Beach Monitoring Investigative Sampling: Rockaway and Twin Rocks Beaches

October 2017

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Watershed Assessment

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State of Oregon
Department of Environmental Quality

Last Updated: 11/1/2017
DEQ17-LAB-0040-TR

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Executive Summary

The Oregon Beach Monitoring Program (OBMP) monitors concentrations of the fecal indicator bacteria (FIB) *Enterococcus* sp. in recreational waters at beaches along the Oregon coast. The primary objective of the OBMP is protecting public health through routine monitoring of beaches conducted between Memorial Day and Labor Day each year. When concentrations of *Enterococcus* sp. exceed the EPA recreational water quality criteria threshold (also known as the beach action value; BAV), water contact advisories are issued (by the Oregon Health Authority) for beaches where the elevated counts were detected.

In addition to routine beach monitoring, the OBMP may conduct investigative sampling to try and identify potential sources of bacterial contamination when unusual or consistently high results are observed during the routine monitoring season. For example, investigative sampling may be conducted within a watershed that discharges through a beach where high bacterial counts were repeatedly detected.

During the 2016 OBMP routine monitoring season, an increase in water contact advisories versus previous years occurred at some sample locations in the Rockaway Beach area (Tillamook County). These high bacteria counts triggered interest in conducting investigative sampling in the Rockaway Beach area to better understand potential sources of bacterial contamination. Four freshwater streams (Rock, Saltair, Heitmiller, and Watseco creeks) that discharge into the Pacific Ocean through Rockaway area beaches were identified as potential sources of bacterial contamination and monitored for FIB following the routine monitoring season.

A total of 20 freshwater and marine sample sites were delineated in the creeks to evaluate whether a residential area was contributing to high bacteria counts observed at the beaches. Sites were sampled weekly for five weeks beginning in early November. A total of 128 samples were collected and analyzed for *Enterococcus* sp. Of these, 77% were non-detections for *Enterococcus* sp. and zero samples exceeded the BAV of 158 MPN (CFU/100 mL). The highest bacteria count was 74 MPN (CFU/100mL) in the Saltair Creek drainage.

Consequently, the source of bacterial contamination observed at beaches during the routine monitoring season could not be identified. Causes of the reduction in bacteria counts versus the routine sample season are not known. However, record rainfall and unseasonably high stream discharges occurred in the region during the month prior to investigative sample collection. These factors are likely to have contributed to the low bacterial counts by flushing accumulated bacteria from the four creeks prior to sample collection. If elevated bacteria counts persist at beaches in the vicinity of Rockaway Beach, future investigative sampling may be warranted to better understand the sources of bacterial contamination. This sampling should be conducted to the extent possible to capture the first flush of freshwater streams occurring with the onset of autumn rain events.

1. Introduction

1.1 Background

The Oregon Beach Monitoring Program (OBMP) is a public health protecting partnership between the Oregon Health Authority (OHA) and the Oregon Department of Environmental Quality (DEQ) and is funded by annual grants from the U.S. Environmental Protection Agency (EPA) (USEPA, 2000). The program conducts routine monitoring of fecal indicator bacteria (FIB) at public beaches along the Oregon coast from Memorial Day to Labor Day each year. Concentrations of FIB provide an estimate of the degree of contamination (i.e., presence and quantity of fecal pathogens) from disease-causing bacteria, viruses, and protozoans in sampled water bodies (NRC 2004). Moreover, FIB concentrations are useful predictors of the potential for human illness to result from exposure to contaminated waters. Marine and freshwater samples collected by the OBMP at public beaches are tested for the FIB *Enterococcus* sp. When *Enterococcus* counts in marine water samples exceed the EPA recreational water quality criteria threshold (known as the beach action value; BAV) of 158 colony forming units per 100 milliliters (CFU/100mL; USEPA 2000), OHA issues water contact advisories for beaches where elevated counts occur.

Specific project tasks of the OBMP are defined in the Quality Assurance Project Plan (QAPP), developed jointly by DEQ and OHA (DEQ 2006). The primary program task identified in the QAPP is to conduct annual routine beach monitoring between Memorial Day and Labor Day. However, the QAPP also provides guidance on discretionary tasks such as 'investigative sampling'. Investigative sampling is typically conducted for purposes such as better defining the extent of beach contamination, or examining freshwater discharges to better understand sources of bacterial contamination at beaches. Investigative sampling is conducted in autumn after the routine sample season has concluded. Beaches that pose a public health risk due to frequent exceedance of the BAV during the routine monitoring season will have been identified by this time. In addition, synchronizing investigative sampling with the onset of autumn "first flush" rain events may aid in identifying potential sources of bacterial contamination. Bacteria are likely to have accumulated in areas such as tributary watersheds and city drainage systems during the dry Oregon summer (DEQ 2012; 12-LAB-0036-SAP). The onset of autumn precipitation will wash these contaminated waters downstream, providing potential cues as to the type and location of bacterial contamination sources.

The OBMP has monitored beach water quality in the vicinity of Rockaway Beach (Tillamook County) since 2002 as an OHA contractor via interagency agreement. Drainage water crossing the beaches has been repeatedly linked to excessive *Enterococcus* concentrations in areas with high recreational use. Routine monitoring has identified Rock, Saltair, Watseco, and Heitmiller creeks as potential sources of marine water contamination in this area (Figure 1) and as areas posing unacceptable public health risks. These creeks discharge to beaches with heavy public use and children are frequently observed playing in the drainage water. During the 2016 OBMP routine monitoring season, an increase in bacteria counts and water contact advisories versus previous sample years occurred at some sample locations in the Rockaway Beach area. At Saltair Creek, 67% of samples (freshwater) exceeded the BAV, while 17% of samples at the mouths of both Saltair and Rock creeks (marine) exceeded the BAV (DEQ Rockaway SAP 2016a). These high bacteria counts triggered interest in conducting investigative sampling of tributaries in the Rockaway Beach area to better understand the sources of contamination. In addition, Rockaway Beach is presently on DEQ's 303(d) water quality limited list in category "TMDL needed".

The goal of this study was to begin to understand the potential sources of bacterial contamination in these creeks. Previous studies have suggested potential sources of bacterial contamination at marine sample locations include freshwater creek discharge, wastewater discharge, storm water outfalls, sewer/residential development, wildlife, domestic animals, agriculture, and beach usage (i.e., humans and pets; ODHS 2010). We investigated both creek and stormwater outfalls, and explored upstream areas to establish background conditions on forest lands (DEQ Rockaway SAP 2016a). This study's intensive monitoring objectives are intended to meet the Beach Monitoring Program's public health goals.

Figure 1. Four creeks that discharge through beaches in the vicinity of Rockaway Beach (Tillamook County) were identified as potential sources of bacterial contamination during routine beach monitoring in 2016: Rock Creek, Saltair Creek, Heitmiller Creek, and Watseco Creek.

1.1.1 EPA Recreational Water Quality Criteria

For investigative sampling conducted in 2016, the OBMP followed EPA's 1986 ambient water quality criteria recommendations for recreational waters (Table 1). EPA issues these recommendations under the authority of the Clean Water Act (CWA). The criteria are developed based on studies of the relationship between human illness and contact with fecal contamination in recreational waters. In marine waters, the FIB *Enterococcus* sp. are used to measure fecal contamination and set the BAV criteria. In freshwater, the FIB *E. coli* are used to measure fecal contamination and set the criteria (USEPA, Ambient Water Quality Criteria for Bacteria – 1986, 1986). For sampling in the Rockaway Beach area, *Enterococcus* sp. was used to evaluate FIB contamination in both marine water and freshwater samples. This approach is consistent with the methods of the OBMP routine monitoring program and has been shown to be effective in both marine and fresh waters (http://www.idexx.de/pdf/de_de/water/096329400L.pdf).

Table 1. EPA Recreational Water Quality Criteria

Water Quality Criteria for Bacteria for Marine Recreational Waters				
	Risk Level (% of swimmers)	Geometric Mean* Density (per 100 ml)	Single Sample Maximum	Upper Percentile Value Allowable Density (per 100 ml)
Enterococcus sp. *Criteria*	1.9	35	158	82nd
Water Quality Criteria for Bacteria for Fresh Recreational Waters				
E. coli Criteria	0.8	126	406	90th
**The geometric mean uses the product rather than the sum of bacteria results in order to better represent bacteria counts on a logarithmic scale.*				

1.1.2 Beach Use

Beach use by the public is a significant consideration when beaches are chosen for routine monitoring (ODHS, 2010) as well as for investigative sampling. Rockaway Beach has historically ranked as a high priority public health beach. During the OBMP routine summer sampling season hundreds of visitors may be on the beach and in the water in the Rockaway Beach and Twin Rocks area.

2. Methods

2.1 Site Selection

Sampling was conducted on four creeks in the Rockaway Beach area: Rock, Saltair, Heitmiller, and Watseco creeks (Figure 1). Sampling effort was focused, however, on the two drainages (Rock Creek and Saltair Creek) where high bacteria counts and water contact advisories were issued during the routine sample season. Locations of potential pollution sources in each creek were identified through historic data collected as part of the OBMP (ODHS, 2010) as well as reconnaissance surveys of the four drainages. Sample sites were delineated in the four drainages to evaluate whether a residential area in Rockaway Beach was the source of or contributing to high bacteria counts observed in the four creeks. To the extent possible, investigative sample sites in each creek drainage were located upstream of the

residential area, within the residential area, and downstream of the residential area. In addition to investigative sites, OBMP routine monitoring sites were sampled in each creek drainage: in freshwater near the creek mouth, and in marine water at the creek mouth. In total, the Rock Creek drainage was sampled at five sites and two OBMP routine sites (Figure 2). The Saltair Creek drainage was sampled at four sites and two OBMP routine sites (Figure 2). The Heitmiller Creek drainage was sampled at two sites (Figure 3). The Watseco Creek drainage was sampled at two sites and two OBMP routine sites (Figure 3). Geographic coordinates of sample sites can be found in Appendix A.

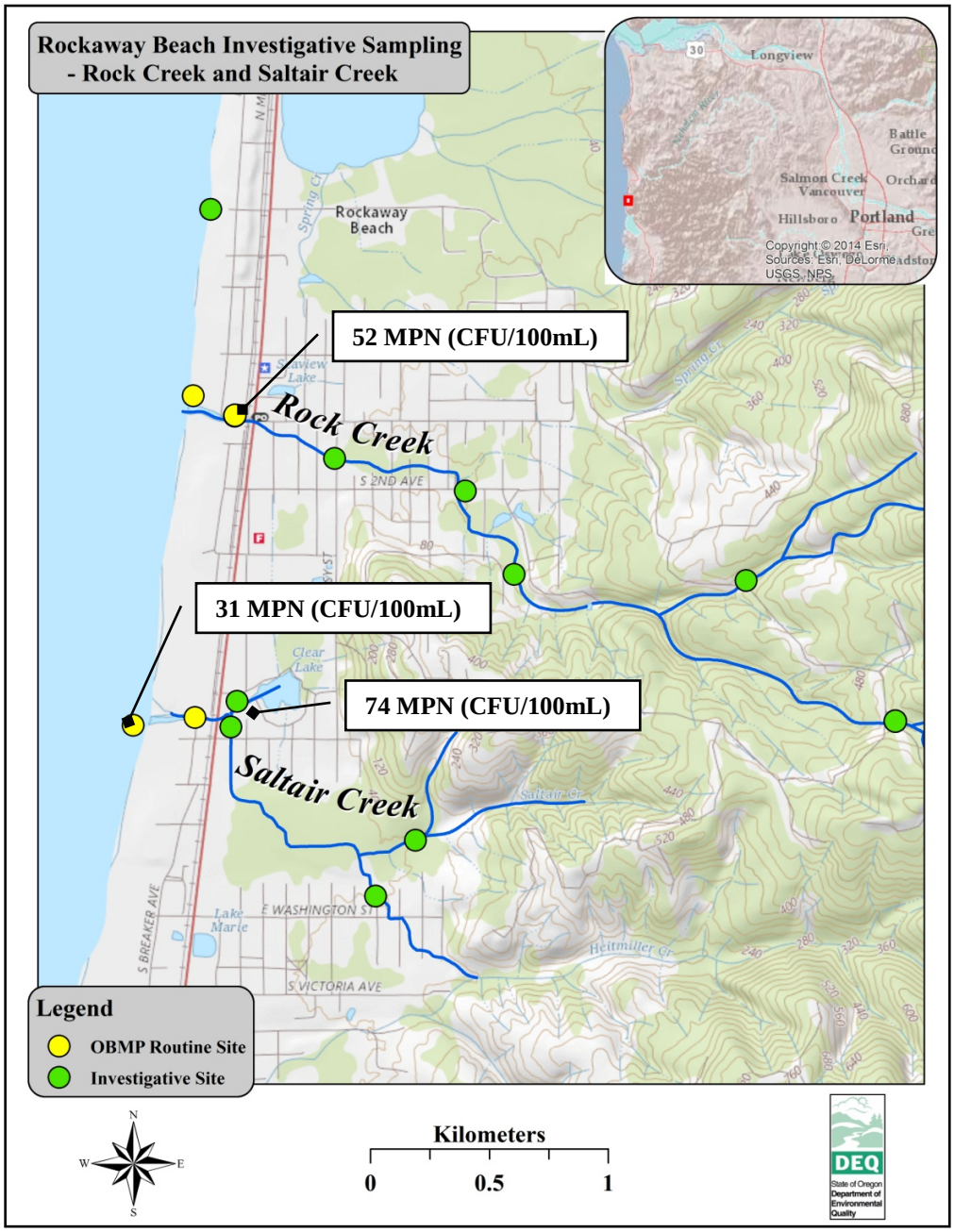

Figure 2. In the Rock Creek and Saltair Creek drainages, investigative sites (green circles) and OBMP routine monitoring sites (yellow circles) were sampled during November and December 2016. The lowermost routine monitoring site on each creek was a marine sample collected where the creeks discharge into the Pacific Ocean, all other sites were freshwater. The sample site with the highest bacterial count is shown in each drainage.

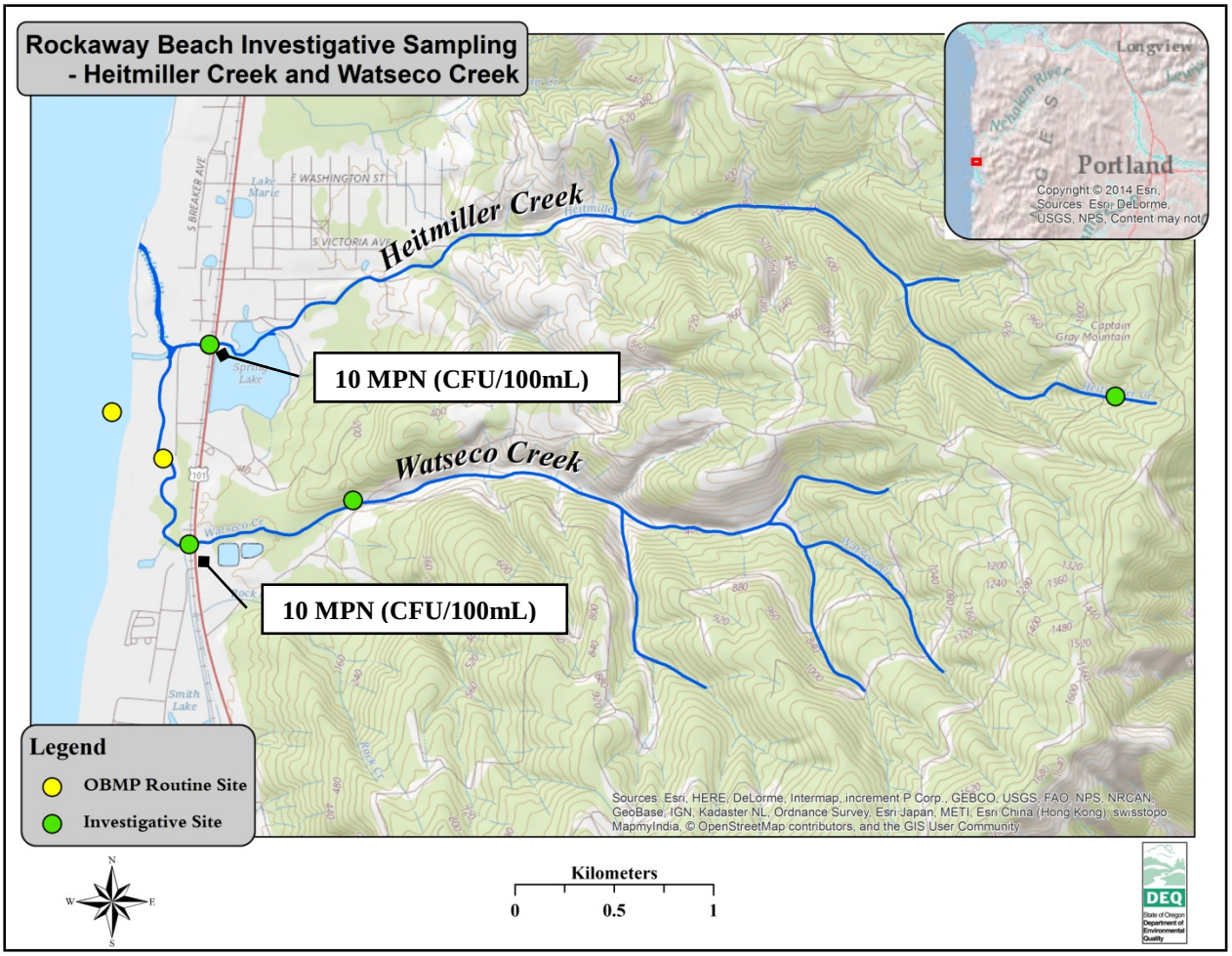

Figure 3. In the Heitmiller Creek and Watseco Creek drainages, investigative sites (green circles) and OBMP routine monitoring sites (yellow circles) were sampled during November and December 2016. The lowermost routine monitoring site on Heitmiller Creek was a marine sample collected where the creek discharges in the Pacific Ocean, all other sites were freshwater. The sample site with the highest bacterial count is shown in each drainage.

2.2 Field Methods

2.2.1 Bacteria Sample Collection and Quantification

Water samples were collected from marine and freshwater sample sites in whirlpaks. Samples were stored up to 8 h on wet ice prior to processing and incubation. Samples were collected in accordance with the DEQ Water Quality Monitoring Mode of Operations Manual Vol. 4, Field Collection Methods (DEQ 2014; Table 2).

This project followed EPA approved methods for quantifying the FIB *Enterococcus* sp. (USEPA, Questions and Answers) in accordance with the DEQ Water Quality Monitoring Mode of Operations Manual Vol. 4 Field Analytical Methods (DEQ 2016b). Enterolert methods use nutrient-indicators that fluoresce when metabolized by FIB (IDEXX, Enterolert, 2013). Results from these methods are quantified using a probability table and are reported as a most probable number (MPN). Water quality criteria for FIB are often described as colony forming units per 100 ml (CFU/100 ml).

Epidemiological studies conducted by EPA have shown *Enterococcus sp.* to be a good predictor of gastrointestinal illness (GI) in fresh and marine recreational waters, while *E. coli* is a good predictor of GI in freshwater (USEPA 2012). The OBMP has tested marine and freshwater samples for *Enterococcus sp.* throughout the program's history (DEQ 2006). Thus, samples collected in this study were tested for *Enterococcus sp.* to maintain consistency with OBMP methods and to allow comparisons to historical OBMP data. Testing samples for *E. coli* would require additional time and expense and may not provide additional information about the sources of bacterial contamination at the sampled locations.

2.2.2 Water Quality Measurements

At freshwater sample sites, water temperature, specific conductance, and salinity were quantified, while at marine sample sites, water temperature and salinity were quantified. Meter calibrations were checked daily against standards in the lab or in the field. All sampling was conducted in accordance with DEQ Water Quality Monitoring Mode of Operations Manual Vol. 4, Field Analytical Methods, 2016b; Table 2).

Table 2. Summary of water sample collection and handling field methods.

Matrix	Analytical Parameters	Sample Type	Container	Preservation	Holding Time	Reference Method
Marine Water	Enterococcus	Grab	Whirlpak	Wet ice	8 h	Enterolert/Quantitray
Marine Water	Salinity, Temperature	Grab	Whirlpak	None	None	Watershed Assessment MOM (DEQ03-LAB-0036-SOP V4)
Fresh Water (creek, pipe effluent)	Enterococcus	Grab	Whirlpak	Wet ice	8 h	Enterolert/Quantitray
Fresh Water (creek, pipe effluent)	Specific Conductance, Temperature	Grab	Whirlpak	None	None	Watershed Assessment MOM (DEQ03-LAB-0036-SOP V4)

3. Results

3.1 Bacteria Quantification

Sampling was conducted weekly between November 2, 2016 and December 7, 2016 and occurred over a total of five days. Of the 128 samples collected from marine and freshwater sites and analyzed for *Enterococcus*, zero samples exceeded the BAV of 158 MPN (CFU/100 mL). The highest bacteria counts occurred in Saltair Creek [74 MPN (CFU/100mL); Table 3] at Clear Lake runoff north of 6th Avenue (Figure 2) and Rock Creek [52 MPN (CFU/100mL); Table 3] at South 1st Avenue (Figure 2). In Heitmiller and Watseco creeks the highest bacteria count was 10 MPN (CFU/100mL; Table 3; Figure 3). At the four marine sites, the highest bacteria count was 31 MPN (CFU/100mL; Table 3) at the Rockaway Beach at Saltair Creek mouth site (Figure 2).

The high frequency of non-detections made calculation of geometric means for each site unreliable. Therefore, geometric means are not reported for this investigation.

Table 3. Overall, low bacteria colony counts were detected in samples collected at freshwater and marine sample sites in the vicinity of Rockaway Beach. No sample from any location exceeded the BAV of 158 CFU/100 mL.

Location	Sample Matrix	Sample Sites	Total Samples	Non-Detection Samples	Highest *Enterococcus* Count MPN (CFU/100mL)
Rock Creek	fresh	6	34	27 (79%)	52
Saltair Creek	fresh	5	36	26 (72%)	74
Heitmiller Creek	fresh	2	11	10 (91%)	10
Watseco Creek	fresh	3	17	15 (88%)	10
Rockaway Beach at N. 6th Ave	marine	1	6	5 (83%)	20
Rockaway Beach at Rock Creek	marine	1	6	3 (50%)	20
Rockaway Beach at Saltair Creek	marine	1	12	8 (75%)	31
Twin Rocks Beach at Heitmiller Creek	marine	1	6	4 (67%)	10

3.2 Water Quality Measurements

At freshwater sample sites in the four creek drainages, average water temperature ranged from 10.2° C to 10.7° C, and average specific conductance ranged from 75.6 µS/cm to 120.5 µS/cm (Table 4). At marine sample sites, average water temperature ranged from 12.2° C to 12.7° C and average salinity ranged from 18.5 PPTH to 28.4 PPTH (Table 4).

Table 4. Temperature, specific conductance, and salinity (mean ± standard error of the mean) from freshwater and marine sample sites in the vicinity of Rockaway Beach.

Location	Sample Matrix	Sample Sites	Sample Number	Temperature (°C)	Specific Conductance (µS/cm)	Salinity (PPTH)
Rock Creek	fresh	6	34	10.4 (±0.4)	77.8 (±2.6)	<0.1
Saltair Creek	fresh	5	36	10.7 (±0.4)	120.5 (±18.1)	0.1
Heitmiller Creek	fresh	2	11	10.4 (±0.8)	75.6 (±9.8)	<0.1
Watseco Creek	fresh	3	17	10.2 (±0.5)	80.8 (±7.1)	<0.1
Rockaway Beach at N. 6th Ave	marine	1	6	12.7 (±0.6)	NA	28.4 (±1.4)
Rockaway Beach at Rock Creek	marine	1	6	12.4 (±0.7)	NA	21.8 (±4.4)
Rockaway Beach at Saltair Creek	marine	1	12	12.7 (±0.3)	NA	25.2 (±2.6)
Twin Rocks Beach at Heitmiller Creek	marine	1	6	12.2 (±0.6)	NA	18.5 (±4.8)

4. Summary

Investigative sampling within the four creek drainages in the Rockaway Beach area did not identify possible sources of bacterial contamination observed at beaches during the 2016 routine monitoring season. Bacteria counts in all drainages were low, thus source identification was not feasible. In total, 77% of samples from freshwater and marine sites resulted in no detection of *Enterococcus* and no sample exceeded the BAV. The results contrast strongly with those of previous investigative sampling conducted in the fall of 2012 in streams near Cannon Beach (DEQ 2013). During this study, high counts of the FIB *Enterococcus* and *E. coli* were detected at many sample locations. The reasons for the difference in sampling results between the two years is not known, however differences in seasonal

environmental conditions (i.e., precipitation and stream flow/discharge) are likely to have contributed to the low counts observed in 2016.

Although bacteria counts during fall investigative sampling were mainly low, several elevated bacteria counts occurred and were at similar locations as elevated counts during summer routine monitoring. During summer routine monitoring, the highest bacteria counts occurred at beaches associated with the mouths of Saltair and Rock creeks. Similarly, during investigative sampling, the highest bacteria counts occurred in the Saltair Creek and Rock Creek drainages. In Saltair Creek, the highest result occurred in a stream draining out of Clear Lake. Ponded freshwater lakes and other lentic environments such as Clear Lake are known to be sources of FIB contamination in recreational waters (He et al. 2007). Historical bacterial monitoring data for Clear Lake is scant. However, one *Enterococcus* quantification conducted in 1994 resulted in a low count (20 MPN [CFU/100mL]; Oregon DEQ unpublished data). Continued monitoring of the Clear Lake outlet stream may be warranted in future sample years if high bacteria counts persist in Saltair Creek and the nearby beach.

The cause of the low bacteria counts observed in investigative samples is not known. Ideally, investigative sampling is intended to occur before or during 'first flush' rain events in the autumn. Flushing of bacterial contamination that has accumulated over the dry summer months in creeks, discharge pipes, and other sources during these storm events is thought to help locate and identify potential bacterial contamination sources. This was the case in 2012 when investigative sampling conducted in the Cannon Beach area in October resulted in high bacteria counts at many of the sites sampled (DEQ 2013). In 2016, investigative sampling began after the onset of autumn precipitation and the first flush. In addition, the Oregon coast received record precipitation in October 2016 (ncdc.noaa.gov). The two closest river systems north and south of Rockaway Beach with USGS stream gauging stations provide evidence of the high stream flow occurring throughout the region prior to and during the 2016 investigative sampling period (Figure 4). Both rivers had discharges that were orders of magnitude higher than median flows in the month prior to sampling (Figure 5). By contrast, during 2012 investigative sampling in the Cannon Beach area, these same gauging stations showed river discharges below median values during the month prior to sampling (Figure 6). Investigative sampling in 2012 successfully captured the first flush rain event at streams in the Cannon Beach area on the second day of sampling (Figure 6). In 2016, by contrast, the consistently high stream flows throughout October are likely to have washed out bacterial accumulations prior to the onset of sampling in early November, resulting in the high frequency of non-detections in the study. Any future investigative sampling in the Rockaway Beach area should be conducted to the extent possible in conjunction with first flush rain events to better elucidate potential sources of bacterial contamination of creeks and beaches in this area.

Ongoing routine monitoring of beaches in the Rockaway Beach area is scheduled to occur in future years as part of the OBMP. If high bacteria counts and frequent water contact advisories persist, additional investigative sampling in tributaries in the area may be warranted to again try and determine bacterial source locations. During the 2017 routine monitoring season (May 28 through September 4), low bacteria counts were observed at six OBMP monitoring sites in the Rockaway Beach area (Appendix B) and no water contact advisories occurred during the season. As such, no investigative sampling was conducted in 2017 following the routine monitoring season. In future years, decisions regarding the need for investigative sampling in this area will continue to be made according to results observed during the routine monitoring season.

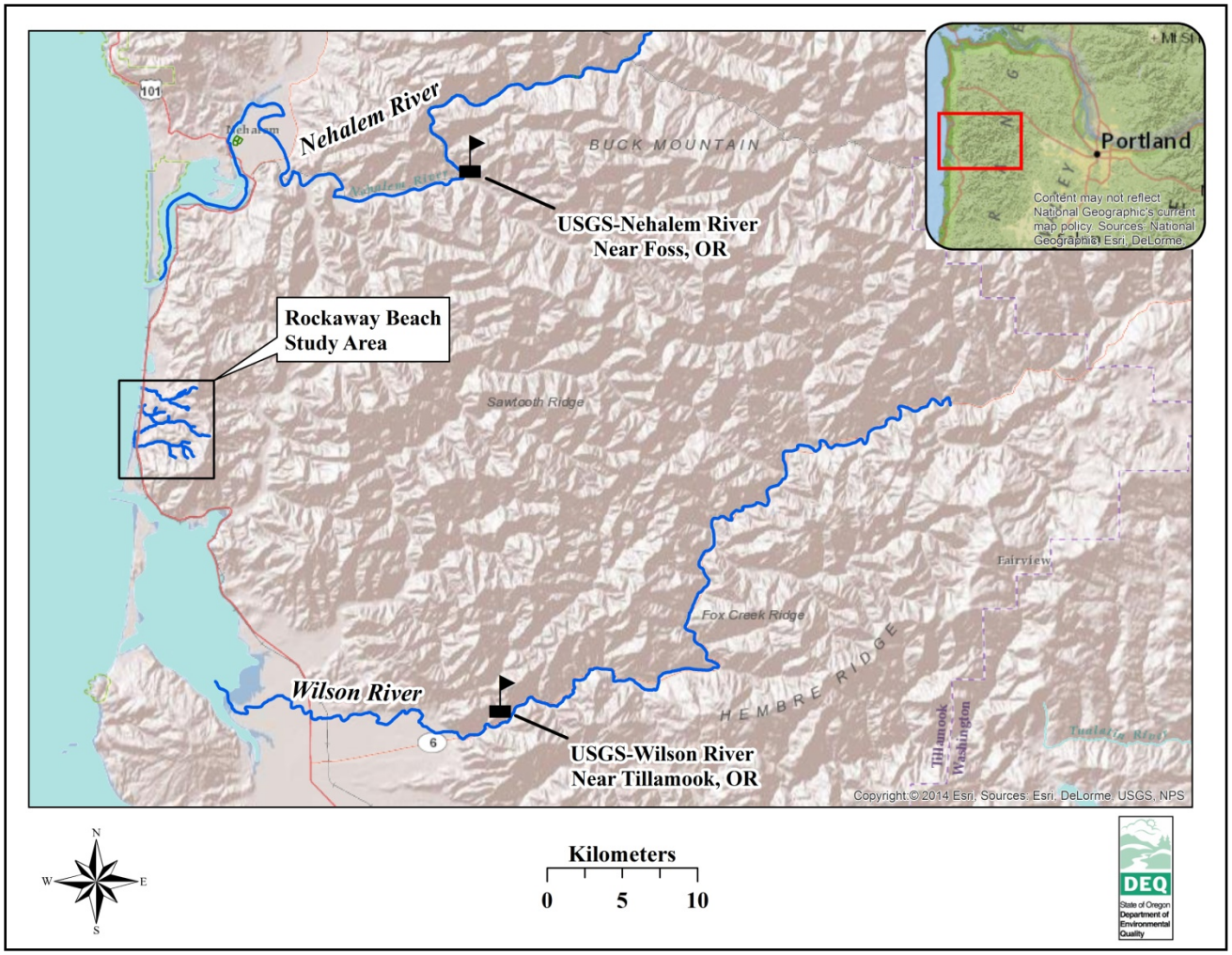

Figure 4. USGS gauging stations in the vicinity of the study area are located on the Nehalem River (about 15 km NE) and Wilson River (about 20 km SE). Discharge data from these gauging stations provide a useful illustration of streamflow conditions occurring in study area creeks in the month prior to and during the investigative sampling period.

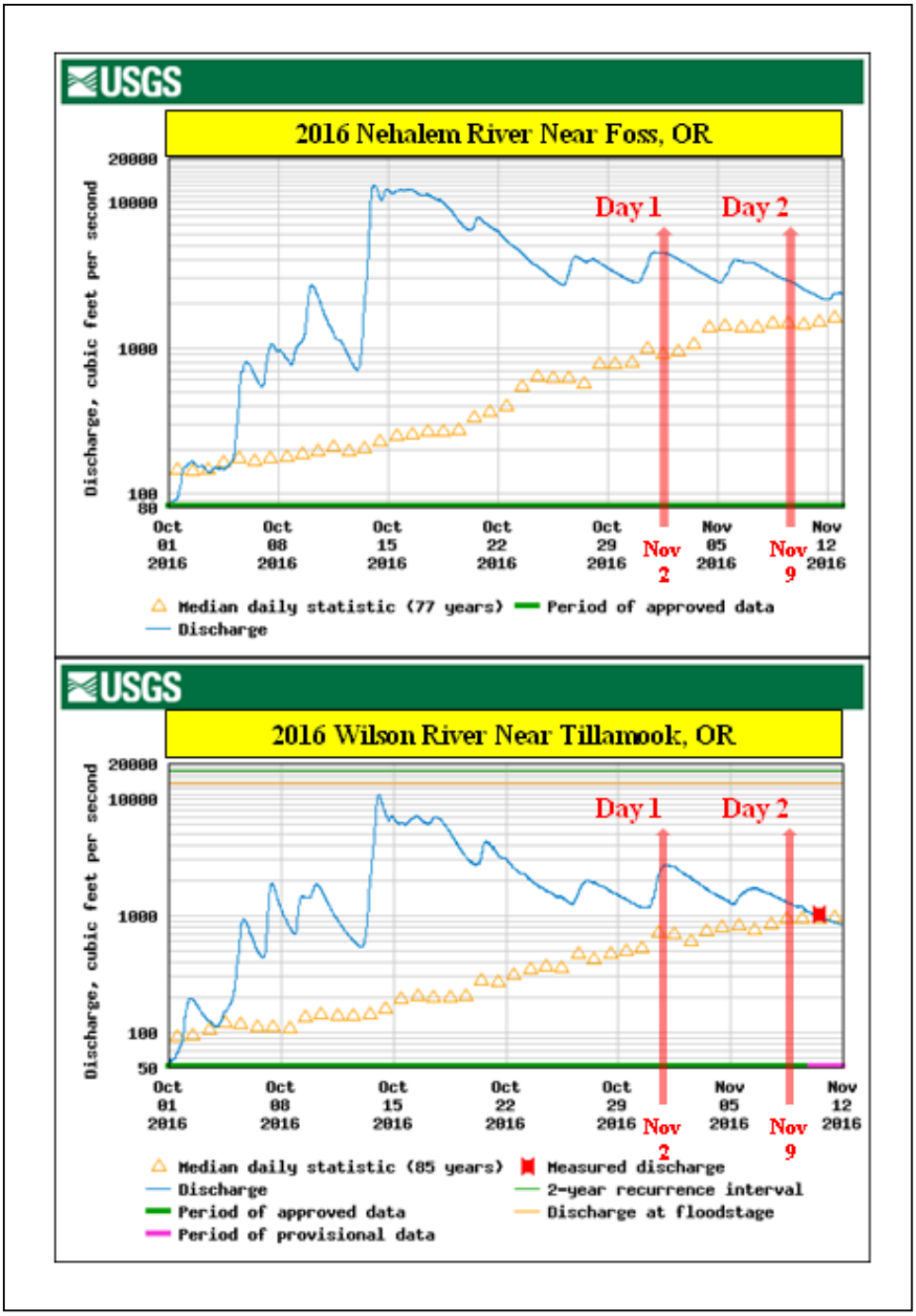

Figure 5. Discharge on the Nehalem River and Wilson River during the month prior to and initiation of investigative sampling in the Rockaway Beach area in 2016. Superimposed over measured discharge and 85 year median discharge data are vertical bars representing the approximate timing of sampling days one and two.

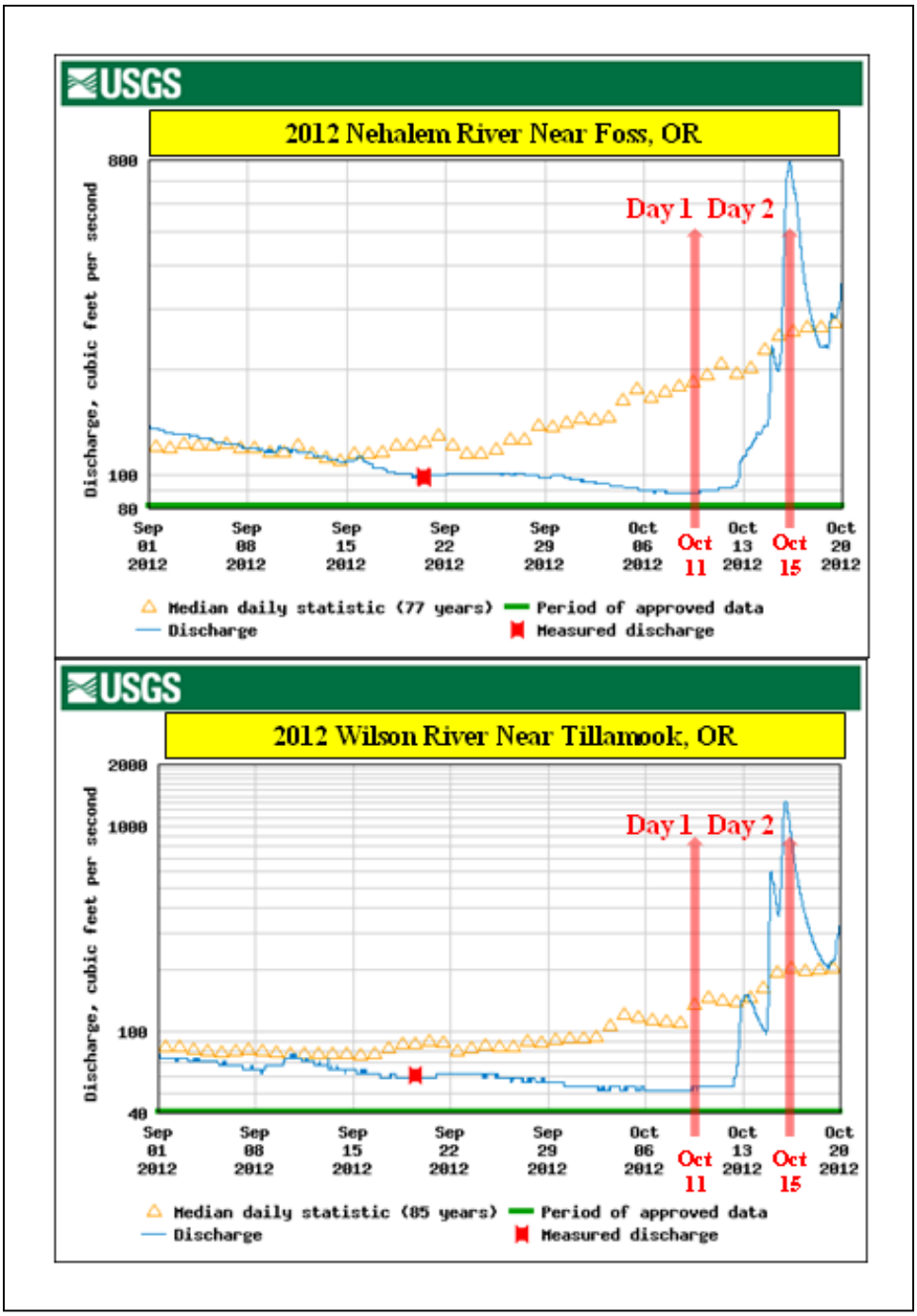

Figure 6. Discharge on the Nehalem River and Wilson River during the month prior to and initiation of investigative sampling in the Cannon Beach area in 2012 (DEQ 2013). Superimposed over measured discharge and median discharge data are vertical bars representing the approximate timing of sampling days one and two.

Appendix A

Table 5. Geographic coordinates of locations sampled during investigative sampling conducted in November and December 2016.

Site Name	Latitude	Longitude
Rockaway Beach at North 6th Street	45.61884	-123.945
Rockaway Beach at Rock Creek (South 1st Avenue)	45.61391	-123.946
Rock Cr. at Rockaway Beach (South 1st Ave. parking area)	45.6133	-123.945
Rock Creek at Easy Street	45.61225	-123.941
Rock Creek at South 2nd Ave. and Lagoon St.	45.61139	-123.936
Rock Creek 100 m south of S. Rock Creek Rd.	45.60919	-123.934
Rock Creek at ORM road 1 km SE of N 3rd St. ORM gate	45.60902	-123.925
Clear Lake runoff north of 6th Ave. 5 m upstream of Saltair Cr. confluence	45.60557	-123.945
Saltair Creek north of 6th Avenue upstream of Clear Lake confluence	45.60546	-123.945
Saltair Cr. at Rockaway Beach (South 6th Ave. access)	45.60541	-123.946
Rock Creek at ORM road 1.75 km SE of N 3rd St. ORM gate	45.6053	-123.92
Rockaway Beach at Saltair creek (South 6th Avenue)	45.6052	-123.948
Saltair Creek N. of Island St. at footbridge in Cedar Wetlands Preserve	45.60215	-123.938
Trib. to Saltair Creek at S. Grayling St.	45.60068	-123.939
Heitmiller Creek at railroad culvert south of Pansy Street	45.59505	-123.947
Heitmiller Creek at ORM road 4.5 km SE of N 3rd St. ORM gate	45.5934	-123.906
Twin Rocks Beach at Watseco Creek	45.5929	-123.952
Watseco/Heltmiller CR at Twin Rocks Beach at W of Pacific ST	45.59144	-123.949
Watseco Creek at ORM road 0.7 km NE of Highway 101 at mile post 52.75	45.59011	-123.941
Watseco Creek at Highway 101 railroad trestle W. of STP	45.58881	-123.948

Appendix B

2017 Routine Beach Monitoring Results

In 2017, continued monitoring of six sites in the Rockaway Beach area was conducted as part of the statewide OBMP routine monitoring program. The sites are the same as those sampled during the 2016 sample season, and where high bacteria counts precipitated the investigative sampling effort discussed in this report. Three of the sites are in marine waters located near the mouths of Rock, Saltair, and Watseco/Heitmiller creeks, and three sites occur in freshwater portions of the creeks near their mouths (Figure 2; Figure 3). Five sample events were conducted between May 28th (Memorial Day) and September 4th (Labor Day) 2017.

According to guidance from the EPA, in 2017 Oregon adopted a revised BAV threshold of 130 MPN (CFU/100mL). This new BAV is a reduction from 158 which had been used since 2002. Of the 30 samples collected in marine and freshwater in the Rockaway Beach area in 2017, two exceeded the

newly adopted BAV of 130 MPN (CFU/100mL; Table 6). However, both samples were collected in freshwater, one in Rock Creek (135 MPN [CFU/100mL]) and one in Saltair Creek (146 MPN [CFU/100mL]). As such water contact advisories were not issued in these cases. In general, bacteria counts were low at the six sample sites (Table 6). Given these low results, no investigative sampling was conducted in the area in 2017.

Table 6. Bacteria counts at six routine OBMP sample sites in 2017 were generally low, however 2 freshwater samples exceeded the newly-adopted Oregon BAV of 130 MPN (CFU/100mL).

Location	Sample Matrix	Total Samples	Non-Detection Samples	Highest *Enterococcus* Count MPN (CFU/100mL)
Rock Creek	fresh	5	2 (40%)	135
Saltair Creek	fresh	5	2 (40%)	146
Watseco/Heitmiller Creek	fresh	5	0 (0%)	41
Rockaway Beach at Rock Creek	marine	5	1 (20%)	97
Rockaway Beach at Saltair Creek	marine	5	5 (100%	<10
Twin Rocks Beach at Heitmiller Creek	marine	5	2 (40%)	120

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