APPENDIX N
SHELLFISH MONITORING PLAN

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PORT GAMBLE BAY CLEANUP PROJECT

Prepared for

Washington State Department of Ecology

Washington Department of Health

Pope Resources, LP/OPG Properties, LLC

Prepared by

Anchor QEA, LLC

Port Gamble S'Klallam Tribe

May 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

µg	micrograms
CAP	*Final Cleanup Action Plan*
CD	Consent Decree
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CLP	Contract Laboratory Program
CoC	contaminant of concern
cy	cubic yard
DGPS	Differential Global Positioning System
DQO	data quality objective
Ecology	Washington State Department of Ecology
EDL	estimated detection limit
EDR	*Engineering Design Report*
EMNR	enhanced monitored natural recovery
FDA	Food and Drug Administration
GPS	global positioning system
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDPE	high-density polyethylene
MDL	method detection limit
mg/kg	milligrams per kilogram
MLLW	mean lower low water
mm	millimeters
MRL	method reporting limit
MTCA	Model Toxics Control Act
NELAC	National Environmental Laboratory Accreditation Conference
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEMD	polyethylene membrane device

PGST	Port Gamble S'Klallam Tribe
PR/OPG	Pope Resources, LP/OPG Properties, LLC
PSP	paralytic shellfish poisoning
RCW	Revised Code of Washington
QA	quality assurance
QC	quality control
SOP	standard operating procedure
SMA	sediment management area
SMS	Sediment Management Standards
SMP	Shellfish Monitoring Plan
USACE	U.S. Army Corps of Engineers
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDOH	Washington Department of Health

1 INTRODUCTION

Port Gamble Bay ("Site") is one of seven bays in Puget Sound identified for sediment cleanup under Ecology's Toxics Cleanup Program Puget Sound Initiative. Site cleanup requirements are described in the *Final Cleanup Action Plan* (CAP; Ecology 2013), and will be implemented in accordance with the requirements of Consent Decree (CD) 13-2-02720-0 between the Washington State Department of Ecology (Ecology) and Pope Resources, LP/ Olympic Property Group, LLC (PR/OPG), entered in December 2013. The *Engineering Design Report* (EDR; Anchor QEA 2014) presents detailed plans for the cleanup project, which will be performed by PR/OPG under Ecology oversight.

Cleanup of the Site is being performed consistent with the requirements of the Model Toxics Control Act (MTCA), Chapter 70.105D in the Revised Code of Washington (RCW), as administered by Ecology under the MTCA Cleanup Regulation, Chapter 173-340 of the Washington Administrative Code (WAC), and with the Sediment Management Standards (SMS) Chapter 173-204 WAC. Cleanup actions will also comply with the requirements of the U.S. Army Corps of Engineers (USACE) Nationwide 38 Permit for the Port Gamble Bay Cleanup Project (NWS-2013-1270).

This *Shellfish Monitoring Plan* (SMP) describes the sampling and analysis plan for shellfish monitoring to be conducted during pile removal, intertidal excavation, and dredging activities and immediately following completion of cleanup construction actions at the Site. While not a MTCA or SMS requirement, shellfish monitoring will be performed as requested by tribes, consistent with USACE permit requirements. This SMP describes data quality objectives (DQOs), sampling and analytical methods, quality assurance/quality control (QA/QC) procedures, and data management to monitor shellfish during pile removal, intertidal excavation, and dredging activities and immediately following completion of cleanup construction actions.

1.1 Project Overview

Cleanup construction activities within individual sediment management areas (SMAs) of the Site will include the following (Figure 1):

- Removal of approximately 5,800 creosote-treated wood piles as practicable (including piles supporting overwater structures), along with approximately 55,000 square feet of overwater structure
- Excavation (primarily during low tide conditions) of approximately 26,000 cubic yards (cy) of intertidal sediments in SMA-1 and SMA-2, and capping/backfilling the excavation areas with 24 inches of clean material
- Dredging of approximately 40,000 cy of subtidal wood waste in SMA-1 and SMA-2, and placement of a 6-inch-thick layer of clean sand/silt to manage dredging residuals
- Advanced mitigation of impacts to existing native eelgrass in some of the SMA-1 and SMA-2 dredging areas by constructing and planting 24,000 square feet of eelgrass habitat at a 1:1 ratio in a mitigation area located in the southern portion of SMA-2
- Placement of a 1-foot-thick layer of silty sand and/or gravel material over approximately 3 subtidal acres in SMA-1, and placement of a 4-foot-thick sand and/or silt cap over approximately 7 subtidal acres in SMA-2
- Placement of 6 inches of sand/silt enhanced monitored natural recovery (EMNR) material over approximately 68 subtidal acres in SMA-2 and SMA-3

The cleanup action is described in detail in the EDR (Anchor QEA 2014).

Sampling and analysis during construction will be performed using various methods to address overall project monitoring objectives, including:

- **Water Quality Monitoring**: described in the *Water Quality Monitoring Plan* included as a part of Appendix E to the EDR, and performed by PR/OPG's contractors with Ecology oversight (separate from this SMP)
- **Shellfish Biotoxin Monitoring**: described in this SMP using caged mussel sampling performed by the Port Gamble S'Klallam Tribe (PGST) and paralytic shellfish poisoning (PSP) analysis performed by Washington Department of Health (WDOH)
- **Shellfish Contaminant of Concern (CoC) Monitoring:** described in this SMP using three complementary monitoring approaches performed by PR/OPG's contractors:
  - Caged mussel sampling and analysis of CoCs
  - Monitoring of water column carcinogenic polycyclic aromatic hydrocarbon (cPAH) concentrations using passive ethylene membrane devices (PEMDs)

- In situ shellfish monitoring if caged mussel tissue concentrations exceed intermediate risk screening levels, and at the completion of in-water construction (currently anticipated in January 2017)

The shellfish biotoxin and CoC monitoring plans are described in detail in this SMP.

1.2 Study Area

Port Gamble Bay is located in Kitsap County and encompasses more than 2 square miles of intertidal and subtidal habitat. The bay and surrounding areas support diverse aquatic and upland habitats, as well as resources for fishing, shellfish harvesting, and many other aquatic uses. The area surrounding the bay remains largely rural in nature, though more than 100 acres of the basin are currently in commercial land use, largely in the Gamble Creek watershed. The PGST Reservation is located east of the bay.

The Site is divided into SMAs as shown on Figure 1. Shellfish monitoring will be conducted during cleanup construction activities within SMA-1, SMA-2, and SMA-3.

1.3 Construction Sequencing

The cleanup project is anticipated to be completed within two construction seasons, and will be sequenced to maximize overall protectiveness. Subject to final permitting approvals, full-scale construction is scheduled to begin in July/August 2015. Work will occur during approved in-water work windows, with demolition preceding excavation, and intertidal excavation above mean lower low water (MLLW) occurring in dry conditions prior to subtidal dredging. Dredging and excavation will be followed by placement of clean residuals cover, EMNR material, and in-water engineered caps. All construction actions within an individual SMA are targeted to be completed within a single construction season; placement of eelgrass habitat bench material in SMA-2 will occur in Year 1. This SMP assumes that 2015 construction will begin in SMA-2; however, the selected contractor will refine the construction sequence and schedule as appropriate, subject to Ecology approval.

1.4 Human Health Contaminants

The CAP (Ecology 2013) evaluated a series of human health CoCs: metals (arsenic, cadmium, copper, and mercury), cPAHs, polychlorinated biphenyls (PCBs), and dioxins/furans. Of this list, cadmium, cPAHs, and dioxins/furans were identified as Site-related human health CoCs. Ecology identified cPAHs as the primary human health CoC throughout the Site; dioxins/furans were identified as a human health CoC in limited areas of the Site, and cadmium was identified as a low-level human health CoC.

In addition to the Site-related CoCs, the affected tribes are also interested in expanding shellfish monitoring to include PCBs. Moreover, PGST and WDOH currently monitor biotoxins to inform tribal members and the public about potential PSP risks from consumption of shellfish harvested from Port Gamble Bay. These additional monitoring elements are included in this SMP.

1.5 Tissue Screening Levels

This section describes shellfish tissue screening levels and response actions if screening levels are exceeded for biotoxins and/or CoCs resulting from in-water construction activities. A summary of the screening levels are presented in Table 1; further details are provided in Sections 1.5.1 and 1.5.2.

1.5.1 Shellfish Biotoxin Monitoring

PSP is a serious illness, caused by eating shellfish that have consumed large amounts of toxin-producing microscopic phytoplankton. Throughout the Pacific Coast, *Alexandrium sp.* is the primary cause of PSP, and most species of shellfish in Washington have been found to contain PSP toxin at one time or another (WDOH 2015a). *Alexandrium* is a dinoflagellate that spends part of its life cycle as a cyst in the sediment before germinating to become a vegetative cell (Anderson 1998). Once vegetative cells enter the water following cyst germination, their growth and transport are affected by circulation, nutrients, stratification, and other chemical and physical factors including sunlight, water temperature, and salinity (Anderson 1998; USEPA 2013). Mussels have been shown to rapidly accumulate PSP toxin. As a result, the PSP toxin levels in mussels are a good index of the abundance of *Alexandrium sp*. present in the water column.

Mussels placed in cages at strategic sites are currently used as the primary element of the WDOH marine biotoxin monitoring and contingency plan (WDOH 2015a). Within Port Gamble Bay, a single sentinel caged mussel tissue location has been established at a primary PGST shellfish harvesting beach (Figure 2), and is currently monitored by PGST and WDOH every other week from May through October. Advisory closures are in effect when any mussel sample equals or exceeds Food and Drug Administration (FDA) regulatory levels (equal to or greater than 80 micrograms [µg] of PSP toxin per 100 g of shellfish tissue; Table 1). An area is reopened when two successive samples, collected at least 7 days apart, fall below 80 µg/100 g of PSP toxin.

In addition to the current monitoring by WDOH and PGST, PGST will perform additional weekly sampling of caged mussels during in-water construction (i.e., pile removal, intertidal excavation, and/or subtidal dredging) from July 15 to October 31. Between November 1 and January 14, PGST will sample caged mussels every other week. Additional sampling will be conducted by PGST using the same procedures currently used by WDOH for their ongoing PSP monitoring in Port Gamble Bay. PR/OPG will be responsible for payment of these additional samples that are above and beyond the current every other week sampling between May and October.

If PSP toxins are detected above FDA regulatory levels in caged mussels, WDOH performs in situ sampling and PSP analysis of subsistence species (oyster, manila, cockle, and butter clam), as this constitutes a public health necessity. WDOH will determine the appropriate frequency for in situ subsistence sampling based on results, and will continue sampling until all species are non-detect for PSP.

Because PSP outbreaks cannot generally be controlled once they are initiated, no contingency actions related to the cleanup will be required if a PSP outbreak occurs in Port Gamble Bay during the first in-water construction season. WDOH may decide to initiate closures of shellfish beds depending on the nature and extent of the PSP outbreak. If a PSP exceedance occurs during the first in-water construction season, adaptive management measures may be implemented during the second in-water construction season, depending on the cause of the PSP outbreak. In addition, if no potential cleanup-related PSP

exceedances occur during the first construction season, the PSP monitoring may be adjusted as appropriate during the second construction season.

1.5.2 Shellfish CoC Monitoring

As discussed in the CAP (Ecology 2013), in addition to reducing risks to benthic organisms from wood waste exposure, one of the other primary objectives of the Port Gamble Bay cleanup project is to:

> *Eliminate, reduce, or otherwise control to the extent practicable risks to humans from ingestion of seafood containing chemicals that exceed risk-based concentrations and/or natural background concentrations.*

The CAP (Ecology 2013) recognized the potential for short-term increases in risks from pile and sediment removal, and balanced such short-term risks with the long-term protection that will result from removing these materials. The EDR incorporates best management practices and other engineering controls to minimize cleanup-related CoC releases and exposures to the extent practicable. Nevertheless, increases in short-term shellfish tissue CoC concentrations, particularly at locations immediately adjacent to SMA-1 and SMA-2, are possible during construction of the Port Gamble Bay cleanup project, followed by accelerated long-term recovery.

In consideration of the overall objectives of the Port Gamble Bay cleanup project, WDOH (2015b) developed short-term shellfish tissue screening levels for intermediate-duration shellfish consumption exposures using toxicological profile data for Site CoCs (as well as PCBs) available from the Agency for Toxic Substances and Disease Control for non-cancer endpoints, based the most sensitive endpoint that, in their best judgment, represents the most sensitive human health effect for a given exposure route and duration. The WDOH screening levels, which assumed a high-level (subsistence) shellfish consumption rate of 499 g per day, are summarized in Table 1. Because the WDOH calculated screening level for cadmium (0.079 milligrams per kilogram [mg/kg]) is below the natural background tissue concentration reported by Ecology (2012), the cadmium screening level was revised upwards to two times the natural background tissue level (0.52 mg/kg; see Table 1). The screening levels will be refined and updated as necessary during implementation of this SMP.

The caged mussel PSP and CoC monitoring data will be compared with appropriate tissue screening levels. If tissue screening levels are exceeded in caged mussel tissue samples during in-water removal actions (i.e., pile removal, intertidal excavation, and subtidal dredging), supplemental in situ shellfish monitoring will be conducted as specified in Sections 2.1.1.3 and 2.1.1.4. In situ shellfish monitoring for CoCs will also be performed at the completion of in-water construction in Year 2 (currently anticipated January 2017) to document post-construction shellfish quality conditions.

There are no screening levels for in situ shellfish monitoring, though the values summarized in Table 1 may be used by tribal shellfish managers and WDOH to provide advisories to tribal members and the public. Similarly, there are no screening levels for passive sampling of water column PAH concentrations using PEMDs. However, PEMD results will be compared with caged mussel tissue PAH concentrations to evaluate the effectiveness of PEMDs as a proxy to more precisely monitor tissue PAH concentration trends.

1.6 Baseline Monitoring Data

Baseline data are available for all shellfish monitoring elements to allow comparison with data collected during the in-water construction period. As described in more detail in later sections of this document, all data collected under this SMP will be obtained using methods and procedures equivalent to those used during the baseline monitoring. Baseline monitoring stations to be reoccupied as part of this SMP are depicted in Figure 2. The available SMP baseline data are summarized as follows:

- Shellfish Biotoxin Monitoring: Biweekly PSP analyses of samples collected during the May to October period since 2008 from the PGST beach location (Figure 2) are summarized in Appendix A-1.
- Shellfish CoC Monitoring:
  - *Caged mussel sampling and analysis of CoCs:* Caged mussels were deployed at 28 locations in Port Gamble Bay in December 2014, and successfully retrieved in February 2015 (WDFW 2014a). Mussel tissue samples were analyzed for cPAHs, dioxins/furans, cadmium, PCBs, and other ancillary chemicals; the baseline data are summarized in Appendix A-2 (*pending until June/July 2015*).

- *Water column cPAH monitoring using PEMDs:* As part of the Ecology/ Washington Department of Fish and Wildlife (WDFW) herring embryo study (WDFW 2014b), PEMDs were deployed at 40 locations in Port Gamble Bay between February and April 2014, and equilibrated for 10 days before retrieval. PEMDs were analyzed for cPAHs and other ancillary chemicals; the baseline data are summarized in Appendix A-3 (*pending until June/July 2015*).
- *In situ shellfish monitoring:* In situ shellfish tissue sampling data have been collected by Ecology and PGST since 2008 within six primary shellfish harvesting areas of Port Gamble Bay (Point Julia, Gravel Plot, The Bars, Central Bay, Western Shoreline, and Mill Site). Sampled species have included mussels, oysters, cockles, littleneck clams, horse clams, manila clams, geoduck, and Dungeness crab. Tissue samples were analyzed for cPAHs, dioxins/furans, cadmium, PCBs, and other ancillary chemicals. The baseline data for harvesting areas targeted in this SMP (i.e., Point Julia, Gravel Plot, Western Shoreline, and SMA-3) are summarized in Appendix A-4.

1.7 Document Organization

The remainder of this document is organized as follows:

- **Section 2, Data Generation and Acquisition**: This section summarizes the sampling design, sampling and processing methods, sample handling and chain-of-custody procedures, laboratory analytical methods, QA/QC procedures, and data management.
- **Section 3, Project Management**: This section describes the project purpose, project organization and responsibilities, project task schedule, DQOs, and special training requirements.
- **Section 4, Assessments and Oversight:** This section includes compliance assessments, response and corrective actions, and reports to management.
- **Section 5, Data Validation and Usability**: This section describes data validation and verification methods and criteria for usability of data.
- **Section 6, References:** This section presents relevant citations or reference material.

2 DATA GENERATION AND ACQUISITION

This section summarizes the sampling design, sampling and processing methods, sample handling, laboratory methods, and QA/QC measures.

2.1 Sampling Design

The shellfish monitoring sampling design is summarized in Table 2 and described in detail in subsequent sections. Monitoring includes the collection and analysis of shellfish tissue for biotoxin and CoC analyses as well as passive sampling with PEMDs for PAH analysis.

2.1.1 Shellfish Tissue Sampling

Shellfish tissue sampling includes using caged mussels to monitor biotoxin and CoC concentrations during in-water construction (i.e., pile removal, intertidal excavation, and/or subtidal dredging) in SMA-1 and SMA-2. In addition, in situ shellfish sampling will be performed if caged mussel tissue concentrations exceed intermediate risk screening levels, and also at the completion of in-water construction actions in Year 2 (anticipated January 2017).

2.1.1.1 Caged Mussel Biotoxin Sampling Design

Shellfish biotoxin monitoring will be conducted in conjunction with PGST's and WDOH's ongoing PSP monitoring in Port Gamble Bay, and will follow methods and procedures described in the *Marine Biotoxin Contingency Plan* (WDOH 2015a). Adult Pacific blue mussels (*Mytilus trossulus;* obtained from Penn Cove Shellfish, Inc. in Whidbey Island, Washington) will be deployed during Years 1 and 2 in-water construction periods to assess effects during pile removal, intertidal excavation, and/or subtidal dredging. Sampling will occur weekly from July 15 to October 31 and every other week from November 1 to January 14.

Caged mussel deployment and sampling will be performed by PGST at the same sentinel station used historically within Port Gamble Bay, placed within the subtidal zone near a primary PGST shellfish harvesting beach (Figure 2). Composite mussel tissue will be

analyzed for PSP by the WDOH laboratory as described in the *Marine Biotoxin Contingency Plan* (WDOH 2015a).

2.1.1.2 Caged Mussel CoC Sampling Design

The caged mussel CoC sampling design follows methods and procedures used during the baseline study in Port Gamble Bay (WDFW 2014a). All cages will be placed immediately above the sediment surface. Adult Pacific blue mussels will be placed in cages and will remain in situ for 60 days prior to retrieval and tissue resection/analysis.

During Year 1 construction actions, and subject to refinement of project sequencing and scheduling (see Section 1.3), caged mussels will be deployed at five locations located 300 feet offshore of the SMA-2 subtidal dredging areas (Figure 3), as well as at three primary shellfish harvesting beaches in Port Gamble Bay (Point Julia, Gravel Plot, and Western Shoreline; see Figure 2). The 300-foot offset from subtidal dredging areas will help ensure that the cages remain intact during construction actions, and are also located close enough to the removal areas to reflect potential transport of CoCs. During Year 2 construction actions, and again subject to refinement of project sequencing and scheduling (see Section 1.3), caged mussels will be deployed at three locations located 300 feet offshore of SMA-1 dredging areas, two representative locations adjacent to SMA-2 (identified based on review of Year 1 sampling data), and at the three primary shellfish harvesting beaches in Port Gamble Bay (Point Julia, Gravel Plot, and Western Shoreline).

Deployment of caged mussels for CoC monitoring will occur during two periods in Year 1:

- September/October 2015 – after pile removal and/or intertidal excavation is underway, but prior to the initiation of subtidal dredging
- January/February 2016 – shortly following completion of Year 1 in-water construction actions

A similar deployment schedule is anticipated in Year 2, subject to refinement based on the results of the Year 1 monitoring.

Composite samples of caged mussel tissue collected from each of the sampling locations will be analyzed for PAHs, dioxins/furans, cadmium, PCBs, and lipids (Table 2).

2.1.1.3 In Situ Shellfish Biotoxin Sampling Design

As discussed in Section 1.5.2, contingent in situ shellfish PSP monitoring will be performed by WDOH if caged mussel tissue concentrations exceed the screening level provided in Table 1.

2.1.1.4 In Situ Shellfish CoC Sampling Design

In situ shellfish monitoring for CoCs will be performed if caged mussel tissue concentrations exceed intermediate risk screening levels listed in Table 1, and also at the completion of in-water construction actions in Year 2 (anticipated January 2017). In situ shellfish sampling will be performed at three primary intertidal shellfish harvesting beaches in Port Gamble Bay (Point Julia, Gravel Plot, and Western Shoreline; see Figure 2), and will target species included in the baseline sampling (mussels, oysters, cockles, littleneck clams, horse clams, and manila clams; see Appendix A-4). In addition, geoduck and Dungeness crab (muscle and hepatopancreas tissue) sampling will be performed in subtidal areas of SMA-3 using divers (Table 2).

At each of the four in situ shellfish sampling locations (Point Julia, Gravel Plot, Western Shoreline, and SMA-3), approximately 5 to 20 composite tissue samples of the predominant shellfish species will be collected, consistent with the baseline data set, and analyzed for PAHs, dioxins/furans, cadmium, PCBs, and lipids (Table 2).

2.1.2 Water Column PAH Monitoring Using PEMDs

Concurrent with the caged mussel CoC sampling discussed above, PEMDs will be co-deployed at the same caged mussel locations in Port Gamble Bay (Figures 2 and 3), and during four separate sampling events (mid-season and post season events in Years 1 and 2). The PEMD sampling design follows methods and procedures used during the baseline study in Port Gamble Bay (WDFW 2014b).

Consistent with the baseline study (WDFW 2014b), PEMDs will equilibrate in situ for 10 days (i.e., retrieved prior to completion of the caged mussel CoC deployments). PEMDs will be analyzed for PAHs. Because a 10-day deployment is far too short for dioxins/furans to reach near-equilibrium in the PEMDs, and also because no baseline dioxin/furan PEMD data were collected (WDFW 2014b), dioxin/furan analysis will not be performed on the PEMD samples. However, as discussed in Section 2.1.1.2, dioxins/furans will be analyzed as part of the caged mussel CoC monitoring (Table 2).

2.2 Sample Collection, Processing, and Handling Procedures

This section describes activities, methods, and procedures for sample collection, processing, and handling. A list of station identifications, sampling locations, sample type and method, and analytical testing is provided in Table 2.

2.2.1 Caged Mussels

Biotoxin and CoC concentrations in shellfish during construction will be determined using methods provided in *Standard Guide for Conducting In-situ Field Bioassays with Caged Bivalves* (ASTM E2122-02, 2007) and the WDFW Port Gamble Bay baseline study (2014a). Caged mussels will be deployed from a sampling vessel with adequate deck space for storing and assembling equipment.

2.2.1.1 Species

Blue mussels will be acquired from Penn Cove Shellfish, Inc., as discussed in Section 2.1.1.1. Adult mussels (45 millimeters [mm] ± 5 mm) will be selected for deployment in the cages. An adequate number of mussels will be placed in each cage to provide sufficient tissue for analyses and to account for potential survival issues during the exposure period. In addition, a 'time zero' sample from each batch of mussels will be shipped to the analytical laboratories to establish background concentrations in mussel tissue prior to deployment.

2.2.1.2 Equipment

Mussels will be placed in cages to prevent predation. Cages will consist of plastic-coated wire mesh with mesh openings of 1.25 cm by 2.5 cm to allow water to flow through the

cages. Mussels will placed in high-density polyethylene (HDPE) mesh bags, which will be secured inside the cages with zip-ties, or similar, so that mussels are suspended approximately 35 cm above the cage bottom.

The mussel cages will be anchored into the sediment surface using rebar or equivalent materials. In addition, extra wire mesh panels will be affixed to the bottom of the cages and rebar to prevent the cages from sinking into the sediment. Cages will be affixed with metal labels with the project and contact information. Subsurface buoys will also be labeled and attached to cages with rope to aid in recovery. Depths at the proposed sampling stations range from -8.7 to -38.2 feet MLLW. An adequate rope length will be used so that buoys remain underwater except at lower tides.

Once deployed, cages will remain in situ for 7 days (biotoxin monitoring) or 60 days (CoC monitoring). All materials will be either rinsed with high-pressure freshwater or soaked in seawater for 24 hours prior to deployment at sampling locations.

2.2.1.3 Deployment of Caged Mussels for Biotoxin Analyses

Mussels will be placed into one or more cages for deployment at the PGST/WDOH sentinel monitoring station (Figure 2). The minimum tissue volume needed for biotoxin analysis is 150 g per sample; an adequate number of mussels will be distributed evenly amongst the cage(s) to provide sufficient volume for analysis of composited replicates.

Cages will be lowered to target depth and the global positioning system (GPS) locations will be recorded on field forms. Cages will remain in situ for 7 days prior to retrieval.

2.2.1.4 Deployment of Caged Mussels for CoC Analyses

Mussels will be placed into three cages (replicates) for deployment at each of the sampling locations in the SMA that is undergoing active construction (Figure 3). The minimum tissue volume needed for COC analysis is 400 g per sample; an adequate number of mussels will be distributed evenly amongst the replicate cages at each station to provide sufficient volume for analysis of composited replicates.

Cages will also be affixed with PEMD samplers (see Section 2.1.2) and lowered to target depth. The GPS locations will be recorded on field forms. Cages will be retrieved and PEMDs recovered after 10 days. Cages will then be re-deployed and remain in situ for 50 more days.

2.2.2 In Situ Shellfish Sampling for CoCs

In situ shellfish sampling methods will follow guidance provided in the *Port Gamble S'Klallam Tribe Brownfields Supplemental Quality Assurance Project Plan Addendum: Standard Operating Procedure: Marine Tissue Sampling* (RIDOLFI Inc. 2011).

Only living, adult organisms will be collected, and Dungeness crab must meet legal take requirements; only males with a carapace length of at least 6.25 inches may be collected. Sampling of shallow-dwelling species (all species except geoduck and crab) will be conducted from harvestable beaches (see Figure 2) in the intertidal or shallow subtidal zone at low tide. Geoducks will be collected using divers; Dungeness crab will be collected using crab pots deployed from a vessel. Individuals will be separated by species and placed in buckets, or equivalent, with site water until processing occurs.

2.2.3 Passive Sampling with PEMDs

Passive sampling will be conducted with PEMDs consistent with methods used in a herring study within Port Gamble Bay (WDFW 2014b) and the methods detailed by Carls et al. (2004).

2.2.3.1 Equipment

PEMDs consist of low-density polyethylene strips that attract and absorb non-polar hydrocarbons. PEMDs will be prepared by the chemical laboratory and constructed from "lay-flat" tubing cut longitudinally to create strips approximately 20 cm by 5 cm. Strips will be placed in a sonicator with methylene chloride for 5 minutes and then rinsed with fresh methylene chloride, wrapped in solvent-rinsed aluminum foil, and placed in zip-top baggies. PEMDs will be shipped or couriered to the field staff.

2.2.3.2 Deployment of PEMDs

PEMDs will be deployed with caged mussels at the stations targeted for CoC analyses (see Figures 2 and 3). PEMDs are easily contaminated; therefore, they will remain sealed in baggies until deployment at each station. One PEMD will be deployed with each cage (for a total of three replicates per station).

Upon arrival at a station, the vessel engine will be turned off. The field staff handling PEMDs will wear clean gloves and be cautious to avoid touching any surface that has not been decontaminated. Each PEMD will be removed from the baggie, fastened to a mussel cage with a zip-tie, or similar, and deployed with the cage.

2.2.4 Sample Identification and Labels

Each composite sample will be assigned a unique alphanumeric identifier. The identifier will have the format of "Project Identifier-Station ID-Species or Media Code-Analytical Program-Date." Samples will be identified according to the following procedure:

- The project designator will be PG to denote Port Gamble
- The station ID will correspond to sample locations shown on Figures 2 and 3
- Species/media codes are as follows:
  - COC = cockles
  - MAN = manila clams
  - BUT = butter clams
  - OYS = oysters
  - GEO = geoducks
  - DUNH = Dungeness crab hepatopancreas
  - DUNM = Dungeness crab muscle
  - PEMD = polyethylene membrane device
- Analytical program will be coded as either BIO for biotoxins or CoC for contaminants of concern
- Date of collection, in the form of YYMMDD
- As an example, a Dungeness crab muscle tissue sample collected on August 24, 2015 from station SMA2-2 will have an ID of PG-SMA2-2-DUNM-COC-150824

Each sample will have an adhesive plastic or waterproof paper label affixed to the container or baggie and will be labeled at the time of collection. The following information will be recorded on the container label at the time of collection:

- Project name
- Sample identifier
- Date and time of sample collection
- Analysis to be performed

2.2.5 Station Positioning

A handheld or vessel-mounted Differential Global Positioning System (DGPS) will be used to navigate to the desired sampling location. GPS coordinates for each sampling station are provided in Table 2. Collection at the sampling location will be guided by the navigation system with an accuracy of ±10 feet. The coordinates will be recorded, when positioned at the sampling location, in latitude and longitude in decimal degrees (to 5 decimal places). Positions will be relative to the Washington State Plane Coordinates, North, North American Datum of 1983.

2.2.6 Shellfish Tissue Retrieval and Processing

2.2.6.1 Caged Mussels for Biotoxins

Mussels will be retrieved after a 7-day exposure period. GPS coordinates and/or cage buoys will be used to locate cages. Mussels from replicates at each station will be composited to create one sample per station. Approximately 150 g of tissue is needed per species composite for PSP analysis. The recommended number of individuals per composite for blue mussels is 75 to 100 individuals. Mussels will be submitted to the WDOH laboratory for PSP analysis under the following conditions:

- Shells will be rinsed free of sediment with either fresh or saltwater.
- Mussels will arrive fresh, alive, and in the shell.
- No cracked or crushed shells will be included in the sampling.
- Mussels will be packed on ice in waterproof plastic bags and maintained cold. If stored overnight, mussels will be refrigerated in a bowl covered by a wet towel.
- Mussels will be held dry; holding in fresh or saltwater will be prohibited.

New mussels will be obtained and placed in cages to ensure sufficient tissue volume is available for weekly monitoring (during July 15 to October 31) and every other week monitoring (during November 1 to January 14) during construction.

2.2.6.2 Caged Mussels for CoCs

Mussels will be retrieved after a 60-day exposure. GPS coordinates and/or cage buoys will be used to locate cages. Mussels from replicates at each station will be composited to create one sample per station. Mussels will be left in mesh bags, placed in zip-top baggies, labeled, and stored in coolers on ice until delivery to the analytical laboratory. Mussels will be composited and processed at the analytical laboratory.

2.2.6.3 In Situ Shellfish for CoCs

One composite sample per beach will be created for each species. Approximately 400 g of tissue is needed per species composite for CoC analysis. The recommended number of individuals per composite is as follows:

- Cockles and small clams: 30
- Oysters: 15 to 20
- Geoduck clams: 5
- Dungeness crab: 1

Samples will be stored in zip-top baggies in coolers on ice until delivery to the analytical laboratory.

2.2.7 PEMD Retrieval and Processing

PEMDs will be retrieved with caution to avoid contamination. Upon arrival at a station, the vessel engine will be shut off. Each cage/PEMD will be located by its float and/or GPS location and retrieved. The PEMD will be removed from its anchoring device, wrapped in aluminum foil, and placed in a zip-top baggie. Each baggie will be labeled consistent with methods described in Section 2.2.4 and stored in a cooler on ice until delivery to the analytical laboratory.

2.3 Sample Handling Requirements

Sample container requirements, holding times, and preservation requirements are outlined in Table 3. Sample containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with sample material must meet high standards of cleanliness. All equipment and instruments that will be used and are in direct contact with various media collected for chemical analyses must be made of glass, stainless steel, HDPE, or polytetrafluoroethylene and will be cleaned prior to each day's use and between sampling or compositing events.

Extra caution will be taken when handling PEMD samples, because they are easily contaminated. PEMDs will only be handled with clean, gloved hands and never come into contact with dirty gloves or any other surface.

2.3.1 Decontamination Procedures

2.3.1.1 Field Sampling Equipment

The following general decontamination procedures will be followed for field sampling equipment:

1. Pre-wash rinse with tap or site water
2. Wash with solution of tap water or site water and phosphate-free soap (e.g., Alconox)
3. Rinse three times with distilled water
4. Cover (no contact) all decontaminated items with aluminum foil
5. Store in a clean, closed container for next use

Cages and associated equipment (mesh, ropes, anchors, etc.) will be pressure-washed with freshwater or soaked in saltwater for 24 hours prior to use and kept clean until deployment.

2.3.2 Investigation Derived Waste Management

All disposable sampling materials and personal protective equipment used in sample collection and processing (e.g., disposable gloves and paper towels) will be placed in heavy-duty garbage bags for disposal in the municipal waste. No hazardous materials will be used during fieldwork for this study.

2.3.3 Sample Custody and Shipping Requirements

Chain-of-custody procedures will be followed for all samples throughout the collection, handling, and analysis process. The principal document used to track possession and transfer of samples is the chain-of-custody form. Each sample will be represented on a chain-of-custody form the day it is collected. All manual data entries will be made using an indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, and then dating and initialing the change. Blank lines and spaces on the chain-of-custody form will be lined out, dated, and initialed by the individual maintaining custody. Electronic chain-of-custody forms generated from a custom field application will be emailed directly to the laboratory and QA managers.

A chain-of-custody form will accompany each shipment of samples to the analytical laboratory. Each person in custody of samples will sign the chain-of-custody form and ensure the samples are not left unattended unless properly secured. Copies of all chain-of-custody forms will be retained in the project files.

All samples will be shipped or hand delivered to the analytical laboratory no later than 1 day after collection. Samples collected on Friday may be held until the following Monday for shipment, provided that this delay does not jeopardize any holding time requirements. Specific sample shipping procedures are as follows:

- Each cooler or container containing samples for analysis will be shipped via overnight delivery to the laboratory. In the event that Saturday delivery is required, the field coordinator will contact the analytical laboratory before 3 p.m. on Friday to ensure that the laboratory is aware of the number of containers shipped and the airbill tracking numbers for those containers. Following each shipment, the field coordinator will call the laboratory and verify that the shipment from the day before has been received and is in good condition.
- Coolant ice will be sealed in separate plastic bags and placed in the shipping containers.
- Individual sample containers will be placed in a sealable plastic bag, packed to prevent breakage, and transported in a sealed ice chest or other suitable container.

- Glass jars will be separated in the shipping container by shock-absorbent material (e.g., bubble wrap) to prevent breakage.
- The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office name and address) to enable positive identification.
- The shipping waybill number will be documented on all chain-of-custody forms accompanying samples.
- A sealed envelope containing chain-of-custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.
- A minimum of two signed and dated custody seals will be placed on adjacent sides of each cooler prior to shipping.
- Each cooler will be wrapped securely with strapping tape, labeled "Glass – Fragile" and "This End Up," and will be clearly labeled with the laboratory's shipping address and the consultant's return address.

Upon transfer of sample possession to the analytical laboratory, the person(s) transferring custody of the sample container will sign the chain-of-custody form. Upon receipt of samples at the laboratory, the custody seals will be broken, and the receiver will record the condition of the samples on a sample receipt form. Chain-of-custody forms will be used internally in the laboratory to track sample handling and final disposition.

2.4 Laboratory Analytical Methods

Analytical parameters, methods, and target reporting limits for tissue and PEMD analyses are listed in Tables 4 and 5, respectively. These methods are consistent with methods used in prior studies within Port Gamble Bay.

2.4.1 Tissue for Biotoxins

Caged mussels will be scrubbed free of debris and shucked. One composited sample will be created for each station by combining tissue from the replicates. Organisms will be processed and composited at the WDOH laboratory and tissue will be analyzed for PSP.

2.4.2 Tissue for CoCs

2.4.2.1 Tissue Analyses

Mussel and in situ shellfish tissue collected for CoC analyses will be analyzed by a National Environmental Laboratory Accreditation Conference (NELAC)-accredited chemistry laboratory. CoC analytes will include PAHs (cPAH and total PAH [sum of 16]), dioxin/furan congeners, cadmium, PCB congeners, and lipids. The analyte list, analytical methods, and reporting limits are summarized in Table 4. All analyses will be conducted with a target 3-week turn-around-time.

2.4.2.2 Tissue Processing

Organisms will be processed at the analytical chemistry laboratory. Caged mussels will be scrubbed free of debris, shucked, and composited. Mussels from the replicate cages at each location will be used to create composites, and a single composited sample from each station will be analyzed for CoCs.

Organisms will be analyzed by major taxonomic group (i.e., clams and cockles, geoducks, oysters, and crabs) from each harvestable beach. Dungeness crabs will be dissected and hepatopancreas and muscle tissues will be composited and analyzed separately.

2.4.3 PEMDs

PEMDs will be analyzed for PAHs using methods consistent with those used by WDFW for the baseline study (WDFW 2014b). A complete list of PAH compounds and analytical methods is provided in Table 5.

2.5 Quality Assurance/Quality Control

QA/QC samples will be prepared in the laboratories to monitor the bias and precision of the analyses procedures.

The quality of laboratory data is assessed by precision, accuracy, representativeness, comparability, completeness, and sensitivity as defined in Section 3.1. Laboratory QA/QC samples include method blanks, laboratory control samples, matrix spike/matrix spike

duplicates, and matrix duplicates. Laboratory QA/QC analytical frequencies are provided in Table 6. Laboratory DQOs for precision, accuracy, and completeness are listed in Table 7.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

This section describes procedures for testing, inspection, and maintenance of field and laboratory equipment.

2.6.1 Field Instruments/Equipment

The field coordinator or designee will maintain inventories of field instruments and equipment and will be responsible for the preparation, documentation, and implementation of preventative maintenance. The frequency and types of maintenance will be based on the manufacturer's recommendations and/or previous experience with the equipment. The frequency of maintenance is dependent on the type and stability of the equipment, the methods used, the intended use of the equipment, and recommendations of the manufacturer. Detailed information regarding the calibration and frequency of equipment calibration is provided in specific manufacturers' instruction manuals.

The field coordinator or designee will also be responsible for navigation and will confirm proper operation of the navigation equipment daily. This verification may consist of internal diagnostics or visiting a location with known coordinates to confirm the coordinates indicated by the navigation system. Samplers will be inspected daily for any mechanical problems, and problems will be noted in the field logbook and corrected prior to continuing sampling operations.

2.6.2 Laboratory Instruments/Equipment

Analytical instrument testing, inspection, maintenance, setup, and calibration will be conducted by each laboratory in accordance with the requirements identified in the laboratory's standard operating procedures (SOPs) and manufacturer instructions. In addition, each of the specified analytical methods provides protocols for proper instrument setup, tuning, and critical operating parameters. Instrument maintenance and repair will be documented in the maintenance log or record book.

2.7 Inspection/Acceptance of Supplies and Consumables

The quality of supplies and consumables used during sample collection and laboratory analysis can affect the quality of the project data. All equipment that comes into contact with the samples and extracts must be sufficiently clean to prevent detectable contamination, and the analyte concentrations must be accurate in all standards used for calibration and QC purposes.

Reagents of appropriate purity and suitably cleaned laboratory equipment will be used for all stages of laboratory analyses. Details of acceptance requirements for supplies and consumables at the laboratories are provided in the laboratory SOPs. All supplies will be obtained from reputable suppliers with appropriate documentation or certification.

2.8 Non-Direct Measurements

Existing chemical data from previous baseline investigations will be used to guide this SMP.

2.9 Data Management

Field data sheets will be checked for completeness and accuracy by the field lead prior to delivery to the QA/QC manager. Data generated in the field will be documented on paper and provided to the QA/QC manager, who is responsible for the entering data into the database. Manually entered data will be checked by a second party. Field documentation will be filed in the main project file after data entry and checking are complete.

Laboratory data will be provided to the QA/QC manager in the EQuIS electronic format. Laboratory data that are electronically provided and loaded into the database will undergo a 10% check against the laboratory print copy data. Data will be validated or reviewed manually, and qualifiers, if assigned, will be entered manually. The accuracy of manually entered qualifiers will be verified by a second party. Data tables and reports will be exported from EQuIS to Microsoft Excel tables.

3 PROJECT MANAGEMENT

This section provides a description of DQOs, special training needed to perform the tasks, and documentation procedures.

3.1 Data Quality Objectives

The overall DQO for field sampling and laboratory analysis is to produce data of known and appropriate quality to support the project objectives. DQOs for the project are provided in Table 7. The quality of laboratory data is assessed by precision, accuracy, representativeness, comparability, completeness, and sensitivity. The definitions for the data quality indicators are as follows.

3.1.1 Precision

Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling, and laboratory analysis.

3.1.2 Accuracy

Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value.

3.1.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an environmental condition.

3.1.4 Comparability

Comparability expresses the confidence with which one dataset can be evaluated in relation to another dataset. For this program, comparability of data will be established through the use of standard analytical methodologies and reporting formats and the use of common traceable calibration and reference materials.

3.1.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected.

3.1.6 Sensitivity

Sensitivity is related to the instrument calibration low-level standard, method detection limits (MDLs) and/or estimated detection limits (EDLs). Analytical methods will be selected to achieve reporting limits that comply with, or are close to, target detection limits.

3.2 Special Training Requirements/Certifications

A technical team will be assembled with the requisite experience and technical skills to successfully complete the sampling for this monitoring program. Personnel involved in sample collection will have extensive environmental sampling experience. All sampling personal will be required to have 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and the 8-hour refresher course, as necessary, to meet the 29 Code of Federal Regulations 1910.120 Occupational Safety and Health Administration regulations. The training provides employees with knowledge and skills that enable them to perform their jobs safely and with minimum risk to their personal health. Documentation of course completion will be maintained in personnel files.

3.3 Documentation and Records

Records will be maintained documenting all activities and data related to sample collection and laboratory analyses. Results of data verification and validation activities will also be documented. Procedures for documentation of these activities are described in this section.

3.3.1 Field Records

All collected field samples will be documented using a custom field application or field collection logs. Additionally, the field coordinator or designee will keep a daily record of significant events, observations, and measurements on a daily log. Entries for each day will begin on a new page. The person recording information must enter the date and time and initial each entry.

In general, sufficient information will be recorded during sampling to reconstruct the event without relying on the memory of the field personnel.

The daily log will contain the following information, at a minimum:

- Project name
- Field personnel on site
- Site visitors
- Weather conditions
- Field observations
- Maps and/or drawings
- Sample collection date and time
- Sample collection method and description of activities
- Deviations from this SMP
- Conferences associated with field sampling activities

3.3.2 Analytical Records

Analytical data records (bookmarked PDF and electronic data deliverable formats) will be generated by the laboratory and submitted to the QA manager upon completion. If files are too large to be emailed, a notification email with download instructions will be sent to the data management team at labdata@anchorqea.com. Level IV data reports will be provided by the laboratory.

The analytical laboratory will be required to report the following, where applicable:

- **Case narrative**: This summary will discuss problems encountered during any aspect of analysis, if any. It should discuss, but is not be limited to, QC issues, sample shipment, sample storage, and analytical difficulties. Any problems encountered, actual or perceived, and their resolutions will be documented in as much detail as appropriate. Analytical QC samples that exceed project performance criteria and/or laboratory performance criteria should also be discussed in the case narrative.
- **Chain-of-custody records:** Legible copies of chain-of-custody forms will be provided as part of the data package. This documentation will include the time of receipt and condition of each sample received by the laboratory. Additional internal tracking of

sample custody by the laboratory will also be documented on a sample receipt form. The form must include all sample shipping container temperatures measured at the time of sample receipt.

- **Sample results:** The data package will summarize results for each sample analyzed. The summary will include the following information when applicable:
  - Field sample identifier and corresponding laboratory identification code
  - Sample matrix
  - Date and time of sample extraction
  - Date and time of analysis
  - Final concentration volumes and dilution factors
  - Instrument and analyst identification
  - Method reporting limits (MRLs) and MDLs accounting for sample-specific factors (e.g., dilution and total solids)
  - Analytical results with reporting units identified
  - Data qualifiers and their definitions
  - Raw data including instrument printouts, chromatograms, and bench sheets (required for full data packages)
- **QA/QC summaries:** Contract Laboratory Program (CLP)-like form summaries should be generated for all required laboratory QC components and samples (i.e., method blanks, instrument daily tunes, surrogate spikes, internal standards, and laboratory control samples). These summaries should include spike volumes, parent sample concentrations, percent recoveries, relative percent differences, area counts, and laboratory control limits as applicable. For full data packages, associated raw data files should be included.
- **Instrument calibration data**: CLP-like form summaries of calibration data (i.e., initial calibration, initial calibration verification, and continuing calibration verification) should be included in all data packages. For full data packages, associated raw data files should be included.

All instrument data shall be fully restorable at the laboratory from electronic backup. The laboratory will be required to maintain all records relevant to project analyses for a minimum of 5 years.

3.3.3 Data Reduction

Data reduction is the conversion of raw data to final results. Methods or procedures for data reduction shall be documented. The following procedures will be implemented to verify the accuracy of data reduction:

- Technical staff will document, review, and QC their own work to ensure accuracy.
- Major calculations will be subject to an independent senior technical review to ensure that both the methods and the calculations are correct and consistent with the approved work plan.
- The project manager will be responsible for ensuring that data reduction is conducted in a manner that produces high quality data via review and approval of concepts, methods, assumptions, and calculations.

4 ASSESSMENTS AND OVERSIGHT

Once data are received from the laboratory, a number of QC procedures will be followed to provide an accurate evaluation of the data quality. Specific procedures will be followed to assess data precision, accuracy, and completeness.

4.1 Compliance Assessments

Laboratory and field performance audits consist of on-site reviews of QA systems and equipment for sampling, calibration, and measurement. Audits will not be conducted as part of this study. However, laboratory audit reports will be made available to the project QA manager upon request. The laboratory is required to have written procedures addressing internal QA/QC. When these procedures have been submitted, the project QA manager will review them to ensure compliance with this SMP. The laboratory must ensure that personnel engaged in sampling and analysis tasks have appropriate training. As part of the audit process, the laboratory will provide the consultant with written details of any method modifications planned.

4.2 Response and Corrective Actions

Sections 4.2.1 and 4.2.2 identify the responsibilities of key project team members and actions to be taken in the event of an error, problem, or nonconformance to protocols identified in this SMP.

4.2.1 Field Activities

The field coordinator will be responsible for correcting equipment malfunctions during the field sampling effort. The QA manager will be responsible for resolving situations identified by the field coordinator that may result in noncompliance with the SMP. All corrective measures will be immediately documented in the field logbook.

4.2.2 Laboratory

The laboratory is required to comply with its SOPs. The laboratory manager will be responsible for ensuring that appropriate corrective actions are initiated as required for

conformance with this SMP. All laboratory personnel will be responsible for reporting problems that may compromise quality data.

The laboratory manager will be notified if any QC sample grossly exceeds the laboratory in-house control limits. The analyst will identify and correct the anomaly before continuing with the sample analysis. If the anomaly cannot be corrected, the laboratory manager will notify the QA manager. A narrative describing the anomaly, steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, and re-extraction) will be submitted with the data package.

4.3 Reports to Management

QA reports to project management will include verbal status reports, written reports on field sampling activities and laboratory processes, data validation reports, and final project reports. These reports shall be the responsibility of the project manager.

5 DATA VALIDATION AND USABILITY

Data generated in the field and at the laboratories will be verified and validated according to methods and procedures described in this section.

5.1 Data Review, Validation, and Verification

During the validation process, analytical data will be electronically and/or manually evaluated for method and laboratory QC compliance, and their validity and applicability for program purposes will be determined.

Based on findings of the validation process, data validation qualifiers may be assigned. Validated project data, including qualifiers, will be entered into the project database, thus enabling this information to be retained or retrieved as needed.

5.2 Validation and Verification Methods

Field and laboratory data for this task will undergo a formal verification and validation process. All entries into the database will be verified. All errors found during the verification of field data, laboratory data, and the database will be corrected prior to release of the final data.

Data verification includes a review for completeness and accuracy by the field coordinator and laboratory manager; review by the data manager for outliers and omissions; and the use of performance criteria to identify laboratory QC sample outliers. Data verification will be conducted manually by Anchor QEA staff or an external validator.

For this program, Stage 2B validation (USEPA 2009) will be conducted following National Functional Guidelines for data validation (USEPA 1999, 2004, 2005, 2008), this SMP, and by using professional judgment. Data will be reviewed with regard to the following, as appropriate to the particular analysis:

- Completeness
- Holding times
- MRLs, MDLs, and EDLs

- Laboratory control samples
- Matrix spike/matrix spike duplicates
- Standard reference materials
- Surrogate recoveries
- Method blanks
- Field QC samples
- Initial calibration data
- Continuing calibration data
- Instrument performance check

A data validation report will be generated to document any issues with data quality and any qualifications applied to data. All validated data will be entered into the database established for this program, and a final data file will be exported. Verification of the database export against the PDF data report will be performed by the QA manager or designee. Any errors found in the data file export will be corrected in the database and reviewed for systemic reporting errors. Once all discrepancies are resolved, the database will be established.

The QA manager will be responsible for the final review of all data validation reports.

5.3 Reconciliation with User Requirements

The QA manager will review data at the completion of the task to determine if DQOs have been met. If data do not meet the project's specifications, the QA manager will review the errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors and will suggest corrective action, if appropriate. It is expected that the problem would be able to be corrected by retraining, revising techniques, or replacing supplies/equipment; if not, the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the QA manager will recommend appropriate modifications. If matrix interference is suspected to have attributed to the exceedance, adequate laboratory documentation must be presented to demonstrate that instrument performance and/or laboratory technique did not bias the result. In cases where the DQOs have been exceeded and corrective actions did not resolve the outlier, data will be qualified per USEPA National Functional Guidelines (1999, 2004, 2005, 2008). In these instances, the usability of data will

be determined by the extent of the exceedance. Rejected data will be assigned an "R" qualifier and will not be used for any purposes.

6 REFERENCES

Anchor QEA, 2014. *Engineering Design Report, Port Gamble Bay Cleanup Project*. Report prepared for Pope Resources, LP/OPG Properties, LLC, and Washington State Department of Ecology. November 2014.

Anderson, D.M., 1998. In: Anderson, D.M. Cembella, A.D., Hallegraeff, G.M. (Eds.), *Physiological Ecology of Harmful Algal Blooms*. NATO ASI Series, Series G, Ecological sciences no. 41. Springer-Verlag, Berlin, pp. 29-48.

Carls, M.G., L.G Holland, J.W. Short, R.A. Heintz, and S.D. Rice, 2004. Monitoring Polynuclear Aromatic Hydrocarbons in Aqueous Environments with Passive Low-Density Polyethylene Membrane Devices. *Environmental Toxicology and Chemistry* 23(6): 1416-1424.

Ecology (Washington State Department of Ecology), 2012. *Final Partial Remedial Investigation and Feasibility Study for Port Gamble Bay, Washington*. December 2012.

Ecology, 2013. *Final Cleanup Action Plan.* Exhibit A to the Port Gamble Bay Consent Decree No. 13-2-02720-0.

RIDOLFI Inc., 2011. *Port Gamble S'Klallam Tribe Brownfields Supplemental Quality Assurance Project Plan Addendum: Standard Operating Procedure: Marine Tissue Sampling*. May 2011.

USEPA (U.S. Environmental Agency), 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*. U.S. Environmental Protection Agency, Office of Emergency Response. EPA 540/R-99/008. October 1999.

USEPA, 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation (OSRTI). EPA 540-R-04-004. October 2004.

USEPA, 2005. *USEPA Contract Laboratory Program National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Data Review*. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation (OSRTI). EPA 540-R-05-001. September 2005.

USEPA, 2008. *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*. Office of Superfund Remediation and Technical Innovation. EPA 540-R-08-01. June 2008.

USEPA, 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. EPA 540-R-08-005. January 2009.

USEPA, 2013. *Impacts of Climate Change on the Occurrence of Harmful Algal Blooms.* EPA 820-S-13-001. May 2013. Available from: http://www2.epa.gov/sites/production/files/documents/climatehabs.pdf.

WDFW (Washington Department of Fish and Wildlife), 2014a. *Toxic Contaminants in Bay Mussels (Mytilus trossulus) Transplanted to Port Gamble Bay, Washington Before and After Cleanup and Restoration (2015 – 2017), Quality Assurance Project Plan*. Prepared for Washington State Department of Ecology, December 2014.

WDFW, 2014b. *Toxic Contaminants in Embryos of Pacific Herring (Clupea pallasii) from Port Gamble Bay, Washington: Extent and Magnitude of Contamination by Polycyclic Aromatic Hydrocarbons*. Draft Quality Assurance Project Plan Addendum: Analysis of PAHs and Other Contaminants in Polyethylene Membrane Devices Deployed in Port Gamble Bay as a Proxy for Biological Tissues. Prepared for Washington State Department of Ecology, August 2014.

WDOH (Washington Department of Health), 2015a. *Marine Biotoxin Contingency Plan*. Office of Shellfish & Water Protection. Updated February 20, 2015.

WDOH, 2015b. Port Gamble Bay Minimal Risk Levels and Screening Values. Correspondence from Lenford O'Garro, Site Assessment & Toxicology Section, Office of Environmental Health, Safety & Toxicology, Division of Environmental Public Health. March 11, 2015.

TABLES

Table 1
Shellfish Screening Levels

Parameter	Units	Tissue Screening Criteria
Paralytic Shellfish Poisoning	µg/100gm wet	80[a]
Total Polycyclic Aromatic Hydrocarbons	mg/kg wet	63[b]
Dioxin/Furan Toxicity Equivalent Quotient	ng/kg wet	3.2[b]
Cadmium	mg/kg wet	0.52[c]
Polychlorinated Biphenyls	µg/kg wet	4.7[b]

Notes:
a Advisory criterion from WDOH (2015a)
b Intermediate-duration shellfish consumption exposure criteria from WDOH (2015b), based on a high shellfish consumption rate (499 grams per day)
c Two times the natural background tissue concentration from Ecology (2012)
µg/100gm = micrograms per 100 grams
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram

Table 2
Sampling Design Summary

Sampling Area	Station ID	Proposed Coordinates[1]		Sample Media	Sampling Method	Composite Sample Analytical Testing Chemistry	Archive
		Northing	Easting				
SMA-1	SMA-1-1	317971.442	1211765.078	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--
	SMA-1-2	317559.819	1212023.905	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--
	SMA-1-3	317123.527	1212194.029	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--
SMA-2	SMA-2-1	316739.530	1211968.535	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--
	SMA-2-2	316303.466	1211795.518	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--
	SMA-2-3	315844.882	1211706.056	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--
	SMA-2-4	315474.392	1211446.785	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--
	SMA-2-5	315172.444	1211104.658	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--

Table 2
Sampling Design Summary

Sampling Area	Station ID	Proposed Coordinates[1]		Sample Media	Sampling Method	Composite Sample Analytical Testing Chemistry	Archive
		Northing	Easting				
SMA-3	SMA-3-1[2]	308268.920	1212681.470	In Situ Geoduck and Dungeness Crab Muscle and Hepatopancreas Tissue	Diver collection (with crab pot)	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual shellfish tissue
Intertidal Sampling Locations							
Point Julia	PJ-1[2]	315818.330	1213098.710	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--
				In Situ Shellfish Tissue	Hand collection on harvestable beaches	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual shellfish tissue
	PJ-2[3]	315532.680	1213791.050	Mussel Tissue	In situ caged mussels	Biotoxin	Individual mussel tissue
Gravel Plot	GP-1[2]	313556.130	1213706.450	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--
				In Situ Shellfish Tissue	Hand collection on harvestable beaches	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual shellfish tissue
West Shoreline	WS-1[2]	312230.280	1210323.390	Mussel Tissue	In situ caged mussels	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual mussel tissue
				Water	PEMD	PAHs	--
				In Situ Shellfish Tissue	Hand collection on harvestable beaches	PAHs, dioxins/furans, cadmium, PCBs, and lipids	Individual shellfish tissue

Notes:
1 Horizontal datum: Washington State Plane North Zone, NAD83, US Feet
2 In situ shellfish will be collected from sampling areas shown on Figure 2. Coordinates are provided for reference; actual sampling area will be determined based on availability of target species. All species except geoducks and crabs will be collected at low tide from the beach. Geoducks will be collected using divers deployed from a vessel; crabs will be collected using crab pots.
3 Point Julia biotoxin sampling location is provisional and subject to PGST Refinement.
NAD 83 = North American Datum of 1983
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
PEMD = polyethylene membrane device

Table 3
Sample Size, Holding Time, and Preservation for Physical/Chemical Analyses

Parameter	Sample Size	Container Size and Type	Holding Time	Preservative
Mussel Tissue Samples				
Biotoxin	120 g	Zip-top baggie	5 days	Freeze -20°C
Lipids	400 g	Wrap in foil and place in Zip-top baggie	1 year	Freeze -20°C
Cadmium			1 year	Freeze -20°C
Dioxins/furans			1 year to extraction	Freeze -20°C
			1 year after extraction	
PCB congeners			1 year to extraction	Freeze -20°C
			1 year after extraction	
PAHs			1 year to extraction	Freeze -20°C
			1 year after extraction	
PEMD Samples				
PAHs	1 - 20 x 5 cm PEMD	Wrap in foil and plastic	14 days to extraction	Cool 4°C
			40 days to analysis	

Notes:
°C = degrees Celsius
cm = centimeter
g = grams
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
PEMD = polyethylene membrane device

Table 4
Tissue Parameters for Chemical Analyses and Analytical Methods

Parameter	Recommended Analytical Method	Reporting Limit[a]
Conventional Parameters (%)		
Lipids	Bligh & Dyer	0.1
Metals (mg/kg)		
Cadmium	6020A	0.1
Dioxin/Furans (ng/kg)		
Dioxins		
2,3,7,8-TCDD	EPA 1613B	0.5
1,2,3,7,8-PeCDD	EPA 1613B	2.5
1,2,3,4,7,8-HxCDD	EPA 1613B	2.5
1,2,3,6,7,8-HxCDD	EPA 1613B	2.5
1,2,3,7,8,9-HxCDD	EPA 1613B	2.5
1,2,3,4,6,7,8-HpCDD	EPA 1613B	2.5
OCDD	EPA 1613B	5
Furans		
2,3,7,8-TCDF	EPA 1613B	0.5
1,2,3,7,8-PeCDF	EPA 1613B	2.5
2,3,4,7,8,-PeCDF	EPA 1613B	2.5
1,2,3,4,7,8-HxCDF	EPA 1613B	2.5
1,2,3,6,7,8-HxCDF	EPA 1613B	2.5
1,2,3,7,8,9-HxCDF	EPA 1613B	2.5
2,3,4,6,7,8-HxCDF	EPA 1613B	2.5
1,2,3,4,6,7,8-HpCDF	EPA 1613B	2.5
1,2,3,4,7,8,9-HpCDF	EPA 1613B	2.5
OCDF	EPA 1613B	5
Polychlorinated Biphenyls (ng/kg)		
PCB Congeners 1-209	EPA 1668A	10
Polycyclic Aromatic Hydrocarbons (µg/kg)		
2-Methylnaphthalene	EPA 8270D SIM	0.5
Acenaphthene	EPA 8270D SIM	0.5
Acenaphthylene	EPA 8270D SIM	0.5
Anthracene	EPA 8270D SIM	0.5
Benzo(a)anthracene	EPA 8270D SIM	0.5
Benzo(a)pyrene	EPA 8270D SIM	0.5
Benzo(b)fluoranthene	EPA 8270D SIM	0.5
Benzo(e)pyrene	EPA 8270D SIM	0.5
Benzo(g,h,i)perylene	EPA 8270D SIM	0.5
Benzo(k)fluoranthene	EPA 8270D SIM	0.5
Chrysene	EPA 8270D SIM	0.5
Dibenzo(a,h)anthracene	EPA 8270D SIM	0.5
Fluoranthene	EPA 8270D SIM	0.5
Fluorene	EPA 8270D SIM	0.5
Indeno(1,2,3-c,d)pyrene	EPA 8270D SIM	0.5
Naphthalene	EPA 8270D SIM	0.5
Perylene	EPA 8270D SIM	0.5
Phenanthrene	EPA 8270D SIM	0.5
Pyrene	EPA 8270D SIM	0.5

Notes:

a Achievable reporting limits may be increased due to sample size and/or matrix interference.

µg/kg = micrograms per kilogram; mg/kg = milligrams per kilogram; ng/kg = nanograms per kilogram

Table 5
PEMD Parameters for Chemical Analyses and Analytical Methods

Parameter	Analytical Method	Reporting Limit
Polycyclic Aromatic Hydrocarbons (ng)		
2-Methylnaphthalene	8270D SIM	TBD
Acenaphthene	8270D SIM	TBD
Acenaphthylene	8270D SIM	TBD
Anthracene	8270D SIM	TBD
Benzo(a)anthracene	8270D SIM	TBD
Benzo(a)pyrene	8270D SIM	TBD
Benzo(b)fluoranthene	8270D SIM	TBD
Benzo(e)pyrene	8270D SIM	TBD
Benzo(g,h,i)perylene	8270D SIM	TBD
Benzo(k)fluoranthene	8270D SIM	TBD
Chrysene	8270D SIM	TBD
Dibenzo(a,h)anthracene	8270D SIM	TBD
Fluoranthene	8270D SIM	TBD
Fluorene	8270D SIM	TBD
Indeno(1,2,3-c,d)pyrene	8270D SIM	TBD
Naphthalene	8270D SIM	TBD
Perylene	8270D SIM	TBD
Phenanthrene	8270D SIM	TBD
Pyrene	8270D SIM	TBD

Notes:
ng = nanogram
PEMD = polyethylene membrane device
TBD = to be decided

Table 6
Laboratory Quality Control Sample Analysis Summary

Analysis Type	Initial Calibration	Ongoing Calibration	Standard Reference Material[a]	Replicates	Matrix Spikes	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes	Laboratory Control Samples
Polycyclic Aromatic Hydrocarbons	As needed[b]	1 per 10 samples	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	Each batch	Every sample	1 per 20 samples
Dioxins/Furans	As needed[b]	Every 12 hours	1 per 20 samples	NA	NA[c]	NA[c]	1 per 20 samples	Every sample	1 per 20 samples
Cadmium	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	Each batch	NA	1 per 20 samples
Polychlorinated biphenyls	As needed[d]	1 per 10 samples	1 per 20 samples	NA	NA[c]	NA[c]	Each batch	Every sample	1 per 20 samples
Lipids	Daily[e]	NA	NA	1 per 20 samples	NA	NA	NA	NA	NA

Notes:
Calibration and certification of drying ovens and weighing scales are conducted bi-annually.
a When a Standard Reference Material is available.
b Initial calibrations are considered valid until the ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed.
c Isotope dilution required by method
d Initial calibration verification and calibration blank must be analyzed at the beginning of each batch.
e Scale should be calibrated with class 5 weights daily; weights must bracket the weight of sample and weighing vessel.
NA = Not applicable

Table 7
Data Quality Objectives

Parameter	Precision	Accuracy[a]	Method Blank	Completeness
Tissue Samples				
Lipids	± 20% RPD	NA	NA	95%
Cadmium	± 25% RPD	75-125% R	≤ PQL[b]	95%
Polycyclic aromatic hydrocarbons	±35 % RPD	50-150% R	≤ PQL[b]	95%
Dioxins/Furans	±35 % RPD	50-150% R	≤ PQL[b]	95%
Polychlorinated biphenyl Congeners	±35 % RPD	50-150% R	≤ PQL[b]	95%
PEMD Samples				
Polycyclic aromatic hydrocarbons	±35 % RPD	50-150% R	≤ PQL[b]	95%

Notes:

a Accuracy goals apply to laboratory control samples and matrix spike samples, as applicable to the analysis.

b When the sample concentration is < 5x the method blank concentration.

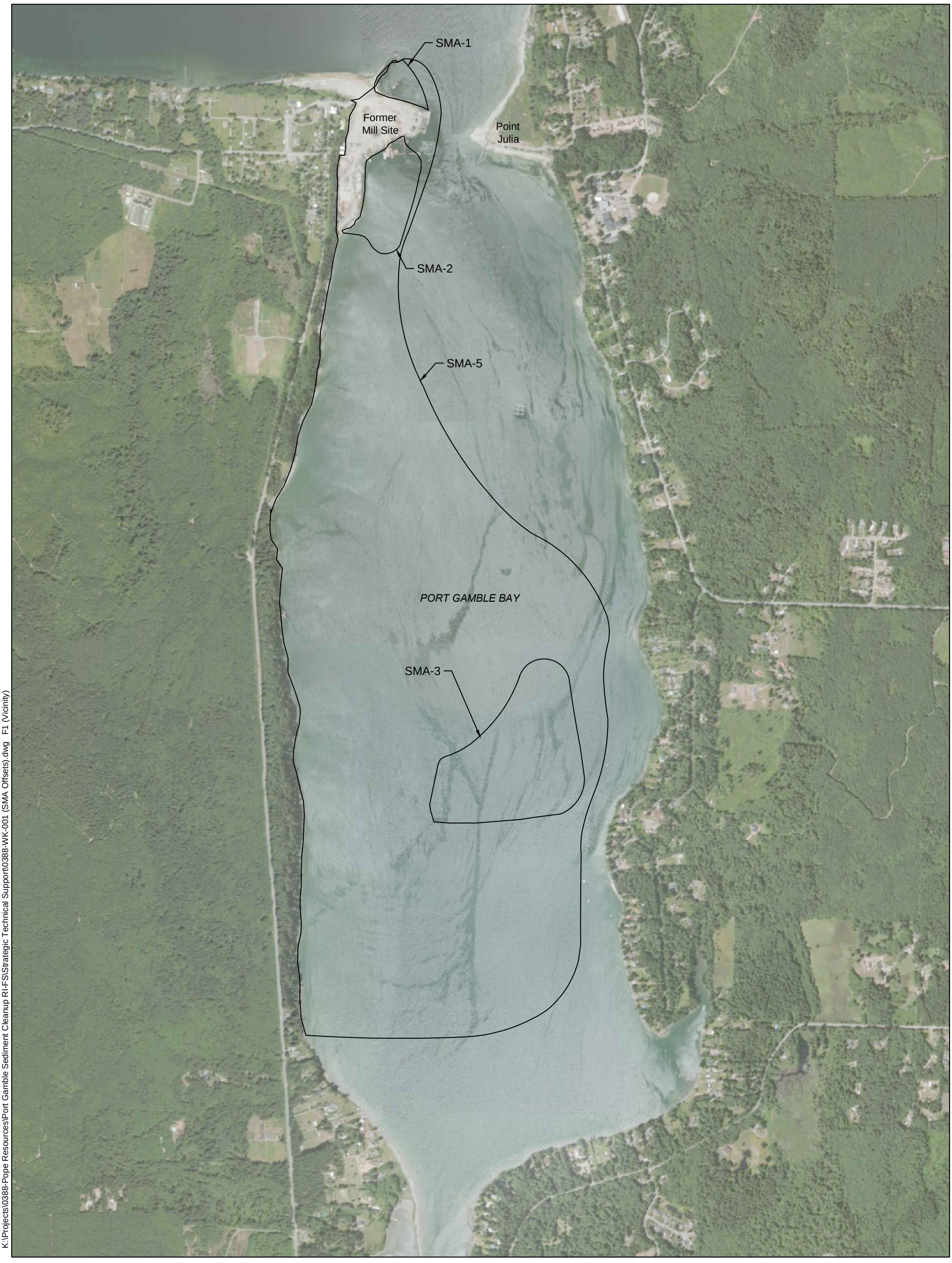
NA = not applicable

PQL = practical quantitation limit

RPD = relative percent difference

R = recovery

FIGURES



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Apr 08, 2015 4:03pm chewett

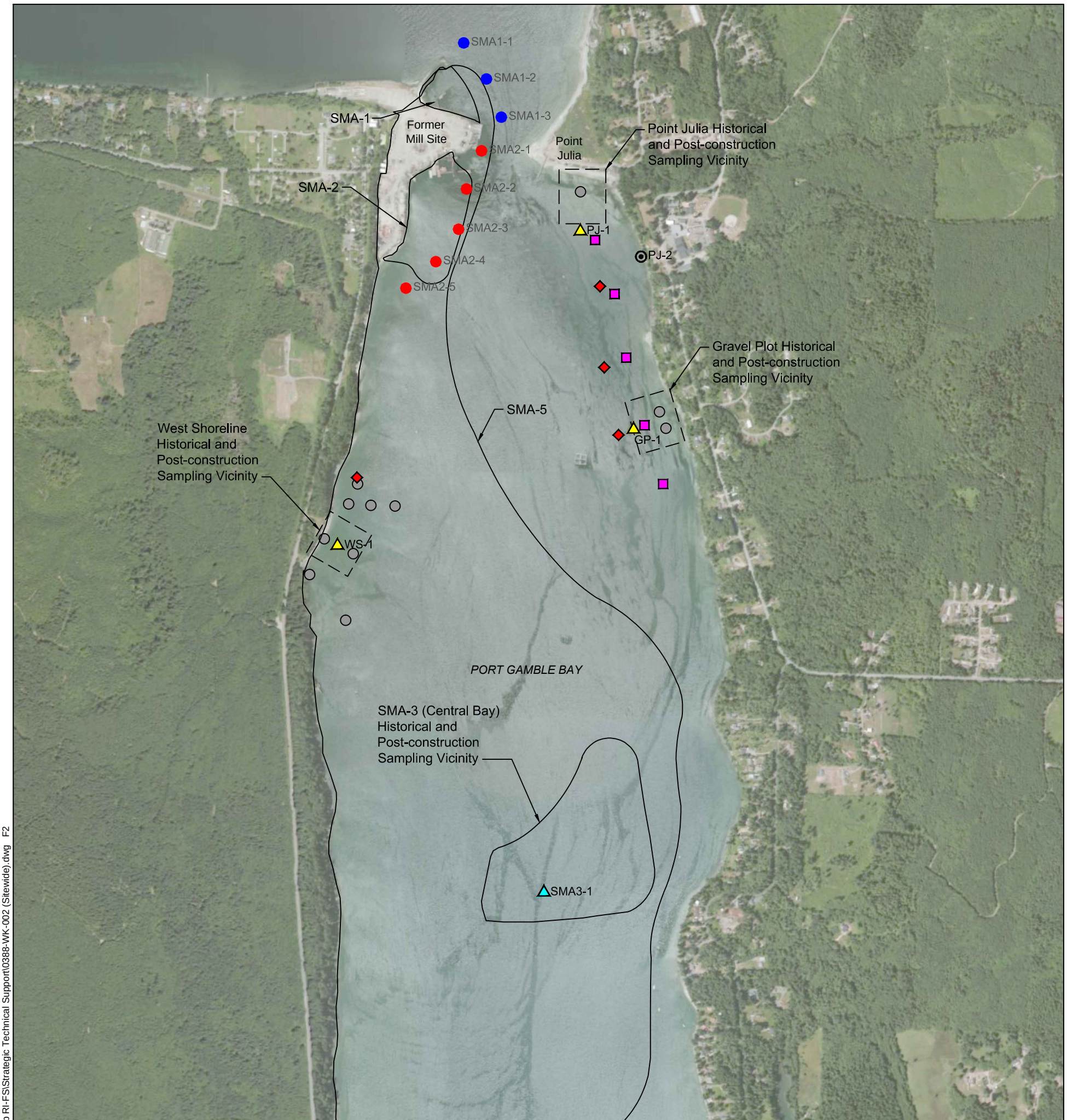
HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet.

0 1200

Scale in Feet

ANCHOR QEA

Figure 1
Vicinity Map
Shellfish Monitoring Plan
Port Gamble, Washington



HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet.

NOTES:

1. For in-situ wild shellfish sampling, historical sampling areas will be reoccupied and target species to collected will consist of those previously sampled (see Tables 2-5).
2. Year 2 Caged Mussel Locations adjacent to SMA-2 will be identified based on Year 1 sampling data.
3. Provisional Sampling Location - subject to PGST refinement.

LEGEND:

- Proposed CoC Caged Mussel, and PEMD Sampling Location, Year 1 and 2
- Proposed Biotoxin Sampling Location (See Note 3), Year 1 and 2
- SMA Area
- Historical Caged Mussel Sampling Location
- Historical PEMD Sampling Location
- Historical Sampling Location, Other
- Geoduck and Crab Tissue Sampling to be Conducted Within SMA-3
- Wild Shellfish Sampling Area
- Proposed CoC Caged Mussel and PEMD Sample Location, Year 1
- Proposed CoC Caged Mussel and PEMD Sample Location, Year 2 (See Note 2)

0 1200
Scale in Feet

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Figure 2
Proposed and Historical Bay Sampling Locations
Shellfish Monitoring Plan
Port Gamble, Washington

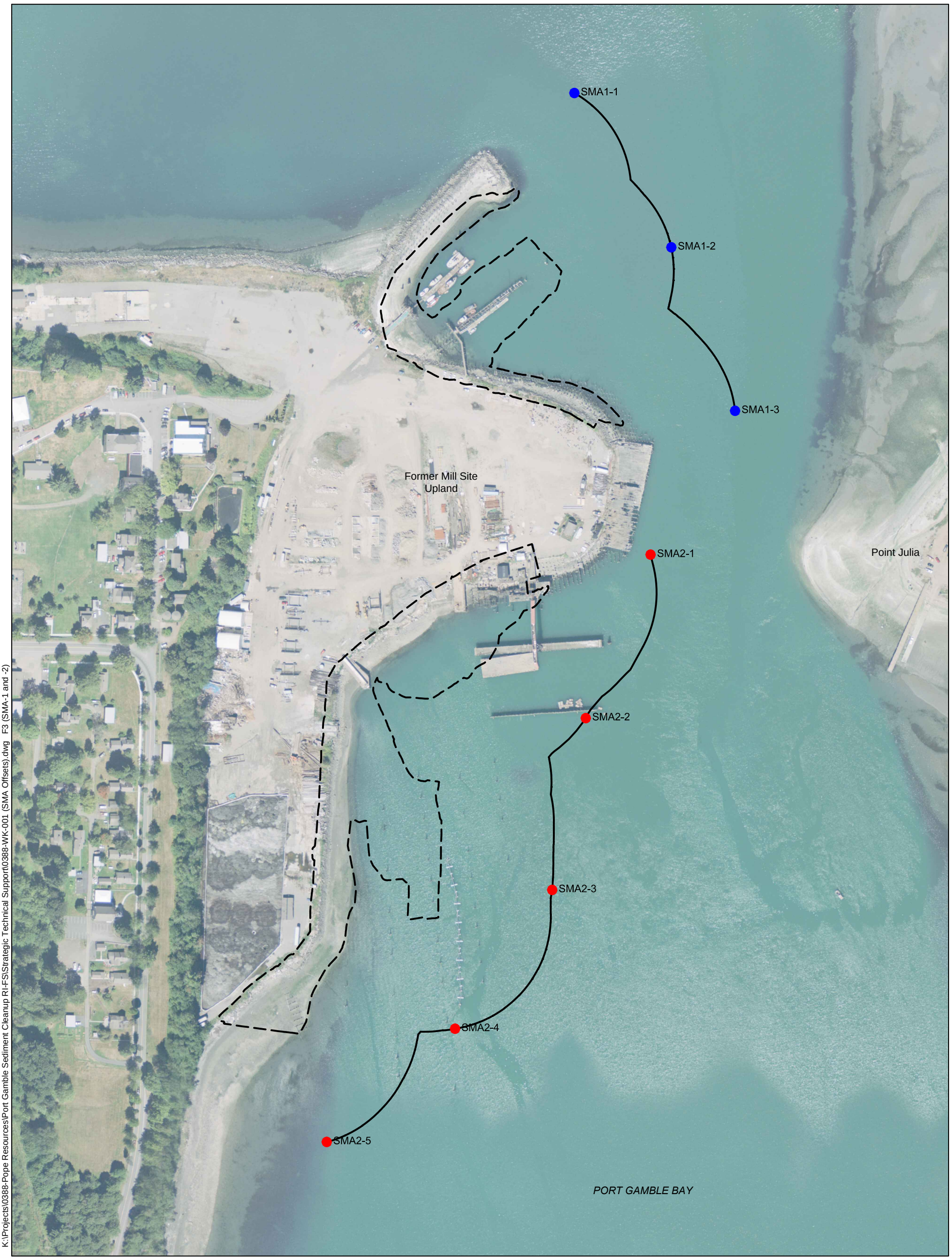

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Figure 3
SMA-1 and SMA-2 Caged Mussel and PEMD Sampling Locations
Shellfish Monitoring Plan
Port Gamble, Washington

APPENDIX A
PORT GAMBLE BAY BASELINE DATA

APPENDIX A-1
HISTORICAL MUSSEL BIOTOXIN DATA

Table A-1
Historical PSP Mussel Tissue Results

Date	Location	PSP Concentration (µg/100g wet weight)[1]
6/9/2008	Port Gamble Bay	ND
6/16/2008	Port Gamble Bay	ND
6/30/2008	Port Gamble Bay	ND
7/14/2008	Port Gamble Bay	ND
7/28/2008	Port Gamble Bay	ND
8/11/2008	Port Gamble Bay	ND
8/25/2008	Port Gamble Bay	ND
9/10/2008	Port Gamble Bay	ND
9/23/2008	Port Gamble Bay	ND
5/11/2009	Port Gamble Bay	ND
5/26/2009	Port Gamble Bay	ND
6/8/2009	Port Gamble Bay	ND
6/21/2009	Port Gamble Bay	ND
7/6/2009	Port Gamble Bay	ND
7/20/2009	Port Gamble Bay	ND
8/4/2009	Port Gamble Bay	ND
8/17/2009	Port Gamble Bay	ND
6/7/2010	Port Gamble Bay	ND
6/22/2010	Port Gamble Bay	ND
7/6/2010	Port Gamble Bay	ND
7/20/2010	Port Gamble Bay	<38
7/26/2010	Port Gamble Bay	ND
8/3/2010	Port Gamble Bay	ND
8/24/2010	Port Gamble Bay	ND
4/18/2011	Point Julia	ND
5/3/2011	Point Julia	ND
5/16/2011	Point Julia	ND
6/6/2011	Point Julia	ND
6/20/2011	Point Julia	ND
7/5/2011	Point Julia	ND
7/18/2011	Point Julia	ND
8/1/2011	Point Julia	ND
8/18/2011	Point Julia	ND
9/8/2011	Point Julia	ND
9/22/2011	Point Julia	ND
9/29/2011	Point Julia	ND
10/6/2011	Point Julia	ND
12/11/2011	Point Julia	ND
1/3/2012	Port Gamble Bay	ND
1/23/2012	Port Gamble Bay	ND
2/6/2012	Port Gamble Bay	ND
2/20/2012	Port Gamble Bay	ND

Table A-1
Historical PSP Mussel Tissue Results

Date	Location	PSP Concentration (µg/100g wet weight)[1]
3/12/2012	Port Gamble Bay	ND
4/17/2012	Port Gamble Bay	ND
5/1/2012	Port Gamble Bay	ND
5/15/2012	Port Gamble Bay	ND
5/29/2012	Port Gamble Bay	ND
6/7/2012	Point Julia	ND
7/11/2012	Point Julia	ND
7/23/2012	Point Julia	ND
8/5/2012	Port Gamble Bay	ND
8/14/2012	Port Gamble Bay	ND
8/19/2012	Port Gamble Bay	**150**
8/27/2012	Port Gamble Bay	43
9/4/2012	Port Gamble Bay	<38
9/10/2012	Port Gamble Bay	46
9/17/2012	Port Gamble Bay	<38
9/24/2012	Port Gamble Bay	ND
10/8/2012	Point Julia	<38
10/15/2012	Port Gamble Bay	ND
1/2/2013	Port Gamble Tract #20100	ND
1/14/2013	Port Gamble Tract #20100	ND
1/28/2013	Port Gamble Tract #20100	ND
2/11/2013	Port Gamble Tract #20100	ND
5/20/2013	Port Gamble Tract #20100	ND
6/17/2013	Port Gamble Bay	ND
6/17/2013	Port Gamble Bay	ND
6/25/2013	Port Gamble Tract #20100	ND
7/1/2013	Port Gamble Bay	ND
7/1/2013	Port Gamble Bay	ND
7/9/2013	Port Gamble Tract #20100	ND
7/11/2013	Port Gamble Tract #20100	ND
7/30/2013	Port Gamble Bay	ND
7/30/2013	Port Gamble Bay	ND
8/6/2013	Port Gamble Tract #20100	ND
8/19/2013	Port Gamble Tract #20100	ND
8/29/2013	Port Gamble Bay	ND
8/29/2013	Port Gamble Bay	ND
9/3/2013	Port Gamble Tract #20100	ND
9/19/2013	Port Gamble Bay	ND
9/19/2013	Port Gamble Bay	ND
9/24/2013	Port Gamble Tract #20100	<38
10/16/2013	Port Gamble Tract #20100	<38
6/24/2014	Point Julia	ND

Table A-1
Historical PSP Mussel Tissue Results

Date	Location	PSP Concentration (µg/100g wet weight)[1]
8/20/2014	Port Gamble Bay	ND
9/15/2014	Port Gamble Bay	ND
10/7/2014	Port Gamble Bay	ND
12/15/2014	Port Gamble Tract #20100	ND
1/8/2015	Port Gamble Tract #20100	ND

Notes:

from 2008 - 2014.

1 Analysis performed on whole-body tissue samples from blue mussels.

Bold text indicates detected result greater than advisory screening criterion (80 µg/100g wet weight; WDOH 2015).

µg/100g = micrograms per 100 grams

ND = not detected

PSP = paralytic shellfish poisoning

APPENDIX A-2
2014 CAGED MUSSEL COC DATA

Pending until June/July 2015

APPENDIX A-3
2014 WATER COLUMN CPAH DATA

Pending until June/July 2015

APPENDIX A-4
HISTORICAL IN SITU SHELLFISH DATA

Table A-4-1
Historical Tissue Data - Point Julia

Parameters	Species	Cockle			Horse Clam				Oyster						Manila Clam			Littleneck Clam				Mussel
	Sampling ID	SB CO-01	SB CO-02	SB CO-03	SB HC-01	SB HC-02	SB HC-03	SB HC-04	Oyster 1A	PJ_O_PGST_100429	SB OY-01	SB OY-02	SB OY-03	SB OY-04	SB MN-01	SB MN-02	SB MN-03	HART14_CLAM1A	SB LN-01	SB LN-02	SB LN-03	HC_PGPJ
	Sampling Date	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	12/15/2008	4/29/2010	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	12/15/2008	9/22/2011	9/22/2011	9/22/2011	1/8/2013
	TEF (as applicable)																				
Conventionals (%)																						
Percent Lipids		0.386	0.388	0.67	0.867	0.634	1.19	0.523	1.97	2.43	3.21	2.62	3.07	2.49	0.448	0.488	0.298	0.232	0.966	0.686	0.966	1.12
Metals (mg/kg)																						
Arsenic		NA	NA	NA	NA	NA	NA	NA	1 U	2	NA	NA	NA	NA	NA	NA	NA	2	NA	NA	NA	0.861
Cadmium		NA	NA	NA	NA	NA	NA	NA	0.99	1.13	NA	NA	NA	NA	NA	NA	NA	0.36	NA	NA	NA	0.365
Chromium		NA	NA	NA	NA	NA	NA	NA	0.1	0.1	NA	NA	NA	NA	NA	NA	NA	0.3	NA	NA	NA	NA
Copper		NA	NA	NA	NA	NA	NA	NA	3.98	6.9	NA	NA	NA	NA	NA	NA	NA	1.37	NA	NA	NA	0.864
Lead		NA	NA	NA	NA	NA	NA	NA	0.4 U	0.4 U	NA	NA	NA	NA	NA	NA	NA	0.4 U	NA	NA	NA	0.0336
Mercury		NA	NA	NA	NA	NA	NA	NA	0.01	0.01	NA	NA	NA	NA	NA	NA	NA	0.01 U	NA	NA	NA	0.0073
Silver		NA	NA	NA	NA	NA	NA	NA	0.1	0.13 J	NA	NA	NA	NA	NA	NA	NA	0.12	NA	NA	NA	NA
Zinc		NA	NA	NA	NA	NA	NA	NA	101	139	NA	NA	NA	NA	NA	NA	NA	10.1	NA	NA	NA	13.1
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/kg)																						
Napthalene		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	0.6 U	0.7 U	0.6 U	0.8 U	0.5 U	0.5 U	0.5 U	NA	0.6 U	0.5 U	0.5 U	1
2-Methylnaphthalene		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	0.9	0.8	0.9	0.7	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1-Methylnaphthalene		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Acenaphthylene		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.86 U
Acenaphthene		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	0.8	0.7	0.8	0.6	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.93 U
Fluorene		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	1	0.9	1.0	0.8	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.64 U
Phenanthrene		0.8	0.7	1.0	1.1	0.9	1.4	0.8	NA	NA	4.8	3.9	4.5	3.9	1.2	0.9	0.8	NA	2.3	2.2	2.1	4
Anthracene		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	0.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.68 U
Fluoranthene		1.4	0.9	1.6	1.2	1.0	1.6	0.9	NA	NA	12	11	12	9.3	1.2	1.1	0.9	NA	2.4	1.6	2.6	3.8
Pyrene		0.6	0.5 U	0.6	0.9	0.6	1.1	0.6	NA	NA	5.6	4.6	5.2	4.0	0.7	0.5	0.5 U	NA	1.1	0.8	1.1	1.9
Benzo(g,h,i)perylene		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.64 U
Dibenzofuran		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	0.6	0.6	0.6	0.7	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Carcinogenic Polycyclic Aromatic Hydrocarbons (µg/kg)																						
Total Benzofluoranthenes	0.1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	2.2	2.5	2.7	1.7	1.1 J	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	2.6
Benzo(b)fluoranthene	0.1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	1.1					0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	1.1
Benzo(k)fluoranthene	0.1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	1.1					0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	1.5
Benz(a)anthracene	0.1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.9	1.1	1.4	1.0	0.7	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	1.1
Chrysene	0.01	0.5	0.5	0.7	0.5 U	0.5 U	0.5 U	0.5 U	NA	2.9	3.5	3.3	3.1	2.2	0.5 U	0.5 U	0.5 U	NA	0.5	0.5	1.3	2.7
Benzo(a)pyrene	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.8	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	.64 U
Indeno(1,2,3-cd)pyrene	0.1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	.63 U
Dibenz(a,h)anthracene	0.1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	.53 U
cPAHs TEQ		0.355	0.355	0.357	0.353	0.353	0.353	0.353	NA	0.897	0.695	1.293	0.601	0.502	0.357	0.394	0.425	NA	0.355	0.355	0.438	0.8542
Polychlorinated Biphenyls (PCBs) Aroclors (µg/kg)																						
Aroclor-1016		3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	8.0 U	4.0 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	8 U	3.9 U	3.9 U	3.8 U	NA
Aroclor-1242		3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	8.0 U	4.0 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	8 U	3.9 U	3.9 U	3.8 U	NA
Aroclor-1248		3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	8.0 U	4.0 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	12 U	3.9 U	3.9 U	3.8 U	NA
Aroclor-1254		3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	8.0 U	4.0 U	2.5 J	4.0 U	2.1 J	4.0 U	3.9 U	3.9 U	3.9 U	8 U	3.9 U	3.9 U	3.8 U	NA
Aroclor-1260		3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	8.0 U	4.0 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	8 U	3.9 U	3.9 U	3.8 U	NA
Aroclor-1221		3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	8.0 U	4.0 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	8 U	3.9 U	3.9 U	3.8 U	NA
Aroclor-1232		3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	8.0 U	4.0 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	3.9 U	3.9 U	8 U	3.9 U	3.9 U	3.8 U	NA
Total Aroclors		3.9 U	3.9 U	3.9 U	4.0 U	3.9 U	4.0 U	3.9 U	8.0 U	4.0 U	2.5 J	4.0 U	2.1 J	4.0 U	3.9 U	3.9 U	3.9 U	8 U	3.9 U	3.9 U	3.8 U	NA
PCB Congeners (ng/kg)																						
PCB-017		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-018		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-028		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.36
PCB-031		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.32

Table A-4-1
Historical Tissue Data - Point Julia

Parameters	Species	Cockle			Horse Clam				Oyster						Manila Clam			Littleneck Clam				Mussel
	Sampling ID	SB CO-01	SB CO-02	SB CO-03	SB HC-01	SB HC-02	SB HC-03	SB HC-04	Oyster 1A	PJ_O_PGST_100429	SB OY-01	SB OY-02	SB OY-03	SB OY-04	SB MN-01	SB MN-02	SB MN-03	HART14_CLAM1A	SB LN-01	SB LN-02	SB LN-03	HC_PGPJ
	Sampling Date	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	12/15/2008	4/29/2010	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	12/15/2008	9/22/2011	9/22/2011	9/22/2011	1/8/2013
	TEF (as applicable)																				
PCB-033		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-044		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-049		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-052		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-066		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-070		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-074		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-077	0.0001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-081	0.0003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-082		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-087		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-095		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-099		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-101		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-105	0.00003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-110		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-114	0.00003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-118	0.00003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-123	0.00003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-126	0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-128		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-138		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-149		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-151		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-153		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-156/157	0.00003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-158		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-167	0.00003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-169	0.03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-170		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-171		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-177		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-180		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-183		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-187		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-189	0.00003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCB-191		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-194		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-195		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-199		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-205		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-206		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-208		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB-209		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.26 U
PCB Congener TEQ		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*
Dioxins / Furans (µg/kg)																						
2,3,7,8-TCDD	1	NA	NA	NA	NA	NA	NA	0.0495 U	0.117 U	NA	0.070 J	NA	NA	NA	NA	NA	NA	0.111 U	NA	NA	NA	NA
1,2,3,7,8-PECDD	1	NA	NA	NA	NA	NA	NA	0.0495 U	0.272 U	NA	0.0480 U	NA	NA	NA	NA	NA	NA	0.26 U	NA	NA	NA	NA

Table A-4-1
Historical Tissue Data - Point Julia

	Species	Cockle			Horse Clam				Oyster						Manila Clam			Littleneck Clam				Mussel
	Sampling ID	SB CO-01	SB CO-02	SB CO-03	SB HC-01	SB HC-02	SB HC-03	SB HC-04	Oyster 1A	PJ_O_PGST_100429	SB OY-01	SB OY-02	SB OY-03	SB OY-04	SB MN-01	SB MN-02	SB MN-03	HART14_CLAM1A	SB LN-01	SB LN-02	SB LN-03	HC_PGPJ
	Sampling Date	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	12/15/2008	4/29/2010	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	9/22/2011	12/15/2008	9/22/2011	9/22/2011	9/22/2011	1/8/2013
Parameters	TEF (as applicable)																					
1,2,3,4,7,8-HXCDD	0.1	NA	NA	NA	NA	NA	NA	0.0495 U	0.399 U	NA	0.0480 U	NA	NA	NA	NA	NA	NA	0.381 U	NA	NA	NA	NA
1,2,3,6,7,8-HXCDD	0.1	NA	NA	NA	NA	NA	NA	0.0495 U	0.421 U	NA	0.104 J	NA	NA	NA	NA	NA	NA	0.402 U	NA	NA	NA	NA
1,2,3,7,8,9-HXCDD	0.1	NA	NA	NA	NA	NA	NA	0.0495 U	0.231 U	NA	0.081 J	NA	NA	NA	NA	NA	NA	0.221 U	NA	NA	NA	NA
1,2,3,4,6,7,8-HPCDD	0.01	NA	NA	NA	NA	NA	NA	0.176 J	0.421 U	NA	0.163 J	NA	NA	NA	NA	NA	NA	0.402 U	NA	NA	NA	NA
OCDD	0.0003	NA	NA	NA	NA	NA	NA	1.06 J	0.816 U	NA	0.872 J	NA	NA	NA	NA	NA	NA	0.779 U	NA	NA	NA	NA
2,3,7,8-TCDF	0.1	NA	NA	NA	NA	NA	NA	0.0495 U	0.111 U	NA	0.308 J	NA	NA	NA	NA	NA	NA	0.106 U	NA	NA	NA	NA
1,2,3,7,8-PECDF	0.03	NA	NA	NA	NA	NA	NA	0.0495 U	0.313 U	NA	0.0480 U	NA	NA	NA	NA	NA	NA	0.299 U	NA	NA	NA	NA
2,3,4,7,8-PECDF	0.3	NA	NA	NA	NA	NA	NA	0.050 J	0.256 U	NA	0.108 J	NA	NA	NA	NA	NA	NA	0.245 U	NA	NA	NA	NA
1,2,3,4,7,8-HXCDF	0.1	NA	NA	NA	NA	NA	NA	0.0495 U	0.563 U	NA	0.0480 U	NA	NA	NA	NA	NA	NA	0.537 U	NA	NA	NA	NA
1,2,3,6,7,8-HXCDF	0.1	NA	NA	NA	NA	NA	NA	0.0495 U	0.135 U	NA	0.0480 U	NA	NA	NA	NA	NA	NA	0.129 U	NA	NA	NA	NA
1,2,3,7,8,9-HXCDF	0.1	NA	NA	NA	NA	NA	NA	0.0495 U	0.26 U	NA	0.0480 U	NA	NA	NA	NA	NA	NA	0.248 U	NA	NA	NA	NA
2,3,4,6,7,8-HXCDF	0.1	NA	NA	NA	NA	NA	NA	0.0495 U	0.307 U	NA	0.0480 U	NA	NA	NA	NA	NA	NA	0.293 U	NA	NA	NA	NA
1,2,3,4,6,7,8-HPCDF	0.01	NA	NA	NA	NA	NA	NA	0.0495 U	0.562 U	NA	0.0480 U	NA	NA	NA	NA	NA	NA	0.537 U	NA	NA	NA	NA
1,2,3,4,7,8,9-HPCDF	0.01	NA	NA	NA	NA	NA	NA	0.0495 U	0.582 U	NA	0.0480 U	NA	NA	NA	NA	NA	NA	0.556 U	NA	NA	NA	NA
OCDF	0.0003	NA	NA	NA	NA	NA	NA	0.051 J	0.725 U	NA	0.064 J	NA	NA	NA	NA	NA	NA	0.692 U	NA	NA	NA	NA
Total TEQ		NA	NA	NA	NA	NA	NA	0.210	0.367	NA	0.191	NA	NA	NA	NA	NA	NA	0.35028	NA	NA	NA	NA

Notes:
For TEQ calculations, non-detects were assumed to be half the quantitation limit
* = Not enough congeners with assigned TEFs were analyzed to make a TEQ
µg/kg = micrograms per kilogram
J = estimated concentration
mg/kg = milligrams per kilogram
NA = Not analyzed
ng/kg = nanograms per kilogram
TEF = toxic equivalency factor
TEQ = toxicity equivalent quotient
U = Not detected at the method detection limit

Table A-4-2
Historical Tissue Data - Gravel Plot

	Species	Oyster						Cockle	Littleneck Clam
	Sampling ID	HART14_OYSTER2A	Port Gamble A1	Port Gamble A2	Port Gamble A3	S_O_PGST_100	12110604	RS_C_PGST_10042	HART14_CLAM2A
	Sampling Date	12/15/2008	9/22/2004	9/22/2004	9/22/2004	4/29/2010	11/28/2012	4/29/2010	12/15/2008
Parameters	**TEF (as applicable)**								
Conventionals (%)									
Percent Lipids		1.97				2.63	1.96	0.28	0.487
Metals (mg/kg)									
Arsenic		1	0.44	0.56	0.46	2	1	1 U	2
Cadmium		0.96	0.78	0.71	0.73	1.49	1	0.04	0.24
Chromium		0.2	NA	NA	NA	0.2	0.2	0.2	0.3
Copper		4.45	NA	NA	NA	9.5	3.64	1.5	1.02
Lead		0.4 U	NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U
Mercury		0.01	NA	NA	NA	0.012	0.008	0.005 U	0.01 U
Silver		0.1	NA	NA	NA	0.16 J	0.06 U	--R	0.09
Zinc		124	78	72	78	174	75.2	9	10.5
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/kg)									
Napthalene		NA	NA	NA	NA	NA	0.7	NA	NA
2-Methylnaphthalene		NA	NA	NA	NA	NA	0.6	NA	NA
1-Methylnaphthalene		NA	NA	NA	NA	NA	0.5 U	NA	NA
Acenaphthylene		NA	NA	NA	NA	NA	0.5 U	NA	NA
Acenaphthene		NA	NA	NA	NA	NA	0.5 U	NA	NA
Fluorene		NA	NA	NA	NA	NA	0.7	NA	NA
Phenanthrene		NA	NA	NA	NA	NA	3	NA	NA
Anthracene		NA	NA	NA	NA	NA	0.6	NA	NA
Fluoranthene		NA	NA	NA	NA	NA	12	NA	NA
Pyrene		NA	NA	NA	NA	NA	6.5	NA	NA
Benzo(g,h,i)perylene		NA	NA	NA	NA	NA	0.5 U	NA	NA
Dibenzofuran		NA	NA	NA	NA	NA	0.6	NA	NA
Carcinogenic Polycyclic Aromatic Hydrocarbons (µg/kg)									
Total Benzofluoranthenes	0.1	NA	NA	NA	NA	4.0	1.8	0.5 U	4.9 U
Benzo(b)fluoranthene	0.1	NA	NA	NA	NA	2.0	1.2	0.5 U	4.9 U
Benzo(k)fluoranthene	0.1	NA	NA	NA	NA	2.0	0.6	0.5 U	4.9 U
Benz(a)anthracene	0.1	NA	NA	NA	NA	1.3	1	0.5 U	4.9 U
Chrysene	0.01	NA	NA	NA	NA	3.8	3.1	0.5 U	4.9 U
Benzo(a)pyrene	1	NA	NA	NA	NA	0.5	0.5 U	0.5 U	4.9 U
Indeno(1,2,3-cd)pyrene	0.1	NA	NA	NA	NA	0.5 U	0.5 U	0.5 U	4.9 U
Dibenz(a,h)anthracene	0.1	NA	NA	NA	NA	0.5 U	0.5 U	0.5 U	4.9 U
cPAHs TEQ		NA	NA	NA	NA	1.14	0.5831	0.353	3.45
Polychlorinated Biphenyls (PCBs) Aroclors (µg/kg)									
Aroclor-1016		8 U	NA	NA	NA	4.0 U	4 U	4.0 U	8.0 U
Aroclor-1242		8 U	NA	NA	NA	4.0 U	4 U	4.0 U	8.0 U

Table A-4-2
Historical Tissue Data - Gravel Plot

	Species	Oyster						Cockle	Littleneck Clam
	Sampling ID	HART14_OYSTER2A	Port Gamble A1	Port Gamble A2	Port Gamble A3	S_O_PGST_100	12110604	RS_C_PGST_10042	HART14_CLAM2A
	Sampling Date	12/15/2008	9/22/2004	9/22/2004	9/22/2004	4/29/2010	11/28/2012	4/29/2010	12/15/2008
Parameters	**TEF (as applicable)**								
Aroclor-1248		8 U	NA	NA	NA	4.0 U	4 U	4.0 U	8.0 U
Aroclor-1254		8 U	NA	NA	NA	4.0 U	6.2	4.0 U	8.0 U
Aroclor-1260		8 U	NA	NA	NA	4.0 U	4 U	4.0 U	8.0 U
Aroclor-1221		8 U	NA	NA	NA	4.0 U	4 U	4.0 U	8.0 U
Aroclor-1232		8 U	NA	NA	NA	4.0 U	4 U	4.0 U	8.0 U
Total Aroclors		8 U	NA	NA	NA	4.0 U	6.2	4.0 U	8.0 U
Dioxins / Furans (µg/kg)									
2,3,7,8-TCDD	1	0.108 U	NA	NA	NA	NA	NA	NA	0.117 U
1,2,3,7,8-PECDD	1	0.252 U	NA	NA	NA	NA	NA	NA	0.273 U
1,2,3,4,7,8-HXCDD	0.1	0.37 U	NA	NA	NA	NA	NA	NA	0.4 U
1,2,3,6,7,8-HXCDD	0.1	0.391 U	NA	NA	NA	NA	NA	NA	0.423 U
1,2,3,7,8,9-HXCDD	0.1	0.214 U	NA	NA	NA	NA	NA	NA	0.232 U
1,2,3,4,6,7,8-HPCDD	0.01	0.391 U	NA	NA	NA	NA	NA	NA	0.422 U
OCDD	0.0003	1.78 T	NA	NA	NA	NA	NA	NA	0.818 U
2,3,7,8-TCDF	0.1	0.375 T	NA	NA	NA	NA	NA	NA	0.111 U
1,2,3,7,8-PECDF	0.03	0.29 U	NA	NA	NA	NA	NA	NA	0.314 U
2,3,4,7,8-PECDF	0.3	0.237 U	NA	NA	NA	NA	NA	NA	0.257 U
1,2,3,4,7,8-HXCDF	0.1	0.522 U	NA	NA	NA	NA	NA	NA	0.564 U
1,2,3,6,7,8-HXCDF	0.1	0.125 U	NA	NA	NA	NA	NA	NA	0.135 U
1,2,3,7,8,9-HXCDF	0.1	0.241 U	NA	NA	NA	NA	NA	NA	0.261 U
2,3,4,6,7,8-HXCDF	0.1	0.285 U	NA	NA	NA	NA	NA	NA	0.308 U
1,2,3,4,6,7,8-HPCDF	0.01	0.521 U	NA	NA	NA	NA	NA	NA	0.564 U
1,2,3,4,7,8,9-HPCDF	0.01	0.54 U	NA	NA	NA	NA	NA	NA	0.584 U
OCDF	0.0003	0.672 U	NA	NA	NA	NA	NA	NA	0.727 U
Total Dioxin TEQ		0.373	NA	NA	NA	NA	NA	NA	0.368

Notes:
For TEQ calculations, non-detects were assumed to be half the quantitation limit
µg/kg = micrograms per kilogram
J = estimated concentration
mg/kg = milligrams per kilogram
NA = not analyzed
ng/kg = nanograms per kilogram
TEF = toxic equivalency factor
TEQ = toxicity equivalent quotient
U = not detected at the method detection limit

Table A-4-3
Historical Tissue Data - SMA-3

	Species	Crab Hepatopancreas					Crab Muscle						
	Sampling ID	HART14_CRAB1A PAN	PG11-BW-04-DCH-R1	PG11-BW-04-DCH-R2	12112801	12112803	HART14_CRAB1A MEAT	PG11-BW-04-DCM-R1	PG11-BW-04-DCM-R2	12PTGB1-DCM01A (muscle)	12PTGB3-DCM01A (muscle)	12112802	12112804
	Sampling Date	12/23/2008	8/2/2011	8/2/2011	11/28/2012	11/28/2012	12/23/2008	8/2/2011	8/3/2011	8/13/2012	8/13/2012	11/28/2012	11/28/2012
Parameters	TEF (as applicable)												
Conventionals (%)													
Percent Lipids		3.01	6.9	6.36	5.11	2.27	0.208	0.22	0.24	0.22	0.17	0.487	0.512
Metals (mg/kg)													
Arsenic		4	8	8	8	7	7	5	5	6.89	7.54	8	8
Cadmium		0.34	0.83	1.44	0.51	0.24	0.04	0.04 U	0.04 U	0.0027	0.0033	0.04 U	0.04 U
Chromium		0.1	0.1 J	0.1 J	0.1	0.1 U	0.1	0.1 U	0.1 J	NA	NA	0.1	0.2
Copper		19.2	4.01	4.07	15.9	23.2	8.65	5.74	3.75	6.84	7.42	8.47	7.2
Lead		0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.0046	0.0041 U	0.4 U	0.4 U
Mercury		0.03	0.02	0.028	0.023	0.023	0.047	0.027	0.036	0.0295	0.0383	0.034	0.054
Silver		0.5	.11 J	0.1 J	0.28	0.47	0.19	0.12 J	0.1 J	NA	NA	0.13	0.13
Zinc		15.1	17.6	15.5	18.8	15.4	50.2	30.3	38.3	44.1	42.3	40.4	37.1
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/kg)													
Napthalene		NA	1 B	1.3 B	0.8	0.5	NA	0.5 B	0.5 B	0.86 B	0.83 B	0.5 U	0.5 U
2-Methylnaphthalene		NA	0.5 U	0.6	0.7	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U
1-Methylnaphthalene		NA	NA	NA	0.5 U	0.5 U	NA	NA	NA	NA	NA	0.5 U	0.5 U
Acenaphthylene		NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.26 U	0.32 U	0.5 U	0.5 U
Acenaphthene		NA	0.6	0.8	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.28 U	0.34 U	0.5 U	0.5 U
Fluorene		NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.27 U	0.33 U	0.5 U	0.5 U
Phenanthrene		NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.3	0.33 U	0.5 U	0.5 U
Anthracene		NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.21 U	0.25 U	0.5 U	0.5 U
Fluoranthene		NA	0.5 U	0.6	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.27 U	0.33 U	0.5 U	0.5 U
Pyrene		NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.27 U	0.33 U	0.5 U	0.5 U
Benzo(g,h,i)perylene		NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.34 U	0.4 U	0.5 U	0.5 U
Dibenzofuran		NA	NA	NA	0.5 U	0.5 U	NA	NA	NA	NA	NA	0.5 U	0.5 U
Carcinogenic Polycyclic Aromatic Hydrocarbons (µg/kg)													
Total Benzofluoranthenes	0.1	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.38 U	0.45 U	0.5 U	0.5 U
Benzo(b)fluoranthene	0.1	NA	NA	NA	0.5 U	0.5 U	NA	NA	NA	0.38 U	0.45 U	0.5 U	0.5 U
Benzo(k)fluoranthene	0.1	NA	NA	NA	0.5 U	0.5 U	NA	NA	NA	0.38 U	0.45 U	0.5 U	0.5 U
Benz(a)anthracene	0.1	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.33 U	0.39 U	0.5 U	0.5 U
Chrysene	0.01	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.38 U	0.46 U	0.5 U	0.5 U
Benzo(a)pyrene	1	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.34 U	0.41 U	0.5 U	0.5 U
Indeno(1,2,3-cd)pyrene	0.1	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.34 U	0.4 U	0.5 U	0.5 U
Dibenz(a,h)anthracene	0.1	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.29 U	0.34 U	0.5 U	0.5 U
cPAHs TEQ		NA	0.353	0.353	0.3775	0.3775	NA	0.353	0.353	0.3884	0.4618	0.3775	0.3775
Polychlorinated Biphenyls (PCBs) Aroclors (µg/kg)													
Aroclor-1016		8 U	NA	NA	4 U	3.9 U	8 U	NA	NA	NA	NA	4 U	4 U
Aroclor-1242		8 U	NA	NA	4 U	3.9 U	8 U	NA	NA	NA	NA	4 U	4 U
Aroclor-1248		8 U	NA	NA	4 U	3.9 U	8 U	NA	NA	NA	NA	4 U	4 U
Aroclor-1254		20 U	NA	NA	12	11	8 U	NA	NA	NA	NA	4 U	6.2
Aroclor-1260		15 P	NA	NA	6.7	4.4	8 U	NA	NA	NA	NA	4 U	4 U
Aroclor-1221		8 U	NA	NA	4 U	3.9 U	8 U	NA	NA	NA	NA	4 U	4 U
Aroclor-1232		8 U	NA	NA	4 U	3.9 U	8 U	NA	NA	NA	NA	4 U	4 U
Total Aroclors		8 U	NA	NA	18.7	15.4	8 U	NA	NA	NA	NA	4 U	6.2

Table A-4-3
Historical Tissue Data - SMA-3

	Species	Crab Hepatopancreas					Crab Muscle						
	Sampling ID	HART14_CRAB1A PAN	PG11-BW-04-DCH-R1	PG11-BW-04-DCH-R2	12112801	12112803	HART14_CRAB1A MEAT	PG11-BW-04-DCM-R1	PG11-BW-04-DCM-R2	12PTGB1-DCM01A (muscle)	12PTGB3-DCM01A (muscle)	12112802	12112804
	Sampling Date	12/23/2008	8/2/2011	8/2/2011	11/28/2012	11/28/2012	12/23/2008	8/2/2011	8/3/2011	8/13/2012	8/13/2012	11/28/2012	11/28/2012
Parameters	TEF (as applicable)												
PCB Congeners (ng/kg)													
PCB-017		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-018		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-028		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-031		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-033		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-044		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-049		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-052		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-066		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-070		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-074		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-077	0.0001	20.8	35.4	37.1	NA	NA	0.91 U	1.78	1.71	NA	NA	NA	NA
PCB-081	0.0003	0.923 U	1.42 U	1.69 U	NA	NA	0.91 U	0.156 U	0.227 U	NA	NA	NA	NA
PCB-082		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-087		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-095		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-099		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-101		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.34	NA	NA
PCB-105	0.00003	425	802	714	NA	NA	29.5	25.3	28.4	0.21 U	0.25 U	NA	NA
PCB-110		NA	NA	NA	NA	NA	NA	NA	NA	0.21	0.27	NA	NA
PCB-114	0.00003	24.6	44.2	39.4	NA	NA	0.91 U	1.24	1.45	NA	NA	NA	NA
PCB-118	0.00003	1210	2120	1990	NA	NA	79.2	66.4	74.4	0.22	0.32	NA	NA
PCB-123	0.00003	20.7	35.6	40.2	NA	NA	0.91 U	1.14	1.09	NA	NA	NA	NA
PCB-126	0.1	15.8	6.82 U	7.03	NA	NA	0.91 U	0.396 U	0.282 U	NA	NA	NA	NA
PCB-128		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-138		NA	NA	NA	NA	NA	NA	NA	NA	0.43	0.86	NA	NA
PCB-149		NA	NA	NA	NA	NA	NA	NA	NA	0.21	0.3	NA	NA
PCB-151		NA	NA	NA	NA	NA	NA	NA	NA	0.20 U	0.25 U	NA	NA
PCB-153		NA	NA	NA	NA	NA	NA	NA	NA	0.42	0.83	NA	NA
PCB-156/157	0.00003	192	429	315	NA	NA	11.3	11.9	11	0.2 U	0.25 U	NA	NA
PCB-158		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-167	0.00003	96.1	188	157	NA	NA	5.18	4.47	4.81	NA	NA	NA	NA
PCB-169	0.03	0.923 U	3.01 U	3.33 U	NA	NA	0.91 U	0.163 U	0.168 U	NA	NA	NA	NA
PCB-170		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-171		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-177		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-180		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-183		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-187		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.38	NA	NA
PCB-189	0.00003	16 J	46.9	31.6	NA	NA	0.91 U	1.01	0.857 U	NA	NA	NA	NA
PCB-191		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-194		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-195		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA

Table A-4-3
Historical Tissue Data - SMA-3

	Species	Crab Hepatopancreas					Crab Muscle						
	Sampling ID	HART14_CRAB1A PAN	PG11-BW-04-DCH-R1	PG11-BW-04-DCH-R2	12112801	12112803	HART14_CRAB1A MEAT	PG11-BW-04-DCM-R1	PG11-BW-04-DCM-R2	12PTGB1-DCM01A (muscle)	12PTGB3-DCM01A (muscle)	12112802	12112804
	Sampling Date	12/23/2008	8/2/2011	8/2/2011	11/28/2012	11/28/2012	12/23/2008	8/2/2011	8/3/2011	8/13/2012	8/13/2012	11/28/2012	11/28/2012
Parameters	TEF (as applicable)												
PCB-199		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-205		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-206		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB-208		NA	NA	NA	NA	NA	NA	NA	NA	0.21 U	0.25 U	NA	NA
PCB-209		NA	NA	NA	NA	NA	NA	NA	NA	0.2 U	0.25 U	NA	NA
PCB Congener TEQ		1.65	0.809	0.817	NA	NA	0.0631	0.0436	0.0325	*	*	NA	NA
Dioxins / Furans (ng/kg)													
2,3,7,8-TCDD	1	.106 U	0.275	0.212 U	NA	NA	0.112 U	0.056 U	0.05 U	NA	NA	NA	0.057 U
1,2,3,7,8-PECDD	1	.428 T	0.96 J	0.736 J	NA	NA	0.262 U	0.049 U	0.0491 U	NA	NA	NA	0.057 U
1,2,3,4,7,8-HXCDD	0.1	.364 U	0.573 J	0.357 J	NA	NA	0.384 U	0.049 U	0.0491 U	NA	NA	NA	0.057 U
1,2,3,6,7,8-HXCDD	0.1	1.05 T	2.45	1.86	NA	NA	0.406 U	0.081 U	0.099 U	NA	NA	NA	0.187
1,2,3,7,8,9-HXCDD	0.1	.211 U	0.954 J	0.665 J	NA	NA	0.223 U	0.049 U	0.057 U	NA	NA	NA	0.057 U
1,2,3,4,6,7,8-HPCDD	0.01	1.8 T	3.88	2.64	NA	NA	0.406 U	0.119 U	0.181 U	NA	NA	NA	0.443
OCDD	0.0003	2.3 T	4.13	3.32	NA	NA	0.786 U	0.231 U	0.224 U	NA	NA	NA	0.612
2,3,7,8-TCDF	0.1	1.03	1.85	1.58	NA	NA	0.223 T	0.065 J	0.071 U	NA	NA	NA	0.169
1,2,3,7,8-PECDF	0.03	.286 U	0.494 J	0.242 J	NA	NA	0.301 U	0.049 U	0.0491 U	NA	NA	NA	0.057 U
2,3,4,7,8-PECDF	0.3	.455 T	0.874 J	0.558 J	NA	NA	0.247 U	0.052 J	0.0491 U	NA	NA	NA	0.064
1,2,3,4,7,8-HXCDF	0.1	.513 U	0.438 J	0.303 U	NA	NA	0.542 U	0.049 U	0.0491 U	NA	NA	NA	0.057 U
1,2,3,6,7,8-HXCDF	0.1	.123 U	0.213 J	0.181 J	NA	NA	0.13 U	0.049 U	0.0491 U	NA	NA	NA	0.057 U
1,2,3,7,8,9-HXCDF	0.1	.237 U	0.0497 U	0.047 U	NA	NA	0.25 U	0.049 U	0.0491 U	NA	NA	NA	0.057 U
2,3,4,6,7,8-HXCDF	0.1	.28 U	0.237 U	0.168 J	NA	NA	0.296 U	0.049 U	0.0491 U	NA	NA	NA	0.057 U
1,2,3,4,6,7,8-HPCDF	0.01	.513 U	0.935	0.766	NA	NA	0.542 U	0.049 U	0.0491 U	NA	NA	NA	0.087
1,2,3,4,7,8,9-HPCDF	0.01	.531 U	0.0497 U	0.047 U	NA	NA	0.561 U	0.049 U	0.0491 U	NA	NA	NA	0.057 U
OCDF	0.0003	.661 U	0.28 U	0.227 U	NA	NA	0.698 U	0.049 U	0.0491 U	NA	NA	NA	0.057
Total Dioxin TEQ		0.940	2.220	1.480	NA	NA	0.370	0.0952	0.0827	NA	NA	NA	0.14

Table A-4-3
Historical Tissue Data - SMA-3

	Geoduck						
	HART14_GD1A	HART14_GD2A	HART14_GD3A	12111903	12111904	12111905	12111906
	12/16/2008	12/16/2008	12/16/2008	11/19/2012	11/19/2012	11/19/2012	11/19/2012
Parameters							
Conventionals (%)							
Percent Lipids	0.481	0.426	0.823	0.47	0.694	0.222	0.34
Metals (mg/kg)							
Arsenic	1	2	2	3	2	9	4
Cadmium	0.19	0.19	0.26	0.36	0.2	1.37	0.76
Chromium	0.1	0.1	0.2	0.5	0.3	0.9	0.4
Copper	3.25	2.85	6.29	6.32	6.44	7.37	4.04
Lead	0.4 U	0.4 U	0.4 U	0.8	0.4 U	1.8	0.4 U
Mercury	0.01	0.01	0.02	0.01	0.008	0.052	0.014
Silver	0.93	1.15	1.47	0.75	0.15	3.47	2.74
Zinc	16.5	14.5	30.8	28.1	14.9	14.8	24.7
Polycyclic Aromatic Hydrocarbo							
Napthalene	NA	NA	NA	0.5	0.5 U	0.5 U	0.5 U
2-Methylnaphthalene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
1-Methylnaphthalene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Acenaphthylene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Acenaphthene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Fluorene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Phenanthrene	NA	NA	NA	0.7	0.7	0.5 U	0.6
Anthracene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Fluoranthene	NA	NA	NA	1	1.7	0.9	0.8
Pyrene	NA	NA	NA	0.5 U	0.5	0.5	0.5 U
Benzo(g,h,i)perylene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Dibenzofuran	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Carcinogenic Polycyclic Aromati							
Total Benzofluoranthenes	NA	NA	NA	0.9	1.2	0.5 U	0.7
Benzo(b)fluoranthene	NA	NA	NA	0.5	0.6	0.5 U	0.5 U
Benzo(k)fluoranthene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Benz(a)anthracene	NA	NA	NA	0.5	0.5	0.5 U	0.5 U
Chrysene	NA	NA	NA	0.7	0.7	0.5 U	0.5
Benzo(a)pyrene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Indeno(1,2,3-cd)pyrene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Dibenz(a,h)anthracene	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
cPAHs TEQ	NA	NA	NA	0.43	0.44	0.38	0.38
Polychlorinated Biphenyls (PCBs							
Aroclor-1016	4.0 U	4.0 U	4.0 U	4 U	4 U	4 U	4 U
Aroclor-1242	4.0 U	4.0 U	4.0 U	4 U	4 U	4 U	4 U
Aroclor-1248	4.0 U	4.0 U	4.0 U	4 U	4 U	4 U	4 U
Aroclor-1254	4.0 U	4.0 U	4.0 U	4 U	4 U	4 U	4 U
Aroclor-1260	4.0 U	4.0 U	4.0 U	4 U	4 U	4 U	4 U
Aroclor-1221	4.0 U	4.0 U	4.0 U	4 U	4 U	4 U	4 U
Aroclor-1232	4.0 U	4.0 U	4.0 U	4 U	4 U	4 U	4 U
Total Aroclors	4.0 U	4.0 U	4.0 U	4 U	4 U	4 U	4 U

Table A-4-3
Historical Tissue Data - SMA-3

	Geoduck						
	HART14_GD1A	HART14_GD2A	HART14_GD3A	12111903	12111904	12111905	12111906
	12/16/2008	12/16/2008	12/16/2008	11/19/2012	11/19/2012	11/19/2012	11/19/2012
Parameters							
PCB Congeners (ng/kg)							
PCB-017	NA	NA	NA	NA	NA	NA	NA
PCB-018	NA	NA	NA	NA	NA	NA	NA
PCB-028	NA	NA	NA	NA	NA	NA	NA
PCB-031	NA	NA	NA	NA	NA	NA	NA
PCB-033	NA	NA	NA	NA	NA	NA	NA
PCB-044	NA	NA	NA	NA	NA	NA	NA
PCB-049	NA	NA	NA	NA	NA	NA	NA
PCB-052	NA	NA	NA	NA	NA	NA	NA
PCB-066	NA	NA	NA	NA	NA	NA	NA
PCB-070	NA	NA	NA	NA	NA	NA	NA
PCB-074	NA	NA	NA	NA	NA	NA	NA
PCB-077	0.977 U	0.836 U	NA	NA	NA	NA	NA
PCB-081	0.977 U	0.836 U	NA	NA	NA	NA	NA
PCB-082	NA	NA	NA	NA	NA	NA	NA
PCB-087	NA	NA	NA	NA	NA	NA	NA
PCB-095	NA	NA	NA	NA	NA	NA	NA
PCB-099	NA	NA	NA	NA	NA	NA	NA
PCB-101	NA	NA	NA	NA	NA	NA	NA
PCB-105	20.2	18.1	NA	NA	NA	NA	NA
PCB-110	NA	NA	NA	NA	NA	NA	NA
PCB-114	0.977 U	0.836 U	NA	NA	NA	NA	NA
PCB-118	70.4	50.4	NA	NA	NA	NA	NA
PCB-123	0.977 U	0.836 U	NA	NA	NA	NA	NA
PCB-126	0.977 U	0.836 U	NA	NA	NA	NA	NA
PCB-128	NA	NA	NA	NA	NA	NA	NA
PCB-138	NA	NA	NA	NA	NA	NA	NA
PCB-149	NA	NA	NA	NA	NA	NA	NA
PCB-151	NA	NA	NA	NA	NA	NA	NA
PCB-153	NA	NA	NA	NA	NA	NA	NA
PCB-156/157	7.93	2.21 J	NA	NA	NA	NA	NA
PCB-158	NA	NA	NA	NA	NA	NA	NA
PCB-167	5.31 J	2.79 J	NA	NA	NA	NA	NA
PCB-169	0.977 U	0.836 U	NA	NA	NA	NA	NA
PCB-170	NA	NA	NA	NA	NA	NA	NA
PCB-171	NA	NA	NA	NA	NA	NA	NA
PCB-177	NA	NA	NA	NA	NA	NA	NA
PCB-180	NA	NA	NA	NA	NA	NA	NA
PCB-183	NA	NA	NA	NA	NA	NA	NA
PCB-187	NA	NA	NA	NA	NA	NA	NA
PCB-189	0.977 UJ	0.836 U	NA	NA	NA	NA	NA
PCB-191	NA	NA	NA	NA	NA	NA	NA
PCB-194	NA	NA	NA	NA	NA	NA	NA
PCB-195	NA	NA	NA	NA	NA	NA	NA

Table A-4-3
Historical Tissue Data - SMA-3

	Geoduck						
	HART14_GD1A	HART14_GD2A	HART14_GD3A	12111903	12111904	12111905	12111906
	12/16/2008	12/16/2008	12/16/2008	11/19/2012	11/19/2012	11/19/2012	11/19/2012
Parameters							
PCB-199	NA	NA	NA	NA	NA	NA	NA
PCB-205	NA	NA	NA	NA	NA	NA	NA
PCB-206	NA	NA	NA	NA	NA	NA	NA
PCB-208	NA	NA	NA	NA	NA	NA	NA
PCB-209	NA	NA	NA	NA	NA	NA	NA
PCB Congener TEQ	0.0669	0.0567	NA	NA	NA	NA	NA
Dioxins / Furans (ng/kg)							
2,3,7,8-TCDD	0.111 U	0.107 U	0.107 U	NA	NA	NA	NA
1,2,3,7,8-PECDD	0.258 U	0.25 U	0.25 U	NA	NA	NA	NA
1,2,3,4,7,8-HXCDD	0.378 U	0.367 U	0.367 U	NA	NA	NA	NA
1,2,3,6,7,8-HXCDD	0.399 U	0.387 U	0.387 U	NA	NA	NA	NA
1,2,3,7,8,9-HXCDD	0.219 U	0.212 U	0.212 U	NA	NA	NA	NA
1,2,3,4,6,7,8-HPCDD	0.399 U	0.387 U	0.387 U	NA	NA	NA	NA
OCDD	2.58 J	1.51 J	1.05 J	NA	NA	NA	NA
2,3,7,8-TCDF	0.105 U	0.102 U	0.102 U	NA	NA	NA	NA
1,2,3,7,8-PECDF	0.297 U	0.288 U	0.288 U	NA	NA	NA	NA
2,3,4,7,8-PECDF	0.243 U	0.235 U	0.235 U	NA	NA	NA	NA
1,2,3,4,7,8-HXCDF	0.533 U	0.517 U	0.517 U	NA	NA	NA	NA
1,2,3,6,7,8-HXCDF	0.128 U	0.124 U	0.124 U	NA	NA	NA	NA
1,2,3,7,8,9-HXCDF	0.246 U	0.239 U	0.239 U	NA	NA	NA	NA
2,3,4,6,7,8-HXCDF	0.291 U	0.282 U	0.282 U	NA	NA	NA	NA
1,2,3,4,6,7,8-HPCDF	0.533 U	0.517 U	0.517 U	NA	NA	NA	NA
1,2,3,4,7,8,9-HPCDF	0.552 U	0.535 U	0.535 U	NA	NA	NA	NA
OCDF	0.687 U	0.666 U	0.666 U	NA	NA	NA	NA
Total Dioxin TEQ	0.349	0.337	0.337	NA	NA	NA	NA

Notes:

For TEQ calculations, non-detects were assumed to be half the quantitation limit

* = not enough congeners with assigned TEFs were analyzed to make a TEQ

µg/kg = micrograms per kilogram

B = analyte was detected in the Method Blank. If the sample value is less than three times the blank value, the sample value is suspect.

J = estimated concentration

mg/kg = milligrams per kilogram

NA = not analyzed

ng/kg = nanograms per kilogram

TEF = toxic equivalency factor

TEQ = toxicity equivalent quotient

U = not detected at the method detection limit

Table A-4-4
Historical Tissue Data - Western Shoreline

Parameters	Species	Oyster	Cockle	Littleneck	Manila
	Sampling ID	LS_O_PGST_100429	LS_C_PGST_100429	LS_LN_PGST_100429	LS_M_PGST_100429
	Sampling Date	4/29/2010	4/29/2010	4/29/2010	4/29/2010
	TEF (as applicable)				
Conventionals (%)					
Percent Lipids		1.65	0.39	0.47	0.38
Metals (mg/kg)					
Arsenic		1	1 U	3	3
Cadmium		1.28	0.04	0.45	0.35
Chromium		0.2	0.20	0.20	0.2
Copper		9.9	1.1	3.3	6.68
Lead		0.4 U	0.4 U	0.4 U	0.4 U
Mercury		0.011	0.005 U	0.008	0.008
Silver		0.14 J	0.06 UJ	0.07 J	0.08 J
Zinc		130	10	13	11.5
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/kg)					
Napthalene		NA	NA	NA	NA
2-Methylnaphthalene		NA	NA	NA	NA
1-Methylnaphthalene		NA	NA	NA	NA
Acenaphthylene		NA	NA	NA	NA
Acenaphthene		NA	NA	NA	NA
Fluorene		NA	NA	NA	NA
Phenanthrene		NA	NA	NA	NA
Anthracene		NA	NA	NA	NA
Fluoranthene		NA	NA	NA	NA
Pyrene		NA	NA	NA	NA
Benzo(g,h,i)perylene		NA	NA	NA	NA
Dibenzofuran		NA	NA	NA	NA
Carcinogenic Polycyclic Aromatic Hydrocarbons (µg/kg)					
Total Benzofluoranthenes	0.1	1.6	0.5 U	0.5 U	0.5 U

Table A-4-4
Historical Tissue Data - Western Shoreline

	Species	Oyster	Cockle	Littleneck	Manila
	Sampling ID	LS_O_PGST_100429	LS_C_PGST_100429	LS_LN_PGST_100429	LS_M_PGST_100429
	Sampling Date	4/29/2010	4/29/2010	4/29/2010	4/29/2010
Parameters	**TEF (as applicable)**				
Benzo(b)fluoranthene	0.1	0.8	0.5 U	0.5 U	0.5 U
Benzo(k)fluoranthene	0.1	0.8	0.5 U	0.5 U	0.5 U
Benz(a)anthracene	0.1	0.9	0.5 U	0.5 U	1.1
Chrysene	0.01	2.4	0.9	0.5 U	1.2
Benzo(a)pyrene	1	0.5 U	0.5 U	0.5 U	0.5 U
Indeno(1,2,3-cd)pyrene	0.1	0.5 U	0.5 U	0.5 U	0.5 U
Dibenz(a,h)anthracene	0.1	0.5 U	0.5 U	0.5 U	0.5 U
cPAHs TEQ		0.7054	0.5784	0.57775	0.6637
Polychlorinated Biphenyls (PCBs) Aroclors (µg/kg)					
Aroclor-1016		3.9 U	4.0 U	4 U	4 U
Aroclor-1242		3.9 U	4.0 U	4 U	4 U
Aroclor-1248		3.9 U	4.0 U	4 U	4 U
Aroclor-1254		3.9 U	4.0 U	4 U	4 U
Aroclor-1260		3.9 U	4.0 U	4 U	4 U
Aroclor-1221		3.9 U	4.0 U	4 U	4 U
Aroclor-1232		3.9 U	4.0 U	4 U	4 U
Total Aroclors					4 U
PCB Congeners (ng/kg)					
PCB-017		NA	NA	NA	NA
PCB-018		NA	NA	NA	NA
PCB-028		NA	NA	NA	NA
PCB-031		NA	NA	NA	NA
PCB-033		NA	NA	NA	NA
PCB-044		NA	NA	NA	NA
PCB-049		NA	NA	NA	NA
PCB-052		NA	NA	NA	NA

Table A-4-4
Historical Tissue Data - Western Shoreline

	Species	Oyster	Cockle	Littleneck	Manila
	Sampling ID	LS_O_PGST_100429	LS_C_PGST_100429	LS_LN_PGST_100429	LS_M_PGST_100429
	Sampling Date	4/29/2010	4/29/2010	4/29/2010	4/29/2010
Parameters	TEF (as applicable)				
PCB-066		NA	NA	NA	NA
PCB-070		NA	NA	NA	NA
PCB-074		NA	NA	NA	NA
PCB-077	0.0001	NA	NA	NA	NA
PCB-081	0.0003	NA	NA	NA	NA
PCB-082		NA	NA	NA	NA
PCB-087		NA	NA	NA	NA
PCB-095		NA	NA	NA	NA
PCB-099		NA	NA	NA	NA
PCB-101		NA	NA	NA	NA
PCB-105	0.00003	NA	NA	NA	NA
PCB-110		NA	NA	NA	NA
PCB-114	0.00003	NA	NA	NA	NA
PCB-118	0.00003	NA	NA	NA	NA
PCB-123	0.00003	NA	NA	NA	NA
PCB-126	0.1	NA	NA	NA	NA
PCB-128		NA	NA	NA	NA
PCB-138		NA	NA	NA	NA
PCB-149		NA	NA	NA	NA
PCB-151		NA	NA	NA	NA
PCB-153		NA	NA	NA	NA
PCB-156/157	0.00003	NA	NA	NA	NA
PCB-158		NA	NA	NA	NA
PCB-167	0.00003	NA	NA	NA	NA
PCB-169	0.03	NA	NA	NA	NA
PCB-170		NA	NA	NA	NA

Table A-4-4
Historical Tissue Data - Western Shoreline

	Species	Oyster	Cockle	Littleneck	Manila
	Sampling ID	LS_O_PGST_100429	LS_C_PGST_100429	LS_LN_PGST_100429	LS_M_PGST_100429
	Sampling Date	4/29/2010	4/29/2010	4/29/2010	4/29/2010
Parameters	**TEF (as applicable)**				
PCB-171		NA	NA	NA	NA
PCB-177		NA	NA	NA	NA
PCB-180		NA	NA	NA	NA
PCB-183		NA	NA	NA	NA
PCB-187		NA	NA	NA	NA
PCB-189	0.00003	NA	NA	NA	NA
PCB-191		NA	NA	NA	NA
PCB-194		NA	NA	NA	NA
PCB-195		NA	NA	NA	NA
PCB-199		NA	NA	NA	NA
PCB-205		NA	NA	NA	NA
PCB-206		NA	NA	NA	NA
PCB-208		NA	NA	NA	NA
PCB-209		NA	NA	NA	NA
PCB Congener TEQ		NA	NA	NA	NA
Dioxins / Furans (ng/kg)					
2,3,7,8-TCDD	1	NA	NA	NA	NA
1,2,3,7,8-PECDD	1	NA	NA	NA	NA
1,2,3,4,7,8-HXCDD	0.1	NA	NA	NA	NA
1,2,3,6,7,8-HXCDD	0.1	NA	NA	NA	NA
1,2,3,7,8,9-HXCDD	0.1	NA	NA	NA	NA
1,2,3,4,6,7,8-HPCDD	0.01	NA	NA	NA	NA
OCDD	0.0003	NA	NA	NA	NA
2,3,7,8-TCDF	0.1	NA	NA	NA	NA
1,2,3,7,8-PECDF	0.03	NA	NA	NA	NA
2,3,4,7,8-PECDF	0.3	NA	NA	NA	NA

Table A-4-4
Historical Tissue Data - Western Shoreline

	Species	Oyster	Cockle	Littleneck	Manila
	Sampling ID	LS_O_PGST_100429	LS_C_PGST_100429	LS_LN_PGST_100429	LS_M_PGST_100429
	Sampling Date	4/29/2010	4/29/2010	4/29/2010	4/29/2010
Parameters	TEF (as applicable)				
1,2,3,4,7,8-HXCDF	0.1	NA	NA	NA	NA
1,2,3,6,7,8-HXCDF	0.1	NA	NA	NA	NA
1,2,3,7,8,9-HXCDF	0.1	NA	NA	NA	NA
2,3,4,6,7,8-HXCDF	0.1	NA	NA	NA	NA
1,2,3,4,6,7,8-HPCDF	0.01	NA	NA	NA	NA
1,2,3,4,7,8,9-HPCDF	0.01	NA	NA	NA	NA
OCDF	0.0003	NA	NA	NA	NA
Total Dioxin TEQ		NA	NA	NA	NA

Notes:

For TEQ calculations, non-detects were assumed to be half the quantitation limit.

µg/kg = micrograms per kilogram

B = analyte was detected in the Method Blank. If the sample value is less than three times the blank value, the sample value is suspect.

J = estimated concentration

mg/kg = milligrams per kilogram

NA = not analyzed

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U = not detected at the method detection limit