

# BACTERIA SAMPLING IN THE PARSONS CREEK WATERSHED

**RYE, NEW HAMPSHIRE**

**SEPTEMBER 2014**



Prepared for:

**Town of Rye**

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# Summary of Rye Bacteria Sampling May – August 2014



## Background

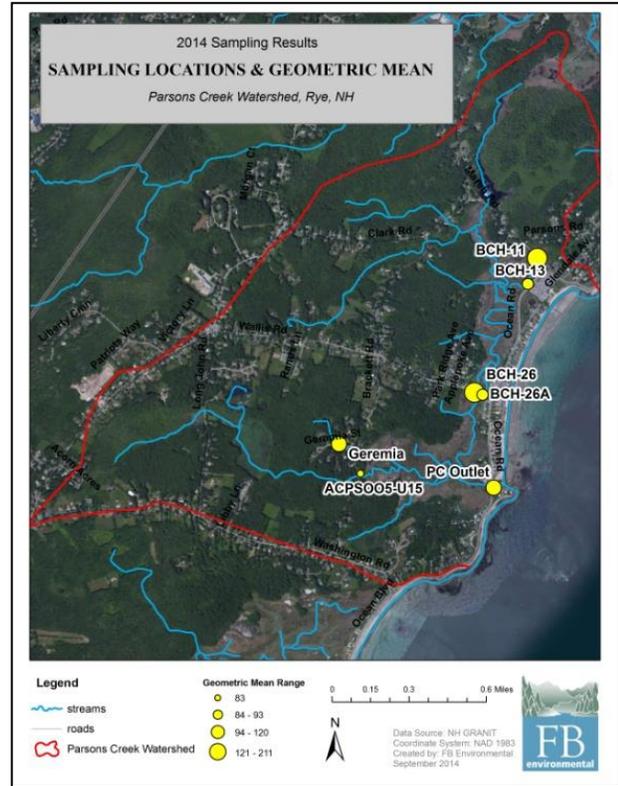
The NH Department of Environmental Services considers Parsons Creek impaired due to high concentrations of bacteria. FB Environmental conducted bacteria sampling at seven locations throughout the Parsons Creek watershed from May to August 2014. Samples were taken under various weather conditions to determine sources (high bacteria in wet weather indicates stormwater, high bacteria in dry weather indicates septic systems or animal waste).

## Results

1. Overall, the geometric mean (or “normalized” average of all results) exceeded the state water quality standard (35 colonies/100mL) at each site.
2. Samples taken in May and June did not exceed the water quality standard at any site.
3. Samples taken in wet weather were higher than those taken in dry.

## Findings

1. Parsons Creek is still considered impaired due to bacteria, though bacteria concentrations in 2014 are much lower than in 2013.
2. Sources of bacteria likely include a variety of sources (stormwater, septic systems, animal waste).
3. Bacteria sources increase at the height of summer with increased population and public use.



*Sampling Locations and Bacteria Concentrations (geometric mean in colonies/100ml) for bacteria sampling in the Parsons Creek Watershed (May – August 2014)*

| Sample ID  | Site Location | 5/8/2014 | 6/6/2014 | 7/16/2014 | 8/5/2014 | 8/14/2014 | 8/28/2014 | TOTAL Geometric Mean | 2013 Geometric Mean |
|------------|---------------|----------|----------|-----------|----------|-----------|-----------|----------------------|---------------------|
|            |               | Dry      | Wet      | Wet       | Dry      | Wet       | Dry       |                      |                     |
| ACPSO05U15 | Brackett      | 20       | 20       | 404       | 41       | 583       | 183       | <b>83</b>            | <b>1046</b>         |
| GEREMIA    | Geremia       | <10      | 10       | 545       | 31       | >24200    | 62        | <b>117</b>           | <b>714</b>          |
| BCH 11     | Marsh         | 20       | 20       | 2490      | 512      | 6499      | 313       | <b>174</b>           | <b>2840</b>         |
| BCH 13     | Ocean         | 20       | 10       | 121       | 144      | 2098      | 86        | <b>93</b>            | <b>860</b>          |
| BCH 26     | Wallis        | 30       | 10       | 158       | 2910     | 1483      | 428       | <b>211</b>           | <b>799</b>          |
| BCH 26A    | Wallis        | 10       | 20       | 565       | 52       | 331       | 320       | <b>92</b>            | <b>346</b>          |
| PC OUTLET  | Outlet        | 10       | <10      | 538       | 98       | 2360      | 246       | <b>120</b>           | <b>315</b>          |

NHDES standard: 104 colonies/100mL (single sample); 35 colonies/100mL (geometric mean of multiple samples) - exceedances in color.

## Next Steps

1. Continue to monitor bacteria in Parsons Creek (under varying weather conditions and at different times of year).
2. Assess septic systems in priority neighborhoods in the watershed (Geremia, Marsh, and Ocean). Other areas of concern may be drawn from the current septic system database.
3. Address stormwater runoff throughout the watershed. The town is currently implementing a grant from the NH DES that includes the installation of Best Management Practices (BMPs) to treat stormwater (Marsh, Wallis, and Brackett).

## **Introduction**

High concentrations of fecal indicator bacteria in waterbodies can lead to posted advisories at swimming beaches and closure of shellfish beds. These bacteria are used to signal human health risks such as gastrointestinal, respiratory, eye, ear, nose, throat, and skin infections transmissible to humans through the consumption of contaminated fish and shellfish, skin contact, and/or ingestion of water.

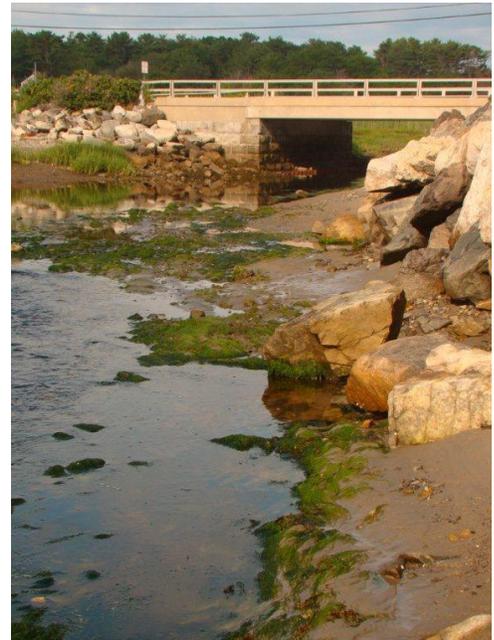
In an effort to assess the impact of bacteria on Parsons Creek and the beaches in Rye, NH, FB Environmental (FBE) conducted bacteria sampling on six days under various weather conditions (three under wet weather conditions and three under dry weather conditions) from May to August 2014 at seven locations throughout the Parsons Creek watershed (Figure 1). Dissolved oxygen and temperature data were also collected at each sampling location.

All bacteria samples were analyzed for enterococci bacteria at Nelson Analytical Water Testing Laboratory in Kennebunk, Maine. Enterococci bacteria are used as an indicator of the presence of fecal material in saltwater by the New Hampshire Department of Environmental Services Beaches Program. In New Hampshire, the state water quality standard for enterococci is 104 colonies/100mL for a single grab sample and 35 colonies/100mL for the geometric mean of multiple samples. Though Parsons Creek is a freshwater stream, the saltwater water quality standard was used to assess the impact of Parsons Creek on potential beach closures in Rye.

Though enterococci results from FBE sampling at the Parsons Creek outlet at Wallis Beach were often above the state standard, only one beach advisory occurred in the 2014 season on July 3, 2014. New Hampshire Beaches Program results at three locations along Wallis Sands Beach were typically less than 10 colonies/100 mL during the sampling period (NH DES OneStop Data, 2014).

## **Bacteria Results**

As shown in Table 1, enterococci concentrations ranged from 10 to over 24,200 colonies/100 mL (the laboratory's detection limit). The geometric mean ranged from 92 to 211 colonies/100 mL. Geometric mean values for all sites were above the New Hampshire standard. Sites BCH26 and BCH11 had the highest geometric mean concentrations for enterococci in 2014. The first two sampling dates (early May and early June) resulted in low bacteria counts with no exceedance of the NH DES standard in both dry and wet weather conditions. From July onward, all sampling sites were above the water quality standard

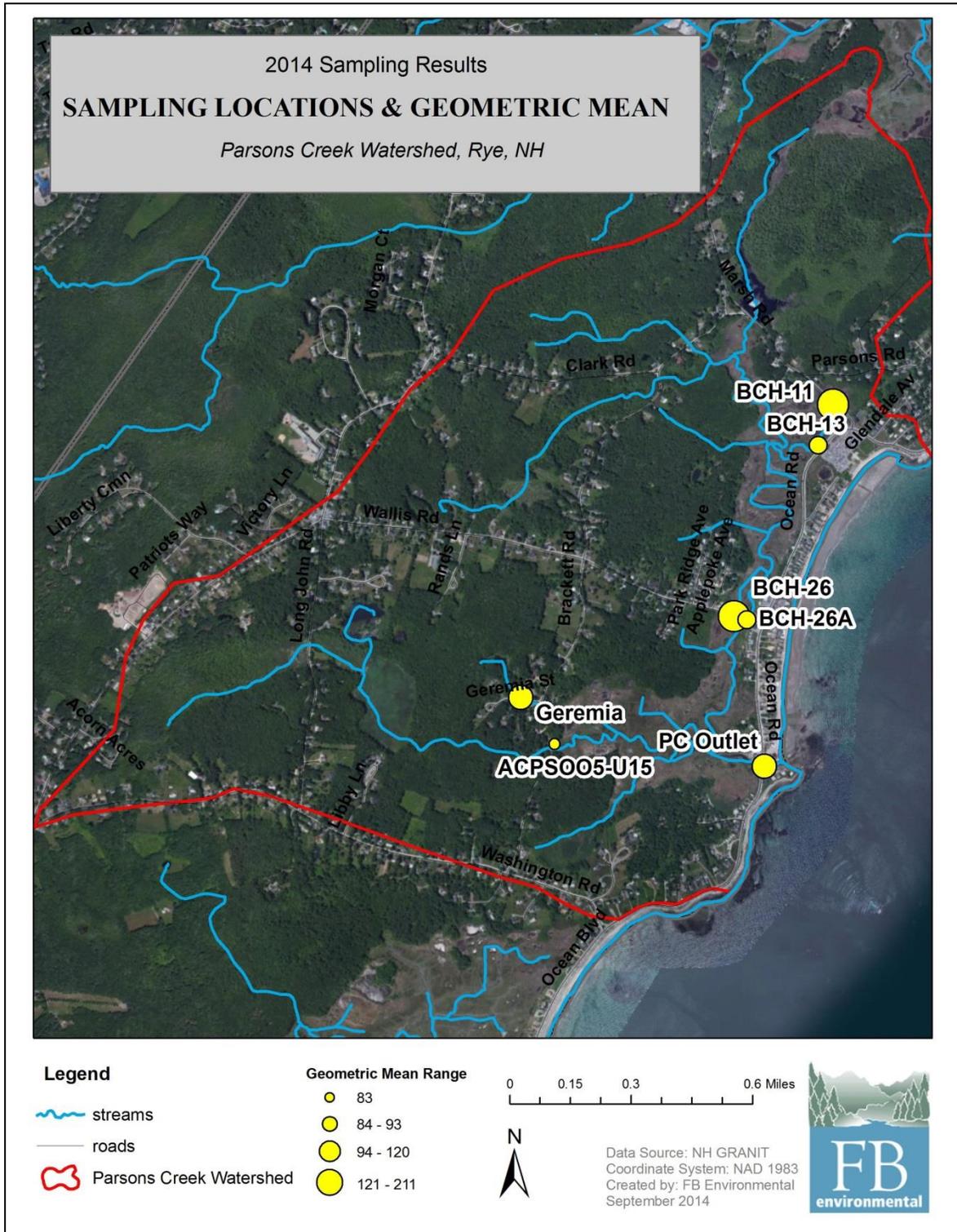


*PC Outlet sample location with the presence of algae.*

*Photo Credit: Kim Reed, Town of Rye*

in dry and/or wet weather, with the exception of Geremia which only exceeded the standard under wet weather conditions. However, the wet weather results for the Geremia site in mid-late summer (July onward) were high with concentrations on one event over 200 times the water quality standard and above the laboratory's detection limit (Table 1).

**Figure 1: Sampling Locations and Bacteria Concentrations (geometric mean in colonies/100ml) for bacteria sampling in the Parsons Creek Watershed (May – August 2014)**



**Table 1: Enterococci (colonies/100mL) results & geometric mean for all sampling locations in the Parsons Creek watershed from May – August 2014.**

| Sample ID   | Site Location                      | 5/8/2014 | 6/6/2014 | 7/16/2014 | 8/5/2014 | 8/14/2014 | 8/28/2014 | Geometric Mean |
|---|------------------------------------|----------|----------|-----------|----------|-----------|-----------|----------------|
|   |                                    | Dry      | Wet      | Wet       | Dry      | Wet       | Dry       |                |
| ACPSOO5U15  | Brackett Road                      | 20       | 20       | 404       | 41       | 583       | 183       | <b>83</b>      |
| GEREMIA   | Geremia Road                       | <10      | 10       | 545       | 31       | >24200    | 62        | <b>117</b>     |
| BCH 11  | Marsh Road                         | 20       | 20       | 2490      | 512      | 6499      | 313       | <b>174</b>     |
| BCH 13  | Ocean Blvd                         | 20       | 10       | 121       | 144      | 2098      | 86        | <b>93</b>      |
| BCH 26  | Wallis Road                        | 30       | 10       | 158       | 2910     | 1483      | 428       | <b>211</b>     |
| BCH 26A   | Wallis Road                        | 10       | 20       | 565       | 52       | 331       | 320       | <b>92</b>      |
| PC OUTLET   | Parson Creek outlet on Ocean Blvd. | 10       | <10      | 538       | 98       | 2360      | 246       | <b>120</b>     |
| <b>NH DES standard for enterococci = 104 colonies/100 mL (single sample) and 35 colonies/100mL (geometric mean)</b><br><b>*Indicates a field duplicate was collected. Result is the average of two samples.</b> |                                    |          |          |           |          |           |           |                |

Wet and Dry Weather Analysis

The geometric means for wet weather and dry weather samples were also calculated in an effort to understand the sources of bacteria in the watershed (Table 2). Wet weather geometric mean values exceeded the water quality standard for enterococci at all sites in the Parsons Creek watershed. Dry weather geometric mean values exceeded the water quality standard at five of the seven sites in the watershed. The total geometric mean for the 2014 sampling season was above the NH DES standard at all sampling locations in the watershed.

**Table 2: Enterococci (colonies/100mL) wet weather, dry weather, and total geometric mean for all sampling locations in the Parsons Creek watershed from May – August 2014.**

| Sample ID  | Site Location                      | DRY Geometric Mean | WET Geometric Mean | TOTAL Geometric Mean |
|--|------------------------------------|--------------------|--------------------|----------------------|
| ACPS005 U15  | Brackett Road                      | 29                 | 168                | <b>83</b>            |
| Geremia  | Geremia Road                       | 27                 | 509                | <b>117</b>           |
| BCH 11   | Marsh Road                         | 147                | 223                | <b>174</b>           |
| BCH 13   | Ocean Blvd                         | 63                 | 136                | <b>93</b>            |
| BCH 26   | Wallis Road                        | 334                | 133                | <b>211</b>           |
| BCH 26A  | Wallis Road                        | 55                 | 155                | <b>92</b>            |
| PC OUTLET  | Parson Creek outlet on Ocean Blvd. | 62                 | 233                | <b>120</b>           |
| <b>NH DES enterococci standard = 35 colonies/100 mL (geometric mean)</b> |                                    |                    |                    |                      |

**Discussion**

As shown in Tables 1 and 2, enterococci concentrations for all sites exceeded New Hampshire’s water quality standard throughout the study period. However, as shown in Table 3, bacteria concentrations and geometric mean for all sites were significantly lower in 2014 than they were in 2013. Wet and dry weather geometric means were also lower in 2013 than they were in 2014 (Table 4). Since the 2013 sampling, the town has installed some stormwater BMPs on Wallis, Marsh, Geremia and Brackett Roads. These BMPs have likely decreased the effect of stormwater runoff to these locations to some extent. However, the weather conditions in 2013 were much different than in 2014. The summer of 2013 had multiple high intensity rain events and was extremely hot. The summer of 2014 had fewer rain events and was more temperate. More data is necessary to be able to determine a trend in bacteria concentrations in the watershed.

**Table 3: Enterococci (colonies/100mL) for all sampling locations in the Parsons Creek watershed from 2013 and 2014.**

| Sample ID  | Site Location                      | 2013 Geometric Mean | 2014 Geometric Mean |
|--|------------------------------------|---------------------|---------------------|
| ACPS005 U15  | Brackett Road                      | 1046                | 83                  |
| Geremia  | Geremia Road                       | 714                 | 117                 |
| BCH 11   | Marsh Road                         | 2840                | 174                 |
| BCH 13   | Ocean Blvd                         | 860                 | 93                  |
| BCH 26   | Wallis Road                        | 799                 | 211                 |
| BCH 26A  | Wallis Road                        | 346                 | 92                  |
| PC OUTLET  | Parson Creek outlet on Ocean Blvd. | 315                 | 120                 |
| <b>NH DES enterococci standard = 35 colonies/100 mL (geometric mean)</b> |                                    |                     |                     |

**Table 4: Enterococci (colonies/100mL) wet weather and dry weather geometric mean for all sampling locations in the Parsons Creek watershed from 2013 and 2014.**

| Sample ID  | Site Location | 2013 DRY Geometric Mean | 2014 DRY Geometric Mean | 2013 WET Geometric Mean | 2014 WET Geometric Mean |
|--|---------------|-------------------------|-------------------------|-------------------------|-------------------------|
| ACPS005 U15  | Brackett Road | 388                     | 29                      | 3927                    | 168                     |
| Geremia  | Geremia Road  | 2504                    | 27                      | 310                     | 509                     |
| BCH 11   | Marsh Road    | 750                     | 147                     | 7707                    | 223                     |
| BCH 13   | Ocean Blvd    | 414                     | 63                      | 1630                    | 136                     |
| BCH 26   | Wallis Road   | 253                     | 334                     | 2524                    | 133                     |
| BCH 26A  | Wallis Road   | 170                     | 55                      | 467                     | 155                     |
| PC OUTLET  | Outlet        | 24                      | 62                      | 930                     | 233                     |
| <b>NH DES enterococci standard = 35 colonies/100 mL (geometric mean)</b> |               |                         |                         |                         |                         |

In 2013 and 2014, bacteria concentrations under varying weather conditions exceeded the water quality standard, indicating a variety of sources of bacteria including stormwater runoff, malfunctioning septic systems, pet waste, and wildlife. Overall, bacteria concentrations were higher under wet weather conditions than under dry weather conditions. However, dry weather concentrations often exceeded the water quality standard, indicating that bacteria sources are derived not only from stormwater runoff. Typically, bacteria results taken under dry weather conditions are lower than results taken under wet weather conditions. As rain water moves over the land and into a waterbody, it will carry bacteria from various sources (i.e. pet waste, dumpsters) as well as other pollutants (nutrients from lawn fertilizers and sediment). High bacteria concentrations during dry weather sampling events can suggest a failing septic system or leach field nearby.

For the months of May and early June, dry and wet weather results were low and did not exceed that water quality standard at any site. The months of July and August resulted in higher bacteria concentrations with all wet weather samples and the majority of dry weather samples exceeding the New Hampshire standard for enterococci. This suggests that the bacteria concentrations may be related to the increased population and public use of the area during the height of the summer season, through an increase in pollutants carried in stormwater runoff and from heavily-used septic systems. Wet weather sampling results ranged from below the standard in early June to over a hundred times the water quality standard later in the summer season. These high wet weather concentrations are likely due to a combination of 1) high water tables leading to a flushing of malfunctioning leach fields into Parsons Creek, and 2) increased stormwater runoff that carries bacteria, among other pollutants, into the creek.

Other bacteria sources including pet and wildlife waste should also be considered. Much of the Parsons Creek watershed is residential or wetland area indicating the potential for bacteria inputs from animals throughout the watershed.

### **Next Steps**

1. Continue bacteria sampling throughout the Parsons Creek watershed under varying weather conditions to monitor changes in bacteria concentrations;
2. Conduct bacteria monitoring throughout the Parsons Creek watershed throughout the year to monitor bacteria concentrations before, during, and after the busy summer season;
3. Determine the septic system history of priority neighborhoods in the Parsons Creek watershed. Based on sampling, focus areas include the neighborhood near Geremia, Marsh Road and Ocean Boulevard. Other areas of concern may be drawn from the current septic system database, and may include parcels in a high priority area with no current information or very old systems on file;
4. Expand the current septic database to include more parcels, specifically in areas of concern;
5. Continue to address stormwater runoff throughout the Parsons Creek watershed. The Town of Rye is currently implementing a Watershed Restoration Grant from the New Hampshire Department of

Environmental Services that includes the installation of Best Management Practices (BMPs) to treat stormwater runoff;

6. Move the portable toilet from the bank of BCH26A;
7. Educate homeowners about proper disposal of pet waste; and
8. Determine areas where wildlife may congregate.

| Sample ID   | Site Location                      | Date      | Time  | Temp (C°) | DO (%) | DO (mg/L) | Salinity (‰) | Entero Results (mpn/100 mL) | Weather Wet/Dry | Notes  |
|-------------|------------------------------------|-----------|-------|-----------|--------|-----------|--------------|-----------------------------|-----------------|--|
| ACPSOO5-U15 | Brackett Road                      | 5/8/2014  | 1:15  | 14.8      | 97.5   | 9.88      | 0            | 20                          | DRY             | lots of flow from culvert  |
| GEREMIA     | Geremia north side                 | 5/8/2014  | 1:10  | 15.4      | 92.8   | 9.91      | 0            | <10                         | DRY             | good flow into culvert   |
| BCH 11      | Marsh Road Crossing - Dwn Stream   | 5/8/2014  | 12:40 | 12.9      | 56.6   | 5.95      | 0            | 20                          | DRY             | slow flow, high water  |
| BCH 13      | Ocean Blvd                         | 5/8/2014  | 12:46 | 18.2      | 37.8   | 3.5       | 20           | 20                          | DRY             | very low water flow observed   |
| BCH 26      | Wallis Road                        | 5/8/2014  | 12:50 | 15        | 30.2   | 3.04      | 10           | 30                          | DRY             | good flow into culvert   |
| BCH 26A     | Wallis Road                        | 5/8/2014  | 12:55 | 14.3      | 94.6   | 9.75      | 14           | 10                          | DRY             | no flow but high oxygen  |
| PC OUTLET   | Parson Creek outlet on Ocean Blvd. | 5/8/2014  | 1:00  | 15        | 91.5   | 9.23      | 15           | 10                          | DRY             | lots of algae, geese   |
| ACPSOO5-U15 | Brackett Road                      | 6/6/2014  | 11:54 | 16.7      | 102.2  | 9.96      | 0            | 20                          | WET             | lots of algae, good flow   |
| GEREMIA     | Geremia north side                 | 6/6/2014  | 12:04 | 18.1      | 59.3   | 5.59      | 0            | 10                          | WET             | low flow/water level   |
| BCH 11      | Marsh Road Crossing - Dwn Stream   | 6/6/2014  | 12:14 | 19.2      | 39.1   | 3.6       | 3            | 20                          | WET             | little/no flow   |
| BCH 13      | Ocean Blvd                         | 6/6/2014  | 12:20 | 24.8      | 70.2   | 5.78      | 15           | 10                          | WET             | pink residue on shore/channel  |
| BCH 26      | Wallis Road                        | 6/6/2014  | 12:35 | 18.3      | 39.1   | 3.7       | 14           | 10                          | WET             | some flow  |
| BCH 26A     | Wallis Road                        | 6/6/2014  | 12:41 | 18.7      | 134.6  | 12.17     | 12           | 20                          | WET             | lots of scum, some oil residue on water  |
| PC OUTLET   | Parson Creek outlet on Ocean Blvd. | 6/6/2014  | 12:49 | 19.6      | 82.6   | 7.53      | 14           | <10                         | WET             | good flow  |
| ACPSOO5-U15 | Brackett Road                      | 7/16/2014 | 8:34  | 21        | 75.2   | 6.8       | 0            | 404                         | WET             | good flow, water level high  |
| GEREMIA     | Geremia north side                 | 7/16/2014 | 8:41  | 20.3      | 51     | 4.54      | 0            | 545                         | WET             | good flow, water stained   |
| BCH 11      | Marsh Road Crossing - Dwn Stream   | 7/16/2014 | 8:51  | 19.3      | 25.8   | 2.37      | 18           | 2490                        | WET             | water level very high  |
| BCH 13      | Ocean Blvd                         | 7/16/2014 | 8:59  | 18.2      | 47.4   | 4.48      | 25           | 121                         | WET             | water level very high  |
| BCH 26      | Wallis Road                        | 7/16/2014 | 9:07  | 16.8      | 51.1   | 4.97      | 26           | 158                         | WET             | good flow, water high  |
| BCH 26A     | Wallis Road                        | 7/16/2014 | 9:12  | 14        | 68.4   | 7.06      | 26           | 565                         | WET             | high water, low flow   |
| PC OUTLET   | Parson Creek outlet on Ocean Blvd. | 7/16/2014 | 9:25  | 16.3      | 58.3   | 5.72      | 27           | 538                         | WET             | high flow and water  |
| ACPSOO5-U15 | Brackett Road                      | 8/5/2014  | 1:34  | 20.6      | 86.8   | 7.81      | 0            | 41                          | DRY             | good flow  |
| GEREMIA     | Geremia north side                 | 8/5/2014  | 1:28  | 22        | 50     | 4.37      | 0            | 31                          | DRY             | high flow  |
| BCH 11      | Marsh Road Crossing - Dwn Stream   | 8/5/2014  | 1:08  | 27.6      | 38.1   | 2.99      | 5            | 512                         | DRY             | water low, trash in water  |
| BCH 13      | Ocean Blvd                         | 8/5/2014  | 1:17  | 29.6      | 60.5   | 4.58      | 17           | 144                         | DRY             | water very low, lots of pink substance (bacteria?)   |
| BCH 26      | Wallis Road                        | 8/5/2014  | 12:49 | 25.6      | 85.3   | 6.97      | 5            | 2910                        | DRY             | low water level, shiny film on surface of water  |
| BCH 26A     | Wallis Road                        | 8/5/2014  | 12:51 | 22.5      | 88.4   | 7.63      | 18           | 52                          | DRY             | water low, low flow  |
| PC OUTLET   | Parson Creek outlet on Ocean Blvd. | 8/5/2014  | 12:40 | 24.5      | 106.7  | 8.89      | 10           | 98                          | DRY             | low water level, lots of algae   |
| ACPSOO5-U15 | Brackett Road                      | 8/14/2014 | 10:10 | 17.8      | 80     | 7.6       | 0            | 583                         | WET             | really high flow   |
| GEREMIA     | Geremia north side                 | 8/14/2014 | 10:17 | 19.1      | 71.1   | 6.59      | 0            | >24,200                     | WET             | high flow, water stained   |
| BCH 11      | Marsh Road Crossing - Dwn Stream   | 8/14/2014 | 9:52  | 19.4      | 17.9   | 1.65      | 15           | 6131                        | WET             | water to top of culvert  |
| BCH 11      | DUP                                | 8/14/2014 | 9:53  |           |        |           |              | 6867                        | WET             |  |
| BCH 13      | Ocean Blvd                         | 8/14/2014 | 9:59  | 19.6      | 49.4   | 4.56      | 17           | 2098                        | WET             | water very high, marsh where sampled was inundated   |
| BCH 26      | Wallis Road                        | 8/14/2014 | 9:41  | 18.8      | 49.6   | 4.62      | 20           | 1483                        | WET             | high water level and flow, sediment in water   |
| BCH 26A     | Wallis Road                        | 8/14/2014 | 9:36  | 18.3      | 49.4   | 4.61      | 22           | 331                         | WET             | high water level   |
| PC OUTLET   | Parson Creek outlet on Ocean Blvd. | 8/14/2014 | 9:25  | 18.4      | 52.1   | 4.9       | 20           | 2360                        | WET             | water very high, moving fast   |
| ACPSOO5-U15 | Brackett Road                      | 8/28/2014 | 6:34  | 20.4      | 80.1   | 7.23      | 0            | 211                         | DRY             | water level low, some foam   |
| GEREMIA     | Geremia north side                 | 8/28/2014 | 6:44  | 19.8      | 24.1   | 2.2       | 0            | 62                          | DRY             | very little flow, orange iron floc bacteria? Took photo  |
| BCH 11      | Marsh Road Crossing - Dwn Stream   | 8/28/2014 | 6:58  | 23        | 4.3    | 0.36      | 22           | 313                         | DRY             | little/no flow, trash in water, pink substance/bacteria on soil, "doggie poop bags" in water, oily film on surface |
| BCH 13      | Ocean Blvd                         | 8/28/2014 | 7:09  | 20.9      | 3.3    | 0.29      | 28           | 86                          | DRY             | water level low  |
| BCH 26      | Wallis Road                        | 8/28/2014 | 7:19  | 21.6      | 11.6   | 1.01      | 25           | 428                         | DRY             | water level low  |
| BCH 26A     | Wallis Road                        | 8/28/2014 | 7:23  | 19.8      | 5.9    | 0.51      | 25           | 320                         | DRY             | low flow/water level   |
| PC OUTLET   | Parson Creek outlet on Ocean Blvd. | 8/28/2014 | 7:31  | 20.5      | 35.9   | 3.24      | 25           | 246                         | DRY             | water low, algae growth  |
| ACPSOO5-U15 | DUP                                | 8/28/2014 | 6:35  |           |        |           |              | 155                         | DRY             |  |

NHDES enterococci standard for enterococci = 104 colonies/100 mL (single sample) and 35 colonies/100mL (geometric mean)