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State of Washington

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BEACH Program Bacteria Sampling

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Purpose of this document

The 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.

Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedures for BEACH Program Bacteria Sampling

Version 1.1

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EAP092

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Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by the Department of Ecology.

Although Ecology follows the SOP in most instances, there may be instances in which the Ecology uses an alternative methodology, procedure, or process.

SOP Revision History

Revision Date	Rev number	Summary of changes	Sections	Reviser(s)
9/17/2014	1.0	SOP development	all	Debby Sargeant
04/04/2017	1.1	Additional lab method and updated field form.	Table 1 & Attachment A	Julianne Ruffner
04/04/2017	1.1	Recertified	All	Bill Kammin

1.0 Purpose and Scope

1.1 This document is the Beach Environmental Assessment, Communication, & Health (BEACH) Program's Standard Operating Procedure (SOP) for the collection of marine and freshwater samples for laboratory analysis of bacteria. The goal of the BEACH program is 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.

1.2 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 the collection of other types of FIB such as fecal coliform and *Escherichia coli*. Methods for laboratory analysis are included in Table 1.

1.3 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, SM9230D
	MF: EPA Method 1600; SM 9230C
Fecal Coliform	MPN: SM 9221E
	MF: SM 9222D
Escherichia coli	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

2.1 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 inhabits the intestinal tract of warm-blooded animals and remains 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 water suggests 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 to be entered into the BEACH database.

4.0 Personnel Qualifications/Responsibilities

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

4.2 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 to ensure their safety when sampling a beach.

4.3 BEACH Program staff conducting sampling will follow the safety guidelines outlined in the Ecology Safety Manual and EAP's Field Safety Manuel (Ecology, 2017).

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

5.0 Equipment, Reagents, and Supplies

5.1 Supplies

5.1.1 Sterile bacteria sample bottles
5.1.2 Gloves
5.1.3 Extension pole with bottle clamp (optional).
5.1.4 Cooler containing ice.
5.1.5 Map with station locations (aerial photo).
5.1.6 Field Data Form (Attachment A).
5.1.7 Antibacterial hand sanitizer.
5.1.8 Sample tags and Chain of Custody form, if needed.
5.1.9 Watch or other time-keeping device.
5.1.10 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. *Note: bottles should not be used after six months.*

6.0 Summary of Procedure

6.1 Field Preparation

6.1.1 Prepare a sample schedule that includes field Quality Assurance (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. *Note: 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 at all times 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. *Note: BEACH bacteria samples have a maximum holding time of six 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 - Left).

6.2.4 When obtaining samples, face the opening of the bottle into the tidal stream for marine water and upstream for fresh water, always collecting the sample from the thalweg or most active, flowing part of a freshwater stream.

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. *Note: 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. Left: Sampling extension pole with bottle. Right: Bottle with small opening between bottle and cap.

6.3 Sample Collection

6.3.1 **Swimming Beach Sampling Methodology**

6.3.1.1 Wade into approximately 2.5 feet of water.

6.3.1.2 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.

6.3.1.3 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 1 - right). Plunge the bottle with the cap still on into the water 15 cm (6 inches) filling the bottle and avoiding particulate in the water. Note on the Field Data Form the sampling technique and the kind of debris/particulate in the water.

6.3.1.4. 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.

6.3.2 **Extension Pole Method.**

6.3.2.1 Secure the sample bottle in the extension pole clamp (Figure 1-left).

6.3.2.2 Remove the lid and position the bottle over the desired sample location in approximately 2.5 feet of water.

6.3.2.3 Invert the bottle and, in one quick motion, plunge the mouth of the bottle into the water about 15 cm (six inches) below the surface. Then tip the bottle mouth up (still submerged) to fill the bottle.

6.3.2.4. 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.

6.4 Field Processing

6.4.1 Note sample site identification, sample date and time on the sample tag.

6.4.2 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.

6.4.3 Fill out the Field Data Form completely including any unusual sample conditions. Check to make sure all information about sampling conditions and times are noted.

6.4.4 If the sample obtained is a duplicate, note that on the sample tag and the Field Data Form.

6.4.5 Notify the laboratory if the sample is a marine or freshwater sample. This may make a difference in sample dilution.

6.4.6 Deliver the samples to the laboratory within six hours of sample collection.

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.

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 Manager 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 Section

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 Quality Control (QC) sample.

8.2 A field duplicate QC sample will be obtained for 10 percent of the samples collected by county per 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 is 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 Gloves should be worn to avoid exposure to harmful microorganisms. If gloves are not worn, hands should be cleaned using antibacterial 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, 2017. *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 No. 06-03-044. fortress.wa.gov/ecy/publications/SummaryPages/0603044.html.

ATTACHMENT A: Field Data Form

Beach Name:
Stations:
Duplicate Sample Station:

Sampled Date	____/____/_____ ___:___		
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	°F		
Water Temp	°F		
Salinity (ppt)			

Please manually enter the following info in the Comments section of the website
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