources were stagnant pools rather than sources flowing into the receiving waters and therefore were not considered as actual sources but rather as potential sources having no impact on the shellfish waters. These sources were not revisited during 2017 but will be evaluated in 2018 during the 12-year shoreline survey.

Great Salt Pond is a destination harbor that sees an explosion of boats during the summer months compared to year-round use. There are six (6) commercial marinas that have nearly 450 slips and moorings available to the boating public. Two (2) staggered seasonal closures go into effect beginning in May and expanding in June, which encompasses almost three quarters of the pond. Sampling continues on a monthly basis even during these closed periods. A dilution calculation was performed and is detailed in the summary report entitled "marina Dilution Analysis – June 2017" and also within the electronic excel document 2017 Marina Calcs VIMS FDA on file in the program's permanent files. By calculations there is sufficient dilution within these seasonal closures to be protective of shellfishing. The Town of New Shoreham operates two (2) pump out boats that services the docked and moored vessels in these waters.

The island encompassing the Town of New Shoreham is a seasonal residential community with a very small percentage of year-round residents. The land surrounding the Great Salt Pond is a mix of residential and commercial properties with no industrial uses other than what may exist within the adjacent marinas in support of the boating industry. In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of the Great Salt Pond due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

Figure 1-1 2017-2018 classification map and routine monitoring stations.



<u>HIGHLIGHTS</u>

- * Sampled 12X during 2017.
- * For approved stations, statistics represent recent 30 samples collected under both wet (n= 16) and dry (n= 14) weather conditions during 7/16/2015 to 12/18/2017.
- * For seasonally approved stations, statistics represent recent 15 samples when area was open 12/15/2015 to 12/18/2017 during both wet (n= 7) and dry (n= 8) conditions.
- * Al approved stations in compliance.
- * All seasonally approved stations in compliance.
- * All samples analyzed by the mTEC method.
- * Data run 1/2/2018.

COMMENTARY

Growing Area 13, the Great Salt Pond at Block Island, was sampled twelve (12) times during 2017, meeting minimum systematic random sampling requirements for conditionally or seasonally approved waters. Block Island sampling was done through a cooperative agreement between the Town of New Shoreham Harbor Master's Office and DEM Water Resources. Following NSSP guidelines, statistics calculated for approved areas are based on the recent 30 samples and are representative of both wet and dry weather, with 16 wet weather and 14 dry weather samples. Similarly, statistics for seasonally approved areas are representative of both wet (n= 7) and dry (n= 8) weather conditions collected when the area was in open status.

The closure of Cormorant Cove (within 200 feet of the tidal pond outlet at Cormorant Cove Road) was lifted in 2017 based on improved water quality in that area. All approved and seasonally approved stations are in program compliance. The area is properly classified.

RECOMMENDATIONS

- * Continue cooperative agreement with Block Island Harbor Master to monitor Block Island shellfish growing areas.
- * No other actions recommended.

RIDEM SHELLFISH GROWING AREA MONITORING: GA13

Approved stations, recent 30 all weather.
(4/15/15 or 7/16/15 to 12/18/2017; all mTEC, 16 wet and 14 dry weather)
FECAL-GEO
a

Station Name	<u>Status</u>	N	MEAN	90 th Percentile (<31)
GA13-9	А	30	3.2	9.7
GA13-10	А	30	2.2	4.0
GA13-11	А	30	2.1	2.6
GA13-13	А	30	2.2	3.8
GA13-16	А	30	4.7	18.1

Results for all observations at seasonally approved and prohibited stations (below) for reference only and not for compliance. Recent 30 all weather. (4/15/15 or 7/16/15 to 12/18/2017; all mTEC, 16 wet and 14 dry weather

	-	FECAL-GEO						
Station Name	<u>Status</u>	N	MEAN	90 th Percentile (<31)				
GA13-1	SA	30	5.1	24.6				
GA13-2	SA	30	5.0	23.8				
GA13-3	SA	30	3.5	15.6				
GA13-4	SA	30	4.0	22.3				
GA13-5	SA	30	3.2	8.9				
GA13-6	SA	30	2.6	4.8				
GA13-7	SA	30	2.5	6.1				
GA13-8	SA	30	2.1	2.7				
GA13-12	SA	30	2.3	4.0				
GA13-14	SA	30	5.3	20.2				
GA13-17	Р	30	4.0	14.5				

RIDEM SHELLFISH GROWING AREA MONITORING: GA13

Results for recent 15 samples at seasonally approved stations in seasonal closure areas A & C when open. Recent 15 samples (12/12/2015 to 12/18/2017, 7 wet and 8 dry weather, all mTEC)

		FECAL-GEO					
Station Name	Status	N	MEAN	%>CRITICAL 31			
GA13-1	SA	15	2.8	6.7			
GA13-2	SA	15	3.4	6.7			
GA13-3	SA	15	2.0	0.0			
GA13-4	SA	15	2.3	0.0			
GA13-5	SA	15	2.2	0.0			
GA13-6	SA	15	2.1	0.0			
GA13-7	SA	15	2.4	6.7			

Results for recent 15 samples at seasonally approved stations in seasonal closure area B when open. Recent 15 samples (9/27/2016 to 12/18/2017, 10 wet and 5 dry weather, all mTEC)

		i i	FECAL-GEO						
Station Name	Status	N	MEAN	%>CRITICAL 31					
GA13-1	SA	15	2.0	0.0					
GA13-2	SA	15	2.0	0.0					

Growing Area 14E and 14 W Offshore 2017 Annual Update

A sanitary shoreline survey of the Offshore Growing Area 14E and 14W was conducted in 2006. There were one hundred and sixty-three (163) actual or potential sources identified during this shoreline survey, excluding marinas. A total of ninety (90) of the one hundred and sixty-three (163) sources were not actively flowing at the time of the shoreline survey with the remaining seventy-three (73) having flows warranting sampling. All sources in which flow was observed were sampled. A triennial update of the growing area was completed in 2015. Of the seventy- three (73) flowing sources sampled, thirty-four (34) had results greater than 240 MPN. Thirteen (13) of those were located in prohibited waters within the growing area and were not re-sampled as part of the 2015 triennial update. Only one of the sources exceeded the threshold for re- sampling in 2016 but had no flow at the time of the survey.

A total of eleven (11) sources were visiting during 2017 with two (2) having no flow and two (2) nonexistent. Seven (7) of the sources had flow and were sampled for bacteria levels. One (1) of the sources (14E-800) had elevated bacteria counts at 15,000 cfu/100ml but was not resampled because it is located within prohibited waters. The remaining six (6) samples were under 2,400 cfu/100ml, which does not require immediate follow-up sampling.

The watershed adjacent to the offshore growing area is a mix of undeveloped beaches, rocky cliffs, small seasonal communities and other residential uses. There are no industrial or large commercial areas adjacent to approved offshore waters. There are several RIPDES permitted WWTFs that discharge to these waters all with associated prohibited safety zones established using the EPA PLUMES dilution and dispersion model program to be protective of adjacent shellfish waters. In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved offshore waters due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

Figure 1-1		Summary of 2017 Results for Growing Area 14 Onshore										
Source ID	Date visited	Lat	Long	Description	Discharging waters classification	2006	2009	2012 Results cfu/100ml	2015 Results cfu/100ml	2016 Results cfu/100ml	2017 Results cfu/100ml	2017 Volumetric Flow (cfs)
14E-007	6/15/2017	41.38448	-71.476117	 (2) 36" diameter concrete and (1) 18" diameter plastic from concrete structure at WWTF. In 2017, lots of red/orange filamentous algae or iron oxidizing bacteria in stream from right outfall pipe. Stinky odor. Sample taken at combined stream formed from both outfalls. 	Prohibited	11000					1600	0.258
14E-008	6/15/2017	41.3916	-71.470667	Box culvert on Scarborough Beach at end of Burnside Ave	Prohibited	4600					2	0.262
14E-009	6/15/2017	41.3927	-71.470067	24" diameter concrete culvert about 100 yards north of # 008. Stream ends at seep into sand.	Prohibited	2400					34	0.283
14E-011	6/15/2017	41.39377	-71.4693	 (2) 36" diameter concrete pipes north of Scarborough Beach. Flow seemed to increase suddenly when surveying and "pushed" the end of the stream closer to the receiving waters. 	Prohibited	4600					1.9	0.283
14E-102		41.44535	-71.434283	6" diameter CI pipe next to # 101. In 2017, buried by sand.	Approved	4300	640	0		NS	0	DNE/Burie d

Figure 1-1 Summary of 2017 Results for Growing Area 14 Offshore

Source ID	Date visited	Lat	Long	Description	Discharging waters classification	2006	2009	2012 Results cfu/100ml	2015 Results cfu/100ml	2016 Results cfu/100ml	2017 Results cfu/100ml	2017 Volumetric Flow (cfs)
14E-717	10/31/201 7	41.46735	-71.300767	5' wide x 3' tall oval concrete pipe	Approved	4600	430	9300	0	NS	1500	0.004
14E-800	10/31/201 7	41.48897	-71.285967	Stream at end of First Beach	Prohibited	2401					15000	1.214
14W- 001	10/14/201 7	41.32935	-71.76305	Weekapaug Breachway	Approved	2401	<3	3		NS	99	318.750
14W- 1301		41.1519	-71.555617	Groundwater flow from bluff	Approved	11000	930	623	4000	NF	0	Not sampled
14W- 300	10/14/201 7	41.36495	-71.59725	Stream from upland pond north of Green Hill beach club. In 2017, no signs of stream. Marsh area very	Approved	4300	NF	NF		NF	0	NF
14W- 301	10/14/201 7	41.36555	-71.594383	24" diameter RCP flared	Approved	4300	NF	NF		NF	0	NF

IS = In stream sample NS = Not sampled NF = No flow DNE = Does not exist

Figure 1-1 2017 Offshore West Growing Area 14E pollution sources.

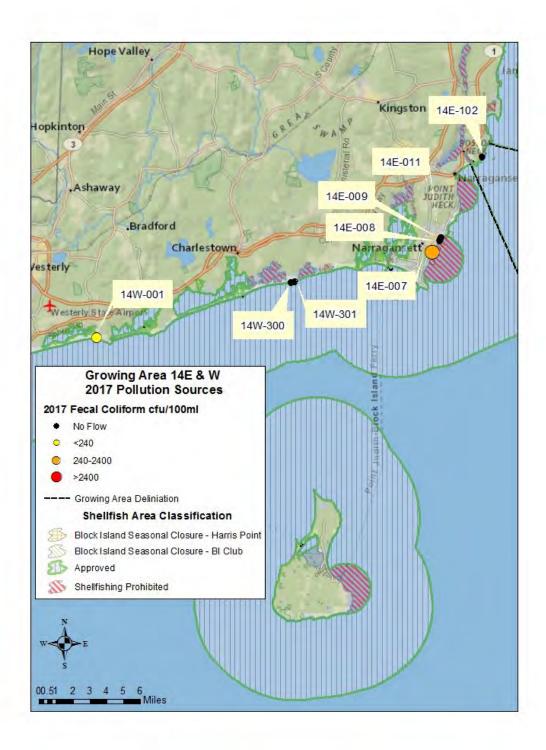


Figure 1-2 2017 Offshore East Growing Area 14E pollution sources.

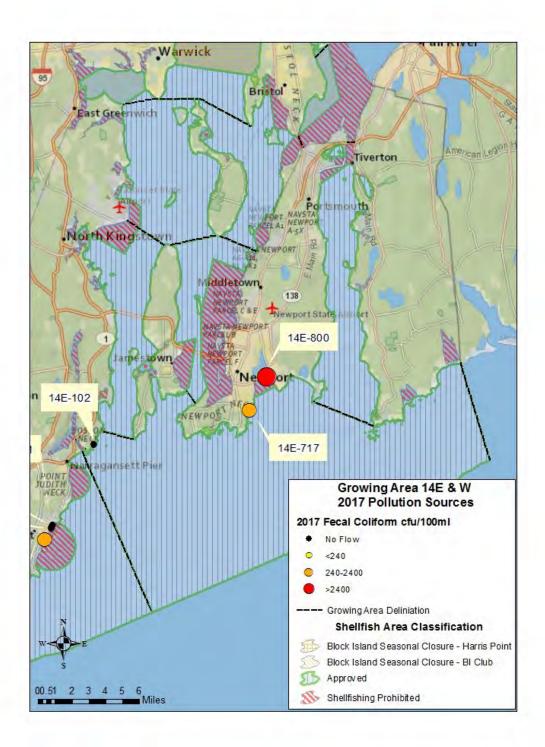


Figure 1-3 Source 2017-14E-007

Source 14E-007 is a 36-inch diameter concrete pipe and one 18-inch diameter plastic pipe located at the Scarborough WWTF. During the 2017 sampling the outflow had orange algae or bacteria with a strong odor. The source flows across a rocky upper beach, which transitions into sand before discharging into the ocean. The bacteria count was elevated at 1,600 cfu/100ml and a flow of 0.258 cfs. These pipes discharge into waters encompassed by the closed safety zone related to the outfall from the WWTF therefore no shellfishing is allowed in proximity to this discharge. The volume of flow from these pipes is not causing any impacts beyond the closed safety zone due to the large volume of open ocean waters they discharge to.



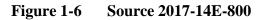
Figure 1-4 Source 2017-14E-007 (continued)



Figure 1-5 Source 2017-14E-717

Source 14E-717 is a 5' wide by 3' tall oval concrete pipe. The source had an elevated bacteria count at 1,500 cfu/100 ml but had a low flow rate of 0.004 cfs. The source is located along the Newport Cliff walk and discharges onto a rocky beach where it dissipates into the beach before reaching the receiving waters of the open ocean.





Source 14E-800 is a stream from an upland marsh, which flows across First Beach before reaching the receiving waters. The bacteria count was elevated at 15,000 cfu/100ml and a steady flow rate at 1.214 cfs. This source is in prohibited waters and thus not causing any impact to approved shellfish waters.



The offshore waters of growing area 14W and 14E are considered to be remote and therefore are only required to be sampled twice in any calendar year. The following statistical analysis is included to indicate compliance with the NSSP model ordinance for remote waters.

RIDEM SHELLFISH GROWING AREA MONITORING: GA14

Recent 30 all weather.

(9/18/2005 to 11/30/2017; 20 mpn and 10 mTEC)

			FECAL-GEC)
Station Name	Status	N	MEAN	<u>90th Percentile (<42)</u>
GA14-1	А	30	2.0	2.2
GA14-2	А	30	2.3	4.6
GA14-3	А	30	2.0	2.4
GA14-4	А	30	2.1	2.6
GA14-5	А	30	2.0	2.4
GA14-6	А	30	2.3	4.3
GA14-7	А	30	2.4	6.0
GA14-8	А	30	2.4	4.5
GA14-9	А	30	2.1	3.0
GA14-10	Р	30	2.8	8.7
GA14-11	А	30	2.1	3.0
GA14-12	А	30	2.0	2.4
GA14-13	А	30	2.4	5.8
GA14-14	А	30	2.1	3.0
GA14-15	А	30	2.2	3.2
GA14-16	А	30	2.0	2.0
GA14-17	А	30	2.0	2.4
GA14-18	А	30	2.0	2.0
GA14-19	А	30	2.2	3.9
GA14-20	Р	30	2.3	5.6
GA14-21	А	30	2.0	2.0
GA14-22	А	30	2.5	4.3

HIGHLIGHTS

- * Sampled 2X during 2017.
- * Statistics represent all data collected 9/17/2002 to 11/30/2017.
- * Area is remote in status.
- * mTEC = 10 (90th percentile criteria adjusted to 42 cfu / 100 ml).
- * All stations in program compliance.
- * Data run 12/27/2017.

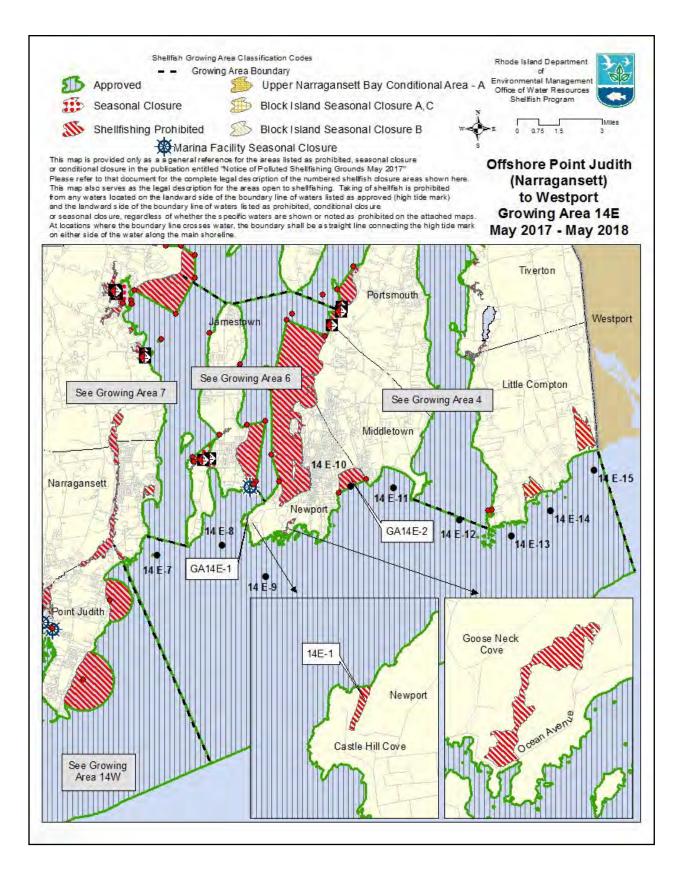
COMMENTARY

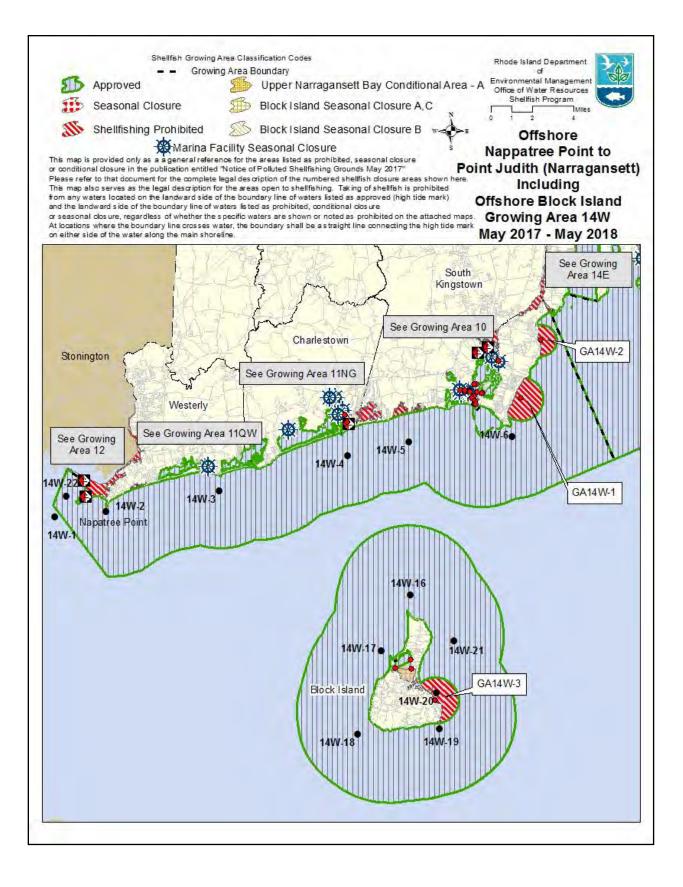
The coastal offshore areas of Rhode Island (Growing Area 14) along the south coast of the mainland and the waters around Block Island are considered remote in status due to their distance from land-based point and non-point sources of fecal coliform contamination. A twice per year sampling program of these areas was begun in 1994, consistent NSSP guidelines for the monitoring of remote areas. Stations 14-1 to 14-15 and 14-22 along the RI coast from the Connecticut to Massachusetts borders were sampled twice during 2017 in a collaborative effort between DEM Water Resources and DEM Enforcement. Waters around Block Island (stations 14-16 to 14-21) were monitored twice during 2017 in collaboration with the Town of New Shoreham Harbor Master's Office. The statistical evaluation included the most recent 30 samples dating back to 2002. Samples were analyzed by a combination of MPN (n= 20) and mTEC (n= 10) methods which, per NSSP guidance, required an adjustment in the 90th percentile criteria analyses to 42 cfu/ 100 ml. Fecal coliform concentration in the offshore waters is consistently low (2 cfu/100 ml), with the last observation of greater than 2 cfu/100 ml occurring in 2013.

The 2017 statistical evaluation demonstrated that all stations in the offshore area (GA14) meet criteria and are in program compliance. The area is properly classified.

RECOMMENDATIONS

* No action recommended based on ambient monitoring results.





Growing Area 15 Seekonk River 2017 Annual Update

All waters of the Seekonk River, Growing Area 15 are currently prohibited to shellfishing. The area was not sampled in 2017. The area has always been closed to shellfish harvesting because of consistently elevated bacteriological levels, and the area's juxtaposition to a large urban environment. The area is properly classified as prohibited.

HIGHLIGHTS

- * Area was not sampled during 2017
- * Harvest of shellfish is prohibited in Growing Area 15.
- * Last sampled in 2008.
- * Summary statistics not updated for 2017.

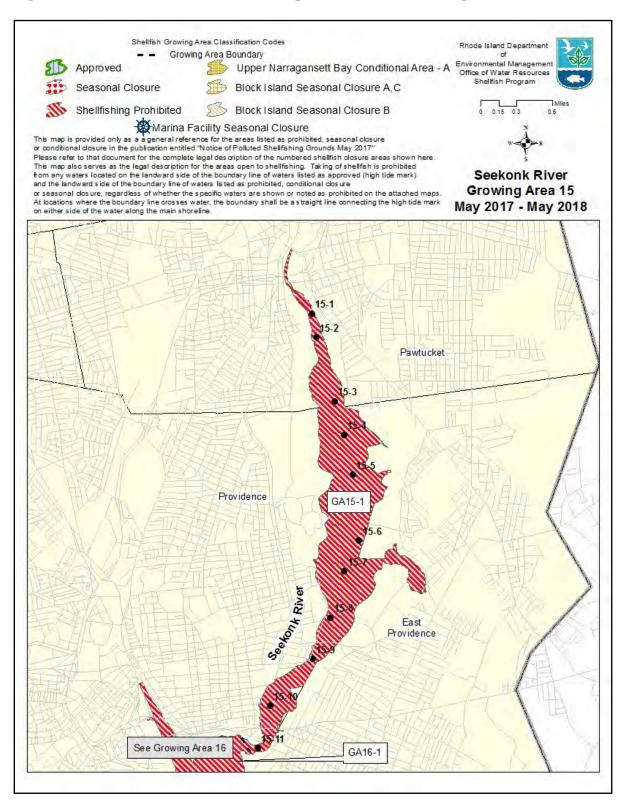
COMMENTARY

The Seekonk River (Growing Area 15) was not sampled during 2017. The area is classified as prohibited for the harvest of shellfish, so there is no minimum sampling requirement. The area is largely urban and has historically been prohibited for the harvest of shellfish because of consistently elevated fecal coliform levels. Sampling Growing Area 15 is a low priority for the Shellfish Program because of its prohibited status.

RECOMMENDATIONS

- * Dependent on staff resources, sample the Seekonk River (Growing Area 15) at least once per year to monitor recent fecal coliform conditions.
- * No action recommended based on ambient monitoring results.

Figure 1-1 2017-2018 classification map and routine monitoring stations.



The Providence River Growing Area 16

Triennial Sanitary Shoreline Survey 2017



Rhode Island Department of Environmental Management

Office of Water Resources Shellfish Program



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Acronyms and Terms

FDA: Food and Drug Administration

ISSC: Interstate Shellfish Sanitation Conference

MPN: Most Probable Number

NSSP: National Shellfish Sanitation Program

OWR: Office of Water Resources

RIDEM: Rhode Island Department of Environmental Management

TMDL: Total Maximum Daily Load

WWTF: Waste Water Treatment Facility

1.0 Introduction

A triennial shoreline survey of the southern portion of the Providence River was conducted during the summer of 2017 by staff from RIDEM's Office of Water Resources Shellfish Program. The survey involved follow-up sampling on previously determined sources of high bacterial levels, a reconnaissance of the entire study area, including Bullocks Cove, to locate and catalog pollution sources and collect bacteriological samples from all actively flowing sources within the survey area to determine their impacts on the Providence River Shellfish Growing Area.

The primary objective of the shoreline survey was to identify and characterize any new sources of pollution impacting the growing area, to reevaluate point and non-point sources identified during previous surveys, and to update information regarding the sampling of previously identified sources. This survey is in support of the potential re-classification of a portion of the Providence River growing area for limited use as either a conditionally approved or a restricted classification. Additional analysis of management conditions supporting such re-classification need to be developed. At this juncture no recommendations for re-classification of this area are proposed.

2.0 Description of the Growing Area

2.1 Location

The Providence River is considered by the shellfish program to be that area of water generally from the confluence of the Woonasquatucket and Moshassuck Rivers in the City of Providence, thru the Fox Point hurricane barrier south to a line from Conimicut Point, easterly to the shore at Nayatt Point in Barrington. The river is bounded on the west by the cities of Providence, Cranston and Warwick, and on the east by the City of East Providence and the Town of Barrington. This survey includes only the southern portion of the river from Gaspee and Bullock Points to its confluence with the Upper Narragansett Bay Growing Area 1 at Conimicut Point, along with those waters of Bullocks Cove.

2.2 Description of the Area

2.2.1 Physical Description

The Providence River is a tidal river, which flows approximately eight miles from its origin to its confluence with the upper portion of Narragansett Bay. Along its way the river is joined by the Seekonk River, approximately one-half mile south of its perceived origin. The tidal portion of the Seekonk River starts at the base of the natural falls in Pawtucket, and at this point the river is locally called the Pawtucket River. The upland source of fresh water to the Seekonk is the Blackstone River, the largest freshwater river in the state. The Providence River is formed by two major tributaries; the Woonasquatucket and Moshassuck Rivers, and is also supplied with fresh water inputs from the Pawtuxet River located south of Fields Point and numerous other smaller named and unnamed tributaries. The West River, another major fresh water tributary, joins the Moshassuck River approximately 1 ½ miles north of the merger with the Woonasquatucket River in Providence. All waters of the Providence River, Growing Area 16 are currently prohibited to shellfishing and have been since 1946.

2.2.2 Latest Survey

The first shoreline survey in GA16 was performed in 2009 and did not include Bullocks Cove. In 2017 a triennial follow-up and southerly limited shoreline survey was performed to determine the number of pollution sources (direct and indirect) and to assess any changes from the 2009 shoreline survey results. Figure 4-1

shows the shoreline survey sources locations and the bacteria results collected by the Office of Water Resources Shellfish Program personnel in 2017.

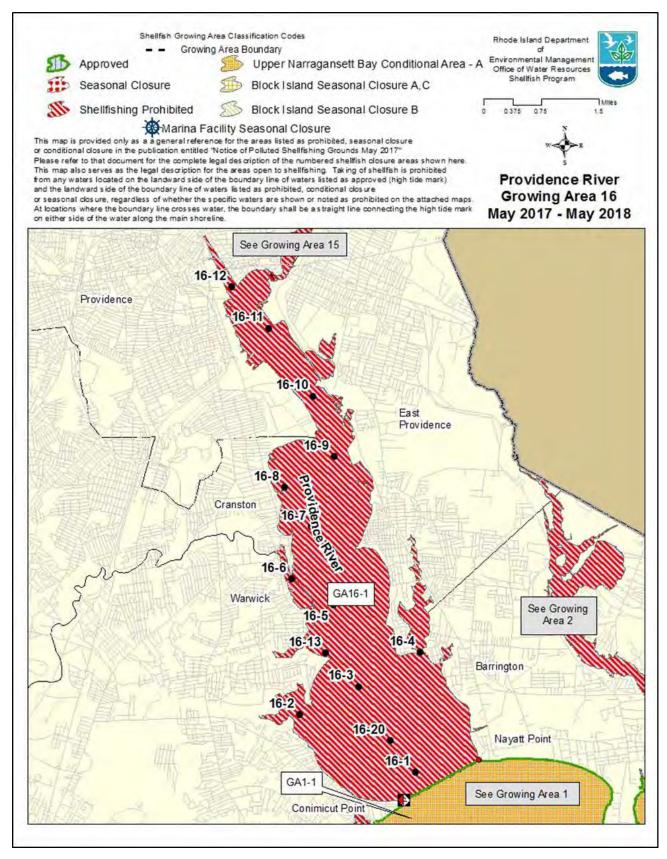
2.2.3 Classification Maps

The following figure (2-1) depicts the Providence River GA16 and the routine water monitoring stations along with the current (May 2017-May 2018) classification boundaries. The Providence River Growing Area waters are all currently classified as Prohibited, as described in the RIDEM document entitled Annual Notice of Polluted Shellfishing Grounds. A legal description of the growing area is described below:

GA16-1

All water of the Providence River north and west of a line from the Rhode Island Department of Environmental Management range marker on a pole located on Conimicut Point to the center of the Old Tower at Nayatt Point including any tributaries north of this line.

Figure 2-1 Classification map of Growing Area 16 with routine monitoring stations.



3.0 Pollution Source Survey

3.1 Personnel

The 2017 shoreline survey was coordinated and conducted by RIDEM Office of Water Resources staff.

3.2 Survey procedures

All pipes, ground seeps, drainage ditches, culverts, and streams were recorded with either a direct (discharges directly to the growing area), indirect (does not discharge directly to the growing area but may contribute to pollution), actual (discharging at the time of the survey), or potential (not actively discharging at the time of the survey but considered a possible source of pollution). Bacteriological samples were collected in sterile, 125 ml Nalgene bottles or in pre-sterilized sample bottles provided by RIDOH, from all actively flowing sources at the time of the field survey. Samples were stored in a cooler kept at 4°C and transported to the Rhode Island Department of Health Water Microbiology Laboratory at the end of each field sampling. All water bacteria samples were analyzed using the standard fecal coliform membrane filtration method (sm48 mTEC) as described in the procedure "Standard Methods for the Examination of Water and Wastewater" (APHA, 1995).

A minimum criterion for follow-up sampling was developed by RIDEM OWR in the program's standard operating procedures. For open portions of a growing area it is necessary to follow-up on any source sample result of fecal coliform >240 CFU/100ml and more than a trickle flow. Sample results >240 CFU/100ml will be sampled during the triennial survey and sample results >2400 CFU/100ml and greater than trickle flow require follow-up sampling and sampling during the annual survey.

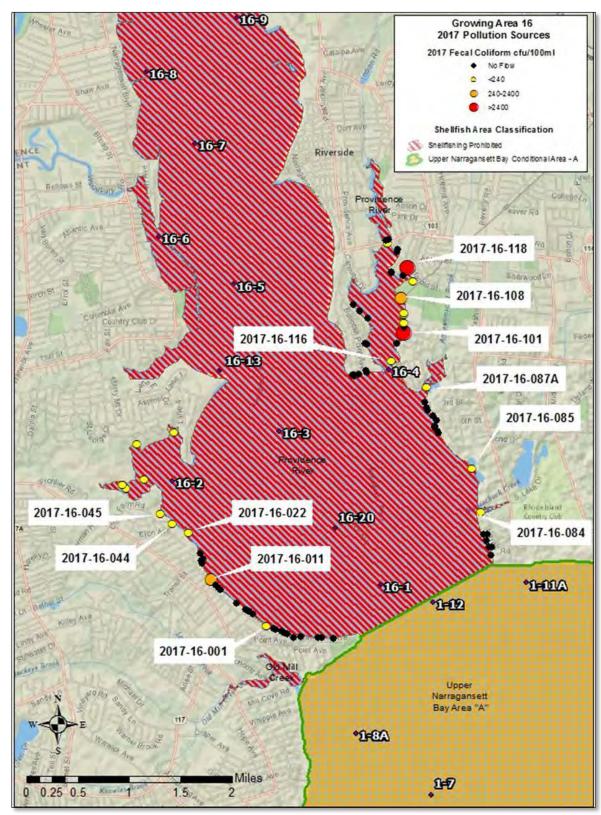
3.3 Summary of Sources and Locations

There was a total of eighty-one (81) actual or potential sources identified during the 2017 shoreline survey, excluding marinas. Twenty-nine (29) of the eighty-eight (88) were actively flowing at the time of the shoreline survey warranting sampling. All sources in which flow was observed were sampled. The remaining fifty-nine (59) sources had no flow. These results can be found in Table 4-1. All actual or potential sources of pollution are illustrated in Figure 4-1 detailing their location within the Providence River.

3.3.1 Locations of Major Sources

The following figure 3-1 is a map locating the sources identified in the 2017 shoreline survey weighted by their sample result bacteria counts.

Figure 3-1 2017 Providence River GA16 Pollution sources.



*Sources > 240 cfu/100ml are labeled

3.3.2 Pollution Source Table

Table 3-1Shoreline Survey Sources

	Date of		Actual/	Direct/		CFU/	'100ml
Source ID	Sampling	Source Description	Potential	Indirect/	Volume (cfs)	2009 Results	2017 Results
2017-16-001	8/2/2017	24" RCP	А	D	0.2125	15	160
2017-16-003	8/2/2017	12" RCP-in seawall w/ additional ~4" hole in seawall to the left	Р	D	NF	240	0
2017-16-006	8/2/2017	12" RCP-address: 1 winter avenue	Р	D	NF	0	0
2017-16-008	8/2/2017	12" RCP and 3 x 4" drainage holes in cement wall-address: 200 Bellman avenue	Р	D	NF	0	0
2017-16-011	8/2/2017	24" RCP next to 24" CMP	А	D	0.00221	460	1600
2017-16-014	8/2/2017	Broken cement storm drain underneath rock wall	А	D	Trickle	240	0
2017-16-016	8/2/2017	4" PVC pipe in cement seawall-address: 150 Shawomet avenue	Р	D	NF	0	0
2017-16-021	8/3/2017	12" RCP-address: end of Grace street.	Р	D	NF	0	0
2017-16-022	8/3/2017	Stream (1' wide x 8" deep) that drains onto marshy beach, upstream is covered in vegetation-address: end of Rock avenue	А	D	0.00047	43	160
2017-16-023	8/2/2017	Stream coming through marsh-IN water North of creek 1.5 FT of water	А	D		750	6
2017-16-024	8/2/2017	In Stream 50 YRDS East of creek mouth	А	D	Not Measured	43	16
2017-16-025	8/2/2017	In Stream in water 20 YRDS South of creek mouth	А	D	Not Measured	460	4
2017-16-026	8/2/2017	In Stream In cove, 50 FT from creek mouth	А	D	Not Measured	93	24
2017-16-027A	8/2/2017	In Stream West of Point	А	D	Not Measured	NA	4
2017-16-028A	8/2/2017	In Stream East of Point	А	D	Not Measured	NA	<2
2017-16-027	8/2/2017	13 x 2" PVC pipe drain holes-address: 380 Shawomet avenue	Р	D	NF	NA	0

Source ID	Date of	Source Description	Actual/	Direct/	Volume (cfs)	CFU/ 2009	100ml 2017
	Sampling	Source 2 coertprion	Potential	Indirect	(eis)	Results	Results
2017-16-028	8/2/2017	8 x 4" clay pipe leading to a posterior 2" PVC pipe within seawall with rod iron gate- address: 336 Shawomet avenue	wall with rod iron gate- P I			NA	0
2017-16-029	8/2/2017	1 x 6" PVC pipe in cement seawall-address: 322 Shawomet avenue	Р	D	NF	NA	0
2017-16-030	8/2/2017	3 x 2" PVC in cement seawall-address: 248 Shawomet avenue	Р	D	NF	NA	0
2017-16-031	8/2/2017	6 x 2" plastic jetfilters in metal seawall- address: 204 Shawomet avenue	Р	D	NF	NA	0
2017-16-032	8/2/2017	5 x 5" PVC with grate inside and cobble behind grate, all within cement seawall- address: 1198 Shawomet avenue	P D N			NA	0
2017-16-033	8/2/2017	5 x 4" CPP with gravel at posterior end within cement seawall	Р	D	NF	NA	0
2017-16-034	8/2/2017	12 x 2" plastic jet filters in metal seawall	Р	D	NF	NA	0
2017-16-036	8/2/2017	5 x 2" drilled holes in cement seawall and 5 x 3" PVC pipes-address 12 Shawomet avenue	Р	D	NF	NA	0
2017-16-037	8/2/2017	3 x 2" drilled holes in cement seawall and 4 x 2" holes around the corner-address: 280 Bellman avenue	Р	D	NF	NA	0
2017-16-038	8/2/2017	8 x 4" metal drain holes in cement seawall (half are clogged)-address: 9 Blake street	Р	P D		NA	0
2017-16-039	8/2/2017	1 x 4" PVC pipe and 9 x 2" holes in metal seawall (all clogged)	Р	P D		NA	0
2017-16-040	8/2/2017	5 x 2" drilled holes in cement seawall	Р	D	NF	NA	0
2017-16-041	8/3/2017	6 x 4" PVC pipe drains in seawall-address: 2 Grace avenue	Р	D	NF	NA	0

	Date of		Actual/	Direct/		CFU	'100ml
Source ID	Sampling	Source Description	Potential	Indirect	Volume (cfs)	2009	2017
2017-16-042	8/3/2017	1 x 4" hole and 6 x 2" holes in seawall- address: 2 Grace avenue	Р	D	NF	Results NA	Results 0
2017-16-043	8/3/2017	12" RCP broken filled with cobble- may not be connected to anything	Р	D	NF	NA	0
2017-16-044	8/3/2017	Seep from marsh (2' wide x 1" deep) at end of Cove road-Cole Farm Beach	А	D	0.04722	NA	8
2017-16-045	8/3/2017	small trickle/stream (6" wide x 0.5" deep) from marsh	А	D	Trickle	NA	8
2017-16-080	8/4/2017	4" PVC pipe	Р	D	NF	0	0
2017-16-081	8/4/2017	12" RCP and 8 x 4" rubber pipes in seawall	Р	D	NF	2	0
2017-16-083	8/4/2017	12" Clay pipe	Р	D	NF	0	0
2017-16-084IS	8/4/2017	IN STREAM (10' wide x 1' deep)-flows under bridge and road from residential area	А	D	5.1	15	134
2017-16-084N	8/4/2017	Downstream on North side	А	D	Not Measured	NA	120
2017-16-084S	8/4/2017	Downstream on South side	А	D	Not Measured	NA	<2
2017-16-085IS	8/4/2017	Marsh In-stream of outlet that flows over gravely beach	А	D	1.275	39	60
2017-16-085N	8/4/2017	In Stream on North side	А	D	Not Measured	NA	60
2017-16-085S	8/4/2017	In Stream on South side	А	D	Not Measured	NA	54
2017-16-086	8/4/2017	12" hole in corner of seawall	Р	D	NF	0	0
2017-16-087	8/4/2017	6" Steal pipe	Р	D	NF	0	0
2017-16-087A- IS	8/4/2017	Marsh In-stream of outlet (30' wide x 5' deep)	А	D	155.833	21	140
2017-16-087A- IS2	8/4/2017	Marsh outlet Downstream	А	D	Not Measured	NA	20
2017-16-089	8/4/2017	2 x 4" PVC pipes in cement seawall-mostly clogged	Р	D	NF	NA	0
2017-16-090	8/4/2017	2" metal pipe in cement seawall	Р	D	NF	NA	0

	Date of		Actual/	Direct/			100ml
Source ID	Sampling	Source Description	Potential	Indirect	Volume (cfs)	2009 Results	2017 Results
2017-16-091	8/4/2017	3 x 6" PVC pipes in stonewall base below cement seawall	Р	D	NF	NA	0
2017-16-092	8/4/2017	13 x 6" PVC pipes in cement seawall, most are clogged with sand	Р	D	NF	NA	0
2017-16-093	8/4/2017	11 x 2" drilled holes in cement seawall	Р	D	NF	NA	0
2017-16-094	8/4/2017	7 x 6" and 1 x 4" clay pipes in ~ 50FT stretch of stone wall	Р	D	NF	NA	0
2017-16-095	8/4/2017	2 x 6" PVC pipes in stone seawall	Р	D	NF	NA	0
2017-16-096	8/4/2017	6" CPP resting on top of a stone wall ~60FT above the beach	CPP resting on top of a stone wall ~60FT				0
2017-16-097	8/4/2017	5 x 2" square holes in seawall	Р	D	NF	NA	0
2017-16-098	8/4/2017	1 x 4" rubber pipe, 2 x 4" metal pipe, and 1 x 4" clay pipe, 1 x 6" square hole w/ clay pipe in back, and 1 x 6"-hole w/ PVC behind all within in cement seawall surrounding address: 55D Nayatt pt.	Р	D	NF	NA	0
2017-16-099	8/16/2017	1 x 24" CPP street drain	Р	D	NF	NA	0
2017-16-100	8/16/2017	Groundwater seep in mid marsh	А	D	Trickle	NA	6
2017-16-101	8/16/2017	Groundwater seep running down sandy boat launch next to Phragmites stand	А	D	Trickle	NA	4000
2017-16-102	8/16/2017	2" x 4" stone rectangular slot in stone wall for drainage	P D		NF	NA	0
2017-16-103	8/16/2017	Groundwater seep from marsh	А	D	Trickle	NA	72
2017-16-104	8/16/2017	1 x 6" PVC pipe resting on rocks above cement wall	P D		NF	NA	0
2017-16-105	8/16/2017	1 x 6" PVC pipe in cement seawall at Cove Haven Marina	Р	D	NF	NA	0

	Date of		Actual/	Direct/		CFU/	'100ml
Source ID	Sampling	Source Description	Potential	Indirect	Volume (cfs)	2009 Results	2017 Results
2017-16-106	8/16/2017	Runoff down marina seawall from boat rinsing station at Cove Haven Marina	А	D	Trickle	NA	8
2017-16-107	8/16/2017	1 x 18" CPP inside of cement seawall at Cove Haven Marina	Р	D	Low flow (couldn't reach for proper measurement)	NA	23
2017-16-108	8/16/2017	Groundwater seep in marsh	А	D	0.000315	NA	600
2017-16-109	8/16/2017	Tidal Channel through 15' diameter X 1 M deep CMP	А	D	41.82	NA	29
2017-16-110	8/16/2017	11 x 2" iron pipes in cement seawall	Р	D	NF	NA	0
2017-16-111	8/16/2017	6 x 4-6" clay pipes in cement seawall	Р	D	NF	NA	0
2017-16-112	8/16/2017	1 x 6" CPP inside drilled holes in cement seawall	Р	D	NF	NA	0
2017-16-113	8/16/2017	5 x 2" PVC pipes in cement seawall	Р	D	NF	NA	0
2017-16-114	8/16/2017	1 x 4" PVC pipe above ground level in cement seawall	Р	D	NF	NA	0
2017-16-115	8/16/2017	18" broken iron pipe storm drain in cement seawall	Р	D	NF	NA	0
2017-16-116	8/16/2017	River outlet from Bullocks cove near marina on East side	А	D	Not Measured	NA	2
2017-16-117	9/14/2017	Small stream in marsh (3ft x 0.5 cm deep)	А	D	slow trickle	NA	46
2017-16-118	9/14/2017	24" RCP under road	A	D	Tide coming in couldn't measure	NA	4000
2017-16-119	9/14/2017	4" CPP laying on top of rock wall from lawn	Р	D	NF	NA	0
2017-16-120	9/14/2017	2" PVC pipes in cement seawall	Р	D	NF	NA	0

	Date of		Actual/	Direct/		CFU/	/100ml
Source ID	Sampling	Source Description	Potential	Indirect	Volume (cfs)		2017 Results
2017-16-121	9/14/2017	1 x 0.5" and 1 x 2" metal pipes in cement seawall	Р	D	NF	NA	0
2017-16-122	9/14/2017	4" CPP connected to cement foundation laying on lawn	Р	D	NF	NA	0
2017-16-123	9/14/2017	24" CMP under road	Р	D	NF	NA	0
2017-16-124	9/14/2017	12" CMP in dirt bank	Р	D	NF	NA	0
2017-16-125	9/14/2017	12" PVC pipe under road coming out of dirt embankment	Р	D	NF	NA	0
2017-16-126	9/14/2017	2" PVC pipe in rock wall	Р	D	NF	NA	0
2017-16-127	9/14/2017	2 x 1" PVC pipes	Р	D	NF	NA	0
2017-16-128	9/14/2017	2" PVC pipe in rock wall	Р	D	NF	NA	0
2017-16-129	9/14/2017	5 x 1" holes in cement seawall	Р	D	NF	NA	0
2017-16-130	9/14/2017	21 x 1" and 1 x 2" PVC pipes in cement seawall	Р	D	NF	NA	0

IS = In stream sample NS = Not sampled NF = No flow NA = Not applicable

3.4 Identification and Evaluation of Pollution Sources

The shoreline survey occurred throughout multiple days in both August and September with additional followup sampling occurring in October 2017. Meteorological conditions during the early August (8/2/2017-8/4/2017) surveying were dry with \geq 9 days since the most recent rainfall with a total of 0.56 inches. Mid-August (8/16/2017) survey sampling occurred during dry weather with one day since 0.05 inches of rainfall. September (9/14/2017) sampling occurred during dry weather conditions with the most recent rainfall 7 days prior at 0.67 inches and the October (10/19/2017) sampling occurred during dry weather with 5 days since 0.17 inches of rain (NOAA, Providence TF Green rain gauge). All actual and potential pollution sources from the survey are located within growing area waters that are classified as prohibited. Four (4) sources had Fecal Coliform (FC) levels exceeding >240 CFU/100ml. Three (3) of the sources (2017-16-101 at 4000 CFU/100ml, 2017-16-108 at 600 CFU/100ml, and 2017-16-118 at 4000 CFU/100ml) were located within Bullocks Cove, as this area does not have the potential to be re-classified and will remain Prohibited due to the high volume of marinas and moorings inside of the cove, and therefore does not require additional follow-up sampling. The remaining source (2017-16-011) had an elevated FC level of 1600 CFU/100ml, which was located on the shoreline of Warwick (Figure 4-1). Upon resampling source 2017-16-011, the bacteria level dropped to 800 CFU/100ml with an in-stream result of 364 CFU/100ml and a low flow rate of 0.00052 cfs.

3.4.1 Discussion of shoreline sources

West bank of the Providence River

The following sources are located on the western side of the Providence River within the potential reclassification area for conditionally approved status.

Figure 3-2 Source 2017-16-001



Source 2017-16-001 is a 24-inch diameter Reinforced Concrete Pipe draining onto a cobble beach located on the western shoreline of the Providence River. The pipe is filled halfway with sand and cobble, and green algae is growing on the rocks within the discharge water. Sampling results, as shown in the table below, were slightly elevated but had a very low flow rate. Due to the low flow and the relatively low bacteria concentration of this source it does not appear to be impacting the shellfish growing area.

Source	Date of	Source	Actual/	Direct/	Volume	CFU/100ml	
ID	Sampling	Description	Potential	Indirect	(cfs)	2009 Results	2017 Results
2017-16- 001	8/2/2017	24" RCP	А	D	0.2125	15	160

Figure 3-3 Source 2017-16-011





Source 2017-16-011 is a 24-inch diameter Reinforced Concrete Pipe (RCP) storm drain located on the western shoreline of the river and discharges onto a pile of large rocks and flows across a sandy beach at low tide. Adjacent to the RCP is a broken Corrugated Metal Pipe that is mostly filled with sand and debris. The source was initially sampled 8/2/2017 during dry weather and had elevated Fecal coliform results with a low volumetric flow (See table below). A follow-up sampling occurred on 10/19/2017 (5 days since 0.17 inches of rainfall) with decreased bacteria count from 8/2/2017 but remaining elevated. Volumetric flow had also decreased compared to prior sampling. Triennial survey results from 2009 show elevated Fecal coliform levels, which indicate that this source may be impacting the growing area. The source will be re-visited during the 2020 triennial shoreline survey. Due to the elevated bacteria counts consideration of dilution requirements will need to be account for while considering re-classification of these waters from Prohibited to any upgraded classification.

Source	Date of	Source	Actual/	Direct/	Volume	CFU/	/100ml	
ID	Sampling	Description	Potential	Indirect	(cfs)	2009 Results	2017 Results	
2017-16- 011	8/2/2017	24" RCP next to 24" CMP	А	D	0.00221	460	1600	
2017-16- 011	10/19/2017	24" RCP next to 24" CMP	А	D	0.00052		800	
2017-16- 011	10/19/2017	Instream	А	D	Not measured		364	



Source 2017-16-044 is a stream that drains onto a marshy beach. The source was sampled during dry weather on 8/3/2017 with a volumetric flow of 0.00047 cfs and a bacteria count of 160 CFU/100ml. The drainage basin of the stream was littered with the green algae Ulva, which was mostly decayed. This source has a very low flow rate and is draining into currently prohibited growing waters, thus the source has enough dilution area before reaching approved growing waters. The potential re-classification area of the lower Providence River would encompass this source, which would require further follow-up on the potential impacts of this stream to the growing area during the 2018 annual review.

Source	Date of	Source	Actual/	Direct/	Volume	CFU/100ml		
ID	Sampling	Description	Potential	Indirect	(cfs)	2009 Results	2017 Results	
2017-16- 022	8/3/2017	Stream (1' wide x 8" deep) that drains onto marshy beach, upstream is covered in vegetation- address: end of Rock avenue	А	D	0.00047	43	160	

Eastern bank of the Providence River

The following sources are located on the eastern side of the Providence River within the potential reclassification area. Based on the number, bacteria counts and volume of flow from these numerous sources along this shoreline an upward reclassification of the receiving water adjacent to these sources is unlikely due to the dilution requirements necessary to meet water quality standards. (See Figure 3-8).

Figure 3-5 Source 2017-16-084



Source 2017-16-084 is Mussachuck Creek (10 feet wide by 1 foot deep) located in Barrington at the end of Nayatt road, which drains Echo Lake and Brickyard Pond and flows through the Rhode Island Country Club golf course and across a gravely beach before draining into the Providence River. The source was sampled during dry weather on 8/4/2017 with a flow of 5.1 cfs and bacteria count of 134 CFU/100ml. In-stream samples were taken with bacteria count of 120 CFU/100ml on the North side and <2 CFU/100ml on the south side of the stream. The receiving waters for this source are currently classified as prohibited, thus this source currently has enough dilution area before it reaches approved waters, but additional dilution calculations need to be performed in order to determine the boundary between this prohibited area and the potential conditionally approved area.

Source	Date of		Actual/	Direct/	Volume	CFU/100ml	
ID	Sampling	Source Description	Potential	Indirect	(cfs)	2009 Results	2017 Results
2017-16- 084IS	8/4/2017	IN STREAM (10' wide x 1' deep)-flows under bridge and road from residential area	А	D	5.1	15	134
2017-16- 084N	8/4/2017	Downstream on North side	А	D	Not Measured	NA	120
2017-16- 084S	8/4/2017	Downstream on South side	А	D	Not Measured	NA	<2

Figure 3-6 Source 2017-16-085



Source 2017-16-085 is a stream located in Barrington south of Annawamscutt, which drains from an upland wetland. The stream flows through a sandy dune before reaching a gravely beach where it discharges into the Providence River. The source was sampled on 8/4/2017 with bacteria count of 60 CFU/100ml and a flow rate of 1.275 cfs. Because of the low bacteria count during the 2017 survey and historically low bacterial results from this source it does not appear to impact the Providence River growing area.

Source	Date of	Source	Actual/	Direct/ Indirect	Volume	CFU/100ml	
ID	Sampling	Description	Potential		(cfs)	2009 Results	2017 Results
2017-16- 085IS	8/4/2017	Marsh In- stream of outlet that flows over gravely beach	А	D	1.275	39	60
2017-16- 085N	8/4/2017	In Stream on North side	А	D	Not Measured	NA	60
2017-16- 085S	8/4/2017	In Stream on South side	А	D	Not Measured	NA	54

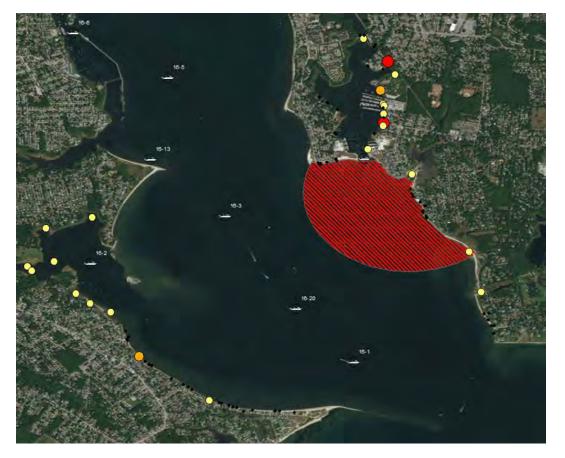


Source 2017-16-087A is the outlet of Allin's Cove (Drown Cove) in Barrington. Allin's Cove is a 10 acre cove located at the mouth of Annawamscutt Creek and is bordered by a small buffering salt marsh. The cove is both tidally impacted and has a freshwater stream input from the northeast, which is fed from an upland wetlands complex north of Bay Spring Avenue. The cove was dredged in 2005 for a salt marsh restoration project (Save the Bay and RI CRMC), which included widening the channel draining into the Providence River (see section 4-5 for more details). The results from sampling the outlet of the cove are listed in the table below. Results from the 2017 sampling were elevated compared to 2009 indicating that the source has the potential to impact the growing area because of the high flow rate and bacteria level measured during dry weather. This source is currently discharging to the prohibited Providence River growing area.

Source ID	Description	Sample date	Previous results 2009 survey MPN/100ml	Volume of source	2017 Survey Results CFU/100ml	Volume of source
2017-16- 087A	Outlet of Allins Cove	8/4/2017	21	Ebb tide	140	155.833 cfs
2017-16- 087IS2	Outlet of Allins Cove downstream	8/4/2017	NS		20	Not measured

As a preliminary calculation, using the FDA dilution calculator and inputting the following parameters, 155.833 cfs with an average bacteria count of (140 + 20 + 21/3) 60.3 CFU/100ml, an average depth in the dilution waters of 4 feet (NOAA chart 13224) source 2017-16-087A would require a dilution area radius of 3,038 feet or 333 acres (as shown in the figure 3-8 below) from the point of confluence to dilute this source to meet the 14 CFU/100ml shellfish water quality criteria.

Figure 3-8 Dilution Zone



As indicated on the above graphic there are additional sources on the easterly shoreline to the south of Allins Cove that have the potential to impact the Providence River if considering an upward re-classification. Additional dilution calculations would need to be completed to support this reclassification. As indicated in the above figure the current routine monitoring stations (small white boat symbol) for the Providence River are located in the main center channel and are unlikely to be representative of the area along the eastern shoreline or in Occupessatuxet Cove due to the strong outgoing currents and depth of waters in the channel compared to the more constrained shallower waters impacted by these sources. With an upward classification in mind additional monitoring stations were added to the GA16 routine run to obtain information within the cove and along the shoreline independent of the channel samples.

Bullocks Cove

Bullocks Cove is located to the north of Allin's Cove and contains three (3) marinas and numerous moorings. Due to the number of marinas and moorings the cove will remain in prohibited classification. Further discussion on individual marinas and dilution calculations is outlined in section 3.4.4.

Figure 3-9 Source 2017-16-001



Source 2017-16-101 is a groundwater seep running down a sandy boat launch next to a Phragmites stand located in Bullocks Cove. The source had a small and steady trickle during the time of sampling (8/16/2017) with elevated bacteria count at 4,000 CFU/100ml. However, this source is draining into prohibited receiving waters, which will not be reclassified due to the high volume of marinas, thus this source is not likely impacting waters beyond the current prohibited area.

Source	Date of	Source	Actual/	Direct/	Volume	CFU/100ml	
ID	Sampling	Description	Potential	Indirect	(cfs)	2009 Results	2017 Results
2017-16- 101	8/16/2017	Groundwater seep running down sandy boat launch next to Phragmites stand	А	D	Trickle	NA	4000

Figure 3-10 Source 2017-16-108



Source 2017-16-108 is a groundwater seep through a small marsh adjacent to Cove Haven Marina in Bullocks Cove. The source had a low flow of 0.0003 cfs but an elevated bacteria count of 600 cfu/100ml. However, source is discharging into prohibited waters, which will not be reclassified due to the high density of marinas, thus this source has enough dilution area before it reaches approved waters.

Source	Date of	Source	Actual/	Direct/	Volume	CFU/100ml	
ID	Sampling	Description	Potential	Indirect	(cfs)	2009 Results	2017 Results
2017-16- 108	8/16/2017	Groundwate r seep in marsh	А	D	0.00031 5	NA	600

Figure 3-11 Source 2017-16-118



Source 2017-16-118 is a 24-inch Reinforced Concrete Pipe running under the East Bay Bike Path. The source was sampled on 9/14/2017 as the tide was coming in so the flow could not be accurately measured and the elevated bacteria count of 4000 CFU/100ml may be inaccurate due to the tidal influence. The source was not revisited because it is located within the prohibited waters of Bullocks Cove, which will not be reclassified due to the number of marinas within the cove.

Source	Date of		Actual/ Potential	Direct/ Indirect	Volume	CFU/100ml	
ID	Sampling				(cfs)	2009 Results	2017 Results
2017-16- 118	9/14/2017	24" RCP under road	А	D	Tide coming in couldn't measure	NA	4000

Bulluck Cove's outlet is more represented by routine monitoring station GA16-4 which is located in the channel that has been dredged to allow boat traffic to enter and exit this heavily used mooring and marina area. As evidenced in the annul statistical analysis this station also appears to be impacted during wet weather. For an approved classification the most recent thirty (30) sample results indicate the station is out of compliance for the 90th percentile (90.2 CFU/100ml) and the geo-mean is approaching non-compliance at 13.1 CFU/100ml. During dry weather the most recent fifteen (15) taken during dry weather indicate the station is in compliance with zero of the samples greater than 31 CFU/100ml and the geo-mean is at 2.4 CFU/100ml. A marina closure due to the large number of vessels, and moorings within this protective cove would need to remain in place and has been calculated using our best professional judgment on the number of slips, occupancy and discharge rates to be an area of approximately nineteen (19) acres. Further details on this calculation can be obtained from the shellfish program document entitled "Evaluation of Waters Adjacent to Marinas, Marina Dilution Analysis Background, June 2017". The area of Bullocks Cove is approximately one hundred and twenty-nine (129 acres) which is ample dilution volume in the event there is a sanitary discharge from the vessels currently utilizing these harbor waters. In addition to the numerous vessels and the necessary marina closure there are several freshwater sources and stormwater outfalls that contribute bacteria loads to this cove. The following graphic illustrates the locations of those sources and the magnitude of the bacteria counts along with the general occupation of the area both in the water and the adjacent land occupation which is a heavily developed residential area with limited access to municipal sewers which are primarily located on the western banks of the cove (2004 RI DEMGIS).

Figure 3-12 Aerial view Bullock Cove



3.4.2 Domestic Wastes

The Providence River watershed directly adjacent to the river has public sewers available to all residents and businesses as indicated by the shaded purple area in figure 3-13. The availability of sewer service has decreased the number of RIDEM's Office of Compliance and Inspection (OCI) OWTS complaints near the Providence River with no outstanding complaints during 2017.

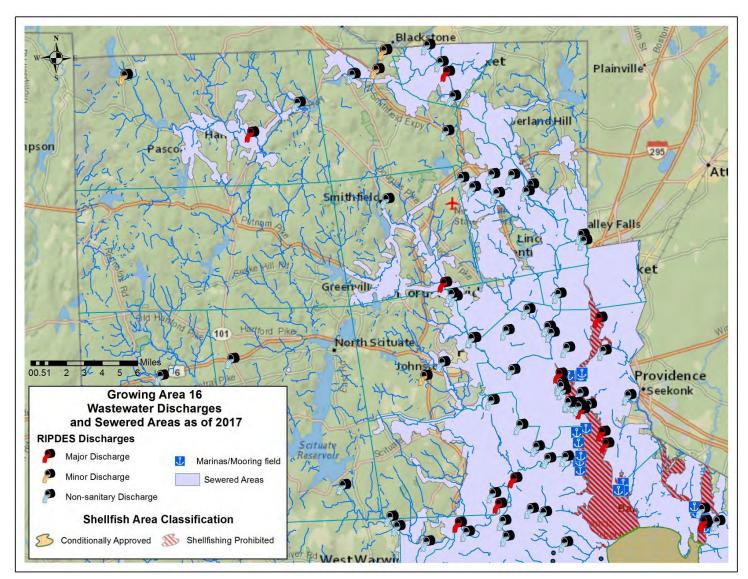


Figure 3-13 Wastewater Discharges and Sewered Areas

3.4.3 Wastewater Treatment Facilities

As shown in the above figure there are numerous permitted dischargers into the Providence River watershed and its tributaries. The Providence River is the recipient of wastewater discharges from seventy-nine (77) Rhode Island Pollutant Discharge Elimination Systems (RIPDES) permitted dischargers from Rhode Island and seventeen (17) from Massachusetts within the watershed. Ten (10) of these are major sanitary dischargers, four (4) are minor sanitary dischargers the remaining sixty-four (64) in RI are non-sanitary dischargers.

3.4.4 Combined Sewer Overflows Stormwater

In Rhode Island within the Narragansett Bay Commission (NBC) district, the cities of Central Falls, Providence and Pawtucket discharge from 64 CSOs an estimated 2.2 billion gallons a year (https://www.narrabay.com/ProgramsAndProjects/Combined%20Sewer%20Overflow%20Project.aspx) of untreated combined sewage into the Bay and its tributaries to the Providence River. NBC has undertaken a significant upgrade to their CSOs to reduce overflows that violate the Federal Clean Water Act. NBC has entered into a consent agreement with RIDEM during the implementation and construction of the comprehensive CSO Abatement Program. The program is a three-phase plan with Phase I being the construction of an overflow storage tunnel and tunnel pump station, with connection of 8 of the 38 CSOs within the Fields Point service area and the Woonasquatucket River Interceptor. Phase I construction was completed in October of 2008 and reduced overflow volumes by approximately 40%. The underground storage tanks and tunnels contain the sewage overflows during rain events so that the stored flows can be returned to the treatment system after the storm. Phase II of the approved abatement plan included the construction of two interceptors, two sewer separation projects, and a constructed wetlands facility to reduce the discharge from the 17 CSOs. Completion of phase II occurred in December of 2014. NBC is currently re-evaluating the Phase III plans due to the USEPA's guidance documents on affordability and integrated planning and is awaiting a review response from RIDEM. After the completion of the three phases, overflow volumes are predicted to be reduced by 98% with untreated overflow events projected to occur only four times per year.

Due to water quality improvements after the completion of phase I and II, the Upper Narragansett Bay Growing Area 1 was reclassified in May of 2017 with Area B changing from conditionally approved to approved, the Conimicut Triangle and Area A were merged, and the rainfall closure threshold for Area A increased from 0.8 inches to 1.2 inches

3.4.5 Stormwater

Additional potential pollution to the growing area is through stormwater runoff that is not treated and can have negative impacts on the water quality. RIDEM has developed a Stormwater Program under the requirements of the EPA's Clean Water Act (CWA) and RI State Law. RIDEM's Pollution Discharge Elimination System (RIPDES) program is used to protect waters from municipal and industrial point source discharges. The program requires large construction sites and certain industrial activities along with larger Municipal Storm Sewer Systems (MS4s) serving populations > 100,000 to obtain permits and implement a storm water management program to control polluted discharges under the Phase I stormwater program. The Phase II stormwater program requires smaller MS4s within urbanized areas to obtain stormwater permits. Each MS4 program is required to implement a stormwater management program plan (SWMPP) that best describes the Best Management Practices (BMPs) to reduce contaminated stormwater runoff and prohibit illicit discharges. The following six measures are to be addressed in the SWMP:

- 1. Public Education and Outreach
- 2. Public Involvement/Participation
- 3. Illicit Discharge detection and Elimination
- 4. Construction Site Runoff Control
- 5. Post Construction Runoff Control
- 6. Pollution Prevention/Good Housekeeping

The SWMPP must contain the measurable goals for each control measure (narrative or numeric, used to measure the success of the program) as well as an implementation schedule including interim milestones and frequency of activities and reporting of results. Additional permit requirements based on the recommendations of a Total Maximum Daily Load (TMDL) may also be applied.

The Rhode Island Department of Transportation (RIDOT) received multiple violations from the EPA of their National Pollutant Discharge Elimination System (NPDES) MS4 permit in 2015. RIDOT entered a consent decree with the EPA through a ruling by the United States District Court, District of Rhode Island in which they must provide annual reports over a 10-year period of all remedial measures implemented to ensure compliance with the Clean Water Act. Some of the violations included failure to: implement a stormwater pollution prevention and management program that minimizes the discharge of pollutants, implement total maximum daily load (TMDL) determinations in their Storm Water Management Program Plan (SWMPP), and maintain catch basins and other elements of RIDOT's storm drainage system

(https://www.epa.gov/enforcement/rhode-island-department-transportation-settlement)

There are 34 municipal permits within RI, which are annually reviewed for items such as post-construction stormwater management, pollution prevention and good housekeeping, and Total Maximum Daily Load (TMDL) Implementation (water quality restoration plan). In 2014 the majority of permits met the criteria, however, for pollution prevention and good housekeeping only 49% reported their goals. The remaining items had greater than 66% completion with the majority over 70%

(http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/pdfs/ms4ann15.pdf)

3.4.6 Marinas

The Providence River leads to New England's second largest deep-water port, with thousands of vessels a year traveling through these waters transporting goods to and from Rhode Island. In addition, hundreds of recreational vessels of various sizes use these waters for their enjoyment. There are a total of fourteen (14) marinas located within Growing Area 16 (Figure 3-13), all of which are north of Gaspee and Bullocks points. Twelve (12) of the marinas are located in the northern section of the Providence River along with the major commercial docks and piers of the Port of Providence, which was not surveyed during the 2017 triennial update. Four of the marinas are located in Bullocks Cove with two of the largest marinas in the Providence River (225 slips and 150 slips). These smaller marinas service approximately 1045 boats with a variety of slips, moorings and floating docks. There are five (5) pumpout facilities located among the fourteen (14) marinas to service the needs of the general boating public. Rhode Island coastal waters are federally designated as "No Discharge" mandating that the discharge of treated and untreated boat sewage is prohibited (not including greywater or sink water) in these designated areas. These designated areas encompass the entire Providence River growing area. Bullocks Cove has a high density of marinas and mooring fields, which means that this area will not be included in the potential re-classification, however the waters surrounding these marinas have sufficient dilution waters to protect shellfishing within the cove itself. The marinas located to the north also have sufficient dilution waters to be protective. The details and calculations for these marinas can be found in the report "Marina Dilution Analysis June 2017" and the electronic excel file "2017 Marina Calcs VIMS FDA" which is located in the program's permanent files.

During the shoreline survey the number of moorings were recorded. Three (3) moorings were counted off of Nayatt point. Twenty (20) riparian seasonally used moorings were located off of Conimicut in Warwick between Talcott Avenue and Beach Avenue.

3.4.7 Agricultural Waste

The Providence River growing area and its watershed have approximately five (4.7) percent of the land used for agricultural purposes, the majority of which is in the upper reaches of the watershed in Massachusetts. As these sources are generally non-point in nature and only constitute a very small portion of this 860 square mile watershed it would be reasonable to assume that they would not appear to have any significant impact on the river's water quality. Any impacts from agricultural uses would be transported to the river via overland runoff or through the existing stormwater systems indirectly to the river.

3.4.8 Wildlife

The Providence River and its watershed are inhabited by a variety of terrestrial wildlife such as birds, raccoons, deer, coyote, muskrat, opossums, and rodents. These animals live in urban, suburban and forested areas adjacent to the Providence River and can contribute pathogens through the watershed via stormwater runoff or direct deposition. Pet waste has been identified as a potentially significant source of pathogens and bacteria to a waterbody especially in urban park sites that may be along the banks of a river and its tributaries.

Marine birds and mammals are also present in the Providence River. Because of the great variety, complex distribution and dispersal patterns, and fluctuating populations of waterfowl it is very difficult to assess their

impact on water quality. Notations within the shoreline survey field sheets of large congregations of waterfowl would require further analysis. No such indications were noted in the 2017 shoreline survey.

3.4.9 Industrial Wastes

The Rhode Island Pollution Discharge Elimination System Program (RIPDES) and in Massachusetts the EPA implemented NPDES are responsible for permitting any and all industrial and municipal waste discharges to waterbodies of the state(s). According to the most recent records available there are fourteen (14) permitted dischargers in Massachusetts and one-hundred and sixteen (116) permitted dischargers in the Rhode Island portion of the watershed. These permits have strict pollutant discharge limitations and are monitored and reported to their respective authorities on a monthly basis.

3.4.10 Poisonous and Deleterious Substances

Quahog (*Mercenaria mercenaria*) samples consisting of ~20 individuals from four locations (19-30, 19-19, 19-16, and 19-29) in the Providence River were collected and analyzed for heavy metals and Bacteria Coliphage concentrations (see map below for specific site locations within area 19). Sites were selected on either side of the lower Providence River (South of Gaspee Point) so as to best assess areas of potential future harvesting. The results are listed in the table below (Table 3-2), along with the acceptable concentrations according to both the FDA and NOAA (Table 3-3).

Samples were collected on 8/21/17 (station 19-29) and 8/22/2017 (Figure 3-14, stations 19-30, 19-19, and 19-16). Sample collection occurred during wet weather conditions with the most recent rain event on 8/18/2017 of 0.3" (NOAA TF Green rain gauge). The most recent by-pass occurred 24-25 days (7/29/2017) prior to sampling at the NBC Bucklin Point Wet Weather Facility with a total of 3.614 MG. Water temperatures during the sample collection dates had a low of 72.5° F and a high of 74.8° F.

The results for each of the heavy metal concentrations came back below threshold concentrations according to both the FDA and NOAA. The only metal with somewhat close values to the threshold level was lead, which was highest at station 19-19 with a concentration of 0.57 mg/kg compared to the NOAA standard of 0.8 mg/kg. The lead results ranged from 0.45-0.57 mg/kg across the stations. The bacteria coliphage results also came back with low concentrations (<2.0 PFU/100ml) at each of the stations.

Station	: 19-30			
Test	Test Code	Result	Units	Analysis date
ICPMS	Lead	0.45	mg/kg	9/7/2017
ICPMS	Chromium	1.05	mg/kg	9/7/2017
ICPMS	Nickel	1.04	mg/kg	9/7/2017
ICPMS	Cadmium	<0.5	mg/kg	9/7/2017
ICPMS	Arsenic	7.33	mg/kg	9/7/2017
	Male Specific Bacteriophage	<2.0	PFU/100ml	9/7/2017
Station	: 19-19			
Test	Test Code	Result	Units	Analysis date
ICPMS	Lead	0.57	mg/kg	9/7/2017
ICPMS	Chromium	4.09	mg/kg	9/7/2017
ICPMS ICPMS	Chromium Nickel	4.09 1.19	mg/kg mg/kg	9/7/2017 9/7/2017
			0. 0	
ICPMS	Nickel	1.19	mg/kg	9/7/2017

Table 3-2Results of Providence River Quahog meat samples on 9/8/2017

Male Specific Bacteriophage <2.0

PFU/100ml 9/7/2017

Station:	: 19-16			
Test	Test Code	Result	Units	Analysis date
ICPMS	Lead	0.46	mg/kg	9/7/2017
ICPMS	Chromium	2.84	mg/kg	9/7/2017
ICPMS	Nickel	1.11	mg/kg	9/7/2017
ICPMS	Cadmium	<0.05	mg/kg	9/7/2017
ICPMS	Arsenic	8.43	mg/kg	9/7/2017
	Male Specific Bacteriophage	<2.0	PFU/100ml	9/7/2017
Station	: 19-29			
Test	Test Code	Result	Units	Analysis date
ICPMS	Lead	0.48	mg/kg	9/7/2017
ICPMS	Chromium	3.34	mg/kg	9/7/2017
ICPMS	Nickel	1.56	mg/kg	9/7/2017
ICPMS	Cadmium	<0.05	mg/kg	9/7/2017
ICPMS	Arsenic	9.64	mg/kg	9/7/2017

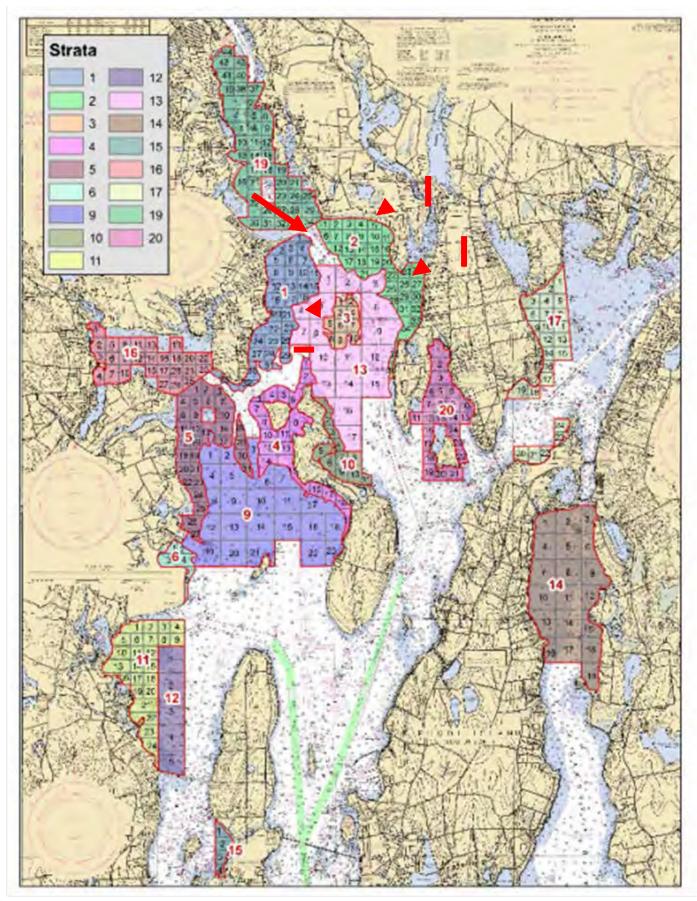
Table 3-3FDA action levels for heavy metal concentrations in shellfish

FDA Accepted Levels (1993)		NOAA Accepted	d Levels	
Lead	1.5	ug/g	Lead	0.8	ug/g
Arsenic	130	ug/g	Arsenic	86	ug/g
Chromium	20	ug/g	Chromium	11	ug/g
Cadmium	6	ug/g	Cadmium	4	ug/g
			Nickel	80	ug/g

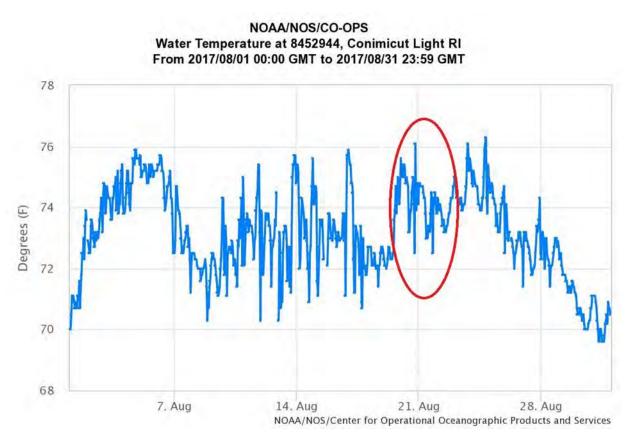
(NSSP Guide, Sec IV, Chapt II, .04, 2007) and Trends assessment.

NOAA (Kimbrough, 2008) Mussel Watch National Status

Figure 3-14 Quahaug Dredging stations within the Providence River







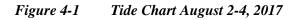
4.0 Hydrographic and Meteorological Characteristics

4.1 Tides

Tides in Rhode Island are semi-diurnal, which means that the tides have a period or cycle of approximately onehalf of a tidal day (12.48), characterized by two similar high waters and two similar low waters each tidal day. The tidal current is said to be semi-diurnal when there are two flood and two ebb periods each day. A semi diurnal constituent has two maxima and two minima each constituent day.

The shoreline survey was scheduled to coincide with ebb and/or low tide, which is the most ideal time to observe stormwater outfalls that may be hidden or influenced by tidal water. Additionally, pollution effects such as runoff are generally more pronounced during low tide. Sampling of streams and pipes during low tides should represent actual stream flows rather than the retreating tidal waters that they may receive.

Sampling for this survey was completed on August 2nd – 4th and 16th, September 14th and October 19th of 2017. Tidal charts indicating tide heights and timing during those survey periods are shown in the following figures.



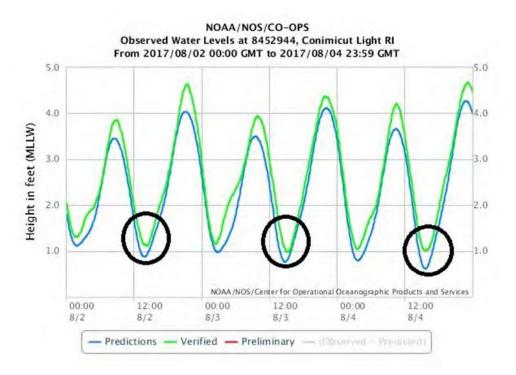


Figure 4-2 Tide Chart August 16, 2017

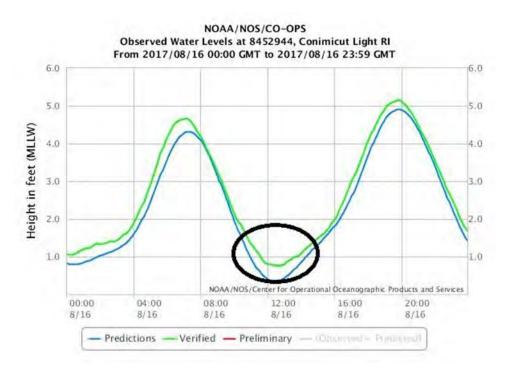


Figure 4-3 Tide Chart September 14, 2017

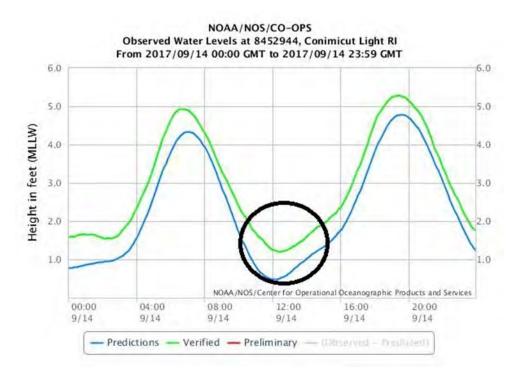
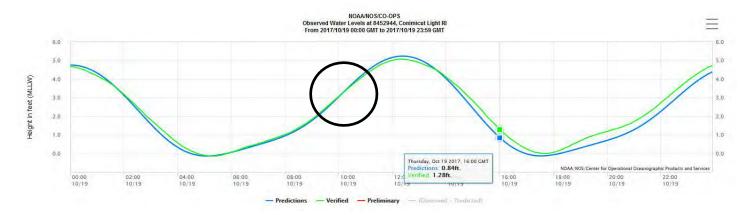


Figure 4-4 Tide Chart October 19, 2017



4.2 Rainfall

There are normally no seasonal precipitation patterns in frequency and amounts during the year in Rhode Island. Two major storm patterns exist within the state, these are storms that typically occur between October and May and are extra-tropical cyclones. They are referred to as "nor-easters," which are low-pressure systems that usually develop off the coast of North and South Carolina and move northeast along the Atlantic seaboard. When they collide with colder and drier air from the north over the New England region this results in heavy rain and/or snow. The other type of storm typically occurs between June and October and are primarily tropical cyclones. The biggest storm formations are hurricanes, which have reached Rhode Island seventy-two (72) times during the last 350 years. Hurricanes normally produce short-duration high-intensity precipitation events and are more localized than nor-easters.

Impacts to shellfish growing areas to these precipitation events varies by storm duration, intensity, and watershed characteristics such as land use, vegetative cover, and soil characteristics 85.5 % of the land within

the Seekonk-Providence River is urban with only 5.6% forested (NBEP, 2017), which indirectly impacts water quality. Changes in land use and vegetative cover are typically accompanied by increases in impervious areas. Growing areas in close proximity to impervious surfaces near stream channels is of particular concern due to the rapid transport of contaminated runoff including fecal coliform bacteria into said growing area.

Day	Maximum Temp.	Minimum Temp.	Average Temp.	Total Precipitation 24 hr (inches)
1	83	70	76.5	Т
2	90	69	79.5	0
3	88	67	77.5	0
4	85	63	74	0
5	84	63	73.5	0
6	79	59	69	0
7	72	64	68	1.02
8	86	63	74.5	Т
9	83	64	73.5	0
10	85	63	74	0.01
11	86	69	77.5	0.75
12	86	69	77.5	0.54
13	81	59	70	0.36
14	68	60	64	0.01
15	78	63	70.5	0
16	86	65	75.5	0
17	80	65	72.5	0
18	83	70	76.5	Т
19	90	73	81.5	Т
20	93	70	81.5	0.2
21	90	71	80.5	0
22	84	70	77	Т
23	77	65	71	0
24	66	58	62	0.56
25	66	58	62	0
26	79	54	66.5	0
27	75	60	67.5	0.01
28	82	68	75	0
29	72	59	65.5	Т
30	82	57	69.5	0
31	81	57	69	0

Table 4-1	July 2017 Rainfall (NOAA)
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Maximum Temp.	Minimum Temp.	Average Temp.	Total Rainfall (inches)
93	54	72.7	3.46

Day	Maximum Temp.	Minimum Temp.	Average Temp.	Total Precipitation 24 hr (inches)
1	86	64	75	0
2	86	68	77	0
3	81	68	74.5	0
4	81	68	74.5	Т
5	76	66	71	0.51
6	78	60	69	0
7	75	59	67	0.06
8	78	63	70.5	0.06
9	83	60	71.5	0
10	83	60	71.5	0
11	81	61	71	0
12	75	62	68.5	0.14
13	86	68	77	0
14	82	62	72	0
15	79	65	72	0.05
16	88	65	76.5	0
17	82	61	71.5	0
18	80	64	72	0.3
19	91	72	81.5	0
20	85	67	76	0
21	87	64	75.5	0
22	90	69	79.5	0
23	86	63	74.5	0.01
24	83	58	70.5	0
25	79	58	68.5	0
26	77	54	65.5	0
27	79	55	67	0
28	79	54	66.5	0
29	72	56	64	0.07
30	74	59	66.5	0.26
31	82	59	70.5	0

Table 4-2August 2017 Rainfall (NOAA)

Maximum Temp.	Minimum Temp.	Average Temp.	Total Rainfall (inches)
91	54	71.9	1.46

Day	Maximum Temp.	Minimum Temp.	Average Temp.	Total Precipitation 24 hr (inches)
1	70	52	61	0
2	71	46	58.5	0.01
3	68	53	60.5	0.37
4	81	58	69.5	0
5	84	64	74	0
6	79	64	71.5	0.56
7	76	58	67	0.67
8	76	54	65	0
9	73	54	63.5	0
10	75	54	64.5	0
11	79	54	66.5	0
12	85	56	70.5	0
13	81	57	69	0
14	83	68	75.5	0.01
15	82	66	74	0.05
16	81	62	71.5	0
17	80	64	72	Т
18	74	66	70	0
19	69	65	67	0.07
20	73	66	69.5	0.2
21	75	66	70.5	0
22	66	58	62	0.2
23	82	62	72	0
24	86	60	73	0
25	84	63	73.5	Т
26	82	66	74	0
27	84	65	74.5	0
28	81	57	69	0
29	69	50	59.5	0
30	62	49	55.5	1.71

 Table 4-3
 September 2017 Rainfall (NOAA)

Maximum Temp.	Minimum Temp.	Average Temp.	Total Rainfall (inches)
86	46	68.1	3.85

Day	Maximum Temp.	Minimum Temp.	Average Temp.	Total Precipitation 24 hr (inches)
1	68	44	56	0
2	72	46	59	0
3	67	47	57	0
4	76	47	61.5	0
5	84	63	73.5	0
6	81	58	69.5	Т
7	75	59	67	0
8	74	69	71.5	0.22
9	75	69	72	0.19
10	82	59	70.5	0
11	74	56	65	Т
12	63	45	54	0.02
13	67	42	54.5	0
14	68	56	62	0.17
15	72	60	66	Т
16	71	44	57.5	Т
17	59	38	48.5	0
18	74	45	59.5	0
19	73	45	59	0
20	72	52	62	0
21	73	45	59	0
22	78	49	63.5	0
23	72	49	60.5	0
24	73	65	69	0.38
25	69	60	64.5	1.4
26	65	49	57	0.72
27	63	43	53	0
28	67	42	54.5	0
29	66	59	62.5	1.65
30	66	49	57.5	0.69
31	61	38	49.5	0

Table 4-4October 2017 Rainfall (NOAA)

Maximum Temp.	Minimum Temp.	Average Temp.	Total Rainfall (inches)
84	38	61.2	5.44

The sampling dates are highlighted in yellow in the rainfall tables for each month listed above. Based on the NOAA data, the survey dates of August $2^{nd} - 4^{th}$ were considered dry weather conditions since it was 9 days following a > 0.5 inches rain storm. The survey date of August 16^{th} was also considered dry weather since it was 4 days following a < 0.5 inches rain storm. September sampling on the 14^{th} was conducted during dry weather due to 7 days since > 0.5 inches of rainfall. Follow-up sampling during October 19^{th} was also dry weather with 5 days since < 0.5 inches of rain.

4.3 Winds/Climate

In Rhode Island, the most common spring and summer wind flow direction is south to southwest. This is due to the temperature of the land being warmer than the ocean and the transfer of air over the ocean landward under the warmer, lighter air over the land. When the southwesterly breeze is prevalent, winds travel in a northeast direction towards the upper portion of the growing area. In the fall and winter, the opposite wind patterns occur. The land has cold and more dense air over the surface and the ocean has warmer and lighter air, so the breeze moves towards the ocean creating a north/ northwesterly wind direction. The wave action from the wind velocity may stir up sediments that have bacteria in them leading to higher concentrations in the water column.

Rhode Island's climate may be summarized as having an equitable distribution of precipitation throughout the four seasons, large ranges of temperature, both daily and annually, great differences in the same season of different years and considerable diversity of the weather over short periods of time. These varying conditions are greatly influenced across the state by the nearness to Narragansett Bay or the Atlantic Ocean and by elevation and nature of the local terrain. Day to day variety is the norm with no particular regular or persistent rhythm to the changes in weather other than a tendency to a roughly twice-weekly alteration from fair weather to cloudy or stormy weather.

Weather averages in Rhode Island are not very useful for important planning purposes due to the large variety of weather patterns. However, the following averages can be used for general understanding of the areas climate.

The mean annual high temperature is 60.50 F and the low is 42.50 F with the coolest temperatures occurring in January and February (21-240 F) the warmest temperatures occurring in July and August (81-830 F). Weather averages in Rhode Island are not always predictable for planning purposes due to the large variety of weather patterns.

According to NOAA climate records, during the last ten (10) years in Rhode Island the annual precipitation has ranged from 40.0 to 57.1 inches. In the last ten (10) years the highest precipitation year occurred in 2008 (57.1") with the last two years (2015-2016) being the driest in the past decade with 2015 totaling 40.8" and 2016 totaling 40.0". During the survey year (2017) the wettest months occurred in April (7.1") and May (6.98"), which was unusually high in comparison to previous years. However, precipitation amounts during the survey months were lower than average with 1.46" in August and 3.85" in September.

4.4 River Discharges

As mentioned earlier in this report there are several large fresh water tributaries along with numerous smaller tributaries that combine with the tidal waters of the Providence River. The more easily quantified pollutants transported to the growing area; travel via these surface water sources such as the aforementioned rivers, streams, stormwater outfalls and swales. Groundwater influences, although more difficult to quantify, cannot be understated.

4.5 Dredging

Allin's Cove located South of Bullocks Cove, underwent a major salt marsh restoration project beginning in 2005, which involved dredging 7,000 cubic feet of fill from three and a half acres located within the channel and marsh (as shown in the image below). In 1959 the Army Corp of Engineers filled in a section of the salt marsh with dredged material from the Providence River Bullock Cove project. This marsh filling lead to changes in the salt marsh native vegetation and increased erosion. The restoration project regraded the marsh elevation so as to reestablish native high and low marsh plant communities and to reduce the robustness of the invasive Phragmites australis. They moved the outflowing channel and created a sand bar to protect the salt marsh and upland on the northern side of the cove. In addition, they hoped to minimize the mosquito population within the cove by remaking historic ditches within the marsh to increase drainage from areas of standing water.

Figure 4-5 Allin's Cove Dredging Project



Image courtesy of Janet Freedman and Save The Bay

5.0 Water Quality Studies

5.1 RIDEM Shellfish Program Monitoring

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA), and managed by the National Shellfish Sanitation Program (NSSP). The purpose of these programs is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain an industry standard. As part of this agreement, the state of Rhode Island is required to conduct continuous bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain certification.

Water samples are collected at fourteen (14) monitoring stations throughout the Providence River Growing Area 16, as seen in figure 3-1, however the four southern stations (16-2, 16-3, 16-4, and 16-20) are sampled on a more routine basis and in support of the potential upward re-classification of the lower portion of the growing area. The remaining northern waters of the growing area will not be considered and will remain prohibited to shellfishing and thus sampled only as time and manpower allow. Stations 16-2, 16-3, 16-4, and 16-20 were sampled twenty-two (22) times during 2017.

Samples are collected one to two (1-2) feet below the water surface using a 125 ml sterile Nalgene bottle or other pre-sterilized bottles provided by RIDOH. All samples are stored in a cooler at 4°C and transported to the Rhode Island Department of Health Water Microbiology Laboratory for analysis of fecal coliform bacteria. Samples are analyzed using the standard fecal coliform membrane filtration method (sm48 mTEC), which has been utilized since August 2012 after phasing out the multiple tube fermentation test (sm01 MPN). Results are sent to the RIDEM Shellfish Program and are reviewed and incorporated into a database. A summary report is written and recommendations regarding the classification of the growing area are made on an annual basis.

The following statistical analysis of routine monitoring results supports the current prohibited classification of these growing area waters.

GROWING AREA 16 – PROVIDENCE RIVER

HIGHLIGHTS

- * Stations 16-2, 16-3, 16-4 and 16-20 in the lower Providence River were sampled twenty-two (22) times during 2017 under both wet (n= 13) and dry (n= 9) weather conditions.
- * Harvest of shellfish is currently prohibited in all waters of the Providence River (GA 16).
- * Statistics calculated for informational purposes only, not for compliance.
- * Recent 30 samples collected 8/11/2016 to 12/1/2017.
- * Recent 15 samples collected 5/8/2017 to 12/1/2017.
- * All samples analyzed by mTEC method.
- * Data run 1/10/2018.

COMMENTARY

The southern portion of the Providence River (stations 16-2, 16-3, 16-4, 16-20 in Growing Area 16) was sampled 22 times during 2017 under a variety of wet (n= 13) and dry (n= 9) weather conditions. While this area is classified as prohibited to shellfish harvest, the Shellfish Program monitors the area in conjunction with the Upper Bay (Growing Area 1) to assess changes in water quality in response to WWTP Phase I and II CSO projects that capture and store combined sewage and storm water that is ultimately pumped back to the plant for treatment prior to discharging into the Providence River. Summary statistics for this shellfishing prohibited area were calculated for informational purposes. The 2017 statistical update indicated that all stations in Growing Area 16 exceed NSSP criteria for approved waters due to elevated fecal coliform levels during wet weather. The area is properly classified as prohibited to shellfish harvest.

RECOMMENDATIONS

- * Continue to monitor lower Providence River stations 16-2, 16-3, 16-4 and 16-20 under all weather conditions to evaluate potential reclassification.
- * No other actions recommended based on ambient monitoring results.

RIDEM SHELLFISH GROWING AREA MONITORING: GA16

Four prohibited-status stations in GA16 (Providence River) were evaluated under three potential management scenarios (below). Statistics shown for informational purposes only, not for compliance.

Recent 30 all weather.

(8/11/2016 or 9/2/2016to 12/1/2017; 17 wet and 13 dry, all mTEC) FECAL-GEO

Station Name	Status	N	MEAN	90 th Percentile (<31)
GA16-2	Р	30	10.1	<mark>93.1</mark>
GA16-3	Р	30	15.3	175.2
GA16-4	Р	30	13.1	90.2
GA16-20	Р	30	8.8	<mark>97.2</mark>

Recent 15 all weather.

(5/8/2017 or 5/9/2017 to 12/1/2017; 12 wet and 3 dry, all mTEC) FECAL-GEO

Station Name	Status	N	MEAN	%>CRITICAL 31
GA16-2	Р	15	15.1	33.3
GA16-3	Р	15	28.1	46.7
GA16-4	Р	15	21.0	40.0
GA16-20	Р	15	11.0	<mark>33.3</mark>

Recent 15 dry weather (<0.5" rain in previous 7 days) only. (3/30/2016to 12/1/2017, all mTEC) FECAL-GEO

Station Name	Status	N	MEAN	%>CRITICAL 31
GA16-2	Р	15	3.0	0.0
GA16-3	Р	15	3.6	0.0
GA16-4	Р	15	3.7	0.0
GA16-20	Р	15	2.4	0.0

GA16 Discussion points:

Recent fecal coliform data from stations in the lower Providence River (16-2, 16-3, 16-4 and 16-20) were evaluated under two management scenarios: Approved (recent 30 samples, all weather) and Conditionally Approved (recent 15 samples, dry (<0.5" rain prior 7 days). All four stations *exceed* criteria under the Approved scenario. The summary statistics for the recent 30 samples include 17 samples were collected during wet weather (we have biased sampling because we "storm track" response in GA16). These recent wet weather samples include 9 sets of samples following greater than 1" of rain and 5 sets of samples collected after >2" of rain in the prior 7 days (see table below). Clearly the area is impacted by wet weather, so wet weather bias in theses samples aside, management as an approved area is not appropriate.

Date	Rain (inches)	Days after
09/21/16	0.88	2.0
12/02/16	1.58	3.0
12/14/16	0.55	2.0
12/20/16	0.55	2.0
01/26/17	1.95	1.5
04/27/17	2.45	1.0
05/08/17	2.96	1.5
05/09/17	2.96	2.5
06/07/17	0.75	3.0
06/28/17	0.66	4.0
07/25/17	0.55	0.5
07/27/17	0.55	3.0
08/07/17	0.51	1.5
10/04/17	1.19	4.0
10/31/17	2.34	1.0
11/03/17	2.36	5.0
11/28/17	1.28	6.0

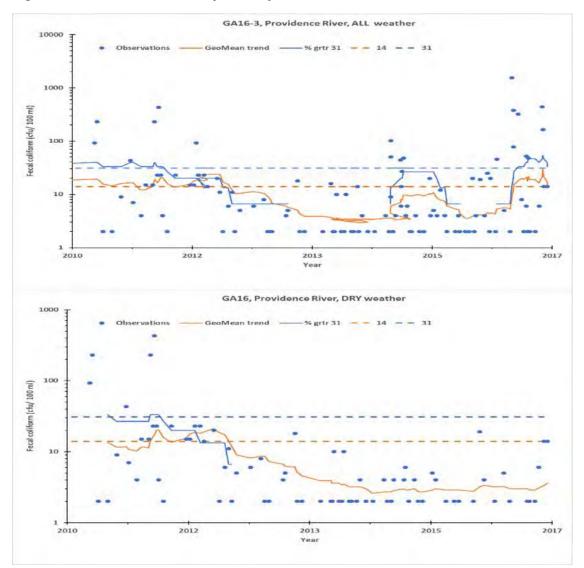


Figure 5-1 Providence River fecal coliform concentrations station 16-3

Several conditional rain thresholds were evaluated (0.5", 0.8" 1.0", 1.2", below):

Recent 15 dry weather (<0.5" rain in previous 7 days) only. (3/30/2016to 12/1/2017, all mTEC) FECAL-GEO

Station Name	Status	N	MEAN	%>CRITICAL 31
GA16-2	Р	15	3.0	0.0
GA16-3	Р	15	3.6	0.0
GA16-4	Р	15	3.7	0.0
GA16-20	Р	15	2.4	0.0

All four stations meet criteria at 0.5" in prior 7 days threshold.

Recent 15 dry weather (<0.8" rain in previous 7 days) only.
(12/20/2016to 12/1/2017, all mTEC)

	Rain					
Date	(")	Days after	16-2	16-3	16-4	16-20
12/20/16	0.55	2	2	20	10	
01/19/17	0.3	1	2	2	10	2
03/13/17	0.1	3	2	5	2	4
04/18/17	1.25	12	2	2	2	2
06/07/17	0.75	3	18	320	64	154
06/28/17	0.66	4	4	8	18	2
07/25/17	0.55	0.5	60	52	18	58
07/27/17	0.55	3	9	6	8	7
08/01/17	0.56	8				2
08/02/17	0.56	9	2	2	2	2
08/07/17	0.51	1.5	11	48	40	24
08/15/17	0.14	3	2	2	4	2
09/18/17	0.67	10	12	2	4	4
10/11/17	0.41	2	2	6	5	2
11/09/17	0.23	1	13	14	12	10
12/01/17	1.28	9	10	14	4	2
			16-2	16-3	16-4	16-20
		Count	15	15	15	15
		GeoMean	5.4	8.8	7.7	5.2
		#grtr 31	1.0	3.0	2.0	2.0
		% grtr 31	6.7	20.0	13.3	13.3

Three of four (3/4) stations exceed variability criteria at <0.8" rain in prior 7 days (above). If threshold is lowered to 0.75", only one station (16-3) would exceed criteria (data not shown; remove 6/7/17 sample from pool). This suggests that a rain threshold of near 0.5" to 0.75" in prior 7 days is required to meet criteria for conditionally approved waters. A regression analysis of GA16 supports a similar 0.5" rain threshold (figure below). Data was plotted from results obtained between August 2012 and December 2017. Rainfall is as measured at the NOAA TF Green weather station in the seven (7) days prior to sample collection. Fecal coliform in GA16 frequently exceeds the variability criteria of 31 cfu /100 ml at rainfall amounts of 0.5 to 1.0 inch of rain. This may be related to a mismatch between the rainfall measurement location (TF Green) and rainfall in the greater Blackstone River watershed. It is evident that a low rainfall threshold of ~0.5" rain (at TF Green) in prior 7 days would be required to manage the lower Providence River (GA16) as a conditionally approved shellfish harvest area.

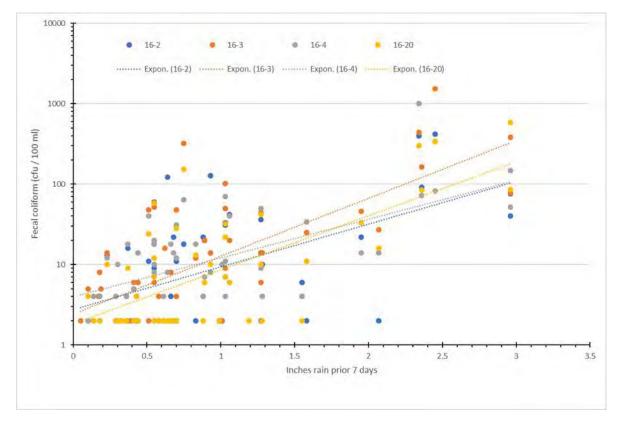


Figure 5-2 Regression analysis of fecal coliform results in response to rain

5.2 RIDEM TMDL Studies

A TMDL for bacteria has been completed and approved by EPA for the Woonasquatucket River in which stormwater has been determined to be the most prevalent source of fecal coliform bacteria loadings. The other major tributaries to the Providence River are in various stages or schedules for TMDL development.

A TMDL for the Providence River itself for fecal coliform is on schedule for completion in 2022, but compliance with the consent agreement for CSO abatement is expected to negate the need for TMDL on major tributaries.

5.3 Narragansett Bay Commission (NBC) Routine Monitoring

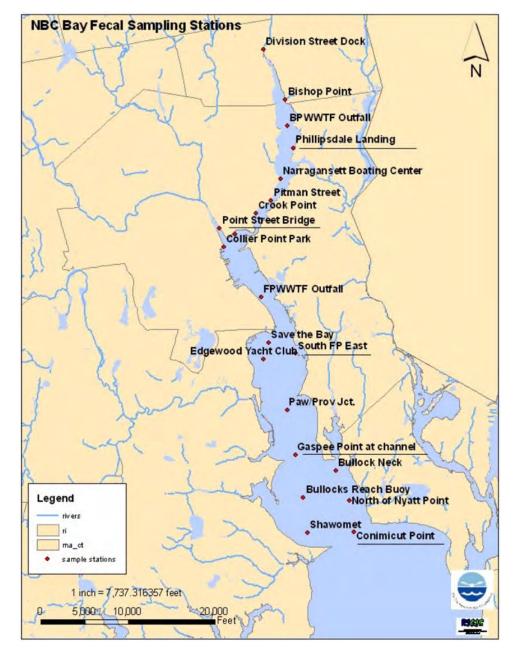
In 1980 the RI General Assembly created the Narragansett Bay Commission (NBC), in order to reduce the amount of pollutants the City of Providence's Fields Point Wastewater facility was discharging into the Bay via the Providence River and other tributaries. At that time, nearly 65 MG of untreated sewage flowed into Rhode Island's waterways every day, resulting in temporary and permanent closures of shellfishing beds, violations of federal laws, and most importantly, a serious threat to public health and the region's environmental and economic well-being. NBC took over the cities facility and turned it into an award-winning treatment facility. In 1992 NBC took over operations of the Bucklin Point WWTF in East Providence. NBC now owns and operates the two largest WWTF in the state with a combined ability to provide preliminary and primary

treatment to 316 MGD of wastewater, secondary treatment to 123 MGD and process an average dry weather flow of approximately 70 MGD (NBC).

An Environmental Monitoring Program and Data Analysis section was created within the NBC Planning, Policy and Regulation Division and is responsible for all aspects of environmental monitoring for the NBC. As part of the Environmental Monitoring and Data Analysis Section duties, the unit performs monitoring activities by conducting routine sampling in the NBC's receiving waters of the Providence and Seekonk Rivers and weekly sampling of the urban rivers for bacteria analysis. NBC has twenty (20) fixed monitoring stations in the Providence River (Figure 5-3), all located north of Conimicut Point. At these stations they collect water samples for fecal coliform on a biweekly (every two weeks) basis. All the monitoring data is available to the public through their yearly reports and on their website:

http://snapshot.narrabay.com/app/WaterQualityInitiatives/PathogenMonitoring

Figure 5-3 NBC bacteria monitoring stations



Some of the NBC stations within the providence river are equivalent to RIDEM OWR water monitoring stations. The following stations are equivalent locations:

NBC Station	RIDEM Station
Edgewood Yacht Club	GA16-13
Pawt./Prov. Junction	GA16-14
Gaspee Pt at channel	GA16-15
Bullock Reach Buoy	GA16-17
Shawomet	GA16-18
North of Nyatt Pt	GA16-19
Conimicut Point	GA16-20 or GA1-12

Table 5-1NBC Fecal results 2017 (MPN/100ml)

	Date	Geomean	Min	Max
	Division St. Dock	96	4	21,000
er	Bishop Point	87	9	46,000
Seekonk River	Off BP Outfall	131	9	15,000
nk	Phillipsdale Landing	164	9	7,500
ekc	Phillipsdale Landing Duplicate	144	9	9,300
Se	Narragansett Boating Center	101	7	9,300
	Crook Point	79	4	930
	India Point Park	89	4	4,300
	Point St. Bridge	282	23	24,000
	Collier Point Park	124	23	9,300
	Off FP Outfall	71	4	4,300
	South FP East	37	4	930
/er	Save the Bay	37	4	2,300
Riv	Edgewood Yacht Club	43	4	930
Providence River	Pawtuxet/Providence Junction	69	4	4,300
ovic	Gaspee Point	40	3	2,300
Pre	Bullock Neck	23	4	930
	Bullock Reach Buoy*	27	4	430
	Shawomet*	19	3	430
	North of Nayatt Point*	29	4	430
	Conimicut Point*	26	4	930
	Conimicut Point Duplicate	30	4	430
	Geomean of all stations	61	5	2946

The results in table 5-1 were compiled from NBC sampling data collected on a bi-monthly basis throughout 2017 during both dry and wet weather conditions. Fecal coliform levels are mostly higher in the Seekonk River compared to the Providence River because of the increased upland tributaries, CSOs and treatment plants. In all weather conditions it can be shown that the stations marked with an asterisk* within the proposed area to be upwardly re-classified are generally in compliance with the WQ variability standard of < 49 MPN/100ml for samples analyzed using the MPN method.

Additional Ongoing Monitoring Efforts

As part of the RIDEM Shellfish Programs routine monitoring of the Upper Narragansett Bay Growing Area 16 sampling runs at stations 16-2, 16-3, 16-4 and 16-20 are now routinely monitored along the same schedule as the Upper Bay Growing Area 1, in addition to targeted wet weather sampling. This initiative began in 2014 and was in support of the potential for reclassification of the lower portions of the Providence River as the predicted water quality improvements are realized due to the completion of the NBC Fields Point WWTF upgrades and the additional combined sewer overflows (CSOs) that are now being diverted to the tunnel for subsequent treatment at the WWTF.

RIDEM Fish and Wildlife performed a dredging survey in 2017 within the Providence River in order to determine the status of shellfish stock within the Providence River. This report will be essential in establishing management restrictions that may be necessary to protect the seeding resources within the Providence River if it were to be conditionally opened to shellfishing.

6.0 Interpretation of Data

6.1 Effects of Meteorological and Hydrographic Conditions

The on-going post storm monitoring and targeted wet weather sampling plans will continue as long as conditions and resources are favorable in order to focus on the targeted objectives. As discussed above, 2017 wet weather monitoring has shown bacteria levels meet approved classification requirements at < 0.5 inches of rain. During excess rain events (> 0.5") the Providence River is impacted by non-point sources, such as runoff and point sources, such as WWTF by-passes and storm drains, which can lead to unacceptable bacteria levels.

6.2 Legal Description

The current legal description of the Providence River with the entire growing area classified as Prohibited is to remain the same until additional monitoring and data analysis can be completed in support of any upward classification of these waters.

GA 16-1

All waters of the Providence River north and west of a line from the Rhode Island Department of Environmental Management pole located on Conimicut Point (Latitude: 41⁰ 43' 2.93" North, Longitude: 71⁰ 21' 27.68" West) to the center of the Old Tower at Nayatt Point including any tributaries north of this line

6.3 Recommendations

The current monitoring schedule is adequate for maintaining the current classification as prohibited. However, continued wet weather monitoring at the frequency of conditional growing areas is recommended at stations located in the lower section of the Providence River (16-1, 16-2, 16-3, 16-4, 16-5, 16-13, and 16-20) where potential re-classification may occur. The addition of two more routing monitoring stations 16-2A and 16-21 will also be sampled at the increased frequency to help better define the impacts from shoreline sources in support of the potential upward reclassification of these river waters.

6.4 Conclusions

Currently there are no recommendations to change the classification of this growing area from prohibited. Additional data collection, analysis and interpretation of results must be completed before any upward reclassification could be considered and the final configuration of waters determined.

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Mt. Hope Bay

Growing Area 17 Triennial Re-Evaluation

Calendar Year 2017



Photo courtesy of the Town of Bristol, RI

Rhode Island Department of Environmental Management Office of Water Resources Shellfish Program



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1.0 Introduction

A 12-year shoreline survey of Mount Hope Bay was conducted during August of 2014 by staff from RIDEM's Office of Water Resources Shellfish Program. The survey involved a shoreline reconnaissance of the study area to locate and catalog pollution sources and collect bacteriological samples from all sources actively flowing into the survey area.

This 2017 shoreline survey was conducted as a triennial re-evaluation of this growing area. As such, the survey involved review of previous shoreline surveys including bacteriological sampling of actual pollution sources noted in previous surveys that were found to be equal to or greater than 240 FC/100ml and identification of any new sources of pollution if applicable. These previously identified pollution sources were re-evaluated to determine their bacteriological impacts on Mount Hope Bay.

The Mount Hope Bay - Growing Area 17 is presently managed on a conditionally approved or prohibited status. There are 16 routine monitoring stations located throughout the growing area between the state line of Massachusetts to the north and the Bristol Point / Arnold Point line and the Sakonnet River Bridge line to the south. This management runs concurrently with the conditionally approved Kickemuit River that discharges into the northwestern corner of Mt. Hope Bay.

2.0 Description of Growing Area

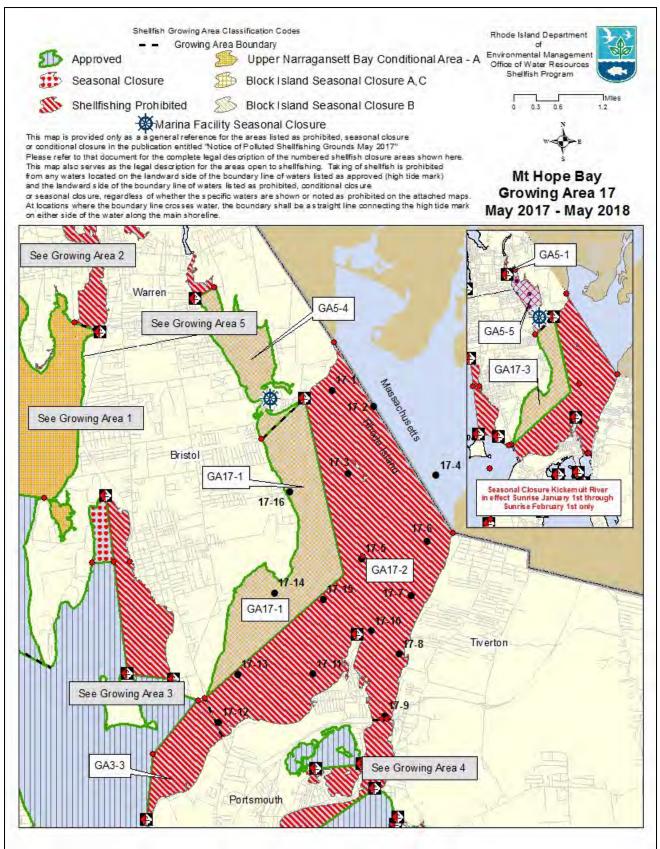
Mt. Hope Bay forms the northeast corner of Narragansett Bay, lying within both Rhode Island to the south and west and Massachusetts to the north and east. The southwest limit of the growing area is bounded to the southwest by a line from Bristol Point to the Hog Island Shoal light, to the southwestern extremity of Arnold Point in Portsmouth. The southeast limit is the Sakonnet River Bridge. The northwest limit abuts the Kickemuit River Growing Area (GA-5) at the mouth of the river, and the northeast limit is the state line between Rhode Island and Massachusetts. Mount Hope Bay adjoins the East Passage of Narragansett Bay where the Mt. Hope Bridge crosses between Bristol and Portsmouth. There are five major freshwater inputs to the Bay. The Taunton River is the largest and includes the Quequechan River, which discharges into the Bay from the north along with the smaller Kickemuit, Cole and Lee Rivers.

Growing Area 17 is presently comprised of sections classified as either prohibited or conditionally approved for shellfishing (Figure 2-1). This divide in classification runs generally north to south with the conditionally approved area being along the western shoreline. The prohibited area has been established as a closed safety zone due to the Fall River WWTF discharges, while the conditional area is managed as a rainfall triggered closure with 0.5" of rain or greater requiring a minimum 7-day closure. The precipitation that initiates these shellfishing closures can be in the form of rain and/or snowmelt. All precipitation totals are based on the total accumulation during any consecutive 24-hour period (24 hr. total) as recorded at the NOAA Taunton weather station. This area is managed along with the Kickemuit River, Growing Area 5.

The following information describes the physical geography of this growing area.

Area of Shellfishing Prohibited in Mt. Hope Bay	4246.8 acres		
Area of Conditionally Approved waters	1508.4 acres		
Longest reach	5.0 miles		
Widest reach	2.6 miles		
Deepest point	75 feet		

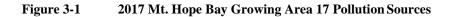




3.0 Pollution Source Surveys

Katherine Rodrigue and Anna Gerber-Williams, Marine Biologists of the RIDEM Office of Water Resources Shellfish Program, coordinated and conducted shoreline sampling of Mount Hope Bay. The subsequent review of the findings and report were compiled by Katherine Rodrigue. The sampling took place on October 17 and November 2 of 2017. The most recent 12-yr shoreline sanitary survey was conducted in 2014.

This shoreline survey was conducted as a triennial re-evaluation of this growing area. As such, the survey involved review of previous shoreline surveys and sampling of actual pollution sources with bacteriological results greater than 240 FC/100ml as well as identification of any new sources of pollution if applicable (Figure 3-1) that discharged to conditionally approved waters. There were four sources identified from previous surveys that required follow-up sampling. The results are presented in Table 3-1.



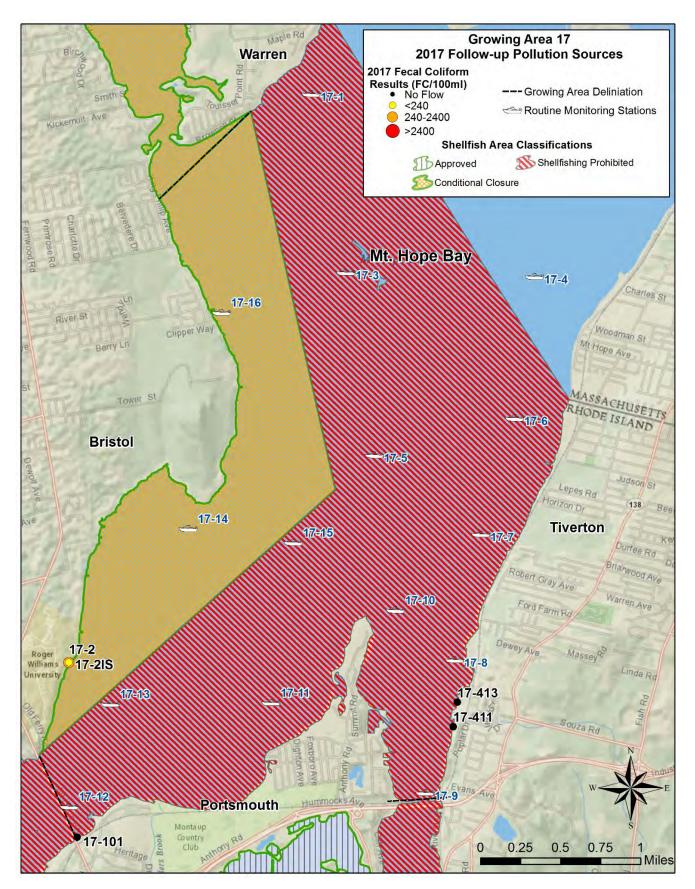


Table 3-1Summary of 2017 Results

*Highlighted sources >240 CFU/100ml. NF=No Flow. DNE= Does not exist

Source ID	Survey Date	Latitude	Longitude	Description	Actual/ Potential	Direct/ Indirect	Max FC Result	Max FC Year	2017 FC Result	2017 Volumetric Flow (cfs)
17-2	11/2/2017	41.65152	-71.25602	Stream from detention basin thru apartment complex	A	D	430	2008	700/818	Trickle/0.085
17-2IS	11/2/2017	41.65152	-71.25602	In stream					200	
17-413	10/17/2017	41.6478	-71.2092	48" dia outfall at condo complex	А	D	800	2014	NF	0
17-411	10/17/2017	41.6456	-71.2097	Drainage swale from wetland. In 2017, could not find/no longer exists.	А	D	430	2014	DNE	0
17-101	10/17/2017	41.6357	-71.2551	Drainage swale along property ROW. In 2017, could not find/no longer exists.	А	D	350	2014	DNE	0

Of the four sources revisited for this triennial survey, three exhibited no flows at the time of sampling. Two of these were either completely dry or no longer exist (sources 17-411 and 17-101, both drainage swales). The remaining source, 17-2, is a stream that runs from a detention basin through an apartment complex on the Roger Williams University campus. It was initially sampled on 10/17/2017 with FC results of 700 CFU/100ml and flowing at only a trickle. Because of the elevated bacteriological results, it was resampled on 11/2/2017. It again showed high bacteria levels, with a result of 818 CFU/100ml and a slightly higher flow of 0.085 ft³/s. A sample was also taken just beyond the end of the stream, with results of 200 CFU/100ml. The initial sample was taken during dry weather, however the follow-up sample on 11/2/2017 was taken during wet weather when the conditionally classified receiving waters were closed (3 days after a 2.63" rain event) (Table 3-3). This would likely have been the reason for the slightly higher flow and bacteria levels. Despite this, the in-stream sample was not incredibly elevated (below the 240 CFU/100ml criteria for triennial resampling) and so dilution is occurring. In addition, the closest routine monitoring station (station 17-13, Figure 3-1) is in compliance for conditionally approved areas, despite being located in prohibited waters (Table 6-1). Because of these considerations, it does not seem that this source is adversely impacting the receiving waters of the growing area. No reclassification is recommended. The source will be resurveyed in dry weather open conditions as part of the 2020 Triennial Evaluation.

Figure 3-2 Source 17-2



4.0 Mooring Fields and Marinas

There are two marinas located along the northeastern shore of Portsmouth within a prohibited portion of Mount Hope Bay growing area. There are approximately 400 slips for a variety of vessels at these two marinas. There is a pump out facility located at the larger of the two marinas (Brewer's Sakonnet Marina) that services the marine sanitation devices on these boats. The two marinas are also located within the prohibited area and the impacts from boater pollution would not affect the classification of this portion of the growing area.

5.0 Wastewater Treatment Facilities (WWTF)

There are several sanitary discharges from wastewater treatment plants in the Massachusetts portion of the watershed to Mt. Hope Bay. The plants closest to the growing area are the Somerset Sewer Treatment Plant and the Fall River Wastewater Treatment Plant. These sources have the potential to have a significant impact on the status of the growing area should failure in treatment occur at any of these facilities and the required closed safety zones are the main impediments to shellfishing in these waters. Consequentially, the majority of Mount Hope Bay is classified as "Prohibited" in which shellfishing is not allowed. This prohibited area, primarily along the eastern and southern sides of the bay, was determined to be a necessary closure in the case of a WWTF failure after the completion of a hydrographic time of travel dye study in November 1989 (RIDEM 1989). The remainder of the bay (approximately the westerly third) is operated as a conditionally approved area, with closures dependent upon rainfall or snowmelt events of 0.5" or greater, necessitating a temporary closure of these waters for a minimum of seven days. This precipitation closure procedure is outlined in more detail in the areas CAMP.

An additional hydrographic dye study was completed in cooperation with FDA in 2013 and 2014 that assessed both the Fall River and Somerset WWTF impacts on this growing area. The final report was completed by FDA in June of 2017. The recommendations for management of this conditionally approved harvest area that are contained within this recently completed report will be assessed during the 2018 annual review.

In January 2018, an emergency 21-day closure of shellfishing waters in Mount Hope was implemented due to a sanitary sewer overflow in Bristol, RI. The overflow was a result of a break in the sewer line caused by work done on a water main in the same vicinity on 1/5/2018. Town officials were not made aware of the overflow until 1/24/2018 and DEM was notified immediately. Repairs to the sewer line were made the morning of 1/25/2018. The overflow resulted in approximately 265,000 gallons of untreated sewage entering a stream and discharging into the conditionally approved portion of the growing area during this time (Figure 5-1). Due to numerous rain and snowmelt events, the area had been closed for much of the month of January, from sunrise on 1/13/2018 until sunrise on 1/20/2018, and again on sunrise 1/24/18, and extending the closure until February 15, 2018 due to the SSO event (resulting in a full 21-day closure). The RI Department of Health verified that no shellfish product from these waters entered the market. Adjacent Massachusetts waters were also closed to shellfishing during the time period of the overflow, and no commercial shellfish product entered the MA market.

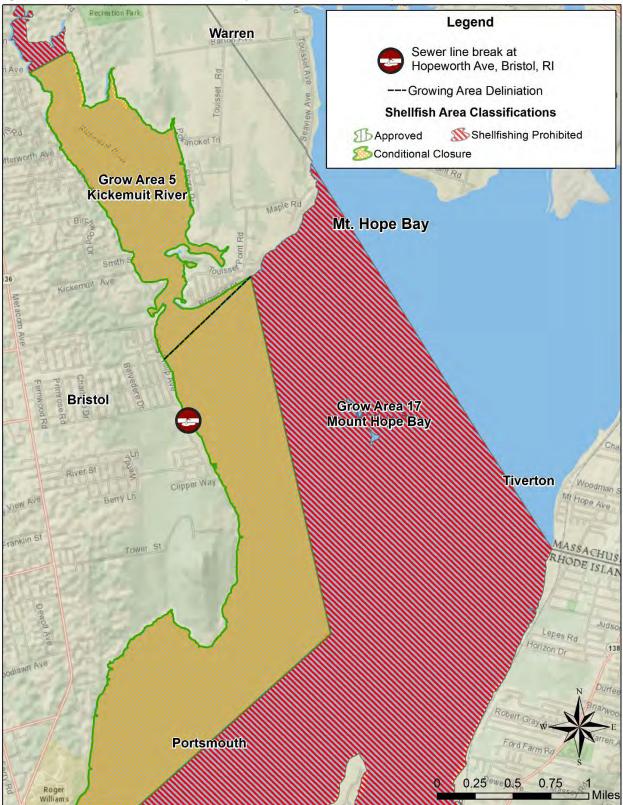


Figure 5-3 Location of Bristol Sanitary Sewer Overflow January 2018

6.0 Poisonous and Deleterious Substances

Poisonous and deleterious substances are contaminants that can include metals, organic chemical compounds (such as pesticides, PAHs, and PCBS) and natural toxins that when released into the environment can cause degradation of habitat and harmful effects on organisms. These compounds can enter waters through runoff, industrial discharges, fossil fuel and waste burning, mining and ore processing, toxin-releasing organisms such as phytoplankton, and agriculture (Kimbrough et al. 2008).

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM August 2017.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the conditionally approved waters of Mount Hope Bay due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

7.0 Water Quality Studies

The Shellfish Growing Area Monitoring program is part of the state of Rhode Island's agreement with the United States Food and Drug Administration's National Shellfish Sanitation Program (NSSP). The purpose of this program is to maintain national health standards by regulating the interstate shellfish industry. As part of this agreement, the state of Rhode Island is required to conduct continuous bacteriological monitoring of the shellfish harvesting waters of the state in order to maintain certification of these waters for shellfish harvesting for direct human consumption.

In 2008, the western portion of Growing Area 17 was re-classified as a conditionally approved area and closed for 7 days following a 0.5" or greater rainfall within a 24-hr period. Water quality monitoring is conducted on a monthly sampling regime during dry weather conditions when the conditionally approved portions of the growing area are in the open status.

All samples are collected at a depth of 1-2 feet below the water's surface using 4-ounce Nalgene bottles. The samples are then stored in a portable cooler at a temperature of approximately 4 degrees Celsius. Upon completion of the monitoring run, samples are transported to the RIDOH laboratories in Providence for analysis. The mTEC method as described in *Standard Methods for the Examination of Water and Wastewater* (APHA 1999) is used to analyze the samples. The data is compiled and reviewed according to NSSP requirements stating that at least the most recent 15 data sets be used. Table 6-1 demonstrates the areas ability to conform to NSSP statistical criteria.

Figures 2-1 and 3-1 show the locations of these monitoring stations within the Mt. Hope Bay Growing Area 17.

Figure 7-1 RIDEM Shellfish Growing Area Monitoring Results

RIDEM SHELLFISH GROWING AREA MONITORING: GA17

Recent 15 when open.

(8/19/2016 to 12/19/2017, all mTEC, all dry weather)

		FECAL-GEO				
Station Name	Status	N	MEAN	%>CRITICAL 31		
GA17-1	Р	15	2.8	0.0		
GA17-2	Р	15	4.5	6.7		
GA17-3	Р	15	4.1	6.7		
GA17-4	Р	15	3.1	0.0		
GA17-5	Р	15	2.5	0.0		
GA17-6	Р	15	2.4	0.0		
GA17-7	Р	15	2.8	0.0		
GA17-8	Р	15	2.1	0.0		
GA17-9	Р	15	2.3	0.0		
GA17-10	Р	15	2.4	0.0		
GA17-11	Р	15	2.2	0.0		
GA17-12	Р	15	3.1	0.0		
GA17-13	Р	15	2.8	0.0		
GA17-14	CA	15	2.5	0.0		
GA17-15	Р	15	2.5	0.0		
GA17-16	CA	15	3.5	0.0		

HIGHLIGHTS

- * Mt. Hope Bay (Growing Area 17) was sampled ten (10) times during 2017.
- * For conditionally approved stations, statistics represent recent 15 samples when area was open during 8/19/2016 to 12/19/2017.
- * Prohibited station summary statistics calculated for informational purposes only.
- * All conditionally approved stations are in program compliance.
- * All samples analyzed by mTEC method.
- * Data run 1/12/2018.

COMMENTARY

Mt. Hope Bay (Growing Area 17) was sampled ten times during 2017, with no samples collected during the months of January, March, June and September of 2017. Several factors contributed in the 2017 reduction in monthly sampling. Frequent rain fall exceeding the 0.5" closure threshold kept the growing area in the closed status for all but one day of January 2017, and for all but three weekdays of June and September of 2017. Cold weather and a HAB outbreak which occupied

Shellfish Program staff for much of March 2017 prevented sampling during that month. Two samples per month (one early- and one late- in the month) were collected during August and November 2017 to offset the missed sampling opportunities. Summary statistics represent the 15 most recent samples collected during 8/19/2016 to 12/19/2017 when Growing Area 17 was open.

Sixteen (16) stations are sampled in Mt. Hope Bay, with two stations classified as conditionally approved, and the remainder classified as prohibited because they are located in the closed safety zone surrounding the waste water treatment facility discharge for the city of Fall River, MA. The 2017 review demonstrated that both conditionally approved stations (17-14 and 17-16) in the Mt. Hope Bay (Growing Area 17) meet criteria and are in program compliance. The area is properly classified.

RECOMMENDATIONS

- * No other actions recommended based on ambient monitoring results.
- * Review recent FDA dye study report recommendations

The CAMP for the Mount Hope Bay was re-evaluated during this survey although the current program document is outdated the monitoring and management actions are current and the sampling and management of closures of this area are in compliance with the management plan as currently written. The CAMP document is scheduled to be updated prior to the end of 2018 to incorporate recommendations from the 2017 FDA PEER review.

8.0 Conclusions and Recommendations

This triennial update of the Mount Hope Bay (Growing Area 17) reevaluated several point sources in the study area. However, none of the sources appear to have any negative impacts on the ambient receiving waters in the areas that are conditionally approved during open conditions. The area shall be classified as "Conditionally-Approved /Prohibited" with wet weather operational closure triggers as established in the current management plan for this area.

Due to the insignificant amount and impact of sources reevaluated during the triennial update of Mount Hope Bay, and the water quality statistical evaluation of the growing area, no changes in growing area classification are recommended. The results of this update, combined with previous water quality statistical evaluations of Mount Hope Bay, indicate that the survey area conforms to all requirements set forth by the National Shellfish Sanitation Program (NSSP) and is properly classified. No changes for reclassification are recommended at this time. The next 12-year shoreline survey is scheduled for 2026.

9.0 References

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