PARSONS CREEK WATERSHED
WATER QUALITY REPORT

November 2018

PREPARED FOR

Town of Rye
10 Central Road
Rye, NH 03862

PREPARED BY

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TRACKING FECAL CONTAMINATION

Current Tools and Challenges

STATEWIDE FECAL CONTAMINATION ISSUE

Surface waters near developed areas are impacted by fecal contamination from polluted stormwater runoff, malfunctioning septic systems, pet, livestock, and wildlife waste, leaky sewer lines, and other aging infrastructure on residential, municipal, and commercial properties. The State of New Hampshire lists over 300 river and estuarine segments as impaired for fecal indicator bacteria (FIB). These impaired waterbodies are particularly concentrated in the populated Seacoast Region. This fecal contamination generates a significant threat to water quality, public health, and the local economy.

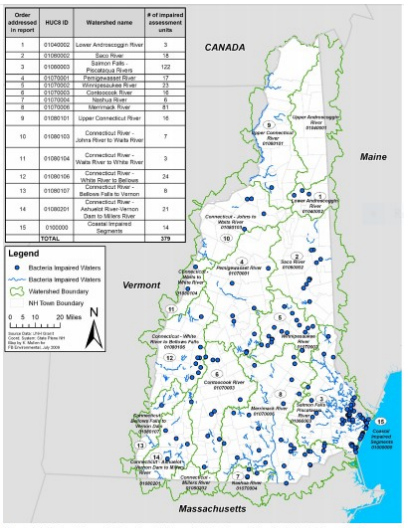
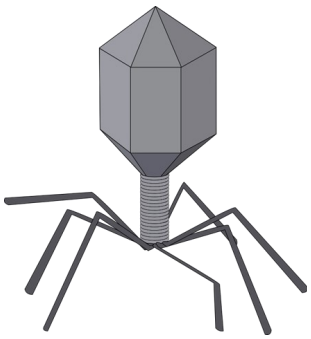


Figure 1-1: Map of Bacteria Impaired Waters in New Hampshire, by HUC 8 Watershed.

TRACKING FECAL SOURCES IS DIFFICULT

Monitoring, tracking, and managing pathogens in fecal matter is extremely difficult, particularly when fecal indicators (e.g., *E.coli,* Enterococci, or fecal coliform) are also highly variable to track and measure. FIB are used to detect fecal contamination and the pathogens associated with fecal matter in surface waters. Previous studies of beaches impacted by point sources of sewage discharge found a significant correlation between FIB and the probability of gastrointestinal (GI) illness in swimmers. However, there are some limitations to using FIB to track pathogens in fecal matter. Bacteria and viral pathogens react differently in the natural environment, so that external factors (temperature, sunlight, proliferation, etc.) may influence the concentration of FIB, but not the viral pathogens of interest for protecting public health. In addition, laboratory analysis of FIB can be highly variable due to the biological nature of the bacteria. For instance, laboratory and field duplicates can vary up to 200% or more, particularly at lower concentrations. As such, bacteria results should not be interpreted as absolute numbers, but as a rough estimate of concentration. New indicators are currently being tested that help address these issues, but until then current FIB must be interpreted with some caution when determining its actual threat to public health.



Designed by L. Diemer, FBE
Graphic credit: OpenClipArt

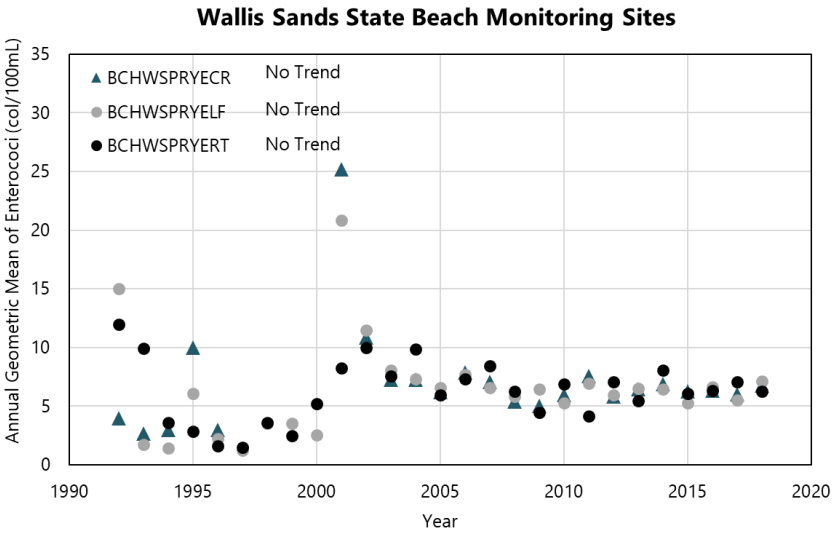
BEACH MONITORING

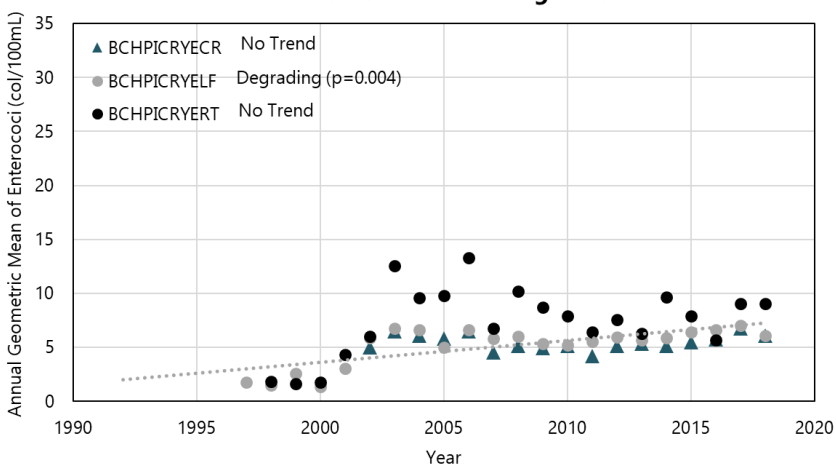
Wallis Sands State Beach and Wallis Beach, Rye, NH

NHDES BEACHES PROGRAM

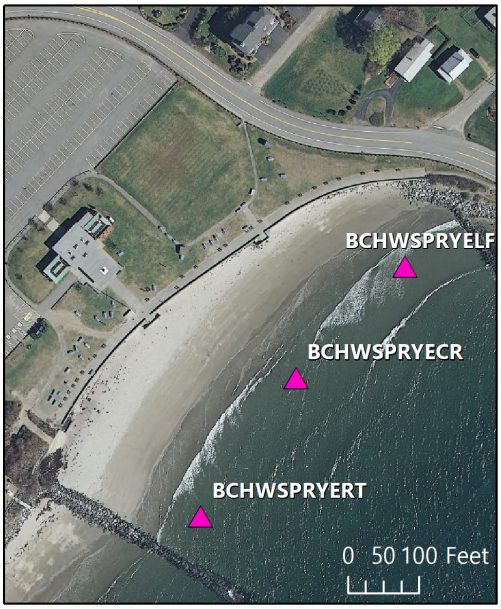
NHDES conducts regular sampling of freshwater and coastal beaches and issues advisories if FIB counts exceed water quality criteria established for the protection of public health. The annual geometric means for the six monitored beach sites were well within acceptable limits for NHDES water quality criteria. One site (BCHPICRYELF) showed a statistically-significant degrading trend from 1997-2018. A beach advisory was issued for both Wallis Sands State Beach and Wallis Beach from 7/25-7/26/2017. This was the first advisory for Wallis Sands State Beach and one of six total advisories for Wallis Beach (other advisory years included 2014, 2010, 2009, 2008, and 2006). FIB counts were especially elevated (>1,000 mpn/100mL) at three of the six sites (BCHWSPRYERT, BCHPICRYELF, and BCHPICRYECR) on 7/25/2017. Wallis Beach was also issued a seventh advisory from 8/24-8/29/2018 following a elevated FIB count of 134 mpn/100mL at BCHPICRYELF.

Wallis Sands State Beach and Wallis Beach were issued a swimming advisory in July 2017, the first ever or since 2014, respectively. Wallis Beach was issued a swimming advisory again in August 2018.

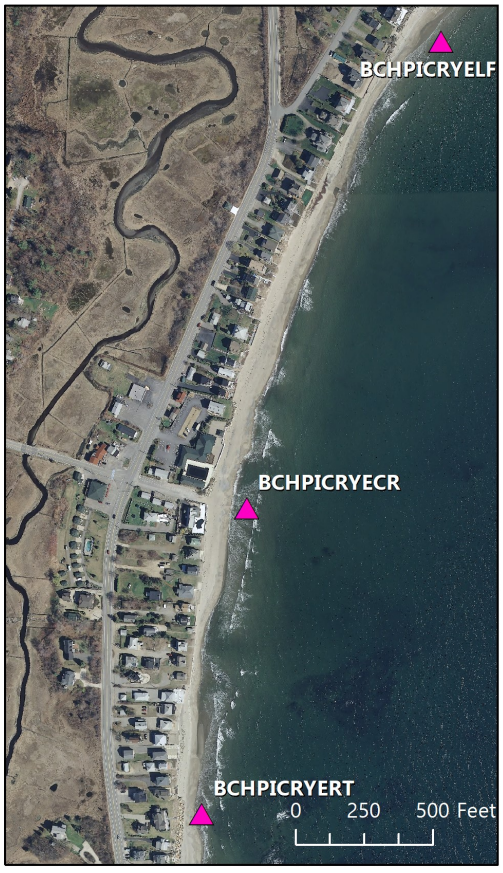




Wallis Sands State Beach



Wallis Beach



WATERSHED MONITORING

Parsons Creek, Rye, NH

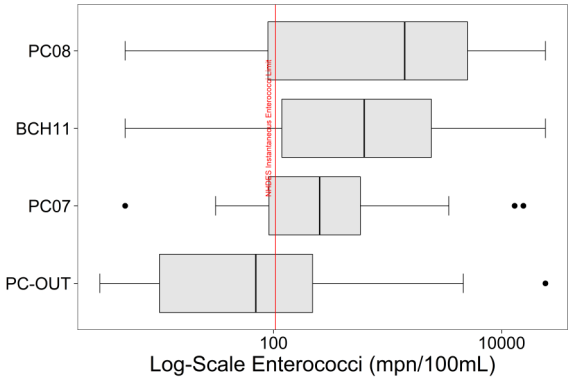
WATERSHED MONITORING

Four sites (PC07, PC08, BCH11, and PC-OUT) within the Parsons Creek watershed were sampled for Enterococci six times at low tide during wet and dry weather conditions from June through September 2018. These sites showed historically-elevated levels of Enterococci for multiple years and hit for human fecal contamination by either ribotyping or canine detection or both. The Town of Rye has identified several septic systems in failure within the watershed, which may be contributing to elevated levels of Enterococci at these sites.

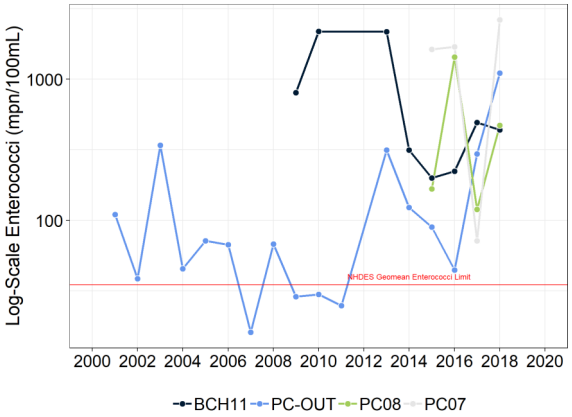
All sites exceeded the state criterion for geometric mean (35 mpn/100mL) in 2018. All but two samples (during dry weather) at two sites (PC07 on 6/13/18 and BCH11 on 8/27/18) surpassed the state criterion for instantaneous level (104 mpn/100mL) in 2018. Refer to Appendix A for data and Appendix B for methods.

Similar to previous years, fecal indicator bacteria counts exceeded state criteria at multiple locations in the upper east branch of Parsons Creek (PC07, PC08, BCH11). Fecal indicator bacteria counts measured at the outlet (PC-OUT) were especially high in 2018 compared to historic levels.

Advisory sign posted at the Parsons Creek outlet. Photo Credit: FBE.



All data (2001-2018) distribution for the four sites monitored in 2018. Sites ordered from highest to lowest median value.

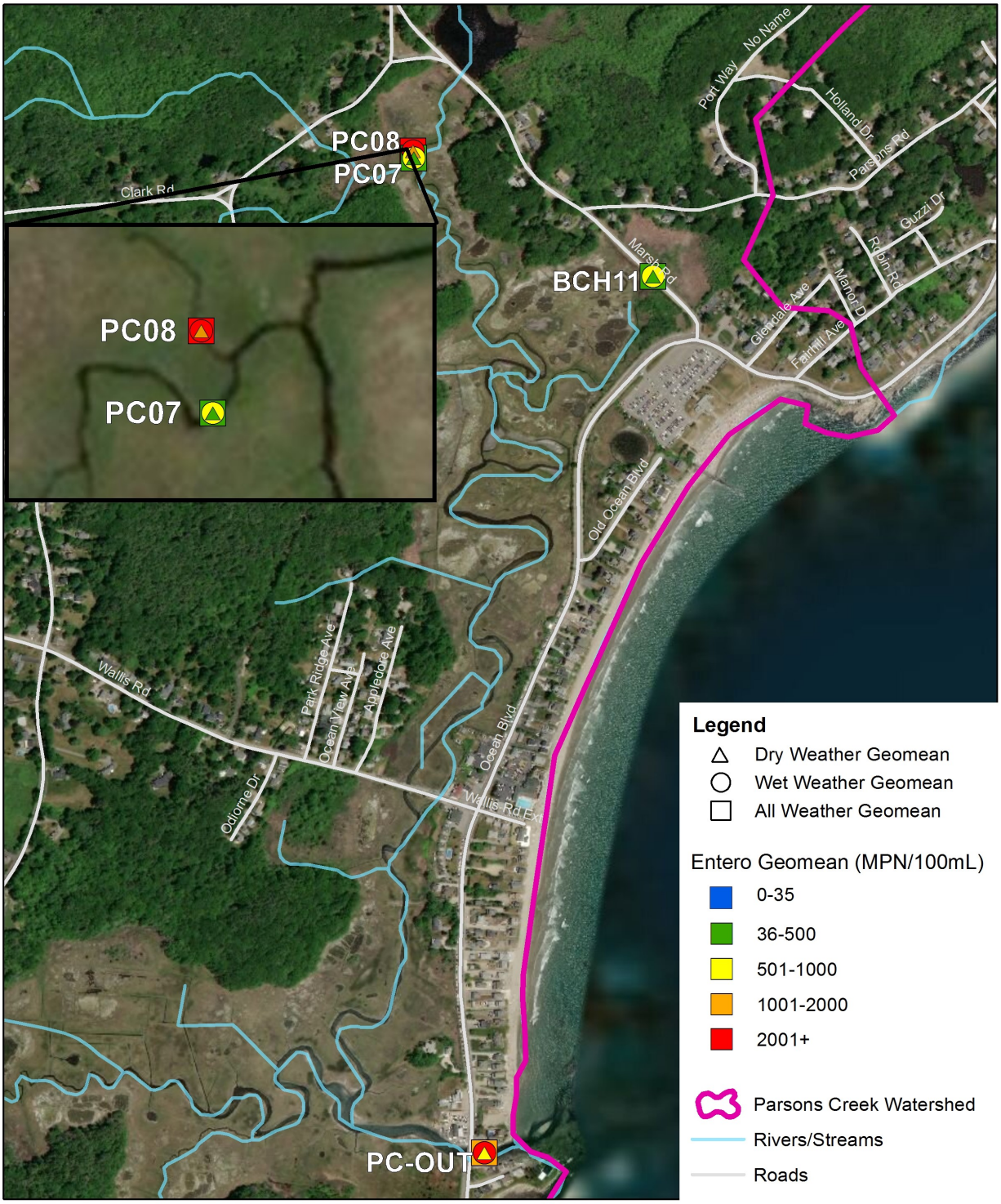


Annual geometric mean for the four sites monitored in 2018.

View of the upper east branch of Parsons Creek near PC07 and PC08. Photo Credit: FBE.

WATERSHED MONITORING

Parsons Creek, Rye, NH



2018 Water Quality Results
Parsons Creek, Rye, NH

0 0.25 0.5 Miles

N

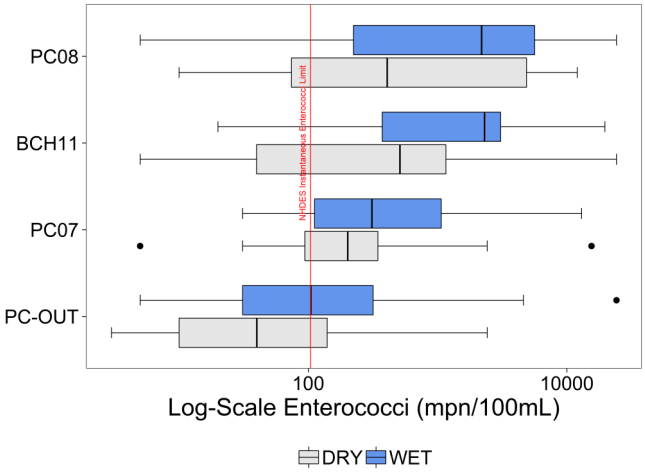
Source: New Hampshire GRANIT, FB Environmental, ESRI, Watershed Area from NHDES. Projection: NAD 1983 New Hampshire State Plane FIPS 2800. Created by FB Environmental (C. Bunyon), November 2018

WET/DRY WEATHER ANALYSIS

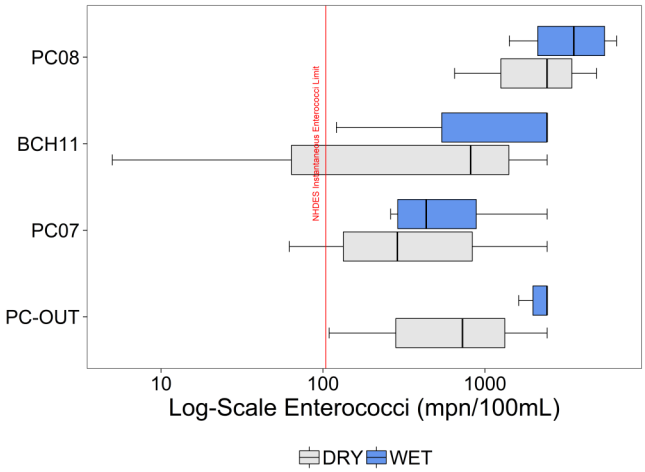
Similar to historical patterns, wet weather in 2018 generated higher counts of Enterococci in surface waters compared to dry weather (though the geometric mean was exceeded during both wet and dry weather at all sites), suggesting that the sources of fecal contamination were largely from surface runoff (i.e., stormwater). However, during significant rain events (several inches) and spring tides, the water table may rise and intercept leachfields, which flush out fecal contamination in groundwater to nearby waterbodies.

Historically and in 2018, fecal indicator bacteria counts exceeded state criteria during both wet and dry weather , suggesting that both stormwater runoff and groundwater are significant sources of contamination to Parsons Creek and the beach. The low-lying topography and high groundwater table in the watershed make leachfields susceptible to malfunction, which is likely the primary source of fecal contamination in the watershed and at the beaches.

PC-OUT during dry (top) and wet (bottom) weather . Photo Credit: FBE.



All data (2001-2018) distribution for the four sites monitored in 2018 by weather condition (dry and wet).



2018 data distribution for the four sites monitored in 2018 by weather condition (dry and wet).

WATERSHED MONITORING

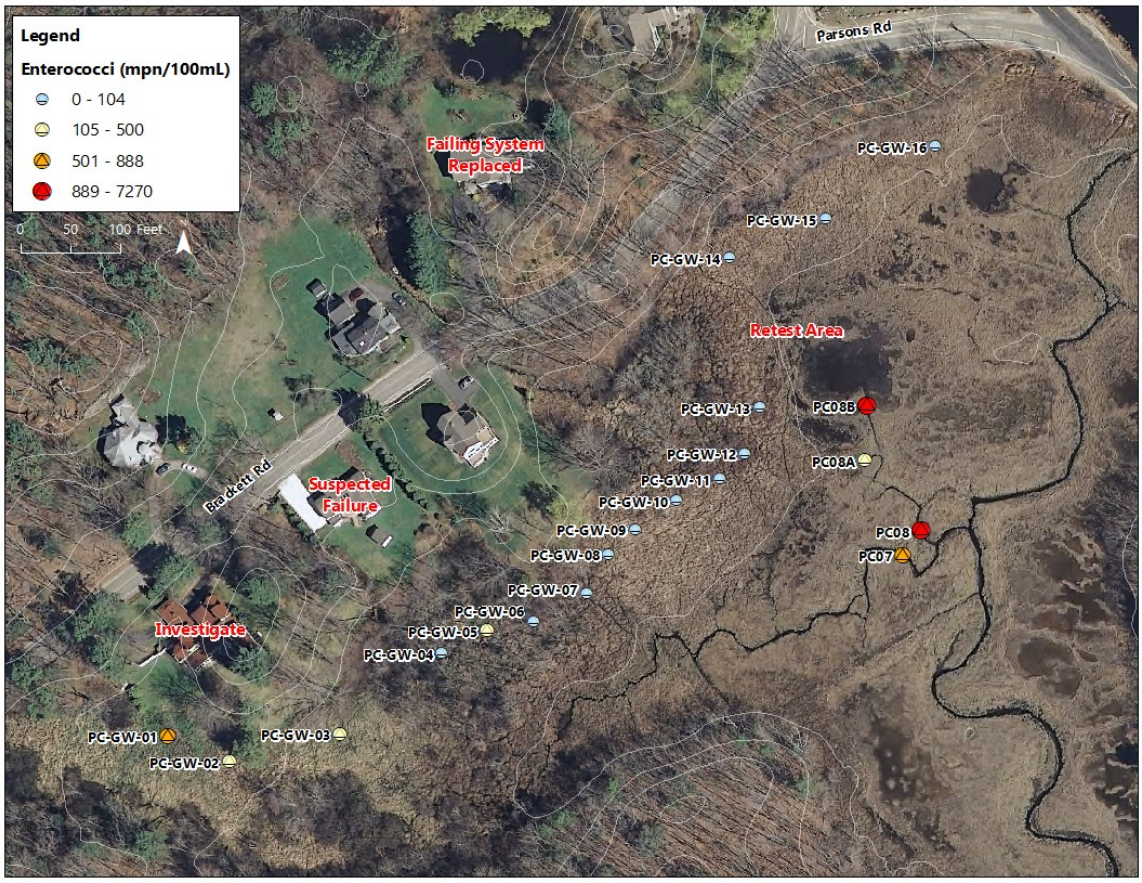
Parsons Creek, Rye, NH

GROUNDWATER TESTING PILOT STUDY

FBE conducted a groundwater testing pilot study of the marsh area draining to two historical hotspot sites: PC07 and PC08. On 9/12/18 following a moderate storm event (1.19 inches over 14 hours), FBE collected 16 groundwater samples along the marsh fringe bordering homes along Brackett Rd, along with 4 surface water samples for a total of 20 samples. Samples were analyzed for Enterococci, nitrate-nitrite, and phosphate - parameters that can be used as indicators of fecal contamination, which is suspected to be from malfunctioning septic systems in the study area.

Eight (8) of the 20 sites exceeded the state instantaneous limit of 104 mpn/100mL (PC-GW-01, PC-GW-02, PC-GW-03, PC-GW-05, PC07, PC08, PC08A, and PC08B). PC08 and PC08B, which flows into PC08 from a large marsh pool, were especially elevated at 6,488 and 7,270 mpn/100mL, respectively. Groundwater samples collected along the marsh fringe draining to the large marsh pool did not show any indication of fecal contamination. We recommend that the area around the large marsh pool be retested to determine whether the elevated fecal indicator levels are from wildlife or possibly remnant from a failing septic system that was recently replaced on a property draining to the large marsh pool. One home on Bracket Rd that was suspected to have a failing septic system did not reveal conclusive results from the groundwater testing. PC-GW-05 showed slightly elevated Enterococci; PC-GW-04 and PC-GW-07 showed slightly elevated nitrate-nitrite; and PC-GW-06 showed elevated phosphate at 508 ppb (the highest measured concentration in the study). No one site potentially impacted by the suspected failure had multiple indicators of fecal contamination that would confirm fecal contamination. One home to the south of the suspected failure showed elevated Enterococci at PC-GW-01 at 888 mpn/100mL (the highest measured groundwater concentration in the study) and elevated phosphate at PC-GW-02 at 410 ppb (the second highest measured concentration in the study). We recommend that the septic system of this home be professionally evaluated for proper functioning.

Overall, the fecal indicators used in the groundwater testing pilot study did not definitively confirm any hotspots of human fecal contamination, but at least two areas require follow-up to exclude the possibility of contamination by malfunctioning septic systems.



Groundwater sample extraction in the Parsons Creek marsh. Photo credit: FBE.

SUMMARY

Snapshot of Results

Overall, the Town of Rye, the NHDES Beaches Program, the NHDES Watershed Assistance Section, the NH Shellfish Program, FB Environmental Associates, the Jackson Laboratory, and Environmental Canine Services have done a considerable amount of work to track sources of fecal contamination in both surface water and groundwater within the Parsons Creek watershed and along the beach. This work has generated a long-term dataset for analysis and interpretation for determining next steps in dealing with this issue. A summary of results is provided below.

Beach Results

⇒ Elevated FIB counts were measured at the beach following a storm event on 8/22/18 (1.1 in); this led to a 5-day beach advisory from 8/24-8/29/18 at Wallis Beach, the second year in a row after a three-year lull. Historical results have shown the critical connection between Parsons Creek water quality and protection of public health at the beach.

⇒ The Town of Rye posted an advisory at the Parsons Creek outlet for the 2018 summer season as a precaution for beach-goers, regardless of weather condition or state-issued advisories.

Watershed Monitoring Results

⇒ Elevated FIB counts continue to be measured in Parsons Creek. Historical investigations by human waste tracking canines showed that human fecal contamination is a diffuse problem throughout the watershed due to the area's low-lying topography and high groundwater table that likely intercept leachfields on a regular basis during storm events and/or spring tides. Even if a high water table is not the issue, sandy soils would allow for fast percolation rates of contaminated leachfield water to groundwater and ultimately surface waters without adequate treatment of pathogens.

⇒ As part of the new health regulation, several septic systems near or contributing to the area around these hotspot sites have been found to be malfunctioning and possibly contributing to human fecal contamination in Parsons Creek.

⇒ FIB counts were especially elevated in 2018 compared to historical levels at the Parsons Creek outlet.

Wet/Dry Weather Analysis

⇒ Historically and in 2018, FIB counts exceeded state criteria during both wet and dry weather, suggesting that both stormwater runoff and groundwater are significant sources of fecal contamination to Parsons Creek and the beach.

Groundwater Testing Results

⇒ Overall, the fecal indicators used in the groundwater testing pilot study did not definitively confirm any hotspots of human fecal contamination, but at least two areas require follow-up to exclude the possibility of contamination by malfunctioning septic systems.

NEXT STEPS

Recommendations and Priorities

Address groundwater sources of fecal contamination

⇒ Update the septic system database on a regular basis.

⇒ Continue to enforce the septic system health regulation that requires pump-outs every 3 years.

⇒ Continue evaluation of individual properties for septic system functioning near hotspots.

- Evaluate the proper functioning of the septic system at 290 Brackett Rd.

⇒ Consider incorporating stricter guidelines for septic system replacement or installation to town ordinances.

⇒ Consider a town sewer system to connect homes in low-lying areas along the marsh and beach.

Address surface runoff sources of fecal contamination

⇒ Continue to locate candidate sites for BMP implementation to address stormwater runoff.

⇒ Continue to secure funding that implements these candidate BMP sites.

⇒ Continue to track and monitor existing BMP conditions and fix or improve sites, as necessary.

⇒ Maintain installed pet waste signs.

Enhance public outreach program

⇒ Continue to post and maintain an advisory at the beach.

⇒ Continue to distribute educational materials and reports to the public via the Town's website.

⇒ Continue to educate homeowners on proper disposal of pet waste and maintenance of septic systems.

⇒ Continue regular meetings with the Parsons Creek Water Quality Committee.

Continue monitoring program

⇒ Continue water quality sampling throughout the Parsons Creek watershed under varying weather conditions to track changes in FIB over time, especially as failing septic systems are replaced.

⇒ Expand sampling program by including co-indicators along with FIB to better pinpoint human sources of fecal contamination. Co-indicators include optical brighteners and inorganic nutrients present in human wastewater.

⇒ Complete a groundwater testing study of the marsh area draining to BCH11.

⇒ Retest the area around the large marsh pool to determine whether the elevated fecal indicator levels are from wildlife or possibly remnant from a failing septic system that was recently replaced on a property draining to the large marsh pool.

⇒ Consider updating the 2011 Parsons Creek Watershed Management Plan.

APPENDIX A

2018 Watershed Monitoring Data

Date	Dry/Wet	Site ID	Water Temp (°C)	DO (%)	DO (ppm)	Cond (mS/cm)	Salinity (ppt)	Entero (mpn/100mL)
6/13/2018	Dry	BCH11	15.8	***12.5***	1.0	47.9	31.0	***816.4***
6/13/2018	Dry	PC07	16.4	***40.8***	3.6	35.3	22.7	62.4
6/13/2018	Dry	PC08	17.1	***25.8***	2.1	51.0	33.1	***648.8***
6/13/2018	Dry	PC-OUT	14.2	***42.6***	3.6	56.0	36.3	***727.0***
6/25/2018	Wet	BCH11	18.4	***13.7***	0.4		17.2	***>2,419.6***
6/25/2018	Wet	PC07	16.2	***62.4***	5.9	8.6	4.8	***>2,419.6***
6/25/2018	Wet	PC08	19.1	***12.0***	1.0	32.0	22.0	***1,413.6***
6/25/2018	Wet	PC-OUT	18.2	***35.9***	2.9		24.6	***>2,419.6***
7/12/2018	Dry	BCH11	17.7	***21.6***	1.6	46.7	30.4	***>2,419.6***
7/12/2018	Dry	PC07	18.2	***34.3***	2.7	43.1	27.8	***>2,419.6***
7/12/2018	Dry	PC08	18.2	***21.8***	1.7	47.2	30.7	***>2,419.6***
7/12/2018	Dry	PC-OUT	16.9	***37.2***	2.9	49.8	32.7	***>2,419.6***
7/18/2018	Wet	BCH11	25.3	***47.0***	3.3	33.0	20.6	***>2,419.6***
7/18/2018	Wet	PC07	22.5	84.3	6.9	16.6	9.8	***298.7***
7/18/2018	Wet	PC08	25.8	***46.6***	3.3	27.9	17.1	***>2,419.6***
7/18/2018	Wet	PC-OUT	23.2	73.6	5.4	38.8	24.7	***>2,419.6***
8/27/2018	Dry	BCH11	22.0	***5.2***	0.3	33.5	20.9	<10.0
8/27/2018	Dry	PC07	20.6	***11.3***	0.9	22.8	13.8	***288.0***
8/27/2018	Dry	PC08	21.7	***9.1***	0.7	30.4	18.9	***4,884.0***
8/27/2018	Dry	PC-OUT	20.3	***41.6***	3.2	41.8	26.9	***109.0***
9/19/2018	Wet	BCH11	21.4	***8.0***	0.6	25.1	16.5	***121.0***
9/19/2018	Wet	PC07	18.6	73.0	6.8	2.2	1.1	***262.0***
9/19/2018	Wet	PC08	20.0	***49.0***	4.4	3.7	2.0	***5,172.0***
9/19/2018	Wet	PC-OUT	19.5	65.0	5.8	9.9	5.9	***1,616.0***

Bold and italicized red text indicates exceedance of the state criterion threshold for individual samples (Enterococci = 104 mpn/100mL; DO = 65%).

APPENDIX A

2018 Groundwater Testing Data

Site ID	Date	Salinity (ppt)	Ammonia (ppm)	Nitrate-Nitrite (ppb)	Phosphate (ppb)	Entero (mpn/100mL)
PC-07	9/12/2018	12	0	88	12	***631***
PC-08	9/12/2018	20	0	10	14	***6,488***
PC08A	9/12/2018	15	0	24	12	***231***
PC08B	9/12/2018	17	0	38	21	***7,270***
PC-GW-01	9/12/2018	4	0	9	112	***888***
PC-GW-02	9/12/2018	1	0	22	410	***254***
PC-GW-03	9/12/2018	1	0	14	118	***183***
PC-GW-04	9/12/2018	20	0	61	247	40
PC-GW-05	9/12/2018	20	0.25	18	249	***122***
PC-GW-06	9/12/2018	18	0.25	8	508	30
PC-GW-07	9/12/2018	10	0	83	137	51
PC-GW-08	9/12/2018	19	0	16	34	10
PC-GW-09	9/12/2018	21	0	12	49	30
PC-GW-10	9/12/2018	20	0	23	127	5
PC-GW-11	9/12/2018	23	0	9	97	5
PC-GW-12	9/12/2018	24	0	16	48	31
PC-GW-13	9/12/2018	24	0	8	242	10
PC-GW-14	9/12/2018	19	0	12	70	5
PC-GW-15	9/12/2018	23	0	17	135	5
PC-GW-16	9/12/2018	22	0	9	267	5

Bold and italicized red text indicates exceedance of the state criterion threshold for individual samples (Enterococci = 104 mpn/100mL).

APPENDIX B

Summary of Methods

SAMPLING PROTOCOL

Baseline sampling was performed as documented in the *NHDES Generic Beach Program Quality Assurance Project Plan* dated April 3, 2012, RFA # 06193, Section B2.0. Samples were collected in labeled whirlpak bags and stored on ice in a cooler for transport to Absolute Resource Associates Laboratory in Portsmouth, NH for analysis of Enterococci. Water quality parameters (dissolved oxygen, temperature, salinity, and specific conductivity) were collected in the field using calibrated instruments: YSI ProODO, YSI 30, and/or YSI 85. Two duplicate samples were collected and were well within acceptable difference (5-11%, RPD).

Groundwater samples were collected 1-2 feet below the marsh surface using a 36-inch MHE PushPoint ¼" diameter field investigation sampler, equipped with syringe assembly. The syringe and sampler were each rinsed three times with distilled water after each site. Samples were collected in labeled whirlpak bags and stored on ice in a cooler for transport to Nelson Analytic Laboratory in Kennebunk, ME and Absolute Resource Associates Laboratory in Portsmouth, NH for analysis of Enterococci. Samples for nitrate and phosphate were collected in 60 mL HDPE bottles and stored on ice in a cooler for transport to the University of New Hampshire Water Quality Analysis Laboratory in Durham, NH. Ammonia was measured in the field using ammonia test strips. Salinity was measured in the field using a calibrated refractometer.

WET/DRY WEATHER CLASSIFICATION

Wet weather was determined as: >0.1" of precipitation in the prior 24 hours; or >0.25" in the prior 48 hours; or >2.0" in the prior 96 hours. Conditions were considered dry weather when precipitation was <0.1" for each day within 72 hours.

STATISTICAL METHODS

A Mann-Kendall trend analysis was performed for beach sites with at least 10 years of data. The Mann-Kendall Trend Test is a non-parametric statistical test that determines if the central value (median) of a dataset has changed over time. A non-parametric test is appropriate here because it does not make assumptions about the normality or variability of the dataset; variation seen year-to-year or within seasons will not influence the results of non-parametric analysis the way that parametric tests can be influenced.

DATA INTERPRETATION – WATER QUALITY STANDARDS

The NHDES Consolidated Assessment Listing Methodology (CALM) describes the process and water quality standards used to assess the state's waters. This information is used to help interpret Parsons Creek water quality results and relate it to state criteria. https://www.des.nh.gov/organization/divisions/water/wmb/swqa/2014/documents/r-wd-15-9.pdf