Quality Assurance Project Plan for Status and Trends Monitoring of Shoreline Water Quality for Fecal Coliform Bacteria

For Monitoring Conducted by Pierce County to Comply with NPDES Municipal Stormwater Permit Special Condition S8.B Requirements

September 15, 2015

Publication information

This Quality Assurance Project Plan is available on the Department of Ecology's Regional Stormwater Monitoring Program (RSMP) website for National Pollutant Discharge Elimination System (NPDES) municipal stormwater permittees at http://www.ecy.wa.gov/programs/wq/stormwater/municipal/status.html.

Data for the RSMP will be available on Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search Study ID, RSMP_MSB2015. Data from Pierce County will be under Study ID RSMP_PC_MSB2015.

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Approved by:

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Introduction

Background on stormwater monitoring strategy

The Stormwater Work Group (SWG) is a coalition of federal, tribal, state, and local governments; business, environmental, and agricultural entities; and academic researchers. All SWG members have interests and a stake in the Puget Sound watershed. The SWG was convened by the Puget Sound Partnership (PSP) and the Washington State Department of Ecology (Ecology) in October 2008 to develop a regional stormwater monitoring strategy and to recommend monitoring requirements in National Pollutant Discharge Elimination System (NPDES) stormwater permits issued by Ecology.

In 2010, the SWG published an overall strategy for monitoring (SWG, 2010a). This strategy included recommendations for status and trends monitoring in the Puget Sound nearshore, with a focus on an integrated approach to quantify stormwater pollutant impacts in Puget Sound and to provide information to efficiently, effectively, and adaptively manage stormwater to reduce harm to the ecosystem.

The SWG also recommended a specific NPDES municipal permittee-funded plan for monitoring the effects of stormwater under the permits in the Puget Sound region (SWG, 2010b). The resulting program, a subset of the overall strategy, is called the Regional Stormwater Monitoring Program (RSMP). Specifically, the RSMP includes status and trends probabilistic sampling which is compatible with ongoing status and trends monitoring programs.

The RSMP pooled fund monitoring will not collect bacteria samples, but rather conduct data analysis based on local and state government programs around marine bacteria monitoring in the Puget Sound, including the data collected per this QAPP. This decision was made in (June 2014) by the SWG Pooled Resources Oversight Committee based on the number of groups collecting fecal indicator bacteria data collected in the Puget Sound, and the cost estimates of a probabilistic regional bacteria program.

Scope of this Quality Assurance Project Plan

Monitoring for this QAPP is focused on a single landscape scale, the marine shoreline and nearshore parallel to the City and Urban Growth Area (UGA). This sampling frame for Puget Sound was defined to include the basins, channels, and embayments of Puget Sound from the US/Canada border to the southern-most bays and inlets near Olympia and Shelton; Hood Canal; and portions of Admiralty Inlet, the San Juan Islands, and the eastern portion of the Strait of Juan de Fuca. The shoreline master sampling frame was targeted to the land-based UGA boundaries within the Puget Sound basin.

Permit Options

Ecology issued NPDES municipal stormwater permits (permits) for Phase I and Phase II communities (Ecology, 2012a,b) effective August 1, 2013 through July 31, 2018. The permittees in Puget Sound were given two options to comply with the permits' Special Condition S8.B for status and trends monitoring requirements. Every permittee in Puget Sound individually chose to either:

- Option 1: Pay a prescribed amount into a pooled fund to support RSMP status and trends monitoring. These permittees' role is limited to providing permit-defined amounts of funding for coordinated implementation of monitoring at sites throughout the Puget Sound region.

  OR

- Option 2: Conduct status and trends monitoring themselves at specified sites inside their jurisdictional boundaries, following the same protocols as the RSMP.

In fall 2013, Pierce County, and the City of Redmond officially selected the second option. This Quality Assurance Project Plan (QAPP) does not apply to the City of Redmond because Redmond's jurisdiction does not include any Puget Sound shoreline and they will not conduct nearshore marine monitoring. Pierce County must complete and follow this QAPP to comply with their permit requirements.

This QAPP defines the marine shoreline bacteria scientific monitoring design and protocols that these permittees will follow as well as the data and reports that they will produce. Marine shoreline bacteria monitoring will be conducted from October 2015 through September 2015. Recommendations for bacteria monitoring came from the Washington State Department of Health (DOH) Shellfish Program, which provided support for a bacteria monitoring program aimed at informing shellfish aquaculture.

This document is one of three "Ecology-approved QAPPs for RSMP Marine Nearshore Status and Trends Monitoring" referenced in Special Condition S8.B.1.b.ii of the Phase I permit and Special Condition S8.B.2.b of the Phase II Western Washington permit.

Municipal stormwater permittees' roles

Pierce County will sample the first **eight** qualifying sites along shorelines of their unincorporated UGA areas. If sampling at any of the original list of sites is unsuccessful, the permittee must sample the next qualifying site in the order listed for their jurisdiction.

The key deadlines for the permittees' required monitoring activities including completion of field and laboratory work, Ecology's Environmental Information Management (EIM) database data entry, and submission of monitoring summary reports are summarized in Table 1.

Table 1. Key deadlines for permittees' QAPPs, monitoring activities, and reports.

Due	Item	Description
Spring and summer 2015	Site selection and verification	Permittees have confirmed all sites to be monitored, including sufficient additional sites to sample if sampling attempted at any of the original sites is unsuccessful.
July 15, 2015	QAPP submitted to Ecology for review	Pierce County submits completed QAPP to Ecology Permit Manager and RSMP Coordinator for review.
August 15, 2015	Ecology QAPP review completed	QAPP reviewed within 30 days; RSMP Coordinator approves or provides comments via Permit Manager.
August 31, 2015	Site selection and verification	Pierce County has confirmed all sites to be monitored, including sufficient additional sites to sample if sampling attempts at any of the original sites is unsuccessful. Site list and documentation sent via email to RSMP Coordinator and Ecology Permit Manager with selected sites and rationale for rejected sites.
September 15, 2015	Deadline for final QAPPs	Final QAPP submitted to RSMP Coordinator with all comments addressed.
October 2015 – September 2016	Conduct monthly bacteria monitoring	Sampling conducted at the permit-required number of sites.
March 31, 2017	Electronic data submittal	All QA/QC'ed data submitted to Environmental Information Management (EIM) database.
March 31, 2017	Final bacteria monitoring report	Final summary report submitted to Permit Manager with Annual Report.

Table 2 lists key permittee staff responsible for monitoring activities detailed in this QAPP.

Table 2. Organization of permittee project staff and responsibilities.

Phase I Permittees	Implementation of Stormwater Permit Monitoring	
Name/Contact	**Role**	**Responsibility**
Carla Vincent, Water Quality Supervisor 253.798.2467	NPDES Stormwater Monitoring Project Manager	Manage overall compliance activities; verify whether QAPP is followed and monitoring data are of known and acceptable quality; ensure adequate training of staff, complies with corrective action requirements
Scott Groce, Water Quality Specialist 3 253.798.2477	Field Lead	Manage and oversee monitoring activities and sampling decisions; coordinate laboratory selection and delivery, and equipment maintenance; manage internal and external field teams. Prepare and upload data to EIM.
Corrie Lee and Berl Eldridge, Water Quality Specialist 2	Field Assistant(s)	Assist in calibrating equipment, collecting and processing field samples.

Ecology's roles

The RSMP Coordinator will either approve or comment on the permittees' completed QAPPs and transmit approval or comments to the permittee via the appropriate Regional Permit Manager by August 15, 2015. After the sampling is completed and the permittee has completed quality assurance and quality control (QA/QC) review of the data and submitted it to the EIM holding area, Ecology staff will provide a database compatibility review. Permittees are responsible for uploading compatible data to EIM. The RSMP Coordinator will review monitoring reports. Ecology Permit Managers will review all submittals for compliance purposes. Ecology staff and their responsibilities for oversight and coordination of this bacteria monitoring effort are listed in Table 3.

Table 3. Ecology project staff and responsibilities.

Ecology – WQ Program	Administration of Stormwater Permits	
Name/Contact	**Role**	**Responsibility**
Brandi Lubliner Lacey, WA	RSMP Coordinator	Ongoing implementation and administration of coordinated monitoring for NPDES Municipal Stormwater Permits. Reviews and approves completed QAPPs and project deliverables from permittees' monitoring efforts.
Chris Montague-Breakwell SWRO: Lacey, WA	Permit Manager	Ecology's contact for stormwater permittees including Pierce County. Reviews QAPP and monitoring reports for permit compliance.
William Kammin Lacey, WA	Ecology Quality Assurance Officer	Draft template QAPP review and approval.
WQP staff	EIM coordinator	Reviews and uploads data submitted by permittees and RSMP contractors.

RSMP: Regional Stormwater Monitoring Program
QAPP: Quality Assurance Project Plan
SWRO: Southwest Regional Office
EIM: Environmental Information Management database
WQP: Water Quality Program

Status and Trends Experimental Design

Scale of regional monitoring

Status and trends is intended to report results at a high level of statistical confidence; as such, a probabilistic random stratified sampling design was selected for the nearshore urban and non-UGAs. This approach was developed by EPA as a spatially-balanced, generalized random tessellation stratified (GRTS) multi-density survey design (http://epa.gov/nheerl/arm/designing/design_intro.htm) and is described by Stevens (1997), and Stevens and Olsen (1999, 2003, 2004). Over 1 million random sampling points were generated to populate the Puget Sound marine nearshore sampling frame along Urban Growth Areas (UGAs) (which is linear) by Sitka Technology Group, LLC.

Candidate sites in unincorporated Pierce County UGAs are listed in Appendix A.

Target Status

Candidate sites will reflect the following target status characteristics:

1. Be located in the shoreline intertidal zone
2. Be parallel to a designated Urban Growth Area
3. The site is NOT within a marina or port (i.e. where multiple motorized vessels are kept in the water)
4. There is permission of property owners and/or tenants is granted prior to sampling
5. The site can be safely accessed and sampled at high tide for one full year

Washington State fecal coliform monitoring methods

Both Washington State's water quality standards and the National Shellfish Sanitation Program (NSSP) (FDA, 2009) set limits for bacteria in surface waters as indicators for risk of human pathogens. DOH implements the NSSP standards and is responsible for evaluating all commercially harvested shellfish areas to determine their suitability for harvest. Ecology develops and implements the state's water quality standards.

The goal of this study is to generate data using methods that are appropriate and useful to both agencies. The RSMP will use the multiple tube-fermentation (MTF) method used to quantify fecal coliform levels in marine and brackish waters of Washington State.

There are several techniques published by Standard Methods for MTF (www.standardmethods.org; APHA, 2012). DOH analyzes fecal coliform samples using a MTF method that uses the A-1 broth for culture and a most-probable-number (MPN) method of enumeration (DOH, 1996; APHA, 2012; SM9221E2). DOH uses the A-1 broth MTF-MPN

method in marine water because it is one of the few methods approved by the U.S. Food and Drug Administration for shellfish growing area classification sampling (NSSP approved lab methods; FDA, 2009). DOH data are used to classify shellfish growing areas, which is not an objective of this study.

Ecology analyzes fecal coliform samples from estuarine or marine areas using the MTF-MPN test with a confirmation step using EC medium (APHA, 2012; SM9221E1). Fecal coliform data generated using both methods are comparable. Ecology does not use the A-1 broth for MTF-MPN because the broth has a short shelf life (7 days), requiring preparation of media on a weekly basis. The EC medium has a longer shelf life, and more laboratories are accredited for SM9221E1 which facilitates sampling logistics.

A third bacterial enumeration technique is supported by both DOH and Ecology under the joint funded the BEACH[1] Program. BEACH samples shoreline water quality for fecal bacteria (enterococci and *Escherichia* coli (E. coli)) in marine water at recreational beaches. BEACH measures enterococci, not fecal coliform bacteria, as the primary fecal indicator, using a rapid culture technique called Enterolert® (Idexx Laboratories, 2012) to notify the public of beach closures. BEACH also uses the EPA approved Colilert®-18 CS (EPA, 2003; Idexx Laboratories, 2012) for fecal coliform, and the Colilert® -18 for E.coli enumeration.

Ecology conducted a comparison study of three fecal coliform methods used to enumerate fecal coliform in the marine environment. Recommendations from the study were to continue using established MTF methods in Washington State due to Colilert®-18 CS low result biases for bacteria levels in the range of state standards (Mathieu, 2012 and 2014).

Goals

The overall goals of the shoreline bacteria monitoring program, identified by SWG, are drawn from the DOH Shellfish Program and Ecology's long-term nearshore monitoring program, Puget Sound Ecosystem Monitoring Program (PSEMP). The goals include:

1. Assess the health of Puget Sound water quality for bacteria at marine urban shorelines, as defined as being parallel to established Urban Growth Areas (UGAs).
2. Document geographic patterns.
3. Document natural and human-caused changes over time in Puget Sound shoreline water quality for bacteria.
4. Identify existing nearshore water quality problems and, where possible, provide data to help target sources.
5. Support nearshore research activities by making available uniformly collected, high quality data.
6. Provide nearshore data to assist the SWG, the PSP, DOH, Ecology and others in measuring the success of stormwater and other environmental management programs.

[1] Beach Environmental Assessment, Communication, and Health (BEACH) www.doh.wa.gov/AboutUs/ProgramsandServices/EnvironmentalPublicHealth/ShellfishandWaterProtection/BEACHProgram.aspx

Objectives

Specific objectives of shoreline bacteria monitoring include:

7. Characterize the status, spatial extent and quality, of water quality in the shoreline UGA sampling frame.
8. Track changes in water quality over time in the shoreline UGA sampling frame. Are concentrations and spatial contamination improving, deteriorating, or remaining the same?

Study Quality Objectives

Quality objectives for marine shoreline fecal coliform monitoring are set to obtain and analyze sufficient numbers of high quality samples to meet the goals and objectives of this project. Data quality indicators of precision, bias, sensitivity, representativeness, comparability, and completeness, are based on Lombard and Kirchmer (2004). Measurement quality objectives (MQOs) for field and laboratory measurements are described in the *Quality Control Procedures* section of this document.

Field measurements

Measurements of water temperature and salinity (or conductivity) are taken by field staff during sample collection. Collection methods, reporting requirements, and quality control (QC) procedures summarized in the *Measurement* and *Quality Control Procedures* sections of this QAPP are intended to provide field measurement data that meet MQOs.

Laboratory measurements

Fecal coliform analyses will be conducted at Ecology-accredited laboratories. Ecology's Laboratory Accreditation Program maintains a searchable database that may be accessed from this website: www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html. All work is expected to meet the QC requirements summarized in the *Quality Control Procedures* section of this document.

Laboratory selection

Marine shoreline water quality samples will be sent to an accredited laboratory for fecal coliform analysis. Laboratories are accredited by Ecology's Laboratory Accreditation Program, which maintains a searchable database (www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html).

Table 4 lists the laboratories and analyses that will be used for this project.

Table 4. Laboratories selected for sample processing and analysis.

Laboratory Name	Analytical Purpose	Address	Phone
Spectra Laboratories Steve Hibbs, Lab Manager	Sample Analysis	2221 Ross Way Tacoma, WA 98421	(253) 272-4850

Study Design

Site Selection

Sampling site criteria for marine monitoring and assessment regions are discussed in this section. All sites are considered candidate sites until confirmed by Pierce County and this QAPP and any supplemental site selection documentation is approved by Ecology. Candidate Tentative bacteria sampling sites are shown in Figure 1 and the complete list of candidate sites is in Appendix A. The list of sites for Pierce County is the same for all the marine monitoring components (bacteria, sediment and mussels). Ideally, the same sites could be sampled for all 3 marine monitoring components, but due to site criteria the finalized lists will likely differ for each marine component. Pierce County must sample unincorporated areas of the county at eight sites per permit requirements.

Sites in Appendix A must be evaluated for suitability in numerical order (Order column). Sampling site information, such as coordinates, jurisdictions, and other classification information, is provided in Appendix A, and a larger list provided electronically to Pierce County by the RSMP Coordinator.

Site confirmation criteria

Pierce County will conduct a desktop reconnaissance of the required number of candidate sites, and alternate sites. Field crews will also field verify sites to determine suitability and/or access. Suitability is defined as:

1. If on-site conditions reflect target status, and
2. Whether the site can be safely accessed and sampled during seasonal conditions, and
3. If permission of property owners and tenants is granted prior to sampling.

If field crews disqualify sites upon visitation, the reason for site disqualification must be documented and alternates sites must then be verified for replacement to reach the required number of sites. Documentation of disqualified sites includes photos and field notes pertaining to the three criteria above. The procedure is to be started prior to the sampling season.

Alternate sites

If one or more of the top eight candidate sites cannot be sampled successfully, Pierce County will sample sites from the remaining master sampling site list in the given list order.

Mid-Study Changes Affecting Site Suitability

Pierce County will make a good faith effort to sample at the selected sites per this QAPP's requirements. Preparedness will include **four** alternate sites that are desktop verified and have permission (if necessary).

If a site becomes unsuitable for sampling during the course of the study, the RSMP Coordinator will be notified. Reasons a site may be come unsuitable include, but are not limited to: the

adjacent parcel(s) change ownership, and the new owner does not grant permission; or natural causes such as mudslides or animals make the site no longer safe to access.

If suitability conditions change prior to 6 months of sampling a site and the site is no longer suitable, then a new site needs to be identified from the list in order and sampled for the remainder of the study period. If suitability conditions change after sampling the site for 6 months and the site is no longer suitable, sampling will simply discontinue for this round of bacteria sampling and conditions noted on the site list and in the Annual Reports.

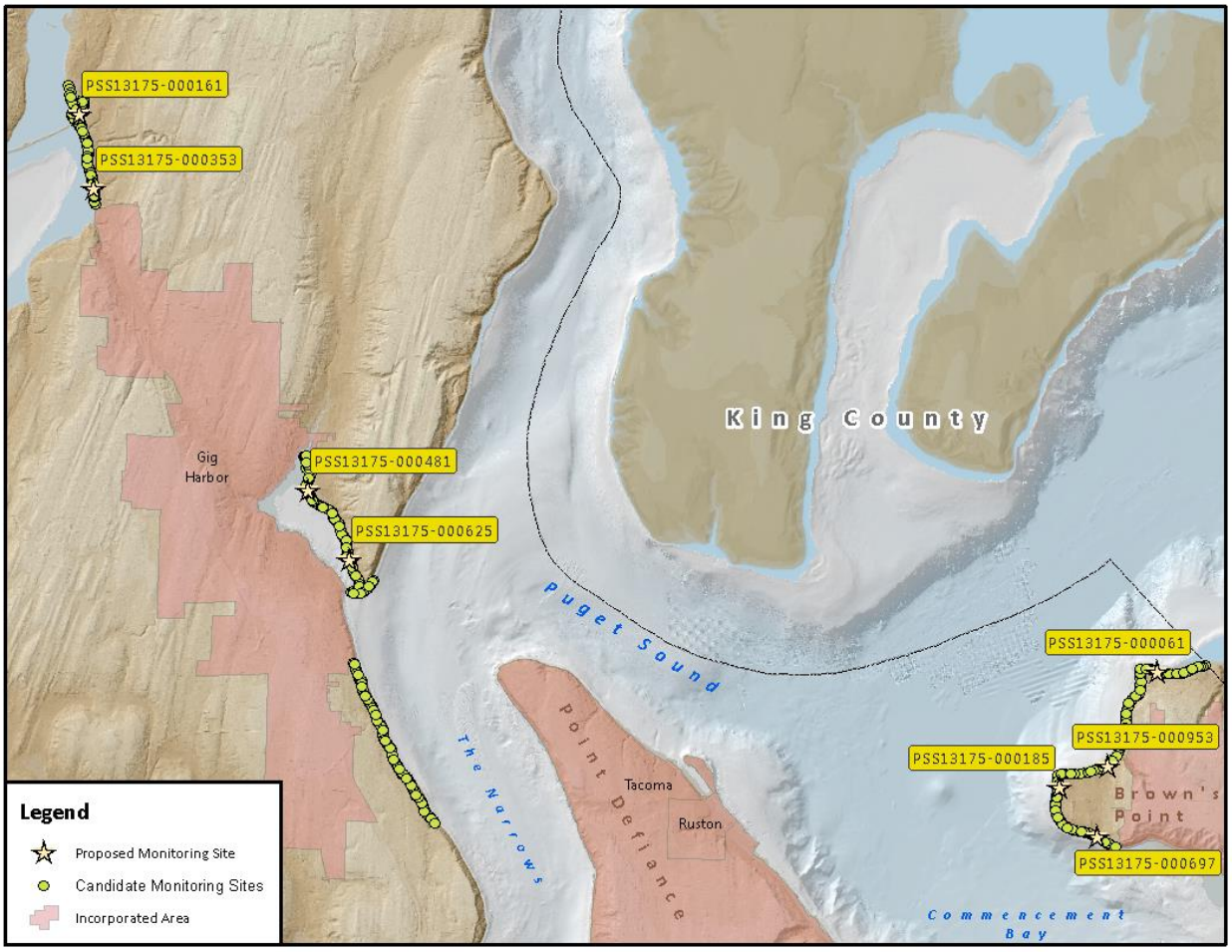

Figure 1. Pierce County candidate sites for marine fecal coliform monitoring along unincorporated urban growth areas (UGAs).

Documentation of Site Evaluations

Documentation of observations from both the desktop and field visits will be recorded in a Field Log and an Excel spreadsheet.

Site ID and Site Name

Site ID

Once appropriate sample sites are verified they will be identified by a unique, pre-assigned "Site ID". The Site ID will eventually becomes the "Location ID" in Ecology's EIM database and serves as the unique site identifier that relates the sampled sites to the GRTS study design, and is denoted as PSS13175-XXXXX where the "X" number changes for each site.

Location Name

The site will also carry a unique and appropriate "Location Name" to more easily identify the location of the site. The Location Name should be succinct, and is limited to 40 characters by the EIM database. The name may be general or describe the location (e.g. Tacoma, or Commencement Bay, or Ruston Waterfront, or Steilacoom) or be more specific descriptor like a nearby stream/river, neighborhood/street, marine location, or other identifying landmark (e.g. Thea Foss, or Hylebos Waterway, or Point Defiance, or Days Island, or Ferry Terminal).

Some examples of appropriate Site Names:

- Tacoma - Titlow Park
- Commencement Bay - Blair Waterway
- Point Defiance - Ferry Terminal
- Ruston Way - Dickman Mill Park
- Thea Foss Waterway - 11th St Bridge

Order

The field in EIM called "Study_Specific_Location_ID" will be used to identify the GRTS study design ORDER and sampling strata. For the marine nearshore sampling design this field will be populated by combining the Order and the acronym "NUGA" which stands for nearshore along Urban Growth Area; for example "044-NUGA".

Overview of site layout

Ideally, at each coordinate point in the site list three distinct sampling sites are located perpendicular to the shoreline extending into the subtidal zone. The three locations exist for marine monitoring components (bacteria at the shoreline, mussel cage location in the intertidal zone, and sediment sampling in the subtidal zone). The marine sediment and mussel sampling are described in separate QAPPs. Figure 2 illustrates the site description at each candidate site.

A linear nearshore sampling frame was developed for marine monitoring. The coordinates describe the shoreline location. Fecal coliform sampling will occur along a linear transect parallel to the shoreline and perpendicular from the target coordinate at roughly calf deep

(approximately 1-2 feet of depth). Because the water level varies, the targeted area is the intertidal zone, defined as elevations above 0 meters mean lower low water (MLLW). If the coordinates preclude beach entry, or the permittee prefers to sample from a small boat, the site may be extended to a depth of -1.8 meters (6 feet or 1 fathom) MLLW.

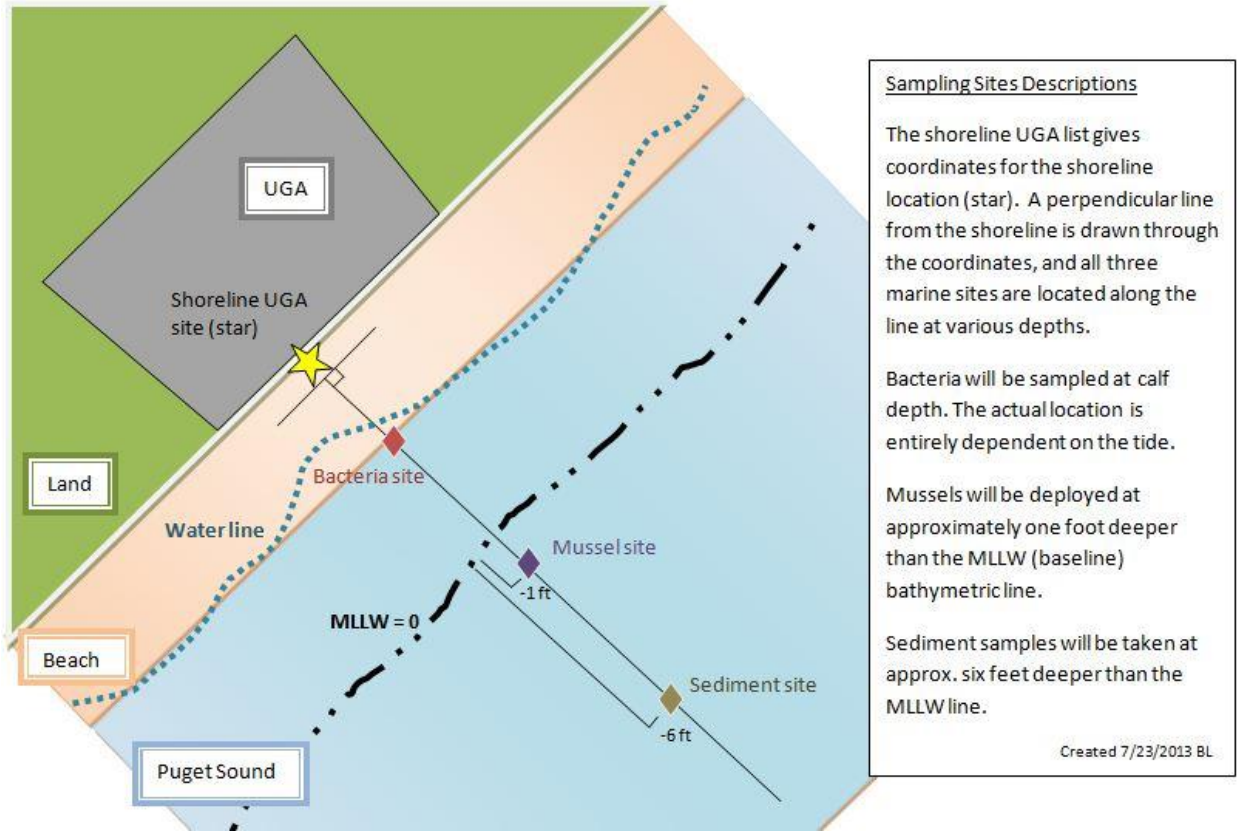

Figure 2. RSMP marine monitoring site layout along UGAs.

Sampling Procedures

General

Necessary permissions

Permittees are responsible for obtaining permission for sampling or accessing sites from private beaches. State or local jurisdictions also should be notified of the planned sampling program. Permittees are advised that it begin seeking private property permission for access several months in advance of sampling.

Decontamination/prevention of spread of aquatic invasive species (AIS)

Field work and equipment will be conducted in a manner as to prevent the spread of invasive species. A map of the areas confirmed to contain aggressive invasive species are shown in maps at the following link: www.ecy.wa.gov/programs/eap/InvasiveSpecies/AIS-PublicVersion.html.

It is possible that during sampling, invasive species could be collected. To avoid the spread of these species to other areas, procedures applicable to the marine environment from Ecology's SOP, *Minimizing the Spread of Aquatic Invasive Species* (Ecology, 2012c), will be implemented.

Any plant, animal, or sediment material inadvertently gathered via the sampling process should be washed from the sampling equipment using seawater at each site.

Safety

Collection of water samples from an active environment poses a number of potential safety hazards to the field crew. Potential hazards for field crews conducting marine water sampling at the shoreline include but are not limited to: low light conditions, uneven ground, exposure to extreme temperatures and sunlight and drowning. To ensure their safety all crew members are required to follow appropriate jurisdictional guidelines for field safety procedures, and to wear the following safety gear when necessary:

- Life vest or floatation suit
- Protective gloves
- Temperature and weather appropriate clothing

Marine fecal coliform water sampling procedures

Timing

Fecal coliform sample collection will occur monthly for one year, October 2015 through September 2016. The day of sampling should be prioritized to focus on work day safety and logistics. The window of time for sampling is dictated by the tidal cycle. The high tide is the targeted time for sampling with the six hour window of opportunity that includes three hours

before high tide (flood) and three hours after high tide (ebb). Figure 3 illustrates the two windows for sampling on an example day.

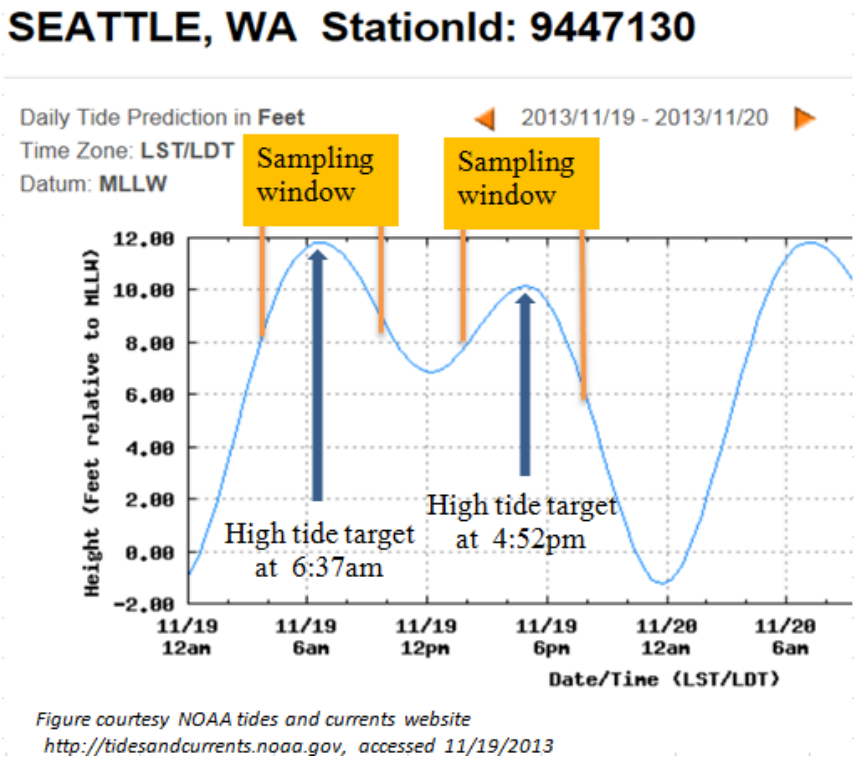

Figure 3. Example sampling timeframes for site located near Seattle.

This sample timing is in line with the DOH Shellfish Program protocols. The BEACH Program prefers to sample a narrower window closer to high tide, which samples the worst-case scenario for contaminating discharges to the beach environment because high tide restricts dispersion.

Supplies

- Sterile plastic sample bottles (100mL minimum volume)
- Sterile plastic sample bottles (250 mL, minimum volume)
- Long-handled sample bottle holder
- Salinometer, refractometer or electrical multiprobe sonde
- Thermometer (centigrade)
- Wristwatch
- Paper towels or hand towel
- Insulated ice chest (light proof)
- Crushed Ice
- Cooler or shipping carton
- I-phone or GIS equipment for approximating latitude & longitude of sampling point
- Frozen ice packs
- Field forms/data sheets
- Sample location map
- Waterproof black marking pen
- Waterproof black ballpoint pen
- Ziplock plastic bags (large) (optional)
- Disposable Gloves
- Lifejackets
- Knee high boots or hip-waders
- Sun protection (hat, sunscreen, etc)

Field documentation

A field log will be completed for each bacteria monitoring site. The field log will consist of the following information:

- Date and time of sample collection
- Coordinates and site name or site ID#
- Sampling crew
- Weather observations at time of sampling
- Tide phase "E" for ebb or "F" for flood[2]
- Time deviation from high tide (E.g. "65min past high tide")
- Collection gear
- Collection status (i.e., successful, site rejected, site moved)
- Sample collection procedure (boat or wading)
- Field measurements
- Parameters sampled
- Approximate distance from site to beach
- Observations of weather and shoreline condition (described below).
- Precipitation amount in previous 24 hours prior to sampling. *(Rain gage needs only be located within 10 miles of shoreline station).*
- Estimated tide height above MLLW at time of sampling
- Who generated the field log
- Comments

Observations of the shoreline will include a description of the adjacent shoreline, including land uses, beach condition, municipal or private outfalls, streams, and other significant landscape features or in-water activities within approximately one-half mile in either direction along the shoreline from the sampling location.

Field log information must document rejected sites, if and when sites are found to be unsuitable. A daily log will also be generated with information on samples collected from each day. These logs are recorded on water-resistant paper.

Boat and Wading Protocols

Field staff will collect water samples following standard protocols described in this section. These are based on standard protocols used by DOH and Ecology:

- DOH Procedure #003 (DOH, 1996) describes marine water bacteria sampling from a boat or by wading. This procedure is summarized in the *Status and Trends in Fecal Coliform Pollution in Puget Sound: Year 2011* (Woolrich, 2012).

[2] DOH (1996) states "Enter an E in the Tide column for all samples collected up to and including one-half hour after low slack. Enter an F in the Tide column for all samples collected up to and including one-half hour after high tide."

- Ecology's standard operating procedures (SOPs) for bacteria sampling are described by SOP EAP030 (Ward and Mathieu, 2011).
- Ecology's BEACH Program wading protocol (Schneider, 2004), and SOP EAP092 (Sargeant, 2014).

DOH boat protocol (summarized from DOH, 1996; and Woolrich, 2012)

Water samples will be collected with an extension rod (~approximately 3 feet) (Figures 4 and 5), from either a boat deck or wading to knee deep. On the day of field sampling, locate stations using a Global Positioning System (GPS) unit. At each station, the sampler collects water samples approximately six inches below the surface and places the samples on ice. The sampler also measures surface salinity (or conductivity) and temperature. The boat operator records all data. The samples are sent to the laboratory for analysis.

1. At the first sample site, fill one or more extra sample bottles to serve as the temperature control (TC). Label this bottle as the TC and place in the cooler. The TC will accompany samples to the lab if more than one cooler will be needed to ship the day's samples to the lab. *Be sure to fill enough TC bottles marked so that one can be placed in each cooler*. The TC bottle is used to determine the temperature of the samples when they arrive at the laboratory. Temperatures greater than 10°C should not be processed by the laboratory.
2. Do not collect a water sample from a silt plume produced by the boat wake. Approach the sample location slowly. Do not use reverse to slow the boat at the sample location in shallow water.
3. Wear gloves and insert bottle into an extension rod.
4. Avoid obvious surface scum, vegetation, or floating debris.
5. Pre-label the sample bottle. Remove the cap from the sample bottle, taking care not to touch the inside of the cap, the lip, or inside of the bottle. If you feel that the bottle has been contaminated, discard it and prepare a new one.
6. Collect samples from approximately six inches below the surface.
7. Collect samples by sweeping the bottle horizontally through the water. The bottle must enter the water and leave the water without stopping forward motion. This is done to prevent any contaminants on the outside of the bottle from entering the sample.
8. Do not fill the sample bottle completely full. The sample volume needed by the laboratory is 100mL. When using a 100mL bottle, pour enough out so that the liquid level is just below the neck of the bottle. This is done to allow enough air space in the bottle so that the sample can be shaken before it is processed.
9. Cap the bottle without touching the lip of the bottle or the inside of the cap, and place the sample upright in the cooler in crushed ice as soon after collection as possible. Do not submerge the sample in ice or melted ice water, as this may contaminate the sample.
10. Collect conductivity and temperature measurements at the sampling point and record this information in the field notebook or field sheet.

11. If measurements cannot be taken with the multiprobe sonde equipment (due to equipment failure, for example), an additional sample will be collected in the 250 ml bottle, following the procedure described above for fecal coliform sample collection. This sample will be iced and delivered to the laboratory, where it will be measured for conductivity. Water temperature will be measured on site with a thermometer, and the date recorded in the field notes.
12. If a refractometer is used, dry the instrument with a clean paper towel or a clean hand towel after each reading.
13. Refractometers are most accurate at temperatures between 70°F and 85°F. In cold weather the refractometer should be placed inside your jacket between readings.

Protocol for Replicate Samples

1. Identify if a replicate sample will be collected at this beach, based on a replicate schedule.
2. Label *replicate* bottle with the following information:
    a. For Station ID, write "Replicate"
    b. Sample Date
    c. Sample Time
    d. Sampler's Initials
3. When collecting a replicate sample, note the station of collection on the field data form.
4. Collect *replicate* sample immediately after the original sample.

Wading protocol (summarized from DOH, 1996; Schneider, 2004; and Sargeant, 2014)

1. When collecting samples from shore, and when possible to do so safely, wade knee deep (roughly 2.5 feet) into the water, and avoid silt stirred up by wading or shoreline wave action. Use an extension rod that holds the sample bottle securely (Figures 4 and 5) to collect samples away from any sediment stirred up by your feet.
2. Follow boat protocol (*above*), steps 4-11.
3. Follow replicate protocol (*above*).
4. Deliver to laboratory within six hours of sample collection.

Figure 4. Extension rod sampler.

(Courtesy DOH 2013, personal communication)

Figure 5. Close-up of extension rod bottle holder.

(Courtesy DOH 2013, personal communication)

Preservation and holding times

Samples must be collected and delivered to the accredited laboratory within six hours**.**

Exposure to light can kill fecal coliform bacteria. It is important to place the sample on ice in a dark cooler as soon as possible after collection. Ice packs are ineffective in reducing the temperature of samples collected during warm weather. In warm months, it is necessary to use crushed ice to bring the temperature of the sample down prior to packing them for shipping (or delivery to the laboratory).[3]

Marine water samples are susceptible to rapid increases or death of microorganisms and hence will be held for the shortest time possible in a temperature-controlled environment to minimize change. Steps for the preservation and transit of collected water samples will be followed precisely, or the sample will not be analyzed and another sample will be collected.

Bacteriological samples must be iced or refrigerated at a temperature of 1-4º Celsius (C) and stored in insulated containers to assure proper maintenance of sample temperature during transit to the laboratory. Sample incubation must start within 24 hours of collection.

[3] DOH (1996) packaging guidance to keep samples cool for shipping states: "Place one or two of the frozen ice packs supplied by DOH in the bottom of the shipping carton and arrange no more than two layers of sample bottles on their sides on top of the ice pack(s). Make sure that each shipping carton contains a temperature control (TC) bottle. The bottles must be arranged so that *EACH* bottle is in contact with an ice pack. Place a second ice pack or packs on top of the bottles and fill any empty spaces with crumpled newspaper".

Measurement Procedures

This section describes the laboratory selection process, sample processing, chain-of-custody, laboratory methods, and reporting limits.

Quality assurance (QA) and quality control (QC) procedures are used to monitor, improve, and assess scientific practices, especially those involving generation and assessment of environmental data. QA planning (such as this QAPP) are required for businesses or agencies submitting data to Ecology. Data quality objectives for data collected under the RSMP and this QAPP are based on existing status and trends monitoring programs (DOH, 2012; Schneider, 2004).

Field measurements

Field personnel will be trained to meet the QC specified in Table 5. Field QC is maintained by following SOPs and protocols outlined herein to obtain consistent measurements of the marine shoreline water quality. All completed sample labels, chain-of-custody forms, and field logs will be double-checked by the field crew after sample collection.

Table 5. Field parameters: methods, reporting limits, and QA/QC procedures.

Parameter	Instrument	Measurement Method	Replicate Frequency	Replicate RSD (median) and QA/QC	Reporting Limit
Water temperature	alcohol thermometer or multiprobe sonde	Calibrate equipment on day of sampling. Equilibrate probe in the marine water and collect reading(s). Collect a sample in a spare bottle if necessary for measurement.	4 times per year per site or quarterly	+/- 0.2° C	0.1° C
Salinity or specific conductance (conductivity	Refractometer or multiprobe sonde.	Calibrate equipment on day of sampling. Set refractometer to 0 ppt with de-ionized water, or calibrate meter on day of sampling. Pipet a drop of the water overlying the sample onto the refractometer and read the salinity from the measurement scale. Or, equilibrate probe in the marine water and collect reading(s).	4 times per year per site or quarterly	Replicate target precision is 5% RSD.	Refractometer: 0.1 umhos/cm, 0.1 uS/cm, or 1.0 ppt. Multiprobe sonde: ±1.0% of reading or 0.1 ppt; whichever is greater.
Conductivity if measured at laboratory	SM 2510 or EPA 120.1	Collect sample in 250 ml HDPE bottle, cool to 4 degrees Celsius and deliver to lab within 48 hours	4 times per year per site or quarterly	Replicate target precision is 5% RSD	±0.2 umhos/cm

QA/QC: Quality assurance/quality control

RPD: relative percent difference
RSD: relative standard deviation

Laboratory analysis

Fecal coliform will be enumerated following standard methods for MTF using EC medium (SM9221E1). The general procedure involves inoculating a series of sterilized fermentation tubes containing EC medium with different water sample dilutions. The tubes are incubated in a water bath at 44.5 ± 0.2°C for 24 ± 2 hours. Gas production with bacterial growth (cloudiness) in the tubes is considered a positive fecal coliform reaction. The EC medium ingredients and water bath temperature selectively grow fecal coliform bacteria versus total coliforms.

Fecal coliform count is calculated from the MPN index tables provided in Standard Methods 9221C, which is based on the combination of positive tubes from each dilution.

Quality Control

This section discusses the quality control (QC) procedures that will be implemented to provide high-quality data. QC procedures will encompass field collection and laboratory processing of all samples; QC will be monitored throughout the duration of the study.

Field quality control procedures

QC will be achieved by conducting sampling in an organized manner, maintaining field equipment properly, and documenting data adequately while sampling. Field protocols presented in this QAPP in the *Sampling Procedures* section are based on DOH Marine Water Sampling protocol (DOH, 1996) and BEACH protocol (Schneider, 2004). In order to maintain the highest degree of data quality, field equipment will undergo routine cleaning, calibrations, and maintenance at the recommended frequency specified by each manufacturer.

Field equipment will be calibrated the morning of any sampling event. Calibration records will be maintained by Pierce County and will be made available upon request.

Field measurements of water temperature and salinity (or conductivity) are taken by field staff during sample collection. Field replicates will be used to evaluate precision and variability. Replicate samples are two or more samples taken from the environment at the same time and place, using the same protocols. Replicates are used to estimate the random variability in the samples and precision in the sampling methodology. Replicate measurements and samples for fecal coliform will be collected quarterly during the year of sampling. One replicate for laboratory analysis of conductivity will be collected in the field during the course of the study. For that sample, conductivity will also be measured in the field for comparison. Initial instrument calibrations shall be conducted prior to the field season, and periodically throughout the season. Field QC data will be evaluated against the criteria shown in Table 5

In addition, a field blank and trip blank will be taken once per year to evaluate potential contamination from sampling equipment or handling. The laboratory shall provide a sealed trip blank which will not be opened during the event. The laboratory will provide a container of deionized water and clean, empty sample bottle(s) for the field blank. The blank samples should be evaluated early in the monitoring program. The trip and field blanks shall be analyzed in the laboratory for fecal coliform bacteria.

Laboratory quality control procedures

Table 6 outlines analytical method, expected precision of sample replicates, and method reporting limits and/or resolution. The targets for analytical precision of laboratory analyses are based on historical performance for environmental samples taken around the state (Mathieu, 2006). The reporting limits are appropriate for the expected range of results and the required level of sensitivity to meet project objectives.

Table 6. Measurement quality objectives (MQOs) for laboratory measurements.

Water Parameters	Methods in Water MQO[3]	Reporting Limit Target	Field/Lab Replicate (RPD)	Lab Duplicate (RPD)	Control Standard/ Surrogate (% Recovery)
		Sensitivity	Bias and Precision	Bias and Precision	Bias and Accuracy
Fecal coliform	SM 9221E1	1.8 MPN/100mL	≤50%	40%	n/a
Specific conductance (conductivity)	SM 2510 or EPA Method 120.1	±0.2 umhos/cm	≤10% (one sample per year from the field)	n/a	90-110

RPD: relative percent difference

Laboratory analysis of fecal coliform in marine shoreline water quality samples is expected to achieve the QC requirements shown in Table 6 All testing, inspection, and maintenance of laboratory equipment will be conducted as prescribed by laboratory QC manuals. The QA procedures for the laboratories were reviewed and maintained through Washington State Accreditation status.

Routine laboratory duplicate sample analyses evaluate the presence of bias in analytical methods. For microbiological analyses, these typically include laboratory blanks of sterile de-ionized water and false positive tests using cultured fecal coliform.

Total variation from field sampling and analytical processes will be assessed by collecting and analyzing replicate samples. The difference between field variability and laboratory variability is an estimate of the sample field variability.

Corrective actions

QC results from replicate samples can indicate problems with field data collection and laboratory procedure. When field data collection problems exist, the monitoring manager will respond by re-training samplers and re-sampling, or data may be flagged or discarded.

Data Management Procedures

Permittees will collect and manage data from field observations/measurements and from laboratory analysis of field samples. All data will be managed and stored by the permittees. Post-processed data will be finalized and incorporated into annual reports and electronic reports. Reports are discussed further in the *Monitoring Summary Reports* section of this document.

Field logs

Field measurement data will be recorded in the field on field logs printed on waterproof paper and then entered into Excel® spreadsheets (Microsoft, 2010 compatible) as soon as practical after returning from the field. Alternatively, the field crew may enter the field data directly onto spreadsheets on laptop computer used in the field. If a laptop is used in the field, electronic files will be regularly backed up during sampling onto a flash drive.

Laboratory data

Fecal coliform laboratory data will be sent to the permittee from the laboratory. Typical reporting turnaround times may vary depending on workload but should not exceed one month of the documented sampling date.

Laboratories shall submit data reports to the project lead. The reports should include:

- Sample chain-of-custody.
- Description of analytical methods.
- Data in electronic format.
- QA sample results.
- Data evaluation results.
- Any problems encountered and corrective actions which were taken.
- Any qualification of the results.

Laboratory reports will be reviewed by the permittees for errors or missing data; permittees may implement corrective actions. Finalized electronic data will be reviewed by staff and the project lead.

Audits

Audits will be conducted by senior staff to ensure this QAPP is being implemented correctly and that the quality of the data is acceptable. A routine audit will ensure:

- Sampling locations were correctly identified and sampled.
- SOPs were followed.

- Documentation of the visit, chain-of-custody, or sample identification forms was correctly filled.
- Correction actions were made as necessary.

Ecology's laboratory accreditation process includes performance testing and periodic lab assessments. No additional audits are envisioned, unless prepared by the permittees through their contract agreements.

Data storage

All field forms, photographs, electronic data, and laboratory electronic or printed copy data generated for this project will be stored by permittees in an organized filing system for electronic and paper files. These files may be sought by Ecology for permit compliance review and audit purposes and must be maintained in according to the records retention requirements for all documents related to the permits. Location, measurement, and sample result data will be evaluated through the data verification process outlined in this QAPP. Acceptable results will be used by scientists to prepare a summary report and entered into Ecology's EIM database.

Data Verification and Usability

Data verification will be conducted by the project lead and laboratory staff by examining all field and laboratory-generated data to ensure:

1. Specified methods and protocols were followed.
2. Data are consistent, correct, and complete, with no errors or omissions.
3. Data specified in the *Sampling Process Design* section were obtained.
4. Results for QC samples as specified in the *Measurement Quality Objectives* and *Quality Control* sections accompany the sample results.
5. Established criteria for QC results were met.
6. Data qualifiers are properly assigned where necessary.

Field data

Throughout the duration of the field sampling, the project lead and crew members are responsible for implementation of sample-collection procedures. The project lead is also responsible for a systematic review of all field documentation generated (e.g., field logs, chain-of-custody sheets, sample labels) to ensure data entries are consistent, correct, and complete, with no errors or omissions. This review should be completed prior to leaving the site where the measurements were made.

Laboratory data

The senior staff or project lead shall review the laboratory data package. Discrepancies will be reported back to the laboratory or contractors for amendment. After data have been reviewed and verified, then staff will report on the data usability.

After data verification is complete, all field and laboratory, data will be entered into Ecology's EIM system. An independent data reviewer will validate the EIM data by checking for errors following Ecology's standard EAP protocols.

Data quality (usability) assessment

Data usability assessment follows verification. This involves a detailed examination of the data package using professional judgment to determine whether the quality objectives have been met. The project manager examines the complete data package to determine compliance with procedures outlined in the QAPP and SOPs. The project manager also ensures that the MQOs have been met and determines if the quality of the data should be usable for the project objectives.

Shoreline Bacteria Monitoring Reports

Summary Report

Pierce County must provide an Annual Monitoring Report, consisting of a narrative report, an Excel spreadsheet with all data, and a submittal to Ecology's Environmental Information Management (EIM) database. For the Annual Monitoring Report to be considered on time, the EIM data submission process must be completed by March 31, 2017. The reports must include all information listed in Table 7.

Table 7: Required monitoring report elements

Category	Reporting Requirement
Site Confirmation	Documentation of the site confirmation process, including desktop evaluation and field visits for each of the required number of assigned sites.
	List of sites disqualified and specific reasons for disqualification.
	List of final sites. In a table, provide final GPS coordinates for each site and the distances from the initial GPS locations provided in the Master Sample.
Ancillary Site Information	Description of the adjacent shoreline, including land uses, municipal or private outfalls, streams, and other significant landscape features or in-water activities within approximately one-half mile in either direction along the shoreline from the sampling location.
	Estimated tide height above MLLW at time of sampling; also indicate whether tide was incoming, at peak, or outgoing?
	Weather condition at time of sampling; rainfall in previous 24 hours
	Other relevant field observations.
Water Quality Monitoring	Sample information (dates, times, locations).
	Tabular water quality data
	Summary results for each site and for all of the sites.
	Documentation of adherence to QA/QC requirements.
Concerns	Narrative description of any deviations from this QAPP, including any delays, problems, and resolutions in conducting required monitoring activities.
Costs	A summary of monitoring costs for this permit-required monitoring program component.

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Appendices

Appendix A. Pierce County candidate marine monitoring sites along unincorporated UGAs (sorted from master sample list)

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
61	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42765083600	47.31947715800
113	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57849932500	47.33585680100
161	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62723174300	47.38544836000
177	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56681804700	47.30708115500
185	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44443520400	47.30313810400
249	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42942761900	47.31731999600
353	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62436068200	47.37648708400
433	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56842564600	47.30957023700
441	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44250634400	47.30621081800
481	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58275338700	47.33831809500
505	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43194883600	47.31375141500
625	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57510704900	47.33026721100
689	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57390536200	47.31740756500
697	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43569055800	47.29802943400
737	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.58376416300	47.34196818300
817	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57648216000	47.33340918800
865	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62639152200	47.38659847000
881	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56155876000	47.30117917500
953	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43514967600	47.30737998000
1005	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.42072510400	47.31934830500
1085	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42960254000	47.31926800900
1121	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62384143700	47.37414470600
1137	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57445147500	47.32903144600
1201	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56760504200	47.30782609400
1209	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43885797100	47.30644430200

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
1273	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43109520400	47.31553455500
1377	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62599495000	47.38241725500
1393	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57350498500	47.32795623000
1445	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57377675200	47.19087788500
1457	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57285582400	47.31578126200
1465	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44004327100	47.29910212100
1505	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58333999200	47.33906965900
1649	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56587203900	47.30544110000
1841	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57683799000	47.33383066200
1889	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62665840900	47.38711368400
1893	Pierce	Pierce Co. - Unincorporated UGA	Man-made, permeable	-122.57572305900	47.18725495600
1905	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56240610000	47.30208148000
1977	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43603516700	47.30708896500
2017	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58341891900	47.34014052600
2029	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42257756100	47.31903201500
2109	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.41868497100	47.31998153300
2145	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62398999400	47.37488114200
2213	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57488866600	47.18815138900
2225	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.56961453100	47.31084125100
2233	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44432416000	47.30568839800
2297	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43177954600	47.31440286500
2401	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62547009300	47.38132605000
2417	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57324822700	47.32646835300
2481	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57252542200	47.31506382200
2489	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44357819000	47.30026664600
2657	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.62907757900	47.38854518800
2673	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.55870582500	47.29833458000
2745	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43666823600	47.29849106600
2865	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57550677800	47.33085009100

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
2913	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.62788765500	47.38620509000
2929	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56070480800	47.30024059000
3001	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.43324733900	47.30885720300
3041	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.58290756000	47.34131826400
3053	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42598273300	47.31912131700
3169	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62439277700	47.37683417800
3185	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57462981300	47.32674714100
3249	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57079329600	47.31274929200
3257	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44060069100	47.30625909200
3297	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58101306000	47.33727426200
3321	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43213800800	47.31183541600
3425	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel flat or fan	-122.62546908400	47.37954317200
3441	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57232670900	47.32689363900
3505	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57125479400	47.31321935600
3513	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44424608900	47.30100182700
3681	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62743447700	47.38415115700
3697	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.55934135800	47.29877268900
3769	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43701514500	47.30680871600
3889	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57854512800	47.33606865900
3937	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62661988500	47.38560624100
3953	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56335070000	47.30326746200
3961	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44420433900	47.30373230700
4025	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43238221100	47.31072715600
4077	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42952135700	47.31847777900
4157	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42684997400	47.31930928200
4209	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57779153900	47.33536478400
4257	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62783997300	47.38537931800
4273	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56647364400	47.30635384700
4281	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44452515200	47.30263898900

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
4345	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42940325900	47.31763332400
4449	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62581033300	47.38211645600
4465	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57332925200	47.32697599000
4517	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57453399700	47.18946238800
4529	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56922619800	47.31046274300
4537	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44079530400	47.29917841400
4577	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58270331600	47.33826246400
4601	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43190859900	47.31403487100
4721	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57496944900	47.33001450500
4785	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57369224900	47.31703373100
4793	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43411227100	47.29739324500
4833	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.58417591900	47.34338721100
4913	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57639901900	47.33327255700
4961	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62667655400	47.38705744800
4977	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56128307500	47.30108603700
5049	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43564140900	47.30720520000
5101	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.42021117800	47.31958238300
5217	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62388441200	47.37438987900
5233	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57433745400	47.32883223500
5297	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56752366200	47.30773575300
5305	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44023431100	47.30629075300
5369	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.43013500800	47.31614610200
5473	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62565903000	47.38188181700
5489	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57420765400	47.32867262000
5553	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57300194600	47.31589534600
5561	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44273931200	47.29969849800
5729	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.62930393300	47.38896234200
5745	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56589441200	47.30546500100
5817	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43463841800	47.29756594900

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
5857	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.58370786300	47.34279642500
5937	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57598195100	47.33265926200
5985	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62638493100	47.38627171200
6001	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56307377900	47.30300369600
6073	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43300688700	47.30937841300
6113	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.58330499700	47.34045751600
6125	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42469929300	47.31907350900
6205	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.41976546700	47.31969363900
6241	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62396954800	47.37448738700
6309	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57488358700	47.18842278900
6321	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.56991243300	47.31159356800
6329	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44430279700	47.30560040000
6393	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43176778300	47.31443640700
6497	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel flat or fan	-122.62531569400	47.38048938200
6513	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57331010600	47.32687840700
6577	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57223068900	47.31425501800
6585	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44435951800	47.30123428800
6753	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.62902453900	47.38847664300
6769	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.55901356200	47.29856726700
6841	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43782938300	47.29873303600
6961	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57582037700	47.33109340300
7009	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.62801689600	47.38629844100
7025	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56464248600	47.30416243900
7097	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.43328963000	47.30881608700
7137	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.58290241500	47.34129709800
7149	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42549912900	47.31908471900
7265	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62451193300	47.37707131100
7281	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57478374500	47.32655385600
7333	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57472474200	47.18928070600

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
7345	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57049019100	47.31233575600
7353	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44095074800	47.30622884200
7393	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58199992900	47.33766477600
7417	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43218667200	47.31154999500
7521	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel flat or fan	-122.62526558000	47.37884391100
7537	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57150911700	47.32753268400
7601	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57100777200	47.31296775000
7609	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43534454500	47.29782850900
7777	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62716490300	47.38394863100
7793	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56000654300	47.29918953600
7865	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43775959500	47.30667693200
7985	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57884283100	47.33649206100
8033	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62852695200	47.38521671600
8049	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56362888200	47.30346019600
8057	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44391232600	47.30474973800
8121	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43220910600	47.31141841800
8173	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42955921000	47.31873217800
8253	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42756139500	47.31945997300
8305	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57813286300	47.33556320300
8369	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56646135800	47.30628874300
8377	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43931535100	47.30637813300
8441	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42945186600	47.31827281800
8545	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62574342400	47.38201380500
8561	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57334492500	47.32766859400
8613	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57397832500	47.19008880100
8625	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57317316400	47.31612314400
8633	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44142292400	47.29927568000
8673	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58346096700	47.33941488400
8817	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57485869900	47.32981625100

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
8889	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43398425000	47.29735233500
8929	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.58405845900	47.34352889500
9009	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57714999100	47.33439324800
9057	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62648198800	47.38723911700
9061	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57505671700	47.18761118700
9073	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56090575200	47.30068711100
9145	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43471281800	47.30758356100
9197	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.42204096200	47.31909158900
9277	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.41766783000	47.32014308300
9313	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62408735800	47.37550003600
9393	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56824525300	47.30866908100
9401	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44454602800	47.30192398500
9465	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42992156900	47.31628178200
9569	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel flat or fan	-122.62535139900	47.38079897500
9585	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57371652400	47.32820807100
9637	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57387224100	47.19023994000
9649	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57259292100	47.31557599900
9657	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44249449800	47.29960554100
9825	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.62867978300	47.38699025500
9841	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56532953300	47.30486157000
9913	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43758961000	47.29868307000
9953	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.58390405500	47.34325799400
10033	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57587438700	47.33231240400
10081	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62665712300	47.38626007400
10097	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56297020500	47.30286064000
10169	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43287294900	47.30963025000
10209	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.58366918300	47.34189034800
10221	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42396390000	47.31903209000
10301	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.41806663300	47.32007029200

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
10337	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62463781000	47.37753060200
10405	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57489709900	47.18877298000
10417	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.56975273100	47.31114725600
10425	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44420099000	47.30595196900
10489	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43164336900	47.31483157000
10593	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel flat or fan	-122.62529761800	47.38033264900
10609	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57242223700	47.32683493000
10673	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57195835800	47.31396230900
10681	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44368449000	47.30035809500
10849	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.62893493500	47.38805300000
10865	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.55962771100	47.29895213800
10937	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43842211100	47.29883787600
11057	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57581483400	47.33175677000
11105	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.62843359000	47.38661332800
11121	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56414322700	47.30381654700
11129	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44388499800	47.30423475300
11193	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43258545700	47.31022447900
11245	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42586095800	47.31911571300
11361	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62506415700	47.37844903700
11377	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57435666800	47.32672151000
11429	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57467493100	47.18932638100
11441	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56890105400	47.31014563700
11449	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44190253700	47.30620793700
11489	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58163600900	47.33751105600
11513	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43198110600	47.31307365900
11633	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57130263300	47.32774266700
11697	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57357011300	47.31681948100
11705	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43471400000	47.29759179700
11873	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62694630400	47.38378440200

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
11889	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56047468800	47.29972922400
11961	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43405140400	47.30810873000
12081	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57949571000	47.33679786300
12129	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62825243700	47.38488828200
12145	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56722805300	47.30740760000
12153	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44416822200	47.30530608100
12217	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42962778100	47.31659695300
12269	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42801278300	47.31953032700
12349	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42929702700	47.31955932500
12401	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57742516000	47.33503109900
12465	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56835050900	47.30919488900
12473	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44002979900	47.30630842500
12537	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43137948100	47.31529687000
12641	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62639070000	47.38316204300
12657	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57333091100	47.32769493500
12721	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57342489900	47.31656474500
12729	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44110909300	47.29922511400
12769	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58353694500	47.33969197300
12913	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57090743700	47.32817587000
12985	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43341525700	47.29726785000
13105	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57708159000	47.33418820600
13153	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62639972200	47.38700695900
13157	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57563408700	47.18739994900
13169	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56226355000	47.30188458100
13241	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43647457500	47.30695925100
13281	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58352355400	47.33987387600
13293	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.42177754300	47.31912432000
13409	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62402053700	47.37500463700
13477	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57495745600	47.18782955100

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
13489	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56828861100	47.30888567700
13497	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44454584700	47.30203948600
13561	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.43049420000	47.31592341400
13665	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62535917000	47.38086611800
13681	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57389560300	47.32639194200
13745	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57233625300	47.31436848200
13753	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44334525500	47.30008641700
13921	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.62879135900	47.38715320800
13937	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56541826100	47.30495635600
14009	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43700016800	47.29856023800
14049	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.58376993900	47.34310743200
14129	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57536538300	47.33060807000
14177	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62664537100	47.38627228900
14193	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56262835700	47.30238847200
14265	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43291240000	47.30955334900
14305	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.58310422000	47.34092641300
14317	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42482121400	47.31908037500
14433	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62464443700	47.37761992600
14449	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57394098700	47.32638855400
14513	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57041860600	47.31220574000
14521	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44124888500	47.30620481400
14561	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58071572100	47.33719307400
14585	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43207513100	47.31226838500
14689	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel flat or fan	-122.62547816200	47.37941912100
14705	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57196596600	47.32712435700
14769	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57161846000	47.31359697100
14777	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44387179600	47.30053937800
14945	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62762043000	47.38429085900
14961	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.55914061400	47.29864688800

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
15033	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43753348600	47.30673857000
15153	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57582427100	47.33161013000
15201	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62643603400	47.38577891300
15217	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56440471100	47.30399770700
15225	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44430967500	47.30350565300
15289	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43272678700	47.30993795300
15341	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42334195800	47.31899705600
15457	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62493248500	47.37820332400
15537	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56879946900	47.31004656300
15545	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44273845200	47.30620753500
15585	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58233279500	47.33776832900
15609	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43196570100	47.31339718900
15729	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57474241800	47.32962734600
15793	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57411565300	47.31777644400
15801	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43602852500	47.29819503900
15841	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.58297556100	47.34170902000
15969	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62670186100	47.38360075300
15985	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56190135500	47.30138428800
16057	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43394737600	47.30819002500
16177	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.57992910400	47.33701083700
16225	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62808127600	47.38544320400
16241	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56666648500	47.30700074000
16249	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44398365300	47.30492172600
16313	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42970057100	47.31649246200
16365	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42817949500	47.31954422300
16423	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57833535700	47.33568773300
16446	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56649384400	47.30646088100
16507	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62435850100	47.37676799200
16535	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56840801400	47.30948215900

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
16553	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58257645600	47.33800283100
16627	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43655497300	47.29844882900
16734	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.42097127700	47.31929920600
16804	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43871295800	47.30646914600
16827	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43090650500	47.31566778600
16937	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57727283400	47.33470900800
16959	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56625704200	47.30585237200
17025	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57680278400	47.33379574600
17042	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62696912500	47.38607497000
17072	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43593353000	47.30711896800
17085	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.58329649300	47.34054871700
17158	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.56945855500	47.31068929900
17218	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel flat or fan	-122.62553129300	47.38017924900
17249	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44309757900	47.29991273200
17338	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43910999100	47.29895252400
17445	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42655886900	47.31921203300
17603	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57131698700	47.31328270100
17664	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62695717400	47.38547952800
17670	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56034003000	47.29942998800
17754	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62849230200	47.38514037000
17762	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44388192500	47.30462431900
17784	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43227512400	47.31104996500
17872	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44454526700	47.30241118600
17896	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42937912600	47.31794373000
17955	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57420809000	47.18977453000
17962	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44150193400	47.29928841100
18092	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57605749500	47.33296130500
18115	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56083388700	47.30052742000
18227	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56808242200	47.30835601900

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
18288	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62559788500	47.38171981000
18294	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57415289700	47.32861082100
18315	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57253100900	47.31527257100
18379	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.62899339700	47.38766170000
18409	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43732456000	47.29862783700
18515	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42425780600	47.31904864400
18554	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62411506300	47.37579273800
18578	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57489122000	47.18862056100
18586	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44369035900	47.30609358200
18607	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43148532200	47.31519893900
18739	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.55848656200	47.29806251700
18806	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57578460300	47.33105257800
18823	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.62841961400	47.38658649600
18828	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56449744200	47.30406195200
18917	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57384980000	47.32668422800
18939	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57030795500	47.31200937600
19000	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel flat or fan	-122.62538105600	47.37910147000
19030	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43519054600	47.29775476600
19120	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43818651700	47.30656458900
19228	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42957246800	47.31888261300
19255	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42953957800	47.31949265000
19363	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57339008200	47.32731270000
19385	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57327254300	47.31629747800
19451	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57109418500	47.32796572200
19535	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57531295800	47.18741328200
19564	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43486054200	47.30751033700
19623	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62405641200	47.37518618800
19653	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44449220900	47.30157511200
19676	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.43025708600	47.31607041700

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
19735	Pierce	Pierce Co. - Unincorporated UGA	Mud flat	-122.57374166200	47.19041562300
19742	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44218987200	47.29947923400
19874	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57587021000	47.33220457500
19897	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56285524600	47.30270185700
19937	Pierce	Gig Harbor - Unincorporated UGA	Mud flat	-122.58330508700	47.34070397900
19967	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.41850440800	47.32003601900
20075	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57281868200	47.32662782100
20098	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57175794200	47.31374689400
20158	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62800266000	47.38462577500
20189	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43926303500	47.29897803100
20256	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44407567600	47.30392284200
20296	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42290786800	47.31899664400
20337	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62486044800	47.37805465600
20368	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44350365900	47.30611592600
20389	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43199569900	47.31276717000
20519	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56159034200	47.30118984400
20587	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57939128200	47.33674956600
20602	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.62855094000	47.38539393700
20608	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56706989100	47.30723202300
20698	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57729060800	47.33475485400
20720	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56794326500	47.30820154700
20782	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62622899300	47.38284982000
20813	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43955915000	47.29902738300
20826	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58330590900	47.33897242900
21007	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.42155017500	47.31915488200
21036	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.41890819200	47.31992028200
21142	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57320069000	47.32647676700
21165	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57251949100	47.31484222100
21226	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.62892593200	47.38746186500

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
21232	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56510997200	47.30462702000
21272	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.58378496100	47.34349450400
21316	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62761526000	47.38600491000
21346	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.43352606300	47.30851771000
21405	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.62473542800	47.37779891000
21410	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57436561900	47.32640336400
21449	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58041116100	47.33709719900
21457	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43208516800	47.31214531800
21523	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44409970600	47.30078339400
21656	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57867027700	47.33642914700
21678	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56380135900	47.30357969200
21856	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57529311900	47.33052240600
21878	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.57399487300	47.31756458000
21896	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.58357786400	47.34232199700
21938	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62665696600	47.38656427300
21970	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43427386100	47.30793210000
22036	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44439973700	47.30323793500
22058	Pierce	Tacoma - Unincorporated UGA	Sand and gravel flat or fan	-122.42949033500	47.31691018600
22076	Pierce	Tacoma - Unincorporated UGA	Sand beach	-122.42842967000	47.31956507700
22105	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43193714700	47.31391378700
22130	Pierce	Tacoma - Unincorporated UGA	Sand flat	-122.41999496300	47.31964858300
22161	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.58366060900	47.34266465100
22234	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.57171444500	47.32732873000
22300	Pierce	Gig Harbor - Unincorporated UGA	Organics/fines	-122.62666655000	47.38680557000
22392	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43242089200	47.31062906700
22406	Pierce	Gig Harbor - Unincorporated UGA	Sand flat	-122.58249717300	47.33790024900
22471	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.43337146400	47.29725713600
22537	Pierce	Gig Harbor - Unincorporated UGA	Sand beach	-122.56980936900	47.31130554400
22545	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel flat or fan	-122.62550214300	47.37985087100

Order	COUNTY_NM	UGA_NM2	BCNAME	LON_DD	LAT_DD
22623	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.62644150900	47.38326014200
22657	Pierce	Gig Harbor - Unincorporated UGA	Sand and gravel beach, narrow	-122.56198420900	47.30149873300
22716	Pierce	Tacoma - Unincorporated UGA	Sand and gravel beach, narrow	-122.44187384400	47.30620780000

Appendix B. Glossary, acronyms, and abbreviations

Glossary

Fecal coliform (fecal coliform): That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. Fecal coliform are "indicator" organisms that suggest the possible presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100 mL).

National Pollutant Discharge Elimination System (NPDES): National program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

Parameter: A physical chemical or biological property whose values determine environmental characteristics or behavior.

Pathogen: Disease-causing microorganisms such as bacteria, protozoa, viruses.

Pollution: Contamination or other alteration of the physical, chemical, or biological properties of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or are likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Acronyms and Abbreviations

DOH	Washington State Department of Health
e.g.	For example
EAP	Environmental Assessment Program in Ecology
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency

et al.	And others
fecal coliform	Fecal coliform (bacteria)
GIS	Geographic Information System software
GRTS	Generalized Random Tessellation Stratified
GPS	Global Positioning System
i.e.	In other words
MLLW	Mean Lower Low Water
MPN	Most Probable Number
MQO	Measurement quality objective
MTF	Multiple tube-fermentation (method)
NPDES	National Stormwater Quality Database
PSEMP	Puget Sound Ecosystem Monitoring Program
PSP	Puget Sound Partnership
QA	Quality assurance
QC	Quality control
QAPP	Quality Assurance Project Plan
RPD	Relative percent difference
RSD	Relative standard deviation
SOP	Standard operating procedures
Subgroup	Marine Nearshore Status and Trends Subgroup
SWG	Stormwater Work Group
UGA	Urban Growth Area
WAC	Washington Administrative Code
WQP	Water Quality Program

Units of Measurement

°C	degrees centigrade
ft	feet
m	meter
mL	milliliters
MPN/100mL	most probable number per 100 milliliters
umhos/cm	micromhos per centimeter
uS/cm	microsiemens per centimeter, a unit of conductivity