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ECOLOGY
State of Washington

Standard Operating Procedure EAP092, Version 1.4

BEACH Program Bacteria Sampling

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Purpose of this Document

The Washington State Department of Ecology develops Standard Operating Procedures (SOPs) to document agency practices related to sampling, field and laboratory analysis, and other aspects of the agency's technical operations.

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SOP Revision History

Revision Date	Revision History	Summary of Changes	Sections	Reviser(s)
9/17/2014	1.0	SOP development	All	Debby Sargeant
4/04/2017	1.1	Additional lab method and updated field form.	Table 1 & Attachment A	Julianne Ruffner
3/19/2020	1.2	Additional language added regarding field data collection, sample holding time, and training video.	Field Processing	Julianne Ruffner
3/19/2020	1.2	Added updated field log	Attachment A	Laura Hermanson
4/20/2021	1.3	Applied Accessibility standards	All	Joan LeTourneau
3/22/2023	1.4	Added field form and alt text Updated database name	6.4.3 7.0	Laura Hermanson

1.0

Purpose and Scope

This document is the Beach Environmental Assessment, Communication, & Health (BEACH) Program's Standard Operating Procedure (SOP) for collecting marine and freshwater samples for laboratory analysis of bacteria. The BEACH program aims to reduce the risk of disease to users of recreational saltwater beaches. The program monitors bacteria levels at popular, high-risk beaches during the swimming season; and notifies the public when there is an increased risk of illness from swimming.

Typically, the BEACH program obtains marine water samples for enterococcus bacteria analysis. Of the fecal indicator bacteria (FIB), enterococcus has been shown to have the highest correlation with swimmer related illness. This SOP is appropriate for collecting other types of FIB, such as fecal coliform and *Escherichia coli*. Methods for laboratory analysis are included in Table 1.

This SOP includes the procedures for sample collection by hand or with an extension pole.

Table 1. Approved BEACH Program Bacteria Laboratory Methods.

Bacterial Fecal Indicator	Method
Enterococcus	MPN/multiple well: ASTMD 6503-99; Enterolert Method®; SM 9230B, SM 9230D MF: EPA Method 1600; SM 9230C
Fecal Coliform	MPN: SM 9221E MF: SM 9222D
<i>Escherichia coli</i>	MPN: EPA Method 1104, SM 9221F, SM 9223B Colilert Method® MF: EPA Method 1603; SM 9222I (Proposed)

MPN: Most probable number

MF: Membrane filter

ASTMD: American Society for Testing and Materials

SM Standard Methods (APHA, 2012)

2.0 Applicability

This SOP applies to the collection of bacteria samples in surface water.

3.0 Definitions

- 3.1 BEACH Program – Beach Environmental Assessment, Communication, and Health Program.
- 3.2 Ecology – Washington State Department of Ecology.
- 3.3 EAP – Environmental Assessment Program.
- 3.4 EIM – Environmental Information Management System. A searchable database developed and maintained by the Washington State Department of Ecology.
- 3.5 Enterococci – A genus of bacteria that inhabit the intestinal tract of warm-blooded animals and remain viable (alive and capable of infecting another organism) in water for a variable period of time. The presence of enterococcus in water indicates fecal contamination by a warm-blooded animal; harmful bacteria, viruses, or protozoa associated with fecal contamination may also be present.
- 3.6 *Escherichia coli* (*E. coli*) – A species of bacteria that inhabit the intestinal tract of warm-blooded animals and remain viable (alive and capable of infecting another organism) in water for a variable period of time. While *E. coli* are normally harmless and live in the intestines of healthy people and animals a few strains may cause illness. The presence of *E. coli* bacteria in water indicates fecal contamination by a warm-blooded animal; harmful bacteria, viruses, or protozoa associated with fecal contamination may also be present.
- 3.7 Fecal coliform – A group of bacteria that inhabit the intestinal tract of warm-blooded animals and remain viable (alive and capable of infecting another organism) in water for a variable period of time. The presence of fecal coliform bacteria in water indicates fecal contamination of the water by a warm-blooded animal; harmful bacteria, viruses, or protozoa associated with fecal contamination may also be present.
- 3.8 FIB – Fecal indicator bacteria. A group of organisms that indicate the possible presence of pathogenic (disease-causing) bacteria. Although FIB are not generally harmful themselves, they indicate the possible presence of pathogenic (disease-causing) bacteria, viruses, and protozoan that also live in the human and animal digestive systems. Therefore, their presence in streams suggest that pathogenic microorganism might also be present.
- 3.9 Field Data Form – Paper form specific to each beach sampling site used to document all field activities, sample data, methods, site conditions, and observations for each beach.
- 3.10 QA – Quality Assurance

- 3.11 SAW – Secure Access Washington, allows access to multiple online government services. The BEACH SAW access allows data entry input into the BEACH database.

4.0 Personnel Qualifications/Responsibilities

BEACH Program samplers include BEACH Program staff, local government and Tribal staff, and volunteers. All samplers undergo sample training from BEACH Program staff or their respective group coordinator following the procedures outlined in this SOP.

Some beaches can present a hazard due to tides. Hazards include but are not limited to exposure of unsafe surfaces due to low water and unsafe passage due to high water. Samplers must use personal judgment when sampling a beach to ensure their safety.

BEACH Program staff conducting sampling will follow the safety guidelines outlined in the Ecology Safety Manual and EAP's Field Safety Manual (Ecology, 2012).

Laboratory samples will be analyzed by laboratories accredited by the State of Washington.

5.0 Equipment, Reagents, and Supplies

5.1 Supplies

- Sterile bacteria sample bottles
- Gloves (optional).
- Extension pole with bottle clamp (optional).
- Cooler containing ice.
- Map with station locations (aerial photo).
- Field Data Form (Appendix A).
- Antibacterial hand sanitizer.
- Sample tags, and Chain of Custody form if needed.
- Watch, or time keeping device.
- Writing implements.

- 5.2 Sample containers
- 5.2.1 Typical bacteria sample containers are 100, 250, or 500 mL pre-autoclaved polypropylene bottles. The sample bottles are supplied by the laboratory and should be replaced by the sampler when dropping off samples at the laboratory. Bottles should not be used after 6 months.

6.0 Summary of Procedure

- 6.1 Field Preparation
- 6.1.1 Prepare a sample schedule that includes field QA duplicates. Reference a tide chart while developing the sample schedule.
- 6.1.2 One month before the start of the sample season, notify the laboratory of the specifics of the sampling regime (some laboratories may require more notice to obtain reagents). Notify the laboratory of the BEACH sample season period, sample dates, and the number of samples per week. Generally sampling occurs from Monday through Thursday.
- 6.1.3 Before sampling check tidal heights to ensure it is safe for sampling. It is unsafe to sample some muddy beaches at low tide; or to access some beaches at higher tides. In addition, make sure that there is enough time to conduct all sampling and deliver the samples to the laboratory by the appropriate time and within six hours of sample collection.
- 6.2 General Sampling Techniques
- 6.2.1 Care should be used to avoid contamination of the inside of the sample bottle and cap. The sample should be placed in the dark, on ice in a cooler as soon as possible after collection. **BEACH bacteria samples have a maximum holding time and need to be received at the lab within 6 hours.**
- 6.2.2 Do not rinse the bottle and do not pour water into a bacteria bottle from another non-sterilized container.
- 6.2.3 Be very careful not to disturb bottom sediments while sampling. If sampling in an area with muddy substrate use a sampling extension pole (Figure 1).
- 6.2.4 When obtaining freshwater samples always collect the sample from the thalweg or most active, flowing part of the stream. When obtaining samples face the opening of the bottle into the tidal stream for marine water, and upstream for freshwater.
- 6.2.5 Avoid sample collection from the surface layer of water and near the substrate (bottom). For freshwater sampling avoid sampling back eddies and side channels. In extremely shallow depths, collect the sample from the surface if unavoidable and record in the field notes.

- 6.2.6 When filling the sample bottle, be careful to pull the bottle out of the water as it reaches the point where it is filled to at or near the shoulder of the bottle. If the bottle becomes filled above this level, then pour out excess sample.



Figure 1. Sampling extension pole with bottle.

6.3 Sample Collection

A training video on BEACH program water quality sampling is available at <https://ecology.wa.gov/Water-Shorelines/Water-quality/Saltwater/BEACH-program/For-BEACH-samplers> or on YouTube at https://www.youtube.com/watch?v=cTjIGbUZcYM&feature=emb_logo.

6.4 Swimming Beach Sampling Methodology

6.4.1 Wade into approximately 2.5 feet of water.

6.4.2 Remove the bottle lid. Invert the bottle, plunge the bottle into the water about 15 cm (6 inches), and tip the bottle mouth up (still submerged). Allow the bottle to fill and then take it out of the water.

6.4.3 If sampling in an area with floating debris in the water (like algae, seaweed, or beach wrack) unscrew the bottle cap and leave the bottle cap on the bottle with a small opening (Figure 2). Plunge the bottle with the cap still on into the water 15 cm (6 inches) filling the bottle and avoiding particulates in the water. Note on the Field Data Form the sampling technique and the kind of debris/particulate in the water.

6.4.4 If the bottle is filled above the shoulder, then immediately pour out enough excess sample to ensure the sample volume is at or near the shoulder. Replace the bottle lid.



Figure 2. Bottle with small opening between bottle and cap.

- 6.5 Extension Pole Method
 - 6.5.1 Secure the sample bottle in the extension pole clamp (Figure 1).
 - 6.5.2 Remove the lid and position the bottle over the desired sample location, in approximately 2.5 feet of water.
 - 6.5.3 Invert the bottle and in one quick motion plunge the mouth of the bottle into the water about 15 cm (6 inches) below the surface. Then tip the bottle mouth up (still submerged) to fill the bottle.
 - 6.5.4 Take the bottle out of the water. If the bottle is filled above the shoulder, then pour off enough excess sample so the sample volume is at or near the shoulder. Replace the lid.
- 6.6 Field Processing
 - 6.6.1 Note sample site identification, sample date, and time on the sample tag.
 - 6.6.2 Label the collected sample bottle with the appropriate tag and immediately place the sample on ice in a cooler to preserve the sample during shipment to the laboratory.
 - 6.6.3 Fill out the Field Data Form completely including any unusual sample conditions (Figure 3). Check to make sure all information about sampling conditions and times are noted. Count people, dogs, and birds that are in the sampling area during the time sampling occurs. Anyone that is making contact with the water is considered in the water, therefore, people do not have to be submerged, but can be wading as well.
 - 6.6.4 If the sample obtained is a duplicate, note that on the sample tag and the Field Data Form.
 - 6.6.5 Notify the laboratory if the sample is a marine or freshwater sample. This may make a difference in sample dilution.
 - 6.6.6 Deliver the samples to the laboratory within six hours of sample collection.

Beach Name:
 Stations:
 Duplicate Sample Station:

Sampled Date	____/____/____		Time ____:____	
Sampled By			Tide Height	Feet
Tide Phase	LowTide	¼Flood	MidFlood	¾Flood
	HighTide	¼Ebb	MidEbb	¾Ebb
Wind Direction	from the N NW W SW S SE E NE			
Wind Speed	Calm	1-3mph	4-8mph	9-12mph
	13-18mph	19-25mph	25+	
Recent Rain	24hours	48hours	72hours	4-7days
	>1week			
Weather	Clear/Sun	Hazy	PartCloudy	Cloudy
	LightShowers	Rain		
People in Water	Comments:			
People on Beach				
Dogs on Beach				
Birds on Beach				
Air Temp				
Water Temp	Algae/seagrass in water? Y/ N Algae/seagrass on beach? None/ Low (1-20%)/ Moderate (21-50%)/ High (>50%) Condition of algae/seagrass: Fresh/ Decaying Does the algae/seagrass have a foul odor? Y/ N Water Clarity: Clear/ Murky Breaking waves on beach? Y/ N			
Salinity (ppt)				

Figure 3: Beach sampling field form.

Image description (Figure 3): The beach sampling form contains fields for entering the following sampling data: Beach name, stations, duplicate sample station, sample date/time, name of the sampler, tide height, tide phase, wind direction, and speed, rainfall, weather conditions, air temperature, water temperature, salinity, number of people in the water and on the beach, and number of dogs and birds on the beach. The form also includes a comment section for notes on algae/seagrass volume, water clarity, and wave conditions.

7.0 Records Management

- 7.1 Field data from the Field Data Form should be entered into the BEACH SAW system by the local field lead. <https://secureaccess.wa.gov/myAccess/saw/select.do>
- 7.2 Laboratory results should be entered into the BEACH SAW system by the laboratory analyzing the samples.
- 7.3 All electronic and hardcopy documentation of the data, such as the Field Data Forms and laboratory results should be sent to the BEACH Program staff. The BEACH Program Coordinator will keep electronic and hardcopy files for six years. After that time hardcopy files and electronic files (transferred to disc) will be boxed and moved to EAP archives.

8.0 Quality Control and Quality Assurance

- 8.1 The QA process consists of two parts: (1) adherence to the SOP procedures for sample/data collection, and periodic evaluation and training of sample personnel and (2) the collection of a field QC sample.
- 8.2 A field duplicate QC sample will be obtained for 10 percent of the samples collected by county by year. The field duplicate should be collected concurrently with the sample, or immediately (within one minute) after sample collection.
- 8.3 Recommendations for evaluating precision from bacteria duplicate results can be found in Mathieu (2006).
- 8.4 After field and laboratory data are entered into the BEACH SAW system and the BEACH database, BEACH staff will review all data entered for accuracy.

9.0 Safety

- 9.1 Safety is the primary concern when collecting samples. BEACH sample sites can be hazardous due to tidal conditions, waves, and current. Samplers must use personal judgement when sampling a beach to ensure their safety. **DO NOT SAMPLE** if hazardous conditions are present. Note the reason on the Field Data Form.
- 9.2 Wear gloves to avoid exposure to harmful microorganisms. If gloves are not worn, clean your hands using anti-bacterial soap or hand sanitizer after completing work at each beach, and after completing work at sampling stations with known high bacteria counts.

10.0 References

- 10.1 APHA (American Public Health Association), American Waterworks Association, and Water Environment Federation, 2012. Standard Methods for the Examination of Water and Wastewater, 22th Edition, American Public Health Association, Washington, DC.

- 10.2 Ecology, 2012. Environmental Assessment Program Safety Manual. Washington State Department of Ecology. Olympia WA.
- 10.3 Mathieu, N., 2006. Replicate Precision for 12 TMDL Studies and Recommendations for Precision Measurement Quality Objectives for Water Quality Parameters. Washington State Department of Ecology, Olympia, WA. Publication 06-03-044.
<https://apps.ecology.wa.gov/publications/SummaryPages/0603044.html>.

11.0 Appendix A

11.1 Printable field forms for samplers.

Beach Name:

Stations:

Duplicate Sample Station:

Sampled Date	____/____/____		Time ____:____						
Sampled By			Tide Height	Feet					
Tide Phase	LowTide	¼Flood	MidFlood	¾Flood	HighTide	¾Ebb	MidEbb	¼Ebb	
Wind Direction	from the	N	NW	W	SW	S	SE	E	NE
Wind Speed	Calm	1-3mph	4-8mph	9-12mph	13-18mph	19-25mph	25+		
Recent Rain	24hours	48hours	72hours	4-7days	>1week				
Weather	Clear/Sun	Hazy	PartCloudy	Cloudy	LightShowers	Rain			
People in Water		Comments:							
People on Beach									
Dogs on Beach									
Birds on Beach									
Air Temp	°F	Algae/seagrass in water? Y/ N							
Water Temp	°F	Algae/seagrass on beach? None/ Low (1-20%)/ Moderate (21-50%)/ High (>50%)							
Salinity (ppt)		Condition of algae/seagrass: Fresh/ Decaying							
		Does the algae/seagrass have a foul odor? Y/ N							
		Water Clarity: Clear/ Murky							
		Breaking waves on beach? Y/ N							