January 2018
Shelton Harbor Sediment Cleanup Unit
Oakland Bay and Shelton Harbor Sediments Cleanup Site (Cleanup Site ID: 13007)

Shelton Harbor Interim Action Plan

Prepared for Simpson Timber Company and the Washington State Department of Ecology

Dioxin data in this report are not correct due to lab error. See corrected data in Shelton Harbor Interim Action Basis of Design - Appendix A - Data Report, 9/30/18

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ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
Agreed Order	Agreed Order DE 14091
CAP	Cleanup Action Plan
cm	centimeter
cm/d	centimeters per day
cm/hr	centimeters per hour
cm/yr	centimeters per year
cm^2/s	square centimeters per second
cm^2/y	square centimeters per year
CoC	chemical of concern
Corps	U.S. Army Corps of Engineers
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CQAP	Construction Quality Assurance Project Plan
CSL	cleanup screening level
CSM	conceptual site model
CWA	Clean Water Act
cy	cubic yard
D_{50}	median (50%) grain size diameter
DCA	disproportionate cost analysis
DMMP	Dredged Material Management Program
D_w	diffusivity in water
Ecology	Washington State Department of Ecology
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
g/mol	grams per mole
H:V	horizontal to vertical
HPA	Hydraulic Project Approval
IAP	*Shelton Harbor Interim Action Plan*
K_{OC}	organic carbon partitioning coefficient
K_{OW}	octanol water partitioning coefficient
L/kg	liters per kilogram
mg/kg	milligrams per kilogram
MNR	monitored natural recovery
MTCA	Model Toxics Control Act
N/A	not applicable

ng/kg	nanograms per kilogram
NWP	Nationwide Permit for Cleanup of Hazardous and Toxic Waste
OC	organic carbon
OMMP	Operations, Maintenance, and Monitoring Plan
PAH	polycyclic aromatic hydrocarbon
PLP	Potentially Liable Party
PQL	practical quantitation level
RAL	remedial action level
RCW	Revised Code of Washington
RD Work Plan	Remedial Design Work Plan
RI/FS	remedial investigation/feasibility study
RI/FS Work Plan	*Shelton Harbor Sediment Cleanup Unit Remedial Investigation/Feasibility Study Work Plan*
SCO	sediment cleanup objective
SCU	Sediment Cleanup Unit
SCUM II	*Sediment Cleanup User's Manual II*
SEPA	State Environmental Policy Act
Simpson	Simpson Timber Company
SMA	sediment management area
SMS	Sediment Management Standards
SPI	sediment profile imaging
SWAC	surface-weighted average concentration
TBT	tributyltin
TEQ	toxic equivalence quotient
USC	United States Code
WAC	Washington Administrative Code

1 Introduction

This *Shelton Harbor Interim Action Plan* (IAP) describes the selected cleanup action for portions of the Shelton Harbor Sediment Cleanup Unit (SCU) within the Oakland Bay and Shelton Harbor Sediments Cleanup Site (Ecology Cleanup Site ID 13007; Figure 1-1). The Shelton Harbor SCU (Figure 1-2) was delineated by the Washington State Department of Ecology (Ecology) in accordance with the Washington State Sediment Management Standards (SMS; 173 204-500(4)(a)), as further described in the 2017 Agreed Order DE 14091 (Agreed Order) between Ecology and the Simpson Timber Company (Simpson). An interim action is a remedial action partially addressing the cleanup of a site, as provided under the Washington State Model Toxics Control Act (MTCA) regulation (Washington Administrative Code [WAC] 173-340-430) and the Agreed Order. Specifically, this IAP describes sediment cleanup actions for three subareas within the Shelton Harbor SCU with elevated concentrations of chemicals of concern (CoCs). This IAP, which fulfills the requirements of Section VII.D of the Agreed Order, describes the proposed interim actions and sets forth functional requirements that these cleanup actions must meet to comply with the requirements of MTCA and the SMS. Simpson, along with other Potentially Liable Parties (PLPs) as appropriate, will implement this IAP to satisfy the requirements of the Agreed Order.

This IAP has also been prepared to expedite cleanup of Shelton Harbor sediments located below the mean higher high-water elevation, including areas within the northern Shelton Harbor habitat restoration project described in Section 2.1. The remainder of the Shelton Harbor SCU will be addressed in a forthcoming SCU-wide Cleanup Action Plan (CAP), currently targeted to be prepared in 2019.

2 Shelton Harbor Environmental Conditions

This section summarizes environmental conditions in Shelton Harbor, including a brief background of the harbor, a summary of sediment data, and the current conceptual site model (CSM) of sediment contamination.

2.1 Shelton Harbor Background

Like the rest of Puget Sound, the Shelton Harbor area was glaciated and carved out during the last ice age. Shelton Harbor, Oakland Bay, and Hammersley Inlet are likely the remnants of a subglacial channel formed during the most recent glacial retreat (Herrera 2010). The current bathymetry of the Shelton Harbor area is depicted on Figure 1-2. Watershed inputs from Goldsborough Creek and Shelton Creek, along with algal (e.g., phytoplankton) production within Oakland Bay, contribute sediments to Shelton Harbor. Sands transported through Goldsborough and Shelton Creeks deposit in the relatively large intertidal delta near the creek mouth in north Shelton Harbor, while finer sediment (silt and clay) is transported into deeper water areas of the SCU.

The non-Native American Shelton area economy was built around the forest products industry and paper manufacturing, farming, dairying, and ranching as well as shellfish aquaculture including oyster cultivation. Industrial development in Shelton Harbor began with sawmill operations in the late 1800s, which continue to this day. In general, waterfront industrial operations peaked in the 1950s and 1960s and have declined since that period, like other areas of Puget Sound.

Both Goldsborough and Shelton Creeks are productive salmonid streams. In 2000, Simpson and the U.S. Army Corps of Engineers (Corps), in conjunction with the Washington State Department of Fish and Wildlife and the Squaxin Island Tribe, removed a 33-foot-high dam in Goldsborough Creek, improving fish passage for Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and chum (*O. keta*) salmon, along with coastal cutthroat trout (*O. clarkii clarkii*) and bull trout (*Salvelinus confluentus*). Today, Goldsborough Creek is one of the only watersheds in Puget Sound with increasing coho salmon runs (https://nwifc.org/recordgoldsborough/). Shelton Creek has continued to support chum (*O. keta*) salmon runs, even though it is in an urbanized watershed.

In 1991, a railroad ferry dock located on the north side of the spit that bisects Shelton Harbor was removed by the Corps, after which the mouth of Goldsborough Creek migrated to the north into deeper, formerly dredged areas, creating an abrupt grade drop from the creek channel into a former dredged area within the delta (Anchor QEA 2017a). Even following removal of the Goldsborough Creek dam, this grade change has continued to propagate an upstream channel incision into Lower Goldsborough Creek as it has adjusted to its new base elevation, exposing buried pipelines in the creek, creating fish passage barriers, and degrading estuary and creek habitat.

The Squaxin Island Tribe, South Puget Sound Salmon Enhancement Group, Simpson, Port of Shelton, and other project partners are currently designing and permitting a habitat restoration project within the northern portion of Shelton Harbor to address these habitat impacts, with the objective of facilitating greater salmon runs. The habitat restoration project is located within a portion of the Shelton Harbor SCU (Figure 2-1). The initial (2017) phase of the habitat restoration project installed engineered log jams designed to slow and reverse the upstream channel incision. Subsequent phases of the habitat restoration project (beginning in 2018) will place clean fill in the estuary to restore saltwater wetland habitat and enhance riparian areas. The overall goals of the habitat restoration project include the following (Anchor QEA 2017a):

- Provide aquatic habitat and hydraulic complexity.
- Promote aggradation and complex flow paths.
- Restore estuary functions and facilitate natural processes.
- Improve habitat conditions at the mouths of Goldsborough and Shelton creeks.

The next (summer/fall 2018) phase of the habitat restoration project will include constructing a salt marsh lobe in the northwest portion of Shelton Harbor on tidelands owned by Simpson and adjacent to Sierra Pacific Industries properties and rerouting the mouth of Shelton Creek into a new lagoon, as depicted in Figure 2-1. As described in this IAP, sediment cleanup actions in northern Shelton Harbor will be designed to be compatible with habitat restoration plans. Cleanup construction is also anticipated to be coordinated with habitat construction to the extent practicable. However, cleanup actions described in this IAP will not be dependent on the habitat restoration project.

Cleanup plans for other areas of the Shelton Harbor SCU, to be addressed in the forthcoming SCU-wide CAP (currently targeted to be prepared in 2019), will also be orchestrated with habitat restoration to the extent practicable. For example, as part of a future (likely 2020 or beyond) phase of the habitat restoration project, a portion of an existing timber railway and underlying upland soils may be excavated from the spit located immediately southeast of the Goldsborough Creek delta, improving connectivity of northern and southern Shelton Harbor habitats (Figure 2-1). Soil excavation, disposal, and other future project elements to be performed within the spit and other harbor areas necessary to ensure human health and environmental protection will be described in the forthcoming (2019) SCU-wide CAP.

2.2 Summary of Sediment Sampling Data

As part of the Puget Sound Initiative for restoration and recovery of Puget Sound, Ecology identified the Oakland Bay and Shelton Harbor Sediments Cleanup Site (Figure 1-1) as one of seven high priority areas in Puget Sound for cleanup and restoration because of its important habitat and valuable natural resources. In 2008, Ecology performed a study of Oakland Bay to identify potential areas of sediment contamination and confirm priority areas for cleanup. Ecology designed the study to characterize sediment quality, determine the nature and extent of sediment contamination and wood debris, and help identify protective sediment cleanup levels. Findings from the study were published in the *Sediment Investigation Report, Oakland Bay Sediment Characterization Study* (Sediment Investigation Report; Herrera 2010).

The scope of Ecology's 2008 Oakland Bay study included Shelton Harbor and adjoining areas, and included an assessment of sediment input and transport throughout the bay system and the collection of sediment samples for both CoC and toxicity analyses (Herrera 2010). Fifty surface grabs and 51 subsurface core samples were collected across the Oakland Bay study area; additionally, three reference sediment surface grab samples were collected from Carr Inlet to provide background toxicity comparisons. Samples were analyzed for a wide range of CoCs associated with historical industrial activities.

Ecology's 2008 Oakland Bay study identified surface and subsurface deposits of wood debris (with associated elevated levels of sulfides and ammonia), dioxins/furans, and other CoCs in portions of the northern and southern Shelton Harbor SCU (Herrera 2010). However, none of the surface sediment samples collected in the northern harbor exceeded SMS sediment cleanup objective (SCO) chemical criteria for benthic community protection, and only one surface sediment sample collected in the southern harbor exceeded the SCO chemical criterion for a single polycyclic aromatic hydrocarbon (PAH; fluoranthene). Historical (2000 to 2005) sampling of the marine railway area in the northern harbor also identified a localized SCO chemical criterion exceedance of copper, as well as localized areas of elevated tributyltin (TBT) concentrations in the upper intertidal zone. There is no promulgated SMS criterion for TBT, but levels can be compared to regional risk-based benchmarks for the purposes of evaluating areas for potential cleanup.

Bioassay testing performed in 2008 found toxicity at several stations within Shelton Harbor, primarily for the larval bioassay test. However, the results were somewhat inconclusive, because "clean" reference sediments that were used for comparison to test sediments failed the SMS acceptability criteria for some of the tests (Herrera 2010). Additionally, test procedures in use for the larval bioassay test in 2008 were later revised because the earlier test method was found to produce a negative bias. Ecology's Oakland Bay study concluded that the 2008 bioassay results were "*associated with the presence of wood waste, fine-grain sediment, synergistic effects of these and other correlated constituents of concern, or some unmeasured condition.*"

The 2008 study reported elevated surface sediment dioxin/furan concentrations at the Site, particularly within the Shelton Harbor SCU (Herrera 2010). Dioxin/furan concentrations were also found in sediment core samples. In most cases the deeper sediment samples were found to contain higher dioxin/furan concentrations, likely due to historical sources. Ecology's (2017a) comparison with the most recent updates of the SMS regulation concluded that dioxins/furans as well as carcinogenic PAHs (cPAHs) are human health CoCs within the Shelton Harbor SCU.

Thus, based on Ecology's previous evaluations, the following CoCs have been identified within the Shelton Harbor SCU:

- Toxicity from wood debris breakdown products
- Dioxins/furans
- cPAHs
- Copper
- TBT

As discussed in the *Shelton Harbor Sediment Cleanup Unit Remedial Investigation/Feasibility Study Work Plan* (RI/FS Work Plan; Anchor QEA 2017b) developed under the Agreed Order, most of the data needed to complete the Shelton Harbor RI/FS were collected between 2005 and 2011, including sampling and analysis data presented in the Sediment Investigation Report (Herrera 2010). Consistent with the RI/FS Work Plan, a final defined data collection effort was completed by Simpson in summer 2017. The 2017 data collection included sediment profile imaging (SPI)[1] throughout Shelton Harbor; confirmatory bioassays using new test methods at several of the stations that failed bioassay criteria in 2008; total volatile solids and porewater sulfide concentrations at bioassay stations; sediment cores for radioisotopes Lead-210 and Cesium-137 to evaluate sedimentation rates; dioxin/furan and cPAH analysis at selected stations, and sediment coring to evaluate wood distributions at targeted locations. A report summarizing the 2017 sampling data is provided in Appendix A (these data are also available on Ecology's Environmental Information Management database). The specific sampling objectives and findings of the 2017 investigations are briefly summarized as follows:

- Evaluate benthic conditions (e.g., SPI at 60 stations and confirmatory bioassays at 11 targeted locations).
  - At almost all SPI locations, surface sediments did not exhibit visible wood debris, and it appears that wood debris and associated toxic conditions in surface sediments throughout most of the Shelton Harbor SCU declined significantly between 2008 and 2017; elevated wood debris levels (greater than 10% by volume) remain in isolated areas of the southern harbor (Figure 2-2).
  - SPI results also reveal that surface sediments in much of the harbor are well oxygenated and indicative of healthy benthic communities.
  - Eight of the 11 confirmatory bioassays performed in 2017, including the single confirmatory station in the northern harbor, passed SCO biological criteria; localized areas of the southern harbor exceeded SCO biological criteria (i.e., no more than minor

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[1] Sediment profile imaging is a survey method that rapidly maps large areas of surface and near-surface sediment, providing information on sediment textures, geochemical conditions, and biological features.

    localized benthic community impacts), and only one sample in the southern harbor (SH-19) exceeded the cleanup screening level (CSL) biological criterion.

- Evaluate potential bioaccumulation exposures to humans and wildlife, building on regional background evaluations recently performed by Ecology (2017a).
  - Dioxin/furan toxic equivalence quotient (TEQ) levels are elevated throughout much of the Shelton Harbor SCU, with the highest levels found in southwestern Shelton Harbor and in the Shelton Creek delta. The maximum surface sediment concentration was detected at Station SH-03, containing approximately 287 nanograms per kilogram (ng/kg; Figure 2-3).
  - cPAH TEQ levels are elevated throughout much of the Shelton Harbor SCU, with the highest concentrations in the southwestern harbor, along the northern shoreline, and in the south-central harbor. The maximum concentration of approximately 320 micrograms per kilogram (µg/kg) was reported historically at Station SH-22 (Figure 2-4).
- Evaluate ongoing sources to sediments (e.g., further evaluation of potential dioxin/furan sources in Shelton Creek).
  - Existing surface sediment dioxin/furan TEQ levels in Shelton Creek above the estuary, including near the clinker deposit on the west bank of the creek, range between approximately 6 and 23 ng/kg, significantly lower than levels measured in the Shelton Creek delta (Station SH-03; Figure 2-3).
  - The dioxin/furan congener "fingerprints" of the clinker and Shelton Creek delta deposits are also dissimilar, further suggesting that the clinker deposit is not a present-day significant source of dioxins/furans to the Shelton Harbor SCU (see Section 3.7).
  - Evaluation of dissolved dioxin/furan concentrations in shallow groundwater underlying the clinker deposit is ongoing, and will be reported in the forthcoming Shelton Harbor RI/FS (and addressed in the SCU-wide CAP as appropriate).
- Evaluate recent natural recovery (e.g., radioisotope and other analyses to better characterize sedimentation rates and sediment stability).
  - Based on radioisotope dating, net sedimentation rates in subtidal areas of Shelton Harbor average 0.30 ± 0.06 centimeters per year (cm/yr; see Section 2.3 for further discussion of natural recovery and sediment stability in the Shelton Harbor SCU).

While the 2017 sediment sampling data presented in Appendix A suggest that subtidal surface sediment concentrations of dioxin/furan TEQ and cPAH TEQ have declined since 2005 consistent with prior source controls and recent natural recovery of these CoC, not all prior sampling stations were reoccupied during the 2017 sampling. To provide a conservative estimate of current surface sediment CoC concentrations across the Shelton Harbor SCU for this IAP, average 2017 and historical sampling data for collocated stations were used to develop concentration interpolations across the

SCU; historical (2005 to 2008) data were used for stations not sampled in 2017. The combined 2005 to 2017 sampling data interpolated by inverse distance weighting for dioxin/furan TEQ and cPAH TEQ are presented in Figures 2-3 and 2-4, respectively, and are discussed in more detail in Section 3.

2.3 Conceptual Site Model

A wide range of historical sources including industrial facilities may have released hazardous substances or wood debris to sediments in Shelton Harbor, based on their scale, nature of operations, and years of operation. More detailed descriptions of historical sources are provided in the "*Summary of Existing Information and Identification of Data Gaps Technical Memorandum*" (Herrera 2008). As discussed in Herrera (2010), historical sources of contamination to Shelton Harbor could have included wood debris, wood burning and hog fuel boiler operations, pulp mill and bleaching operations, sawmill facilities, wastewater discharges from industrial sources as well as public-owned treatment works, vessel maintenance and repair, and other operations. Historical transport pathways may have included currents and tidal fluctuations, aerial deposition, and stormwater runoff.

Potential current ecological and human health risks have been identified in Shelton Harbor, summarized as follows:

- Benthic effects have been studied primarily through a series of SMS bioassay tests; the 2008 and 2017 bioassay data (summarized in Section 3 and presented in Appendix A) reveal that risks to sensitive benthic invertebrates are localized to active log rafting operational areas in southern Shelton Harbor, as well as historical log rafting areas in the southwestern corner of the harbor (Figure 2-2).
- While several of the 2008 larval bioassay SCO exceedance stations in the northern harbor were not resampled in 2017, these stations had lower levels of wood debris and associated degradation product concentrations than the northern harbor station (SH-04) that was resampled in 2017, which passed SCO biological criteria using improved larval bioassay test procedures (Anchor QEA 2017b). Based on the weight of evidence of the combined 2008 and 2017 data (i.e., SPI results showing a healthy benthic community, improved larval bioassay methods, recent natural recovery), no benthic risks were identified in the northern harbor.
- For several bioaccumulative chemicals including dioxins/furans and cPAHs, risk-based values protective of human health and upper trophic level wildlife fall below natural and regional background concentrations defined in the SMS (WAC 173-204-505; Ecology 2017b). As discussed in Section 3, average concentrations of dioxins/furans in Shelton Harbor are higher than South Puget Sound draft regional background levels; however, average cPAH concentrations in the Shelton Harbor SCU are less than regional background levels.
- Based on radioisotope dating, net sedimentation rates in subtidal areas of Shelton Harbor average approximately 0.30 ± 0.06 cm/yr, at the low end of net sediment deposition rates

measured throughout Puget Sound (roughly 0.5 to 2 cm/yr; Carpenter et al. 1985; Lavelle et al. 1985; see Section 3.6). At these rates, it would take approximately 15 to 30 years for CoC concentrations in the top 10 centimeters (cm) of subtidal sediments to decline by 50 percent, depending on the degree of surface sediment mixing and bioturbation. Observed declines between 2008 and 2017 in subtidal surface sediment dioxin/furan TEQ concentrations in the Shelton Harbor SCU are consistent with this measured sedimentation rate, and also suggest that there has been relatively little mixing/bioturbation of subtidal surface sediments over the last few decades. These data reveal that a portion of the more highly contaminated sediment from pre-1970 legacy releases remain in surface and subsurface sediments of the Shelton Harbor SCU.

3 Cleanup Requirements

Consistent with WAC 173-340-430, this IAP has been developed to achieve cleanup standards for portions of the Oakland Bay and Shelton Harbor Sediments Cleanup Site. The interim action is also intended to be consistent with the SCU-wide CAP, which will be developed in 2019. In this situation, the interim action also needs to be compatible with habitat restoration plans. Interim action construction will be coordinated with habitat construction as practicable, but the cleanup action will not depend on the habitat restoration to meet cleanup standards.

The MTCA regulations and SMS provide that a cleanup action must comply with cleanup levels for CoCs at the points of compliance. Site-specific cleanup standards are summarized in the following sections, along with delineation of sediment management areas (SMAs) in both the northern and southern portions of the Shelton Harbor SCU. Cleanup action objectives and applicable or relevant and appropriate requirements, based on federal and state laws (WAC 173-340-710) that the interim action must meet, are also briefly summarized at the end of this section.

3.1 Sediment Management Standards Cleanup Levels

Cleanup standards consist of the following: 1) cleanup levels that are protective of human health and the environment; 2) the point of compliance at which the cleanup levels must be met; and 3) additional regulatory requirements from applicable state and federal laws. Site-specific cleanup standards are developed for the protection of the benthic community, human health, and upper trophic-level wildlife, as discussed in the following sections.

3.1.1 Protection of the Benthic Community

Sediment cleanup levels for benthic community protection are based on SMS bioassay criteria (WAC 173-204-562(3)). The proposed site-specific bioassay cleanup level is the SCO criterion (Table 3-1). Evaluation of compliance with the biological criteria in the Shelton Harbor SCU uses the 2008 and 2017 bioassay results and other supporting information. As discussed in Section 2.3, based on the weight of evidence of these combined data (i.e., SPI results showing a healthy benthic community, oxygenated conditions, no visible wood, improved larval bioassay methods, recent natural recovery), all the northern Shelton Harbor area within the footprint of northern habitat restoration project is considered to meet the SCO bioassay cleanup level. However, the SCO bioassay cleanup level is currently exceeded in localized active log rafting operational areas in southern Shelton Harbor, as well as in historical log rafting areas within the southwestern corner of the harbor (Figure 2-2).

As discussed in Section 2.2, historical (2000 to 2005) sampling of the marine railway area in the northern harbor also identified a localized exceedance of the SCO chemical criterion for copper (390 milligrams per kilogram [mg/kg]), as well as localized areas of elevated TBT concentrations in the upper intertidal zone. While there is no promulgated SMS criterion for TBT, detailed evaluations of sediment TBT exposure and toxicity in Seattle's East Waterway resulted in the development of a risk-based benchmark for the protection of the benthic invertebrate community from sediment TBT of 7.5 mg/kg, normalized to the organic carbon content of the sediment (OC-normalized; Windward and Anchor QEA 2014). Historical sampling of the marine railway area in the northern harbor identified localized TBT concentrations in the upper intertidal zone exceeding this benchmark.

3.1.2 Protection of Human Health

The SMS regulation as updated in 2013 provides a process for developing site-specific cleanup levels for protection of human health from fish and shellfish consumption as well as incidental sediment ingestion and direct contact, considering risk-based threshold concentrations as well as comparisons with background concentrations and practical quantitation levels (PQLs). SMS sediment cleanup levels for human health protection are summarized in the following sections.

3.1.2.1 Fish and Shellfish Consumption

Based on recent cleanup projects in other similar areas of Puget Sound, SMS risk calculations for protection of human health from dioxin/furan TEQ associated with potential fish and shellfish consumption are very low—typically below both the natural background level and the PQL. For example, calculated risk-based threshold concentrations of dioxin/furan TEQ in surface sediments that would be protective of potential human seafood consumption at both the Lower Duwamish Waterway and Western Port Angeles Harbor sites are less than 1 ng/kg (LDWG 2012; NewFields 2013). These calculated concentrations are below the Puget Sound natural background level (4 ng/kg; Ecology 2017b), the PQL (5 ng/kg), and the draft South Puget Sound regional background level (19 ng/kg; Ecology 2017a). A site-specific risk-based dioxin/furan TEQ sediment cleanup level for fish and shellfish consumption protection was not developed for this IAP because under any reasonable maximum exposure scenario applicable to Shelton Harbor, calculated values would be well below the PQL and background concentrations. Therefore, under the SMS framework for developing cleanup standards, SMS human health-based sediment cleanup levels for dioxin/furan TEQ default to PQL and/or background levels, whichever are higher. Regional background-based cleanup levels are discussed in Section 3.1.4.2.

Similarly, calculated risk-based threshold concentrations of cPAH TEQ in surface sediments that would be protective of potential human seafood consumption are also below both the natural background level and the PQL. For example, calculated concentrations of cPAH TEQ in surface sediments that would be protective of potential human seafood consumption at both the Lower Duwamish Waterway and Western Port Angeles Harbor sites are less than 1 µg/kg (LDWG 2012; NewFields 2013), below the PQL (9 µg/kg), the Puget Sound natural background level (21 µg/kg; Ecology 2017b), and the draft South Puget Sound regional background level (78 µg/kg; Ecology

2017a). Thus, SMS human health-based sediment cleanup levels for cPAH TEQ also default to PQL and background levels discussed in Section 3.1.4.2.

While relatively high sediment TBT concentrations have the potential to pose human health risks associated with fish and shellfish consumption, detailed evaluations of sediment TBT exposure and toxicity in Seattle's East Waterway concluded that the primary risk posed by TBT is to the benthic community (Windward and Anchor QEA 2014). Moreover, these evaluations reveal that achieving the risk-based benchmark for the protection of the benthic invertebrate community from sediment TBT exposure (7.5 mg/kg OC) by addressing localized accumulations of TBT (in this case within the northern harbor marine railway area; see Section 3.1.1) would also protect human health as well as upper trophic-level wildlife.

3.1.2.2 Sediment Ingestion and Direct Contact

Ecology (2017b) developed risk-based sediment concentrations that are protective of human health from a range of incidental ingestion and direct contact pathways associated with child beach play, adult subsistence clam digging, and adult subsistence net fishing. The most conservative risk-based sediment concentrations developed by Ecology for these pathways (dioxin/furan TEQ = 15 ng/kg; cPAH TEQ = 75 μg/kg[2]) are slightly lower than the draft South Puget Sound regional background levels (Ecology 2017a).

3.1.3 Protection of Upper Trophic-Level Wildlife

Risk calculations for protection of upper trophic level species (e.g., fish, birds, and mammals) are usually above both regional background levels and risk levels that are protective of human health (Windward and Anchor QEA 2014). Thus, by protecting human health and achieving regional background, upper trophic-level species will also be protected, obviating the need for this IAP to develop cleanup levels for higher trophic-level receptors.

Both Shelton Harbor and Port Angeles Harbor are characterized by similar historical CoC sources (e.g., wood burning and hog fuel boiler operations, pulp mill, bleaching, and sawmill facilities, wastewater discharges from industrial and public-owned treatment works), as well as similar historical transport pathways (e.g., currents and tidal fluctuations; Herrera 2010; Ecology & Environment and NewFields 2012). Existing surface sediment dioxin/furan and PAH concentrations and associated "fingerprint" patterns in these two harbors are also similar, further supporting comparability between these sites. The *Port Angeles Harbor Marine Environment: Sediment Investigation Report and Screening Level Human Health and Ecological Risk Assessment* (Ecology & Environment and NewFields 2012) included a quantitative evaluation of potential risks of

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[2] Note that the U.S. Environmental Protection Agency (EPA 2017) recently relaxed the cancer potency factor for cPAHs by approximately 7-fold, which is not reflected in Ecology's (2017b) SCUM II calculations (i.e., risk-based cPAH TEQ concentrations are now approximately 7-fold higher, further underscoring the protectiveness of human health-based cPAH TEQ cleanup levels)

dioxin/furan and PAH exposure to upper trophic-level wildlife from bioaccumulation (e.g., ingestion of prey and incidental ingestion of sediment). The Port Angeles Harbor ecological risk assessment evaluated three piscivorous species (double-crested cormorant [*Phalacrocorax auritus*], harbor seal [*Phoca vitulina*], and bald eagle [*Haliaeetus leuCoCephalus*]), as well as three omnivorous species (brant [*Branta bernicula*], greater scaup [*Aythya marila*], and common raccoon [*Procyon lorot*]). The risk assessment used conservative exposure parameters for the species evaluated, providing quantitative risk characterization results for dioxin/furan and PAH exposures using current toxicity reference values. The Port Angeles Harbor ecological risk assessment concluded that there were no unacceptable dioxin/furan or PAH risks for any of the species evaluated. Because of similarities between these sites (e.g., similar estuarine and nearshore habitats), similarly low ecological risks are likely present in Shelton Harbor, further underscoring that protection of human health will also protect upper-trophic-level species in Shelton Harbor.

3.1.4 Background

3.1.4.1 Natural Background

Puget Sound natural sediment background concentrations of dioxin/furan TEQ (4 ng/kg) and cPAH TEQ (21 µg/kg) have been developed by Ecology and other regulatory agencies in sediment remediation and dredge disposal guidance (DMMP 2009; Ecology 2017b). Nearly all surface sediments within and adjacent to the Shelton Harbor SCU exceed natural background criteria for both dioxin/furan TEQ and cPAH TEQ (Figures 2-3 and 2-4, respectively).

3.1.4.2 Regional Background

In 2013, Ecology revised the SMS regulations (Chapter 173-204 WAC) to establish a new framework for identification and cleanup of sediment sites. A key component of that framework was the concept of regional background sediment concentrations, which represents the concentration in surface sediment that is technically possible to maintain. This concept recognizes that some chemicals are ubiquitous in urban environments (e.g., from stormwater runoff and aerial deposition), which would result in recontamination of cleaned up sediments (Ecology 2017b). The SMS allows adjustment of the sediment cleanup level from natural background (the SCO) up to regional background (the CSL) to practicably protect human health and the environment at sediment sites located within urban settings such as Shelton Harbor, when the calculated risk-based concentrations and PQL are less than background concentrations. The SMS includes a definition for regional background and parameters for establishing regional background (WAC 173-204-560[5]):

> *"Regional Background" means the concentration of a contaminant within a department-defined geographic area that is primarily attributable to diffuse sources, such as atmospheric deposition or storm water, not attributable to a specific source or release (WAC 173-204-505[16]).*

Ecology recently developed regional background levels for several Puget Sound areas, including draft values for South Puget Sound, to support progress on sediment cleanup projects. As discussed in the *South Puget Sound Regional Background: Draft Final Data Evaluation and Summary Report* (Ecology 2017a), the South Puget Sound regional background levels for dioxin/furan TEQ (19 ng/kg) and cPAH TEQ (78 µg/kg) apply to the Shelton Harbor SCU, consistent with the SMS definition above. Like the natural background comparison discussed above, much of the Shelton Harbor SCU contains surface sediments that exceed these regional background levels, particularly for dioxin/furan TEQ (Figure 2-3). Point of compliance considerations for comparison with these cleanup levels are discussed in Section 3.3.

3.2 Site-Specific Sediment Cleanup Levels

Sediment cleanup levels for the Shelton Harbor SCU were developed for all Shelton Harbor CoCs identified in Section 2.2, including toxicity from wood debris breakdown products, dioxin/furan TEQ, cPAH TEQ, copper, and TBT. In accordance with *Sediment Cleanup User's Manual II* (SCUM II; Ecology 2017b), cleanup levels for each CoC were selected from the highest of regional/natural background, benthic protection, human health/upper-trophic-level risk, or the PQL. Table 3-1 summarizes site-specific sediment cleanup levels. Human health risk-based cleanup levels for dioxin/furan TEQ and cPAH TEQ are based on background concentrations because calculated risk-based values and PQLs are below background. For sites where background concentrations are proposed as cleanup levels because risk-based concentrations are below background, Ecology considers the SCO to be natural background, while the CSL is recognized to be regional background.

As discussed in SCUM II (Ecology 2017b), the site-specific sediment cleanup level can be adjusted upward from the SCO to a value no greater than the CSL based on the following considerations:

- Technical possibility: whether it is technically possible to achieve a sediment cleanup level at the applicable point of compliance within the Site or SCU (WAC 173-204-560(2)(a)(ii)(A)).
- Net adverse environmental impacts: whether meeting a sediment cleanup level will have a net adverse environmental impact on the aquatic environment.

Technically possible is defined as "…*capable of being designed, constructed and implemented in a reliable and effective manner, regardless of cost*" (WAC 173-204-505(23)). Technical possibility depends on a variety of site-specific factors that include the ability to achieve the sediment cleanup level using available technologies. Although achieving the SCO is technically possible at least for a short post-construction period, ongoing non-point sources (not under the control of PLPs) of cPAH TEQ, and potentially also dioxin/furan TEQ, are likely to increase the post-construction surface-weighted average concentration (SWAC) to concentrations greater than the natural background SCO. Thus, the inability to maintain natural background-based SCOs for bioaccumulative CoCs renders the SCO technically impossible to achieve under WAC 173-204-505(23). Ecology (2017a) established draft regional background for South Puget Sound (including Shelton Harbor) in recognition that it is not technically possible to maintain natural background-based SCOs for dioxin/furan TEQ and cPAH TEQ within the urbanized areas of South Puget Sound (see SCUM II Section 7.2.3.2; Ecology 2017b).

The draft south Puget Sound regional background report establishes regional background values for dioxin/furan TEQ of 19 ng/kg, and for cPAH TEQ of 78 µg/kg (Ecology 2017a). Because the study's intent was to identify concentrations due to diffuse nonpoint sources, it did not include areas of known point sources such as Shelton Harbor. In contrast to the regional background value of 78 µg/kg, the current SWAC for cPAH TEQ in Shelton Harbor is approximately 52 µg/kg. The lower SWAC value in Shelton Harbor is likely because a large area within central Shelton Harbor contains very low levels of contaminants due to ongoing contribution of clean sediments from Goldsborough Creek. Therefore, it appears to be technically possible to maintain a SWAC value lower than regional background for cPAH TEQ in Shelton Harbor.

The determination of net adverse environmental impacts is based on whether meeting the cleanup level will have a net adverse impact, considering short- and long-term positive and adverse impacts of cleanup actions on natural resources, including shellfish, forage fish, aquatic habitat, and restoration and enhancement opportunities (WAC 173-204-560[2][a][ii][B]). Targeting portions of the Shelton Harbor SCU by establishing the site-specific sediment cleanup levels above the SCO for bioaccumulative CoCs would reduce risks more rapidly by focusing active remediation on the higher concentration areas and avoiding extensive disturbance of lower-concentration sediments. The duration of adverse impacts on natural resources and habitat associated with remedial construction would be more limited, and the natural recovery of the rest of the SCU would be accelerated.

Therefore, based on considerations of net adverse environmental impacts, as well technical impossibility as outlined above, the site-specific SWAC-based sediment cleanup levels for bioaccumulative CoCs in the Shelton Harbor SCU are appropriately set as follows (Table 3-1):

- Dioxin/furan TEQ = 19 ng/kg (South Puget Sound regional background level; Ecology 2017a)
- cPAH TEQ = 52 µg/kg (current SWAC for cPAH TEQ in Shelton Harbor)

Separate considerations of net adverse environmental impacts based on the short- and long-term positive and negative effects of cleanup actions on natural resources, as required under WAC 173-204-560(2)(a)(ii)(B), apply to benthic community protection. For example, potential sediment toxicity impacts on natural resources resulting from setting site-specific benthic chemical criteria at levels greater than the SCO must be appropriately balanced with construction impacts during and after remediation. For benthic toxicity, the SCO is the criterion at which no adverse effects occur, including no acute or chronic adverse effects on biological resources. The CSL is the minor adverse effects level, which is the minimum level to be achieved in all cleanup actions under the SMS. Because of the more localized exceedances of the benthic SCO in southern portions of the Shelton Harbor SCU

(Figure 2-2), the site-specific sediment cleanup level for benthic community protection is appropriately set at the SCO, the level of no adverse effects (Table 3-1).

Table 3-1
Shelton Harbor SCU Cleanup Levels and Remedial Action Levels

Site-Specific Sediment Action Levels	Toxicity from Wood Debris Degradation	Dioxin/Furan TEQ ng/kg	cPAH TEQ µg/kg	Copper mg/kg	TBT (mg/kg OC)
Benthic Community Protection[1]	SCO Bioassay Criteria	N/A	N/A	390	7.5
Human Health Fish and Shellfish Consumption[2]	N/A	<1	<1	N/A	N/A
Human Health Sediment Ingestion and Contact[2]	N/A	15	75	N/A	N/A
Upper Trophic-Level Wildlife Protection[2,3]	N/A	N/A	N/A	N/A	N/A
Practical Quantitation Limit	N/A	5	9	0.1	1
Puget Sound Natural Background (SCO)[2]	N/A	4	21	N/A	N/A
South Puget Sound Regional Background (CSL; Ecology 2017a)[2]	N/A	19	78	N/A	N/A
Existing Shelton Harbor SWAC	N/A	29	52	N/A	N/A
Sediment Cleanup Level	**SCO Bioassay Criteria**[1]	**19**[2]	**52**[2]	**390**[1]	**7.5**[1]
Remedial Action Level	N/A	**42 (Section 3.4)**	Not Required	N/A	N/A

Notes:
1. Sample-specific point of compliance is the top 10 cm
2. SWAC-based point of compliance is the top 10 cm
3. A specific cleanup level for upper trophic-level wildlife protection is not applicable as discussed in Section 3.1.3

3.3 Points of Compliance

Under MTCA, the point of compliance is the point or location within an SCU where cleanup levels must be attained. For sediments, the vertical point of compliance is the biologically active zone, which is the depth in surface sediments where most benthic organisms are found and where bioturbation occurs. For typical subtidal, soft-bottom sediment in Puget Sound, SCUM II (Ecology 2017b) has established a 10-cm biologically active zone. Site-specific radioisotope (Lead-210) data collected in south Shelton Harbor (Appendix A; also see Section 3.6) suggest that relatively little bioturbation and vertical mixing of sediment occurs within the SCU over the top 10 cm.

As set forth in the SMS, sediment cleanup levels for protection of the benthic community (proposed to be the SCO bioassay criteria for the Shelton Harbor SCU) apply to individual sampling stations and, therefore, each station across the cleanup area is evaluated for compliance separately. As discussed in Section 3.1.1, based on the weight of evidence of the combined 2008 and 2017 data (i.e., SPI results showing a healthy benthic community, oxygenated conditions, no visible wood, improved larval bioassay methods, recent natural recovery), all the northern Shelton Harbor area within the footprint of northern habitat restoration project is considered to meet the SCO bioassay cleanup level. However, the SCO bioassay cleanup level is currently exceeded in localized active log rafting operational areas in southern Shelton Harbor, as well as in historical log rafting areas within the southwestern corner of the harbor (Figure 2-2).

For protection of human health and upper-trophic-level species, SMS cleanup levels apply to the SWAC across the entire Shelton Harbor SCU. SMS further clarifies that cleanup levels need to be achieved within at most 10 years following completion of remedial construction (achieving cleanup levels immediately upon completion of construction is preferred as practicable). As discussed in Section 2.2, while the 2017 sediment sampling data suggest that subtidal surface sediment concentrations of dioxin/furan TEQ and cPAH TEQ have declined over the past ten years consistent with prior source controls and recent natural recovery of these CoCs, not all prior sampling stations were reoccupied during the 2017 sampling. To provide a conservative estimate of current surface sediment CoC concentrations across the Shelton Harbor SCU for this IAP, average 2017 and historical sampling data for collocated stations were used to develop concentration interpolations across the SCU; historical (2005 to 2008) data were used for stations not sampled in 2017. The combined 2005 to 2017 interpolated sampling data for dioxin/furan TEQ and cPAH TEQ are presented in Figures 2-3 and 2-4, respectively. Based on these data, current SWACs within the Shelton Harbor SCU are estimated as follows:

- Dioxin/furan TEQ = 29 ng/kg (above the 19 ng/kg regional background-based cleanup level)
- cPAH TEQ = 52 µg/kg (equal to the current SWAC for cPAH TEQ in Shelton Harbor).

Thus, of the two bioaccumulative CoCs, only dioxin/furan TEQ was carried forward in this IAP for further evaluation of cleanup requirements, as discussed in the following sections.

3.4 Remedial Action Levels

As it relates to the proposed interim actions, the concept of identifying a remedial action level (RAL) is to identify areas with chemical concentrations above which a cleanup action is needed for the overall cleanup unit to meet the SWAC-based cleanup levels. To develop initial RALs for dioxin/furan TEQ that would achieve the SWAC-based regional background concentration immediately after completion of remedial construction, a "hill-topping" analysis was conducted in which surface sediment concentrations in the Shelton Harbor SCU were ranked from highest to lowest (using the data set presented in Figure 2-3), and the areas with the highest values sequentially replaced with post-remedy "clean" sediment (natural background level) until the SWAC concentration was reduced to the regional background-based cleanup level of 19 ng/kg. The hill-topping calculations were separately performed for the footprint of the northern habitat restoration area (44 acres; Figure 2-1), as well as the entire Shelton Harbor SCU (198 acres). The hill-topping calculations revealed that a dioxin/furan TEQ RAL of approximately 42 ng/kg would achieve the cleanup level of 19 ng/kg as a SWAC across the northern habitat restoration area as well as the Shelton Harbor SCU immediately following completion of remedial construction. The approximate areas within the northern and southern portions of the Shelton Harbor SCU that exceed 42 ng/kg are depicted in Figure 2-3.

3.5 Sediment Management Areas

Based largely on the interpolated extent of existing dioxin/furan TEQ concentrations exceeding the 42 ng/kg RAL, three SMAs within the Shelton Harbor SCU, two within the footprint of the northern habitat restoration area and one in the southwestern harbor, were identified for consideration of interim actions. Each of these SMAs is described as follows (see Figure 3-1):

- **SMA-1**: Based on the combined 2005 to 2017 data, approximately 4.4 acres in the Shelton Creek delta (within the footprint of the northern Shelton Harbor habitat restoration project) are estimated to currently exceed the dioxin/furan TEQ RAL of 42 ng/kg.
- **SMA-2**: Based largely on historical (2000 to 2005) data, approximately 0.6 acres in the former marine railway area (also within the footprint of the northern Shelton Harbor habitat restoration project) are estimated to currently exceed the copper RAL of 390 mg/kg, the TBT RAL of 7.5 mg/kg OC, and/or the dioxin/furan TEQ RAL of 42 ng/kg (Table 3-1).
- **SMA-3**: Based on the combined 2005 to 2017 data, approximately 10 acres in the southwestern harbor (outside of the footprint of the northern Shelton Harbor habitat restoration project) has recently exceeded the dioxin/furan TEQ RAL of 42 ng/kg (Figure 2-3). Based on the potential for natural recovery over the past ten years (discussed in Section 2.3), this IAP contemplates a smaller 3.5-acre remediation area in SMA-3. The footprint of SMA-3 will be further refined as described below.

The extent of all three SMAs will be refined in spring 2018 by sampling surface sediments in these areas to inform final remedial designs. Note that some of the dioxin/furan TEQ, copper, and TBT data used to develop preliminary SMA delineations are 10 or more years old; updated data are needed to refine the extent of the interim action areas.

While interim actions in SMA-1 and SMA-2 would immediately achieve cleanup levels throughout the footprint of the northern Shelton Harbor habitat restoration project, interim actions in SMA-3 may only partially achieve cleanup levels throughout the rest of the Shelton Harbor SCU. Follow-on remedial actions as may be necessary in other areas of the Shelton Harbor SCU will be addressed in the forthcoming SCU-wide CAP (targeted for 2019).

3.6 Cleanup Action Objectives

Cleanup action objectives consist of chemical- and medium-specific goals for protecting the environment. The cleanup action objectives specify the media and contaminants of interest, potential exposure routes and receptors, and proposed cleanup goals for the Shelton Harbor SCU.

Exposure routes to be addressed by cleanup actions in north Shelton Harbor include transport pathways to benthic receptors, humans, and upper-trophic-level wildlife. Consistent with WAC 173-340-430, this IAP is intended to be consistent with the final cleanup action. The sediment cleanup action objectives for this IAP are summarized as follows:

- Eliminate, reduce, or otherwise control to the extent practicable risks to humans and upper-trophic-level wildlife from ingestion of seafood that may accumulate contaminants from sediments containing elevated concentrations of dioxins/furans.
- Eliminate, reduce, or otherwise control to the extent practicable risks to benthic organisms through exposure to sediments containing deleterious wood debris degradation products, copper, and/or TBT that exceed the cleanup levels summarized in Table 3-1.

3.7 Source Control Status

The *Oakland Bay Sediment Dioxin Source Study* (NewFields 2014) presents a review of sediment dioxin data in Shelton Harbor and Oakland Bay to identify potential upland sources and transport pathways using chemometric interpretations of sediment dioxin/furan congener profiles. A main deduction of that study is that dioxin/furan concentrations remaining in surface sediments within Shelton Harbor were from historical practices that are no longer occurring. For example, most of the dioxin/furan deposits detected in Shelton Harbor were either associated with pentachlorophenol, a chemical currently banned from most industrial uses, or hog fuel burners that have either been decommissioned or no longer use salt-laden wood. As discussed in Section 2.3, a portion of pre-1970 legacy releases to Shelton Harbor remain in surface and near-surface sediments within the SCU and are recovering slowly. Significantly lower dioxin/furan TEQ levels in the top 10 cm of southern Shelton Harbor subtidal sediments, compared to underlying sediments, corroborates this CSM (Figure 3-2).

As a condition of the mitigated Determination of Non-Significance under the State Environmental Policy Act (SEPA) for demolition of former sawmill buildings and construction of new mills, Sierra Pacific Industries has been capping and closing historical catch basins, storm drain lines, and storm outfalls that discharged from historic sawmill facilities to Shelton Harbor (City of Shelton 2015).

These recent actions provide further assurance of effective source control from the former sawmill facilities to north Shelton Harbor.

The pattern of elevated surface sediment dioxin/furan TEQ levels in the Shelton Harbor SCU further suggests that the SMA-1 dioxin/furan deposit is attributable to the legacy releases described in the NewFields source study report, as lower dioxin/furan TEQ levels are present in both Goldsborough and Shelton Creeks, compared to concentrations in the delta (Figure 2-3). Ecology (2013) noted that a deposit of former pulp mill and/or sawmill burner "clinker" residues is present on the north bank of Shelton Creek. Two samples from the clinker material (Ecology 2013) contained an average dioxin/furan TEQ level of approximately 31 ng/kg, below the 42 ng/kg RAL, but exceeding the 19 ng/kg regional background level (Table 3-1). While the clinker deposit initially may have been a source of legacy contaminants, it does not appear to be a continuing source. The distinctly different congener concentrations and proportions (fingerprints) of SMA-1 sediments (Station SH-03) and samples of the clinker deposit on the Shelton Creek bank indicate that the present-day material within the clinker deposit is not a significant ongoing source of dioxins/furans to sediments in SMA-1 (Figure 3-3a and 3-3b).

An additional evaluation of the clinker deposit on the Shelton Creek bank is ongoing to also confirm that this deposit is not a significant ongoing source of dissolved-phase dioxins/furans to Shelton Harbor (Anchor QEA 2017b). In addition, under Ecology oversight, Simpson and other PLPs will perform post-construction monitoring of surface sediments to further ensure the protectiveness of remedial actions, implementing contingency actions as appropriate based on the findings of post-construction performance monitoring (see Section 6).

3.8 Compliance with Applicable Laws

The interim action in the Shelton Harbor SCU will be performed pursuant to MTCA and the SMS under the terms of the Agreed Order. In addition to the cleanup standards developed through the SMS process, other regulatory requirements must be considered in the selection and implementation of an interim action. MTCA requires cleanup standards to be at least as stringent as all applicable state and federal laws (WAC 173-340-700(6)(a)). In addition, cleanup standards must ensure compliance with applicable state and federal laws (WAC 173-340-710(1)). The applicable state and federal laws may impose certain technical and procedural requirements (including obtaining permits or approvals) for performing remedial actions. Applicable state and federal laws are identified in this section. Ecology has not identified any relevant and appropriate requirements that apply to the interim action.

Pursuant to Revised Code of Washington (RCW) 70.105D.090(1), the interim action is exempt from the procedural requirements of Chapters 70.94, 70.95, 70.105, 77.55, 90.48, and 90.58 RCW and of any laws requiring or authorizing local government permits or approvals. However, the interim action must comply with the substantive requirements of such permits or approvals. The exempt permits or approvals and the applicable substantive requirements of those permits or approvals, as they are known at the time of this IAP, are identified in Section 3.8. Where they are not identified, they will be determined at the remedial design stage of the interim action.

3.8.1 State Environmental Policy Act

SEPA (RCW 43.21C; WAC 197-11) and the SEPA procedures (WAC 173-802) are intended to ensure that state and local government officials consider environmental values when making decisions. Under WAC 197-11-250, MTCA and SEPA procedural requirements are integrated to reduce duplication and improve public participation, including common public review and comment. SEPA requires the identification, avoidance, minimization and/or mitigation of environmental impacts associated with agency permitting or actions such as the interim MTCA cleanup action in north Shelton Harbor. The impacts from this cleanup have been identified along with requirements to select construction methods and timing and implementation of best management practices that will mitigate those impacts that cannot be avoided. Avoidance, minimization, and mitigation measures identified during preparation of the SEPA checklist are described in a Mitigated Determination of Non-Significance. Additional avoidance and minimization measures and/or mitigation requirements identified prior to and during construction must also be met.

3.8.2 Puget Sound Dredged Material Management Program

In Puget Sound, the open-water disposal of sediments is managed under the Dredged Material Management Program (DMMP), which is administered jointly by Ecology, Corps, the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Natural Resources. The DMMP developed the Puget Sound Dredge Disposal Analysis protocols, which include testing requirements to characterize whether dredged sediments are appropriate for unconfined, open-water disposal. The results of this characterization are formalized in a written suitability determination from the Dredged Material Management Office. As discussed in Section 4.1 below, the DMMP has made past determinations that sediments with concentrations like those in SMA-1 to SMA-3 are not suitable for unconfined, open water disposal.

3.8.3 Shoreline Management Act

The Shoreline Management Act (RCW 90.58) and its implementing regulations establish requirements for developments on the shorelines of the state. A substantial development shall not be undertaken on shorelines of the state without first obtaining a permit from the government entity having administrative jurisdiction. Any development must be consistent with the policy of RCW 90.58.140, and the applicable guidelines, rules, or master program.

3.8.4 Washington Hydraulics Code

The Washington Hydraulics Code (WAC 220-110) establishes requirements for the construction of any hydraulic project or the performance of any work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh water of the state. The code also creates a program requiring Hydraulic Project Approval (HPA) permits for any activities that could adversely affect fisheries and water resources. Timing restrictions and technical requirements under the hydraulics code are applicable to dredging, capping, and placement of post-dredge residual covers.

3.8.5 Federal Clean Water Act

The Clean Water Act (CWA) is the primary federal law for protecting water quality from pollution. The CWA regulations provide requirements for the discharge of dredged or fill material to waters of the United States and are applicable to any in-water work. The CWA regulations also prescribe permitting requirements for point source and non-point source discharges. Acute criteria are relevant and appropriate requirements for discharges to marine surface water during sediment dredging, as well as for return flows (if necessary) to surface waters from dewatering operations.

3.8.5.1 Construction Stormwater Permit

Section 402 of the CWA requires a permit for discharge of pollutants pursuant to 33 United States Code (USC) § 1342 that is likely to apply to construction stormwater from the cleanup. Construction activities that disturb one acre or more of land need to comply with the provisions of construction stormwater regulations. Ecology has determined that a construction stormwater general permit does not meet the requirements for the permit exemptions in RCW 70.105D.090, and thus a project-specific construction stormwater permit will be required if land disturbance greater than one acre is necessary (e.g., for equipment staging areas). As needed, a construction stormwater general permit would be obtained during the remedial design process, supplemented as appropriate by the remedial contractor.

3.8.5.2 Corps of Engineers Section 404 Permit

Section 404 of the CWA requires permits from the Corps for discharges of dredged or fill material into waters of the United States, including wetlands (33 USC § 1344). CWA Section 404(b)(1) requires an alternatives analysis as part of the permitting process. Requirements for all known, available, and reasonable technologies for treating waste water prior to discharge to state waters are applicable to any dewatering of marine sediment prior to upland disposal.

The cleanup action may qualify for a Corps Nationwide Permit for Cleanup of Hazardous and Toxic Waste (NWP) 38, as appropriate. Otherwise, the cleanup action may qualify for the full permitting process under 33 USC § 1344.

3.8.5.3 Clean Water Act Section 401 Water Quality Certification

CWA Section 401 requires the state to certify that federal permits are consistent with water quality standards (33 USC § 1341). If the cleanup action is permitted under NWP 38, a formal 401 certification would not be needed. Instead, the project would be subject to NWP 38 conditions, and Ecology would ensure that the project is consistent with water quality standards via regulatory oversight under this IAP.

3.8.6 Washington Water Pollution Control Act

Ecology has promulgated statewide water quality standards under the Washington Water Pollution Control Act (RCW 90.48). Under these standards, all surface waters of the state are divided into classes (Extraordinary, Excellent, Good, and Fair) based on the aquatic life uses of the water bodies. Water quality criteria are defined for different types of pollutants and the characteristic uses for each class of surface water. The standards for marine waters are applicable to discharges to surface water during sediment dredging or capping, and return flows (if necessary) to surface waters from dewatering operations.

3.8.7 Archaeological and Historic Preservation Act

The Archaeological and Historic Preservation Act (16 USC § 496a-1) is applicable if any covered materials are discovered during excavation or dredging activities performed as a part of the selected sediment cleanup action. Early in the remedial design and permitting of the cleanup action, Simpson, in consultation with the Washington Department of Archaeology and Historic Preservation and the Squaxin Island Tribe, will further evaluate areas where cleanup-related disturbance of cultural resources may occur, including capping, dredging, staging and mooring areas, and transport routes as appropriate. More detailed cultural resource evaluations, as necessary, will be integrated with studies for engineering design as practicable.

3.8.8 Health and Safety

Sediment cleanup construction activities will be performed in accordance with the requirements of the Washington Industrial Safety and Health Act (RCW 49.17) and implementing regulations, as well as the federal Occupational Safety and Health Act and implementing regulations (29 CFR §§ 1910, 1926). These applicable regulations include requirements that workers are to be protected from exposure to contaminants and that excavations are to be properly shored. A health and safety plan would be developed as part of the engineering design and remedial action processes.

3.9 Exemptions from Procedural Requirements

Interim action construction in the Shelton Harbor SCU, as required by this IAP, will be performed under the existing Agreed Order between Ecology and Simpson, in which Ecology's approvals will address substantive requirements of state and local regulations as outlined as follows.

3.9.1 City of Shelton Shoreline Master Program

The cleanup action will take place within the City of Shelton. Ecology has consulted with city planning staff on the substantive requirements of the Shoreline Master Program in developing this IAP. The capping and dredging alternatives considered in this IAP are permissible actions under the Shelton Shoreline Master Program. For example, Section 5.6.2 allows "*cleanup and/or disposal of contaminated sediments as part of an interagency environmental cleanup plan*", and states that "*fill in shoreline areas is required to be 'sand, gravel, soil, rock, crushed concrete or a similar material*". Dredging waterward of the ordinary high water mark is allowed for environmental cleanup activities (Section 6.18.3). Section 6.21.2 allows structural stabilization measures (e.g., bulkheads/rip-rap) to protect hazardous substance remediation projects only when nonstructural measures, vegetation, or on-site drainage improvements are not feasible or sufficient; and that the stabilization structure will not result in a net loss of shoreline ecological functions.

The preferred alternative under this IAP (capping) will utilize sand and gravel fill. Dredging is not a preferred alternative. A bulkhead is not proposed. Vegetation and non-structural stabilization measures will be evaluated in the design planning for the shoreline slope at SMA-3. Ecology will continue to consult with the City of Shelton during the remedial design phase of the interim action to ensure that all substantive requirements are met.

3.9.2 Hydraulic Project Approval Permit

Ecology has also consulted with the area habitat biologist for the Washington State Department of Fish and Wildlife regarding the substantive requirements for the HPA Permit and with tribal biologists on specific fish closure periods; requirements may be refined during the remedial design phase. The substantive requirements that have been identified to date for planning purposes include the following:

- Authorized in-water construction windows to protect juvenile salmonids in the Shelton Harbor SCU are from July 15 to February 15.
- There are no known baitfish spawning areas within or adjacent to the Shelton Harbor SCU.

Ecology will continue to consult with the Washington State Department of Fish and Wildlife during the remedial design phase of the interim action to ensure that all substantive requirements are met.

4 Interim Action Alternatives and Comparative Evaluation

This section builds on the CSM developed in Section 2.3 and the cleanup requirements in Section 3 to develop and compare remedial alternatives for Shelton Harbor SMA-1 to SMA-3. Specifically, this section summarizes potentially viable sediment cleanup technologies for the Shelton Harbor SCU (Section 4.1), presents an engineered cap design evaluation for SMA-1 to SMA-3 (Section 4.2), develops Shelton Harbor interim action alternatives (Section 4.3), presents a detailed comparative analysis of these alternatives consistent with MTCA/SMS requirements (Section 4.4), and identifies the recommended sediment interim action remedy (Section 4.5).

4.1 Cleanup Technologies

Remedial technologies and sediment remediation practices are relatively well established for sediment cleanup sites in Puget Sound, and common remedial technologies are listed in the SMS rule (WAC 173-204-570(4)(b)) and described in Section 12.4.3 of SCUM II (Ecology 2017b). Table 4-1 summarizes the technology screening for the Shelton Harbor interim actions based on the technologies listed in the SMS rule.

Table 4-1
Remedial Technology Screening

Remedial Technology (173-204-570(4)(b))	Screening Determination
(i) Source controls in combination with other cleanup technologies	**Eliminated**. Extensive historical source control work in Shelton Harbor has eliminated sources sufficiently to allow in-water remediation work to proceed (see Section 3.6). Further sampling and analysis will be performed under the Agreed Order (including additional sampling in the clinker deposit area as well as post-construction sediment monitoring) to further confirm that effective source controls are in place.
(ii) Beneficial reuse of site sediments	**Eliminated**. There is a lack of currently viable beneficial uses for contaminated sediments.
(iii) Treatment to immobilize, destroy, or detoxify contaminants	**Eliminated**. While promising in situ treatment technologies such as activated carbon amendments are available to control the bioavailability of CoCs such as dioxin/furan TEQ, site-specific evaluations of such amendments in Shelton Harbor have not been completed. In situ treatment may be evaluated in more detail as part of the forthcoming SCU-wide CAP, if it can be shown to be effective.
(iv) Dredging and disposal in an upland engineered facility that minimizes subsequent releases and exposures to contaminants	**Retained**. Demonstrated to be effective in similar Puget Sound sites. Based on the most recent sediment core data collected as part of the RI/FS, approximately two feet of subsurface contaminated sediment is present in SMA-1 and SMA-2; approximately 10 feet of subsurface contaminated sediment is present in much of SMA-3. Following removal, the pre-construction grade would need to be restored to mitigate habitat disturbances.

Remedial Technology (173-204-570(4)(b))	Screening Determination
(v) Dredging and disposal in a nearshore, in-water, confined aquatic disposal facility	**Eliminated**. No current facility exists in the Shelton area. However, as appropriate, nearshore, in-water, confined aquatic disposal will be evaluated in more detail as part of the SCU-wide CAP.
(vi) Containment of contaminated sediments in place with an engineered cap	**Retained**. Capping is expected to be an effective technology, based on similar Puget Sound sites and contaminant transport modeling. Detailed site-specific cap designs are presented in Section 4.2.
(vii) Dredging and disposal at an open water disposal site approved by applicable state and federal agencies	**Eliminated**. The DMMP has made past determinations that sediments with concentrations like those in SMA-1 to SMA-3 are not suitable for unconfined, open water disposal.
(viii) Enhanced natural recovery (ENR)	**Retained**. ENR (i.e., placement of thin layer of sand to augment natural recovery) has been demonstrated to be effective at similar Puget Sound sites. Time trends and deposition observations in the Shelton Harbor SCU indicate that surface sediments are relatively stable. Site-specific chemical transport modeling presented in Section 4.2 suggests that an ENR layer could effectively isolate the underlying sediments.
(ix) Monitored natural recovery (MNR)	**Retained**. Time trends and deposition observations indicate that surface sediments are relatively stable, but at an average sedimentation rate of 0.30 ± 0.06 cm/yr, MNR is proceeding relatively slowly within the Shelton Harbor SCU. MNR is applicable to relatively lower concentration areas of the SCU.
(x) Institutional controls and monitoring	**Retained**. Institutional controls and monitoring are important aspects of all alternatives. However, consistent with MTCA/SMS rules, institutional controls and monitoring are not employed as stand-alone technologies, but are used in conjunction with other cleanup technologies.

Thus, the resulting list of remedial technologies retained for further evaluation in this IAP include the following:

- Dredging and disposal in upland facility
- Engineered capping
- Enhanced natural recovery (ENR)
- Monitored natural recovery (MNR)

Institutional controls and monitoring are part of all alternatives. To further support the development of protective interim action alternatives for the Shelton Harbor SCU, a site-specific cap design evaluation was performed, as summarized in the following section.

4.2 Cap Design Evaluation

This section describes preliminary cap design for SMA-1 to SMA-3, developed in accordance with the following detailed EPA and Corps guidance for in situ capping:

- *Guidance for Subaqueous Dredged Material Capping* (Palermo et al. 1998a)

- *Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In Situ Subaqueous Capping of Contaminated Sediments* (Palermo et al. 1998b)

These documents provide detailed procedures for cap design. Importantly, caps designed following the EPA and Corps guidance have been demonstrated to be protective of human health and the environment (EPA 2005). For the purposes of this IAP, and consistent with EPA and Corps guidance, a preliminary cap design for SMA-1 to SMA-3 was developed based on consideration of the following four components:

- Chemical isolation and bioturbation
- Erosion protection
- Consolidation
- Constructability considerations (e.g., placement accuracy)

Each of these considerations are discussed in the following sections.

4.2.1 Chemical Isolation and Bioturbation

A preliminary cap design analysis was conducted to identify cap chemical isolation layer requirements to maintain surface sediment dioxin/furan TEQ concentrations below the regional background level of 19 ng/kg (Table 3-1) within SMA-1. This analysis was performed in accordance with Corps and EPA sediment cap design guidance (Palermo et al. 1998a, 1998b).

Consistent with current EPA (2005) guidance, this cap design evaluation used the one-dimensional steady-state model of chemical transport within sediment caps developed by Dr. Danny Reible (Texas Tech University), based on the steady state analytical solution to the governing equations. Details on the model structure and underlying theory and governing equations for the steady-state model were published in "*An Analytical Modeling Approach for Evaluation of Capping of Contaminated Sediments*" (Lampert and Reible 2009). The steady-state model has been used to support the evaluation and design of sediment caps at Superfund sediment cleanup sites throughout the United States (e.g., Hudson River, New York; Lower Fox River, Wisconsin; Lower Willamette River, Oregon), and has also been used at MTCA/SMS cleanup sites in Washington State (e.g., Port Gamble Bay, Bellingham Bay).

The Reible model simulates the fate and transport of chemicals (dissolved and sorbed phases) under the processes of bioturbation, advection, diffusion, dispersion, biodegradation, and exchange with the overlying surface water, as generally depicted in Figure 4-1. Steady-state predictions provide a useful means of assessing long-term contaminant profiles within a cap, although the time to reach the steady-state concentrations will vary depending on the chemical characteristics of the contaminant, sediment geochemical conditions, and subsurface hydrogeology. For this analysis, the fate and transport of all 17 dioxin/furan congeners was simulated. Model-predicted steady-state concentrations of the individual congeners at the cap surface were then used to calculate the dioxin/furan TEQ concentration as follows in Equation 1:

Equation 1

$$D/F\ TEQ = \sum_{i=1}^{17} C_i \times TEF_i$$

where:

C = model-predicted dioxin or furan congener concentration

TEF = World Health Organization toxic equivalency factor for each dioxin/furan congener (unitless) (Van den Berg et al. 2006)

The cap design model uses several input parameters that describe site-specific conditions, chemical-specific properties, cap material properties, and chemical mass transport rates. These input parameters were based on site-specific data, information from literature, and cap designs successfully constructed at other similar sites. For this evaluation, the maximum detected surface sediment dioxin/furan TEQ concentration measured in the Shelton Harbor SCU (Station SH-03 [Figure 2-3]; 2017 sampling; 287 ng/kg TEQ) was input into the model to ensure a protective cap design. A listing of model inputs is provided in Tables 4-2 and 4-3.

Table 4-2
Input Parameter Values for Chemical Isolation Cap Modeling

Model Input Parameter	Value	Data Source
Chemical-specific Properties		
OC partitioning coefficient, log K_{OC} (log L/kg)	See Table 4-3	Log K_{OC} values calculated from K_{OW} values reported in Govers and Krop (Govers and Krop 1998) using Di Toro (Di Toro 1985) relationship
Water diffusivity (cm^2/s)	See Table 4-3	Calculated based on the molecular weight of the compound using the correlation identified from *Environmental Organic Chemistry* (Schwarzenbach et al. 1993)
Chemical biodegradation rate	0	Assumed no degradation
Chemical porewater concentration in underlying sediment (µg/L)	See Table 4-3 and Appendix A	Calculated from the maximum surface sediment concentration measured in Shelton Harbor (location SH-03; 2017 sampling) using equilibrium partitioning; total OC level of 3.8% measured at this location
Cap Properties		
Cap thickness (cm)	Design parameter	Assumed placement of 6 inches of sand; refined as necessary based on model results

Model Input Parameter	Value	Data Source
Porosity	0.4	Typical value for sand (e.g., Domenico and Schwartz 1990)
Fraction OC of cap material (%)	Design parameter	Assumed typical regional quarry value (0.1%); refined as necessary based on model results
Fraction OC of bioturbation zone (%)	3.8	Surface sediment level at station SH-03, representing sediment that will deposit on the cap
Mass Transport Properties		
Boundary layer mass transfer coefficient (cm/hr)	0.75	Typical value used for capping design (e.g., Reible 2012); consistent with range of values measured in other systems (e.g., Thibodeaux et al. 2001)
Groundwater seepage Darcy velocity (cm/d)	0.1 to 1.0	Based on regional hydrogeological evaluations in similar estuarine settings; evaluated range as sensitivity analysis
Deposition rate (cm/yr)	0 to 0.30	Averaged measured values are 0.30 ± 0.06 cm/yr; but also evaluated a wider range as a sensitivity analysis
Dispersion Length (cm)	3	Representing tidal mixing with an increased dispersion coefficient is a common approach in groundwater modeling (e.g., La Licata et al. 2011); based on tidal range of approximately 10 feet (NOAA 2017), dispersivity is based on 20% of model domain length (cap thickness)
Bioturbation zone thickness (cm)	10	Typical value for cap design (e.g., Clarke et al. 2001; Reible 2012); consistent with SMS (Ecology 2017a)
Porewater biodiffusion coefficient (cm^2/yr)	940	Parameter represents bioturbation rate applied to dissolved phase; typical value used for capping design (e.g., Reible 2012)
Particle biodiffusion coefficient (cm^2/yr)	9.4	Parameter represents bioturbation rate applies to particulate phase; typical value used for capping design (e.g., Reible 2012)

Table 4-3
Chemical-Specific Model Input Parameters

Chemical	log K_{OC} (log L/kg)	Molecular Weight (g/mol)	Dw (cm^2/s)	Surface Sediment Concentration (ng/kg)	Calculated Porewater Concentration (µg/L)
2,3,7,8-TCDD	6.8	322.0	4.5E-06	3.76 J	1.4E-08 J
1,2,3,7,8-PeCDD	7.4	356.4	4.2E-06	26.4	2.9E-08
1,2,3,4,7,8-HxCDD	7.8	390.9	3.9E-06	41.2	1.7E-08
1,2,3,6,7,8-HxCDD	7.8	390.9	3.9E-06	346	1.3E-07
1,2,3,7,8,9-HxCDD	7.8	390.9	3.9E-06	108	4.1E-08
1,2,3,4,6,7,8-HpCDD	8.3	425.3	3.7E-06	8,990 J	1.3E-06 J
OCDD	8.6	459.8	3.5E-06	108,000 J	7.1E-06 J
2,3,7,8-TCDF	6.4	306.0	4.6E-06	13.4	1.6E-07
1,2,3,7,8-PeCDF	6.9	340.4	4.3E-06	19.5	6.9E-08
2,3,4,7,8-PeCDF	7.0	340.4	4.3E-06	60.4	1.6E-07
1,2,3,4,7,8-HxCDF	7.4	374.9	4.0E-06	181	1.9E-07
1,2,3,6,7,8-HxCDF	7.4	374.9	4.0E-06	58	5.5E-08
1,2,3,7,8,9-HxCDF	7.6	374.9	4.0E-06	2.77 U	1.7E-09 U
2,3,4,6,7,8-HxCDF	7.5	374.9	4.0E-06	102	8.1E-08
1,2,3,4,6,7,8-HpCDF	7.9	409.3	3.8E-06	2,600	9.1E-07
1,2,3,4,7,8,9-HpCDF	8.1	409.3	3.8E-06	146	3.1E-08
OCDF	8.5	443.8	3.6E-06	11,800	1.1E-06
Total Dioxin/Furan TEQ (U = 1/2)	--	--	--	287 J	--

The steady-state model predicts that a 6-inch sand cap isolation layer with relatively low total OC content (0.1%) will maintain long-term dioxin/furan TEQ concentrations in the top 10 cm (vertical average) of the cap to below the regional background dioxin/furan TEQ of 19 ng/kg (Table 4-4). As discussed in Section 3.3, site-specific radioisotope (Lead-210) data collected in south Shelton Harbor suggest that relatively little bioturbation and vertical mixing of sediment occurs within the SCU over the top 10 cm, even though benthic community feeding voids were observed at depths greater than 10 cm in SPI surveys. The 6-inch cap incorporates a 10-cm bioturbation layer.

The protectiveness of a 6-inch combined bioturbation/chemical isolation layer is also corroborated by vertical sediment CoC profiles; that is, significantly lower dioxin/furan TEQ levels are present in the top 10 cm of Shelton Harbor sediments compared to underlying sediments, consistent with the CSM (Figure 3-2). A 6-inch-thick cap isolation layer would also be protective over the range of possible groundwater flow rates (0.1 to 1 cm/day), and net sedimentation rates (0 to 0.30 cm/year). Using the highest potential groundwater flux (1 cm/day) and lowest (zero) deposition rate, the model predicts the steady-state dioxin/furan TEQ in the top 10-cm to be at the regional background concentration of 19 ng/kg. Considering more realistic groundwater flow and site-specific measured net sediment deposition rates, the model-predicted concentrations within the cap surface would be well below the 19 ng/kg TEQ regional background-based cleanup level.

Table 4-4
Steady-State Model Results for a 6-inch Chemical Isolation/Bioturbation Layer

Variable Model Inputs		Model-predicted Steady-State Dioxin/Furan TEQ (ng/kg)[1]
Darcy Flux (cm/d)	Deposition Rate (cm/yr)	
0.1	0.30	2.2E-06
1	0.30	0.014
0.1	0	2.2
1	0	19

Notes:

1. Vertical average in the top ten centimeters of sediment

4.2.2 Erosion Protection

In addition to chemical isolation, an erosion analysis was performed to calculate the stable grain size of capping material within SMA-1 to SMA-3. This analysis builds on a similar analysis performed for the Oakland Bay Habitat Restoration project, which includes the SMA-1 and SMA-2 footprint (Anchor QEA 2017a). SMA-1 and SMA-2 overlap with the north marsh and west marsh areas delineated in that analysis; however, as a conservative simplifying assumption, only the results for the north marsh area are presented here because it has higher erosion forces than the west marsh area. The erosion protection analysis focused on resisting forces produced by wind and waves. The Corps' automated coastal engineering system revetment module (Leenknecht et al. 1992) was used to estimate the stable sediment sizes under wave attack[3], using a stability formula like the one developed by Hudson (1958). The SMA-1 and SMA-2 areas have existing slopes of approximately ten horizontal to one vertical (10H:1V). The automated coastal engineering system revetment calculation assumes a steeper slope (6H:1V) resulting in a more conservative stable sediment size of one inch (median grain size diameter or D_{50}) for the protection layer. These steeper slopes also apply to the proposed SMA-3 embankment cap (see Section 4.3.2).

For suitable armor protection, the thickness of the armor layer needs to be at least double the median grain size (D_{50}), or two inches (Palermo et al. 1998b). However, given constructability considerations (see Section 4.2.4), and to provide an additional factor of safety to ensure protection, the cap armor layer is assumed to have a minimum thickness of six inches.

The gravel armor layer requires an underlying sand filter layer to restrict the movement of finely grained native sediments through the armor. For gravel armor materials with a one- to two-inch D_{50}, the underlying filter layer would need to have a D_{50} of approximately 0.1 inches. The thickness of the filter layer is assumed to be at least six inches to perform the function of chemical isolation (Section 4.2.1) and for constructability (Section 4.2.4).

4.2.3 Consolidation

The cap materials are anticipated to be granular and to undergo elastic settlement within the period of construction, with negligible additional consolidation settlement after construction. Therefore, no additional thickness is included to account for long-term cap consolidation. However, the softer silty sand sediments that underlie the cap would consolidate up to several inches following placement of the cap. Porewater flux associated with this post-construction subgrade consolidation was considered in the chemical isolation thickness design outlined in Section 4.2.2.

4.2.4 Constructability Considerations

Given the inherent difficulties in achieving accurate placement tolerances for in-water construction, an additional thickness (overplacement allowance) is typically specified in capping contracts. Based on anticipated material placement equipment (mechanical clamshell or skip box), along with recent experience at other similar thin layer sand placement and capping projects (e.g., 2015 to 2017 Port Gamble Bay cleanup project), regional capping contractors can accurately place sand and gravel within a thickness tolerance of approximately two to three inches. Thus, an additional three inches of material would likely need to be placed to achieve the required design thickness for each cap layer.

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[3] Refinements to preliminary cap designs and long-term monitoring and maintenance requirements addressing these and other potential forces, such as earthquakes, would be developed during design.

4.2.5 Preliminary Cap Design Specifications

Based on the site-specific cap design analyses summarized above, preliminary SMA-1 to SMA-3 cap design specifications are summarized in Table 4-5. The preliminary cap design consists of placement of six inches of sand (D_{50} = 0.1 inches) as a combined chemical isolation and filter layer and placement of an additional six inches of gravel (D_{50} = one inch) as a combined armor and bioturbation layer. The total minimum design thickness is twelve inches, plus an average overplacement of three inches for each layer. The total placement thickness of the SMA-1 to SMA-3 caps would thus average approximately 18 inches.

Table 4-5
Cap Design Specifications

Cap Layer	Thickness of Armored Cap
Erosion Protection (Armor) and Bioturbation	6 inches (D_{50} = 1 to 2 inches)
Chemical Isolation and Filter Layer	6 inches (D_{50} = 0.1 inches)
Overplacement	Armor Layer: 3 inches Isolation/Filter Layer: 3 inches
Total Placed Thickness (Average)	**18 inches**

If capping is selected as the SMA-1 to SMA-3 interim action, the specifications will be refined as part of remedial design.

4.3 Shelton Harbor Interim Action Alternatives

This section assembles the technologies screened in Section 4.1 into interim action alternatives for Shelton Harbor SMA-1 to SMA-3. As described in Section 3.4, the prospective Shelton Harbor interim action area comprises three SMAs totaling approximately 8.2 acres (Figure 3-1):

- SMA-1: Approximately 4.4 acres in the Shelton Creek delta
- SMA-2: Approximately 0.6 acres in the former marine railway area
- SMA-3: Approximately 3.5 acres in the southwestern harbor

For each of these SMAs, the four retained remedial technologies (dredging, capping, ENR, and MNR) were combined into corresponding interim action alternatives, as described in the following sections.

4.3.1 Alternative 1 – Dredging

Alternative 1 consists of the removal of all contaminated sediment from SMA-1 to SMA-3 (Figure 4-2). Based on available sediment coring data in SMA-1 (Station SH-03), sediments in SMA-1 and SMA-2 that exceed the 42 ng/kg dioxin/furan TEQ RAL likely extend approximately two feet below mudline (Appendix A), while contaminated sediments in much of SMA-3 likely extend approximately 4 to 10 feet below mudline, depending on the location (see Figure 5-4). An additional one-foot overdredge allowance for constructability along with a 20 to 30 percent side slope allowance (depending on the depth of cut) has been assumed for volume and cost estimating purposes (see Table B-2). Removal of the SMA-1 to SMA-3 deposits would result in approximately 81,000 cubic yards (cy) of dredged material. Backfill of the dredge cut with an equivalent volume of sand and/or gravel material would contain anticipated post-removal dredging residuals (Bridges et al. 2010), and would also restore pre-construction grade. Backfill materials would be supplied from a local quarry and likely barged to Shelton Harbor. Additional delineation of required dredge thickness would be performed during remedial design as necessary.

Removal would likely be conducted using a barge-mounted mechanical excavator or equivalent equipment. All dredged material would be placed onto a transport barge and transported to a regional sediment transload facility (e.g., in Tacoma or Seattle) for loading on to rail cars for disposal at a permitted subtitle D landfill (e.g., in eastern Washington).

The Alternative 1 cost is estimated at approximately $29 million, including removal, disposal, backfilling, and construction monitoring, and would likely require approximately three years of in-water construction (Appendix B).

4.3.2 Alternative 2 – Engineered Capping

Alternative 2 consists of engineered capping to isolate contaminated sediments within SMA-1 to SMA-3 (Figure 4-3). Capping involves placing granular material to provide chemical confinement and to physically isolate contaminated material to protect biological receptors (e.g., benthic infauna, forage fish, and crabs). As discussed in Section 4.2.1, placement of an average thickness of 18 inches of sand and gravel materials is needed to withstand erosive forces generated by wind and wave action, physically isolate contaminated material from biological receptors, and contain the flux of CoCs into the bioactive zone. In SMA-3, additional cap thickness (to 3 feet) would be placed to create a stable embankment slope. Approximately 23,000 cy of capping material would be required in SMA-1 to SMA-3. Using materials supplied from local upland quarries, cap material could be placed either using barge-mounted mechanical placement equipment (i.e., mechanical clamshell or skip box), or with land-based equipment (i.e., amphibious excavators, dozers, and/or conveyor equipment).

The Alternative 2 cost is estimated at approximately $1.9 million, including placement and performance monitoring of an engineered cap in SMA-1 to SMA-3, along with long-term monitoring and maintenance, and would likely require approximately three months of in-water construction (Appendix B).

4.3.3 Alternative 3 – Enhanced Natural Recovery

Alternative 3 consists of placement of an ENR layer over SMA-1 to SMA-3 (Figure 4-4). ENR involves the placement of approximately four inches (10 cm) of suitable sand or sediment to accelerate the natural recovery process and reduce surface concentrations to below the RALs. ENR is often applied in areas where natural recovery may be an appropriate remedy, yet the rate of sedimentation or other natural processes is insufficient to reduce potentially unacceptable risks within an acceptable time frame. ENR includes the implementation of active remediation measures or further monitoring and analysis if cleanup levels are not achieved in a reasonable restoration time frame. ENR layers are designed to potentially mix with underlying sediment, thereby diluting sediment CoC concentrations. ENR layers are not designed to be completely isolating, in contrast to an engineered cap.

Radioisotope dating performed in the Shelton Harbor SCU reveals that the average sedimentation rate in the SCU is approximately 0.3 ± 0.06 cm/year, providing a relatively slow natural recovery (i.e., a half time in surface sediments of approximately 10 to 30 years (see Section 2.3). To achieve cleanup standards within a reasonable time frame in SMA-1 to SMA-3, some placement is likely necessary. The ENR alternative would place a minimum of four inches of sand material, described above in Section 4.2.2, sourced from a local quarry. Considering overplacement allowances, the average placed thickness would be approximately six inches. Thus, the total volume of ENR material placed in SMA-1 to SMA-3 would be approximately 6,000 cy, likely placed in the same fashion as described for Alternative 2.

The Alternative 3 cost is estimated at approximately $1.1 million, including mechanical placement and long-term verification monitoring of the ENR layer, and would likely require approximately one month of in-water construction (Appendix B).

4.3.4 Alternative 4 – Monitored Natural Recovery

Alternative 4 consists of MNR within SMA-1 to SMA-3. As discussed in Section 4.1, MNR relies on the natural deposition of sediments to reduce contaminant concentrations to meet cleanup levels in the biologically active zone. Because of the relatively low sedimentation rates in north Shelton Harbor, the dioxin/furan TEQ RAL in these three SMAs would likely not be achieved for at least 50 years. Long-term monitoring costs are estimated at approximately $1.4 million (Appendix B).

4.4 Detailed Analysis of Alternatives

The SMS evaluation criteria are specified in WAC 173-204-570, which evaluates the cleanup action alternatives under the SMS and provides the basis for selecting a preferred alternative. The following sections summarize minimum MTCA/SMS requirements, present the MTCA disproportionate cost analysis (DCA), and from the DCA identify the preferred sediment remediation alternative for north Shelton Harbor.

4.4.1 Minimum Requirements

Cleanup actions performed under SMS must comply with eleven minimum requirements under WAC 173-204-570(3). This section discusses MTCA/SMS minimum requirements for alternatives.

4.4.1.1 Compliance with Cleanup Standards

Under SMS, compliance with cleanup standards represents the measure of whether and when an alternative has reduced risk sufficiently to protect human health and the environment. Site-specific sediment cleanup levels summarized in Section 3.2 were developed to protect human health, the health of the benthic community, and ecological (higher trophic level species) health under WAC 173-204-560 through 564. Therefore, compliance with cleanup standards is used to evaluate the minimum requirements of "protection of human health and the environment" (WAC 173-204-570(3)(a)), "compliance with cleanup standards" (WAC 173-204-570(3)(c)), and to "provide for a reasonable restoration time frame" (WAC 173-204-570(3)(e)).

Alternatives 1 through 3 are expected to meet cleanup levels in the northern harbor immediately following construction. Consistent with WAC 173-204-570(5)(a), these alternatives are considered to have a reasonable restoration time frame and meet these three minimum requirements. Due to elevated starting concentrations and the rate of natural recovery, Alternative 4 would have an extended restoration time frame and therefore does not meet these minimum requirements.

As discussed in Section 3.5, the scope of the SMA-3 interim action will be refined during remedial design. Follow-on remedial actions as may be necessary in other areas of the Shelton Harbor SCU will be addressed in the forthcoming SCU-wide CAP (targeted for 2019).

4.4.1.2 Other Minimum Requirements

The achievement of other minimum requirements is summarized as follows:

- All alternatives comply with all applicable laws as summarized in Section 3.7 (WAC 173-204-570(3)(b)).
- Source control measures are not necessary for any of the interim action cleanup alternatives (WAC 173-204-570(3)(f)) because the historical sources of site-related contamination no longer exist.
- A sediment recovery zone is not expected to be necessary for Alternatives 1 through 3 because cleanup standards would be achieved within ten years following construction (WAC 173-204-570(3)(g)). Alternative 4 would require a sediment recovery zone.
- Alternatives 1 through 3 do not exclusively rely on MNR or institutional controls (WAC 173-204-570(3)(h)). Alternative 4 does not meet this minimum requirement, and therefore was eliminated from further consideration in the DCA.
- This IAP will undergo appropriate public review and comment by affected landowners and the general public (WAC 173-204-570(3)(i)).

- All alternatives include adequate monitoring to ensure effectiveness of the cleanup action (WAC 173-204-570(3)(j)).
- All alternatives leave some contamination in place, which will be subject to periodic reviews under WAC 173-204-570(3)(k).

The DCA summarized in the next section addresses the minimum requirement of "using permanent solutions to the maximum extent practicable" (WAC 173-204-570(3)(d)).

4.4.2 Disproportionate Cost Analysis

MTCA and SMS specify that preference shall be given to cleanup actions that are permanent solutions to the maximum extent practicable. Identifying an alternative that is permanent to the maximum extent practicable requires weighing costs and benefits. SMS uses the MTCA DCA (WAC 173-340-360(3)(e)) as the tool for comparing each remedial alternative's incremental environmental benefits with its incremental costs. The DCA is the primary method by which the alternatives are systematically compared to each other in this IAP. Under MTCA, costs are considered disproportionate to benefits when the incremental costs of an alternative exceed the incremental benefits compared to other, lower cost, protective alternatives. Alternative 4 is not included in the DCA because it did not satisfy SMS minimum requirements for protectiveness.

Seven MTCA criteria, which are listed in WAC 173-340-360(3)(f), are used to evaluate and compare remedial alternatives when conducting the DCA. Under SMS, each criterion is not equal in the DCA evaluation and, therefore, is assigned a relative weight for the DCA. Consistent with recent DCA and equivalent evaluations performed by Ecology at similar Puget Sound sediment cleanup sites (e.g., Bellingham Bay, Fidalgo Bay, and Lower Duwamish Waterway), the first six evaluation criteria are weighted and assigned a score for total benefits; those total benefits are then summed and compared with costs of the alternatives, using the following weighting:

- Protectiveness (30% of total benefit score)
- Permanence (20% of total benefit score)
- Effectiveness over the long term (20% of total benefit score)
- Management of short-term risks (10% of total benefit score)
- Technical and administrative implementability (10% of total benefit score)
- Consideration of public concerns (10% of total benefit score)
- Cost (compared to total benefits as above)

The following sections describe the methodology and rationale for evaluating the remedial alternatives under each criterion. Total benefit scores and costs are shown in Table 4-6 and plotted in Figure 4-5. For scoring purposes, criteria were ranked numerically from 1 to 5, with 1 representing the lowest score or benefit and 5 representing the highest score or benefit.

Table 4-6
Disproportionate Cost Analysis

					Alternative 1	Alternative 2	Alternative 3
Criterion			Site-Specific Considerations		Removal	Engineered Capping	ENR
Protectiveness	30%	Overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, on-site and offsite risks resulting from implementing the alternative, and improvement of the overall environmental quality	Protection of human health (regional background for dioxins/furans) and protection of the benthic community		As discussed in Section 4.4.1.1, Alternatives 1 through 3 are expected to meet cleanup levels in the northern harbor immediately following construction. The scope of the SMA-3 interim action will be refined during remedial design. Follow-on remedial actions as may be necessary in other areas of the Shelton Harbor SCU will be addressed in the forthcoming SCU-wide CAP (targeted for 2019). Alternative 3 is the least protective because the ENR layer may be subject to erosion		
			Total	**Score**	**5.0**	**5.0**	**3.0**
Permanence	20%	The degree to which the alternative permanently reduces the toxicity, mobility or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated	Certainty and reliability the alternative will not result in future releases to the biologically active zone		Dredging removes most contaminated sediment, but some resuspension and residuals may occur during construction	Engineered caps permanently isolate contaminated sediment; monitoring verifies protectiveness in the long term	ENR sand placement has been demonstrated to be protective at other Puget Sound sites; however, contaminated sediment is not completely isolated from the biologically active zone; contaminated sediment could be exposed by wind/wave forces
			Total	**Score**	**5.0**	**4.0**	**2.0**
Effectiveness over the Long Term	20%	When assessing the relative degree of long-term effectiveness of cleanup action components, the following types of components may be used as a guide, in descending order: (i) Source controls in combination with other cleanup technologies (ii) Beneficial reuse of the sediments (iii) Treatment to immobilize, destroy, or detoxify contaminants (iv) Dredging and disposal in an upland engineered facility that minimizes subsequent releases and exposures to contaminants (v) Dredging and disposal in a nearshore, in-water, confined aquatic disposal facility (vi) Containment of contaminated sediments in-place with an engineered cap (vii) Dredging and disposal at an open water disposal site approved by applicable state and federal agencies (viii) Enhanced natural recovery (ix) Monitored natural recovery (x) Institutional controls and monitoring	Remedial technologies used		Dredging with Backfill	Engineered Capping	ENR
			Total	**Score**	**5.0**	**3.0**	**1.0**

Criterion			**Site-Specific Considerations**		**Alternative 1**	**Alternative 2**	**Alternative 3**
					Removal	**Engineered Capping**	**ENR**
Management of Short-term Risks	10%	The risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks	Risk to human health and safety and risks to environment during construction (proportional to construction time)	Construction time (days)	370	58	15
				Score	1	4	5
			Site risks during restoration time	Time to achieve cleanup standards	As discussed in Section 4.4.1.1, Alternatives 1 through 3 are expected to meet cleanup levels in the northern harbor immediately following construction. The scope of the SMA-3 interim action will be refined during remedial design. Follow-on remedial actions as may be necessary in other areas of the Shelton Harbor SCU will be addressed in the forthcoming SCU-wide CAP (targeted for 2019).		
				Score	5	5	5
			Total (average)	**Score**	**3.0**	**4.5**	**5.0**
Technical and Administrative Implementability	10%	Technical and administrative implementability. Ability to be implemented including consideration of whether the alternative is technically possible, availability of necessary offsite facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other current or potential remedial actions	Technical feasibility to implement	Performance	All work is technically feasible; there are challenges related to the mobilization of marine-based equipment and logistics related to transloading and disposal of contaminated sediment	All work is technically feasible; there are challenges related to the mobilization of marine-based equipment and logistics related to transloading	All work is technically feasible; there are challenges related to the mobilization of marine-based equipment and logistics related to transloading
				Score	2	4	4
			Administrative implementability	Performance	All work is administratively implementable; there are challenges related to permitting in-water work, performing work within the established "fish-window," and additional permitting or contaminated sediment transloading operations	All work is administratively implementable; there are challenges related to permitting in-water work and performing work within the established "fish-window"	All work is administratively implementable; there are challenges related to permitting in-water work, performing work within the established "fish-window"
				Score	3	4	4
			Total (average)	**Score**	**2.5**	**4.0**	**4.0**
Consideration of Public Concerns	10%	Whether the community has concerns regarding the alternative and, if so, the extent to which the alternative addresses those concerns. This process includes concerns from individuals, community groups, local governments, tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the site	Consistency with land use, protection of users, habitat restoration, certainty of technology to permanently improve the environment	Performance	Public likely to support removal of contaminated sediment from the harbor	Public likely to support engineered permanent isolation of contaminated sediment, but slightly less than removal	Public may question the effectiveness of thin-layer placement and the certainty that contaminants are isolated in the long term
			Total	**Score**	**5**	**3**	**2**
Total Weighted Benefits					**4.6**	**4.1**	**2.6**
Cost					**$29,000,000**	**$1,900,000**	**$1,100,000**

4.4.2.1 Protectiveness

WAC 173-340-360(3)(f)(i) defines protectiveness as follows:

> *Overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality*

Consistent with DCAs used by Ecology at other Puget Sound sediment cleanup sites, the protectiveness of each remedial alternative was scored based on the anticipated human health and ecological risk reductions during and following remedial actions (i.e., compared to the regional background and SCO benthic criteria). All alternatives achieve regional background dioxin/furan TEQ concentrations and achieve protection of the benthic community (benthic SCO) within SMA-1 to SMA-3, but Alternative 3 is the least protective as the ENR layer may be subject to erosion.

As shown in Table 4-6, Alternatives 1 and 2 protect human health and the environment by rapidly reducing concentrations to protective levels; each of these alternatives score 5 out of 5 for this criterion. Alternative 3 scores 3 out of 5 for this criterion.

4.4.2.2 Permanence

WAC (173-340-360)(3)(f)(ii) defines permanence as follows:

> *The degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated*

Permanence is scored based on the certainty and reliability that an alternative will not result in future releases to the biologically active zone. Alternative 1 is designed to provide permanence as it would remove all contaminated material to the extent practicable, and includes backfill to contain anticipated dredging residuals. While some CoCs may not be removed and some resuspension may occur during dredging (Bridges et al. 2010), Alternative 1 scores 5 of 5. Alternative 2 scored slightly lower (4 of 5) because CoCs would be contained in place; caps designed following EPA and Corps guidance have been demonstrated to be permanent (EPA 2005). Alternative 3 scored the lowest (2 of 5) based on the possible disturbance of placed ENR material and because the ENR layer is not designed to provide permanent isolation.

4.4.2.3 Effectiveness over the Long Term

As part of the long-term effectiveness evaluation, SMS provides a preferential hierarchy of remedial technologies, which replaces a similar upland-oriented list in MTCA, as follows:

> *When assessing the relative degree of long-term effectiveness of cleanup action components, the following types of components may be used as a guide, in descending order, in place of the components listed in WAC 173-340-360 (3)(f)(iv):*
>
> *(i) Source controls in combination with other cleanup technologies*
>
> *(ii) Beneficial reuse of the sediments*
>
> *(iii) Treatment to immobilize, destroy, or detoxify contaminants*
>
> *(iv) Dredging and disposal in an upland engineered facility that minimizes subsequent releases and exposures to contaminants*
>
> *(v) Dredging and disposal in a nearshore, in-water, confined aquatic disposal facility*
>
> *(vi) Containment of contaminated sediments in-place with an engineered cap*
>
> *(vii) Dredging and disposal at an open water disposal site approved by applicable state and federal agencies*
>
> *(viii) Enhanced natural recovery*
>
> *(ix) Monitored natural recovery*
>
> *(x) Institutional controls and monitoring (WAC 173-204-570(4)(b))*

All alternatives provide institutional controls and monitoring as necessary to maintain effectiveness in the long term. For this criterion, the alternatives were ranked in the order consistent with the MTCA/SMS regulations: Alternatives 1, 2, and 3 scored 5, 3, and 1, respectively.

4.4.2.4 Management of Short-term Risk

Management of short-term risk considers impacts during construction, and the risks remaining on site during the restoration time frame. WAC 173-340-360(3)(f)(v) defines management of short-term risk as follows:

> *The risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks*

As summarized in Table 4-6, the remedial alternatives were evaluated based on short-term risks during construction, also considering risks associated with sediment concentrations exceeding the RAL until cleanup levels are achieved.

During remedial construction, multiple short-term risks are present: risks to human health from worker safety, impacts to the benthic community during placement and removal activities, and impacts to the water column during removal activities. The magnitude of impacts on human health and the environment during construction are generally proportional to the construction time frame for each alternative. The construction time frames range from approximately 380 days for Alternative 1 to 16 days for Alternative 3, and score 1, 4, and 5 for Alternatives 1 through 3 respectively.

The restoration time frame provides a general measure for the risks due to remaining contaminated sediment on site. Because Alternatives 1 through 3 all achieve cleanup levels within 10 years following construction, they all score a 5 for this criterion.

4.4.2.5 Technical and Administrative Implementability

WAC 173-340-360(3)(f)(vi) defines technical and administrative implementability as follows:

> *Ability to be implemented including consideration of whether the alternative is technically possible, availability of necessary off-site facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other current or potential remedial actions*

As summarized on Table 4-6, both technical and administrative implementability are scored based on a narrative evaluation of the technical and administrative challenges of each alternative.

For technical implementability, all alternatives require the mobilization of marine construction equipment and the development or use of transload facilities for moving material to and from land. Alternative 1 scores the lowest because of the need to coordinate removal and disposal of contaminated material, given that the closest available transload facilities for contaminated sediments are in Tacoma and Seattle. Alternative 2 scores higher because of the need to only furnish and place clean capping material; local sand/gravel quarries and transload facilities are available in the Shelton area. The highest score was given to Alternatives 2 and 3 because they only require furnishing and placement of clean material. For this criterion, Alternatives 1, 2, and 3 scored 2, 4, and 4, respectively.

For administrative implementability, all alternatives require permitting for performing in-water construction activities. Alternative 1 scored the lowest (3) due to the complexity involved in permitting both removal and contaminated sediment transloading. Alternatives 2 and 3 both scored higher than Alternative 1 (4), because they both require permitting of marine filling activities, but do not involve the transport of contaminated sediment. In addition, they are both compatible with the Shelton Harbor habitat restoration project, which includes filling within the SMA-1 area.

4.4.2.6 Consideration of Public Concerns

WAC 173-340-360(3)(f)(vii) defines consideration of public concerns as follows:

> *Whether the community has concerns regarding the alternative and, if so, the extent to which the alternative addresses those concerns. This process includes concerns from individuals, community groups, local governments, tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the site*

Generally, public concerns may regard the certainty that the cleanup protects human health and the environment in the most permanent manner practicable. Alternative 1 scores highest (5 out of 5) because dredging has been previously demonstrated effective and permanent over a wide range of conditions. Alternative 2 scores 3 out of 5 because, although capping has been previously demonstrated to permanently isolate material, the public often equates removal as a more protective option. Alternative 3 scores lower (2 out of 5) because of potential public concerns that ENR may not fully isolate the contaminated material from the bioactive zone and disturbance could result in the release of contaminated material.

4.4.2.7 Total Benefits and Costs

Total benefit scores and costs are shown in Table 4-6 and plotted in Figure 4-5. For SMA-1 to SMA-3, the total weighted benefits range from 2.6 for Alternative 3, to 4.1 for Alternative 2, to 4.6 for Alternative 1. Estimated costs increase from $1.1 million for Alternative 3, to $1.9 million for Alternative 2, to $29 million for Alternative 1 (detailed cost estimates are provided in Appendix B). As summarized in Figure 4-5, while total weighted benefits increase proportionately to costs between Alternatives 3 and 2, the cost of Alternative 1 is disproportionately costly compared to Alternative 2 relative to the incremental benefits provided.

4.5 Recommended Interim Action Remedy

Based on the analysis described in Section 4, Alternative 2, Engineered Capping, provides the most benefits that are not disproportionately costly. Thus, Alternative 2 is the recommended sediment interim action remedy for the Shelton Harbor SCU. Under this recommended alternative, contaminated sediments within SMA-1 to SMA-3 will be capped with a chemical isolation/filter layer (D_{50} = 0.1 inches) overlain by an erosion protection/bioturbation layer (D_{50} = 1 to 2 inches). Subject to final design refinements, the total cap thickness including overplacement allowances would be approximately 18 inches. In SMA-3, additional cap materials (approximately 3-foot-thick) would be placed to create a stable embankment slope. Material specifications will be refined during design in coordination with permitting agency and stakeholder reviews to optimize habitat functions.

Approximately 23,000 cy of capping material would be required in SMA-1 to SMA-3. Using materials supplied from local upland quarries, cap material could be placed either using barge-mounted mechanical placement equipment (i.e., mechanical clamshell or skip box), or with land-based equipment (i.e., amphibious excavators, dozers, and/or conveyor equipment).

Consistent with Chapter 70.105D Revised Code of Washington, as implemented by Chapter 173-340 WAC (MTCA Cleanup Regulation), the recommended interim sediment cleanup action is protective of human health and the environment, will attain federal and state requirements that are applicable or relevant and appropriate, complies with cleanup standards, and provides for compliance monitoring. The recommended interim action also satisfies the preference expressed in WAC 173-340-360 for the use of permanent solutions to the maximum extent practicable and provides for a reasonable restoration time frame.

The recommended interim sediment cleanup action was identified consistent with MTCA and SMS alternatives evaluation and remedy selection criteria. Those criteria include the following:

- **Compliance with SMS Minimum Requirements:** The recommended interim action complies with the minimum requirements, which include protecting human health and the environment and complying with the cleanup standards in a reasonable restoration time frame (cleanup standards will be met within 10 years following completion of remedial construction).
- **Use of Permanent Solutions to the Maximum Extent Practicable:** As described in Section 4.4.2 and summarized in Figure 4-1, the recommended interim action uses permanent solutions to the maximum extent practicable and has costs commensurate with the benefits based on the findings of the DCA. The recommended alternative will achieve significant human health and environmental benefits at a cost (approximately $1.9 million) that is not disproportionate. Lower-cost alternatives provide less environmental benefit compared with the recommended alternative, and higher-cost alternatives include minimal additional benefits.

Consistent with WAC 173-340-430, the recommended interim sediment cleanup action remedy will achieve cleanup standards for portions of the Shelton Harbor SCU, and is intended to be consistent with the final cleanup action to be developed in a forthcoming SCU-wide CAP, currently targeted to be prepared in 2019. The recommended interim action will restore surface sediments in the biologically active zone to achieve cleanup standards. The recommended remedy is expected to sequester contaminants below the placed sand and gravel layers.

5 Interim Action Implementation Plans

Implementation of interim actions in the Shelton Harbor SCU will begin with the development of a Remedial Design Work Plan (RD Work Plan) to be approved by Ecology under the existing Agreed Order. Among other elements, the RD Work Plan will describe any remaining data collection efforts necessary to complete engineering design of the interim action. For example, surface sediments in SMA-1 to SMA-3 would be sampled in early 2018 to refine the current extent of exceedance of the Table 3-1 RALs to inform final remedial designs (note that some of the dioxin/furan TEQ and copper data used to develop preliminary SMA delineations are ten or more years old; updated data are needed to refine the extent of the interim action areas). The RD Work Plan would also describe planned cap design refinements (e.g., to ensure stability during earthquakes) and development of detailed plans and specifications for remedial construction.

As summarized in Section 3.8.5.2, subject to Corps review, the cleanup action may qualify for permitting under NWP 38. The RD Work Plan will describe coordination and sequencing of the interim action with the Oakland Bay Habitat Restoration project (Anchor QEA 2017a). For example, to ensure protectiveness, construction of cleanup actions (i.e., engineered caps) will precede habitat restoration actions. The relationship of SMA-1 and SMA-2 cleanup caps with follow-on habitat restoration actions in these areas is depicted in Figures 5-1 and 5-2, respectively.

Subject to permitting schedules, construction of the SMA-1 to SMA-3 caps is currently targeted for summer/fall 2018. Rerouting of the Shelton Creek delta and construction of the lagoon and western salt marsh lobe adjacent to Sierra Pacific Industries is also currently targeted for summer/fall 2018. Construction of the remainder of the Oakland Bay Habitat Restoration project depicted in Figure 2-1 is targeted for 2020 or later, subject to funding.

As discussed above, separate from the Oakland Bay Habitat Restoration project, additional cap materials would be placed in SMA-3 to create a stable intertidal embankment slope and adjacent subtidal cap. A preliminary plan and section of the SMA-3 interim action is depicted in Figures 5-3 and 5-4, respectively. These preliminary designs would be refined in early 2018 based on more detailed engineering design and permitting requirements,

6 Interim Action Compliance Monitoring

Compliance monitoring and contingency responses (as needed) will be implemented in accordance with WAC 173-340-410, Compliance Monitoring Requirements. The RD Work Plan would describe development of a detailed Construction Quality Assurance Project Plan (CQAP) and Operations, Maintenance, and Monitoring Plan (OMMP). The objective of these plans is to confirm that cleanup standards have been achieved, and also to confirm the long-term effectiveness of interim cleanup and source control actions in the Shelton Harbor SCU. The plans will contain discussions on duration and frequency of monitoring, the trigger for contingency response actions, and the rationale for terminating monitoring. The three types of compliance monitoring to be conducted include the following:

- **Protection Monitoring:** To confirm that human health and the environment are adequately protected during the construction period of the interim action
- **Performance Monitoring:** To confirm that the interim action has attained site-specific cleanup standards and other performance standards
- **Confirmation Monitoring:** To confirm the long-term effectiveness of the cleanup and source control actions once performance standards have been attained

Cleanup levels and associated points of compliance for the cleanup action are described above in Section 3.

6.1 Monitoring Objectives and Rationale

Monitoring would be performed to determine whether cleanup standards have been achieved during and after the interim cleanup action. Three broad categories of compliance monitoring would be performed as follows:

- **Water Quality (Protection and Confirmation Monitoring)**: During the interim action, construction controls and protection monitoring would be implemented as practicable to ensure surface water quality protection within Shelton Harbor. Detailed monitoring and contingency response requirements will be described in the CQAP and OMMP to be prepared as a part of remedial design as approved by Ecology.
- **Physical Limits and Integrity (Performance and Confirmation Monitoring)**: Bathymetric performance monitoring would be conducted during the interim action to guide the limits of construction activities. Following completion of construction, physical confirmation monitoring of sediment cap surfaces would be performed to verify that caps are not substantially eroded over time by natural and/or anthropogenic forces. During these confirmation monitoring events, sediment cap thickness would be assessed and compared with the minimum required thickness determined during remedial design to ensure integrity of the caps to protect human health and the environment (Palermo et al. 1998a, 1998b).

Again, detailed monitoring and contingency response requirements would be described in the CQAP and OMMP to be prepared as a part of remedial design.

- **Sediment Quality (Performance and Confirmation Monitoring)**: Following completion of construction, performance monitoring of surface sediments on the surface of the SMA-1 to SMA-3 caps would be conducted. Chemical monitoring would be performed to verify that these areas achieve and maintain site-specific RALs (Table 3-1). Post-construction monitoring may include sampling and analysis of the 0 to 2 cm and 2 to 10 cm sediment intervals to help differentiate potential ongoing sources from underlying cap performance. Again, detailed monitoring and contingency response requirements would be described in the OMMP to be prepared as a part of remedial design.

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Figures

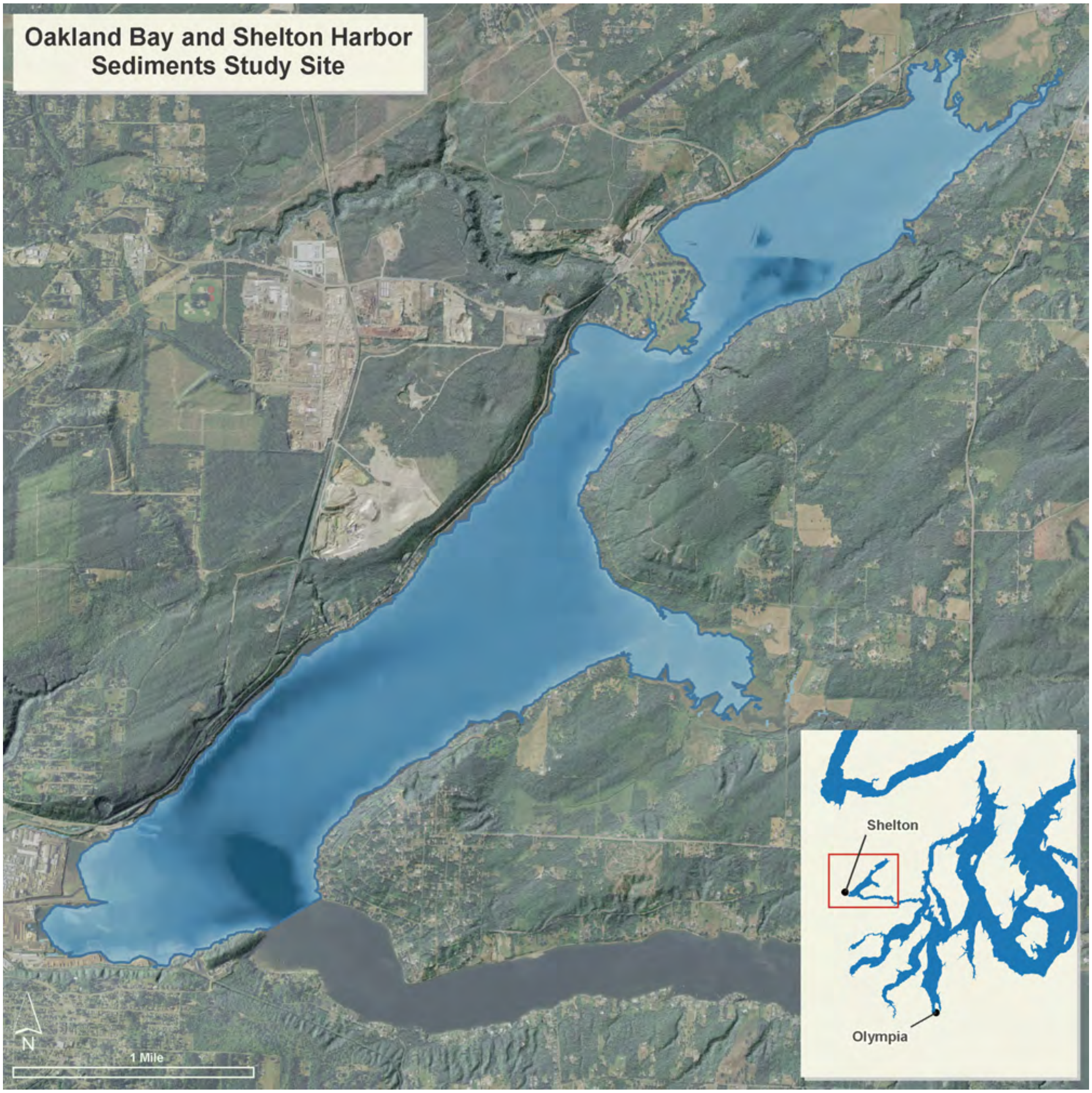

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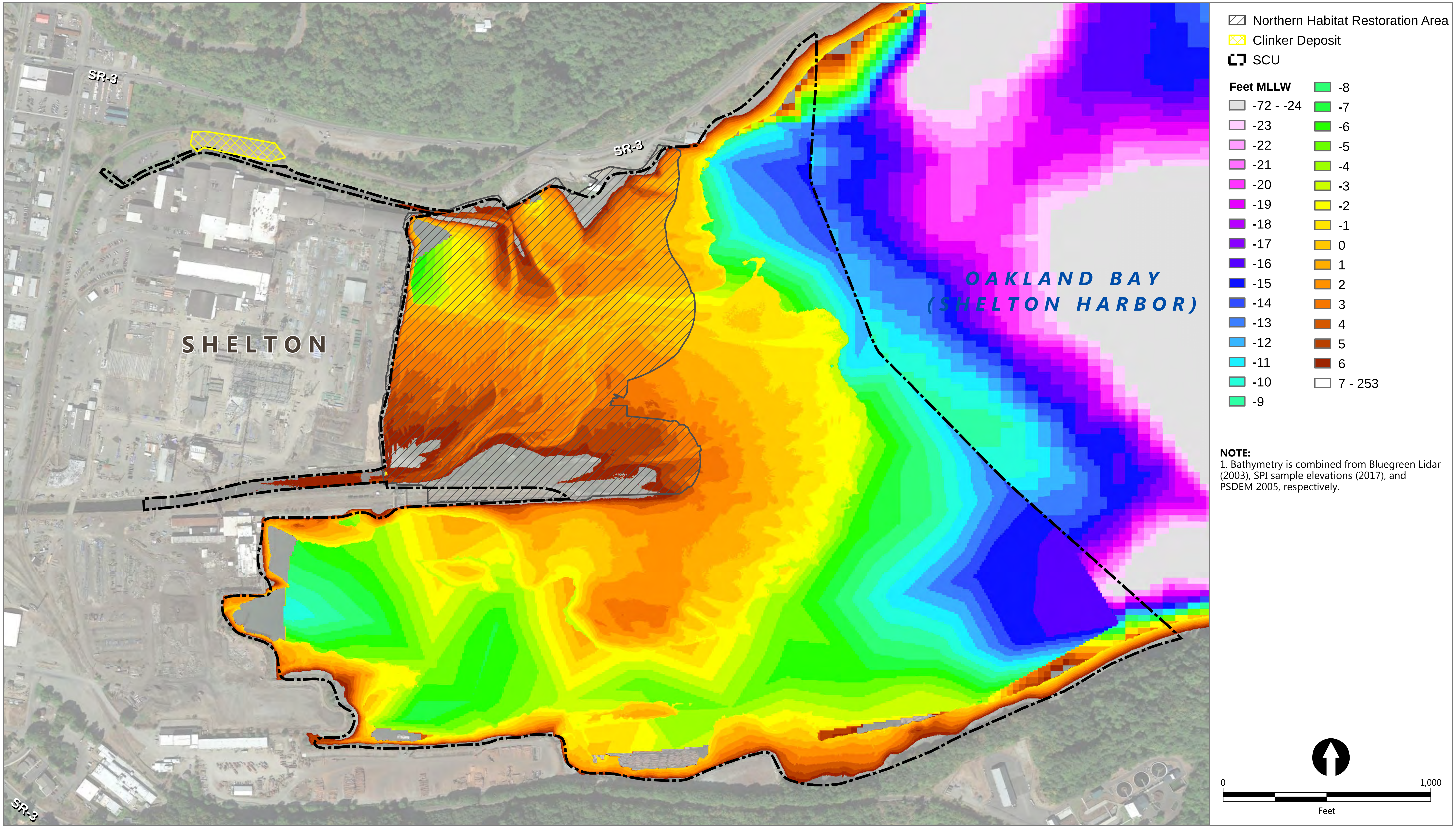
Figure 1-1

Oakland Bay and Shelton Harbor Sediments Cleanup Site

Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site



NOTE:
1. Bathymetry is combined from Bluegreen Lidar (2003), SPI sample elevations (2017), and PSDEM 2005, respectively.

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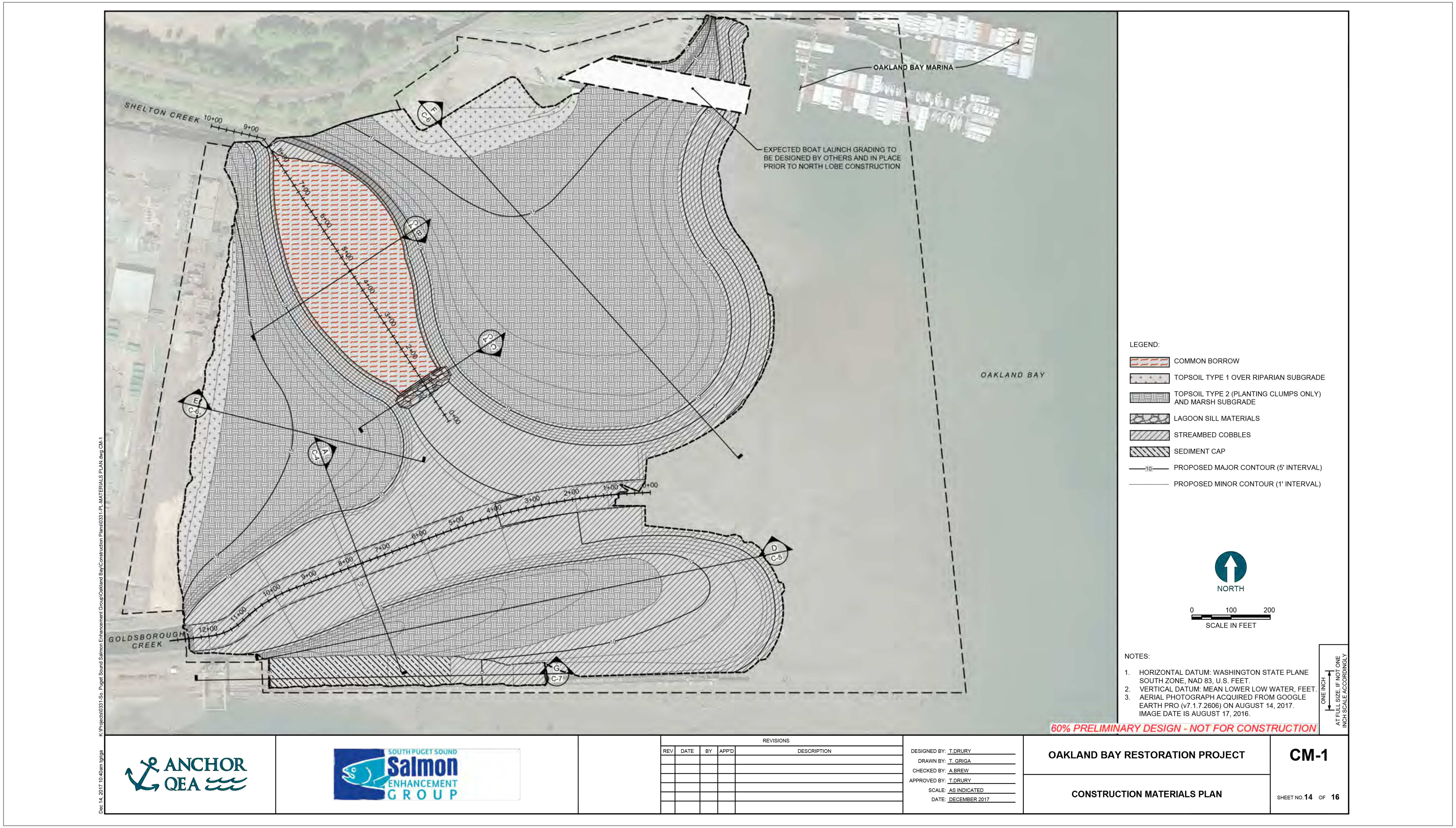
Figure 1-2
Shelton Harbor Sediment Cleanup Unit and Bathymetry
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site



LEGEND:

▨	COMMON BORROW
▨	TOPSOIL TYPE 1 OVER RIPARIAN SUBGRADE
▨	TOPSOIL TYPE 2 (PLANTING CLUMPS ONLY) AND MARSH SUBGRADE
▨	LAGOON SILL MATERIALS
▨	STREAMBED COBBLES
▨	SEDIMENT CAP
—10—	PROPOSED MAJOR CONTOUR (5' INTERVAL)
——	PROPOSED MINOR CONTOUR (1' INTERVAL)

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NAD 83, U.S. FEET.
2. VERTICAL DATUM: MEAN LOWER LOW WATER, FEET.
3. AERIAL PHOTOGRAPH ACQUIRED FROM GOOGLE EARTH PRO (v7.1.7.2606) ON AUGUST 14, 2017. IMAGE DATE IS AUGUST 17, 2016.

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: T.DRURY
DRAWN BY: T. GRIGA
CHECKED BY: A.BREW
APPROVED BY: T.DRURY
SCALE: AS INDICATED
DATE: DECEMBER 2017

OAKLAND BAY RESTORATION PROJECT

CONSTRUCTION MATERIALS PLAN

CM-1

SHEET NO. 14 OF 16

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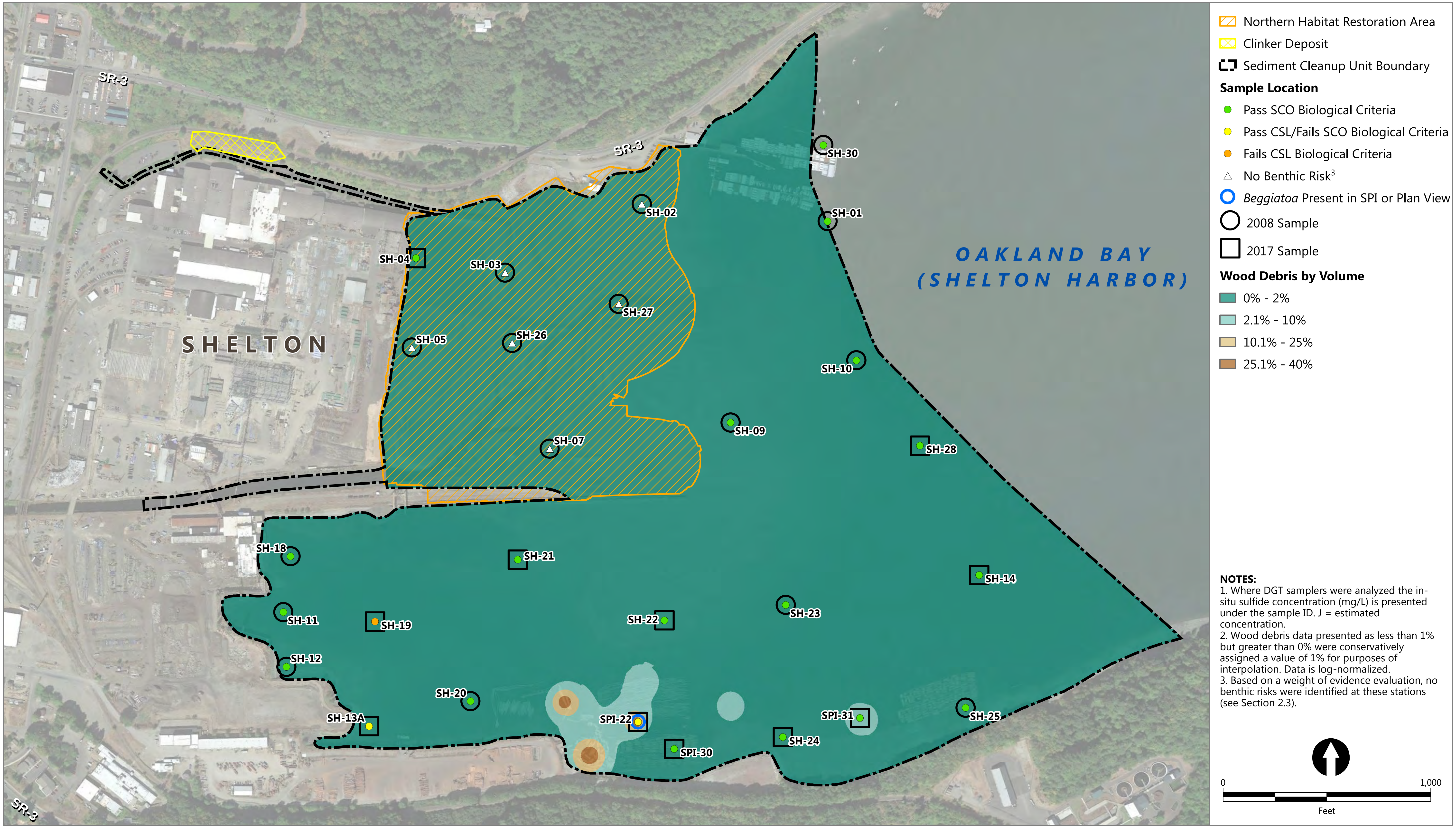
Figure 2-1
North Shelton Harbor Habitat Restoration Project
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site



NOTES:
1. Where DGT samplers were analyzed the in-situ sulfide concentration (mg/L) is presented under the sample ID. J = estimated concentration.
2. Wood debris data presented as less than 1% but greater than 0% were conservatively assigned a value of 1% for purposes of interpolation. Data is log-normalized.
3. Based on a weight of evidence evaluation, no benthic risks were identified at these stations (see Section 2.3).

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Figure 2-2
Shelton Harbor Surface Sediment Toxicity
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site

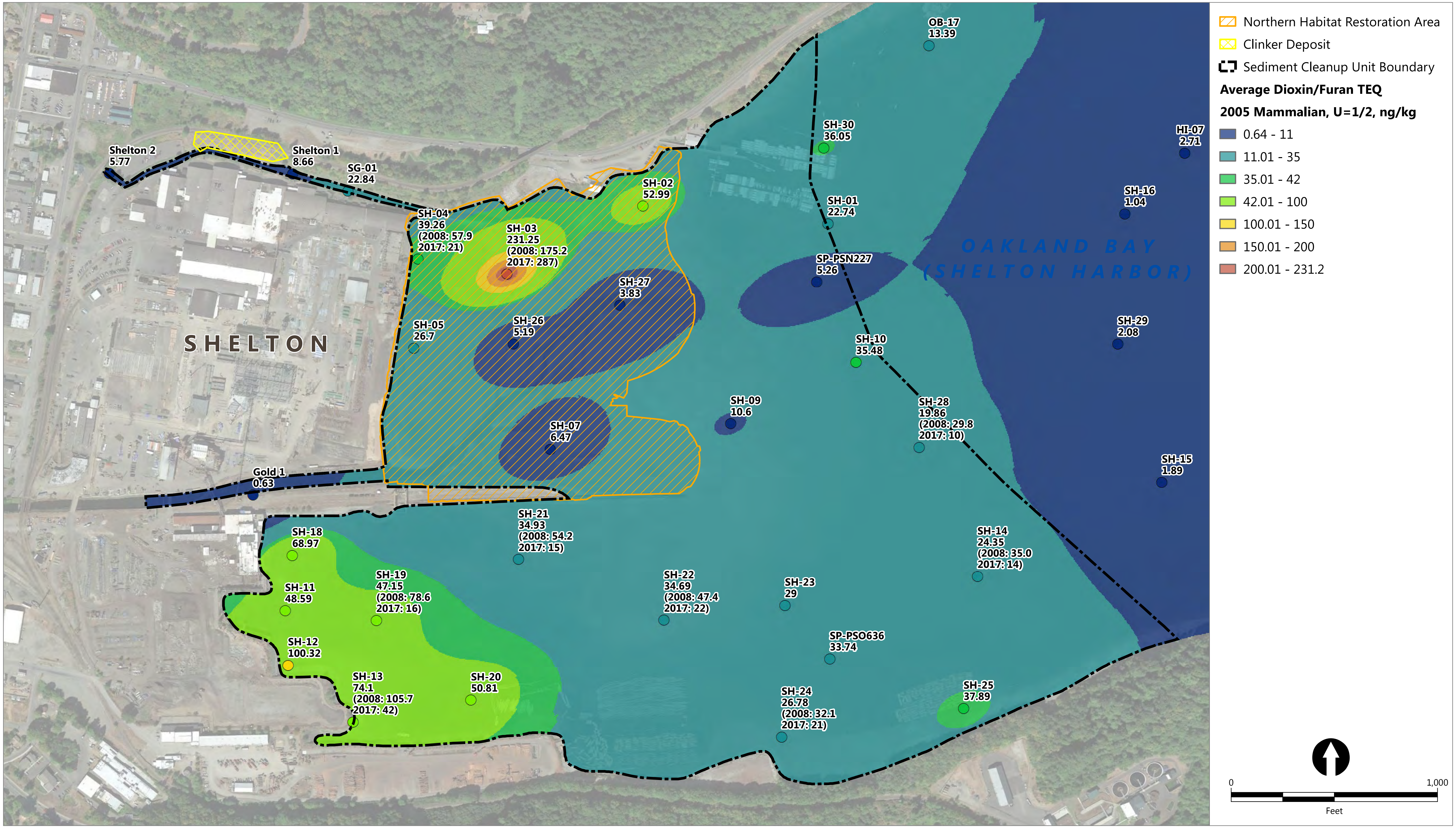

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Figure 2-3
Shelton Harbor Surface Sediment Dioxin/Furan TEQ
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site

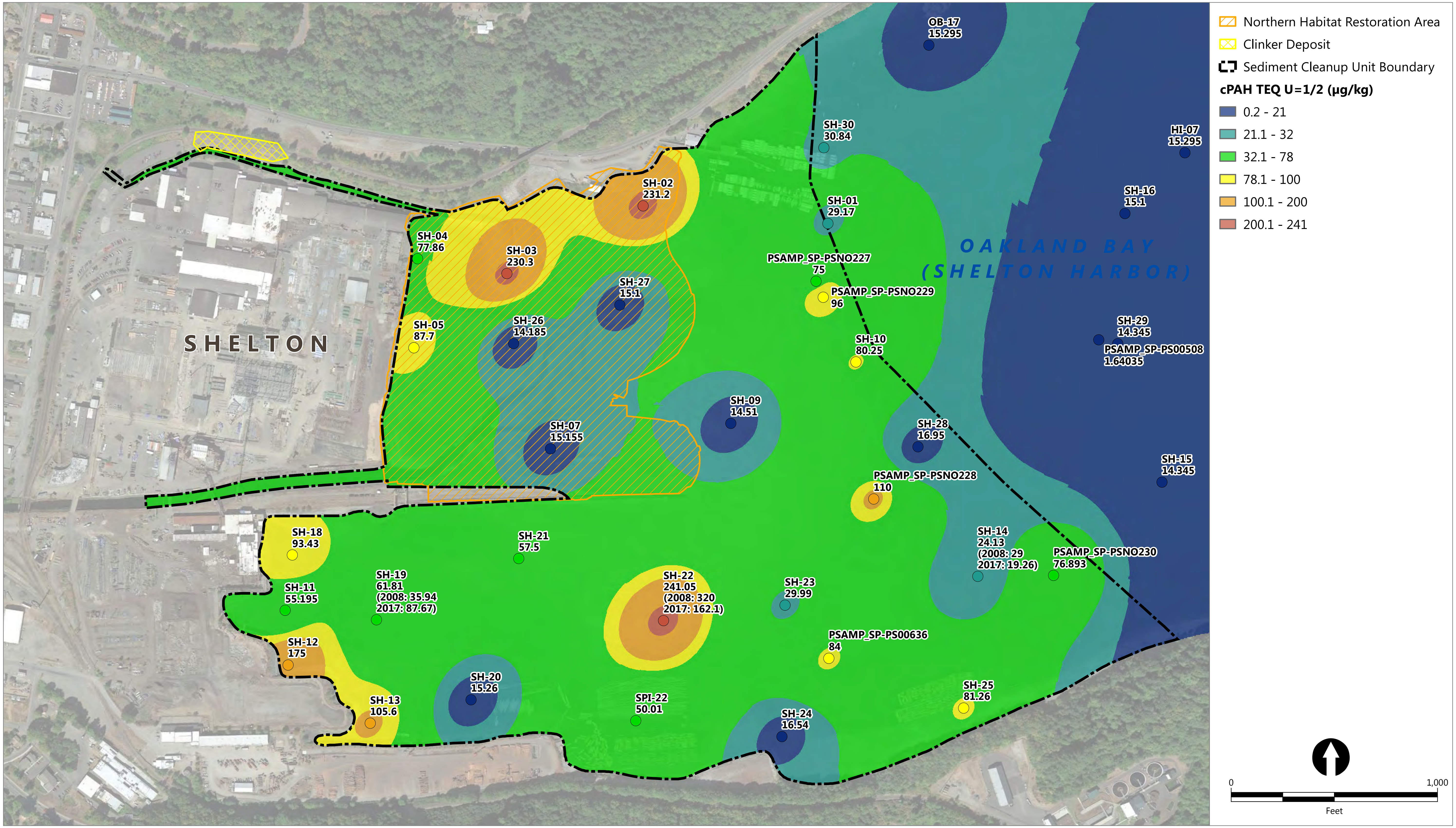

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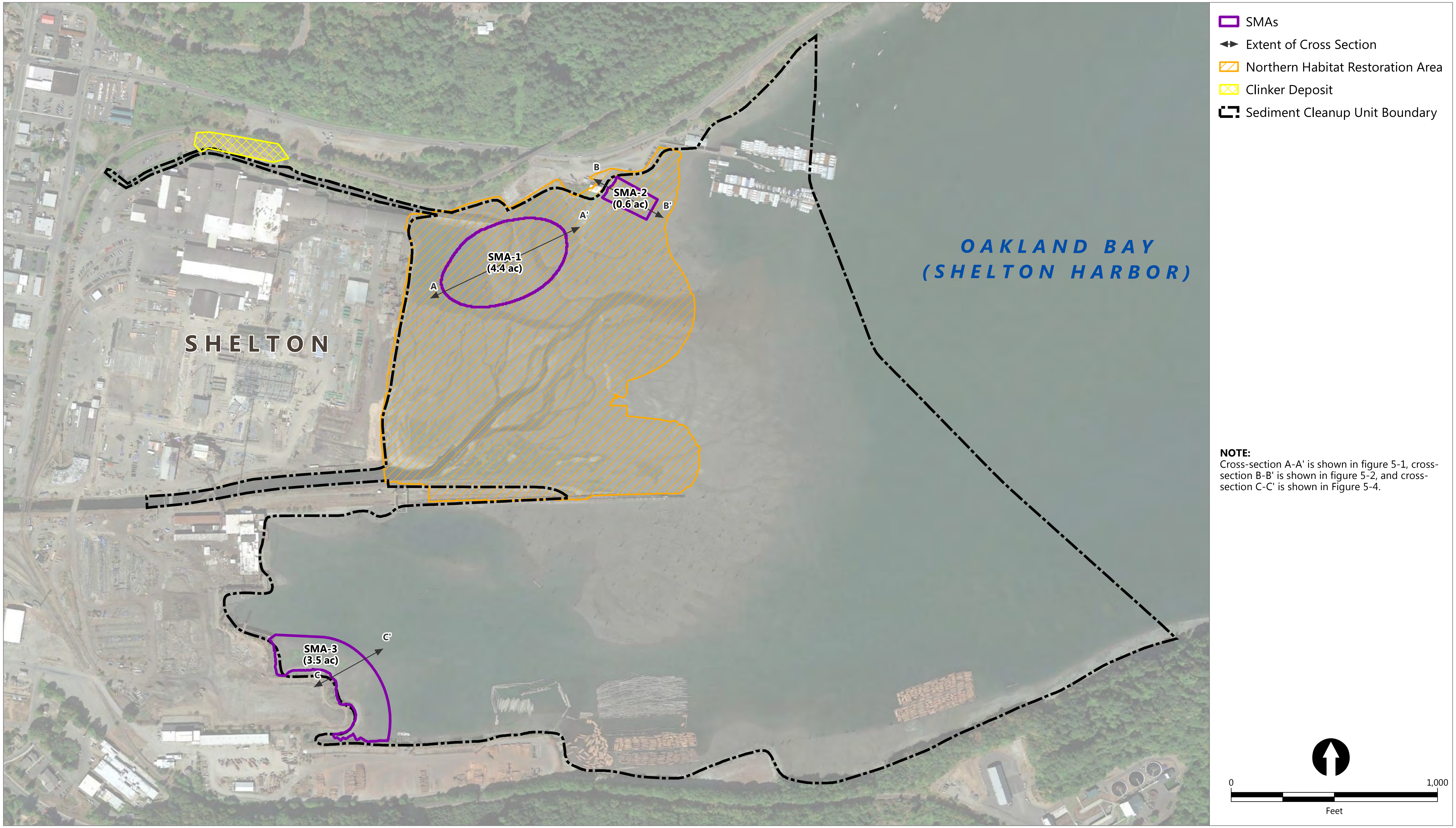
Figure 2-4
Shelton Harbor Surface Sediment cPAH TEQ
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site



NOTE:
Cross-section A-A' is shown in figure 5-1, cross-section B-B' is shown in figure 5-2, and cross-section C-C' is shown in Figure 5-4.

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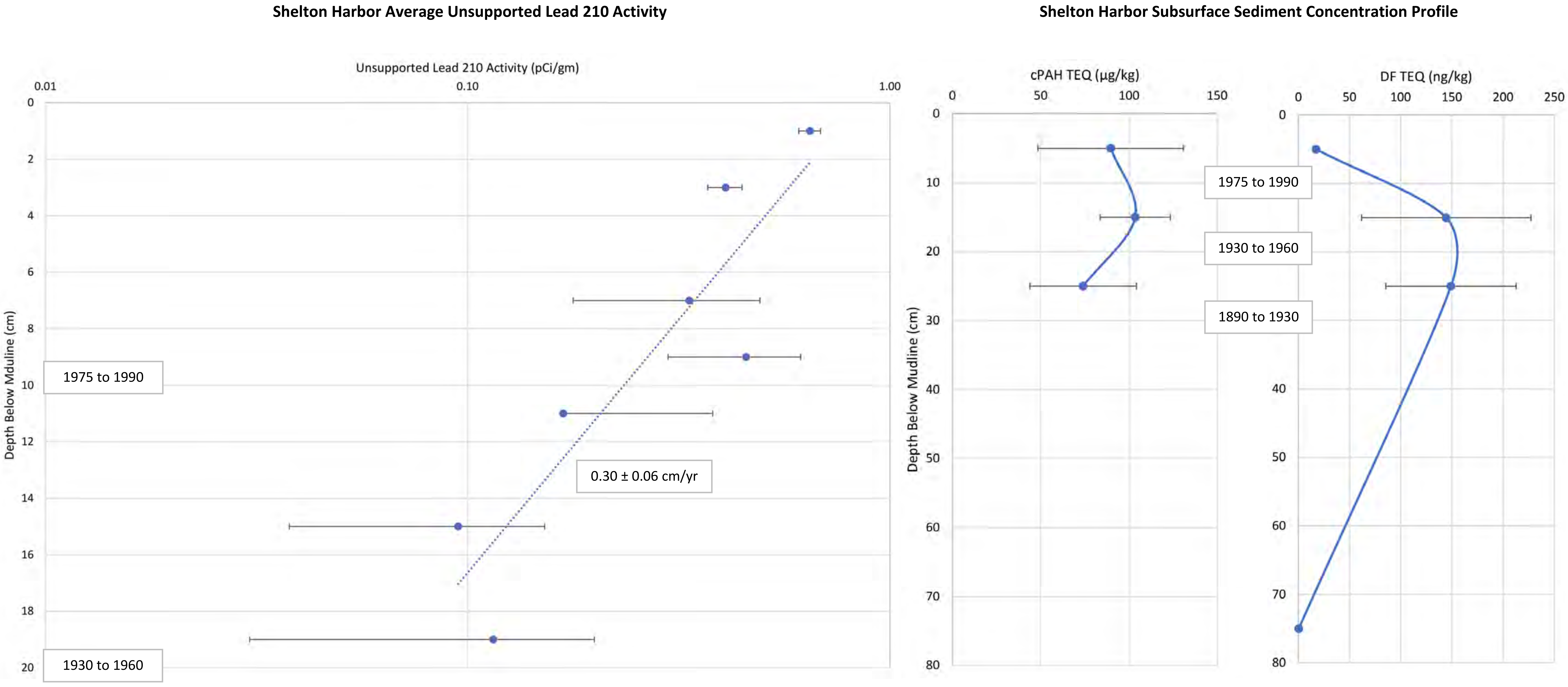
Filepath: \\orcas\gis\Jobs\Simpson_Timber_0008\SheltonHarbor\Maps\Interim_CAP\SMAs.mxd

Figure 3-1
Northern Shelton Harbor Sediment Management Areas
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site



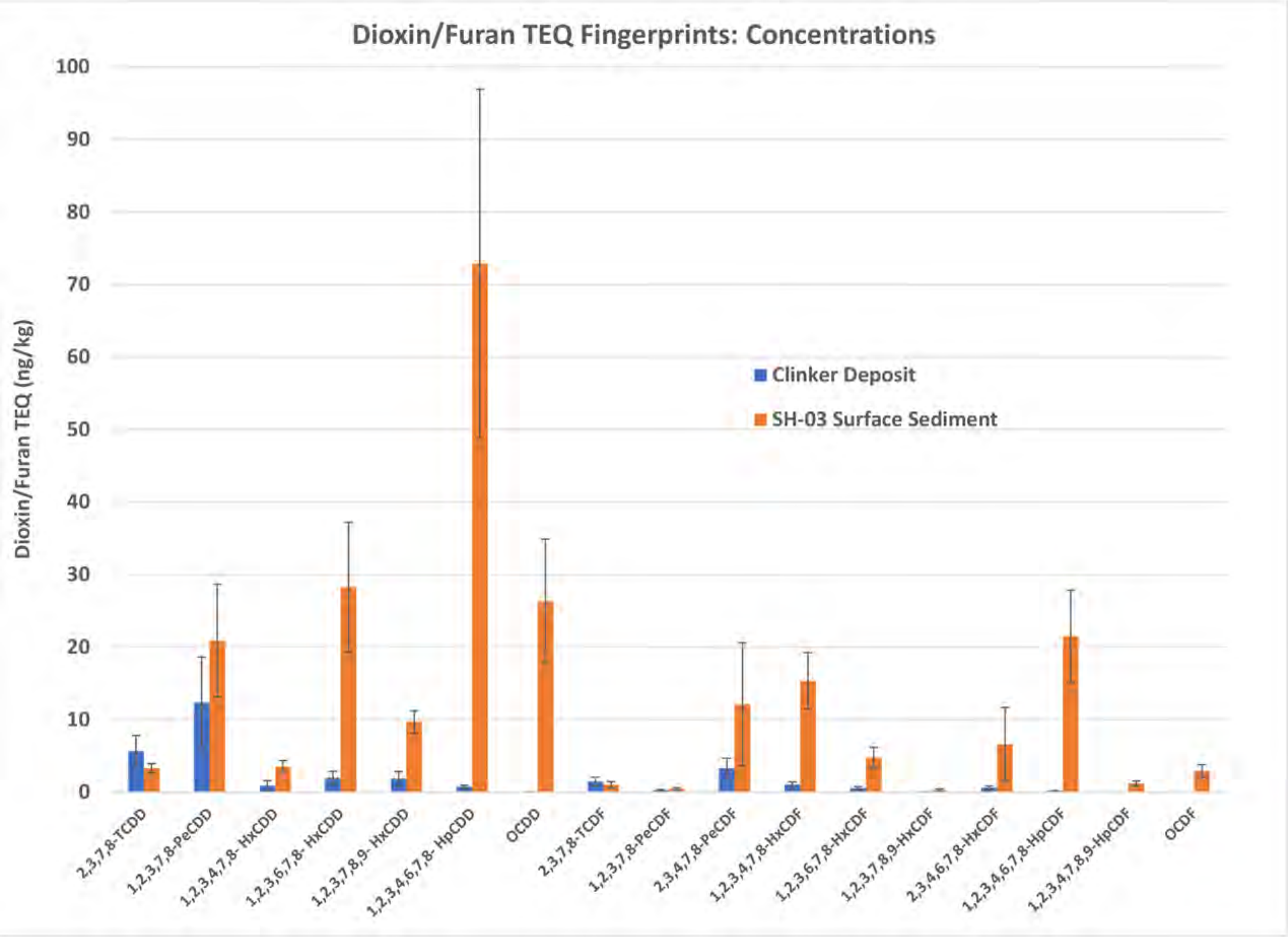
Notes:

1. Profiles depict the standard error of the mean.
2. cPAH TEQ and dioxin/furan TEQ profiles include locations SH14, SH19, and SH22.

Filepath: I:\Projects\Simpson\Shelton\2017 Evaluations\2017 CAP\N. Harbor Interim CAP\Figures\Source Files\Figure 3-2\Figure 3-2 Radiochem and Core Profile_01-29-18.docx

Figure 3-2

Southern Shelton Harbor Subsurface Sediment Lead-210 and COC Profiles

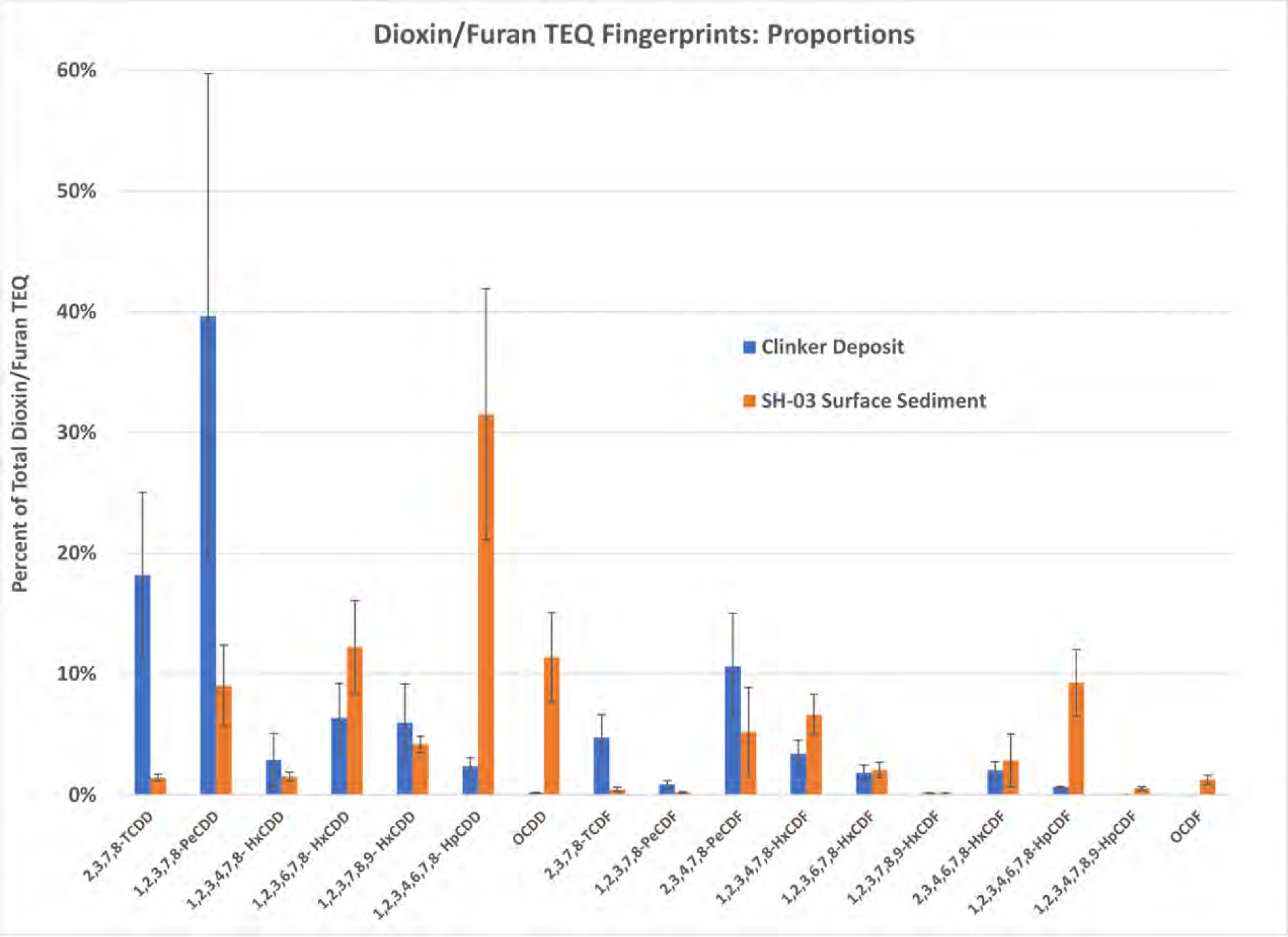


Filepath: I:\Projects\Simpson\Shelton\2017 Evaluations\2017 CAP\N. Harbor Interim CAP\Figures\Source Files\Figure 3-3a.docx

Figure 3-3a

Dioxin/Furan TEQ Fingerprints: Clinker Deposit and SH-03 Sediment – Concentrations

Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site



Filepath: I:\Projects\Simpson\Shelton\2017 Evaluations\2017 CAP\N. Harbor Interim CAP\Figures\Source Files\Figure 3-3b.docx

Figure 3-3b

Dioxin/Furan TEQ Fingerprints: Clinker Deposit and SH-03 Sediment – Proportions

Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site

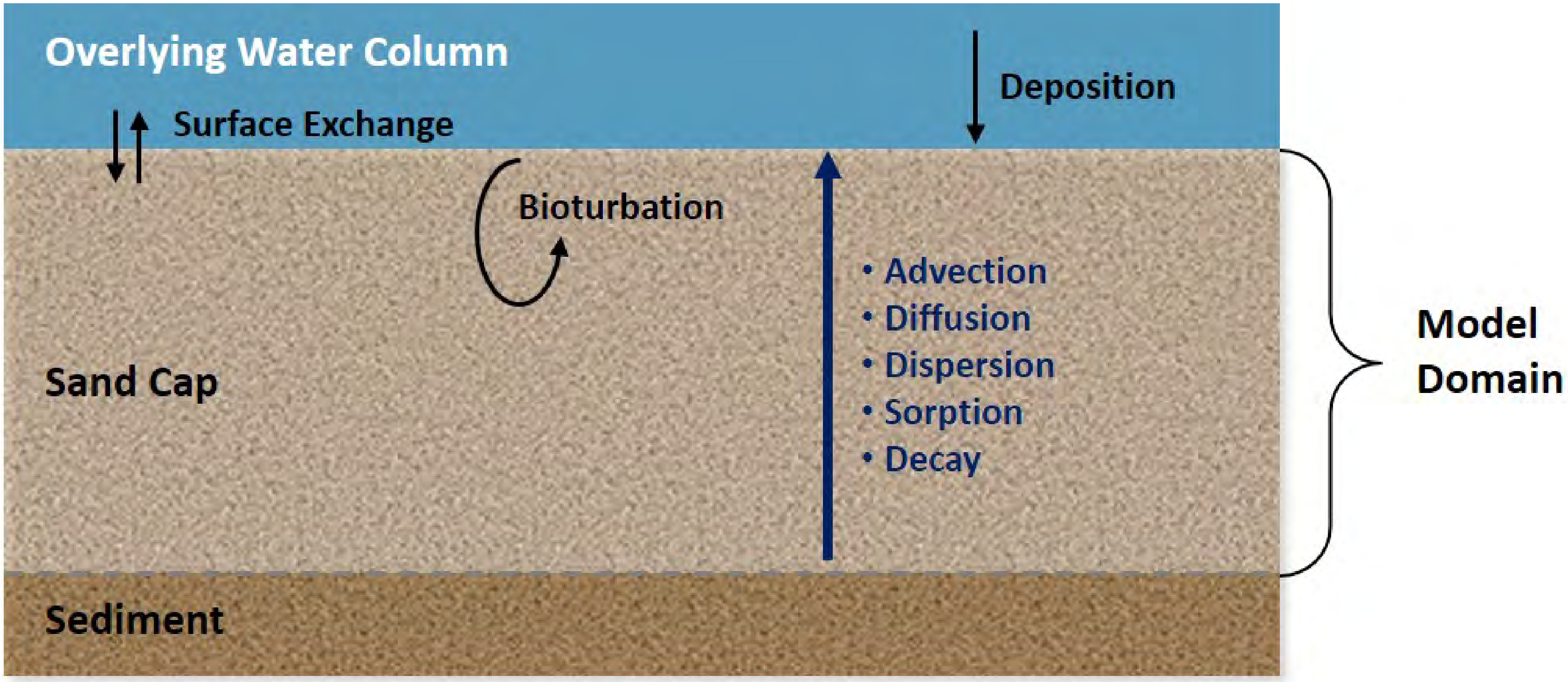


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Figure 4-1
Chemical Isolation Cap Model Domain and Processes
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site

Publish Date: 2017/12/21, 3:24 PM | User: ckiblinger
Filepath: \\orcas\gis\Jobs\Simpson_Timber_0008\SheltonHarbor\Maps\Interim_CAP\SMAs_Alts_DDP.mxd

Figure 4-2
Interim Action Alternative 1 – Removal
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site

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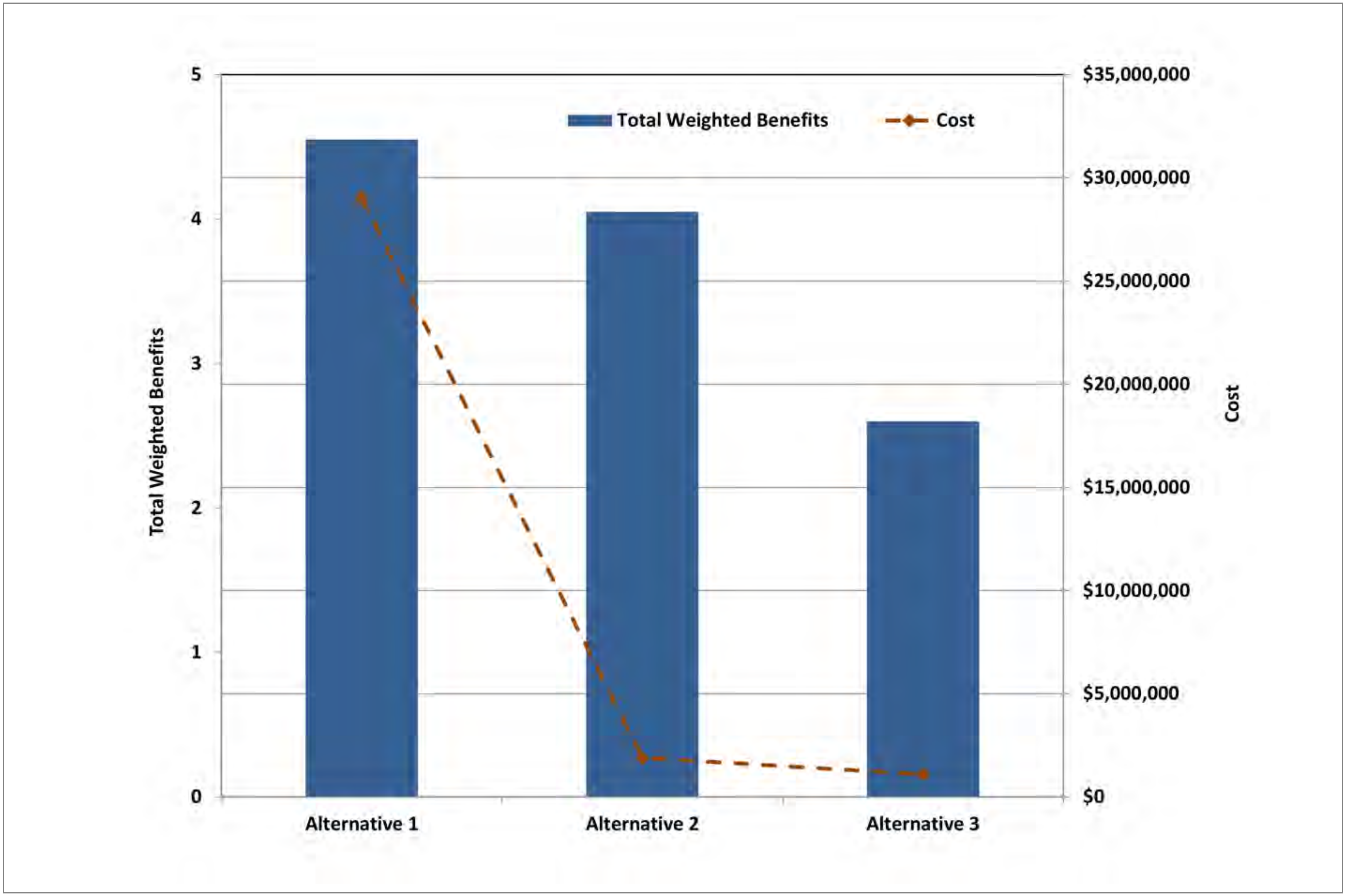
Filepath: \\orcas\gis\Jobs\Simpson_Timber_0008\SheltonHarbor\Maps\Interim_CAP\SMAs_Alts_DDP.mxd

Figure 4-3
Interim Action Alternative 2 – Engineered Capping
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site

Publish Date: 2017/12/21, 3:25 PM | User: ckiblinger
Filepath: \\orcas\gis\Jobs\Simpson_Timber_0008\SheltonHarbor\Maps\Interim_CAP\SMAs_Alts_DDP.mxd

Figure 4-4
Interim Action Alternative 3 – Enhanced Natural Recovery
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site

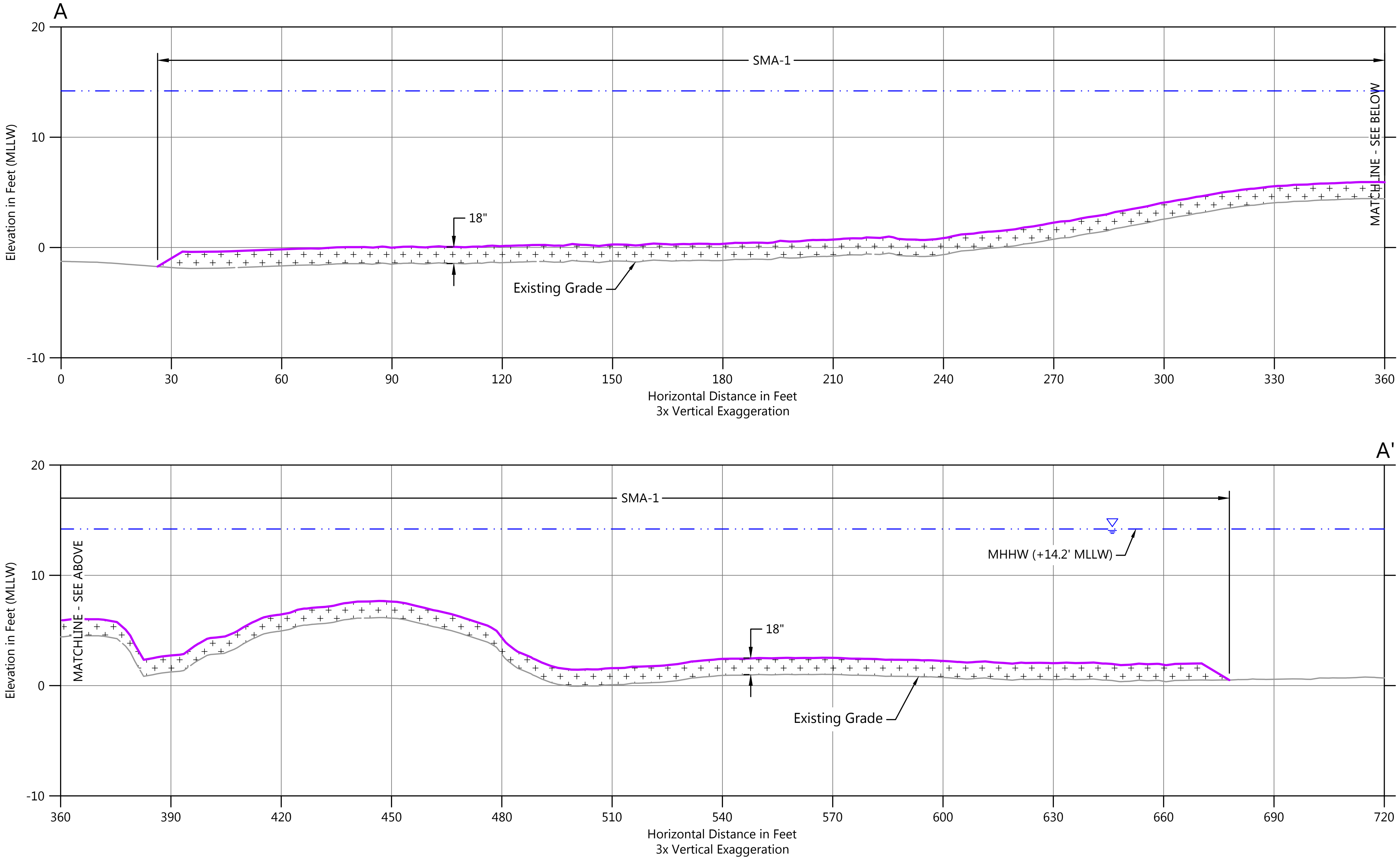


Filepath: I:\Projects\Simpson\Shelton\2017 Evaluations\2017 CAP\N. Harbor Interim CAP\Figures\Source Files\Figure 4-5.docx

Figure 4-5

Interim Action Alternatives Disproportionate Cost Analysis

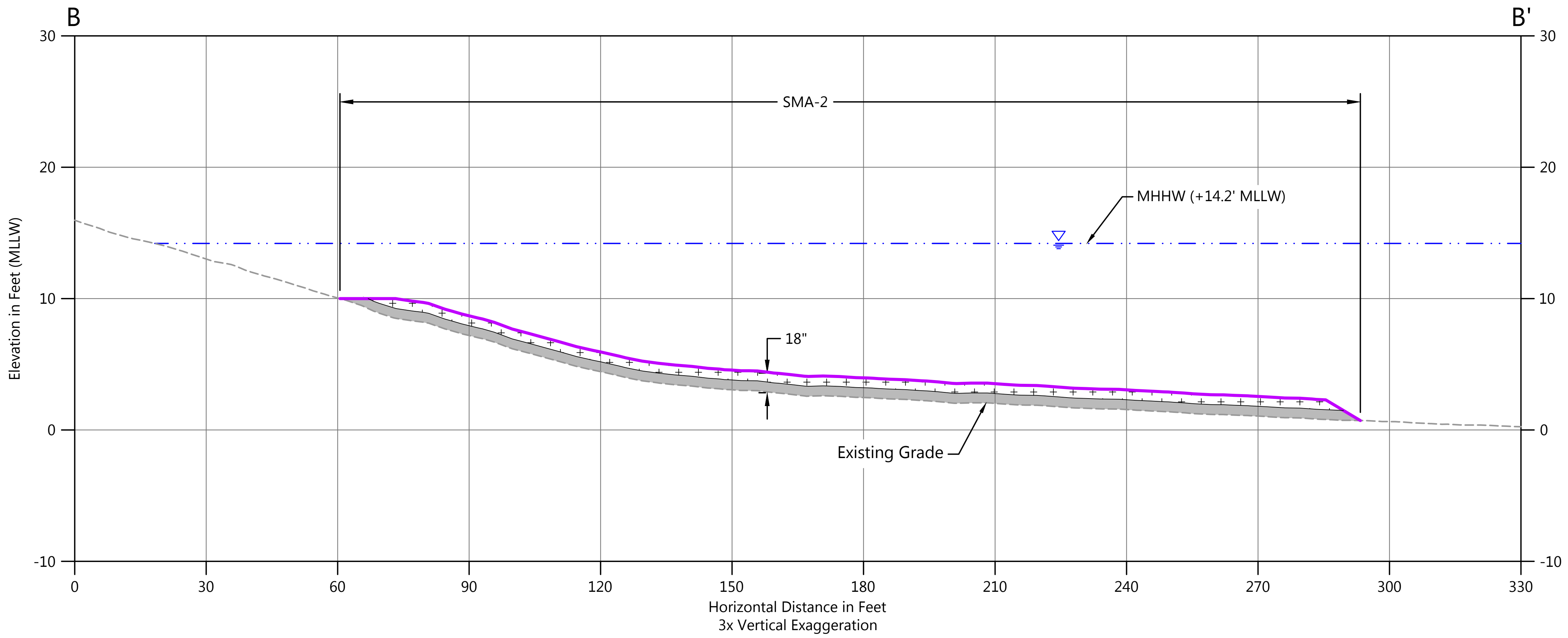
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site



NOTE: The extent of this cross section is shown on Figure 3-1.

Publish Date: 2018/01/30 1:45 PM | User: tgriga
Filepath: K:\Projects\0331-So. Puget Sound Salmon Enhancement Group\Oakland Bay\0331-RP-002-Cap-XS.dwg Figure 5-1

Figure 5-1
SMA-1 Cap Section

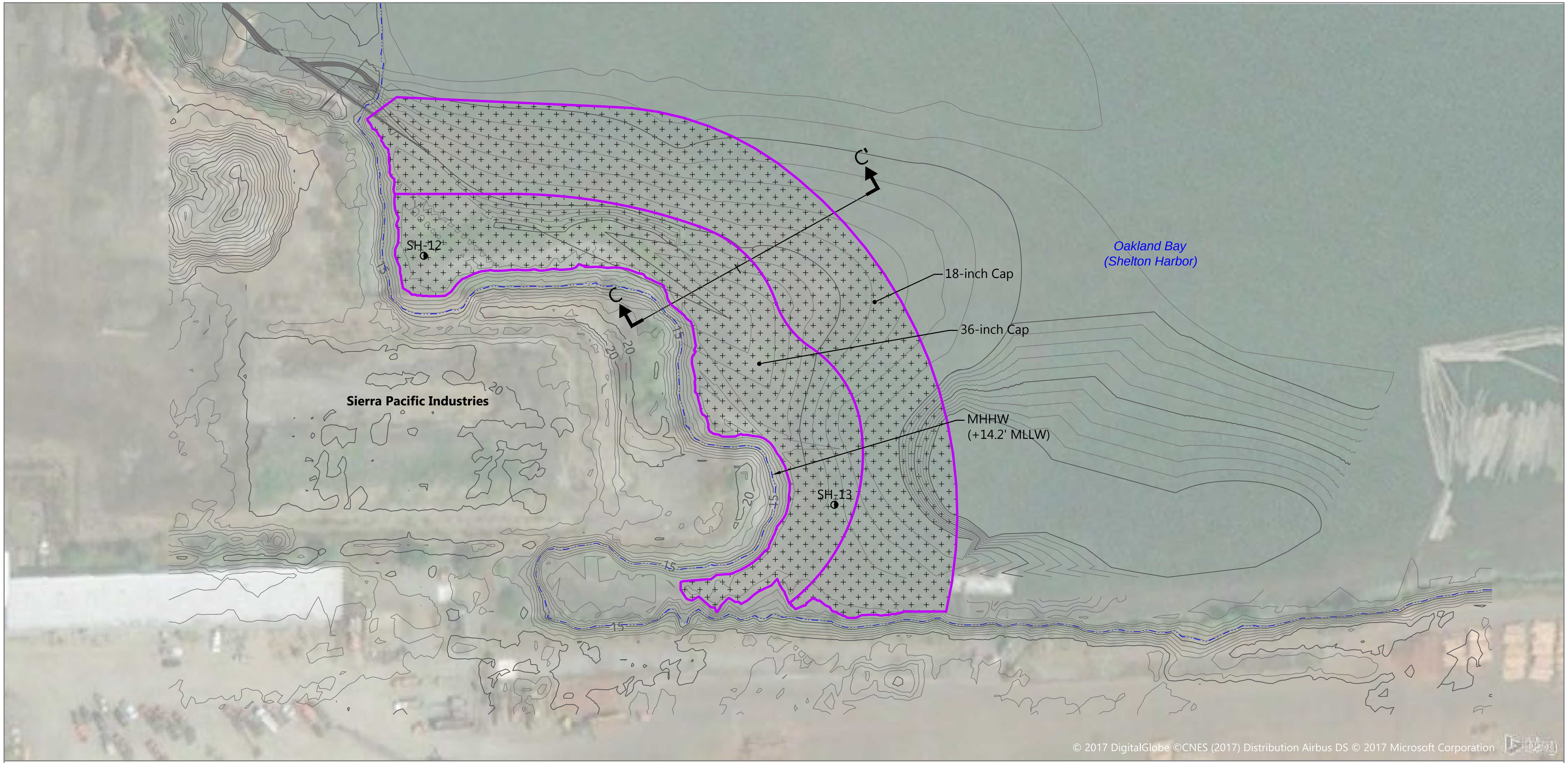


NOTE: The extent of this cross section is shown on Figure 3-1.

Publish Date: 2018/01/30 1:45 PM | User: tgriga
Filepath: K:\Projects\0331-So. Puget Sound Salmon Enhancement Group\Oakland Bay\0331-RP-002-Cap-XS.dwg Figure 5-2

Figure 5-2
SMA-2 Cap Section

Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site



SOURCE: Drawing prepared from topographic LiDAR acquired from Puget Sound LiDAR Consortium and bathymetric data from Herrera, 2007. Aerial photo provided by Bing Maps.
HORIZONTAL DATUM: Washington State Plane South, NAD83, U.S. Feet.
VERTICAL DATUM: Mean Lower Low Water (MLLW), Feet.

NOTE: Drawing is conceptual only and prepared with available information. No site topographic or bathymetric survey has been conducted.

LEGEND:

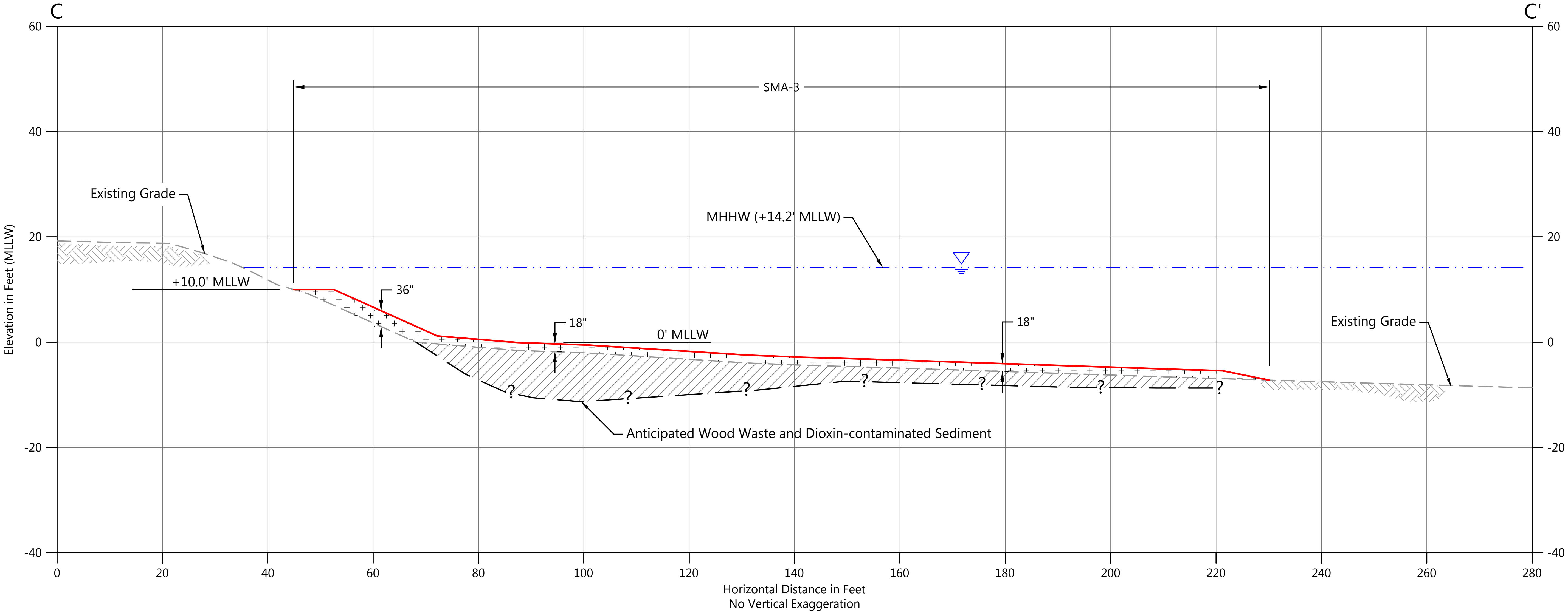
— Major Existing Topographic Contour (5' Interval)
— Minor Existing Topographic Contour (1' Interval)
-·-·- Mean Higher High Water (MHHW,+14.2' MLLW)
+ + Proposed Cap
◑ Historical Sediment Sample Location

0 100
Feet

Publish Date: 2018/01/30 1:47 PM | User: tgriga
Filepath: K:\Projects\0331-So. Puget Sound Salmon Enhancement Group\Oakland Bay\0331-RP-003-SMA-3.dwg Figure 5-3

Figure 5-3
SMA-3 Embankment Cap Plan

Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site



Publish Date: 2018/01/30 1:47 PM | User: tgriga
Filepath: K:\Projects\0331-So. Puget Sound Salmon Enhancement Group\Oakland Bay\0331-RP-003-SMA-3.dwg Figure 5-4

Figure 5-4
SMA-3 Embankment Cap Section

Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site

Appendix A
2017 Data Report

Dioxin data in this report are not correct due to lab error. See corrected data in Shelton Harbor Interim Action Basis of Design - Appendix A - Data Report, 9/30/18

January 2018
Shelton Harbor Sediment Cleanup Unit
Oakland Bay and Shelton Harbor Sediments Cleanup Site (Cleanup Site ID: 13007)

Appendix A – Data Report

Prepared for Simpson Timber Company and the Washington State Department of Ecology

Dioxin data in this report are not correct due to lab error. See corrected data in Shelton Harbor Interim Action Basis of Design - Appendix A - Data Report, 9/30/18

January 2018
Shelton Harbor Sediment Cleanup Unit
Oakland Bay and Shelton Harbor Sediments Cleanup Site (Cleanup Site ID: 13007)

2017 Data Report

Prepared for
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1305 5th Avenue Suite 2700
Seattle, Washington 98101

Washington State Department of Ecology
Toxics Cleanup Program, Southwest Region
PO Box 47775
Olympia, Washington 98504-7775

Prepared by
Anchor QEA, LLC
720 Olive Way, Suite 1900
Seattle, Washington 98101

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENT

ABBREVIATIONS

DQO	data quality objective
Ecology	Washington State Department of Ecology
PAH	polycyclic aromatic hydrocarbon
QA	quality assurance
QC	quality control
RI/FS	Remedial Investigation/Feasibility Study
SCU	Sediment Cleanup Unit
SPI	sediment profile imaging
SQAPP	Sampling and Quality Assurance Project Plan
TVS	total volatile solids
Work Plan	Shelton Harbor Sediment Cleanup Unit Remedial Investigation/ Feasibility Study Work Plan

1 Introduction

In accordance with Agreed Order DE 14091 and under oversight by the Washington State Department of Ecology (Ecology), Simpson Timber Company is performing a Remedial Investigation/Feasibility Study (RI/FS) for the Shelton Harbor Sediment Cleanup Unit (SCU) in Shelton, Washington (Figure 1). The Shelton Harbor SCU RI/FS Work Plan (Work Plan; Anchor QEA 2017; Exhibit B of the Agreed Order) describes the data needed to complete the RI/FS, along with corresponding data quality objectives (DQOs). This Data Report summarizes 2017 field sample collection activities and analytical results, consistent with DQOs summarized in the Sampling and Quality Assurance Project Plan (SQAPP; Appendix A of Anchor QEA 2017).

1.1 Document Organization

This 2017 Data Report is organized as follows:

- Section 2 – Data quality and management
- Section 3 – Sample acquisition and results as they pertain to the DQOs
- Section 4 – References

2 Analytical Data Quality

This section describes the quality and management aspects of the data acquired.

2.1 Analytical Data Quality

DQOs and quality assurance procedures are provided in the Sampling and Quality Assurance Project Plan (SQAPP; Anchor QEA 2017). Chemical analyses were performed by SGS in Wilmington, North Carolina; ALS Environmental in Kelso, Washington; and Analytical Resources, Inc., in Tukwila, Washington. Stage 2B and/or Stage 4 (dioxin/furan) data validation was performed on all data (EPA 2009). During the validation process, analytical data were evaluated for method quality control (QC) and laboratory QC compliance, and their validity and applicability for program purposes determined. Based on the findings of the validation process, data validation qualifiers were assigned.

The data package was validated by Laboratory Data Consultants and Anchor QEA. Laboratory data reports are provided in Attachment 1, and data validation reports are provided in Attachment 2. All qualifiers applied to the data during final validation have been incorporated into the database for this project. Data qualifiers assigned during data validation included the following:

- "J" indicates that the result is an estimated concentration.
- "U" indicates a method detection limit below which the analyte was not detected.
- "UJ" indicates an estimated method detection limit below which the analyte was not detected.

The validation process resulted in some J-qualified data (estimated values) based on a specified protocol or technical advisory, as discussed in the attached data validation reports (Attachment 2). Overall, all reporting limits were acceptable and met the SQAPP (Appendix A of Anchor QEA 2017) objectives. All data are considered useable for site characterization as reported or as qualified.

2.2 Data Management

The validated project data, including qualifiers, were entered into the project database, enabling this information to be retained or retrieved, as needed. Validated data have also been submitted to Ecology's Environmental Information Management database.

3 Sample Acquisition and Results

The section reports the results of the data acquired for each identified DQO.

3.1 Data Quality Objective 1: Evaluate Benthic Conditions

As identified through the Work Plan DQO process and detailed in the SQAPP, additional data were collected to characterize current sediment quality within the SCU. Sediment benthos quality was evaluated using a combination of sediment profile imaging (SPI), bioassay testing, and surface sediment porewater sulfide and ammonia analyses. Field sample collection forms are included as Attachment 3.

3.1.1 Sediment Profile Imaging

The SPI survey was conducted by NewFields with support from Marine Sampling Systems and Anchor QEA on July 10 and 11, 2017. In accordance with the SQAPP (Appendix A of Anchor QEA 2017), a meeting between NewFields, Anchor QEA, and Ecology was conducted on the mornings of July 11 and 12, 2017, to discuss the initial results of the SPI images collected the previous day, which informed the collection of additional surface sediment sampling and analysis. In total, 63 locations were surveyed using the SPI apparatus (Figure 2). The results of each survey location included the estimated presence of wood, presence of methane, presence of bacterial mats *(Beggiatoa sp.)*, and apparent redox potential discontinuity depth. Detailed SPI results are provided in NewFields' Shelton Harbor SPI Survey Data Report (Attachment 4).

3.1.2 Sediment Bioassay

On July 12 and 13, 201,7 Anchor QEA, with support from Marine Sampling Systems, collected surface sediments for bioassay testing (Attachment 3-a). The sediment bioassay testing was conducted at 11 locations throughout the SCU. Eight pre-defined historical exceedance locations were reoccupied and three locations were added, at the direction of Ecology, following the SPI image review meetings (Figure 2; see Section 3.1.1). Where the historical bioassay exceedance locations were reoccupied, testing was conducted for larval and/or polychaete bioassays consistent with the SQAPP. At the three additional locations, a full suite of bioassay tests were conducted. All tests were performed in accordance with the current Ecology-approved testing methodology (Kendall et al. 2013). Table 5-1 in EcoAnalyst Inc's Shelton Harbor Sediment Cleanup Site Toxicology Testing Results (Attachment 5), provides a summary of all bioassay test results.

To supplement the bioassay test results, bulk sediment conventional testing was conducted in accordance with the SQAPP-specified methodology for total volatile solids (TVS) and grain size. The conventional and chemical bulk sediment testing results are presented in Table 1.

In situ free hydrosulfide and hydrogen sulfide porewater concentrations (free sulfides) were measured using a diffusive gradient thin film passive sampling method. Due to physical conditions encountered during deployment, diffusive gradient thin film samplers were deployed at 7 of 11 locations bioassay locations. Of the 7 locations, 5 resulted in calculated free sulfide concentrations, ranging from 0.005 to 1.6 milligrams per liter, as detailed in Table 2.

3.2 Data Quality Objective 3: Evaluate Ongoing Sources to Sediments

The RI/FS is evaluating spatial gradients of chemicals of concerns in surface sediments, focusing on areas that exceed preliminary cleanup levels. Field reconnaissance of the intertidal Shelton Creek delta was conducted to field locate a single dioxin/furan sampling location (SG-01; Figure 2) downstream of the clinker deposit. The results of the SG-01 dioxins/furans analysis are presented in Table 2.

Passive sampling of porewater in the vicinity of the clinker deposit is ongoing, in accordance with the SQAPP (Appendix A of Anchor QEA 2017), and will be reported in the draft RI/FS.

3.3 Data Quality Objective 4: Evaluate Recent Natural Recovery

The natural recovery DQO called for the collection of paired sediment cores where advanced at three locations (Figure 2). Initial field core collection was conducted on July 12, 2017, but was terminated due to equipment failure. The additional cores were collected on August 8, 9, and 10, 2017, and subsequently processed. All core collection and processing logs are presented in Attachments 3-b and 3-c, respectively.

At each location, the paired cores were processed into 2-centimeter intervals for initial radioisotope testing with archives for further radioisotope and chemical testing, where needed. The initial radioisotope laboratory results were evaluated, which informed a secondary submittal to refine the dataset. All core radioisotope testing results are provided in Table 3.

After review of the radioisotope results, selected archived intervals were laboratory composited and submitted for polycyclic aromatic hydrocarbon (PAH) and dioxin/furan testing. The results of the laboratory testing are presented in Table 4.

In addition to the planned testing of subsurface sediments to inform natural recovery, selected surface sediments were submitted for supplemental PAH and dioxin/furan testing for comparison to historical results. Results from the supplemental surface sediment PAH and dioxin/furan testing are included in Table 1.

3.4 Feasibility Study Evaluations

The SQAPP (Appendix A of Anchor QEA 2017) describes bench-scale testing of an activated carbon amendment to control dioxin/furan bioavailability, as well as subsurface coring and analyses to characterize the thickness of wood debris in portions of the southern harbor. At Ecology's request, an additional core was advanced at station SH-03 to characterize the thickness of dioxins/furans at this northern harbor location.

3.4.1 Bench-Scale Activated Carbon Testing

To determine if in situ treatment is an effective remedial technology, a surface sediment sample was collected from station SH-19 and is currently undergoing treatability testing. The surface sediment was tested for black carbon and the result is included in Table 3. Treatability testing results will be reported in the draft RI/FS.

3.4.2 Extent of Wood Debris Sediment Coring

Upon review of the SPI results in consultation with Ecology (see Section 3.1.1), core locations were selected and advanced to delineate the vertical extent of wood debris (Figure 2). The cores were logged (Attachment 3-c), and the interval underlying the last identified presence of wood debris was submitted for TVS analyses. The results of the TVS testing are presented in Table 4.

3.4.3 Extent of Dioxins/Furans at SH-03

All SH-03 core interval results are presented in Table 4.

4 References

Anchor QEA, 2017. Shelton Harbor Sediment Cleanup Unit Remedial Investigation/Feasibility Study Work Plan. Prepared for Simpson Timber Company and the Washington State Department of Ecology. June 2017.

EPA (U.S. Environmental Protection Agency), 2009. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response. EPA 540-R-08-005. January 2009.

EPA, 2012. Guidelines for Using Passive Samplers to Monitor Organic Contaminants at Superfund Sediment Sites. Office of Solid Waste and Emergency Response Directive 9200.1-110FS. December 2012.

EPA, 2016. National Functional Guidelines for High Resolution Superfund Methods Data Review. EPA 542-B-16-001. April 2016.

EPA, 2017a. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. EPA 540-R-2017-001. September 2016.

EPA, 2017b. USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. EPA 540-R-2017-002. January 2017.

Kendall, D., R. McMillan, W. Gardiner, B. Hester, and J.D. Word, 2013. *Bioassay Endpoint Refinements: Bivalve Larval and Neanthes Growth Bioassays*. DMMP/SMS Clarification Paper. May 2013.

Tables

Table 1
Surface Bulk Sediment Results

Task				SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017
Location ID				**SG-01-170713**	**SH-03-170809**	**SH-04-170713**	**SH-13A-170713**	**SH-14-170712**	**SH-19-170712**	**SH-21-170712**	**SH-22-170712**	**SH-24-170713**
Sample ID				**SG-01-SG-170713**	**SH-03-SC-0-10-170809**	**SH-04-SG-170713**	**SH-13A-SG-170713**	**SH-14-SG-170712**	**SH-19-SG-170712**	**SH-21-SG-170712**	**SH-22-SG-170712**	**SH-24-SG-170713**
Sample Date				**7/13/2017**	**8/9/2017**	**7/13/2017**	**7/13/2017**	**7/12/2017**	**7/12/2017**	**7/12/2017**	**7/12/2017**	**7/13/2017**
Depth				**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**
Sample Type				**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**
X				**1078804.278**	**1079571.097**	**1079142.371**	**1078917.959**	**1081852.952**	**1078945.317**	**1079632.45**	**1079632.45**	**1080908.296**
Y				**86149.22393**	**85744.088**	**85824.72775**	**83577.94747**	**84299.87451**	**84076.30474**	**84373.99247**	**84373.99247**	**83520.27469**
		AET_Marine_ SCO_SCUMII	**AET_Marine_ CSL_SCUMII**									
Conventional Parameters (pct)												
Total volatile solids	D2974			**8.37**	--	**12.13**	**13.3**	**6.71**	**15.09**	**13.82**	**8.66**	**11.73**
Black Carbon	Ghosh			--	--	--	--	--	**1.23**	--	--	--
Grain Size (pct)												
Gravel	PSEP			**38.36**	--	**1.61 J**	**0 J**	**0.65 J**	**2.67 J**	**3.4 J**	**5.51 J**	**8.55 J**
Sand, very coarse	PSEP			**7.09**	--	**2.19**	**0.32**	**1.27**	**2.31**	**5.75**	**2.65**	**2.52**
Sand, coarse	PSEP			**6.16**	--	**2.2**	**3.68**	**1.65**	**2.85**	**6.57**	**4.24**	**3.29**
Sand, medium	PSEP			**4.61**	--	**3.86**	**5.15**	**3**	**4.91**	**7.34**	**19.69**	**11.82**
Sand, fine	PSEP			**6.81**	--	**6.92**	**6.45**	**14.07**	**4.75**	**11.44**	**21.85**	**12.55**
Sand, very fine	PSEP			**11.7**	--	**15.23**	**13.55**	**33.79**	**8.15**	**10.79**	**11.41**	**8.95**
Percent retained 31.25 micron sieve	PSEP			**5.06**	--	**33.3**	**36.74**	**14.78**	**27.94**	**27.64**	**11.88**	**20.07**
Percent retained 62.5 micron sieve	PSEP			**8.43**	--	**3.49 J**	**3.27 J**	**6.29 J**	**0.68 J**	**1.03 J**	**2.26 J**	**3.97 J**
Percent retained 15.6 micron sieve	PSEP			**2.33**	--	**10.65**	**12.07**	**6.52**	**13.6**	**11.82**	**4.15**	**8.36**
Percent retained 7.8 micron sieve	PSEP			**2.22**	--	**8.39**	**6.54**	**5.73**	**11.7**	**6.94**	**4.12**	**7.07**
Percent retained 3.9 micron sieve	PSEP			**1.61**	--	**5.08**	**3.38**	**3.88**	**8.2**	**4**	**3.27**	**4.79**
Percent retained 1.95 micron sieve	PSEP			**0.97**	--	**4.98**	**4.31**	**3.69**	**6.79**	**4.76**	**2.64**	**3.48**
Percent retained 0.98 micron sieve	PSEP			**1.06**	--	**7.8**	**7.76**	**5.73**	**10.19**	**8.97**	**3.91**	**5.58**
Total Fines (sum of all sieves)				**21.68**		**73.69**	**74.07**	**46.62**	**79.1**	**65.16**	**32.23**	**53.32**
Polycyclic Aromatic Hydrocarbons (µg/kg)												
2-Methylnaphthalene	SW8270DSIM	670	670	--	--	--	--	**5.1**	**24**	--	**4.8**	--
Acenaphthene	SW8270DSIM	500	500	--	--	--	--	**5.5**	**23**	--	**11**	--
Acenaphthylene	SW8270DSIM	1300	1300	--	--	--	--	**4.7**	**22**	--	**6.1**	--
Anthracene	SW8270DSIM	960	960	--	--	--	--	**8.3**	**53**	--	**240**	--
Benzo(a)anthracene	SW8270DSIM	1300	1600	--	--	--	--	**15**	**43**	--	**150**	--
Benzo(a)pyrene	SW8270DSIM	1600	1600	--	--	--	--	**13**	**65**	--	**100**	--
Benzo(b,j)fluoranthene	SW8270DSIM			--	--	--	--	**24**	**99**	--	**250**	--
Benzo(e)pyrene	SW8270DSIM			--	--	--	--	**16**	**55**	--	--	--
Benzo(g,h,i)perylene	SW8270DSIM	670	720	--	--	--	--	**10**	**43**	--	**45**	--
Benzo(k)fluoranthene	SW8270DSIM			--	--	--	--	**8.4**	**33**	--	**100**	--
Chrysene	SW8270DSIM	1400	2800	--	--	--	--	**52**	**73**	--	**590 J**	--
Dibenzo(a,h)anthracene	SW8270DSIM	230	230	--	--	--	--	**2.2**	**8.4**	--	**11**	--
Dibenzofuran	SW8270DSIM	540	540	--	--	--	--	--	--	--	**14**	--
Fluoranthene	SW8270DSIM	1700	2500	--	--	--	--	**95**	**270**	--	**710**	--
Fluorene	SW8270DSIM	540	540	--	--	--	--	**5.2**	**26**	--	**20**	--

Table 1
Surface Bulk Sediment Results

Task				SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017
Location ID				**SG-01-170713**	**SH-03-170809**	**SH-04-170713**	**SH-13A-170713**	**SH-14-170712**	**SH-19-170712**	**SH-21-170712**	**SH-22-170712**	**SH-24-170713**
Sample ID				**SG-01-SG-170713**	**SH-03-SC-0-10-170809**	**SH-04-SG-170713**	**SH-13A-SG-170713**	**SH-14-SG-170712**	**SH-19-SG-170712**	**SH-21-SG-170712**	**SH-22-SG-170712**	**SH-24-SG-170713**
Sample Date				**7/13/2017**	**8/9/2017**	**7/13/2017**	**7/13/2017**	**7/12/2017**	**7/12/2017**	**7/12/2017**	**7/12/2017**	**7/13/2017**
Depth				**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**
Sample Type				**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**
X				**1078804.278**	**1079571.097**	**1079142.371**	**1078917.959**	**1081852.952**	**1078945.317**	**1079632.45**	**1079632.45**	**1080908.296**
Y				**86149.22393**	**85744.088**	**85824.72775**	**83577.94747**	**84299.87451**	**84076.30474**	**84373.99247**	**84373.99247**	**83520.27469**
		AET_Marine_ SCO_SCUMII	**AET_Marine_ CSL_SCUMII**									
Indeno(1,2,3-c,d)pyrene	SW8270DSIM	600	690	--	--	--	--	**7.8**	**36**	--	**51**	--
Naphthalene	SW8270DSIM	2100	2100	--	--	--	--	**46**	**170**	--	**23**	--
Perylene	SW8270DSIM			--	--	--	--	**9.4**	**31**	--	--	--
Phenanthrene	SW8270DSIM	1500	1500	--	--	--	--	**37**	**200**	--	**120**	--
Pyrene	SW8270DSIM	2600	3300	--	--	--	--	**83**	**330**	--	**580**	--
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 1/2)				--	--	--	--	**19.26**	**87.67**	--	**162.1 J**	--
Total Benzofluoranthenes (b,j,k) (U = 0)		3200	3600	--	--	--	--	**8.4**	**33**	--	**100**	--
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 0)				--	--	--	--	**19.26**	**87.67**	--	**162.1 J**	--
Total HPAH (SMS) (U = 0)		12000	17000	--	--	--	--	**310.4**	**1000.4**	--	**2587 J**	--
Total LPAH (SMS) (U = 0)		5200	5200	--	--	--	--	**106.7**	**494**	--	**420.1**	--
Dioxin Furans (ng/kg)												
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B			**1.06**	**3.76 J**	0.506 U	**2.68**	**0.432 J**	**0.884**	0.382 U	0.258 U	0.447 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B			**4.2**	**26.4**	**2.7 J**	**7.49**	**2.47 J**	**2.17 J**	**1.77 J**	**1.5 J**	**3.02 J**
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B			**7.11**	**41.2**	**5.3 J**	**14.1 J**	**3.42**	**3.16**	**3.97 J**	**4.3**	**6.37**
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B			**26.9**	**346**	**25.5**	**55.9**	**17.7**	**17.3**	**19.6**	**30.4**	**27.3**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B			**12.7**	**108**	**8.92 J**	**21.6 J**	**5.54**	**5.04**	**7.17**	**7.41**	**10.9**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B			**488**	**8990 J**	**613**	**913**	**295**	**296**	**528**	**960**	**574**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613B			**4000**	**108000 J**	**6420**	**8200**	**2480**	**2390**	**4650**	**7940**	**4670**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B			**89.5 J**	**713 J**	**147 J**	**861**	**212 J**	**85.3 J**	**107 J**	**73 J**	**212**
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B			**144 J**	**913 J**	**157 J**	**841 J**	**138 J**	**101 J**	**137 J**	**93.9**	**187 J**
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B			**263**	**3260**	**370 J**	**992 J**	**275**	**193**	**332**	**489 J**	**433**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B			**941**	**21200**	**1310**	**2280**	**835**	**832**	**1670**	**4940**	**1290**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613B			**3.12**	**13.4**	**1.54**	**8.81**	**1.88 J**	**4.16**	**1.41 J**	**1.8**	**2.61**
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B			**2.95**	**19.5**	**1.53 J**	**6.19**	**1.56 J**	**2.96 J**	**1.39 J**	**1.98 J**	**2.29 J**
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B			**7.23**	**60.4**	**4.26**	**11.7**	**5.44**	**6.44**	**3.38 J**	**4.46**	**5.42**
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B			**11.8**	**181**	**11.8**	**19.6**	**8.79**	**11.3**	**7.46**	**7.86**	**13.1**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B			**6.16**	**58**	**3.58**	**8.5**	**2.92**	**4.27**	**2.9 J**	**2.71**	**4.76**
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613B			**1.03 J**	2.77 U	1.47 U	1.34 U	**0.431 J**	0.623 U	0.563 U	**0.681 J**	0.767 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B			**9.06**	**102**	**5.83 J**	**12.8**	**5.09**	**6.6**	**4.76**	**4.95**	**8.24**
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613B			**126**	**2600**	**164**	**245**	**75.1**	**158**	**99**	**81.1**	**169**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613B			**8.66**	**146**	**11.9**	**14.5**	**4.92**	6.66 U	**5.52**	**4.61**	**9.64**
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613B			**370**	**11800**	**806**	**795**	**300**	**359**	**415**	**256**	**701**
Total Tetrachlorodibenzofuran (TCDF)	E1613B			**61.2 J**	**341 J**	**22.3 J**	**202 J**	**64.1 J**	**106 J**	**35.1 J**	**37.2 J**	**64 J**
Total Pentachlorodibenzofuran (PeCDF)	E1613B			**79.9 J**	**575 J**	**43.3 J**	**141 J**	**60.2 J**	**87 J**	**38.8 J**	**48.5**	**62.1 J**
Total Hexachlorodibenzofuran (HxCDF)	E1613B			**231 J**	**3710**	**263 J**	**370 J**	**159 J**	**216**	**136 J**	**149 J**	**236**
Total Heptachlorodibenzofuran (HpCDF)	E1613B			**466**	**11200**	**732 J**	**937**	**303**	**501 J**	**374**	**283**	**676**
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2)				**22.8431 J**	**287.2635 J**	**20.6542 J**	**42.4872 J**	**13.7421 J**	**15.68695 J**	**15.61655 J**	**21.9534 J**	**21.44225 J**
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0)				**22.8431 J**	**287.125 J**	**20.3277 J**	**42.4202 J**	**13.7421 J**	**15.6225 J**	**15.3974 J**	**21.8244 J**	**21.1804 J**

Table 1
Surface Bulk Sediment Results

			Task	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017
			Location ID	SH-28-170712	SPI-22-170713	SPI-30-170713	SPI-31-170713	SPI-31-170713
			Sample ID	SH-28-SG-170712	SPI-22-SG-170713	SPI-30-SG-170713	SPI-131-SG-170713	SPI-31-SG-170713
			Sample Date	7/12/2017	7/13/2017	7/13/2017	7/13/2017	7/13/2017
			Depth	0–10 cm	0–10 cm	0–10 cm	0–10 cm	0–10 cm
			Sample Type	N	N	N	FD	N
			X	1081568.517	1080205.879	1080380.919	1081277.578	1081277.578
			Y	84922.72201	83592.417	83461.02485	83610.71742	83610.71742
		AET_Marine_ SCO_SCUMII	AET_Marine_ CSL_SCUMII					
Conventional Parameters (pct)								
Total volatile solids	D2974			**5.61**	**26.69**	**15.87**	**13.13**	**12.56**
Black Carbon	Ghosh			--	--	--	--	--
Grain Size (pct)								
Gravel	PSEP			**7.55 J**	**16.63 J**	**7.59 J**	--	**2.24 J**
Sand, very coarse	PSEP			**3.39**	**4.15**	**2.12**	--	**1.44**
Sand, coarse	PSEP			**2.49**	**2.95**	**1.94**	--	**1.45**
Sand, medium	PSEP			**2.99**	**4.33**	**3.13**	--	**4.09**
Sand, fine	PSEP			**17.37**	**5.45**	**6.18**	--	**7.6**
Sand, very fine	PSEP			**31.07**	**7.43**	**8.52**	--	**10.26**
Percent retained 31.25 micron sieve	PSEP			**11.08**	**28.66**	**29.88**	--	**32.34**
Percent retained 62.5 micron sieve	PSEP			**3.22 J**	**2.94 J**	**2.23 J**	--	**5.16 J**
Percent retained 15.6 micron sieve	PSEP			**4.7**	**10.23**	**13.25**	--	**13**
Percent retained 7.8 micron sieve	PSEP			**4.42**	**6.13**	**7.73**	--	**9.87**
Percent retained 3.9 micron sieve	PSEP			**3.3**	**4.17**	**4.72**	--	**5.71**
Percent retained 1.95 micron sieve	PSEP			**3.02**	**4.31**	**5.11**	--	**5.33**
Percent retained 0.98 micron sieve	PSEP			**4.39**	**9.36**	**9.23**	--	**8.93**
Total Fines (sum of all sieves)				**34.13**	**65.8**	**72.15**	--	**80.34**
Polycyclic Aromatic Hydrocarbons (µg/kg)								
2-Methylnaphthalene	SW8270DSIM	670	670	--	**1.6 J**	--	--	--
Acenaphthene	SW8270DSIM	500	500	--	**4.4**	--	--	--
Acenaphthylene	SW8270DSIM	1300	1300	--	**1.7**	--	--	--
Anthracene	SW8270DSIM	960	960	--	**17**	--	--	--
Benzo(a)anthracene	SW8270DSIM	1300	1600	--	**68**	--	--	--
Benzo(a)pyrene	SW8270DSIM	1600	1600	--	**32**	--	--	--
Benzo(b,j)fluoranthene	SW8270DSIM			--	**57**	--	--	--
Benzo(e)pyrene	SW8270DSIM			--	**26**	--	--	--
Benzo(g,h,i)perylene	SW8270DSIM	670	720	--	**15**	--	--	--
Benzo(k)fluoranthene	SW8270DSIM			--	**23**	--	--	--
Chrysene	SW8270DSIM	1400	2800	--	**100**	--	--	--
Dibenzo(a,h)anthracene	SW8270DSIM	230	230	--	**5.1**	--	--	--
Dibenzofuran	SW8270DSIM	540	540	--	--	--	--	--
Fluoranthene	SW8270DSIM	1700	2500	--	**140**	--	--	--
Fluorene	SW8270DSIM	540	540	--	**7.1**	--	--	--

Table 1
Surface Bulk Sediment Results

Task				**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**
Location ID				**SH-28-170712**	**SPI-22-170713**	**SPI-30-170713**	**SPI-31-170713**	**SPI-31-170713**
Sample ID				**SH-28-SG-170712**	**SPI-22-SG-170713**	**SPI-30-SG-170713**	**SPI-131-SG-170713**	**SPI-31-SG-170713**
Sample Date				**7/12/2017**	**7/13/2017**	**7/13/2017**	**7/13/2017**	**7/13/2017**
Depth				**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**	**0–10 cm**
Sample Type				**N**	**N**	**N**	**FD**	**N**
X				**1081568.517**	**1080205.879**	**1080380.919**	**1081277.578**	**1081277.578**
Y				**84922.72201**	**83592.417**	**83461.02485**	**83610.71742**	**83610.71742**
		AET_Marine_ SCO_SCUMII	**AET_Marine_ CSL_SCUMII**					
Indeno(1,2,3-c,d)pyrene	SW8270DSIM	600	690	--	**17**	--	--	--
Naphthalene	SW8270DSIM	2100	2100	--	**2.2**	--	--	--
Perylene	SW8270DSIM			--	**11**	--	--	--
Phenanthrene	SW8270DSIM	1500	1500	--	**45**	--	--	--
Pyrene	SW8270DSIM	2600	3300	--	**110**	--	--	--
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 1/2)				--	**50.01**	--	--	--
Total Benzofluoranthenes (b,j,k) (U = 0)		3200	3600	--	**23**	--	--	--
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 0)				--	**50.01**	--	--	--
Total HPAH (SMS) (U = 0)		12000	17000	--	**567.1**	--	--	--
Total LPAH (SMS) (U = 0)		5200	5200	--	**77.4**	--	--	--
Dioxin Furans (ng/kg)								
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B			**0.365 J**	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B			**1.6 J**	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B			**2.25 J**	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B			**12.2**	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B			**4.77**	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B			**219**	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613B			**1790**	--	--	--	--
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B			**93.9 J**	--	--	--	--
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B			**85.9 J**	--	--	--	--
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B			**206 J**	--	--	--	--
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B			**587**	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613B			**1.62**	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B			**1.34 J**	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B			**3.47**	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B			**6.12**	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B			**2.53**	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613B			**0.38 J**	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B			**4.36**	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613B			**62.5**	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613B			**3.98**	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613B			**208**	--	--	--	--
Total Tetrachlorodibenzofuran (TCDF)	E1613B			**35.1 J**	--	--	--	--
Total Pentachlorodibenzofuran (PeCDF)	E1613B			**41.4 J**	--	--	--	--
Total Hexachlorodibenzofuran (HxCDF)	E1613B			**112**	--	--	--	--
Total Heptachlorodibenzofuran (HpCDF)	E1613B			**215**	--	--	--	--
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2)				**9.9234 J**	--	--	--	--
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0)				**9.9234 J**	--	--	--	--

Table 1
Surface Bulk Sediment Results

Notes

Bold: detected result

µg/kg: micrograms per kilogram

CAEPA: California EPA

cPAH: carcinogenic polycyclic aromatic hydrocarbons

FD: field duplicate

J: estimated value

HPAH: high-molecular-volumen polycyclic aromatic hydrocarbon

LPAH: low-molecular-weight polycyclic aromatic hydrocarbon

N: normal sample

ng/kg: nanograms per kilogram

pct: percent

TEQ: Toxic Equivalence Quotient

U: compound analyzed, but not detected above detection limit

Table 2
Surface Sediment Porewater Results

Station ID	DGT Gel Thickness (mm)	Trap Sample Sulfide Mass (µmol)	Trap Sample Sulfide Concentration (mg/L)	Hours of Deployment	Calculated Porewater Free Sulfide Concentration (mg/L)	Sampling notes
Free hydrosulfide ion (HS^-) and Hydrogen Sulfide (H_2S)						
SH-04	0.78	R	R	48.1	R	Rejected - DGT observed lying flat on sediment surface
SH-13A	0.78	11	0.18	45.3	0.4	Sediment observed on appuratus to ~ 3.5 inches
SH-14	0.78	NA	NA	NA	NA	Sampler Lost
SH-19	0.78	0.11	0.0018	41.6	0.005	Sediment observed to top of appuratus
SH-21	0.78	21.5	0.34	46.5	0.8	Sediment observed to top of appuratus
SH-22	0.78	1	0.016	47.3	0.04	Sediment observed on appuratus to ~ 3.5 inches
SPI-31	0.78	36	0.58	39.6	1.6	Visual confirmation of full insertion

Notes:

Example Calculation:

$$PW\ concentration = \frac{\text{mass of sulfide sorbed by DGT}(35.7\ \mu\text{mol}) * 0.001\,\frac{\text{mmol}}{\mu\text{mol}} * 32\,\frac{\text{mg}}{\text{mmol}} * \text{thickness of diffusion layer } (0.78\text{mm}) * 0.1\ \text{cm/mm}}{\text{Diffusion coefficient of sulfide in gel } (1.48 * \frac{10^{-5}cm^2}{\text{s}}) * \text{surface area of the gel } (27\ cm^2) * \text{exposure time}(48\ \text{hours} = 172800\ \text{s}) * \frac{ml}{cm^3} * 0.001L/ml}$$

Bold: detected result

µmol: micromole

DGT: diffusive gradient thin

mg/L: milligrams per liter

mm: millimeter

NA: not available

R: result rejected

Table 3
Radiochemistry Results

		SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017
		SH-14-170808	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**
		SH-14-GEO-0-2-170809	**SH-14-GEO-10-12-170809**	**SH-14-GEO-12-14-170809**	**SH-14-GEO-14-16-170809**	**SH-14-GEO-16-18-170809**	**SH-14-GEO-18-20-170809**	**SH-14-GEO-22-24-170809**	**SH-14-GEO-2-4-170809**	**SH-14-GEO-28-30-170809**
Sample Date		**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**
Depth		**0–2 cm**	**10–12 cm**	**12–14 cm**	**14–16 cm**	**16–18 cm**	**18–20 cm**	**22–24 cm**	**2–4 cm**	**28–30 cm**
Sample Type		**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**
Matrix		**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**
X		**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**
Y		**84302.015**	**84302.015**	**84302.015**	**84302.015**	**84302.015**	**84302.015**	**84302.015**	**84302.015**	**84302.015**
Radionuclides (pci/g)										
Beryllium 7	E901.1	--	--	--	--	--	--	--	--	--
Cesium 137	E901.1	--	0.0986 U	0.0847 U	0.0981 U	0.0893 U	--	--	0.0993 U	--
Lead 210	TBE-2015	0.126 U	**0.253**	--	**0.293**	--	**0.429**	**0.13**	**0.634**	0.133 U

Table 3
Radiochemistry Results

		SheltonRI_FS_2017	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**
		SH-14-170808	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**	**SH-19-170712**	**SH-19-170712**
		SH-14-GEO-38-40-170809	**SH-14-GEO-4-6-170809**	**SH-14-GEO-48-50-170809**	**SH-14-GEO-6-8-170809**	**SH-14-GEO-78-80-170809**	**SH-14-GEO-8-10-170809**	**SH-19-GEO-000002-170714**	**SH-19-GEO-002004-170714**
Sample Date		**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**	**7/14/2017**	**7/14/2017**
Depth		**38–40 cm**	**4–6 cm**	**48–50 cm**	**6–8 cm**	**70–80 cm**	**8–10 cm**	**0–2 cm**	**2–4 cm**
Sample Type		**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**
Matrix		**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**
X		**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**	**1078945.317**	**1078945.317**
Y		**84302.015**	**84302.015**	**84302.015**	**84302.015**	**84302.015**	**84302.015**	**84076.30474**	**84076.30474**
Radionuclides (pci/g)									
Beryllium 7	E901.1	--	--	--	--	--	--	0.99 U	--
Cesium 137	E901.1	--	0.0643 U	--	0.089 U	--	0.0958 U	--	0.196 U
Lead 210	TBE-2015	0.13 U	--	0.135 U	**0.404**	**0.309**	0.126 U	**0.854 J**	**0.6**

Table 3
Radiochemistry Results

		SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017
		SH-19-170712	SH-19-170712	SH-19-170712	SH-19-170712	SH-19-170712	SH-19-170712	SH-19-170712	SH-19-170712
		SH-19-GEO-004006-170714	SH-19-GEO-006008-170714	SH-19-GEO-008010-170714	SH-19-GEO-010012-170714	SH-19-GEO-012014-170714	SH-19-GEO-014016-170714	SH-19-GEO-016018-170714	SH-19-GEO-018020-170714
	Sample Date	7/14/2017	7/14/2017	7/14/2017	7/14/2017	7/14/2017	7/14/2017	7/14/2017	7/14/2017
	Depth	4–6 cm	6–8 cm	8–10 cm	10–12 cm	12–14 cm	14–16 cm	16–18 cm	18–20 cm
	Sample Type	N	N	N	N	N	N	N	N
	Matrix	SE	SE	SE	SE	SE	SE	SE	SE
	X	1078945.317	1078945.317	1078945.317	1078945.317	1078945.317	1078945.317	1078945.317	1078945.317
	Y	84076.30474	84076.30474	84076.30474	84076.30474	84076.30474	84076.30474	84076.30474	84076.30474
Radionuclides (pci/g)									
Beryllium 7	E901.1	--	--	--	--	--	--	--	--
Cesium 137	E901.1	0.0921 U	0.0969 U	0.0979 U	0.0892 U	0.0652 U	0.098 U	0.0843 U	--
Lead 210	TBE-2015	--	**0.823**	**0.812 J**	**0.154**	--	**0.267**	--	**0.221 J**

Table 3
Radiochemistry Results

		SheltonRI_FS_2017 SH-19-170712 SH-19-GEO-020022-170714	SheltonRI_FS_2017 SH-19-170712 SH-19-GEO-022024-170714	SheltonRI_FS_2017 SH-19-170712 SH-19-GEO-024026-170714	SheltonRI_FS_2017 SH-19-170712 SH-19-GEO-028030-170714	SheltonRI_FS_2017 SH-19-170712 SH-19-GEO-032034-170714	SheltonRI_FS_2017 SH-19-170712 SH-19-GEO-038040-170714	SheltonRI_FS_2017 SH-19-170712 SH-19-GEO-044046-170714	SheltonRI_FS_2017 SH-19-170712 SH-19-GEO-048050-170714
	Sample Date	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**
	Depth	**20–22 cm**	**22–24 cm**	**24–26 cm**	**28–30 cm**	**32–34 cm**	**38–40 cm**	**44–46 cm**	**48–50 cm**
	Sample Type	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**
	Matrix	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**
	X	**1078945.317**	**1078945.317**	**1078945.317**	**1078945.317**	**1078945.317**	**1078945.317**	**1078945.317**	**1078945.317**
	Y	**84076.30474**	**84076.30474**	**84076.30474**	**84076.30474**	**84076.30474**	**84076.30474**	**84076.30474**	**84076.30474**
Radionuclides (pci/g)									
Beryllium 7	E901.1	--	--	--	--	--	--	--	--
Cesium 137	E901.1	0.056 U	--	0.0951 U	--	0.0752 U	0.0949 U	0.0914 U	--
Lead 210	TBE-2015	--	**0.159**	--	0.0949 UJ	--	**0.232 J**	--	**0.231 J**

Table 3
Radiochemistry Results

		SheltonRI_FS_2017 SH-19-170712 SH-19-GEO-050052-170714	SheltonRI_FS_2017 SH-19-170712 SH-19-GEO-052054-170714	SheltonRI_FS_2017 SH-19-170809 SH-19-GEO-98-100-170810	SheltonRI_FS_2017 SH-22-170712 SH-22-GEO-000002-170714	SheltonRI_FS_2017 SH-22-170712 SH-22-GEO-002004-170714	SheltonRI_FS_2017 SH-22-170712 SH-22-GEO-004006-170714	SheltonRI_FS_2017 SH-22-170712 SH-22-GEO-006008-170714	SheltonRI_FS_2017 SH-22-170712 SH-22-GEO-008010-170714
	Sample Date	7/14/2017	7/14/2017	8/10/2017	7/14/2017	7/14/2017	7/14/2017	7/14/2017	7/14/2017
	Depth	50–52 cm	52–54 cm	98–100 cm	0–2 cm	2–4 cm	4–6 cm	6–8 cm	8–10 cm
	Sample Type	N	N	N	N	N	N	N	N
	Matrix	SE	SE	SE	SE	SE	SE	SE	SE
	X	1078945.317	1078945.317	1078962.382	1079632.45	1079632.45	1079632.45	1079632.45	1079632.45
	Y	84076.30474	84076.30474	84090.036	84373.99247	84373.99247	84373.99247	84373.99247	84373.99247
Radionuclides (pci/g)									
Beryllium 7	E901.1	--	--	--	0.731 U	--	--	--	--
Cesium 137	E901.1	0.0819 U	0.0982 U	--	--	0.0962 U	0.0976 U	0.0862 U	**0.0657**
Lead 210	TBE-2015	--	--	0.126 U	**0.882 J**	**0.651**	--	**0.443**	**0.543 J**

Table 3
Radiochemistry Results

		SheltonRI_FS_2017	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**
		SH-22-170712	**SH-22-170712**	**SH-22-170712**	**SH-22-170712**	**SH-22-170712**	**SH-22-170712**	**SH-22-170712**	**SH-22-170712**
		SH-22-GEO-010012-170714	**SH-22-GEO-012014-170714**	**SH-22-GEO-014016-170714**	**SH-22-GEO-016018-170714**	**SH-22-GEO-018020-170714**	**SH-22-GEO-020022-170714**	**SH-22-GEO-022024-170714**	**SH-22-GEO-024026-170714**
	Sample Date	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**
	Depth	**10–12 cm**	**12–14 cm**	**14–16 cm**	**16–18 cm**	**18–20 cm**	**20–22 cm**	**22–24 cm**	**24–26 cm**
	Sample Type	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**
	Matrix	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**
	X	**1079632.45**	**1079632.45**	**1079632.45**	**1079632.45**	**1079632.45**	**1079632.45**	**1079632.45**	**1079632.45**
	Y	**84373.99247**	**84373.99247**	**84373.99247**	**84373.99247**	**84373.99247**	**84373.99247**	**84373.99247**	**84373.99247**
Radionuclides (pci/g)									
Beryllium 7	E901.1	--	--	--	--	--	--	--	--
Cesium 137	E901.1	0.0905 U	0.0749 U	0.0946 U	0.0955 U	--	0.0772 U	--	0.098 U
Lead 210	TBE-2015	**0.764**	--	**0.381**	--	**0.351 J**	--	0.101 U	--

Table 3
Radiochemistry Results

		SheltonRI_FS_2017	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**
		SH-22-170712	**SH-22-170712**	**SH-22-170712**	**SH-22-170712**	**SH-22-170712**	**SH-22-170712**	**SH-22-170712**	**SH-22-170712**
		SH-22-GEO-028030-170714	**SH-22-GEO-032034-170714**	**SH-22-GEO-038040-170714**	**SH-22-GEO-044046-170714**	**SH-22-GEO-048050-170714**	**SH-22-GEO-050052-170714**	**SH-22-GEO-052054-170714**	**SH-22-GEO-058060-170714**
Sample Date		**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**	**7/14/2017**
Depth		**28–30 cm**	**32–34 cm**	**38–40 cm**	**44–46 cm**	**48–50 cm**	**50–52 cm**	**52–54 cm**	**58–60 cm**
Sample Type		**N**	**N**	**N**	**N**	**N**	**N**	**N**	**N**
Matrix		**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**	**SE**
X		**1079632.45**	**1079632.45**	**1079632.45**	**1079632.45**	**1079632.45**	**1079632.45**	**1079632.45**	**1079632.45**
Y		**84373.99247**	**84373.99247**	**84373.99247**	**84373.99247**	**84373.99247**	**84373.99247**	**84373.99247**	**84373.99247**
Radionuclides (pci/g)									
Beryllium 7	E901.1	--	--	--	--	--	--	--	--
Cesium 137	E901.1	--	**0.0934**	0.0936 U	0.0939 U	--	0.0916 U	0.0725 U	--
Lead 210	TBE-2015	**0.309 J**	--	**0.102 J**	--	**0.248 J**	--	--	**0.128 J**

Table 3
Radiochemistry Results

		SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017
		SH-22-170712	SH-22-170712	SH-22-170712	SH-22-170712	SH-22-170809
		SH-22-GEO-060062-170714	SH-22-GEO-066068-170714	SH-22-GEO-068070-170714	SH-22-GEO-078080-170714	SH-22-GEO-118-120-170809
	Sample Date	7/14/2017	7/14/2017	7/14/2017	7/14/2017	8/9/2017
	Depth	60–62 cm	66–68 cm	68–70 cm	78–80 cm	118–120 cm
	Sample Type	N	N	N	N	N
	Matrix	SE	SE	SE	SE	SE
	X	1079632.45	1079632.45	1079632.45	1079632.45	1080337.853
	Y	84373.99247	84373.99247	84373.99247	84373.99247	84082.176
Radionuclides (pci/g)						
Beryllium 7	E901.1	--	--	--	--	--
Cesium 137	E901.1	0.0468 U	0.0996 U	--	--	--
Lead 210	TBE-2015	--	--	**0.191 J**	**0.22 J**	**0.36**

Table 3
Radiochemistry Results

Notes:

Bold: detected result

cm: centimeter

J: estimated value

N: normal

pci/g: picocuries per gram

SE: sediment

U: compound analyzed, but not detected above detection limit

UJ: compound analyzed, but not detected above estimated detection limit

Table 4
Subsurface Bulk Sediment Results

Task		**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**
Location ID		**SH-03-170809**	**SH-03-170809**	**SH-03-170809**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**
Sample ID		**SH-03-SC-00-1.9-170809**	**SH-03-SC-1.9-3.75-170809**	**SH-03-SC-3.75-4.6-170809**	**SH-14-10-20-170810**	**SH-14-20-30-170810**	**SH-14-GEO-52-70-170810**	**SH-14-GEO-60-88-170810**
Sample Date		**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/10/2017**	**8/10/2017**	**8/10/2017**	**8/10/2017**
Depth		**0–1.9 ft**	**1.9–3.75 ft**	**3.75–4.6 ft**	**0.3-0.7 ft**	**0.7-1 ft**	**1.7-2.3 ft**	**2-2.9 ft**
Sample Type		**N**	**N**	**N**	**N**	**N**	**N**	**N**
X		**1079571.097**	**1079571.097**	**1079571.097**	**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**
Y		**85744.088**	**85744.088**	**85744.088**	**84302.015**	**84302.015**	**84302.015**	**84302.015**
Conventional Parameters (pct)								
Total volatile solids	D2974	--	--	**3.41**	--	--	**6.92**	--
Polycyclic Aromatic Hydrocarbons (µg/kg)								
2-Methylnaphthalene	SW8270DSIM	--	--	--	**28**	**22**	--	--
Acenaphthene	SW8270DSIM	--	--	--	**26**	**16**	--	--
Acenaphthylene	SW8270DSIM	--	--	--	**34**	**32**	--	--
Anthracene	SW8270DSIM	--	--	--	**30**	**32**	--	--
Benzo(a)anthracene	SW8270DSIM	--	--	--	**32**	**22 J**	--	--
Benzo(a)pyrene	SW8270DSIM	--	--	--	**54**	**24**	--	--
Benzo(b,j)fluoranthene	SW8270DSIM	--	--	--	**33**	**27**	--	--
Benzo(e)pyrene	SW8270DSIM	--	--	--	**57**	**22**	--	--
Benzo(g,h,i)perylene	SW8270DSIM	--	--	--	**52**	**25**	--	--
Benzo(k)fluoranthene	SW8270DSIM	--	--	--	**9.2**	**8.2**	--	--
Chrysene	SW8270DSIM	--	--	--	**49**	**31**	--	--
Dibenzo(a,h)anthracene	SW8270DSIM	--	--	--	**8.5**	**2.7**	--	--
Fluoranthene	SW8270DSIM	--	--	--	**150**	**180**	--	--
Fluorene	SW8270DSIM	--	--	--	**24**	**19**	--	--
Indeno(1,2,3-c,d)pyrene	SW8270DSIM	--	--	--	**20**	**15**	--	--
Naphthalene	SW8270DSIM	--	--	--	**320**	**240**	--	--
Perylene	SW8270DSIM	--	--	--	**78**	**94**	--	--
Phenanthrene	SW8270DSIM	--	--	--	**190**	**180**	--	--
Pyrene	SW8270DSIM	--	--	--	**170**	**210**	--	--
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 1/2)		--	--	--	**64.76**	**31.8 J**	--	--
Total Benzofluoranthenes (b,j,k) (U = 0)		--	--	--	**9.2**	**8.2**	--	--
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 0)		--	--	--	**64.76**	**31.8 J**	--	--
Total HPAH (SMS) (U = 0)		--	--	--	**577.7**	**544.9 J**	--	--
Total LPAH (SMS) (U = 0)		--	--	--	**624**	**519**	--	--
Dioxin Furans (ng/kg)								
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B	**5.57**	0.214 U	0.0702 U	**3.31**	**2.72**	--	0.117 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B	**29.6**	0.275 U	0.0797 U	**17.9**	**13.3**	--	0.154 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	**50.9**	0.322 U	0.0937 U	**32.9**	**23.7**	--	0.204 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	**350**	**0.546 J**	0.1 U	**365**	**229**	--	0.192 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	**118**	**0.5 J**	0.0922 U	**80.4**	**47.3**	--	0.232 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B	**10,200 J**	**8.59**	**1.09 J**	**10,400 J**	**5,160 J**	--	0.557 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613B	**74,700 J**	**54**	**8.23**	**78,900 J**	**36,700 J**	--	6.36 U

Table 4
Subsurface Bulk Sediment Results

	Task	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**
	Location ID	**SH-03-170809**	**SH-03-170809**	**SH-03-170809**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**	**SH-14-170808**
	Sample ID	**SH-03-SC-00-1.9-170809**	**SH-03-SC-1.9-3.75-170809**	**SH-03-SC-3.75-4.6-170809**	**SH-14-10-20-170810**	**SH-14-20-30-170810**	**SH-14-GEO-52-70-170810**	**SH-14-GEO-60-88-170810**
	Sample Date	**8/9/2017**	**8/9/2017**	**8/9/2017**	**8/10/2017**	**8/10/2017**	**8/10/2017**	**8/10/2017**
	Depth	**0–1.9 ft**	**1.9–3.75 ft**	**3.75–4.6 ft**	**0.3-0.7 ft**	**0.7-1 ft**	**1.7-2.3 ft**	**2-2.9 ft**
	Sample Type	**N**	**N**	**N**	**N**	**N**	**N**	**N**
	X	**1079571.097**	**1079571.097**	**1079571.097**	**1081852.559**	**1081852.559**	**1081852.559**	**1081852.559**
	Y	**85744.088**	**85744.088**	**85744.088**	**84302.015**	**84302.015**	**84302.015**	**84302.015**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B	**388 J**	**7.42 J**	0.0702 U	**513 J**	**255 J**	--	0.117 U
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B	**505**	**7.22 J**	0.0797 U	**645**	**257**	--	0.154 U
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	**2,340**	**7.73 J**	0.0952 U	**2,950**	**1,860**	--	**0.282 J**
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B	**20,900**	**17.8**	**2.48**	**21,000**	**11,600**	--	**1.46 J**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613B	**11.3**	**0.733**	0.0683 U	**12**	**8.58**	--	0.118 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B	**12.5**	0.336 U	0.0499 U	**16.1**	**11.6**	--	0.0838 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B	**45.3**	0.343 U	0.0547 U	**49.5**	**27.3**	--	0.0925 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	**150**	0.363 U	0.0835 U	**217**	**176**	--	0.0701 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	**51.7**	0.367 U	0.0729 U	**64.1**	**40.5**	--	0.0672 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613B	**9.45**	0.467 U	0.0996 U	**12.1**	**7.98**	--	0.13 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	**103**	0.36 U	0.078 U	**112**	**76.6**	--	0.0724 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613B	**4,170**	**2.57 J**	**0.418 J**	**4,770**	**3250**	--	0.209 U
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613B	**170**	0.392 U	0.0923 U	**237**	**159**	--	0.113 U
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613B	**13,800 J**	**7.36**	**0.976 J**	**18,900 J**	**9,430 J**	--	0.436 U
Total Tetrachlorodibenzofuran (TCDF)	E1613B	**380 J**	**12.2 J**	0.0683 U	**315 J**	**294 J**	--	0.118 U
Total Pentachlorodibenzofuran (PeCDF)	E1613B	**814**	0.34 U	0.0522 U	**743 J**	**765 J**	--	0.088 U
Total Hexachlorodibenzofuran (HxCDF)	E1613B	**4,550**	**2.64 J**	**0.305 J**	**5,530**	**4,030**	--	0.0815 U
Total Heptachlorodibenzofuran (HpCDF)	E1613B	**17,000**	**8.34**	**1.3**	**22,000**	**12,900**	--	**0.578 J**
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2)		**305.52 J**	**0.704808 J**	**0.1366168 J**	**309.503 J**	**185.053 J**	--	0.154 U
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0)		**305.52 J**	**0.307908 J**	**0.0178418 J**	**309.503 J**	**185.053 J**	--	0.154 U

Table 4
Subsurface Bulk Sediment Results

	Task	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017
	Location ID	SH-19-170809	SH-19-170809	SH-19-170809	SH-19-170809	SH-22-170809	SH-22-170809	SH-22-170809
	Sample ID	SH-19-10-20-170810	SH-19-20-30-170810	SH-19-GEO-28-46-170810	SH-19-GEO-60-90-170810	SH-22-10-20-170809	SH-22-20-30-170809	SH-22-GEO-3.1-4.2-170809
	Sample Date	8/10/2017	8/10/2017	8/10/2017	8/10/2017	8/9/2017	8/9/2017	8/9/2017
	Depth	0.3-0.7 ft	0.7-1 ft	0.9-1.5 ft	2-3 ft	0.3-0.7 ft	0.7-1 ft	3.1–4.2 ft
	Sample Type	N	N	N	N	N	N	N
	X	1078962.382	1078962.382	1078962.382	1078962.382	1080337.853	1080337.853	1080337.853
	Y	84090.036	84090.036	84090.036	84090.036	84082.176	84082.176	84082.176
Conventional Parameters (pct)								
Total volatile solids	D2974	--	--	**3.46**	--	--	--	**5.65**
Polycyclic Aromatic Hydrocarbons (µg/kg)								
2-Methylnaphthalene	SW8270DSIM	**33**	**24 J**	--	--	**40**	**70**	--
Acenaphthene	SW8270DSIM	**36**	**30**	--	--	**52**	**48**	--
Acenaphthylene	SW8270DSIM	**49**	**25**	--	--	**27**	**62**	--
Anthracene	SW8270DSIM	**82**	**48**	--	--	**61**	**66**	--
Benzo(a)anthracene	SW8270DSIM	**73 J**	**39 J**	--	--	**82**	**63**	--
Benzo(a)pyrene	SW8270DSIM	**87**	**44 J**	--	--	**100**	**110**	--
Benzo(b,j)fluoranthene	SW8270DSIM	**100**	**47 J**	--	--	**100**	**66**	--
Benzo(e)pyrene	SW8270DSIM	**72**	**34 J**	--	--	**110**	**120**	--
Benzo(g,h,i)perylene	SW8270DSIM	**92**	**48 J**	--	--	**85**	**110**	--
Benzo(k)fluoranthene	SW8270DSIM	**34**	**15**	--	--	**39**	**20**	--
Chrysene	SW8270DSIM	**100**	**48**	--	--	**260**	**110**	--
Dibenzo(a,h)anthracene	SW8270DSIM	**7.4**	**3.7**	--	--	**18**	**20 J**	--
Fluoranthene	SW8270DSIM	**580**	**290 J**	--	--	**320**	**340**	--
Fluorene	SW8270DSIM	**44**	**31**	--	--	**55**	**57**	--
Indeno(1,2,3-c,d)pyrene	SW8270DSIM	**56**	**29**	--	--	**42**	**44**	--
Naphthalene	SW8270DSIM	**350**	**200 J**	--	--	**350**	**830**	--
Perylene	SW8270DSIM	**47**	**90 J**	--	--	**96**	**140**	--
Phenanthrene	SW8270DSIM	**480**	**250 J**	--	--	**270**	**410**	--
Pyrene	SW8270DSIM	**750**	**350 J**	--	--	**310**	**330**	--
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 1/2)		**115.04 J**	**57.85 J**	--	--	**130.7**	**132.4 J**	--
Total Benzofluoranthenes (b,j,k) (U = 0)		**34**	**15**	--	--	**39**	**20**	--
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 0)		**115.04 J**	**57.85 J**	--	--	**130.7**	**132.4 J**	--
Total HPAH (SMS) (U = 0)		**1,879.4 J**	**913.7 J**	--	--	**1356**	**1213 J**	--
Total LPAH (SMS) (U = 0)		**1041**	**584 J**	--	--	**815**	**1473**	--
Dioxin Furans (ng/kg)								
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B	**3.44**	**2.19**	--	0.128 U	**1.34**	**2.42**	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B	**9.79**	**6.27**	--	0.108 U	**5.82**	**13.7**	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	**12.7**	**8**	--	0.0891 U	**11.4**	**23.8**	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	**43.4**	**23.2**	--	0.0904 U	**87.7**	**269**	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	**17.7**	**11.8**	--	0.101 U	**22.3**	**58.1**	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B	**730**	**331**	--	1.1 U	**2490**	**7,650 J**	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613B	**6,180**	**2240**	--	8.51 U	**20,400 J**	**62,700 J**	--

Table 4
Subsurface Bulk Sediment Results

	Task	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017
	Location ID	SH-19-170809	SH-19-170809	SH-19-170809	SH-19-170809	SH-22-170809	SH-22-170809	SH-22-170809
	Sample ID	SH-19-10-20-170810	SH-19-20-30-170810	SH-19-GEO-28-46-170810	SH-19-GEO-60-90-170810	SH-22-10-20-170809	SH-22-20-30-170809	SH-22-GEO-3.1-4.2-170809
	Sample Date	8/10/2017	8/10/2017	8/10/2017	8/10/2017	8/9/2017	8/9/2017	8/9/2017
	Depth	0.3-0.7 ft	0.7-1 ft	0.9-1.5 ft	2-3 ft	0.3-0.7 ft	0.7-1 ft	3.1–4.2 ft
	Sample Type	N	N	N	N	N	N	N
	X	1078962.382	1078962.382	1078962.382	1078962.382	1080337.853	1080337.853	1080337.853
	Y	84090.036	84090.036	84090.036	84090.036	84082.176	84082.176	84082.176
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B	**465 J**	**356 J**	--	**0.179 J**	**217 J**	**294 J**	--
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B	**511 J**	**389 J**	--	0.108 U	**249**	**328**	--
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	**690**	**499**	--	**0.588**	**860**	**1,770**	--
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B	**1630**	**763**	--	**2.78 J**	**6,960**	**17,900**	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613B	**17.6**	**10.2**	--	0.0756 U	**5.9**	**9.69**	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B	**11.3**	**6.12**	--	0.104 U	**6.76**	**14.5**	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B	**19.5**	**10.4**	--	0.0827 U	**21.7**	**50.8**	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	**23.3**	**11.5**	--	0.0475 U	**63**	**208**	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	**11.7**	**6.38**	--	0.0435 U	**17.8**	**53.9**	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613B	**1.82 J**	**1.05 J**	--	0.0788 U	**4.28**	**13.5**	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	**16.5**	**8.35**	--	0.0488 U	**29**	**93.7**	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613B	**296**	**129**	--	0.262 U	**778**	**3,180**	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613B	**16.3**	**7.31**	--	0.0982 U	**45.5**	**182**	--
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613B	**861**	**310**	--	**0.928 J**	**2,990**	**11,900 J**	--
Total Tetrachlorodibenzofuran (TCDF)	E1613B	**358 J**	**206 J**	--	0.0756 U	**119 J**	**250 J**	--
Total Pentachlorodibenzofuran (PeCDF)	E1613B	**226 J**	**123 J**	--	**0.199 J**	**242 J**	**639 J**	--
Total Hexachlorodibenzofuran (HxCDF)	E1613B	**417 J**	**199**	--	**0.185 J**	**1,120**	**4,040**	--
Total Heptachlorodibenzofuran (HpCDF)	E1613B	**1090**	**444**	--	**0.915 J**	**3,380**	**14,300**	--
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2)		**46.4263 J**	**25.2497 J**	--	**0.1695559 J**	**78.1628 J**	**237.264 J**	--
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0)		**46.4263 J**	**25.2497 J**	--	**0.0002784 J**	**78.1628 J**	**237.264 J**	--

Table 4
Subsurface Bulk Sediment Results

	Task	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017	SheltonRI_FS_2017
	Location ID	**SH-22-170809**	**SPI-22A-170810**	**SPI-31-170809**	**SPI-31-170809**	**SPI-131-170809**
	Sample ID	**SH-22-GEO-60-90-170810**	**SPI-22A-SC-6.7-7.6-170810**	**SPI-31-SC-3-5-170809**	**SPI-31-SC-5-7-170809**	**SPI-131-SC-5-7-170809**
	Sample Date	**8/9/2017**	**8/10/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**
	Depth	**2-3 ft**	**6.7–7.6 ft**	**3–5 ft**	**5–7 ft**	**5–7 ft**
	Sample Type	**N**	**N**	**N**	**N**	**FD**
	X	**1080337.853**	**1080479.550**	**1081265.397**	**1081265.397**	**1081265.397**
	Y	**84082.176**	**83563.844**	**83607.691**	**83607.691**	**83607.691**
Conventional Parameters (pct)						
Total volatile solids	D2974	--	**5.2**	**5.38**	**6.32**	**6.08**
Polycyclic Aromatic Hydrocarbons (µg/kg)						
2-Methylnaphthalene	SW8270DSIM	--	--	--	--	--
Acenaphthene	SW8270DSIM	--	--	--	--	--
Acenaphthylene	SW8270DSIM	--	--	--	--	--
Anthracene	SW8270DSIM	--	--	--	--	--
Benzo(a)anthracene	SW8270DSIM	--	--	--	--	--
Benzo(a)pyrene	SW8270DSIM	--	--	--	--	--
Benzo(b,j)fluoranthene	SW8270DSIM	--	--	--	--	--
Benzo(e)pyrene	SW8270DSIM	--	--	--	--	--
Benzo(g,h,i)perylene	SW8270DSIM	--	--	--	--	--
Benzo(k)fluoranthene	SW8270DSIM	--	--	--	--	--
Chrysene	SW8270DSIM	--	--	--	--	--
Dibenzo(a,h)anthracene	SW8270DSIM	--	--	--	--	--
Fluoranthene	SW8270DSIM	--	--	--	--	--
Fluorene	SW8270DSIM	--	--	--	--	--
Indeno(1,2,3-c,d)pyrene	SW8270DSIM	--	--	--	--	--
Naphthalene	SW8270DSIM	--	--	--	--	--
Perylene	SW8270DSIM	--	--	--	--	--
Phenanthrene	SW8270DSIM	--	--	--	--	--
Pyrene	SW8270DSIM	--	--	--	--	--
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 1/2)		--	--	--	--	--
Total Benzofluoranthenes (b,j,k) (U = 0)		--	--	--	--	--
Total cPAH TEQ (7 minimum CAEPA 2005) (U = 0)		--	--	--	--	--
Total HPAH (SMS) (U = 0)		--	--	--	--	--
Total LPAH (SMS) (U = 0)		--	--	--	--	--
Dioxin Furans (ng/kg)						
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B	0.145 U	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B	0.322 U	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	0.206 U	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	0.193 U	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	0.224 U	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B	**6.33**	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	E1613B	**50.2**	--	--	--	--

Table 4
Subsurface Bulk Sediment Results

Task		**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**	**SheltonRI_FS_2017**
Location ID		**SH-22-170809**	**SPI-22A-170810**	**SPI-31-170809**	**SPI-31-170809**	**SPI-131-170809**
Sample ID		**SH-22-GEO-60-90-170810**	**SPI-22A-SC-6.7-7.6-170810**	**SPI-31-SC-3-5-170809**	**SPI-31-SC-5-7-170809**	**SPI-131-SC-5-7-170809**
Sample Date		**8/9/2017**	**8/10/2017**	**8/9/2017**	**8/9/2017**	**8/9/2017**
Depth		**2-3 ft**	**6.7–7.6 ft**	**3–5 ft**	**5–7 ft**	**5–7 ft**
Sample Type		**N**	**N**	**N**	**N**	**FD**
X		**1080337.853**	**1080479.550**	**1081265.397**	**1081265.397**	**1081265.397**
Y		**84082.176**	**83563.844**	**83607.691**	**83607.691**	**83607.691**
Total Tetrachlorodibenzo-p-dioxin (TCDD)	E1613B	**4.62 J**	--	--	--	--
Total Pentachlorodibenzo-p-dioxin (PeCDD)	E1613B	**3.56 J**	--	--	--	--
Total Hexachlorodibenzo-p-dioxin (HxCDD)	E1613B	**6.47 J**	--	--	--	--
Total Heptachlorodibenzo-p-dioxin (HpCDD)	E1613B	**15.8**	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	E1613B	0.366 U	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B	**0.187 J**	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	E1613B	0.11 U	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	0.187 U	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	0.164 U	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	E1613B	0.338 U	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	E1613B	0.199 U	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	E1613B	**3.67**	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	E1613B	0.541 U	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	E1613B	**9.68 J**	--	--	--	--
Total Tetrachlorodibenzofuran (TCDF)	E1613B	**2.37**	--	--	--	--
Total Pentachlorodibenzofuran (PeCDF)	E1613B	**1.29 J**	--	--	--	--
Total Hexachlorodibenzofuran (HxCDF)	E1613B	**4.39 J**	--	--	--	--
Total Heptachlorodibenzofuran (HpCDF)	E1613B	**13.6**	--	--	--	--
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 1/2)		**0.470129 J**	--	--	--	--
Total Dioxin/Furan TEQ 2005 (Mammal) (U = 0)		**0.123574 J**	--	--	--	--

Table 4
Subsurface Bulk Sediment Results

Notes:

Bold: detected result

µg/kg: micrograms per kilogram

CAEPA: California EPA

cPAH: carcinogenic polycyclic aromatic hydrocarbons

FD: field duplicate

J: estimated value

HPAH: high-molecular-volumen polycyclic aromatic hydrocarbon

LPAH: low-molecular-weight polycyclic aromatic hydrocarbon

N: normal sample

ng/kg: nanograms per kilogram

pct: percent

TEQ: Toxic Equivalence Quotient

U: compound analyzed, but not detected above detection limit

UJ: compound analyzed, but not detected above estimated detection limit

Figures

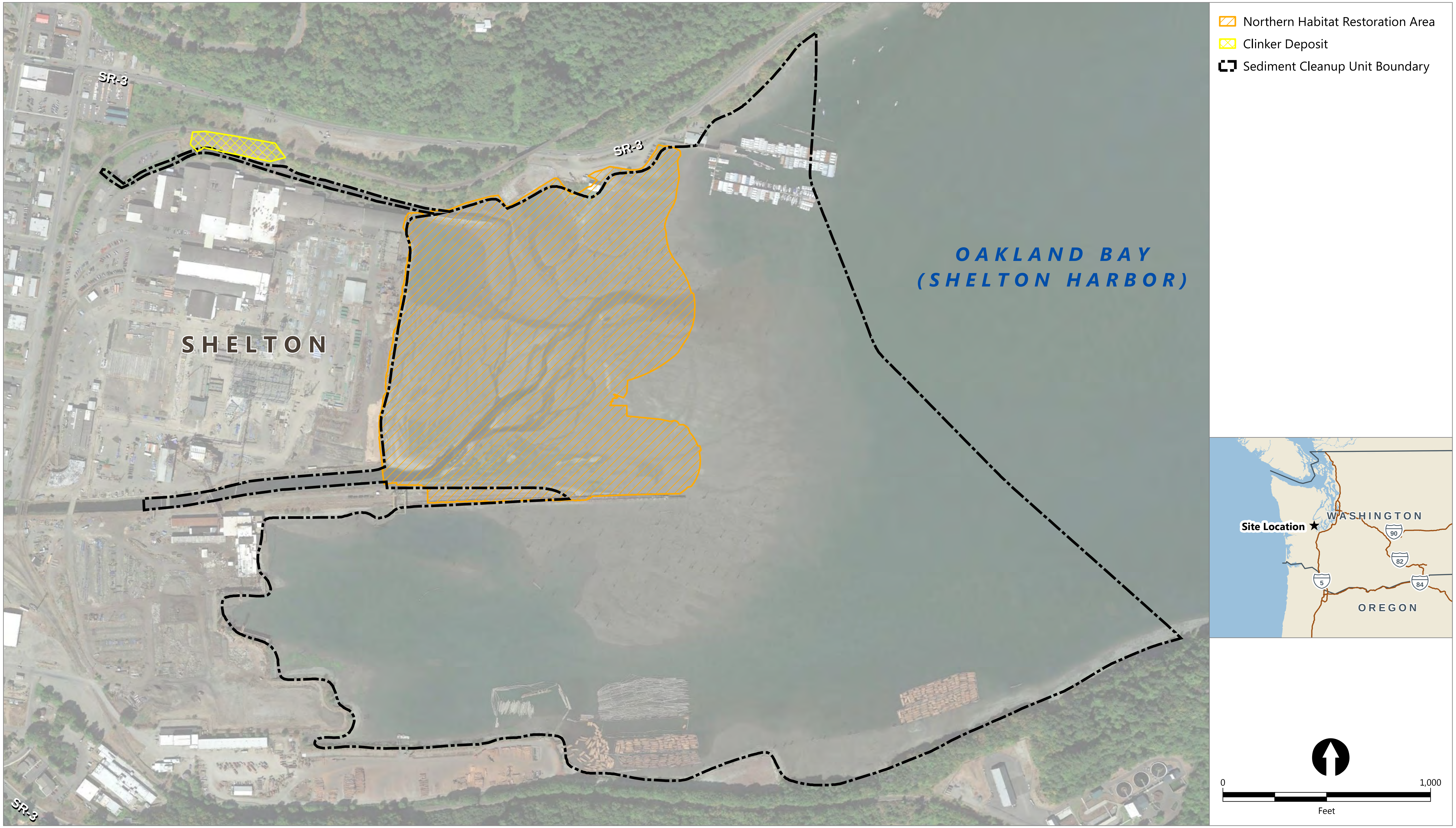

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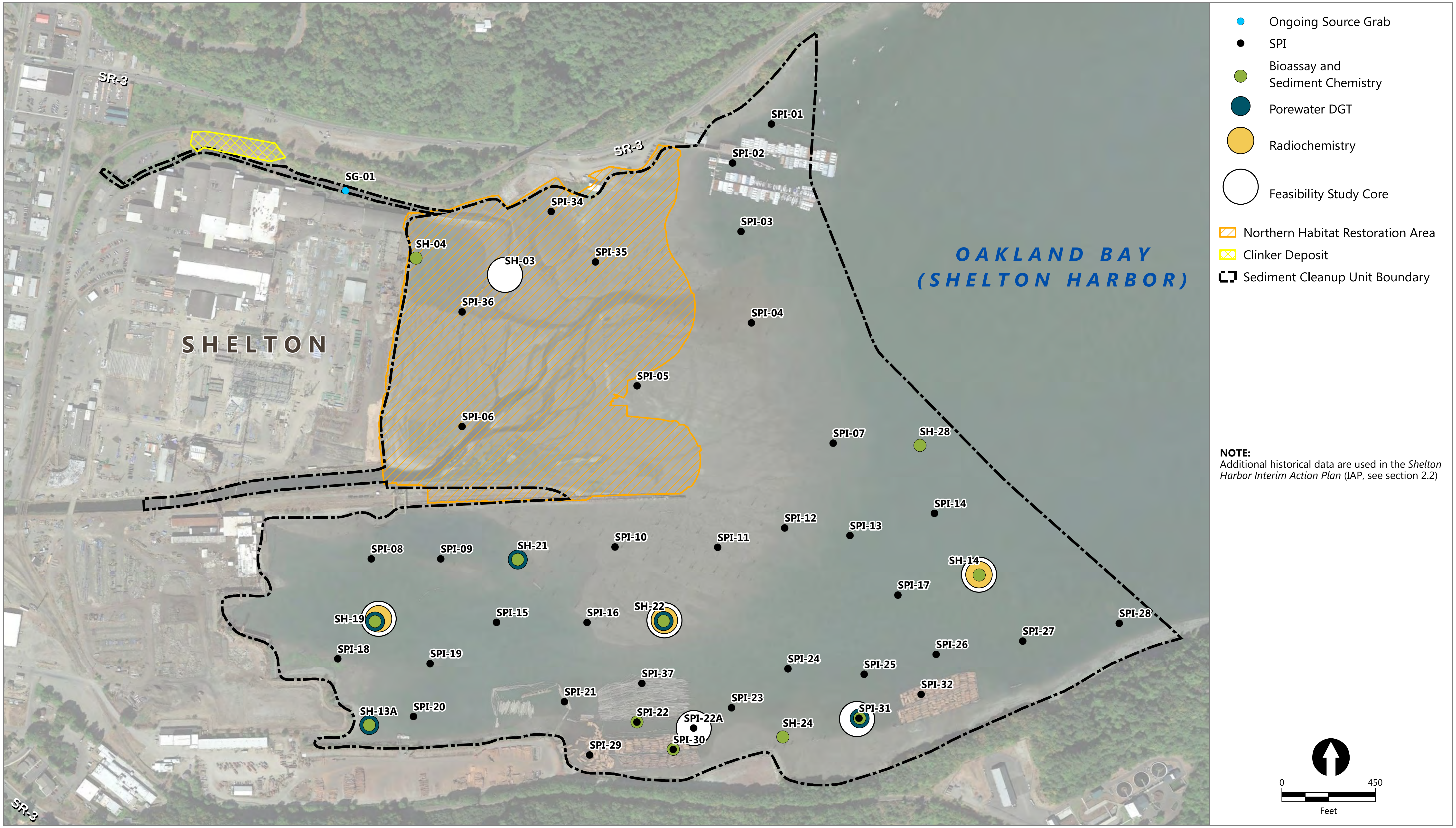
Figure 1
Vicinity Map
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site



NOTE:
Additional historical data are used in the *Shelton Harbor Interim Action Plan* (IAP, see section 2.2)

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Figure 2
2017 SPI Survey and Sampling Locations
Shelton Harbor Interim Action Plan
Oakland Bay and Shelton Harbor Sediments Cleanup Site

Attachment 1

Laboratory Reports (Not Included)

Due to file size, this attachment is only available upon request.

Attachment 2

Data Validation Reports (Not Included)

Due to file size, this attachment is only available upon request.

Attachment 3

Field Collection Forms

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name: **Project No:** 11006-01.01 **Station ID:** SH-24

Sampling Crew: BJ, NB & EP
Sample Date: 7/13/2017 Sampling Method: Power Grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS Weather:
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

47.20653' N
123.08496' W

Sample ID: SH-24-SG-170713
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest Other:
TS / TVS / Grain Size / TOC / Ammonia / Sulfides Other:
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 11.6 ft. Grab Recovery: 20 cm Time: ~~0440~~ 1005
Tide Level: ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	[✓ H2S]	[✓ none]	Dry
gravel	gray	[✓ soft/loose]	slight	Petroleum	trace	Damp
sand C M F	[✓ black]	mod dense/stiff	[✓ moderate]	other:	slight	Moist
[✓ silt clay]	brown	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	[✓ brown surface]	very dense/stiff	overwhelming		heavy	

Comments: Occasional wood present in grab.

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Date/Time Lab Drop Off:

Recorded by: Eli Partmaff

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name: **Project No:** 110008-01.01 **Station ID:** SPI-30

Sampling Crew: BJ, NB, & EP
Sample Date: 7/13/2017 Sampling Method: Power Grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS Weather:
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

Sample ID: SPI-30-SG-170713
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest
TS / TVS / Grain Size / TOC / Ammonia / Sulfides
(Circle Appropriate Analyses)
Other:
Other:

47.20654 N
123.06658 W

Grab Number: 1 Water Depth: ~~[illegible]~~ ft. 16.3 Grab Recovery: 22 cm Time: 0940
Tide Level: ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt clay]	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Rejected grab

47.20632 N
123.06658 W

Grab Number: 2 Water Depth: 16.4 ft. Grab Recovery: 27 cm Time: 0940
Tide Level: ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	[✓ H2S]	[✓ none]	Dry
gravel	gray	[✓ soft/loose]	slight	Petroleum	trace	Damp
sand C M F	[✓ black]	mod dense/stiff	[✓ moderate]	other:	slight	Moist
[✓ silt clay]	brown	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	[✓ brown surface]	very dense/stiff	overwhelming		heavy	

Comments: Roughly 25% woody debris, with other organic matter such as leaves.

[illegible] N
123.08446 W
SH-24-SG

Grab Number: 1 Water Depth: 11.6 ft. 7/13/2017 Grab Recovery: 20 cm Time:
Tide Level: ft. SH-24 Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	[✓ H2S]	[✓ none]	Dry
gravel	gray	[✓ soft/loose]	[✓ slight]	Petroleum	trace	Damp
sand C M F	[✓ black]	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt clay]	brown	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	[✓ brown surface]	very dense/stiff	overwhelming		heavy	

Comments: Occasional wood present in grab.

Date/Time Lab Drop Off:

Recorded by: Eli Patrant

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name: **Project No:** 110008-01.01 **Station ID:** SPI-31

Sampling Crew: BJ/NB/EP
Sample Date: 7/13/2017 Sampling Method: B Power Grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS Weather:
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

47.20691' N
123.08300' W

Sample ID: SPI-31-SG-170713
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest Other:
TS / TVS / Grain Size / TOC / Ammonia / Sulfides Other:
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 14.8 ft. Grab Recovery: 22 cm Time: 1035
Tide Level: ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	[✓ none]	H2S	[✓ none]	Dry
gravel	[✓ gray]	[✓ soft/loose]	slight	Petroleum	trace	Damp
sand C M [✓ F]	[✓ black]	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt] clay	brown	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	[✓ brown surface]	very dense/stiff	overwhelming		heavy	

Comments: Occasional wood debris that are mostly twigs and small sticks.

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Date/Time Lab Drop Off:

Recorded by: Eli Partmort

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name: **Project No:** 110008-01.01 **Station ID:** SPI-22

Sampling Crew: BJ, NB, & EP
Sample Date: 7/13/2017 Sampling Method: Power Grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS Weather: Sunny
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

Sample ID: SPI-22-SG-170713
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest
TS / TVS / Grain Size / TOC / Ammonia / Sulfides
(Circle Appropriate Analyses)
Other:
Other:

47.20667° N
123.08730° W

Grab Number: 1 Water Depth: ~~[illegible]~~ ft. 15.8 Grab Recovery: 18 cm Time: 0900
Tide Level: ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	[✓ Very soft/Loose]	none	[✓ H2S]	[✓ none]	Dry
gravel	gray	soft/loose	~~slight~~	Petroleum	trace	Damp
sand C M F	[✓ black]	mod dense/stiff	[✓ moderate]	other:	slight	Moist
[✓ silt clay]	brown	dense/stiff	strong		moderate	Wet
[✓ organic matter]	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Newly floated log rafts bordering station. Grab sample is mostly woody debris (at least 50%)

47.20691° N
123.08300° W

SPI-31

Grab Number: 1 Water Depth: ~~[illegible]~~ ft. SPI-31 Grab Recovery: cm Time: 1035
Tide Level: 14.8 ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	[✓ none]	H2S	[✓ none]	Dry
gravel	[✓ gray]	[✓ soft/loose]	slight	Petroleum	trace	Damp
sand C M [✓ F]	[✓ black]	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt] clay	brown	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	[✓ brown surface]	very dense/stiff	overwhelming		heavy	

Comments: Occasional wood debris that are mostly twigs & sticks. Some bark.

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Date/Time Lab Drop Off:

Recorded by: Eli Patmont

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name: **Project No:** 110008-01.01 **Station ID:** SH-28

Sampling Crew: BJ, HB EP
Sample Date: 7/12/2017 Sampling Method: Power Grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS Weather:
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

Sample ID: SH-28-SG-170712
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest Other:
TS / TVS / Grain Size / TOC / Ammonia / Sulfides Other:
(Circle Appropriate Analyses)

47.21041° N
123.08197° W

Grab Number: 1 Water Depth: 4.8 ft. Grab Recovery: cm Time: ~~[illegible]~~ 16:10
Tide Level: ft. Sample Interval: ~~[illegible]~~ cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Over penetration

47.21043 N
123.08200° W

Grab Number: 2 Water Depth: 10.0 ft. Grab Recovery: 22 cm Time: ~~[illegible]~~ 16:20
Tide Level: ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	[✓ none]	H2S	[✓ none]	Dry
gravel	[✓ gray]	[✓ soft/loose]	slight	Petroleum	trace	Damp
sand C M [✓ F]	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt] clay	[✓ brown]	dense/stiff	strong		moderate	[✓ Wet]
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments: large 2-4 inch woody debris. Ghost shrimp present in sample

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Date/Time Lab Drop Off:

Recorded by: Eli Partmont

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name: **Project No:** 110008-01.01 **Station ID:** SH-22

Sampling Crew: NB, BJ & EP N.K Bicher, Ben Johnson, & Eli Patmont
Sample Date: 7/12/2017 Sampling Method: Power grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS Weather:
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

Sample ID: SH-22-SG-170712
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest Other:
[✓ TS] / [✓ TVS] / Grain Size / TOC / Ammonia / Sulfides Other:
(Circle Appropriate Analyses)

47.20802°N
123.08682°W

Grab Number: 1 Water Depth: 10.7 ft. Grab Recovery: 22 cm Time: 0855
Tide Level: ft. Sample Interval: 10 cm
[✓ Bioassay] / [✓ Chemistry] Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	[✓ Very soft/Loose]	none	[✓ H2S]	[✓ none]	Dry
gravel	[✓ gray]	soft/loose	[✓ slight]	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt] clay	[✓ brown]	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Mnla Clams & Wood debris.

47.20801°N
123.08684°W

Grab Number: 2 Water Depth: 10.9 ft. Grab Recovery: 19 cm Time: 0930
Tide Level: ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	[✓ Very soft/Loose]	none	[✓ H2S]	[✓ none]	Dry
gravel	[✓ gray]	soft/loose	[✓ slight]	Petroleum	trace	Damp
sand C [✓ M F]	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt clay]	[✓ brown]	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Crabs, clamshells, & worms

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Date/Time Lab Drop Off:

Recorded by: Eli Patmont

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name: **Project No:** 1100080-01 01 **Station ID:** SH-19

Sampling Crew: Eli Patmont, Ben Johnson, Nik Bacher
Sample Date: 7/12/2017 Sampling Method: Power Grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS Weather:
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

Sample ID: SH-19-SG-170712
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest Other:
TS / TVS / Grain Size / TOC / Ammonia / Sulfides Other:
(Circle Appropriate Analyses)

47.22196 N
123.05245 W

Grab Number: 1 Water Depth: 13.6 ft. Grab Recovery: ___ cm Time: 12:05
Tide Level: ___ ft. Sample Interval: ___ cm
Bioassay / Chemistry Depth MLLW: ___ ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt] clay	brown	dense/stiff	strong		moderate	Wet
[✓ organic matter]	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Overpenetration

47.22189 N
123.05242 W

Grab Number: 2 Water Depth: 13.6 ft. Grab Recovery: 25 cm Time: 12:25
Tide Level: ___ ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ___ ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	[✓ Very soft/Loose]	[✓ none]	H2S	[✓ none]	Dry
gravel	[✓ gray]	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt] clay	[✓ brown]	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Wood debris chunks, few clams

47.20789 N
123.05241 W

Grab Number: ~~3~~ 4 Water Depth: ~~12.3~~ ft. 11.7 Grab Recovery: 20 cm Time: ~~[illegible]~~ 13:00
Tide Level: ___ ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ___ ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	[✓ Very soft/Loose]	[✓ none]	H2S	none	Dry
gravel	[✓ gray]	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt] clay	[✓ brown]	dense/stiff	strong		moderate	Wet
[✓ organic matter]	brown surface	very dense/stiff	overwhelming		heavy	

Comments: AC treatability test. Grab 3 rejected ~~over~~ @12:49 12.3 ft depth
Woody debris in grab. Biota present in grab sample.

47.22190 N
123.05242 W

13:00 Grab 4

Date/Time Lab Drop Off:

Recorded by: Eli Patmont

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name: **Project No:** 110008-01.01 **Station ID:** SH-13A

Sampling Crew: BJ, NB, EP
Sample Date: 7/13/17 Sampling Method: Power Grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS Weather:
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

47.20653 N
123.05246 W

Sample ID: SH-13A-SG-170713
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest Other:
TS / TVS / Grain Size / TOC / Ammonia / Sulfides Other:
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 13.2 ft. Grab Recovery: 22 cm Time: 8:20
Tide Level: ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	[✓ none]	H2S	[✓ none]	Dry
gravel	[✓ gray]	[✓ soft/loose]	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt clay]	[✓ brown]	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Trace organic matter. ~~Minor~~ trace woody debris, mostly twigs.

Grab Number: Water Depth: ft. ~~SH-01~~ Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

~~SH-01~~

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Date/Time Lab Drop Off:

Recorded by: Eli Patnort

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name:
Project No: ~~SH-04~~ 110008-01.01
Station ID: SH-04

Sampling Crew: Ben Johnson, Nick Bacher, Eli Patmont
Sample Date: 7/13/2017
Sampling Method: Power Grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS
Weather:
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

Sample ID: SH-04-SG-~~0~~170713
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest
TS / TVS / Grain Size / TOC / Ammonia / Sulfides
(Circle Appropriate Analyses)
Other:
Other:

Grab Number: ~~1~~
Water Depth: ft.
Tide Level: ft.
Depth MLLW: ft.
Bioassay / Chemistry
Grab Recovery: -0- cm
Sample Interval: cm
Time: 7:25

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt] clay	brown	dense/stiff	strong		moderate	Wet
[✓ organic matter]	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Bucket tipped over. No recovery

Grab Number: ~~#~~1
Water Depth: 12.4 ft.
Tide Level: ft.
Depth MLLW: ft.
Bioassay / Chemistry
Grab Recovery: cm
Sample Interval: ~~10~~ cm
Time: 07:30

47.21270' N
123.09185' W

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Rejected.

Grab Number: 2
Water Depth: 11.5 ft.
Tide Level: ft.
Depth MLLW: ft.
Bioassay / Chemistry
Grab Recovery: 25 cm
Sample Interval: 10 cm
Time: 7:40

47.21270' N
123.09185' W

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	[✓ Very soft/Loose]	[✓ none]	H2S	[✓ none]	Dry
gravel	[✓ gray]	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt] clay	[✓ brown]	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Trace woody debris present. Oysters & other biota present in grab

Date/Time Lab Drop Off:

Recorded by: Eli Patmont

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name: **Project No:** 110008-01.01 **Station ID:** SH-21

Sampling Crew: EP & NB
Sample Date: 7/12/2017 Sampling Method: Power Grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS Weather:
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

Sample ID: SH-21-SG-170712
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest Other:
TS / TVS / Grain Size / TOC / Ammonia / Sulfides Other:
(Circle Appropriate Analyses)

47.20817 °N
123.08145 °W

Grab Number: 1 Water Depth: 5.5 ft. Grab Recovery: 28 cm Time: 1800
Tide Level: ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	[✓ Very soft/Loose]	none	[✓ H2S]	[✓ none]	Dry
gravel	gray	soft/loose	[✓ slight]	Petroleum	trace	Damp
sand C M F	[✓ black]	mod dense/stiff	moderate	other:	slight	[✓ Moist]
[✓ silt clay]	[✓ brown]	dense/stiff	strong		moderate	Wet
[✓ organic matter]	[✓ brown surface]	very dense/stiff	overwhelming		heavy	

Comments: soft seds with leaf litter & black below the surface

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Date/Time Lab Drop Off:

Recorded by: Eli Portmont

ANCHOR QEA

Surface Sediment Field Sample Record

Project Name: **Project No:** 110008-01.01 **Station ID:** SH-14

Sampling Crew: NB & EP
Sample Date: 7/12/2017 Sampling Method: Power grab
Sampling Vessel: Nancy Anne
Subcontractor(s): MSS Weather: Sunny
Station Coordinates: N / Lat.
E / Long.
Datum: NAD 83 / WGS 84 zone:

42.20876° N
123.08015° W

Sample ID: SH-14-SG-0170712
Analysis: Metals / TBT / SVOCs / VOCs / PCBs / Pest Other:
TS / TVS / Grain Size / TOC / Ammonia / Sulfides Other:
(Circle Appropriate Analyses)

Grab Number: 1 Water Depth: 15.5 ft. Grab Recovery: 25 cm Time: ~~[illegible]~~ 1715
Tide Level: ft. Sample Interval: 10 cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	[✓ none]	H2S	[✓ none]	Dry
gravel	[✓ gray]	[✓ soft/loose]	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
[✓ silt clay]	[✓ brown]	dense/stiff	strong		moderate	[✓ Wet]
[✓ organic matter]	brown surface	very dense/stiff	overwhelming		heavy	

Comments: Seaweed present & wood debris in the jaws of the grab
→ BROAD BLADE BROWN ALGAE (LAMINARIA)

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Grab Number: Water Depth: ft. Grab Recovery: cm Time:
Tide Level: ft. Sample Interval: cm
Bioassay / Chemistry Depth MLLW: ft.

Sediment Type:	Sediment Color:	Density:	Sediment Odor:		Sheen:	Moisture:
cobble	D.O.	Very soft/Loose	none	H2S	none	Dry
gravel	gray	soft/loose	slight	Petroleum	trace	Damp
sand C M F	black	mod dense/stiff	moderate	other:	slight	Moist
silt clay	brown	dense/stiff	strong		moderate	Wet
organic matter	brown surface	very dense/stiff	overwhelming		heavy	

Comments:

Date/Time Lab Drop Off:

Recorded by: Eli Patmont

ANCHOR QEA

Sediment Core Collection Log

Page 1 of 1

Job: Shelter Harbor

Job No: 110008-0101

Field Staff: BJ, NB, EP

Contractor: MSS

Vertical Datum:

Station ID: SH-19

Attempt No. 1

Date: 7/12/2017

Logged By: Eli Patmont

Horizontal Datum:

Field Collection Coordinates:

Lat/Northing:

Long/Easting:

A. Water Depth

DTM Depth Sounder:

DTM Lead Line:

B. Water Level Measurements

Time: 1225

Height: 11.7

Source:

C. Mudline Elevation

Recovery Measurements (prior to cuts)

Core Collection Recovery Details:

Core Accepted: Yes / No

Core Tube Length:

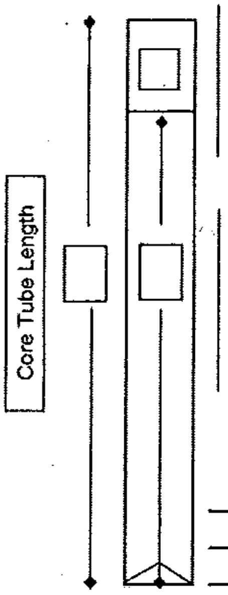
Drive Penetration: 2.7 ft

Headspace Measurement: 26 inches

Recovery Measurement: 22 inches

Recovery Percentage:

Total Length of Core To Process: 22 inches



Sections To Process:

A:

B:

C:

D:

Drive Notes:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

No woody debris in core, pronounced color change at bottom from dark brown to tan to light brown.

Notes:

Steve

ANCHOR QEA

Sediment Core Collection Log

Page 1 of 1

Job: ~~Site~~ Shelton Harbor

Job No: 110008-01.01

Field Staff: MB, BJ, & EP

Contractor: MSS

Vertical Datum:

Station ID: SH-22

Attempt No. 1

Date: 7/12/2017

Logged By: EP

Horizontal Datum:

Field Collection Coordinates:

Lat/Northing:

Long/Easting:

A. Water Depth

DTM Depth Sounder:

DTM Lead Line:

B. Water Level Measurements

Time: 0855

Height: 10.7 ft

Source:

C. Mudline Elevation

Recovery Measurements (prior to cuts)

Core Collection Recovery Details:

Core Accepted: Yes / [✓ No]

Core Tube Length: 4 ft

Drive Penetration: 0 ft 8 inches

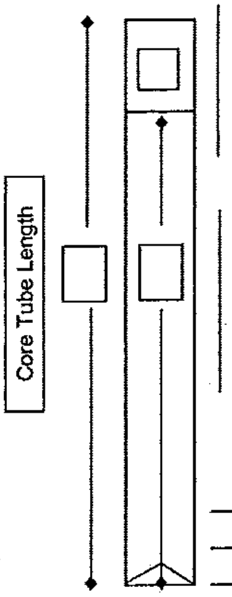
Headspace Measurement: 0 ft 1 inch

Recovery Measurement: 0 ft 7 inches

Recovery Percentage:

Total Length of Core To Process: Rejected

Drive Notes: Recovery to 7 inches with woody debris layer at the bottom. Core rejected.



Sections To Process:

A:

B:

C:

D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:

ANCHOR QEA

Sediment Core Collection Log

Page 1 of __

Job: Shelton Harbor

Job No: 110008-0101

Field Staff: NB, BJ & EP

Contractor: MSS

Vertical Datum:

Station ID: SH-22

Attempt No. 2

Date: 7/12/2017

Logged By: EP

Horizontal Datum:

Field Collection Coordinates:

Lat/Northing:

Long/Easting:

A. Water Depth

DTM Depth Sounder:

DTM Lead Line:

B. Water Level Measurements

Time:

Height:

Source:

C. Mudline Elevation

Recovery Measurements (prior to cuts)

Core Collection Recovery Details:

Core Accepted: [✓ Yes] / No

Core Tube Length: 4 ft

Drive Penetration: ~~[illegible]~~ 32 inches

Headspace Measurement:

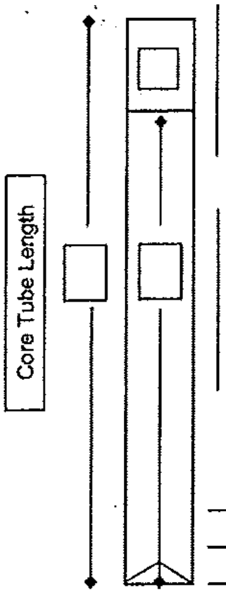
Recovery Measurement: ~~[illegible]~~ 32 inches

Recovery Percentage:

Total Length of Core To Process:

Drive Notes: ~~[illegible]~~

Refusal encountered at 32 inches of penetration



Sections To Process:

A:

B:

C:

D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Mostly clay/silt like material, woody debris encountered at bottom of core

Notes:

ANCHOR QEA

Sediment Core Collection Log

Page 2 of 2

SPI-23A

Job: SHELTON HARBOR
Job No: 110008-0101
Field Staff: NB, EP, HS
Contractor: MGS
Vertical Datum: MLLW

Station ID: SPI-38
Attempt No. 2
Date: 8/10/2017
Logged By: HS
Horizontal Datum: WGS84

Field Collection Coordinates:
Lat/Northing: 47° 12.39678 N
Long/Easting: 123° 05.17171 W

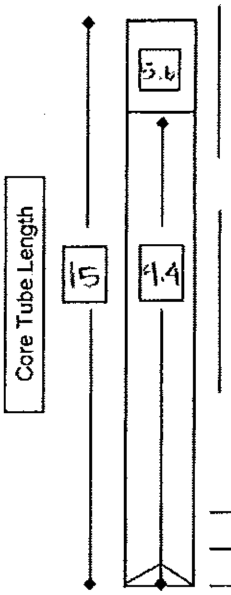
A. Water Depth
DTM Depth Sounder: –
DTM Lead Line: 10.6 FT

B. Water Level Measurements
Time: 1230
Height: 4.8 FT
Source: NOAA SHELTON, OAKLAND BAY

C. Mudline Elevation
-5.8 FT

Core Collection Recovery Details:
Core Accepted: [✓ Yes] / No
Core Tube Length: 15 FT
Drive Penetration: 14.0 FT
Headspace Measurement: 5.6 FT
Recovery Measurement: 9.4 FT
Recovery Percentage: 67%
Total Length of Core To Process: 9.2 FT

Recovery Measurements (prior to cuts)



Drive Notes:
8-10" OF FREEFALL. BREAKS THROUGH SOMETHING AT SURFACE. EASY DRIVE AT BOTTOM AFTER ~4' MARK.

Sections To Process:
A: 0 - 4.6 FT
B: 4.6 - 9.2 FT
C:
D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

WOOD WASTE VISIBLE AT CUT BETWEEN SECTIONS A & B.

Notes:
SILT IN BOTTOM & TOP OF SHOE

ANCHOR QEA

Sediment Core Collection Log

Page 2 of 2

Job: SHELTON HARBOR
Job No: 110008-0101
Field Staff: NB, EP, HS
Contractor: NGS
Vertical Datum: MLLW

Station ID: SP1-31
Attempt No. 2
Date: 8/9/2017
Logged By: HS
Horizontal Datum: WGS 84

Field Collection Coordinates:
Lat/Northing: 47° 12.40771 N
Long/Easting: 123° 04.98242 W

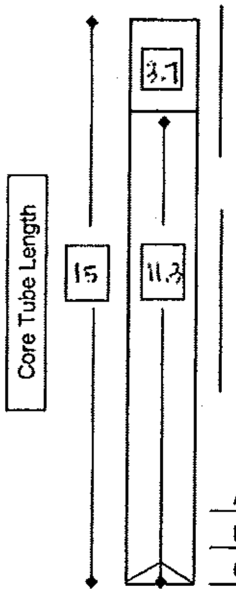
A. Water Depth
DTM Depth Sounder: —
DTM Lead Line: 9.1 FT

B. Water Level Measurements
Time: 1205
Height: 3.9 FT
Source: NOAA SHELTON, OAKLAND HARBOR

C. Mudline Elevation
-5.2 FT

Core Collection Recovery Details:
Core Accepted: [✓ Yes] / No
Core Tube Length: 15 FT
Drive Penetration: 14.0 FT
Headspace Measurement: 3.7 FT
Recovery Measurement: 11.3 FT
Recovery Percentage: 81%
Total Length of Core To Process: 10.9 FT

Recovery Measurements (prior to cuts)



Drive Notes:
EASY DRIVE FOR FIRST FIVE FEET; UNIFORM DRIVE

Sections To Process:
A: 0 - 5.5 FT
B: 5.5 - 10.9 FT
C:
D:

Core Field Observations and Description:
Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

ALOT OF WATER RELEASED FROM BOTTOM OF SECTION A WHEN CUT

Notes:
SILTY CLAY IN SHOE

ANCHOR QEA

Sediment Core Collection Log

Page 4 of 4

Job: Shelton Harbor
Job No: 110208-01.01
Field Staff: JB/HS/EP
Contractor: MSS
Vertical Datum:

Station ID: SH-03
Attempt No. 4
Date: 8/9/2017
Logged By: EP
Horizontal Datum:

6'4"

Field Collection Coordinates:
Lat/Northing: 47 12.75087N
Long/Easting: 123° 05.40632

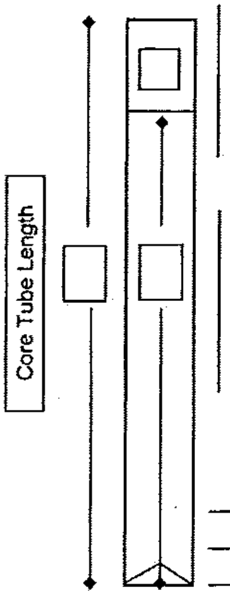
A. Water Depth
DTM Depth Sounder:
DTM Lead Line: 4.9 ft

B. Water Level Measurements
Time: 1022
Height:
Source:

C. Mudline Elevation

Recovery Measurements (prior to cuts)

Core Collection Recovery Details:
Core Accepted: [✓ Yes] / No
Core Tube Length: 15 ft
Drive Penetration: ~~7~~ 6.92
Headspace Measurement: 9.08 ft
Recovery Measurement: 5.92 ft
Recovery Percentage: 86%
Total Length of Core To Process: 5.5 ft



Drive Notes: Drove well to ~6.5 ft then met hard material core stopped advancing. ~~Stopp~~ Pulled core up. Gravel in core shoe?

Sections To Process:
A:
B:
C:
D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:

ANCHOR QEA

Sediment Core Collection Log

Page 2 of 2

Job: ~~110008-0101~~ Shelton Harbor

Station ID: SH-14(B)

Job No: 110008-01.01

Attempt No. ~~2~~ 1

Field Staff: NB, EP, HS

Date: 8/8/2017

Contractor: MSS

Logged By: EP

Vertical Datum: MLLW

Horizontal Datum: WGS 84

Field Collection Coordinates:

Lat/Northing:

Long/Easting:

A. Water Depth

DTM Depth Sounder: —

DTM Lead Line: 13.9 ft

B. Water Level Measurements

Time: 1450

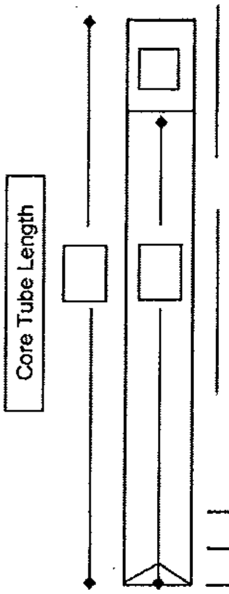
Height: -0.4 FT

Source: NOAA SHELTON, OAKLAND BAY

C. Mudline Elevation

-14.3 FT

Recovery Measurements (prior to cuts)



Core Collection Recovery Details:

Core Accepted: [✓ Yes] / No

Core Tube Length: 5'0"

Drive Penetration: 4' 2"

Headspace Measurement:

Recovery Measurement: 3'1" INCLUDING LOST 2"

Recovery Percentage:

Total Length of Core To Process: 2' 11"

Drive Notes:

EASY DRIVE UNTIL RESISTANCE AT END

Sections To Process:

A:

B:

C:

D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:

2" LOST OFF CORE BOTTOM DURING CAPPING, length to process 2' 11"

PISTON CORE

13.9

ANCHOR QEA

Sediment Core Collection Log

Page 1 of 2

Job: SHELTON HARBOR
Job No:
Field Staff: NB, EP, HS
Contractor: MSS
Vertical Datum: MLLW

Station ID: SH-14(A)
Attempt No. 1
Date: 6/8/2017
Logged By: HS
Horizontal Datum: WGS 84

Field Collection Coordinates:
Lat/Northing:
Long/Easting:

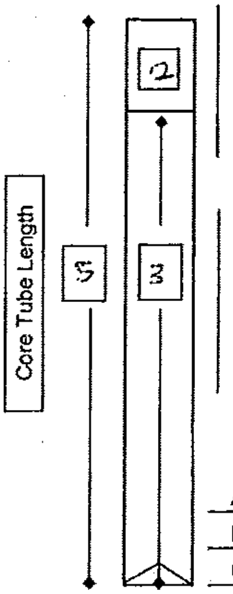
A. Water Depth
DTM Depth Sounder: –
DTM Lead Line: 13.7 FT

B. Water Level Measurements
Time: 14:20
Height: -0.6 FT
Source: NOAA SHELTON, OAKLAND BAY

C. Mudline Elevation
-14.5 FT

Core Collection Recovery Details:
Core Accepted: [✓ Yes] / No
Core Tube Length: 5' 0"
Drive Penetration: 4' 0"
Headspace Measurement: 2' 0"
Recovery Measurement: 3' 0"
Recovery Percentage: 75%
Total Length of Core To Process: 2' 0"

Recovery Measurements (prior to cuts)



9.8" TO BTO WASHER ABOVE WATER

+2'

Drive Notes:
EASY DRIVE. MORE RESISTANCE TOWARDS BOTTOM

Sections To Process:
A:
B:
C:
D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:
~~FOR CHEMISTRY~~ Length to process 3'
PISTON CORE

ANCHOR QEA

Sediment Core Collection Log

Page 2 of 2

Job: SHELTON HARBOR
Job No: 110000-01.01
Field Staff: NB, EP, HS
Contractor: MSS
Vertical Datum: MLLW

Station ID: SH-19
Attempt No. 2
Date: 8/9/2017
Logged By: HS
Horizontal Datum: WGS 84

Field Collection Coordinates:
Lat/Northing: 47° 12.47598 N
Long/Easting: 123° 05.54148 W

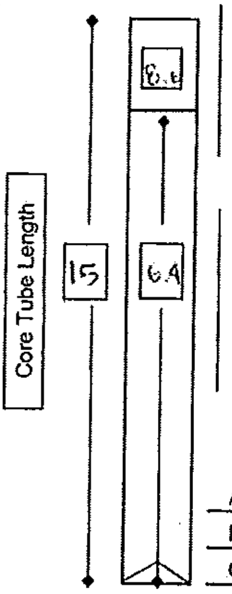
A. Water Depth
DTM Depth Sounder: –
DTM Lead Line: 8.2 FT

B. Water Level Measurements
Time: 1405
Height: -0.3 FT
Source: NOAA SHELTON, OAKLAND HARBOR

C. Mudline Elevation
-8.5 FT

Core Collection Recovery Details:
Core Accepted: [✓ Yes] / No
Core Tube Length: 15.6 FT
Drive Penetration: 8.0 FT
Headspace Measurement: 8.6 FT
Recovery Measurement: 6.4 FT
Recovery Percentage: 80%
Total Length of Core To Process: 6.0 FT

Recovery Measurements (prior to cuts)



Sections To Process:
A: 0-3 FT
B: 3-6 FT
C:
D:

Drive Notes:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

SILT BETWEEN SECTIONS A & B
SAND BETWEEN SECTION B & SHOE

Notes:
SAND & GRAVEL IN SHOE

ANCHOR QEA

Sediment Core Collection Log

Page 2 of 2

Job: Shelton Harbor

Job No: 110008-01.01

Field Staff: NB, HS, EP

Contractor: MSS

Vertical Datum: MLLW

Station ID: SH-22

Attempt No. 2

Date: 8/9/2017

Logged By: EP

Horizontal Datum: NOS 64

Field Collection Coordinates:

Lat/Northing: 47° 12.48224N

Long/Easting: 123° 05.20305W

A. Water Depth

DTM Depth Sounder: —

DTM Lead Line: 6.5 FT

B. Water Level Measurements

Time: 1104

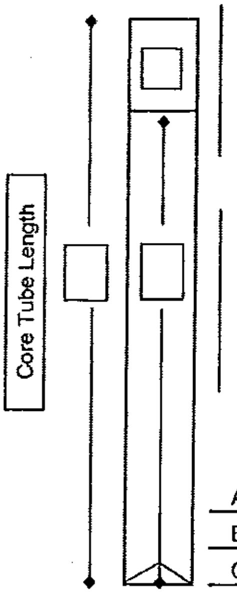
Height: 6.9 FT

Source: NOAA SHELTON, OAKLAND BAY

C. Mudline Elevation

0.6 FT

Recovery Measurements (prior to cuts)



Core Collection Recovery Details:

Core Accepted: [✓ Yes] / No

Core Tube Length: 15 ft

Drive Penetration: 11 Ft

Headspace Measurement: 5.08

Recovery Measurement: 9.92

Recovery Percentage: 90%

Total Length of Core To Process: 9.5 ft

Drive Notes: Hard at the top then easy driving down to ~10 ft. During retrieval soft until ~1 ft above mudline then stiff.

Sections To Process:

A: 0-4 ft

B: 4-9.5 ft

C:

D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Lost about 2 inches out of the bottom of core A during cutting.

Notes:

SILTY SAND w/ SHELL HASH IN SHOE

ANCHOR QEA

Sediment Core Collection Log

Page 1 of 2

Job: SHELTON HARBOR
Job No: 110008-01.01
Field Staff: NB, EP, HS
Contractor: MSS
Vertical Datum: MLLW

Station ID: SP1-36
Attempt No. 1
Date: 8/10/2017
Logged By: HS
Horizontal Datum: WGS84

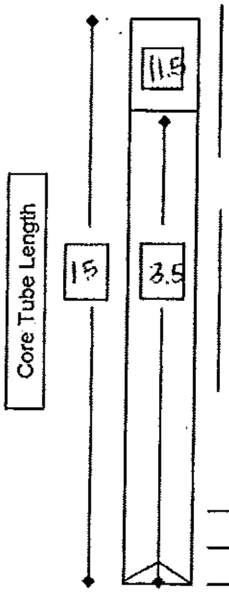
Field Collection Coordinates:
Lat/Northing: 47° 12.39666 N
Long/Easting: 123° 05.17253 W

A. Water Depth
DTM Depth Sounder: —
DTM Lead Line: 11.7 FT

B. Water Level Measurements
Time: 1200
Height: 6.1 FT
Source: NOAA SHELTON, OAKLAND BAY

C. Mudline Elevation
-5.6 FT

Recovery Measurements (prior to cuts)



Core Collection Recovery Details:
Core Accepted: Yes [✓ No]
Core Tube Length: 15 FT
Drive Penetration: 4.2 FT
Headspace Measurement: 11.5 FT
Recovery Measurement: 3.5 FT
Recovery Percentage: 23%
Total Length of Core To Process:

Drive Notes:
2" OF FREEFALL. ABOUT 4.5', PENETRATION SLOWED DOWN SIGNIFICANTLY

Sections To Process:
A:
B:
C:
D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:
WOOD & SAND IN BOTTOM OF SHOE

ANCHOR QEA

Sediment Core Collection Log

Page 1 of 2

Job: SHELTON HARBOR
Job No: 110008-01.01
Field Staff: NB, EP, HS
Contractor: MCG
Vertical Datum: ~~NGS~~ MLLW

Station ID: SPI-31
Attempt No. 1
Date: 6/9/2017
Logged By: HS
Horizontal Datum: WGS 84

Field Collection Coordinates:
Lat/Northing: 47°12.40908 N
Long/Easting: 123° 04.98439 W

A. Water Depth
DTM Depth Sounder: —
DTM Lead Line: 10.3 FT

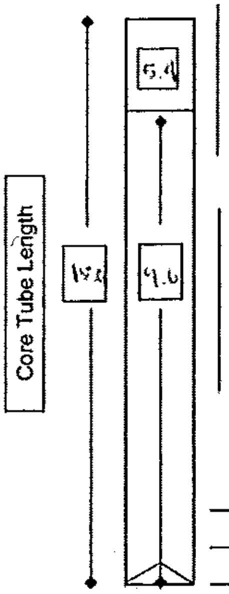
B. Water Level Measurements
Time: 1140
Height: 5.0 FT
Source: NOAA SHELTON, OAKLAND BAY

C. Mudline Elevation
-5.3 FT

Core Collection ib **Recovery Details:**
Core Accepted: ~~Yes~~ / [✓ No]
Core Tube Length: 15.0 FT
Drive Penetration: 14.0 FT
Headspace Measurement: 5.4 FT
Recovery Measurement: 9.6 FT
Recovery Percentage: ~~64~~.ib ~~69~~!b 69%
Total Length of Core To Process:

Drive Notes:
1 FT OF FREEFALL BEFORE STIFFER MATERIAL

Recovery Measurements (prior to cuts)



Sections To Process:
A:
B:
C:
D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:
SILT IN SHOE

ANCHOR QEA

Sediment Core Collection Log

Page 1 of 2

Job: Shelton Harbor

Job No: 10008-01.01

Field Staff: NB, HS, EP

Contractor: MSS

Vertical Datum: MLLW

Station ID: SH-22

Attempt No. 1

Date: 8/9/2017

Logged By: EP

Horizontal Datum: WGS 84

Field Collection Coordinates:

Lat/Northing: 47° 12.48125 N

Long/Easting: 123° 05.20319 W

A. Water Depth

DTM Depth Sounder: –

DTM Lead Line: 6.4 ft

B. Water Level Measurements

Time: 1100

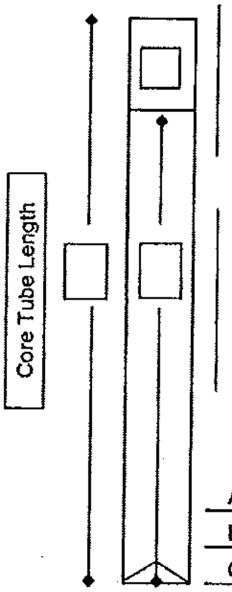
Height: 6.4 FT

Source: NOAA SHELTON, OAKLAND BAY

C. Mudline Elevation

0.5 FT

Recovery Measurements (prior to cuts)



Core Collection Recovery Details:

Core Accepted: Yes / [✓ No]

Core Tube Length:

Drive Penetration:

Headspace Measurement:

Recovery Measurement:

Recovery Percentage:

Total Length of Core To Process:

Drive Notes: ~10" of free fall, Refusal at 10".

Sections To Process:

A:

B:

C:

D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:

ANCHOR QEA

Sediment Core Collection Log

Page 1 of 2

Job: SHELTON HARBOR

Job No: 110006-01.01

Field Staff: NB, EP, HS

Contractor: MSS

Vertical Datum: MLLW

Station ID: SH-19

Attempt No. 1

Date: 8/9/2017

Logged By: HS

Horizontal Datum: WGS 84

Field Collection Coordinates:

Lat/Northing: 47° 12.47097 N

Long/Easting: 123° 05.54736 W

A. Water Depth

DTM Depth Sounder: --

DTM Lead Line: 9.1 FT

B. Water Level Measurements

Time: 1335

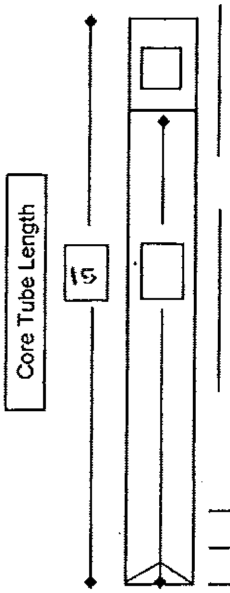
Height: 0.4 FT

Source: NOAA, SHELTON, OAKLAND BAY

C. Mudline Elevation

-8.7 FT

Recovery Measurements (prior to cuts)



Core Collection Recovery Details:

Core Accepted: Yes [✓ No]

Core Tube Length: 15 FT

Drive Penetration: 3.1 FT

Headspace Measurement:

Recovery Measurement:

Recovery Percentage:

Total Length of Core To Process:

Drive Notes:

Sections To Process:

A:

B:

C:

D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

SAND & GRAVEL

Notes:

REJECTED BASED ON LENGTH

ANCHOR QEA

Sediment Core Collection Log

Page 1 of 4

Job: Shelton Harbor

Job No: 110003-01.01

Field Staff: NB, HS, EP

Contractor: MSS

Vertical Datum:

Station ID: SH-03

Attempt No. 1

Date: 8/4/2017

Logged By: EP

Horizontal Datum:

Field Collection Coordinates:

Lat/Northing:

Long/Easting:

A. Water Depth

DTM Depth Sounder:

DTM Lead Line: 7.4

B. Water Level Measurements

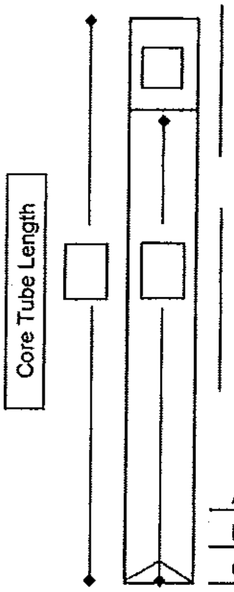
Time: ~~0400~~ 0403

Height:

Source:

C. Mudline Elevation

Recovery Measurements (prior to cuts)



Core Collection Recovery Details:

Core Accepted: Yes / [✓ No]

Core Tube Length: 15 ft

Drive Penetration: 4.18 ft

Headspace Measurement: 11.25

Recovery Measurement: 3.75

Recovery Percentage: ~~8~~ 90%

Total Length of Core To Process:

Drive Notes:

~2 ft of free fall, soft on top with stiff material below. ~~Hit refusal at~~ stiff material from ~2 to 4 ft. Core catcher empty but closed w/clear water running out end of core tube

Sections To Process:

A:

B:

C:

D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

~~Exp~~ After opening core, mix of shell hash, wood, in ~50% fines

Notes:

~~~2 ft of fre~~ Water flowing out of core tube, ~~clean~~ clear. Reject core and check material

47° 12.75114 N 123° 05.40605 W
~~~

Sediment Core Collection Log

Page 2 of 4

Job: Shelton Harbor
Job No: 110008 01.01
Field Staff: VB HS, EP
Contractor: MSS
Vertical Datum:

Station ID: SH-03
Attempt No. 2
Date: 8/9/2017
Logged By: EP
Horizontal Datum:

Field Collection Coordinates:

Lat/Northing:

Long/Easting:

A. Water Depth

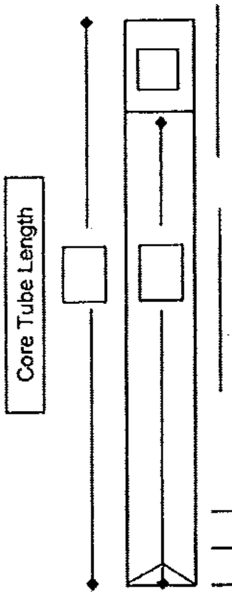
DTM Depth Sounder:
DTM Lead Line: ~~[illegible]~~ 7.7

B. Water Level Measurements

Time: 0930
Height: 8.7 ft
Source: NOAA Shelton, Oakland Bay

C. Mudline Elevation

Recovery Measurements (prior to cuts)



Core Collection Recovery Details:

Core Accepted: Yes / No
Core Tube Length: 15'
Drive Penetration: 11.08'
Headspace Measurement: 9.5
Recovery Measurement: ~~4~~ 5.5
Recovery Percentage: 50%
Total Length of Core To Process:

Drive Notes: 1' of freefall, hard material ~~[illegible]~~ ~~[illegible]~~ under. Core catcher empty w/ a little sand & gravel.

Sections To Process:
A:
B:
C:
D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:

Holding

47° 12.75207 N 123° 05 40867 W

ANCHOR QEA

Sediment Core Collection Log

Page 3 of 4

Job:
Job No:
Field Staff:
Contractor:
Vertical Datum:

Station ID: SH-03
Attempt No. 3
Date:
Logged By:
Horizontal Datum:

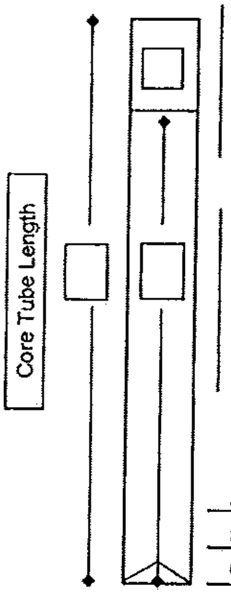
Field Collection Coordinates:
Lat/Northing:
Long/Easting:

A. Water Depth
DTM Depth Sounder:
DTM Lead Line: 5.5'

B. Water Level Measurements
Time: 1006
Height:
Source:

C. Mudline Elevation

Recovery Measurements (prior to cuts)



Core Collection Recovery Details:
Core Accepted: Yes [✓ No]
Core Tube Length: 15 ft
Drive Penetration: 1.58 ft
Headspace Measurement:
Recovery Measurement:
Recovery Percentage:
Total Length of Core To Process:

Sections To Process:
A:
B:
C:
D:

Drive Notes:
1.5 ft free fall, encountered refusal early. Nothing in core cutter.

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Chunk of wood in bottom of core.

Notes:

47° 12.75203 N
123° 06.40516 W

PROJECT: Shelton Harbor		Log of Core No. SH-19	
CORE LOCATION: SH-19		ELEVATION AND DATUM:	
CORING CONTRACTOR MSS (AQ)		DATE STARTED: 7/14/17	DATE COMPLETED: 7/14/17
CORING METHOD: Piston coring		PENETRATION LENGTH:	PERCENT RECOVERY:
CORING EQUIPMENT: Piston Core (AQ)		RECOVERED LENGTH: 59cm	
SAMPLING METHOD: Cut into 2cm slices		LOGGED BY: N. Bacher	
CORE DIAMETER: 3" polycarbonate		Notes:	

DEPTH (feet)	SAMPLES	DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	FIELD-ESTIMATED % Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	REMARKS AND / OR TEST RESULTS
	SH-19-GEO-000002 → SH-19-GED-056058	0-22 cm wet, brownish gray, soft silt ~~w~~ 95 ~~88~~% fines, ~~1~~5% fine sand, 2 large 2" pieces of wood in upper 14cm. Scattered small bark fragments throughout. Sl. to mod. H_2S odor					5	95	
		22-36 wet, gray ~~silty 85%~~ ~~fines, 15% fn. sandy~~ sand mod. dense w/ silt 90% fn sand, 10% fines, few 3/4" subrounded gravel from 32-36cm.					90	10	
		36-44 wet, gray silt ~~99%~~ 100% ~~[illegible]~~ fines, mod. stiff mod. plast. 40-44cm ~~w~~ scattered red bark fragments.						100	
		44-52 wet, gray, sand, mod. dense, trace small brownish red bark fragments					90	10	
		52-59 wet, oxidation red, mod. dense, sand w/ trace ~~to~~ pea gravel. ~~85~~ 90% fn sand 10% pea gravel., trace ~~to~~ black wood frags.		⑩			90		

Project No 110008-01.01

PROJECT: Shelton Harbor

Log of Core No. SH-22

CORE LOCATION: SH-22

ELEVATION AND DATUM:

CORING CONTRACTOR MSS (AQ)

DATE STARTED: 7/14/17

DATE COMPLETED: 7/14/17

CORING METHOD: Piston coring

PENETRATION LENGTH:

PERCENT RECOVERY:

CORING EQUIPMENT: Piston core (AQ)

RECOVERED LENGTH: 80cm

SAMPLING METHOD: Cut into 2cm slices

LOGGED BY: N. Bacher

CORE DIAMETER: 3" polycarbonate

Notes:

DEPTH (feet)	SAMPLES	DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	FIELD-ESTIMATED %						REMARKS AND / OR TEST RESULTS
			Gravel		Sand			Fines	
			Coarse	Fine	Coarse	Medium	Fine		
	SH-22-GEO-000002 → SH-22-GEO-078080	0-16 cm wet, olivegray, mod. soft silt, ~~trace~~ 10% bark fragments to 1", non-pl. fines, sl. to mod. H_2S odor. 2.5" bark frag @ 14cm.				10		80	
		16-24 cm 65-75% bark fragments, trace shell hash.							
		16-34 cm wet, brownish gray, mod. stiff wood (bark frags) 65-75% bark fragments				10		~~[illegible]~~	25
		34-60 cm wet, brownish gray, mod. stiff, wood (bark frags) 85 ~~[illegible]~~ % wood, @ 54-60 sand pockets gray, med-cr. sand. → trace shell hash, mod-strong H_2S odor				5		10	→ 2.5"-3", large cored through.
		60-80 cm wel, olive gray, mod. stiff, silt, 20-25% bark fragments to 1/2". non-pl. fines. sl. H_2S odor. trace shell hash.				20		60	
		Increse to 40% wood from 75-80cm.							

Project No 110008-01.01

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections: 1
Drive Length: 4 ft
Recovery: 3-Ft
% Recovery: ~~100~~ 76%
Notes:

Station ID: SH-14-Geo (A)
Date/Time: ~~8/8/17~~ 8/9/17
Core Logged By: Casey Truisch
Attempt #: 1
Type of Core - Mudmole Vibracore Diver Core PISTON CORE
Diameter of Core (inches) 3"
Core Quality [✓ Good] Fair Poor Disturbed

Recovered Length ~~(ft)~~ cm	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	~~PID~~	Sample	Summary Sketch
	0	15	85	0-34 cm Dk Olive Grey, ~~moist~~ wet, low plast. silt soft, sl. shell hash wood frag @ 26 cm, ~~thin net~~ 3 cm long			SH-14-GEO-000-002 SH-14-GEO-002-004	
10								
~~10~~ 20								
30								
	0	10	90	34-88 cm olive grey, ~~moist~~, wet, silt sl. shell hash, throughout soft to mod. firm, low plasticity				
40								
50				@ 50 wood fragment, 4 cm long				
60 ~~3~~								
70								
80				@ 80 wood fragment, 6 cm long				
90								

Page____ of _____

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections:
Drive Length: ~~5.7~~ 6.9
Recovery: 5.6
% Recovery: ~~??~~ 81%
Notes:

Station ID: SH-03-
Date/Time: 8/09/17 1200
Core Logged By: Casey Janich
Attempt #: 4
Type of Core Mudmole [✓ Vibracore] Diver Core
Diameter of Core (inches) 4
Core Quality [✓ Good] Fair Poor Disturbed

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
	0	15	85	0-3.75 Wet, mod. soft, grey silt. sl. shell hash. low to med. plasticity Sulfur smell present.			SH-03-00-1.9	
				@ 0.7 wood debri fragment				
1								
				1.4 to 3.75 mixed wood fragments 25% to 35%				
2				2-2.1 Wood fragment			SH-03-1.9-3.75	
				2.5 Wood Fragment				
3				@ 3.1 Wood fragment				
		60	40	@ 3.35 fine sand layer, 0.05-inch thick grey, wet.				
				@ 3.4 wood fragments, 0.1-inch thick, black				
4	5	70	25	3.75 to 5.5 Silty Sand, mod. dense med to fine sand, sub-angular, small amount of gravel, rounded. Grey sand and silt, moist			SH-03-3.75-4.6	
				4.6 → transition of silty sand to more				
5	5	85	10	sand, Dense. coarse to med sand.			SH-03-4.6-5.6	

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections:
Drive Length: 6.4
Recovery: 5.6
% Recovery: 81%
Notes:

Station ID: SH-03
Date/Time: 8/07/17 1200
Core Logged By: CJ
Attempt #: 1
Type of Core Mudmole [✓ Vibracore] Diver Core
Diameter of Core (inches) 4
Core Quality [✓ Good] Fair Poor Disturbed

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
5	5	85	10					
				@ 5.5 sand w/ silt, small % of gravel transition to brown, sub-angular; dense, moist				

Page 2 of 2

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections: 2
Drive Length: ~~N/A~~ 14 ft
Recovery: 11.3 ft
% Recovery: 81%
Notes:

Station ID: SPI-31-SC
Date/Time: 08/09/17 1523
Core Logged By: Casey Jeasch
Attempt #: ~~1~~ 2
Type of Core Mudmole ~~Vibracore~~ Diver Core
Diameter of Core (inches)
Core Quality ~~Good~~ Fair Poor Disturbed

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
	0	5	95	0-0.5' Very soft, wet, dk grey silt, presence of organics, silt, no plasticity			SPI-31-SC-0-2-170807	
	0	10	90	0.5-3.0 Soft to m soft dk olive grey silt, presence of wood fragments, slight sulfur odor; low to mod plasticity. 30-35% wood				
1				@ 1.4 → 0.4 ft wood fragment				
2				@ 2.1 wood fragments			SPI-31-SC-2-3-170807	
3	0	10	90	3-10.4 m. soft to firm, olive grey silt, low to mod. plasticity. presence of oyster shells			SPI-31-SC-3-5-170804	
4				4.5 to 4.8 Oyster shells				
5								

cont. on Pg 2

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections: 2
Drive Length: 14ft
Recovery: 11.3 ft
% Recovery: 81%
Notes:

Station ID: SPI-31
Date/Time: 08/09/17
Core Logged By: CJ
Attempt #: 2
Type of Core: Mudmole [✓ Vibracore] Diver Core
Diameter of Core (inches)
Core Quality: [✓ Good] Fair Poor Disturbed

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
5							SPI-31-SC-5-7-170809	
6				Same, mod. firm, olive grey				
				@ 6.7 Oyster shells				
7							SPI-31-SC-7-9-170809	
8								
9				@ 9.1 Oyster shells			SPI-31-SC-9-10-170809	
10								

E 10.4 End

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Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections: 2
Drive Length: 11 ft
Recovery: ~~[illegible]~~ 9.9ft
% Recovery: 90%
Notes:

Station ID: ~~SPI-22~~ SH-22
Date/Time: 08/09/17
Core Logged By: Casey Janisch
Attempt #: ~~1~~ 2
Type of Core Mudmole [✓ Vibracore] Diver Core
Diameter of Core (inches) 4
Core Quality [✓ Good] Fair Poor Disturbed

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
	0	5	95	0-0.5 Soft, wet, dk grey silt, wood fragments 25%, Sulfur Odor			SH-22-GEO-00-02-170809	
1	0	15	85	0.5 - 1.7 Mod. ~~R~~stiff, dk olive grey silt Wood fragments throughout including rots wet				
2	0	25	75	1.7 - 6.2 mod. soft olive grey silt, wet slight shell hash throughout 5% presence of more sand, med to fine, sub-angular. slight presence of wood fragments				
3				@ 3.7 Shell layer, whole and pieces 50-60% for 0.2 ft				
4				4.2 to 5.0 intermittent course sand			SH-22-GEO-118-120-170809	
5				@ 4.7 course sand particles, rounded			SH-22-GEO-3.1-4.2-170809 SH-22-GEO-4.2-6.2-170809	

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections: 2
Drive Length: 11 ft
Recovery: 9.9 ft
% Recovery: 90%
Notes:

Station ID: SH-22
Date/Time: 08/01/17
Core Logged By: EJ
Attempt #: ~~1~~ 2
Type of Core Mudmole [✓ Vibracore] Diver Core
Diameter of Core (inches) 4
Core Quality [✓ Good] Fair Poor Disturbed

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
5				Same, see prev. sheet				
6								
	0	5	95	6.2 - 9 grey w/ brown, mod. stiff, wet, silt w/ clay. slight shell and wood fragments <5%.				
7								
				@ 7.7 wood fragment				
8								
9				End of Sample				

Page 2 of 2

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections:
Drive Length: 4.2 ft
Recovery: 3.1 ft
% Recovery: 74%
Notes: Kept on ice, sampled 8/08

Station ID: SH-14-GEO (B)
Date/Time: 08/10/17
Core Logged By: Casey Janish
Attempt #: 1
Type of Core Mudmole Vibracore Diver Core Pistol Core
Diameter of Core (inches) 3
Core Quality [✓ Good] Fair Poor Disturbed

Recovered Length ~~(ft)~~ cm	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
0	0	10	90	0–30 Soft, wet, dk brown grey silt sl. sulfur odor, no plasticity, some shell fragments in top 10 cm			SH-14- 0-2-170	GEO- 810
20				@ 30 cm wood fragment, 6 cm wide, redish brown color			↓	
40				@ 46 cm wood fragments and shell hash				
	0	5	95	50–88cm mod. stiff, wet, olive grey, silt w/ clay sl. shell hash throughout, low to m. plasticity				
60								
				@ 76 cm whole clam				
80							SH-14-GEO- 86-88-1	70810
				End of Sample @ 88cm				
100								

Page 1 of 1

8

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections: 2
Drive Length: 8 ft
Recovery: 6.4 ft
% Recovery: 80%
Notes:

Station ID: SH-19-GEO
Date/Time: 08/10/17
Core Logged By: Casey Janisck
Attempt #: 2
Type of Core Mudmole [✓ Vibracore] Diver Core
Diameter of Core (inches)
Core Quality [✓ Good] Fair Poor Disturbed

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
1	0	15	85	0-1.1 Soft, wet, olive grey silt, wood fragments present, sl. amount of sand + organics, scattered wood fragments				
	0	40	60	1.1-1.5 m. soft, wet, olive grey to dk grey silt with sand, angular,				
2	15	80	5	1.5-2.2 Sand with silt and gravel, olive w/ yellow brown and grey, rounded gravel and angular fine sand, coarse to fine, N.P., med. firm				
3	0	25	75	2.2-3.1 mod. stiff, grey, silt, high plasticity, sl. amount sand and clay, moist, v. fine sand				
	0	30	70	3.1-3.4 dk brown + grey silt, low plasticity, mod. stiff, v. fine sand, angular, odor				
4	40	60	0	3.4-4.3 sand w/ gravel, sand angular, gravel sub-rounded, v. dense, oxidized red + brown				
	0	30	70	4.3-4.5 stiff, wet, silt, brown, no plasticity v. fine to fine sand, angular,				
5	5	90	5	4.5-5.7 see next page				

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections: 2
Drive Length:
Recovery:
% Recovery:
Notes:

Station ID: SH-19-GEO
Date/Time: 08/10/17
Core Logged By: Casey Janisch
Attempt #: 2
Type of Core Mudmole ~~Vibracore~~ Diver Core
Diameter of Core (inches) 4
Core Quality ~~Good~~ Fair Poor Disturbed

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
5	5	90	5	4.5'-5.7 Brown, v. dense sand with gravel and silt, mix coarse to fine sand, SP,				
				End @ 5.7 ft				
6								
7								

Page____of ______

SPI-22A

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections: 2
Drive Length: 14ft
Recovery: 9.1 ft
% Recovery: 65%
Notes:

Station ID: ~~SPI-38-SC~~
Date/Time: 08/10/17 1845
Core Logged By: Casey Janisch
Attempt #: ~~1~~ 2
Type of Core Mudmole ~~Vibracore~~ Dive
Diameter of Core (inches) 4
Core Quality ~~Good~~ Fair Poor Disturbed

Renamed to SPI-22A

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
0	0	10	90	0-6.7ft Soft to mod. soft, olive grey, silt, wet, wood fragments 20-30%. Wood fragments vary between shards and 0.3-ft chunks @ tube diameter, Both yellow + red wood. Trace shell hash throughout.			SPI-38- 00-02-17	SC- 08-10
1								
2				@ 2.3' frequency of wood fragments increase to 65-75% to 4.6'			SPI-38-SC- 02-04-17	0810
3								
				@ 3.8 ft - saturated silt, 80% wood, 0.3 ft thick				
4							SPI-38- 04-06-170	SC- 810
				@ 4.6' presence of wood back to 20-30%				
5								

SPI-22A

Sediment Core Processing Log

ANCHOR QEA

Job: Shelton Harbor
Job No. 110008-01.01
No. of Sections: 2
Drive Length: ~~8.5~~ 14
Recovery: 9.1
% Recovery: ~~14~~ 65%
Notes:

Station ID: ~~SPI-38-SC~~
Date/Time: 08/10/17
Core Logged By: CJ
Attempt #: ~~1~~ 2
Type of Core Mudmole ~~Vibracore~~ Dive
Diameter of Core (inches) 4
Core Quality ~~Good~~ Fair Poor Disturbed

Renamed to SPI-22A

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	Classification and Remarks (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch
5	0	10	90	Same, olive grey silt, soft to mod. soft, 20-30% wood fragments throughout				
6							SPI-38-SC-06-6.7-170810	
				Wood fragments end @ 6.7				
7	0	25	75	6.7 to 7.6 ft olive grey to grey, wet, mod. soft, silt, some sand, angular, sl. shell hash whole shell @ 7.2 ft. 7.6-7.65 Saturated silt.			SPI-38-SC-6.7-7.6-170810	
8	0	0	100	7.6 to 9.1 ft, grey, firm, silt w/clay, no shell hash or wood, moist,			SPI-38-SC-7.6-9.1-170810	
9								
				End Sample @ 9.1 ft				
10								

Attachment 4

SPI Report

Shelton Harbor SPI Survey

Data Report

September 15, 2017

NewFields
115 2nd Ave N, Suite 100
Edmonds, WA 98020

Table of Contents

List of Figures

1.0 Introduction

This report presents the results of the 2017 Sediment Profile Imaging (SPI) survey conducted in Shelton Harbor, WA, in support of the Shelton Harbor Remedial Investigation and Feasibility Study (RI/FS). NewFields, Edmonds, WA, was contracted by Simpson Timber Company to conduct the survey on July 10 and 11, 2017. Technical direction for the survey was provided by Anchor QEA, Seattle, WA. The focus of the SPI investigation was to determine the presence of woody debris in surface sediments, determine the presence of methane gas and bacterial mats, and measure the depth of the apparent redox potential discontinuity (RPD) in Shelton Harbor. The apparent RPD depth approximates the depth of oxygenation and biological mixing in surface sediments. Sampling methods and analysis protocols used for conducting the SPI survey are provided in Section 2.0. Results are presented in Section 3.0 and a summary is provided in Section 4.0.

2.0 Methods

2.1 Sediment Profile Imaging

SPI images were collected using an Ocean Imaging System model 3731 sediment-profile camera deployed from the research vessel (R/V) *Nancy Ann*, owned and operated by Marine Sampling Systems, Burley, WA. The sediment-profile camera consisted of a wedge-shaped prism with a Plexiglas face plate and a back mirror mounted at a 45 degree angle. Light was provided by an internal strobe. The camera obtained images of up to 20 cm of the upper sediment column in profile (Figure 2-1).

Over the course of two days (July 10 and 11, 2017), SPI images were collected at 62 stations throughout Shelton Harbor (Figure 2-2). A minimum of one SPI image was collected at each station.

2.2 SPI Image Analysis

Computer image analysis of SPI images apparent RPD depths followed a formal and standardized technique developed by Rhoads and Germano (1982, 1986). Physical and biological parameters were measured directly from the digital SPI images by an analyst using computer image analysis software. A minimum of one SPI image was analyzed at each station and a duplicate image was analyzed at 21 stations (33% of stations).The image analysis parameters for the Shelton Harbor survey included:

- Wood debris (presence and percent coverage)
- Presence of methane
- Presence of bacterial mats
- Depth of the apparent RPD (cm)

All data were edited and verified by a senior-level scientist before final data synthesis, statistical analysis, and interpretation. Final SPI image analysis results are provided in Appendix A.

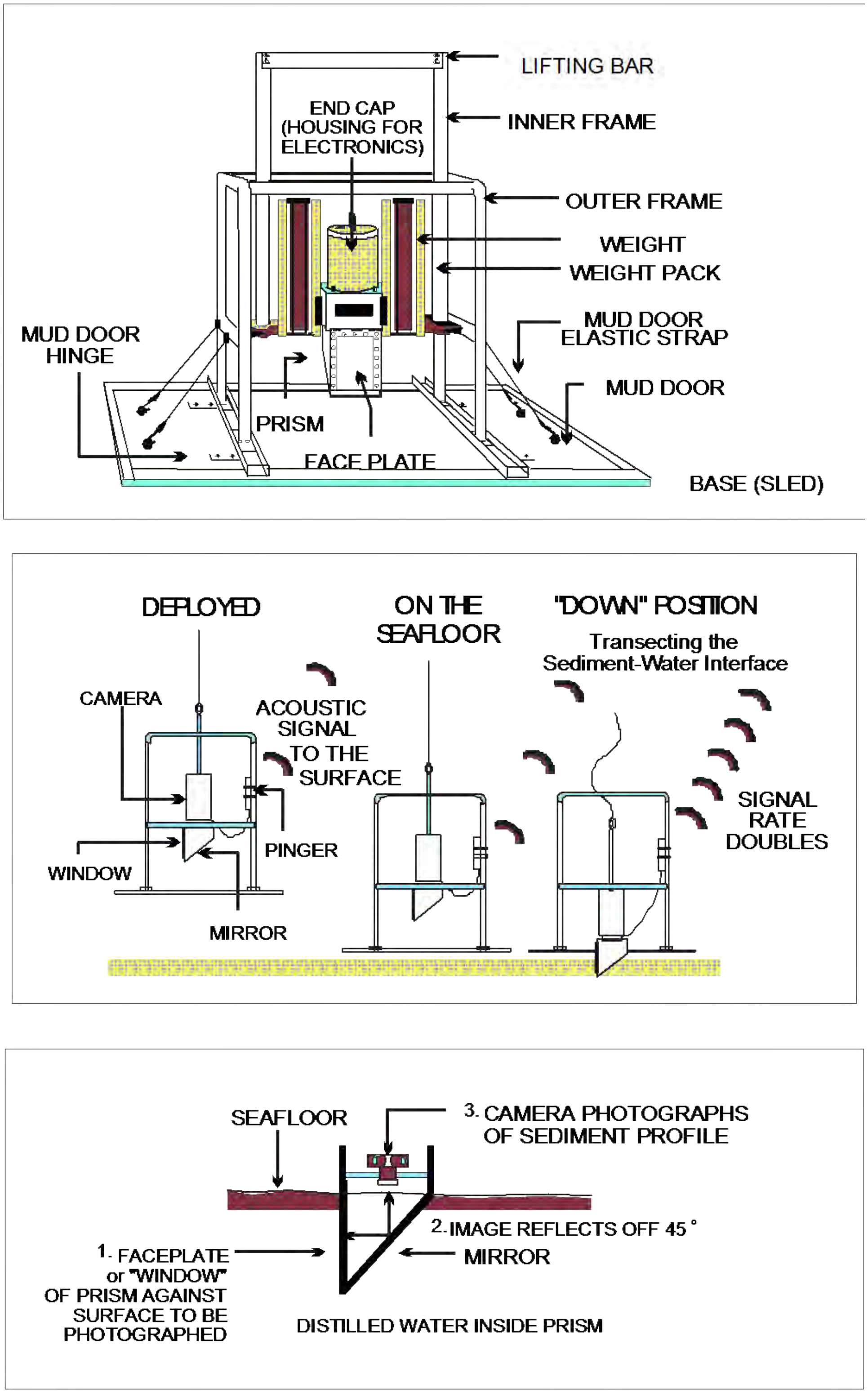

Figure 2-1. Schematic diagram of the sediment profile camera and sequence of operation on deployment.

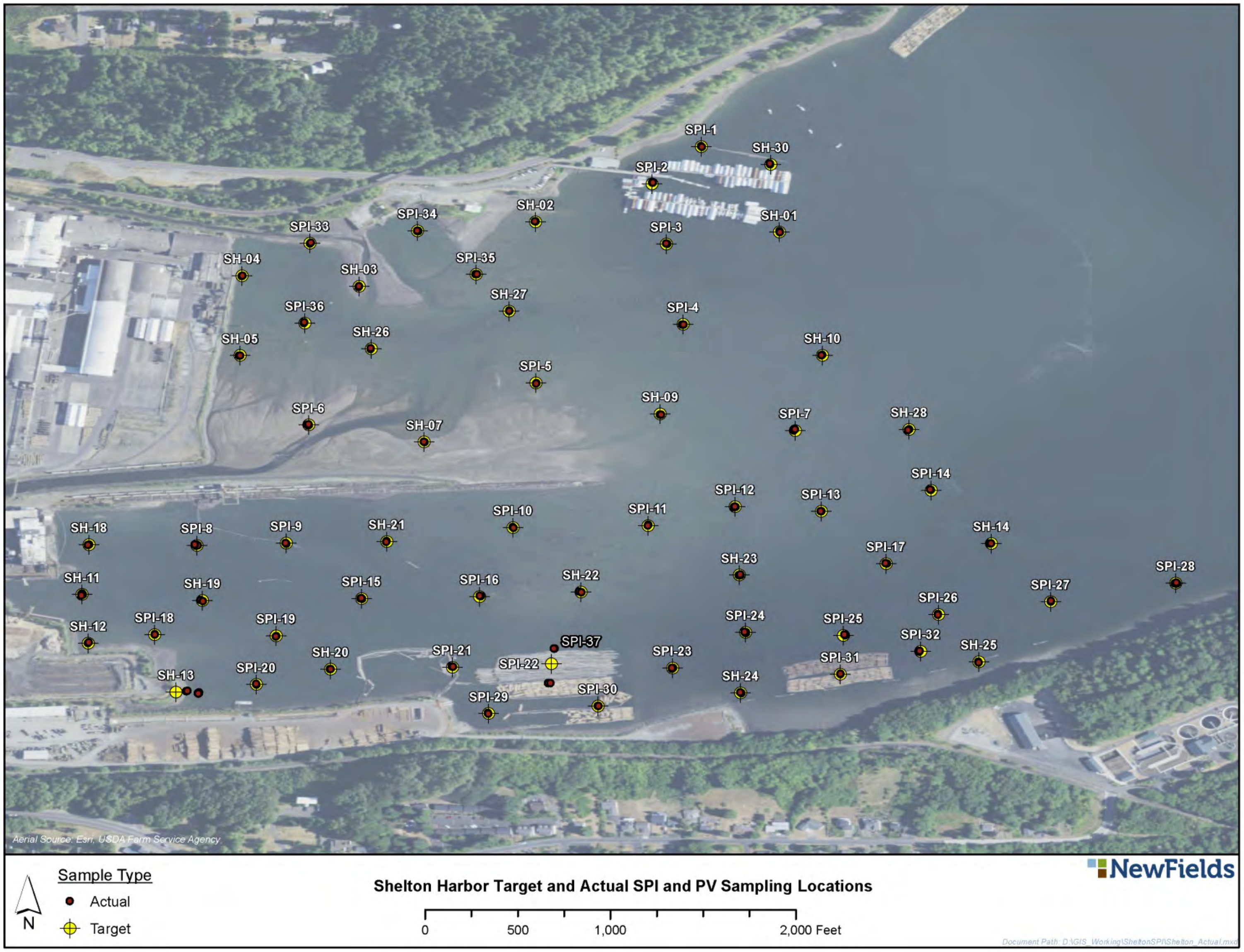

Figure 2-2. Shelton Harbor target and actual SPI and PV sampling locations.

2.2.1 Presence of Wood Debris

Presence of wood debris relies on the visual identification of wood-like particles in surface sediments that contrast with the surrounding sedimentary texture. Wood debris can consist of dark or brown particles, shards, bark, or larger wood pieces. The estimate of percent wood debris in SPI images was determined visually using Munsell charts for estimating proportions of mottles and coarse fragments (GretagMacbeth 2000).

2.2.2 Presence of Methane

Gas-filled voids in sediment are identifiable in SPI images because of their irregular, generally circular shape and glassy appearance (due to the reflection of the camera strobe off the gas). The presence of sedimentary methane indicates high organic matter loading to a system as methanogenesis predominates where sulfate is depleted by organic overloading.

2.2.3 Presence of Bacterial Mats

Sulfate-reducing bacterial mats such as *Beggiatoa* can be visually identified in SPI images. *Beggiatoa* can exist at the interface between oxic and anoxic conditions. It usually lives within sediments and its presence on the surface indicates the lack of oxygen in underlying sediments. In SPI images, the bacterial mats can appear as layers of white fibrous material or accumulations of light gray organic aggregations. Sediments below these layers generally appeared black and anoxic, devoid of any organisms or evidence of biological activity.

2.2.4 Apparent Redox Potential Discontinuity (RPD) Depth

The depth of the apparent RPD, which is the change from oxidized to reduced sediment, can be measured using SPI and computer image analysis. The upper surface of aerobic fine-grained sediments has a higher light reflectance value than underlying hypoxic or anoxic sediments. This is readily apparent in SPI images and is due to oxidized surface sediment that contains minerals in an oxidized state (typically an olive brown color), while the reduced sediments below this oxygenated layer are generally green, gray, blue, or black. The boundary between the colored ferric hydroxide surface sediment and underlying sediment is called the apparent redox potential discontinuity (RPD). The apparent RPD is a sensitive indicator of infaunal succession, sediment bioturbation activity, and sediment oxygen demand. The depth of the apparent RPD has proven to be a useful parameter for mapping gradients of enrichment on the seafloor (Rhoads and Germano 1982, Lyle 1983).

The actual RPD is the boundary that separates the positive Eh region (presence of free oxygen) of the sediment column from the underlying negative Eh region (absence of free oxygen). The exact location of the Eh boundary (where $Eh = 0$) can only be determined with microelectrodes. Therefore, the reflectance boundary observed in the SPI images is termed the apparent RPD. In general, the depth of the actual RPD will be shallower than the depth of the apparent RPD, because organisms cause bioturbation of ferric hydroxide-coated particles downward below the $Eh = 0$ horizon. As a result, the apparent RPD depth provides an estimate of the degree of biogenic sediment mixing. This variable is important in evaluating the effect of colonizing benthos. Bioturbation vertically transports buried reduced compounds to the sediment surface and exposes them to an oxidizing water column (Aller 1982). Bioturbation also affects sediment transport by changing the physical properties of sediments and their mechanical behavior (Rhoads and Boyer 1982).

Another important characteristic of the apparent RPD is the contrast in reflectance values at this boundary. This contrast is related to the interactions among the degree of organic-loading in the sediment, bioturbation, and bottom-water dissolved oxygen levels. A high input of labile organic material increases sediment oxygen demand, stimulates the sulfate reduction rate, and results in sulfitic products. This results in more highly reduced (lower-reflectance) sediments at depth and higher RPD contrasts. In a region where generally low RPD contrasts exist, images with high RPD contrasts indicate localized sites of relatively high inputs of organic-rich material, such as wood debris.

2.3 Plan View Imaging

Plan view (surface) imaging was conducted using a downward facing underwater Chimaera MKII camera with external flash, manufactured by SubC Control, Newfoundland, Canada. The plan view (PV) camera and external flash were mounted on the frame of the SPI camera in a downward-looking orientation. Images were collected just before the SPI camera touched the seafloor, using a lead ball and cable attached to a bounce trigger.

Collection of PV images were attempted at the same 62 stations in Shelton Harbor where SPI images were collected (Figure 2-2). Turbidity in the water column affected PV image quality. A minimum of one PV image was collected at each station, with the exception of seven stations (SH-02, SH-09, SH-14, SPI-13, SPI-26, SPI-27, and SPI-35). Useable PV images were not collected at these stations due to high turbidity in the water column.

2.4 Plan View Image Analysis

Image analysis of the PV images consisted primarily of evaluating the images for the presence of wood debris on the sediment surface. Percent estimates of wood debris for the PV images were not determined due to turbidity affecting image quality. However, where wood debris was documented the percent cover was at least 50% or greater in most cases. Final PV image analysis results are provided in Appendix A.

3.0 Results

3.1 Wood Debris

Wood debris observed in SPI images in Shelton Harbor ranged from very fine wood particles to large wood pieces and bark. Wood debris was observed at 52 percent of the stations surveyed (32 of 62 stations) (Figure 3-1). Of the 32 stations showing wood debris, 78 percent of the stations (25 stations) showed trace amounts of fine, black, wood-like particles in the surface sediments[1]. The amount of this type of wood debris was characterized as less than 1 percent by area in the SPI images (Figure 3-2). Fine wood debris particles were not evident in the PV images.

Higher concentrations of wood debris (2 to 15 percent by area in the SPI images) were observed at four stations surrounding the Manke log storage site, along the southern shoreline of Shelton Harbor (SH-22, SPI-23, SPI-31, and SPI-37) (see Figure 3-1). The wood debris consisted of large to small wood pieces or particles visible on the surface or in the sediment column. This wood debris was also visible in PV images (Figures 3-3 and 3-4).

The highest concentrations of wood debris (30 to 50 percent by area in the SPI images) consisted of large wood pieces and bark, and were observed at three stations located in areas within the Manke log storage site (stations SPI-21, SPI-22, and SPI-29) (Figures 3-5 and 3-6). This wood debris was clearly evident in PV images.

Presence of larger wood debris in PV images was generally consistent with SPI observations. The PV image at station SPI-02 showed the presence of wood debris on the sediment surface (Figure 3-7). However, the SPI image did not show clear evidence of wood debris. Station SPI-02 is located within the Oakland Bay Marina and the wood debris was likely attributed to activities within the marina.

3.2 Sedimentary Methane

Sedimentary methane was observed in SPI images at 5 stations (SH-02, SH-07, SH-14, SH-21, and SH-25) within Shelton Harbor (Figure 3-1). The methane was observed as gas-filled voids within the sediment column, and the methane had a glassy appearance due to reflection from the camera strobe (Figure 3-8). Benthic habitat quality did not appear to be impacted at the stations where methane was observed (i.e., apparent RPD depths were well developed and feeding voids were visible, indicating the presence of head-down deposit feeding organisms). This suggested that the organic loading at these locations may be related to deposition of natural organic materials versus impacts from recent wood debris accumulation.

3.3 Distribution of Bacterial Mats (*Beggiatoa*)

Sulfate-reducing bacteria (likely *Beggiatoa*) were observed at 8 stations along the southern shoreline of Shelton Harbor where wood debris was observed (stations SPI-21, SPI-22, SPI-23, SPI-29, SPI-30, SPI-31, and SPI-32). The *Beggiatoa* bacteria generally consisted of a white-colored layer or coating visible on wood debris in SPI and PV images (Figure 3-1). The presence of bacterial mats at these locations suggested the lack of oxygen in underlying sediments. In

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[1] The trace amounts of fine organic black particles mixed into the sediments were presumed to be related to wood debris, but could be from other natural sources in Shelton Harbor.

most instances, the underlying sediments observed in SPI images were black in color, indicating low oxygen sedimentary conditions (see Figures 3-5 and 3-6).

3.4 Apparent Redox Potential Discontinuity

The apparent RPD depth estimates the depth of oxygenation in the upper sediment column and provides an estimate of the biological mixing depth by infaunal organisms. Overall, mean apparent RPD depths were well developed throughout most of Shelton Harbor, and ranged from 0.16 to 5.48 cm, with an average depth of 2.51 (±1.20 cm; n=83) for the 62 SPI stations (Figure 3-9). The presence of fine wood debris in low concentrations (less than 1 percent by area in SPI images) did not appear to affect benthic habitat quality in Shelton Harbor. Apparent RPD depths at these stations averaged 2.95 cm (±0.94 cm; n=36).

The shallowest apparent RPD depths were measured in areas within the Manke log storage site where the highest accumulation of wood debris was observed (Figures 3-9 and 3-10). Within the log storage site, apparent RPD depths averaged 0.34 cm (±0.28 cm; n=7) at stations SPI-21, SPI-22, SPI-29, SPI-30, and SPI-37. Outside of the log storage site, apparent RPD depths averaged 2.72 cm (±1.05 cm; n=69).

Apparent RPD contrast was also higher in areas within and around the Manke log storage site, suggesting benthic habitat stress due to input of organic-rich material (likely wood debris) (see Figure 3-10).

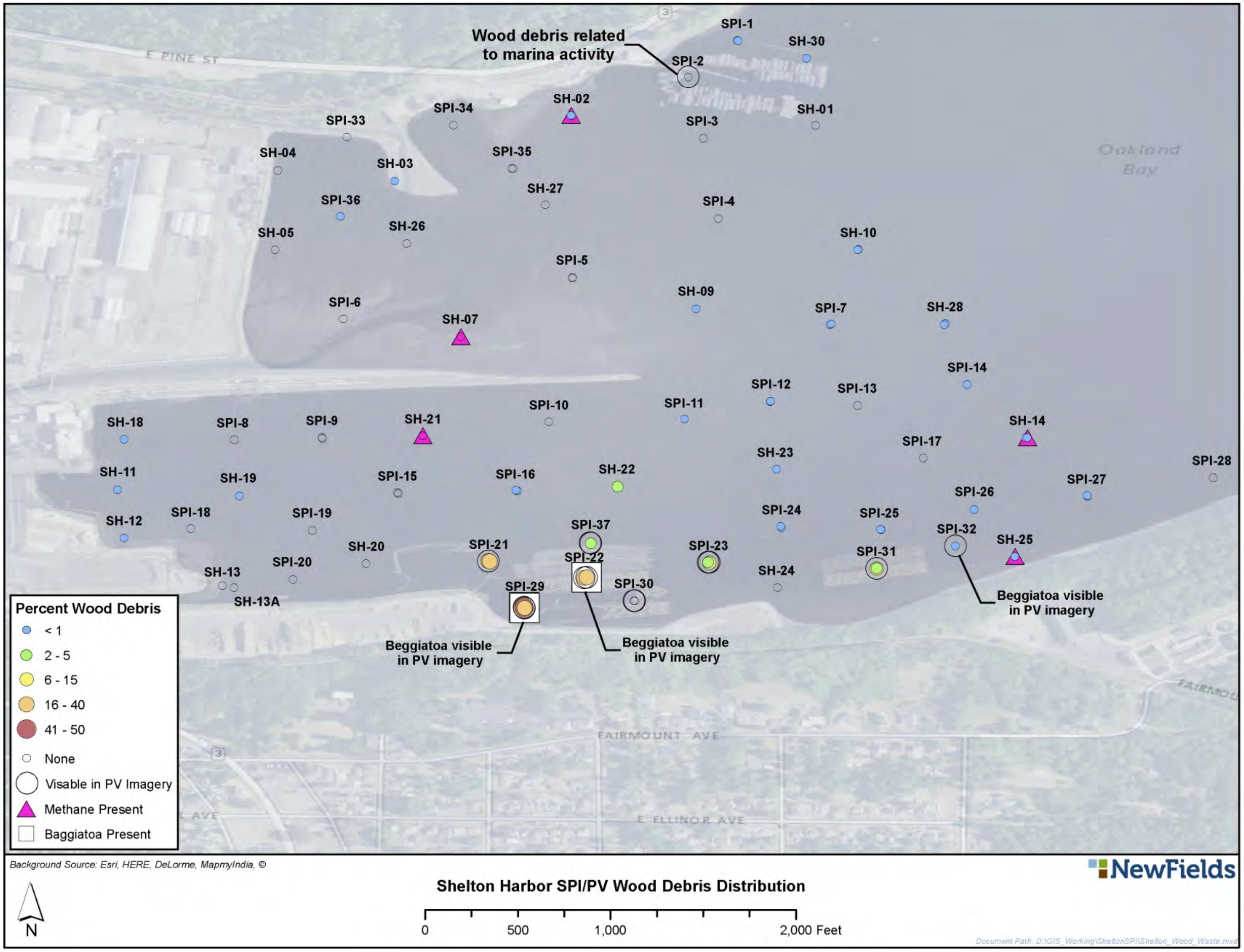


Figure 3-1. Shelton Harbor SPI/PV wood debris distribution.

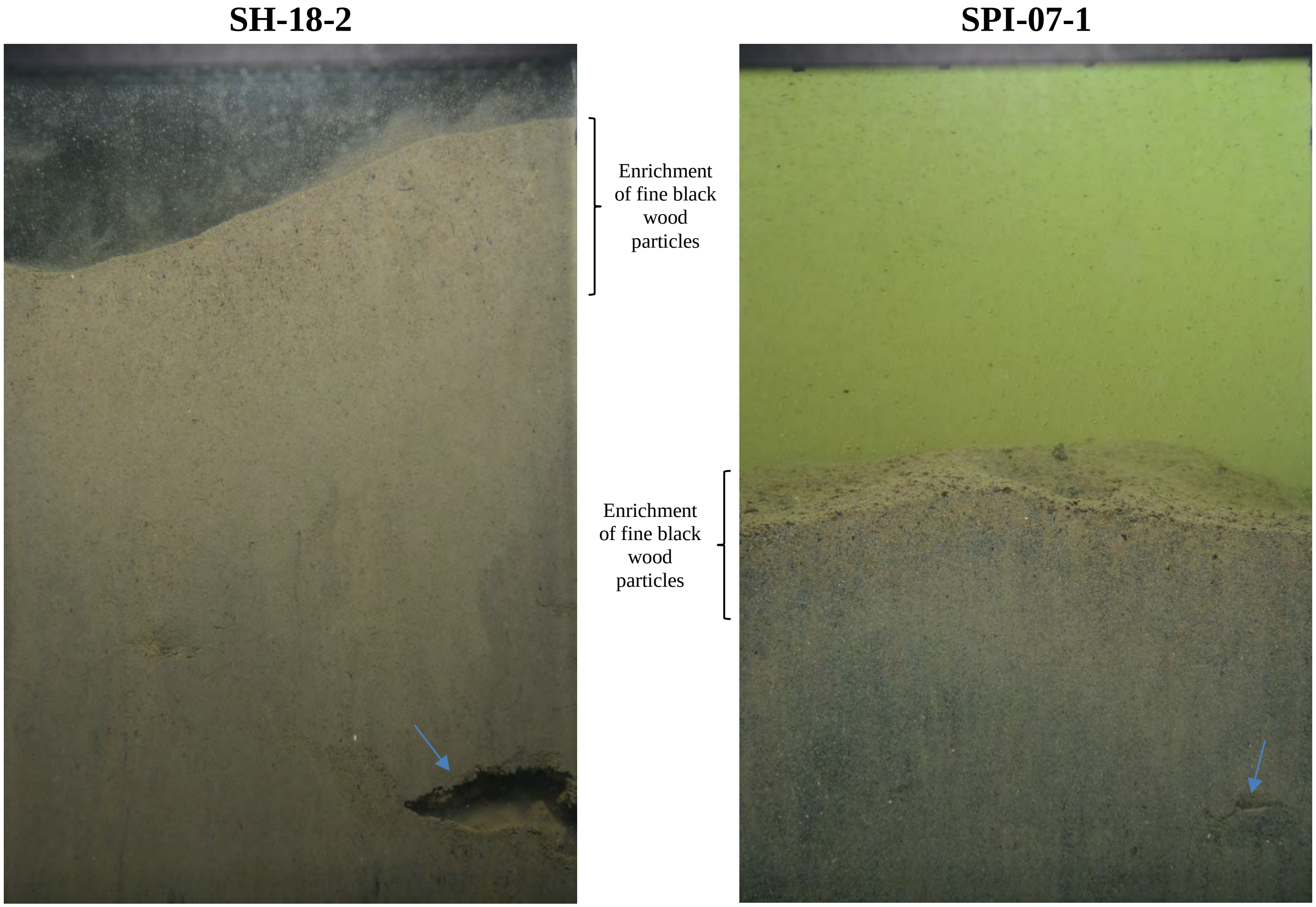


Figure 3-2. SPI images from station SH-18 and SPI-07 showed very fine wood debris.

SPI images from stations SH-18 replicate 2 (SH-18-2) and SPI-07 replicate 1 (SPI-07-1) showed very fine, black particles in fine-grained surface sediments. The black particles were presumed to be wood debris. Feeding voids were visible at depth at both stations (blue arrow), which were created by head-down deposit feeders. Presence of feeding voids is an indicator of healthy and well established benthic habitat. SPI image width = 15 cm.

SPI-23-2 (SPI)

SPI-23-4 (PV)

Wiper bar visible due to low prism penetration

Figure 3-3. SPI and PV images from station SPI-23.

The SPI image from SPI-23-2 showed silt covered wood pieces protruding from the sediment surface (blue arrows). The surface PV image showed scattered wood pieces, branches, and bark on the sediment surface. A crab (likely *Cancer gracilis*) was present (white arrow). SPI image width = 15 cm. PV image area = 0.7 square meters.

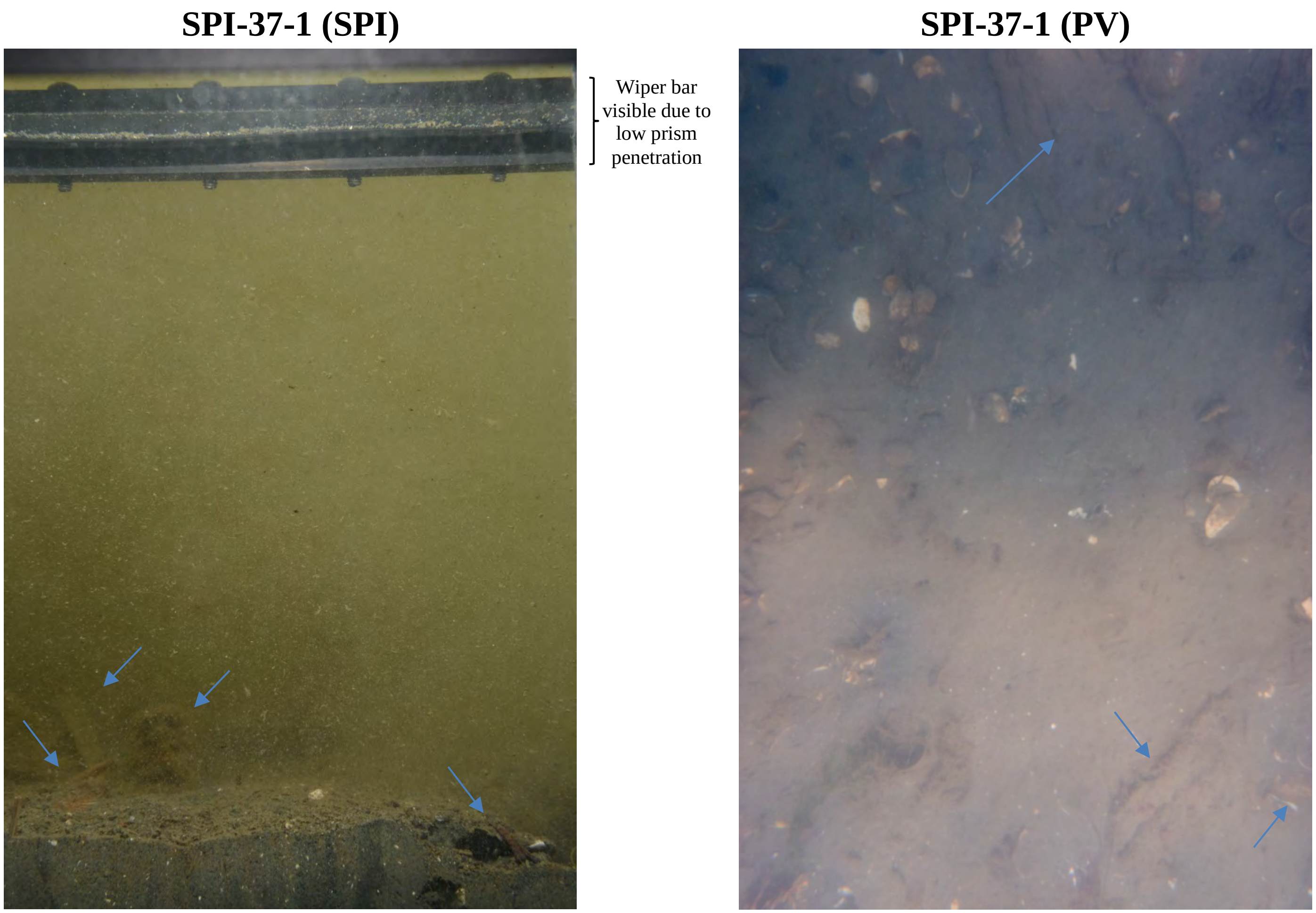
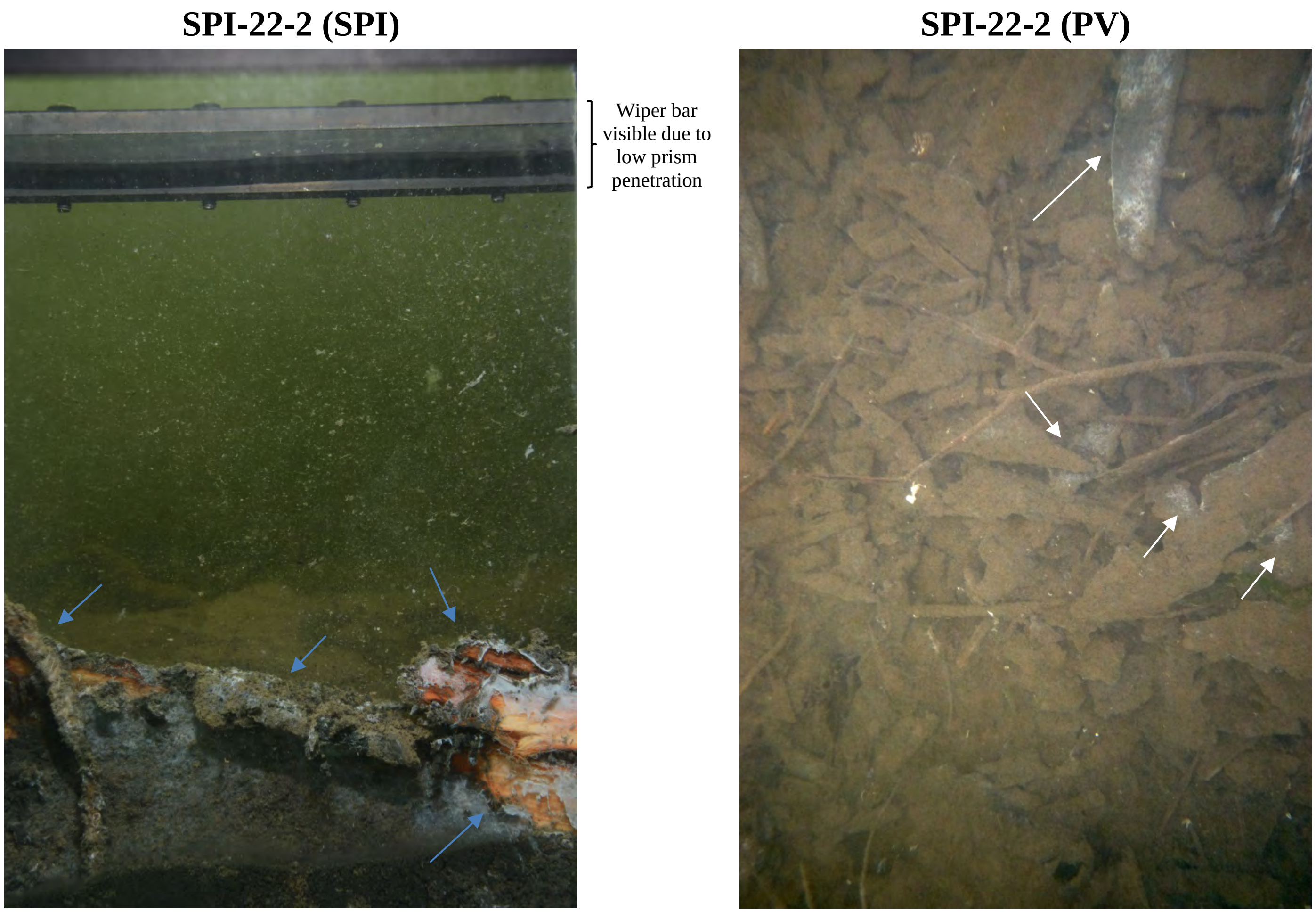


Figure 3-4. SPI and PV images from station SPI-37.

The SPI image from SPI-37-1 showed scattered pieces of wood debris on the sediment surface (blue arrows). Compact sands were present and SPI camera prism penetration was low. The surface PV image showed scattered pieces of larger wood debris (blue arrows) and shells. SPI image width = 15 cm. PV image area = 0.7 square meters.



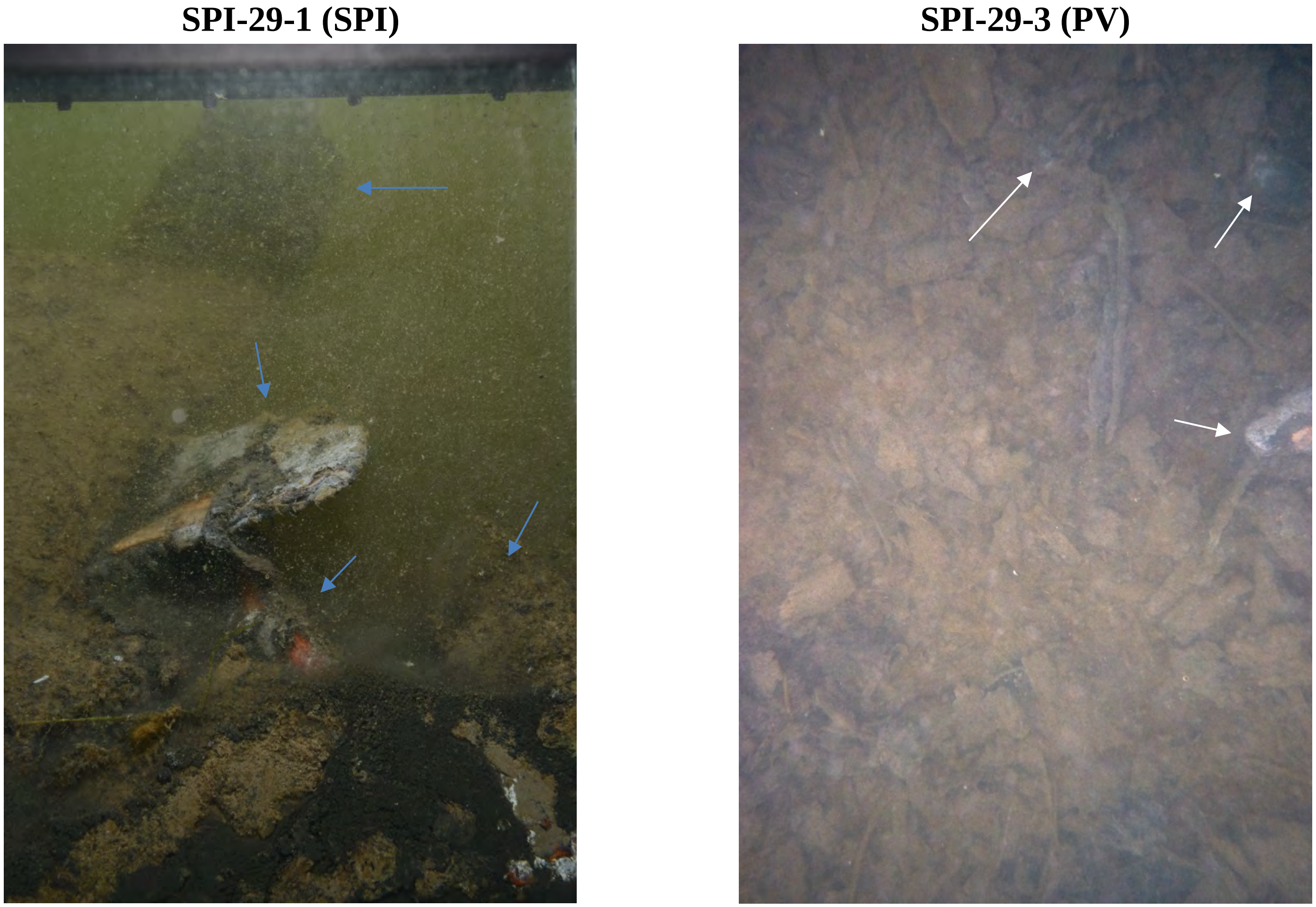
SPI-22-2 (SPI)

SPI-22-2 (PV)

Wiper bar visible due to low prism penetration

Figure 3-5. SPI and PV images from station SPI-22.

The SPI image from SPI-22-2 showed wood pieces and branches (blue arrows), overlying black anoxic sediments. The white coating present on the wood debris was likely *Beggiatoa* bacteria. The surface PV image showed a dense mat of wood debris consisting of wood pieces, branches, and bark. The white coating visible on some wood pieces was likely *Beggiatoa* bacteria (white arrows). SPI image width = 15 cm. PV image area = 0.7 square meters.

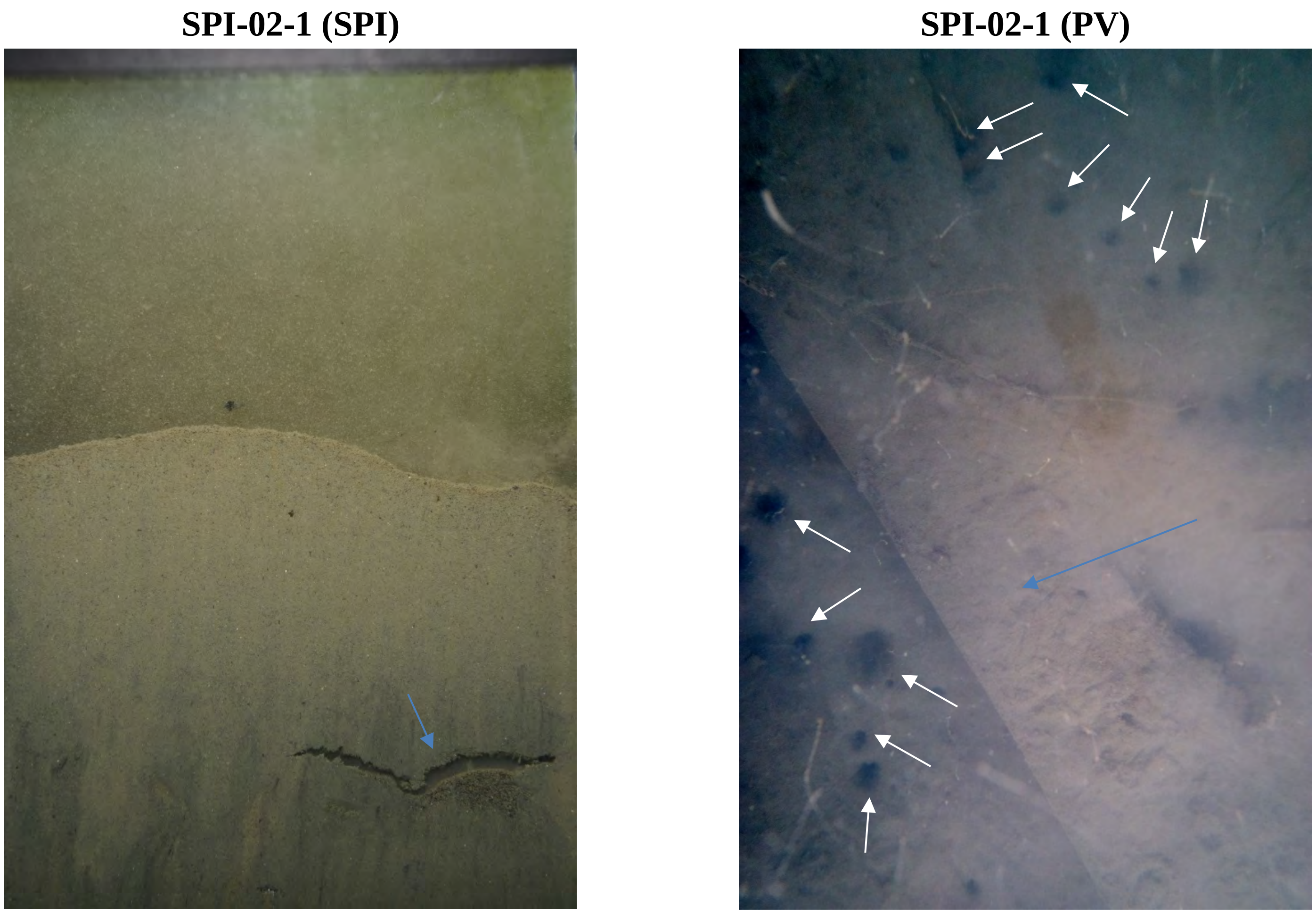


SPI-29-1 (SPI)

SPI-29-3 (PV)

Figure 3-6. SPI and PV images from station SPI-29.

The SPI image from SPI-29-1 also showed wood pieces (blue arrows), overlying black anoxic sediments. The white coating present on the wood debris was likely *Beggiatoa* bacteria. The PV image showed a mat of wood debris consisting of wood pieces, branches, and bark. The white coating visible on some wood pieces was likely *Beggiatoa* bacteria (white arrows). SPI image width = 15 cm. PV image area = 0.7 square meters.



SPI-02-1 (SPI)

SPI-02-1 (PV)

Figure 3-7. SPI and PV images from station SPI-02.

The SPI image from SPI-02-1 showed fine grained sediments with no apparent evidence of wood debris. A large feeding void was visible at depth (blue arrow). The surface PV image appeared to show a wooden board lying on the sediment surface (blue arrow). Large surface burrows were visible (white arrows). The board was likely related to activities at the marina. SPI image width = 15 cm. PV image area = 0.7 square meters.

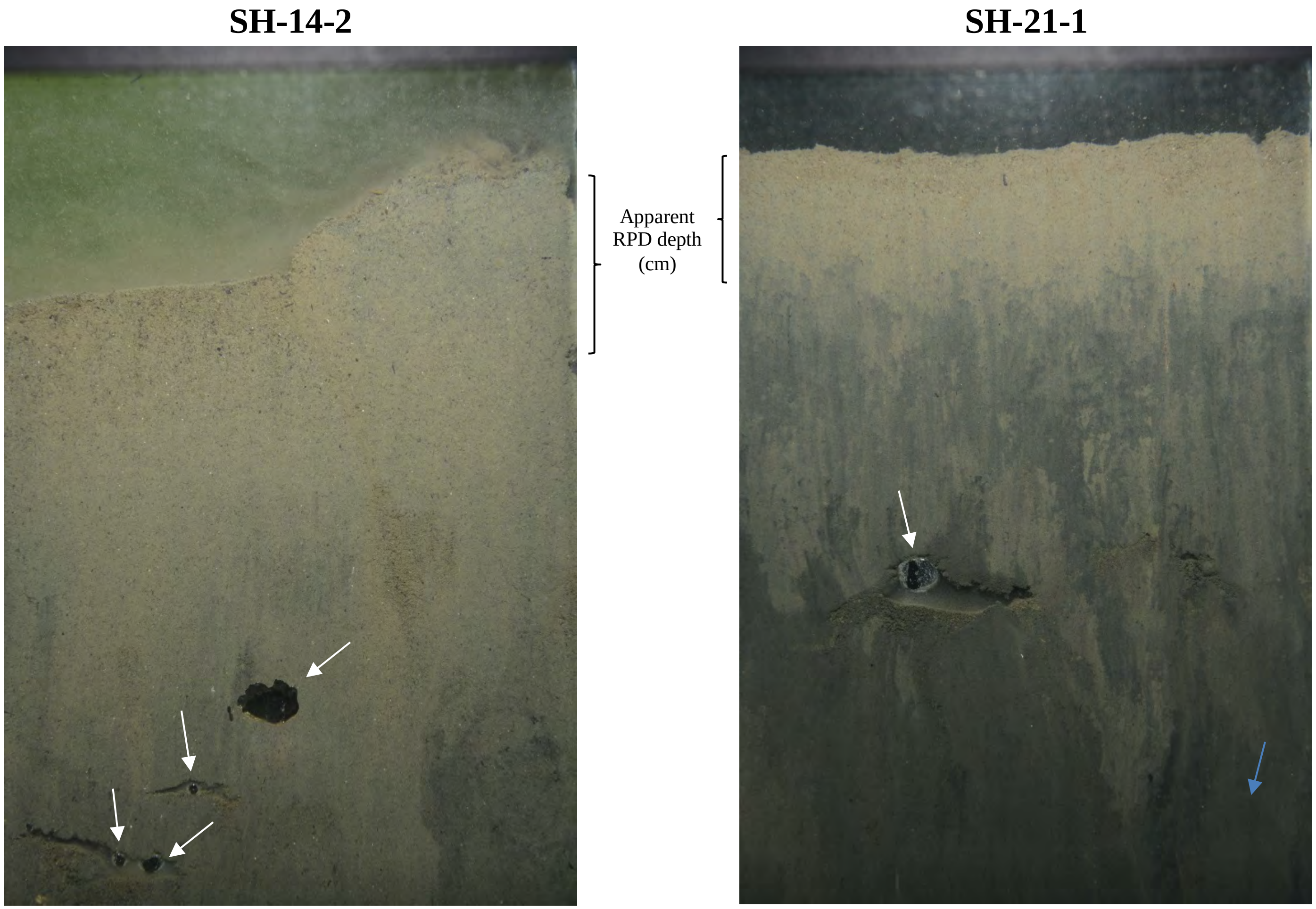


Figure 3-8. SPI images from station SH-14 and SPI-07 showing methane.

SPI images from stations SH-14-2 and SH-21-1 (SPI-07-1) showed fine grained silt/clay sediments with sedimentary methane bubbles at depth (white arrows). In several cases the methane bubbles were present within active feeding voids. The apparent RPD depth was relatively well developed in both images. SPI image width = 15 cm.

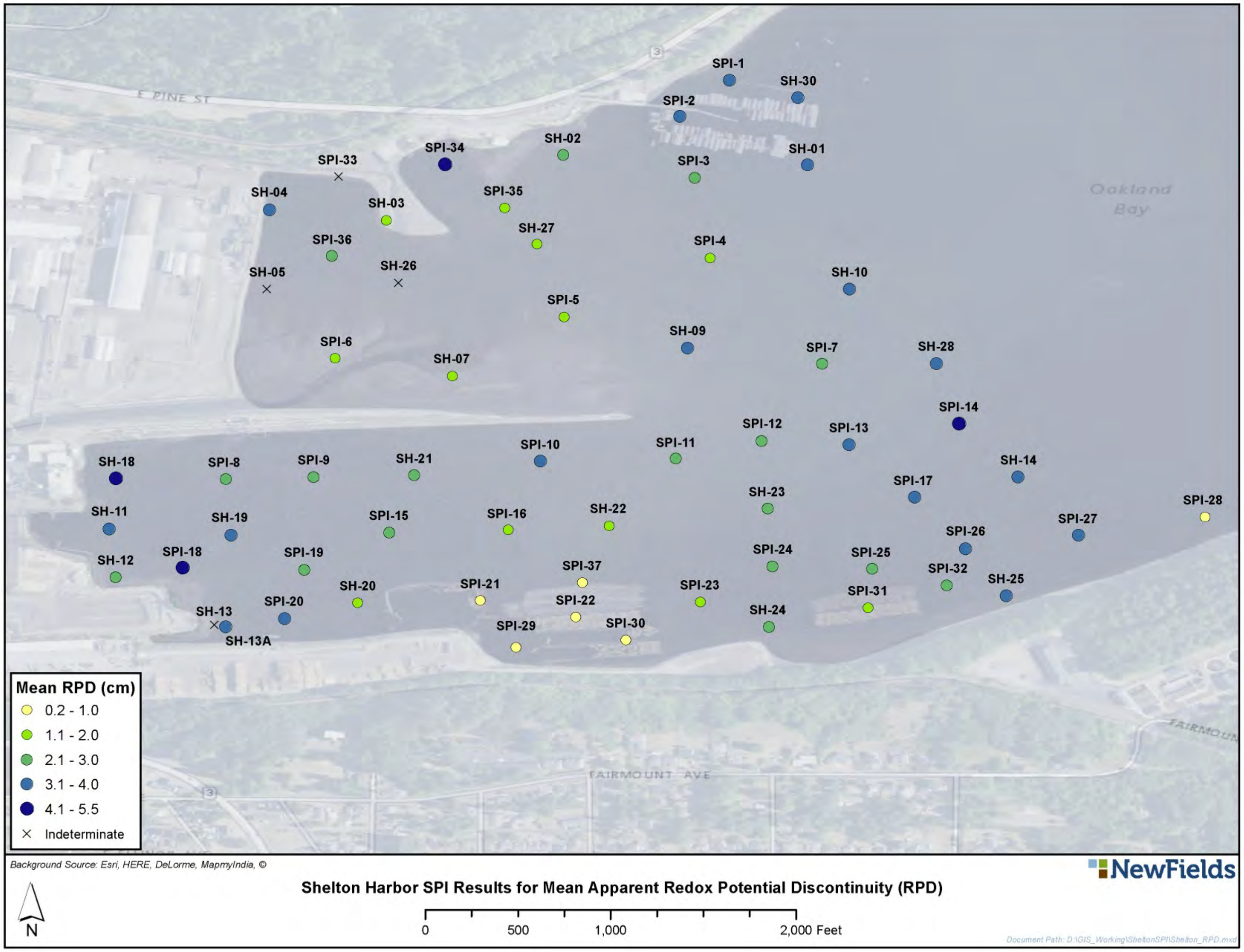


Figure 3-9. Shelton Harbor SPI results for mean apparent RPD.

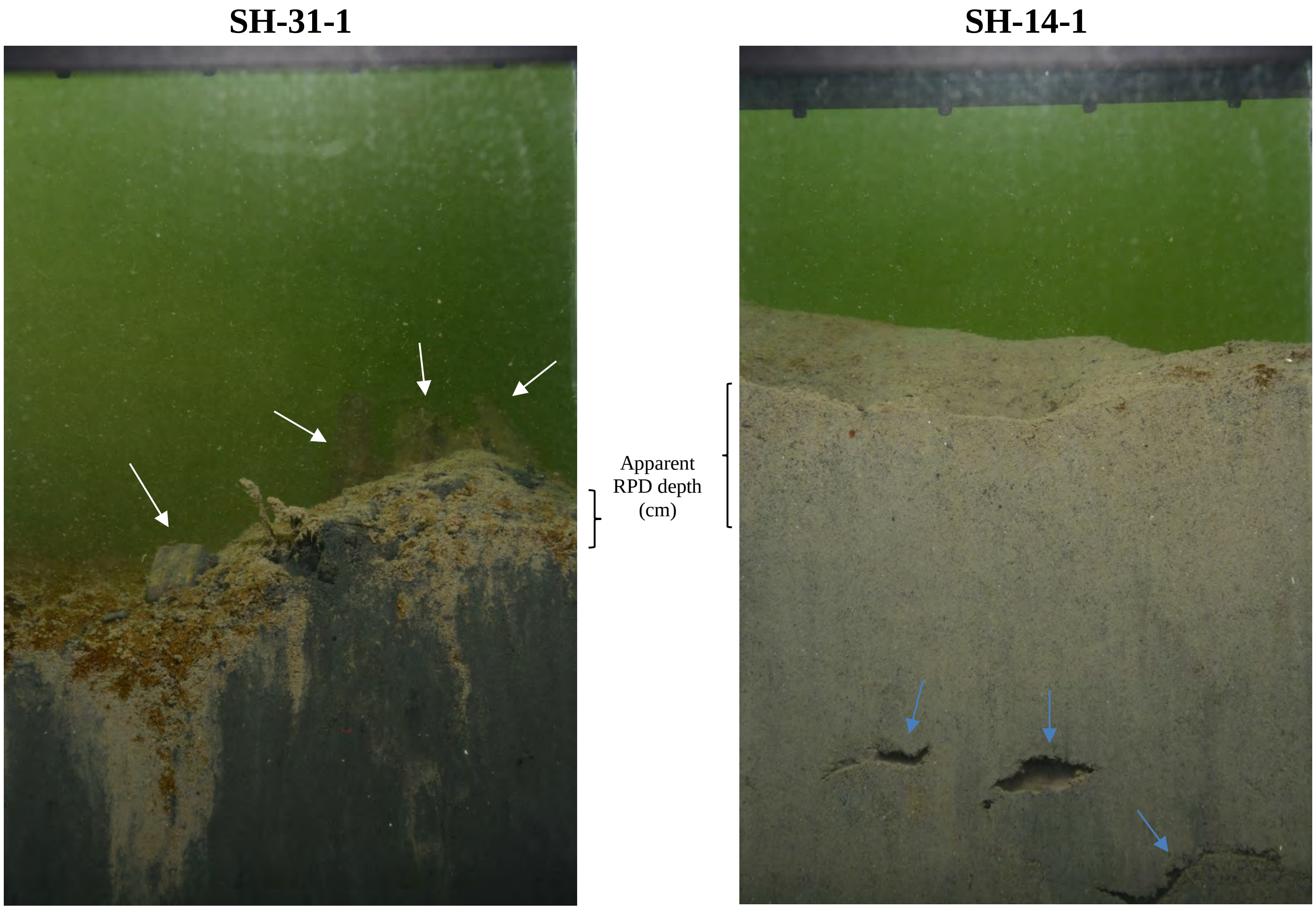


Figure 3-10. SPI images from stations SPI-31 and SH-14.

The SPI image from station SPI-31-1 showed high apparent RPD contrast (thin apparent RPD layer of light colored oxidized sediment contrasted with the underlying black anoxic sediments). Sediment oxygen demand was high at this station. Wood debris was visible on the sediment surface (white arrows). In comparison, the SPI image from station SH-14 showed a deeper apparent RPD with underlying sediments that were much lighter in color (higher oxygen penetration and lower concentrations of sulfides). Feeding voids were visible at depth (blue arrows) indicating the presence of head-down deposit feeders. SPI image width = 15 cm.

4.0 Summary

- Wood debris observed in SPI images in Shelton Harbor ranged from very fine wood particles to large wood pieces and bark. The highest concentrations of wood debris (30 to 50 percent by area in the SPI images) consisted of large wood pieces and bark, and were observed in areas within the Manke log storage site.
- Fine, black particles were observed in surface sediments throughout Shelton Harbor and presumed to be wood debris. This type of wood debris was characterized as less than 1 percent by area in the SPI images and did not affect benthic habitat quality.
- Sedimentary methane was observed in SPI images at 5 stations but did not appear to affect benthic habitat quality. Apparent RPD depths were well developed and feeding voids were visible, indicating the presence of head-down deposit feeding organisms.
- Sulfate-reducing bacteria (likely *Beggiatoa*) were observed at 8 stations along the southern shoreline of Shelton Harbor where wood debris was observed.
- Mean apparent RPD depths were well developed throughout most of Shelton Harbor, and ranged from 0.16 to 5.48 cm, with an average depth of 2.51 cm. The shallowest apparent RPD depths (average of 0.34 cm) were measured in areas within the Manke log storage site where the highest accumulation of wood debris was observed.

5.0 References

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Table A.1 - Sediment Profile Image Results Summary

NewFields Sediment Profile Image Analysis

Project: Shelton Harbor **Pixel Calib. Factor: 0.3619175**

Analyst (Initials)	Station	Replicate	Date	Time	Apparent RPD Thickness (cm)				Wood Debris		Methane				Bacterial Mats	Comments
					Area	Min	Max	Mean	Present	Percent	Present	Count	Mean Depth	Diameter		
JSN	SH-01	1	7/11/17	14:56	49.26	2.48	4.37	3.41	FALSE							Silty sands, feeding voids at depth
JSN	SH-02	1	7/10/17	10:40	41.75	0.35	5.81	2.89	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SH-02	2	7/10/17	10:42	31.66	0.00	3.55	2.19	TRUE	< 1.00	TRUE	8	10.42	0.32		Methane gas bubbles at depth, traces of very fine organic black particles mixed in the sediment column
JSN	SH-03	1	7/11/17	8:17	22.3	0.67	2.19	1.54	TRUE	< 1.00						Low pen, surface tubes, feeding void at depth, scattered small black particles on surface
JSN	SH-04	1	7/11/17	8:08	46.66	1.1	6.12	3.23	FALSE							Unconsolidated fine grained sediments
JSN	SH-05	1	7/11/17	8:42				indet	FALSE							Low pen, gravel bottom coated with organics/fines
JSN	SH-07	1	7/11/17	9:11	20.34	0.38	2.33	1.41	FALSE		TRUE	26	1.56	0.19		Low pen, compact sand bottom with organic filamentous mat coating, apparent methane gas bubbles at depth
JSN	SH-09	1	7/10/17	11:22	44.82	1.82	4.62	3.10	TRUE	< 1.00						Fine sands and silts, possible scattered small wood particles on surface? Large feeding void at depth
JSN	SH-10	1	7/11/17	14:40	51.36	1.29	6.59	3.55	TRUE	< 1.00						Traces of small organic black particles mixed in the surface (possible wood origins?)
JSN	SH-10	2	7/11/17	14:41	36.54	0.85	4.53	2.53	TRUE	< 1.00						Scattered wood particles on surface (brown and black), feeding voids at depth
JSN	SH-11	4	7/11/17	14:00	47.83	2.07	6.30	3.31	TRUE	< 1.00						Unconsolidated fine grained sediments, traces of fine black particles mixed in the surface sediment column
JSN	SH-12	1	7/11/17	10:54	34.27	1.43	5.04	2.37	TRUE	< 1.00						Fine grained sediments, reduced at depth (higher RPD contrast), traces of fine black particles mixed in the surface
JSN	SH-13	1	7/11/17	11:07				indet	FALSE							Gravel bottom - intertidal area
JSN	SH-13A	3	7/11/17	11:32	49.02	1.55	6.86	3.39	FALSE							Unconsolidated fine grained sediments, numerous feeding voids at depth
JSN	SH-14	1	7/10/17	15:35	48.61	1.19	6.66	3.36	TRUE	< 1.00						Unconsolidated fine grained sediments, feeding voids at depth
JSN	SH-14	2	7/10/17	15:36	59.14	1.10	7.80	4.09	TRUE	< 1.00	TRUE	5	12.57	0.56		Unconsolidated fine graine sediments, methane bubbles at depth in feeding voids, traces of small organic black particles mixed into sediment column
JSN	SH-18	2	7/11/17	10:38	74.8	3.72	6.24	5.17	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SH-19	2	7/11/17	13:48	48.45	1.33	7.53	3.35	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SH-20	1	7/11/17	13:16	28.11	0.38	5.24	1.94	FALSE							Fine grained sediments, small feeding void at depth center
JSN	SH-21	1	7/10/17	18:37	35.79	1.61	3.17	2.47	FALSE		TRUE	1	10.63	1.00		Fine grained sediments, feeding voids at depth, methane gas bubble in void
JSN	SH-22	2	7/10/17	17:39	28.44	0.56	3.2	1.97	TRUE	2.00						Consolidated bottom, scattered black wood particles on surface, polychaete visible at depth
JSN	SH-23	4	7/10/17	13:31	30.92	1.19	4.3	2.14	TRUE	< 1.00						Fine grained sediments, traces of very fine organic black particles mixed in the sediment column
JSN	SH-24	1	7/10/17	18:17	35.48	1.10	4.05	2.45	FALSE							Low pen, compact sediments, high RPD contrast, organic coating (algae?) on surface
JSN	SH-25	1	7/11/17	9:54	46.46	2.04	7.02	3.21	TRUE	< 1.00	TRUE	6	10.47	0.26		Fine grained sediments, methane bubbles, traces of very fine organic black particles mixed in the sediment column
JSN	SH-26	1	7/11/17	8:48				indet	FALSE							Compact silt/sand bottom, numerous surface tubes, twigs, crab far field
JSN	SH-27	1	7/10/17	11:03	28.07	0.72	2.61	1.94	FALSE							Compact sand bottom
JSN	SH-28	1	7/10/17	16:32	62.42	1.23	10.12	4.32	TRUE	< 1.00						Scattered fine organic black particles mixed in the sediment column, feeding voids at depth
JSN	SH-28	2	7/10/17	16:33	47.78	1.23	5.20	3.30	TRUE	< 1.00						Scattered fine organic black particles mixed in the sediment column, numerous feeding voids at depth
JSN	SH-30	1	7/11/17	15:04	44.32	2.07	4.2	3.06	TRUE	< 1.00						silty fine sands, traces of fine organic black particles near surface, feeding void
JSN	SPI-01	1	7/11/17	15:11	56.59	1.61	7.49	3.91	TRUE	< 1.00						silty fine sands, numerous feeding voids, scattered shell particles, traces of fine organic black particles
JSN	SPI-01	2	7/11/17	15:13	44.27	1.27	6.14	3.06	TRUE	< 1.00						silty fine sands, numerous feeding voids, scattered shell particles, traces of fine organic black particles
JSN	SPI-02	1	7/11/17	15:21	52.67	2.45	4.50	3.64	FALSE							Fine grained sediments, void at depth
JSN	SPI-03	1	7/11/17	14:49	43.29	1.23	6.85	2.99	FALSE							Fine grained sediments, voids at depth, burrow right surface
JSN	SPI-04	1	7/11/17	9:28	27	0.91	2.98	1.87	FALSE							Fine sands, lower pen, surface tubes
JSN	SPI-05	1	7/11/17	9:21	25.58	0.58	3.74	1.77	FALSE							Fine sands, lower pen
JSN	SPI-05	2	7/11/17	9:22	20.9	0.61	1.95	1.45	FALSE							Fine sands, lower pen

Table A.1 - Sediment Profile Image Results Summary

NewFields Sediment Profile Image Analysis

Project: Shelton Harbor **Pixel Calib. Factor:** **0.3619175**

Analyst (Initials)	Station	Replicate	Date	Time	Apparent RPD Thickness (cm)				Wood Debris		Methane				Bacterial Mats	Comments
					Area	Min	Max	Mean	Present	Percent	Present	Count	Mean Depth	Diameter		
JSN	SPI-06	3	7/11/17	9:06	17.54	0.45	1.56	1.21	FALSE							Low pen, consolidated fine sands, organic filamentous algae coating
JSN	SPI-07	1	7/10/17	11:30	42.17	0.88	3.63	2.92	TRUE	< 1.00						silty fine sands, scattered black particles on surface (possible woody debris)
JSN	SPI-07	2	7/10/17	11:32	41.02	0.55	4.86	2.84	TRUE	< 1.00						silty fine sands, scattered black particles on surface (possible woody debris), voids at depth
JSN	SPI-08	5	7/11/17	13:52	42.72	2.14	4.30	2.95	FALSE							Unconslidated fine grained sediments
JSN	SPI-09	1	7/10/17	18:46	31.47	0.87	3.47	2.18	FALSE							Fine grained sediments, higher RPD contrast
JSN	SPI-09	2	7/10/17	18:47	33.17	1.13	4.04	2.29	FALSE							Fine grained sediments, higher RPD contrast
JSN	SPI-10	1	7/10/17	18:56	55.24	1.23	7.05	3.82	FALSE							Fine grained unconsolidated sediments, feeding voids at depth
JSN	SPI-11	1	7/10/17	19:09	29.82	1.38	2.69	2.06	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SPI-12	1	7/10/17	12:01	37.67	0.41	4.23	2.60	TRUE	< 1.00						Traces of very fine organic black particles, voids at depth, scattered fine shell particles
JSN	SPI-12	3	7/10/17	18:00	36.53	1.71	2.91	2.53	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SPI-13	1	7/10/17	11:37	53.43	1.88	6.12	3.69	FALSE							Fine grained sediments, voids at depth
JSN	SPI-14	1	7/10/17	16:23	79.28	3.50	11.36	5.48	TRUE	< 1.00						Scattered fine organic black particles, scattered fine shell particles
JSN	SPI-15	3	7/11/17	13:09	34.7	0.8	3.72	2.40	FALSE							Unconsolidated fine grained sediments
JSN	SPI-15	4	7/11/17	13:10	39.88	1.65	4.24	2.76	FALSE							Unconsolidated fine grained sediments
JSN	SPI-16	1	7/10/17	18:25	19	0.39	2.30	1.31	TRUE	< 1.00						Low pen, consolidated fine sands with shell particles, scattered organic black particles on surface
JSN	SPI-16	2	7/10/17	18:27	14.98	0.23	3.94	1.04	TRUE	< 1.00						consolidated fine sands with shell particles, scattered organic black particles on surface
JSN	SPI-17	1	7/10/17	13:37	56.41	0.61	10.38	3.90	FALSE							Unconsolidated fine grained sediments
JSN	SPI-18	1	7/11/17	11:00	74.15	2.85	7.35	5.13	FALSE							Unconsolidated fine grained sediments, feeding voids at depth, burrow left surface
JSN	SPI-19	1	7/11/17	13:39	37.46	1.04	4.70	2.59	FALSE							Fine grained sediments, voids at depth
JSN	SPI-20	1	7/11/17	13:20	51.38	2.07	8.09	3.55	FALSE							Fine grained sediments, voids at depth
JSN	SPI-21	1	7/10/17	13:04	11.89	0.00	2.74	0.82	TRUE	30.00						Larger wood pieces
JSN	SPI-21	2	7/10/17	13:05	6.65	0.00	1.66	0.46	TRUE	40.00						Larger wood pieces
JSN	SPI-22	1	7/10/17	16:57	4.3	0.00	1.06	0.30	TRUE	30.00						
JSN	SPI-22	2	7/10/17	16:58				indet	TRUE	40.00					TRUE	Bacterial mat coating on wood (white) likely beggiatoa. Some "fresher" wood exposed
JSN	SPI-23	3	7/10/17	13:13	21.81	0.07	3.34	1.51	TRUE	15.00						Sed-covered wood pieces protruding from sediment
JSN	SPI-23	4	7/10/17	13:14	10.28	0.00	2.68	0.71	TRUE	3.00						Small scattered black wood particles
JSN	SPI-24	3	7/10/17	13:21	31.93	0.68	3.20	2.21	TRUE	< 1.00						Trace fine small woody particles near surface
JSN	SPI-24	4	7/10/17	13:23	33.3	1.29	3.20	2.30	TRUE	< 1.00						Trace fine small woody particles near surface
JSN	SPI-25	1	7/10/17	15:25	34.74	1.56	3.63	2.40	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SPI-25	2	7/10/17	15:27	31.52	0.42	3	2.18	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SPI-26	2	7/10/17	15:19	50.78	2.27	4.55	3.51	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SPI-27	1	7/10/17	15:10	48.18	1.62	4.92	3.33	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column, reddish-brown particles at depth possible wood debris
JSN	SPI-27	2	7/10/17	15:12	54.07	1.81	8.00	3.74	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SPI-28	3	7/10/17	14:49	8.14	0.00	1.72	0.56	FALSE							Low penetration, compact sand bottom with shell debris
JSN	SPI-29	1	7/10/17	17:16				indet	TRUE	50.00					TRUE	Wood debris in black sediments at depth, white coating on wood likely beggiatoa bacteria
JSN	SPI-29	2	7/10/17	17:18	2.85	0.00	0.25	0.20	TRUE	30.00					TRUE	White coated wood particle likely beggiatoa bacteria
JSN	SPI-30	1	7/10/17	17:30	2.25	0.00	0.55	0.16	FALSE							Thin RPD, high contrast with reduced black fine-grained sediments, stressed habitat
JSN	SPI-30	2	7/10/17	17:31	3.73	0.00	0.51	0.26	FALSE							Thin RPD, high contrast, possible burrow center?

Table A.1 - Sediment Profile Image Results Summary

NewFields Sediment Profile Image Analysis

Project: Shelton Harbor **Pixel Calib. Factor:** **0.3619175**

Analyst (Initials)	Station	Replicate	Date	Time	Apparent RPD Thickness (cm)				Wood Debris		Methane				Bacterial Mats	Comments
					Area	Min	Max	Mean	Present	Percent	Present	Count	Mean Depth	Diameter		
JSN	SPI-31	1	7/11/17	10:05	5.42	0.00	0.85	0.37	TRUE	10.00						High RPD contrast, wood pieces on surface
JSN	SPI-31	2	7/11/17	10:05	28.39	0.00	3.50	1.96	TRUE	5.00						Deeper RPD, but strong contrast, scattered wood particles
JSN	SPI-32	1	7/11/17	9:59	40.88	1.07	5.65	2.83	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SPI-33	2	7/11/17	8:02				indet	FALSE							Gravels on bottom, no penetration
JSN	SPI-34	3	7/11/17	8:23	62.65	1.43	7.34	4.33	FALSE							Fine-grained unconsolidated sediments
JSN	SPI-35	1	7/10/17	10:56				indet	FALSE							Low penetration, clams and/or shells on surface, consolidated bottom
JSN	SPI-35	2	7/10/17	10:57	23.34	1.00	2.19	1.61	FALSE							Low penetration, consolidated bottom
JSN	SPI-36	2	7/11/17	8:31	36.51	1.27	4.37	2.52	TRUE	< 1.00						Traces of very fine organic black particles mixed in the sediment column
JSN	SPI-37	1	7/11/17	14:25	11.38	0.00	1.56	0.79	TRUE	5.00						Low penetration, compact, sandy bottom, wood pieces on surface

Table A.2 - Plan View Image Summary

NewFields Sediment Profile Image Analysis
Project: Shelton Harbor

OID	image file	Station	Rep	Date	time	Image Area (sqft)	Class	Wood Waste Present	Wood Waste Type	Turbidity	Notes
132	SH01A.ARW	SH01	1/1/00	0:00	42928	7.80	-			high	suspended organics masking bottom
133	SH01B.ARW	SH01	1/2/00	0:00	42928	7.80	soft mud, silt			high	suspended organics, can make out ghost shrimp holes so likely very soft bottom
61	SH03A.ARW	SH03	1	7/11/2017	8:17	7.8	sands, rocks			moderate	suspended organics, a few large rocks are visible on the sand
62	SH03B.ARW	SH03	1/2/00	0:00	42927	7.80	sands			high	suspended organics
59	SH04A.ARW	SH04	1	7/11/2017	8:07	7.8	-			high	sediment plume masking the bottom, air bubble trapped on camera face
60	SH04B.ARW	SH04	2	7/11/2017	8:08	7.8	-			high	sediment plume masking the bottom, air bubble trapped on camera face
67	SH05A.ARW	SH05	1	7/11/2017	8:41	7.8	hard bottom			moderate	suspended organics, cobble covering the bottom
68	SH05B.ARW	SH05	2	7/11/2017	8:42	7.8	hard bottom			moderate	suspended organics, cobble covering the bottom
77	SH07A.ARW	SH07	1	7/11/2017	9:11	7.8	sands, silt				ghost shrimp hole
78	SH07B.ARW	SH07	2	7/11/2017	9:13	7.8	sands, silt				ghost shrimp holes, air bubble trapped on camera face
129	SH10A.ARW	SH10	1/1/00	0:00	42928	7.80	soft mud, silt				ghost shrimp holes
130	SH10B.ARW	SH10	2	7/11/2017	14:41	7.8	soft mud, silt				ghost shrimp holes
106	SH11A.ARW	SH11	1	7/11/2017	11:47	7.8	-			high	high turbidity masking bottom
107	SH11B.ARW	SH11	2	7/11/2017	11:48	7.8	-			high	high turbidity masking bottom
125	SH11C.ARW	SH11	3	7/11/2017	13:59	7.8	-			high	suspended organics masking the bottom, air bubble trapped in camera face
126	SH11D.ARW	SH11	4	7/11/2017	14:00	7.8	-			high	high turbidity masking bottom
94	SH12A.ARW	SH12	1	7/11/2017	10:53	7.8	soft mud, silt				some organic leafy material and green algae, sediment transition from dark grey to light reddish
95	SH12B.ARW	SH12	2	7/11/2017	10:54	7.8	-			high	sediment plume masking bottom
98	SH13A.ARW	SH13	1	7/11/2017	11:07	7.8	rocks				
99	SH13B.ARW	SH13	2	7/11/2017	11:08	7.8	rocks				
100	SH13A-A.ARW	SH13A	1	7/11/2017	11:10	7.8	soft mud, silt				ghost shrimp holes
101	SH13A-C.ARW	SH13A	3	7/11/2017	11:31	7.8	-			high	suspended organics masking the bottom
102	SH13A-D.ARW	SH13A	4	7/11/2017	11:32	7.8	-			high	sediment plume masking bottom
93	SH18B.ARW	SH18	2	7/11/2017	10:37	7.8	-			high	sediment plume masking bottom
121	SH19A.ARW	SH19	1	7/11/2017	13:46	7.8	-			high	suspended organics masking the bottom
122	SH19B.ARW	SH19	2	7/11/2017	13:47	7.8	-			high	suspended organics masking the bottom, image out of focus
112	SH20A.ARW	SH20	1	7/11/2017	13:14	7.8	soft mud, silt			high	high suspended organics in water column, ghost shrimp holes so likely very soft
113	SH20B.ARW	SH20	2	7/11/2017	13:15	7.8	soft mud, silt			high	suspended organics, ghost shrimp holes
114	SH20C.ARW	SH20	3	7/11/2017	13:15	7.8	soft mud, Silt			high	high suspended organics in water column, ghost shrimp holes so likely very soft
115	SH20D.ARW	SH20	4	7/11/2017	13:16	7.8	-				image too dark
47	SH21A.ARW	SH21	1	7/10/2017	18:36	7.8	sands, silt			moderate	suspended organics, ghost shrimp holes
48	SH21B.ARW	SH21	2	7/10/2017	18:37	7.8	-			high	sediment plume masking the bottom
37	SH22A.ARW	SH22	1	7/10/2017	17:37	7.8	sands?			high	high in suspended organics
38	SH22B.ARW	SH22	2	7/10/2017	17:38	7.8	-			high	high in suspended organics, unable to resolve the bottom
39	SH22C.ARW	SH22	3	7/10/2017	17:42	7.8	sands			high	high in suspended organics
7	SH23A.ARW	SH23	1	7/10/2017	12:16	13.8	soft mud, silt			high	high in suspended organics, ghost shrimp holes visible so likely very soft bottom
8	SH23B.ARW	SH23	2	7/10/2017	12:17	13.8	soft mud, silt			high	high in suspended organics, ghost shrimp holes visible so likely very soft bottom
42	SH24A.ARW	SH24	1	7/10/2017	18:17	7.8	-			high	high in suspended organics, unable to resolve the bottom

Table A.2 - Plan View Image Summary

OID	image file	Station	Rep	Date	time	Image Area (sqft)	Class	Wood Waste Present	Wood Waste Type	Turbidity	Notes
43	SH24B.ARW	SH24	2	7/10/2017	18:18	7.8	-			high	sediment plume masking the bottom
83	SH25A.ARW	SH25	1	7/11/2017	9:53	7.8	soft mud, silt				ghost shrimp holes, crab (Cancer gracilis)
84	SH25B.ARW	SH25	2	7/11/2017	9:54	7.8	-				sediment plume masking bottom
69	SH26A.ARW	SH26	1	7/11/2017	8:48	7.8	sands, hard bottom			moderate	few broken shells, crab (Cancer gracilis), air bubble trapped on camera face
70	SH26B.ARW	SH26	2	7/11/2017	8:48	7.8	sands hard bottom			moderate	few broken shells, air bubble trapped on camera face
1	SH27A.ARW	SH27	1	7/10/2017	11:02	13.8	soft mud, silt			high	high in suspended organics, ghost shrimp holes visible so likely very soft bottom
2	SH27B.ARW	SH27	2	7/10/2017	11:03	13.8	-			high	high in suspended organics masking bottom
27	SH28A.ARW	SH28	1	7/10/2017	16:31	7.8	soft mud, Silt			high	high in suspended organics
28	SH28B.ARW	SH28	2	7/10/2017	16:33	7.8	soft mud, Silt			high	high in suspended organics
134	SH30A.ARW	SH30	1	7/11/2017	15:04	7.8	soft mud, silt			high	suspended organics, can make out ghost shrimp holes so likely very soft bottom
135	SH30B.ARW	SH30	2	7/11/2017	15:05	7.8	soft mud, silt			high	suspended organics, can make out ghost shrimp holes so likely very soft bottom
136	SPI01A.ARW	SPI01	1	7/11/2017	15:11	7.8	soft mud, silt				ghost shrimp holes, air bubble trapped on camera face
137	SPI01B.ARW	SPI01	2	7/11/2017	15:12	7.8	soft mud, silt			high	ghost shrimp holes
138	SPI02A.ARW	SPI02	1	7/11/2017	15:21	7.8	soft mud, wood waste	yes	board		ghost shrimp holes
139	SPI02B.ARW	SPI02	2	7/11/2017	15:22	7.8	-				image too dark
131	SPI03A.ARW	SPI03	1	7/11/2017	14:48	7.8	soft mud, silt			moderate	suspended organics, ghost shrimp holes
81	SPI04A.ARW	SPI04	1	7/11/2017	9:27	7.8	sands, silt				
82	SPI04B.ARW	SPI04	2	7/11/2017	9:28	7.8	-				sediment plume masking bottom
79	SPI05A.ARW	SPI05	1	7/11/2017	9:21	7.8	sands, silt				few suspended organics, ghost shrimp holes
80	SPI05B.ARW	SPI05	2	7/11/2017	9:22	7.8	-				sediment plume masking bottom
71	SPI06A.ARW	SPI06	1	7/11/2017	8:53	7.8	sands, hard bottom				few suspended organics, air bubble trapped on camera face
72	SPI06B.ARW	SPI06	2	7/11/2017	8:54	7.8	sands, hard bottom			moderate	suspended organics
74	SPI06C.ARW	SPI06	3	7/11/2017	9:06	7.8	sands, hard bottom			moderate	few suspended organics
75	SPI06D.ARW	SPI06	4	7/11/2017	9:06	7.8	-			high	sediment plume masking bottom
76	SPI06E.ARW	SPI06	5	7/11/2017	9:06	7.8	sands hard bottom				white object likely a bone of some type
3	SPI07A.ARW	SPI07	1	7/10/2017	11:30	13.8	Sands			high	high in suspended organics
4	SPI07B.ARW	SPI07	2	7/10/2017	11:31	13.8	Sands			high	high in suspended organics
91	SPI08A.ARW	SPI08	1	7/11/2017	10:29	7.8	-			high	sediment plume masking bottom
92	SPI08B.ARW	SPI08	2	7/11/2017	10:36	7.8	-			high	sediment plume masking bottom
103	SPI08C.ARW	SPI08	3	7/11/2017	11:39	7.8	-			high	sediment plume masking bottom
104	SPI08D.ARW	SPI08	4	7/11/2017	11:40	7.8	soft mud, silt			high	sediment plume masking bottom, likely very soft bottom given organics in sediment plume
105	SPI08E.ARW	SPI08	5	7/11/2017	11:43	7.8	-			high	suspended organics masking the bottom
123	SPI08F.ARW	SPI08	6	7/11/2017	13:51	7.8	-			high	suspended organics masking the bottom
124	SPI08G.ARW	SPI08	7	7/11/2017	13:53	7.8	-			high	suspended organics masking the bottom
49	SPI09A.ARW	SPI09	1	7/10/2017	18:45	7.8	silts, soft sed			high	suspended organics, ghost shrimp holes
50	SPI09B.ARW	SPI09	2	7/10/2017	18:46	7.8	-			high	sediment plume masking the bottom
51	SPI10A.ARW	SPI10	1	7/10/2017	18:56	7.8	silts, soft sed			high	suspended organics, ghost shrimp holes
52	SPI10B.ARW	SPI10	2	7/10/2017	18:58	7.8	-				image too dark
53	SPI11A.ARW	SPI11	1	7/10/2017	19:08	7.8	silts, soft sed			moderate	suspended organics, ghost shrimp holes
54	SPI11B.ARW	SPI11	2	7/10/2017	19:11	7.8	silts, soft sed			moderate	suspended organics, ghost shrimp holes, mud clast
5	SPI12A.ARW	SPI12	1	7/10/2017	12:00	13.8	soft mud, silt			high	high in suspended organics, ghost shrimp holes
6	SPI12B.ARW	SPI12	2	7/10/2017	12:02	13.8	-			high	high in suspended organics, air bubble trapped in camera face

Table A.2 - Plan View Image Summary

OID	image file	Station	Rep	Date	time	Image Area (sqft)	Class	Wood Waste Present	Wood Waste Type	Turbidity	Notes
40	SPI12C.ARW	SPI12	3	7/10/2017	18:00	7.8	sands, silt			moderate	suspended organics, ghost shrimp holes
41	SPI12D.ARW	SPI12	4	7/10/2017	18:01	7.8	sands, silt			moderate	suspended organics, ghost shrimp holes
25	SPI14A.ARW	SPI14	1	7/10/2017	16:23	7.8	-			high	sediment plume masking the bottom
26	SPI14B.ARW	SPI14	2	7/10/2017	16:24	7.8	-			high	sediment plume masking the bottom
108	SPI15A.ARW	SPI15	1	7/11/2017	11:55	7.8	soft mud, silt			high	high turbidity, can just make out the bottom, ghost shrimp holes so likely very soft
109	SPI15B.ARW	SPI15	2	7/11/2017	11:56	7.8	soft mud, silt			high	sediment plume masking bottom, likely very soft bottom given organics in sediment plume
110	SPI15C.ARW	SPI15	3	7/11/2017	13:08	7.8	soft mud, silt			high	suspended organics, ghost shrimp holes so likely very soft
111	SPI15D.ARW	SPI15	4	7/11/2017	13:09	7.8	soft mud, silt			high	sediment plume, ghost shrimp holes so likely very soft
44	SPI16A.ARW	SPI16	1	7/10/2017	18:25	7.8	sands, shell debris			moderate	
45	SPI16B.ARW	SPI16	2	7/10/2017	18:27	7.8	sands, shell debris			high	sediment plume masking portion of the bottom
46	SPI16C.ARW	SPI16	3	7/10/2017	18:29	7.8	sands, shell debris				
19	SPI17A.ARW	SPI17	1	7/10/2017	13:37	7.8	-			high	high in suspended organics masking bottom
20	SPI17B.ARW	SPI17	2	7/10/2017	13:39	7.8	soft mud, Silt				image is out of focus, likely camera triggered late due to weight sinking in very soft sediment
96	SPI18A.ARW	SPI18	1	7/11/2017	10:59	7.8	soft mud, silt			moderate	some suspended organics, ghost shrimp holes
97	SPI18B.ARW	SPI18	2	7/11/2017	11:00	7.8	-			high	sediment plume masking bottom
118	SPI19A.ARW	SPI19	1	7/11/2017	13:39	7.8	soft mud, silt			high	high suspended organics in water column, ghost shrimp holes so likely very soft
119	SPI19B.ARW	SPI19	2	7/11/2017	13:40	7.8	-			high	sediment plume masking the bottom
120	SPI19C.ARW	SPI19	3	7/11/2017	13:44	7.8	-			high	sediment plume masking the bottom, image out of focus
116	SPI20A.ARW	SPI20	1	7/11/2017	13:20	7.8	soft mud, silt			high	suspended organics
117	SPI20B.ARW	SPI20	2	7/11/2017	13:21	7.8	-				image too dark
13	SPI21A.ARW	SPI21	1	7/10/2017	13:04	7.8	soft mud, wood waste	possible	sticks	high	high in suspended organics, can just make out possible wood waste debris
14	SPI21B.ARW	SPI21	2	7/10/2017	13:05	7.8	-			high	high in suspended organics
29	SPI22A.ARW	SPI22	1	7/10/2017	16:57	7.8	wood waste	yes	wood chunks, bark, sticks		Beggiatoa present on wood waste
30	SPI22B.ARW	SPI22	2	7/10/2017	16:58	7.8	wood waste	yes	wood chunks, bark, sticks		Beggiatoa present on wood waste
9	SPI23C.ARW	SPI23	3	7/10/2017	12:18	13.8	-			high	image too dark, unable to resolve the bottom
12	SPI23A.ARW	SPI23	1	7/10/2017	12:28	13.8	wood waste	yes	sticks, bark	high	high in suspended organics
15	SPI23D.ARW	SPI23	4	7/10/2017	13:13	7.8	wood waste	yes	sticks, bark	moderate	crab (Cancer gracilis)
16	SPI23E.ARW	SPI23	5	7/10/2017	13:14	7.8	-			high	sediment plume of turbidity masking the bottom
17	SPI23F.ARW	SPI23	6	7/10/2017	13:14	7.8	wood waste	yes	wood chunks, bark	moderate	crab (Cancer gracilis) , turbidity plum masking portion of the image
10	SPI24A.ARW	SPI24	1	7/10/2017	12:22	13.8	soft mud, silt			high	high in suspended organics, ghost shrimp holes visible so likely very soft bottom
11	SPI24B.ARW	SPI24	2	7/10/2017	12:23	13.8	-			high	high in suspended organics masking bottom
18	SPI24C.ARW	SPI24	3	7/10/2017	13:22	7.8	-			high	high in suspended organics masking bottom
24	SPI25A.ARW	SPI25	1	7/10/2017	15:25	7.8	-			high	sediment plume masking the bottom
21	SPI28A.ARW	SPI28	1	7/10/2017	14:32	7.8	hard Sands, shell debris			moderate	broken shells litter the bottom
22	SPI28B.ARW	SPI28	2	7/10/2017	14:34	7.8	hard Sands, shell debris			moderate	broken shells litter the bottom
23	SPI28C.ARW	SPI28	3	7/10/2017	14:52	7.8	hard Sands, shell debris			moderate	broken shells litter the bottom
31	SPI29A.ARW	SPI29	1	7/10/2017	17:15	7.8	wood waste	yes	wood chunks, bark		Beggiatoa present on wood waste
32	SPI29A1.ARW	SPI29	2	7/10/2017	17:15	7.8	wood waste	yes	wood chunks, bark		
33	SPI29A2.ARW	SPI29	3	7/10/2017	17:15	7.8	wood waste	yes	wood chunks, bark		
34	SPI29E.ARW	SPI29	5	7/10/2017	17:17	7.8	wood waste	yes	wood chunks	high	high in suspended organics
35	SPI30A.ARW	SPI30	1	7/10/2017	17:30	7.8	wood waste	possible	wood chunks	high	high in suspended organics
36	SPI30B.ARW	SPI30	2	7/10/2017	17:31	7.8	wood waste	possible	wood chunks	high	high in suspended organics

Table A.2 - Plan View Image Summary

OID	image file	Station	Rep	Date	time	Image Area (sqft)	Class	Wood Waste Present	Wood Waste Type	Turbidity	Notes
87	SPI31A.ARW	SPI31	1	7/11/2017	10:04	7.8	soft mud, wood waste	yes	fibrous, wood chunks	moderate	high concentration of organics on bottom, few chunks of wood
88	SPI31B.ARW	SPI31	2	7/11/2017	10:05	7.8	-			high	sediment plume masking bottom
89	SPI31C.ARW	SPI31	3	7/11/2017	10:05	7.8	-			high	sediment plume masking bottom, extra image
90	SPI31D.ARW	SPI31	4	7/11/2017	10:06	7.8	-			high	sediment plume masking bottom, extra image
85	SPI32A.ARW	SPI32	1	7/11/2017	9:59	7.8	soft mud, wood waste	yes	fibrous	moderate	high concentration of organics on bottom, Beggiatoa present on wood waste
86	SPI32B.ARW	SPI32	2	7/11/2017	10:00	7.8	-				sediment plume masking bottom
57	SPI33A.ARW	SPI33	1	7/11/2017	8:00	7.8	rocky				large cobles and rocks
58	SPI33B.ARW	SPI33	2	7/11/2017	8:01	7.8	rocky				large cobles and rocks
55	SPI34A.ARW	SPI34	1	7/11/2017	7:46	7.8	silts, soft sed			moderate	suspended organics, ghost shrimp holes
56	SPI34B.ARW	SPI34	2	7/11/2017	7:47	7.8	-				image too dark
63	SPI34C.ARW	SPI34	3	7/11/2017	8:23	7.8	soft mud, Silt			high	suspended organics and sediment plume, image out of focus, camera may have sunk in soft sediment
64	SPI34D.ARW	SPI34	4	7/11/2017	8:24	7.8	soft mud, Silt			high	suspended organics and sediment plume, image out of focus, camera may have sunk in soft sediment
65	SPI36A.ARW	SPI36	1	7/11/2017	8:30	7.8	hard bottom			high	suspended organics and sediment plume, possible rocks in image, likely hard bottom
66	SPI36B.ARW	SPI36	2	7/11/2017	8:31	7.8	-			high	sediment plume masking the bottom
127	SPI37A.ARW	SPI37	1	7/11/2017	14:24	7.8	sand, wood waste	yes	wood chunks, bark		wood debris and other organics cover bottom, some broken shells
128	SPI37B.ARW	SPI37	2	7/11/2017	14:26	7.8	sand, wood waste	possible			some organics cover bottom, possible wood waste, some broken shells

Attachment 5

Bioassay Report

ECOANALYSTS, INC.

TOXICOLOGY TESTING RESULTS

SHELTON HARBOR SEDIMENT CLEANUP SITE
SHELTON, WASHINGTON

Prepared for
Anchor QEA LLC
720 Olive Way, Suite 1900
Seattle, WA 98101

On behalf of:
Simpson Timber Company
1305 5th Ave, Suite 2700
Seattle, WA 98101

Prepared by
EcoAnalysts, Inc.
4770 NE View Drive
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EcoAnalysts Report ID:
081417.01

Submittal Date
September 18, 2017

All testing reported herein was performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and EcoAnalysts is not responsible for use of less than the complete report. The test results summarized in this report apply only to the sample(s) evaluated.

APPROVED BY:

Brian Hester

____
Brian Hester

Laboratory Director

Authors:

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Bridget Gregg

CONTENTS

TABLES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AFDW:	Ash-free dry weight
ARI:	Analytical Resources, Inc., Tukwila, WA
cm:	Centimeter
CSL:	Cleanup Screening Level
°C:	Degrees Celsius
EC_{50}:	Effective Concentration that results in a 50% reduction in a sub-lethal endpoint
g:	Grams
LC_{50}:	Lethal Concentration that results in a 50% reduction in survival
L:	Liter
µm:	Micrometer
mg:	Milligram
mg/L:	Milligrams per liter
mL:	Milliliter
mm:	Millimeter
NELAP:	National Environmental Laboratory Accreditation Program
NOEC:	No Observed Effect Concentration
OR:	Oregon
ppt:	parts per thousand
PSEP:	Puget Sound Estuary Protocols (PSEP 1995)
SCO:	Sediment Cleanup Objective
SMS:	Sediment Management Standards
SOP:	Standard operation procedure
SSAPA:	Sediment Sampling and Analysis Plan Appendix (SSAPA; WDOE 2008)
SMARM:	Sediment Management Annual Review Meeting
UIA:	Un-ionized ammonia
USACE:	United States Army Corps of Engineers
USEPA:	United States Environmental Protection Agency
WA:	Washington State
WAC:	Washington Administrative Code
WDOE:	Washington (State) Department of Ecology

1. INTRODUCTION

EcoAnalysts conducted biological toxicity testing with sediment samples collected by Anchor QEA, LLC. as part of a Remedial Investigation/Feasibility Study (RI/FS) being performed at the Shelton Harbor Cleanup Site in Shelton, Washington. Sediments were evaluated for biological effects following guidance provided by the Washington State Department of Ecology (WDOE) Sediment Management Standards (SMS) under the Washington Administrative Code (WAC) 173-204-315. This report presents the results of the toxicity testing portion of the Shelton Harbor sediment investigation.

2. METHODS

This section summarizes the test methods followed for this biological characterization. Test methods followed guidance provided by the Puget Sound Estuary Program (PSEP 1995), the Sediment Cleanup User's Manual II (SCUM II; WDOE 2015), and the various updates presented during the Sediment Management Annual Review Meeting (SMARM). Sediment toxicity was evaluated using three standard PSEP bioassays; the 10-day amphipod test, the 20-day juvenile polychaete survival and growth test, and the 48-hour benthic larval development test.

2.1 Sample Collection and Organism Receipt

Eleven test sediments were collected on July 12 – 13, 2017 and were received at EcoAnalysts on July 15, 2017. Reference sediments from Carr Inlet, WA were collected by EcoAnalysts on July 22, 2017 and received on the same day. Sediment samples were stored in a walk-in cold room at 4 ± 2°C in the dark. The test sediment was not sieved prior to testing. All tests were conducted within the eight-week holding time.

Amphipods (*Eohaustorius estuarius*) were supplied by Northwestern Aquatic Sciences in Newport, Oregon. Animals were held in native sediment at 15°C prior to test initiation. Juvenile polychaete worms (*Neanthes arenaceodentata*) were obtained from Aquatic Toxicology Support in Bremerton, Washington. Juvenile polychaetes were held in seawater at 20°C (Neanthes were cultured in water-only and were not held in sediment prior to testing). *Mytilus galloprovincialis* (mussel) broodstock were provided by Taylor Shellfish in Shelton, WA. Broodstock were held in unfiltered seawater at 14 – 16°C prior to spawning.

Native *Eohaustorius* sediment from Yaquina Bay, Oregon was also provided by Northwest Aquatic Sciences for use as control sediment treatments for the amphipod and juvenile polychaete tests.

2.2 Sample Testing Plan

Based on historical data of the Shelton Harbor Cleanup Unit, Ecology approved a modified testing approach. Larval and polychaete bioassays were conducted at sample locations where historical SMS exceedances had occurred. Areas with higher wood debris content than historical sampling locations received full suite bioassay testing (larval, polychaete, and amphipod). Sample locations and their corresponding bioassays are outlined in Table 2-1.

Table 2-1. Bioassay Sample Assignments

Sample ID	Benthic Larval Development Test	Juvenile Polychaete Survival and Growth Test	Amphipod Survival Test
SH-04	X		
SH-13A		X	
SH-14	X		
SH-19	X	X	
SH-21	X		
SH-22	X	X	
SH-24	X		
SH-28		X	
SPI-22	X	X	X
SPI-30	X	X	X
SPI-31	X	X	X

X = Indicates test to be conducted with associated samples

2.3 Sample Grain Size and Reference Comparison

Sediment grain size is one of the characteristics used in selecting the appropriate reference sediment(s) to compare the chemical and biological responses of project sediments. The percent fines value is defined as the amount of sediment that passes through a 62.5-µm sieve, expressed as a percentage of the total sample analyzed. This is also the sum of the silt and clay fraction of sediment. Wet-sieve grain size results for the reference sample was conducted in the field (at the time of collection) and after receipt at the EcoAnalysts laboratory. The percent-fines determination of the project sediments are summarized in Table 2-2.

Table 2-2. Sample and Reference Grain Size Comparison.

Treatment	Percent Fines[1]	Treatment Compared To:
SH-Ref-1 (Reference)	10%	
CARR/SH-Ref-1 (Reference)	28%	
CARR (Reference)	52%	
CR-022 (Reference)	72%	
SH-04	48%	CARR
SH-13A	46%	CARR
SH-14	32%	CARR/SH-Ref-1
SH-19	48%	CARR
SH-21	62%	CARR or CR-022
SH-22	36%	CARR/SH-Ref-1
SH-24	38%	CARR/SH-Ref-1
SH-28	28%	CARR/SH-Ref-1
SPI-22	10%	SH-Ref-1
SPI-30	34%	CARR/SH-Ref-1
SPI-31	56%	CARR

[1] Wet sieve results

2.4 10-day Amphipod Bioassay

The 10-day acute toxicity test with *E. estuarius* was initiated on July 28, 2017. To prepare the test exposures, approximately 175 mL of sediment was placed in clean, acid and solvent-rinsed 1-L glass jars, which were then filled with 775 mL of 0.45-µm filtered seawater at 28 ppt. The control and reference sediment were tested concurrently with the test treatment. Five replicates were used to evaluate sediment toxicity while the remaining two replicates were designated as sacrificial surrogate chambers. One surrogate chamber was sacrificed at test initiation to measure porewater and overlying ammonia and sulfides. The remaining surrogate chamber was used for measuring daily water quality throughout the test, as well as porewater and overlying ammonia and sulfides at test termination. Total ammonia as nitrogen was monitored using an Orion meter fitted with an ammonia ion-specific probe. Total sulfides as S^{2-} were monitored using a HACH DR/2800 Spectrophotometer.

Test chambers were placed in randomly assigned positions in a 15°C water bath and allowed to equilibrate overnight. Trickle-flow aeration was provided to prevent dissolved oxygen concentrations from dropping below acceptable levels.

Immediately prior to test initiation, water quality parameters were measured in the surrogate chamber for each treatment. Dissolved oxygen (DO), temperature, pH, and salinity were then monitored in the surrogate chambers daily until test termination. Target test parameters were:

Dissolved Oxygen:	≥5.1 mg/L
Temperature:	15 ± 1°C
Salinity:	28 ± 1 ppt
pH:	7 - 9 units

The tests were initiated by randomly allocating 20 *E. estuarius* into each test chamber, ensuring that each of the amphipods successfully buried into the sediment. Amphipods that did not bury within approximately one hour were replaced with healthy amphipods. The 10-day amphipod bioassay was conducted as a static test with no feeding during the exposure period. At test termination, sediment from each test chamber was sieved through a 0.5-mm screen and all recovered amphipods transferred into a Petri dish. The number of surviving and dead amphipods was then determined under a dissecting microscope.

To evaluate the relative sensitivity of the organisms, reference toxicity tests were performed using standard reference toxicants (Lee 1980). A water-only, 4-day reference-toxicant test was conducted concurrently with the sediment tests using ammonium chloride. The ammonium chloride reference-toxicant test was used to ensure animals used in the test were healthy and of similar sensitivity to prior tests. This test also provided information on the sensitivity to any ammonia concentrations that might be present in the sediments.

2.5 20-day Juvenile Polychaete Bioassay

The 20-day chronic toxicity test with *N. arenaceodentata* was initiated on July 28, 2017. Test exposures were prepared with approximately 175 mL of sediment placed in clean, acid and solvent-rinsed 1-L glass jars, which were then filled with 775 mL of 0.45-µm filtered seawater at 28 ppt. The control and reference sediment were tested concurrently with the test treatment. Five replicates were used to evaluate sediment toxicity while the remaining two replicates were designated as sacrificial surrogate chambers. One surrogate chamber was sacrificed at test initiation to measure overlying and interstitial ammonia and sulfides. The remaining surrogate chamber was used for measuring daily water quality throughout the test, as well as overlying and interstitial ammonia and sulfides at test termination. Total ammonia as nitrogen was monitored using an Orion meter fitted with an ammonia ion-specific probe. Total sulfides as S^{2-} were monitored using a HACH DR/2800 Spectrophotometer.

Test chambers were placed in randomly assigned positions in a water bath at 20°C and allowed to equilibrate overnight. Trickle-flow aeration was provided to prevent dissolved oxygen concentrations from dropping below acceptable levels.

Immediately prior to test initiation, water quality parameters were measured. Dissolved oxygen, temperature, pH, and salinity were then monitored in the surrogates daily until test termination. Target test parameters were:

Dissolved Oxygen:	≥4.6 mg/L
Temperature:	20 ± 1°C
Salinity:	28 ± 2 ppt
pH:	7 - 9 units

The juvenile polychaete test was initiated by randomly allocating five *N. arenaceodentata* into each test chamber, and observing whether each of the worms successfully buried into the sediment. Worms that did not bury within approximately one hour were replaced with healthy worms. The 20-day test was conducted as a static-renewal test, with exchanges of 300 mL of water occurring every third day. *N. arenaceodentata* were fed every other day with 40 mg of TetraMarin® (approximately 8 mg dry weight per worm).

At test termination, sediment from each test chamber was sieved through a 0.5-mm screen and all recovered worms transferred into a Petri dish. The number of surviving and dead worms was determined. All surviving worms were then transferred to pre-weighed, aluminum foil weigh-boats, and dried in a drying oven at 60°C for approximately 24 hours. Each weigh-boat was removed, cooled in a desiccator, and then weighed on a microbalance to 0.01 mg. Each of the weigh boats was then heated to 550°C for 2 hours to determine the ashed weight. Ash-free dry weights (AFDW) were calculated to correct for the influence of sediment grain size differences between treatments. The ashed boats were weighed to 0.01 mg and the ashed weight was subtracted from the dry weight to calculate the AFDW. Both dry weight and AFDW were used to determine individual worm weight and growth rates.

To evaluate the relative sensitivity of the organisms, reference toxicity tests were performed using standard reference toxicants (Lee 1980). A water-only, 4-day reference-toxicant test was conducted concurrently with the sediment tests using ammonium chloride. The ammonium chloride reference-toxicant test was used to ensure animals used in the test were healthy and of similar sensitivity to prior tests. This test also provided information on the sensitivity to any ammonia concentrations that might be present in the sediments.

2.6 Larval Developmental Bioassay

Test sediment was evaluated using the larval benthic toxicity test with the mussel, *M. galloprovincialis*. The mussel larval test was initiated on August 1, 2017. The control and reference sediment were tested with the test treatments. To prepare the test exposures, 18 g (±1 g) of test sediment was placed in clean, acid and solvent-rinsed 1-L glass jars, which were then filled to 900 mL with 0.45-µm filtered seawater. Six replicate chambers were prepared for the test treatment, reference sediment, and the native sediment control treatment. Five of the replicates were used to evaluate the test; the sixth replicate was used as a water quality surrogate. Each chamber was shaken for 10 seconds and then placed in predetermined randomly-assigned positions in a water bath at 16°C.

To collect gametes for each test, mussels were placed in clean seawater and acclimated at 16°C for approximately 20 minutes. The water bath temperature was then increased over a period of 15 minutes to 20°C. Mussels were held at 20°C and monitored for spawning individuals. Spawning females and males were removed from the water bath and placed in individual containers with seawater. These individuals were allowed to spawn until sufficient gametes were available to initiate the test. After the spawning period, eggs are transferred to fresh seawater and filtered through a 0.5 mm Nitex® mesh screen to remove large debris, feces, and excess gonadal matter. A composite was made of the sperm and diluted with fresh seawater. The fertilization process was initiated by adding sperm to the isolated egg containers. Egg-sperm solutions were periodically homogenized with a perforated plunger during the fertilization process and sub-samples observed under the microscope for egg and sperm viability. Approximately one to one and a half hours after fertilization, embryo solutions were checked for fertilization rate. Only those embryo stocks with >90% fertilization were used to initiate the tests. Embryo solutions were rinsed free of excess sperm and then combined to create one embryo stock solution. Density of the embryo stock solution was determined by counting the number of embryos in a subsample of homogenized stock solution. This was used to determine the volume of embryo stock solution to deliver approximately 20,000 to 40,000 embryos to each test chamber.

Dissolved oxygen, temperature, pH, and salinity were monitored in water quality surrogates to prevent loss or transfer of larvae by adhesion to water-quality probes. Ammonia and sulfides in the overlying water were measured on Day 0 and Day 2 (test termination). Total ammonia as nitrogen was monitored using an Orion meter fitted with an ammonia ion-specific probe. Total sulfides as S^{-2} were monitored using a HACH DR/2800V Spectrophotometer. Target test parameters were as follows:

Dissolved Oxygen:	≥5.0 mg/L
Temperature:	16 ± 1°C
Salinity:	28 ± 1ppt
pH:	7 - 9 units

The development test was conducted as a static test without aeration. The protocol calls for test termination when 95% of the embryos in the control have reached the prodissoconch I stage (approximately 48-60 hours). At termination, the overlying seawater was decanted into a clean 1-L jar and mixed with a perforated plunger. From this container, a 10 mL subsample was transferred to a scintillation vial and preserved in 5% buffered formalin. Larvae were subsequently stained with a dilute solution of Rose Bengal in 70% alcohol to help visualization of larvae. The number of normal and abnormal larvae was enumerated on an inverted microscope. Normal larvae included all D-shaped prodissoconch I stage larvae. Abnormal larvae included abnormally shaped prodissoconch I larvae and all early stage larvae.

To evaluate the relative sensitivity of the organisms, reference toxicity tests were performed using standard reference toxicants (Lee 1980). A water-only reference-toxicant test was conducted concurrently with the sediment tests using ammonium chloride. The ammonium chloride reference-toxicant test was used to ensure animals used in the test were healthy and of similar sensitivity to prior tests. This test also provided information on the sensitivity to ammonia concentrations that would possibly be present in the sediments.

2.7 Data Analysis and QA/QC

All water quality and endpoint data were entered into Excel spreadsheets. Water quality parameters were summarized by calculating the mean, minimum, and maximum values for each test treatment. Endpoint data were calculated for each replicate and the mean values and standard deviations were determined for each test treatment.

All hand-entered data was reviewed for data entry errors, which were corrected prior to summary calculations. A minimum of 10% of all calculations and data sorting were reviewed for errors. Review counts were conducted on any apparent outliers.

For the larval test, the normalized combined mortality and abnormality endpoint was used to evaluate the test sediment. This was based on the number of normal larvae in each treatment and reference sample divided by the mean number of normal larvae in the control replicates, as defined in the SCUM II guidance document (Ecology 2015).

Experiment-wide survival, growth, and development data were analyzed using one-way analysis of variance (ANOVA). When ANOVA showed a significant difference, multiple comparison t-tests then compared survival in each of the control and test sediments against survival in the reference sediments. Prior to analyses, normality and homogeneity of variance was assessed. When necessary to satisfy these assumptions, proportional survival data were arcsine square-root transformed. Solid-phase analyses were performed with GraphPad Prism, Version 7.03. Statistical analyses of all dose-response tests were performed using CETIS Comprehensive Toxicity Data Analysis and Database Software version 1.9.2.6. Comparisons between the lab control and each test concentration were performed following recommended USEPA decision matrices (USEPA 2002).

3. RESULTS

The results of the sediment testing, including a summary of test results and water quality observations are presented in this section. Data for each of the replicates, as well as laboratory bench sheets are provided Appendix A and statistical analyses are provided in Appendix B.

3.1 10-day Amphipod Bioassay

The bioassay test with *E. estuarius* was validated with 1% mortality in the native sediment control, which met the performance criterion of ≤10% mortality for SMS evaluations. This result indicates that the test conditions were suitable for adequate amphipod survival. Mean mortality in the reference treatments CARR, SH-Ref-1 and CARR/SH-Ref-1 was between 1 – 5% which met the performance criteria (≤25% mortality) and indicated that the reference sediment was acceptable for suitability determination. Mean mortality in the three project samples was between 8 – 9%. All endpoint results are summarized in Table 3-1. Summaries of water quality measurements, ammonia and sulfide concentrations, and test conditions are presented in Table 3-2, Table 3-3, and Table 3-4.

Temperature was recorded above the targeted range of 15 ± 1°C (Max value of 16.8°C) on Day 9 among all treatments. The temperature control system was adjusted upon discovery and temperatures were returned to the targeted range for the duration of the test. The pH of replicate 5 of sample SPI-31 was 6.7 units on Day 10. This was slightly outside the expected range of 7 – 9 pH units. No corrective action is warranted for instances of pH variance. Survival within this replicate was 100%, indicating that the pH did not impair organism survival. All other water quality parameters were within the acceptable limits throughout the duration of the test. Given the high level of survival among all treatments (≥91%), these deviations did not affect the significance of the test results.

A reference-toxicant test (positive control) was performed on the batch of test organisms utilized for this study. The LC_{50} value was within ±2 standard deviations from the laboratory historical mean. This result indicates that the test organisms used in this study were of similar sensitivity to those previously tested at EcoAnalysts.

Ammonia concentrations observed in the *E. estuarius* test were below the No Observed Effect Concentration (NOEC) value derived from the concurrent ammonia reference-toxicant test (Table 3-3; compare to NOEC of 151 mg/L). Values were also below the published threshold concentration of 15 mg/L total ammonia (Barton 2002). Therefore, ammonia concentrations within the sediment samples should not have been a contributor to any adverse biological effects observed in the test treatments. Initial sulfide concentrations in interstitial water ranged from 0.090 – 25.9 mg/L. Project samples SPI-22 and SPI -30 expressed elevated porewater sulfide values of 15.0 and 25.9 mg/L total sulfides, respectively. While these values exceeded the potential trigger values for purging (1.9 mg/L total sulfides / 0.122 mg/L hydrogen sulfide) (Inouye 2015), this evaluation did not require sample purging prior to testing (Soccorsy 2017). Given the high survival observed in all test treatments, these values did not appear to affect the test results.

Table 3-1. Test Results for *Eohaustorius estuarius*.

Treatment	Replicate	Number Initiated	Number Surviving	Number Missing or Dead	Percentage Survival	Mean Percentage Survival	SD
Control	1	20	20	0	100	99.0	2.2
	2	20	19	1	95		
	3	20	20	0	100		
	4	20	20	0	100		
	5	20	20	0	100		
SH-Ref-1	1	20	18	2	90	95.0	5.0
	2	20	19	1	95		
	3	20	18	2	90		
	4	20	20	0	100		
	5	20	20	0	100		
CARR	1	20	20	0	100	96.0	4.2
	2	20	19	1	95		
	3	20	18	2	90		
	4	20	20	0	100		
	5	20	19	1	95		
CARR / SH-Ref-1	1	20	20	0	100	99.0	2.2
	2	20	20	0	100		
	3	20	20	0	100		
	4	20	20	0	100		
	5	20	19	1	95		
SPI-22	1	20	20	0	100	91.0	5.5
	2	20	17	3	85		
	3	20	18	2	90		
	4	20	18	2	90		
	5	20	18	2	90		
SPI-30	1	20	20	0	100	91.0	10.8
	2	20	17	3	85		
	3	20	20	0	100		
	4	20	15	5	75		
	5	20	19	1	95		
SPI-31	1	20	18	2	90	92.0	5.7
	2	20	17	3	85		
	3	20	19	1	95		
	4	20	18	2	90		
	5	20	20	0	100		

Table 3-2. Water Quality Summary for *Eohaustorius estuarius*.

Treatment	Dissolved Oxygen (mg/L) ≥5.1 mg/L			Temperature (°C) 15 ± 1°C			Salinity (ppt) 28 ± 1 ppt			pH 7 - 9 units		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Control	8.3	7.7	8.5	15.0	14.1	**16.6**	29	28	29	8.1	8.0	8.2
SH-Ref-1	8.3	8.1	8.5	15.0	14.2	**16.6**	29	29	29	8.2	8.0	8.5
CARR	8.3	8.1	8.4	15.1	14.2	**16.7**	29	28	29	8.1	8.0	8.3
CARR / SH-Ref-1	8.3	7.9	8.5	15.1	14.3	**16.7**	29	29	29	8.1	8.0	8.3
SPI-22	8.2	7.9	8.4	15.1	14.4	**16.8**	29	28	29	8.2	7.8	8.6
SPI-30	8.2	7.9	8.4	15.1	14.2	**16.7**	28	28	29	8.3	7.8	8.6
SPI-31	8.3	8.0	8.5	15.2	14.4	**16.8**	28	27	29	8.2	**6.7**	8.6

Bold = Values that fell outside of the targeted water quality criteria

Table 3-3. Ammonia and Sulfide Summary for *Eohaustorius estuarius*.

Treatment	Overlying Ammonia (mg/L Total) [1]NOEC = 151 mg/L		Interstitial Ammonia (mg/L Total) [1]NOEC = 151 mg/L		Overlying Sulfides (mg/L Total) [2]Trigger Value = 1.9 mg/L		Interstitial Sulfides (mg/L Total) [2]Trigger Value = 1.9 mg/L	
	Day 0	Day 10	Day 0	Day 10	Day 0	Day 10	Day 0	Day 10
Control	0.00	0.00	NM	NM	0.011	0.020	NM	NM
SH-Ref-1	0.365	0.588	NM	2.61	0.082	0.005	NM	NM
CARR	0.226	0.00	3.80	1.46	0.037	0.02	0.090	0.069
CARR / SH-Ref-1	0.432	0.163	5.10	1.43	0.061	0.011	0.11	0.122
SPI-22	0.522	0.674	6.00	2.81	0.031	0.035	**15.0**	0.298
SPI-30	0.805	2.42	8.50	2.90	0.009	0.012	**25.9**	0.198
SPI-31	0.603	0.252	5.30	2.20	0.021	0.043	0.1	0.196

[1] NOEC (concurrent reference-toxicant test derived) = 151 mg/L total ammonia

[2] Inouye 2015: Total sulfide value 1.9 mg/L derived from hydrogen sulfide dissociation (0.122 mg/L H_2S @ 15°C, 28 ppt, and 8.1 pH)

NM = not measured; insufficient porewater recovered for analysis

Bold = Values that fell outside of the targeted water quality criteria

Table 3-4.Test Condition Summary for *Eohaustorius estuarius*.

Test Conditions: PSEP *E. estuarius*		
Date sampled	July 12 – 13, 2017	
Date received	July 15, 2017	
Test dates	July 28 – August 7, 2017	
Sample storage conditions	4°C, dark	
Days of holding Recommended: ≤8 weeks (56 days)	15 – 16 Days	
Source of control sediment	Yaquina Bay, OR	
Test Species	*E. estuarius*	
Supplier	Northwestern Aquatic Sciences, Newport, OR	
Date acquired	July 27, 2017	
Age class	Mature adult, 3-5 mm	
Test Procedures	PSEP 1995 with SMARM revisions, SCUM II (2015) SOP No. SED002.09	
Test location	EcoAnalysts Port Gamble Laboratory	
Test type/duration	10-Day static	
Control water	North Hood Canal seawater, 0.45µm filtered	
Test dissolved oxygen	Recommended: > 5.1 mg/L	Observed: 7.7 – 8.5 mg/L
Test temperature	Recommended: 15 ± 1 °C	Observed: 14.1 – 16.8°C
Test Salinity	Recommended: 28 ± 1 ppt	Observed: 27 – 29 ppt
Test pH	Recommended: 7 - 9	Observed: 6.7 – 8.6
Control Performance Standard SMS	Recommended: Control ≤ 10% mortality	Observed: 1% mortality; Pass
Reference Performance Standard SMS	Recommended: Reference ≤ 25% mortality	Observed mortality: 1 – 5%; Pass
Reference Toxicant LC50 (total ammonia)	LC_{50} = 196.9 mg/L	
Mean; Acceptable Range (total ammonia)	151.1; 55.5 – 246.7 mg/L	
NOEC (total ammonia)	151 mg/L	
NOEC (unionized ammonia)	1.74 mg /L	
Test Lighting	50 – 100 foot candles (ambient and constant)	
Test chamber	1-Liter Glass Chamber	
Replicates/treatment	5 + 2 surrogates (one used for WQ measurements throughout the test)	
Organisms/replicate	20	
Exposure volume	175 mL sediment/ 775 mL water	
Feeding	None	
Water renewal	None	
Deviations from Test Protocol	Temperature, pH	

3.2 20-day Juvenile Polychaete Bioassay

No mortality was observed in the *N. arenaceodentata* control sediment and mean individual growth (MIG) in the control was 0.397 mg/ind/day (dry weight) and 0.261 mg/ind/day (AFDW). These values fall within the test acceptability criteria of <10% mean mortality and ≥0.38 mg/ind/day dry weight (Kendall 1996), indicating that the test conditions were suitable for adequate polychaete survival and growth. A summary of the test results for all samples is shown in Table 3-5. Summaries of water quality measurements, ammonia and sulfide concentrations, and test conditions are presented in Table 3-6, Table 3-7, Table 3-8, and Table 3-9.

Mean mortality in the reference treatments ranged from 0 – 4%, meeting the reference performance standard of ≤10% (WDOE 2015; USACE 2015). Mean individual growth for the reference treatments ranged from 0.362 to 0.417 mg/ind/day (dry weight) and 0.274 to 0.305 mg/ind/day (AFDW). When compared to the control, MIG expressed as AFDW ranged from 1.049 to 1.169, which met the reference performance standard of ≥0.80 (WDOE 2015).

Mortality in the project sediments ranged from 0% to 16%. Mean individual growth (as dry weight) in the test treatments ranged from 0.250 to 0.428 mg/ind/day. Mean individual growth in the AFDW assessment, which removes variability caused by gut contents, ranged from 0.198 to 0.341 mg/ind/day as AFDW.

All water quality parameters were within the acceptable limits throughout the duration of the test. Initial mean individual biomass (pretest) of the test organisms was below the recommended criterion of 0.25 – 0.50 mg/individual at 0.111 mg/ind; however, the test organisms were within the recommended age for testing (2 -3 weeks old). The control growth criterion was met (0.397; ≥0.38 mg/ind/day), indicating a valid test.

A reference-toxicant test (positive control) was performed on the batch of test organisms utilized for this study. The LC_{50} value was within control chart limits (±2 standard deviations from the laboratory historical mean). This result indicates that the test organisms used in this study were of similar sensitivity to those previously tested at EcoAnalysts.

Ammonia concentrations observed in the *N. arenaceodentata* test were below the No Observed Effect Concentration (NOEC) value derived from the concurrent ammonia reference-toxicant test (Table 3-7; compare to NOEC of 99.9 mg/L). Initial sulfide concentrations in the interstitial water were below the NOEC of 3.4 mg/L total sulfides (Kendall and Barton 2004) for all samples except SPI-30 and SPI-31, which had measured sulfide levels of 3.5 and 7.8 mg/L, respectively. While these values exceeded established trigger values, this evaluation did not warrant sample purging prior to testing (Soccorsy 2017).

Table 3-5. Test Results for *Neanthes arenaceodentata*.

Treatment	Rep	Number Initiated	Survivors	Mean Mortality (%)	Individual Growth (mg/ind/day)					
					Dry Weight	Mean	Std Dev	AFDW	Mean	Std Dev
Control	1	5	5	0	0.669	0.397	0.154	0.411	0.261	0.089
	2	5	5		0.312			0.199		
	3	5	5		0.373			0.272		
	4	5	5		0.317			0.201		
	5	5	5		0.317			0.224		
SH-Ref-1	1	5	5	0	0.322	0.362	0.059	0.234	0.274	0.054
	2	5	5		0.320			0.230		
	3	5	5		0.333			0.261		
	4	5	5		0.460			0.364		
	5	5	5		0.376			0.277		
CARR	1	5	5	0	0.432	0.417	0.030	0.301	0.305	0.029
	2	5	5		0.419			0.330		
	3	5	5		0.407			0.307		
	4	5	5		0.454			0.330		
	5	5	5		0.372			0.260		
CARR / SH-Ref-1	1	5	5	4.0	0.353	0.410	0.033	0.258	0.301	0.031
	2	5	4		0.427			0.326		
	3	5	5		0.416			0.313		
	4	5	5		0.416			0.281		
	5	5	5		0.438			0.330		
SH-13A	1	5	5	0	0.160	0.250	0.052	0.132	0.198	0.037
	2	5	5		0.278			0.220		
	3	5	5		0.276			0.209		
	4	5	5		0.283			0.221		
	5	5	5		0.254			0.207		
SH-19	1	5	5	0	0.295	0.262	0.050	0.249	0.216	0.041
	2	5	5		0.206			0.174		
	3	5	5		0.282			0.218		
	4	5	5		0.316			0.265		
	5	5	5		0.212			0.176		
SH-22	1	5	5	0	0.397	0.326	0.060	0.301	0.253	0.038
	2	5	5		0.378			0.275		
	3	5	5		0.313			0.253		
	4	5	5		0.257			0.201		
	5	5	5		0.285			0.238		
SH-28	1	5	5	0	0.282	0.307	0.129	0.213	0.219	0.089
	2	5	5		0.438			0.293		
	3	5	5		0.127			0.086		
	4	5	5		0.264			0.197		
	5	5	5		0.426			0.307		
SPI-22	1	5	5	0	0.416	0.415	0.076	0.334	0.329	0.061
	2	5	5		0.537			0.427		
	3	5	5		0.405			0.311		
	4	5	5		0.385			0.313		
	5	5	5		0.330			0.260		

Treatment	Rep	Number Initiated	Survivors	Mean Mortality (%)	Individual Growth (mg/ind/day)					
					Dry Weight	Mean	Std Dev	AFDW	Mean	Std Dev
SPI-30	1	5	5	4.0	0.395	0.428	0.062	0.307	0.341	0.055
	2	5	5		0.527			0.433		
	3	5	4		0.443			0.348		
	4	5	5		0.409			0.325		
	5	5	5		0.367			0.292		
SPI-31	1	5	5	16.0	0.402	0.324	0.096	0.295	0.245	0.061
	2	5	5		0.226			0.174		
	3	5	5		0.317			0.244		
	4	5	3		0.438			0.315		
	5	5	3		0.235			0.196		

Table 3-6. Water Quality Summary for *Neanthes arenaceodentata*.

Treatment	Dissolved Oxygen (mg/L) ≥4.6 mg/L			Temperature (°C) 20 ± 1°C			Salinity (ppt) 28 ± 2 ppt			pH 7 - 9 units		
	Mean	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
Control	7.5	7.3	7.8	19.3	18.9	19.8	29	29	29	8.1	7.2	8.2
SH-Ref-1	7.5	7.3	7.7	19.3	18.9	19.9	29	29	29	8.2	7.4	8.4
CARR	7.5	6.7	7.7	19.4	19.0	19.9	29	28	29	8.0	7.1	8.1
CARR / SH-Ref-1	7.5	7.2	7.7	19.4	19.1	19.9	29	29	29	8.1	7.3	8.2
SH-13A	7.5	7.0	7.7	19.5	19.2	20.0	29	28	29	8.0	7.2	8.1
SH-19	7.5	7.1	7.7	19.4	19.0	19.9	28	27	29	8.0	7.2	8.1
SH-22	7.4	7.1	7.7	19.6	19.3	20.1	29	28	29	8.2	7.5	8.3
SH-28	7.5	7.0	8.0	19.5	19.0	19.9	29	28	29	8.0	7.2	8.2
SPI-22	7.1	5.4	7.6	19.5	19.1	19.8	29	28	29	7.9	7.2	8.2
SPI-30	7.4	7.0	7.6	19.5	19.1	19.9	29	28	29	8.1	7.4	8.3
SPI-31	7.0	6.6	7.5	19.6	19.0	20.1	29	28	29	8.0	7.7	8.4

Bold = Values that fell outside of the targeted water quality criteria

Table 3-7. Ammonia Summary for *Neanthes arenaceodentata*.

Treatment	Overlying Ammonia (mg/L Total) [1]NOEC = 99.9 mg/L		Interstitial Ammonia (mg/L Total) [1]NOEC = 99.9 mg/L	
	Day 0	**Day 20**	**Day 0**	**Day 20**
Control	0.00	1.94	NM	1.39
SH-Ref-1	0.897	0.00	NM	1.01
CARR	0.541	0.103	NM	1.21
CARR / SH-Ref-1	0.549	0.006	4.60	1.09
SH-13A	0.426	0.00	3.04	0.335
SH-19	0.318	0.00	2.25	0.566
SH-22	1.59	0.00	12.9	1.94
SH-28	0.217	0.00	1.69	0.586
SPI-22	0.629	0.431	4.90	3.15
SPI-30	1.15	2.42	5.40	3.86
SPI-31	0.765	0.066	7.60	0.995

[1]NOEC (concurrent reference-toxicant test derived) = 99.9 mg/L total ammonia

NM = not measured; insufficient porewater recovered for analysis

Bold = Values that fell outside of the targeted water quality criteria

Table 3-8. Sulfide Summary for *Neanthes arenaceodentata*.

Treatment	Overlying Sulfides (mg/L Total) [1]Trigger Value = 3.4 mg/L		Interstitial Sulfides (mg/L Total) [1]Trigger Value = 3.4 mg/L	
	Day 0	Day 20	Day 0	Day 20
Control	0.000	0.017	0.010	0.043
SH-Ref-1	0.035	0.006	0.180	0.111
CARR	0.014	0.011	0.050	0.037
CARR / SH-Ref-1	0.066	0.026	0.130	0.051
SH-13A	0.008	0.014	0.060	0.040
SH-19	0.021	0.013	0.070	0.104
SH-22	0.049	0.006	0.140	0.052
SH-28	0.018	0.004	0.090	0.066
SPI-22	0.014	0.012	**3.530**	0.168
SPI-30	0.035	0.010	**7.780**	0.182
SPI-31	0.014	0.003	0.160	0.134

[1]Kendall and Barton 2004

Bold = Values that fell outside of the targeted water quality criteria

Table 3-9. Test Condition Summary for *Neanthes arenaceodentata*.

Test Conditions: PSEP *N. arenaceodentata*		
Date sampled	July 12 - 13, 2017	
Date received	July 15, 2017	
Test dates	July 28 – August 17, 2017	
Sample storage conditions	4°C, dark	
Days of holding Recommended: ≤8 weeks (56 days)	15 – 16 days	
Source of control sediment	Yaquina Bay, OR	
Test Species	*N. arenaceodentata*	
Supplier	Aquatic Toxicology Support	
Date acquired	July 28, 2017	
Age class	Juvenile; 14 - 18 Days post emergence	
Test Procedures	PSEP 1995 with SMARM revisions, SCUM II (2015) SOP No. SED009.08	
Test location	EcoAnalysts Port Gamble Laboratory	
Test type/duration	20-Day static renewal	
Control water	North Hood Canal seawater, 0.45µm filtered	
Test dissolved oxygen	Recommended: > 4.6 mg/L	Observed: 5.4 – 8.0 mg/L
Test temperature	Recommended: 20 ± 1 °C	Observed: 18.9 – 20.1 °C
Test Salinity	Recommended: 28 ± 2 ppt	Observed: 27 – 29 ppt
Test pH	Recommended: 7 - 9	Observed: 7.1 – 8.4
Initial biomass	Recommended: 0.5 - 1.0 mg Minimum: 0.25 mg	0.111 mg
Control Performance Standard	Recommended: Control < 10% mortality	Observed: 0% Pass
	Recommended: ≥ 0.72 mg/ind/day Minimum: ≥ 0.38 mg/ind/day (as Dry Weight)	Observed: 0.397 mg/ind/day; Pass
Reference performance standard (SMS)	Recommended: Mortality ≤20% $MIG_{Reference}/MIG_{Control}$ ≥ 80%	0 – 4%; Pass 91.0% (mean); Pass
Reference Toxicant LC_{50} (total ammonia)	LC_{50} = 183.1 mg/L	
Mean; Acceptable Range (total ammonia)	163.7; 90.1 – 237.3 mg/L	
NOEC (total ammonia)	99.9 mg/L	
NOEC (unionized ammonia)	1.532 mg /L	
Test Lighting	50 – 100 foot candles	
Test chamber	1-Liter Glass Chamber	
Replicates/treatment	5 + 2 surrogates (one used for WQ measurements throughout the test)	
Organisms/replicate	5	
Exposure volume	175 mL sediment/ 775 mL water	
Feeding	40 mg/jar every other day (8 mg/ind every other day)	
Water renewal	Water renewed every third day (1/3 volume of exposure chamber)	
Deviations from Test Protocol	Initial biomass	

3.3 Larval Development Bioassay

The larval development test with *M. galloprovincialis* was validated by 93.1% normal survivorship, defined as the mean number of normal larvae within the control divided by the stocking density. This value was within both the SMS acceptability criteria of >70%. A summary of the test results for all samples is shown in Table 3-10. Summaries of water quality measurements, ammonia and sulfide concentrations, and test conditions are presented in, Table 3-11, Table 3-12, and Table 3-13.

Mean normal survival of the reference sediments were between 79.6 and 92.0% of the control response, which met the SMS reference acceptability criteria (N_R/N_C) of ≥65%. This is defined as the number of normal larvae in the reference sample(s) divided by the number of normal larvae in the control. The test mean chamber stocking density (measured at test initiation) was 27.9 embryos/mL and was within the test objective of 20 – 40 embryos/mL.

Water quality parameters were within acceptable limits throughout the duration of the test, except for dissolved oxygen on the final day of testing.

The reference-toxicant test EC_{50} for total ammonia was 9.27 mg/L, which fell slightly above the confidence limits of 2.31 – 8.59 mg/L. While it is useful to report results in terms of total ammonia because these values are directly measured by ion-selective electrode, the calculated unionized ammonia (UIA) values can sometimes be a better predictor of aquatic toxicity. This is primarily a reflection that slight differences within test pH have a significant effect on the expression of UIA. After correction for actual test conditions (pH, salinity, temperature) the unionized ammonia LC_{50} value was calculated to be 0.136 mg/L UIA, which was within two standard deviations of the running mean (0.017 – 0.184 mg/L UIA). Given these results it is unlikely that the test organisms were unhealthy or less sensitive than usual.

Ammonia concentrations observed in the *M. galloprovincialis* test were below the No Observed Effect Concentration (NOEC) value derived from the concurrent ammonia reference-toxicant test (Table 3-12; compare to NOEC 6.4 mg/L). This indicates that ammonia concentrations within the sediment samples should not have contributed to any adverse biological effects observed in the test treatments.

Table 3-10. Test Results for *Mytilus galloprovincialis*.

Treatment	Rep	Number Normal	Number Abnormal	Mean # Normal (N)	Std. Dev.	Control Normal Survival N_C/I	Reference Normal Survival Relative to Control N_R/N_C	Performance Standard
Control	1	286	8	259.6	1.6	93.1		>0.70; Meets Criterion
	2	253	15					
	3	236	17					
	4	252	12					
	5	271	10					
SH-Ref-1	1	224	5	238.8	1.4		92.0	≥0.65; Meets Criterion
	2	273	13					
	3	232	12					
	4	233	7					
	5	232	4					
CARR / SH-Ref-1	1	224	28	224.4	2.4		86.4	≥0.65; Meets Criterion
	2	225	27					
	3	228	25					
	4	236	43					
	5	209	34					
CARR	1	228	8	236.6	0.7		91.1	≥0.65; Meets Criterion
	2	257	7					
	3	240	7					
	4	225	7					
	5	233	11					
CR-022	1	211	9	206.6	3.1		79.6	≥0.65; Meets Criterion
	2	207	6					
	3	225	3					
	4	221	11					
	5	169	18					
SH-04	1	218	13	236.2	1.2	See Section 4.3 for Larval Test Suitability Determination		
	2	252	7					
	3	264	8					
	4	213	8					
	5	234	8					
SH-14	1	233	18	231.4	1.3			
	2	230	13					
	3	221	14					
	4	228	9					
	5	245	12					
SH-19	1	196	32	182.0	3.1			
	2	189	24					
	3	177	29					
	4	185	17					
	5	163	13					
SH-21	1	207	2	220.0	0.9			
	2	217	3					
	3	225	5					
	4	243	8					
	5	208	5					

Treatment	Rep	Number Normal	Number Abnormal	Mean # Normal (N)	Std. Dev.	Control Normal Survival N_C/I	Reference Normal Survival Relative to Control N_R/N_C	Performance Standard
SH-22	1	213	9	208.6	1.4			
	2	190	8					
	3	247	13					
	4	203	3					
	5	190	5					
SH-24	1	231	10	222.6	1.0			
	2	227	9					
	3	208	4					
	4	230	6					
	5	217	8					
SPI-22	1	174	19	177.6	2.1			
	2	184	10					
	3	175	12					
	4	194	13					
	5	161	7					
SPI-30	1	214	8	211.8	0.9			
	2	210	11					
	3	229	13					
	4	224	9					
	5	182	6					
SPI-31	1	230	10	230.8	1.0			
	2	236	7					
	3	241	4					
	4	236	9					
	5	211	8					

I = Mean Initial count (Stocking density); 278.8
N_C = Mean Control Normal
N_R = Mean Reference Normal

Table 3-11. Water Quality Summary for *Mytilus galloprovincialis*.

Treatment	Dissolved Oxygen (mg/L) ≥5.0 mg/L			Temperature (°C) 16± 1°C			Salinity (ppt) 28 ± 2 ppt			pH 7 - 9 units		
	Mean	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
Control	7.2	7.1	7.2	16.0	15.9	16.2	28	28	28	7.8	7.8	7.8
SH-Ref-1	6.1	5.5	7.1	16.2	16.0	16.3	28	28	28	7.7	7.7	7.8
CARR/SH-Ref-1	6.2	5.5	6.9	16.1	16.0	16.3	28	28	28	7.7	7.7	7.8
CARR	6.3	5.9	6.9	16.3	16.0	16.5	28	28	28	7.8	7.7	7.8
CR-022	6.1	5.6	6.4	16.3	16.0	16.5	28	28	28	7.8	7.8	7.8
SH-04	5.9	5.3	6.3	16.4	16.0	16.7	28	28	28	7.6	7.6	7.7
SH-14	6.2	5.8	6.8	16.3	16.1	16.7	28	28	28	7.7	7.6	7.7
SH-19	5.9	5.0	7.0	16.1	16.0	16.2	28	28	28	7.6	7.6	7.7
SH-21	5.5	**4.4**	6.2	16.1	15.9	16.2	28	28	28	7.8	7.7	7.8
SH-22	6.3	5.7	6.7	16.1	16.0	16.3	28	28	28	7.7	7.6	7.7
SH-24	5.8	5.3	6.2	16.3	15.8	16.7	28	28	28	7.7	7.6	7.7
SPI-22	5.4	**3.6**	6.3	16.4	16.1	16.6	28	28	28	7.6	7.5	7.7
SPI-30	5.0	**4.6**	5.5	16.4	16.3	16.5	28	28	28	7.6	7.6	7.7
SPI-31	6.2	5.0	6.8	16.2	15.9	16.5	28	28	28	7.7	7.7	7.8

Bold = Values that fell outside of the targeted water quality criteria

Table 3-12. Ammonia and Sulfide Summary for *Mytilus galloprovincialis*.

Treatment	Overlying Ammonia (mg/L Total) [1]NOEC = 6.4 mg/L		Overlying Sulfides (mg/L Total) [2]Trigger Value = 0.009 mg/L	
	Day 0	Final (Day 2)	Day 0	Final (Day 2)
Control	0.00	0.00	0.008	0.001
SH-Ref-1	0.00	0.00	**0.101**	**0.023**
CARR/SH-Ref-1	0.00	0.00	**0.202**	**0.029**
CARR	0.00	0.00	**0.084**	**0.025**
CR-022	0.00	0.00	**0.156**	**0.031**
SH-04	0.00	0.00	ND	**0.018**
SH-14	0.00	0.00	0.003	**0.024**
SH-19	0.00	0.00	**0.091**	**0.024**
SH-21	0.00	0.00	ND	**0.020**
SH-22	0.00	0.00	**0.054**	**0.017**
SH-24	0.00	0.00	ND	**0.013**
SPI-22	0.01	0.00	ND	**0.014**
SPI-30	0.14	0.00	ND	**0.012**
SPI-31	0.00	0.00	ND	**0.029**

[1] NOEC (concurrent reference-toxicant test derived) = 6.4 mg/L total ammonia

[2] Inouye 2015: Total sulfide value 0.009 mg/L derived from hydrogen sulfide dissociation (0.0025 mg/L H_2S @ 16°C, 28 ppt, and 7.7 pH)

ND = Non-detect

Bold = Values that fell outside of the targeted water quality criteria

Table 3-13. Test Condition Summary for *Mytilus galloprovincialis*.

Test Conditions: PSEP *M. galloprovincialis*		
Date sampled	July 12 - 13, 2017	
Date received	July 15, 2017	
Test dates	August 1 – 3, 2017	
Sample storage conditions	4°C, dark	
Holding time Recommended: < 8 weeks (56 days)	20 Days	
Test Species	*M. galloprovincialis*	
Supplier	Taylor Shellfish, Shelton, Wa	
Date acquired	July 25, 2017	
Age class	<4-h old embryos	
Test Procedures	PSEP 1995 with SMARM revisions, SCUM II (2015) SOP No. SED005.06	
Test location	EcoAnalysts Port Gamble Laboratory	
Test type/duration	48-60 Hour static test (Actual: 48 hours)	
Control water	North Hood Canal sea water, 0.45µm filtered	
Test dissolved oxygen	Recommended: > 4.8 mg/L	Observed: 3.6 – 7.2 mg/L
Test temperature	Recommended: 16 ± 1 °C	Observed: 15.8 – 16.7 °C
Test Salinity	Recommended: 28 ± 1 ppt	Observed: 28 ppt
Test pH	Recommended: 7 - 9	Observed: 7.5 – 7.8
Stocking Density	Recommended: 20 – 40 embryos/mL	Observed: 27.9 embryos/mL
Control performance standard (SMS)	Recommended: Control normal survival ≥ 70%	Observed: 93.1%; Pass
Reference performance standard (SMS)	Recommended: Reference normal survival relative to control ≥ 65%	Observed: 79.6 – 92.0%; Pass
Reference Toxicant	Total Ammonia	Unionized Ammonia
Reference Toxicant EC$_{50}$ (total ammonia)	EC$_{50}$ = 9.27 mg/L	EC$_{50}$ = 0.136 mg/L
Mean; Acceptable Range (total ammonia)	5.45; 2.31 – 8.59 mg/L	0.100; 0.017 – 0.184 mg/L
NOEC Combined proportion normal (total ammonia)	6.4 mg/L	0.094 mg /L
Test Lighting	50 – 100 foot candles	
Test chamber	1-Liter Glass Chamber	
Replicates/treatment	5 + 1 surrogate (used for WQ measurements throughout the test)	
Exposure volume	18 g sediment/ 900 mL water	
Feeding	None	
Water renewal	None	
Deviations from Test Protocol	Dissolved oxygen	

4. DISCUSSION

Sediments were evaluated based on Sediment Management Standards (SMS) criteria. The biological criteria are based on both statistical significance (a statistical comparison) and the degree of biological response (a numerical comparison). The SMS criteria are derived from the Washington Department of Ecology's Sediment Cleanup User's Manual II (SCUM II; WDOE 2015). Comparisons were made for each treatment against the reference sample. Two numerical comparisons were made under SMS, the Sediment Cleanup Objective (SCO) and the Cleanup Screening Level (CSL).

4.1 Amphipod Test Suitability Determination

Under the SMS program, a treatment will fail SCO if mean mortality in the test sediment relative to the reference sediment is >25% and the difference between mean mortality in the treatment compared to mean mortality in the reference is statistically significant ($p < 0.05$). Treatments fail the CSL if mean mortality in the test treatment >30% relative to the reference sediment and the difference is statistically significant.

Project sediments from the Shelton Harbor Site do not fail the SCO and CSL criteria for the amphipod test as shown in Table 4-1.

Table 4-1. SMS Comparison for *Eohaustorius estuarius*.

Treatment	Mean Mortality (%)	Compared To:	Statistically Different than Reference? (P=0.05)	Mortality Comparison to Reference M_T-M_R (%)	Fails SCO?[1] > 25 %	Fails CSL?[2] > 30 %
Control	1					
SH-Ref-1	5					
CARR	4					
CARR/SH-Ref-1	1					
SPI-22	9	SH-Ref-1	No	4	No	No
SPI-30	9	CARR/SH-Ref-1	No	8	No	No
SPI-31	8	CARR	No	4	No	No

[1]SCO: Statistical Significance and M_T >25%
[2]CSL: Statistical Significance and M_T-M_R >30%
M_T = Treatment Mortality
M_R = Reference Mortality

4.2 Juvenile Polychaete Test Suitability Determination

Suitability determinations for the juvenile polychaete test were based on mean individual growth (MIG). A test treatment fails SCO criteria if MIG is statistically lower in the test treatment, relative to the reference, and the ratio of the MIG in the test treatment is <0.70 that of the reference. The treatments will fail CSL criteria if the MIG is significantly lower than the reference treatment and the ratio between the MIG of the treatment and the MIG of the reference is <0.50.

Project sediments SH-13A and SH-19 fail the SCO criteria for both dry weight and AFDW. Additionally, sample SH-28 fails the SCO criteria for AFDW. All other Shelton Harbor project sediments do not fail the SCO and CSL criteria when evaluated on the dry weight and AFDW basis (Table 4-2).

Table 4-2. SMS Comparison for *Neanthes arenaceodentata*.

Treatment	MIG (mg/ind/day)	Comparison To:	Statistically Less than Reference? (p=0.05)	MIG Relative to Reference MIG_T/MIG_R	Fails SCO?[1] < 0.70	Fails CSL?[2] < 0.50
			Dry Weight			
Control	0.397					
SH-Ref-1	0.362					
CARR	0.417					
CARR/SH-Ref-1	0.410					
SH-13A	0.250	CARR	Yes	0.60	**Yes**	No
SH-19	0.262	CARR	Yes	0.63	**Yes**	No
SH-22	0.326	CARR/SH-Ref-1	No	0.80	No	No
SH-28	0.307	CARR/SH-Ref-1	No	0.75	No	No
SPI-22	0.415	SH-Ref-1	No	1.15	No	No
SPI-30	0.428	CARR/SH-Ref-1	No	1.04	No	No
SPI-31	0.324	CARR	No	0.78	No	No
			Ash-Free Dry Weight			
Control	0.261					
SH-Ref-1	0.274					
CARR	0.305					
CARR/SH-Ref-1	0.301					
SH-13A	0.198	CARR	Yes	0.65	**Yes**	No
SH-19	0.216	CARR	No	0.71	No	No
SH-22	0.253	CARR/SH-Ref-1	No	0.84	No	No
SH-28	0.219	CARR/SH-Ref-1	No	0.73	No	No
SPI-22	0.329	SH-Ref-1	No	1.20	No	No
SPI-30	0.341	CARR/SH-Ref-1	No	1.13	No	No
SPI-31	0.245	CARR	No	0.80	No	No

[1] SCO: Statistical Significance and MIG_T/MIG_R <70%

[2] CSL: Statistical Significance and MIG_T/MIG_R <50%

MIG_T = Treatment Mean Individual Growth

MIG_R = Reference Mean Individual Growth

4.3 Larval Test Suitability Determination

Larval test treatments fail SCO criteria if the number of normal larvae in the test treatment is significantly lower ($p < 0.10$) than that of the reference and if the ratio between the normal larval development in the test treatment is less than 0.85 of the normal development in the reference. Treatments fail CSL criteria if the number of normal larvae in the test treatment is significantly lower ($p < 0.10$) than that of the reference and if the ratio between the normal larval development in the test treatment is less than 0.70 of the normal development in the reference.

Project sediments SH-19 and SH-22 fail the SCO criteria for larval development, but do not exceed the CSL criteria. All other project sediments from the Shelton Harbor Site pass the SCO and CSL criteria for the bivalve development evaluation (Table 4-3).

Table 4-3. SMS Comparison for *Mytilus galloprovincialis*.

Treatment	Mean Normal Survival (%)[1]	Mean Number Normal	Compared To:	Statistically Less than Reference? ($p=0.10$)	Normal Survival to Reference N_T/N_R	Fails SCO?[2] <0.85	Fails CSL?[3] <0.70
Control	93.1	260					
SH-Ref-1	92.0	239					
CARR/SH-Ref-1	86.4	224					
CARR	91.1	237					
CR022	79.6	207					
SH-04	93.4	236	CARR	No	0.996	No	No
SH-14	94.2	231	CARR/SH-Ref-1	No	1.03	No	No
SH-19	79.0	182	CARR	Yes	0.768	**Yes**	No
SH-21	86.5	220	CR022	No	1.06	No	No
SH-22	83.3	209	CARR/SH-Ref-1	No	0.933	No	No
SH-24	88.6	223	CARR/SH-Ref-1	No	0.996	No	No
SPI-22	73.1	178	SH-Ref-1	Yes	0.745	**Yes**	No
SPI-30	85.2	212	CARR/SH-Ref-1	No	0.946	No	No
SPI-31	91.8	231	CARR	No	0.975	No	No

[1] Control data is normalized to the stocking density; reference and project treatments are normalized to the control

[2] SCO: Statistical Significance and (N_T/N_R) <0.85

[3] CSL: Statistical Significance and (N_T/N_R) <0.70

N_T =Treatment Mean Number Normal

N_R =Reference Mean Number Normal

N_C =Control Mean Number Normal

5. SUMMARY

A summary of the biological tests conducted on the Shelton Harbor Site sediments evaluated under the SMS sediment quality criteria (Table 5-1) are provided below.

Samples SH-13A and SH-19 fail SCO criteria for polychaete growth and SH-19 and SPI-22 fail SCO for bivalve normality. All other project samples pass the SCO and CSL performance criteria for all tests performed on the Shelton Harbor Site sediments.

Table 5-1. Summary of SMS Evaluation.

Treatment	Sediment Cleanup Objectives			Cleanup Screening Levels		
	Amphipod	Polychaete	Larval	Amphipod	Polychaete	Larval
SH-04		Pass	Pass		Pass	Pass
SH-13A		**Fail**	Pass		Pass	Pass
SH-14			Pass			Pass
SH-19		**Fail**	**Fail**		Pass	Pass
SH-21			Pass			Pass
SH-22		Pass	Pass		Pass	Pass
SH-24			Pass			Pass
SH-28		Pass			Pass	
SPI-22	Pass	Pass	**Fail**	Pass	Pass	Pass
SPI-30	Pass	Pass	Pass	Pass	Pass	Pass
SPI-31	Pass	Pass	Pass	Pass	Pass	Pass

*Shaded cells represent tests not conducted as part of the test design

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APPENDIX A. TEST AND REFERENCE TOXICANT TEST RESULTS

1. *Eohaustorius estuarius* 10-Day Test

EcoAnalysts

10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	JOB NO.	PROJECT MAN.	LABORATORY	PROTOCOL	SPECIES
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble /	PSEP 1995	*Eohaustorius estuarius*

#S= Number on the Surface
#M= Number of Mortality
L=Anoxic Surface
F=Fungal Patches
D=No Air Flow (DO?)
U=Excess food
N=Normal
B=No Burrows

INITIAL # OF ORGANISMS: 20

ENDPOINT DATA & OBSERVATIONS

				DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8	DAY 9	DAY 10	
				DATE 7/29/17	DATE 7/30	DATE 7/31	DATE 8/01	DATE 8/2	DATE 8/3	DATE 8/4	DATE 8/5	DATE 8/6	DATE 8/7	MK / JL
				TECHNICIAN UB	TECHNICIAN KE	TECHNICIAN JL	TECHNICIAN JL	TECHNICIAN UB	TECHNICIAN UB	TECHNICIAN UB	TECHNICIAN UB	TECHNICIAN KE	TECHNICIAN KE	
Sample ID	REP	JAR #	INITIAL #	OBSERVNS.	OBSERVNS.	OBSERVNS.	OBSERVNS.	OBSERVNS.	OBSERVNS.	OBSERVNS.	OBSERVNS.	OBSERVNS.	OBSERVNS.	NUMBER REMAINING
Control /	1	▨	▨	N	N	N	N	N	N	N	N	N	N	20
	2	▨	▨	↓	↓	1m	↓	↓	1m	↓	↓	↓	↓	19
	3	▨	▨	↓	↓	N	↓	↓	N	↓	↓	↓	↓	20
	4	▨	▨	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	20
	5	▨	▨	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	20
SH-Ref-1 /	1	▨	▨	↓	↓	1m ①~~F~~L	L	N	N	N	N	↓	↓	18
	2	▨	▨	↓	↓	N	N	↓	↓	↓	↓	↓	↓	19
	3	▨	▨	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	18
	4	▨	▨	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	20
	5	▨	▨	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	20
CARR /	1	▨	▨	↓	↓	↓	L	L	L	L	N	↓	↓	③~~19~~20
	2	▨	▨	↓	1S	↓	N	N	N	N	↓	↓	↓	19
	3	▨	▨	↓	N	↓	↓	↓	↓	↓	↓	↓	↓	18
	4	▨	▨	↓	↓	↓	↓	↓	② ~~L~~ N	↓	↓	↓	↓	20
	5	▨	▨	↓	↓	↓	↓	↓	N	↓	1S	↓	↓	19
CARR / SH-Ref-1 /	1	▨	▨	↓	↓	↓	↓	↓	N	N	N	↓	↓	20
	2	▨	▨	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	20
	3	▨	▨	↓	↓	↓	↓	↓	1m	↓	↓	↓	↓	20
	4	▨	▨	↓	↓	↓	↓	↓	N	↓	↓	↓	↓	20
	5	▨	▨	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	19

① IE JL 7/31/17
② IE, UB 8/3/17

③ WC - MK 8/7.

✓

7/28/2017 Shelton Eoh SP Endpoint

10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	JOB NO.	PROJECT MAN.	LABORATORY	PROTOCOL	SPECIES
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble /	PSEP 1995	*Eohaustorius estuarius*

ENDPOINT DATA & OBSERVATIONS

#S= Number on the Surface
#M= Number of Mortality
L=Anoxic Surface
F=Fungal Patches
D=No Air Flow (DO?)
U=Excess food
N=Normal
B=No Burrows

INITIAL # OF ORGANISMS: 20

	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8	DAY 9	DAY 10
DATE	7/29/17	7/30	7/31	8/01	8/2	8/3	8/4	8/5	8/6	8/7
TECHNICIAN	UB	HZ	JL	JL	UB	UB	UB	UB	HZ	[illegible]

Sample ID	REP	JAR #	INITIAL #	DAY 1 OBSERVNS.	DAY 2 OBSERVNS.	DAY 3 OBSERVNS.	DAY 4 OBSERVNS.	DAY 5 OBSERVNS.	DAY 6 OBSERVNS.	DAY 7 OBSERVNS.	DAY 8 OBSERVNS.	DAY 9 OBSERVNS.	DAY 10 OBSERVNS.	MK/JL NUMBER REMAINING
SPI-22 /	1	▨	▨	N	N	N	N	N	N	N	N	N	N	20
	2	▨	▨		2S	3S	1S							17
	3	▨	▨		N	N	N							18
	4	▨	▨			3S	L	↓						18
	5	▨	▨	↓		② ~~F~~ L	L	1S	↓	↓	↓	↓		18
SPI-30 /	1	▨	▨	①		1S	N	N	N	N	N	N		20
	2	▨	▨	①		N	2S	L	L	L		↓		17
	3	▨	▨	①		1S	1S	N	N	N		1S		20
	4	▨	▨	①		N	N					N		15
	5	▨	▨	①	↓	↓		↓	↓	↓	↓	↓	↓	19
SPI-31 /	1	▨	▨	N	3S	1M		L	L	L, 3S, 1M	L, 1S	③ N	1S, L	18
	2	▨	▨		N	N		N	N	N	L		N	17
	3	▨	▨								L	③		19
	4	▨	▨	↓							N			18
	5	▨	▨	1S	↓	↓	↓	↓	↓	↓	↓	↓	↓	20

① Cloudy / Turbid, UB 7/29 ② 1E. JL 7/31/17 ③ Algal growth HZ 8/6

EcoAnalysts

10 DAY SOLID PHASE TEST DATA

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**SPECIES** *Eohaustorius estuarius*	**TEST START DATE** Port Gamble	**TEST START DATE** 28Jul17	**TEST END DATE** 07Aug17
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY** Port Gamble /	**DILUTION WATER BATCH** FSW072717.01	**PROTOCOL** PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 2		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
Control /	0	1	8	8.2	8	14.6	8	28	8	8.0	BG	7/28/17
Control /	0	2	↓	8.4	↓	14.5	↓	29	↓	8.1	↓	↓
Control /	0	3		8.5		14.5		29		8.1		
Control /	0	4		8.5		14.7		29		8.1		
Control /	0	5		7.7		14.8		① ~~3~~ 28		8.0		
Control /	1	Surr	8	8.5	8	14.1	8	29	8	8.1	UB	7/29/17
Control /	2	Surr	8	8.2	8	15.4	8	29	8	8.1	KE	7/30
Control /	3	Surr	9	8.0	9	15.6	9	29	9	8.1	JL	7/31
Control /	4	Surr	8	8.5	8	14.3	8	29	8	8.1	JL	8/01
Control /	5	Surr	8	8.3	8	② ~~15.2~~ 14.9	8	② ~~28~~ 29	8	② ~~8.1~~ 8.0	UB	8/2
Control /	6	Surr	8	8.3	8	14.6	8	29	8	8.1	UB	8/3
Control /	7	Surr	8	8.1	8	15.4	8	29	8	8.1	UB	8/4
Control /	8	Surr	8	8.0	8	15.4	8	29	8	8.1	UB	8/5
Control /	9	Surr	8	8.1	8	16.6 ③	8	29	8	8.2	KE	8/6
Control /	10	1	8	8.4	8	14.9	8	29	8	8.1	KE	8/7
Control /	10	2	↓	8.4	↓	15.0	↓	29	↓	8.1	↓	↓
Control /	10	3		8.4		15.1		29		8.1		
Control /	10	4		8.4		15.1		29		8.2		
Control /	10	5		8.3		15.0		29		8.1		

① RE BG 7/27/17 ② Wrong sheet; UB 8/2 ③ Bath temp ↓ 2°C KE 8/6

7/28/2017 Shelton Eoh SP WQ

✓

ECOANALYSTS

10 DAY SOLID PHASE TEST DATA

CLIENT Anchor QEA	PROJECT Shelton Harbor	SPECIES *Eohaustorius estuarius*	TEST START DATE Port Gamble	TEST START DATE 28Jul17	TEST END DATE 07Aug17
JOB NUMBER PG1019	PROJECT MANAGER Brian Hester	LABORATORY Port Gamble /	DILUTION WATER BATCH FSW072717.01	PROTOCOL PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 2		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
SH-Ref-1 /	0	1	8	8.4	8	14.9	8	29	8	8.1	BG	7/28/17
SH-Ref-1 /	0	2		8.4		14.5		29		8.1		
SH-Ref-1 /	0	3		8.4		14.5		29		8.1		
SH-Ref-1 /	0	4		8.3		14.6		29		8.1		
SH-Ref-1 /	0	5		8.4		14.6		29		8.0		
SH-Ref-1 /	1	Surr	8	8.4	8	14.2	8	29	8	8.1	UB	7/29/17
SH-Ref-1 /	2	Surr	8	8.3	8	15.3	8	29	8	8.2	HK	7/30
SH-Ref-1 /	3	Surr	9	8.1	9	15.7	9	29	9	8.2	JL	7/31
SH-Ref-1 /	4	Surr	8	8.5	8	14.3	8	29	8	8.2	JL	8/01
SH-Ref-1 /	5	Surr	8	8.3	8	14.9	8	29	8	8.2	UB	8/2
SH-Ref-1 /	6	Surr	8	8.4	8	14.6	8	29	8	8.2	UB	8/3
SH-Ref-1 /	7	Surr	8	8.1	8	15.5	8	29	8	8.3	UB	8/4
SH-Ref-1 /	8	Surr	8	8.1	8	15.3	8	29	8	8.3	UB	8/5
SH-Ref-1 /	9	Surr	8	8.1	8	16.6	8	29	8	8.3	HK	8/6
SH-Ref-1 /	10	1	8	8.3	8	15.3	8	29	8	8.5	HK	8/7
SH-Ref-1 /	10	2		8.3		15.2		29		8.4		
SH-Ref-1 /	10	3		8.3		15.1		29		8.4		
SH-Ref-1 /	10	4		8.3		15.2		29		8.4		
SH-Ref-1 /	10	5		8.2		15.2		29		8.4		

✓

EcoAnalysts

10 DAY SOLID PHASE TEST DATA

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**SPECIES** *Eohaustorius estuarius*	**TEST START DATE** Port Gamble	**TEST START DATE** 28Jul17	**TEST END DATE** 07Aug17
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY** Port Gamble /	**DILUTION WATER BATCH** FSW072717.01	**PROTOCOL** PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 2		pH (pH units) 7 - 9		TECH.	Date
			D.O.		TEMP		SALINITY		pH			
SAMPLE ID	DAY	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit		
CARR /	0	1	8	8.2	8	14.9	8	28	8	8.0	BG	7/28/17
CARR /	0	2	↓	8.4	↓	14.5	↓	29	↓	8.1	↓	↓
CARR /	0	3		8.4		14.6		29		8.0		
CARR /	0	4		8.3		15.3		29		8.1		
CARR /	0	5		8.4		14.6		28		8.0		
CARR /	1	Surr	8	8.4	8	14.2	8	29	8	8.1	UB	7/29/17
CARR /	2	Surr	8	8.4	8	15.4	8	29	8	8.1	HR	7/30
CARR /	3	Surr	9	8.1	9	15.7	9	29	9	8.1	JL	7/31
CARR /	4	Surr	8	8.4	8	14.4	8	29	8	8.1	JL	8/01
CARR /	5	Surr	8	8.3	8	15.2	8	29	8	8.0	UB	8/2
CARR /	6	Surr	8	8.4	8	14.7	8	29	8	8.1	UB	8/3
CARR /	7	Surr	8	8.2	8	15.5	8	29	8	8.1	UB	8/4
CARR /	8	Surr	8	8.1	8	15.4	8	29	8	8.1	UB	8/5
CARR /	9	Surr	8	8.1	8	16.7	8	29	8	8.1	HR	8/6
CARR /	10	1	8	8.3	8	15.2	8	29	8	8.2	HR	8/17
CARR /	10	2	↓	8.3	↓	15.1	↓	29	↓	8.3	↓	↓
CARR /	10	3		8.3		15.3		29		8.2		
CARR /	10	4		8.3		15.1		29		8.2		
CARR /	10	5		8.3		15.1		29		8.2		

EcoAnalysts

10 DAY SOLID PHASE TEST DATA

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**SPECIES** *Eohaustorius estuarius*	**TEST START DATE** Port Gamble	**TEST START DATE** 28Jul17	**TEST END DATE** 07Aug17
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY** Port Gamble /	**DILUTION WATER BATCH** FSW072717.01	**PROTOCOL** PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			**D.O. (mg/L)** >5.1		**TEMP (°C)** 15 ± 1		**SALINITY (ppt)** 28 ± 2		**pH (pH units)** 7 - 9			
			D.O.		**TEMP**		**SALINITY**		**pH**			
SAMPLE ID	**DAY**	**REP**	**meter**	**mg/L**	**meter**	**°C**	**meter**	**ppt**	**meter**	**unit**	**TECH.**	**Date**
CARR / SH-Ref-1 /	0	1	8	8.5	8	14.5	8	29	8	8.1	BG	7/28/17
CARR / SH-Ref-1 /	0	2	↓	8.6	↓	14.4	↓	29	↓	8.1	↓	↓
CARR / SH-Ref-1 /	0	3	↓	8.4	↓	14.5	↓	29	↓	8.0	↓	↓
CARR / SH-Ref-1 /	0	4	↓	8.4	↓	14.5	↓	29	↓	8.1	↓	↓
CARR / SH-Ref-1 /	0	5	↓	8.5	↓	14.5	↓	29	↓	8.1	↓	↓
CARR / SH-Ref-1 /	1	Surr	8	8.3	8	14.3	8	29	8	8.0	UB	7/29
CARR / SH-Ref-1 /	2	Surr	8	8.2	8	15.6	8	29	8	8.1	HG	7/30
CARR / SH-Ref-1 /	3	Surr	9	7.9	9	15.9	9	29	9	8.0	JL	7/31
CARR / SH-Ref-1 /	4	Surr	8	8.5	8	14.5	8	29	8	8.1	JL	8/01
CARR / SH-Ref-1 /	5	Surr	8	8.3	8	15.2	8	29	8	8.0	UB	8/2
CARR / SH-Ref-1 /	6	Surr	8	8.3	8	14.8	8	29	8	8.1	UB	8/3
CARR / SH-Ref-1 /	7	Surr	8	8.1	8	15.7	8	29	8	8.1	UB	8/4
CARR / SH-Ref-1 /	8	Surr	8	8.0	8	15.6	8	29	8	8.1	UB	8/5
CARR / SH-Ref-1 /	9	Surr	8	8.0	8	16.7 ①	8	29	8	8.2	HG	8/6
CARR / SH-Ref-1 /	10	1	8	8.4	8	15.1	8	29	8	8.3	HG	8/7
CARR / SH-Ref-1 /	10	2	↓	8.3	↓	15.1	↓	29	↓	8.3	↓	↓
CARR / SH-Ref-1 /	10	3	↓	8.4	↓	15.1	↓	29	↓	8.3	↓	↓
CARR / SH-Ref-1 /	10	4	↓	8.3	↓	15.2	↓	29	↓	8.3	↓	↓
CARR / SH-Ref-1 /	10	5	↓	8.3	↓	15.2	↓	29	↓	8.2	↓	↓

① Bath temp ↓ 2°C HG 8/6

EcoAnalysts

10 DAY SOLID PHASE TEST DATA

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**SPECIES** *Eohaustorius estuarius*	**TEST START DATE** Port Gamble	**TEST START DATE** 28Jul17	**TEST END DATE** 07Aug17
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY** Port Gamble /	**DILUTION WATER BATCH** FSW072717.01	**PROTOCOL** PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 2		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
SPI-22 /	0	1	8	8.1	8	14.6	8	28	8	7.9	BG	7/28/17
SPI-22 /	0	2	↓	8.0	↓	14.6	↓	28	↓	7.8	↓	↓
SPI-22 /	0	3	↓	8.4	↓	14.7	↓	28	↓	8.1	↓	↓
SPI-22 /	0	4	↓	8.3	↓	14.7	↓	28	↓	7.9	↓	↓
SPI-22 /	0	5	↓	7.9	↓	14.7	↓	28	↓	7.8	↓	↓
SPI-22 /	1	Surr	8	8.3	8	14.4	8	29	8	8.1	UB	7/29
SPI-22 /	2	Surr	8	8.3	8	15.5	8	29	8	8.1	HK	7/30
SPI-22 /	3	Surr	9	8.0	9	15.8	9	29	9	8.1	JL	7/31
SPI-22 /	4	Surr	8	8.4	8	14.5	8	29	8	8.2	JL	8/01
SPI-22 /	5	Surr	8	8.3	8	15.1 ~~14.9~~ ①	8	29	8	8.1	UB	8/2
SPI-22 /	6	Surr	8	8.3	8	14.8	8	29	8	8.3	UB	8/3
SPI-22 /	7	Surr	8	8.1	8	15.5	8	29	8	8.4	UB	8/4
SPI-22 /	8	Surr	8	8.1	8	15.5	8	29	8	8.4	UB	8/5
SPI-22 /	9	Surr	8	8.0	8	16.8	8	29	8	8.5	HK	8/6
SPI-22 /	10	1	8	8.3	8	15.2	8	29	8	8.5	HK	8/7
SPI-22 /	10	2	↓	8.0	↓	15.3	↓	29	↓	8.3	↓	↓
SPI-22 /	10	3	↓	8.2	↓	15.3	↓	29	↓	8.6	↓	↓
SPI-22 /	10	4	↓	8.2	↓	15.2	↓	29	↓	8.5	↓	↓
SPI-22 /	10	5	↓	8.3	↓	15.2	↓	28	↓	8.5	↓	↓

① Wrong sheet, UB 8/2

ECOANALYSTS

10 DAY SOLID PHASE TEST DATA

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**SPECIES** *Eohaustorius estuarius*	**TEST START DATE** Port Gamble	**TEST START DATE** 28Jul17	**TEST END DATE** 07Aug17
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY** Port Gamble /	**DILUTION WATER BATCH** FSW072717.01	**PROTOCOL** PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 2		pH (pH units) 7 - 9		TECH.	Date
			D.O.		TEMP		SALINITY		pH			
SAMPLE ID	DAY	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit		
SPI-30 /	0	1	8	8.4	8	14.4	8	28	8	8.1	BG	7/28/17
SPI-30 /	0	2	↓	8.3	↓	14.5	↓	28	↓	8.0	↓	↓
SPI-30 /	0	3		8.1		14.6		28		7.9		
SPI-30 /	0	4		8.2		14.6		28		8.1		
SPI-30 /	0	5		8.2		14.6		28		7.8		
SPI-30 /	1	Surr	8	8.3	8	14.2	8	29	8	8.1	UB	7/29
SPI-30 /	2	Surr	8	8.3	8	15.5	8	29	8	8.2	HK	7/30
SPI-30 /	3	Surr	9	7.9	9	15.7	9	29	9	8.1	VL	7/31
SPI-30 /	4	Surr	8	8.4	8	14.4	8	28	8	8.2	VL	8/01
SPI-30 /	5	Surr	8	8.2	8	15.1	8	28	8	8.1	UB	8/2
SPI-30 /	6	Surr	8	8.3	8	14.7	8	28	8	8.2	UB	8/3
SPI-30 /	7	Surr	8	8.0	8	15.5	8	28	8	8.4	UB	8/4
SPI-30 /	8	Surr	8	8.1	8	15.5	8	28	8	8.5	UB	8/5
SPI-30 /	9	Surr	8	8.0	8	16.7 ①	8	28	8	8.6	HK	② ~~8/6~~ 8/6
SPI-30 /	10	1	8	8.2	8	15.2	8	28	8	8.6	HK	8/7
SPI-30 /	10	2	↓	8.3	↓	15.3	↓	29	↓	8.6	↓	↓
SPI-30 /	10	3		8.2		15.2		28		8.6		
SPI-30 /	10	4		8.2		15.3		29		8.6		
SPI-30 /	10	5		8.2		15.2		28		8.6		

① Bath at lowest temp HK 8/6 ② Illegible HK 8/6

✓

ECOANALYSTS

10 DAY SOLID PHASE TEST DATA

CLIENT	PROJECT	SPECIES	TEST START DATE	TEST START DATE	TEST END DATE
Anchor QEA	Shelton Harbor	*Eohaustorius estuarius*	Port Gamble	28Jul17	07Aug17
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY**	**DILUTION WATER BATCH**	**PROTOCOL**	
PG1019	Brian Hester	Port Gamble /	FSW072717.01	PSEP 1995	

WATER QUALITY DATA

TEST CONDITIONS			D.O. (mg/L) >5.1		TEMP (°C) 15 ± 1		SALINITY (ppt) 28 ± 2		pH (pH units) 7 - 9		TECH.	Date
SAMPLE ID	DAY	REP	D.O.		TEMP		SALINITY		pH			
			meter	mg/L	meter	°C	meter	ppt	meter	unit		
SPI-31 /	0	1	8	8.2	8	15.1	8	28	8	8.0	BG	① ~~8/~~ 7/28/17
SPI-31 /	0	2	↓	8.4	↓	14.6	↓	28	↓	8.0	↓	↓
SPI-31 /	0	3	↓	8.5	↓	14.5	↓	28	↓	8.1	↓	↓
SPI-31 /	0	4	↓	8.4	↓	14.6	↓	28	↓	8.1	↓	↓
SPI-31 /	0	5	↓	8.18 ②	↓	15.2	↓	27	↓	7.9	↓	↓
SPI-31 /	1	Surr	8	8.4	8	14.4	8	29	8	8.1	UB	7/29
SPI-31 /	2	Surr	8	8.3	8	15.5	8	29	8	8.2	HZ	7/30
SPI-31 /	3	Surr	9	8.1	9	15.8	9	29	9	8.1	JL	7/31
SPI-31 /	4	Surr	8	8.5	8	14.6	8	28	8	8.2	JL	8/01
SPI-31 /	5	Surr	8	8.3	8	15.2	8	28	8	8.1	UB	8/2
SPI-31 /	6	Surr	8	8.4	8	14.9	8	28	8	8.2	UB	8/3
SPI-31 /	7	Surr	8	8.1	8	15.7	8	28	8	8.4	UB	8/4
SPI-31 /	8	Surr	8	8.2	8	15.6	8	28	8	8.4	UB	8/5
SPI-31 /	9	Surr	8	8.0	8	③ 16.8	8	28	8	8.4	HZ	8/6
SPI-31 /	10	1	8	8.3	8	15.3	8	28	8	8.6	HZ	8/7
SPI-31 /	10	2	↓	8.3	↓	15.4	↓	29	↓	8.5	↓	↓
SPI-31 /	10	3	↓	8.3	↓	15.3	↓	29	↓	8.5	↓	↓
SPI-31 /	10	4	↓	8.4	↓	15.3	↓	28	↓	8.6	↓	↓
SPI-31 /	10	5	↓	8.3	↓	15.3	↓	28	↓	6.7	↓	↓

① DA BG 7/27/17 ③ bath at lowest temp HZ 8/6

② ER BG 7/27/17

Ammonia and Sulfide Analysis Record

Page 1 of 1

Client/Project:	Organism:	Test Duration (days):
Archer / Shelton Harbor	Echs	10-d

② ~~PRETEST~~ / [✓ INITIAL] / ~~FINAL~~ / OTHER (circle one) DAY of TEST: 0

[✓ OVERLYING (OV)] / [✓ POREWATER (PW)] (circle one) / Comments:

Calibration Standards Temperature		Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
Date:	**Temperature:**	
7/28/17	19.4°C	

	Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV	Ø	Surr	7/28/17 JL	0.00	18.9	7/28/17 UB	N			10	0.011	NA	NA
↓	SH-Ref-1	↓	↓	0.365	↓	↓	↓			↓	0.082	↓	↓
↓	Carr	↓	↓	0.226	↓	↓	↓			↓	0.037	↓	↓
↓	Carr/SH-Ref-1	↓	↓	0.432	↓	↓	↓			↓	0.061	↓	↓
↓	SPI-22	↓	↓	0.522	↓	↓	↓			↓	0.031	↓	↓
↓	SPI-30	↓	↓	0.805	↓	↓	↓			↓	0.009	↓	↓
↓	SPI-31	↓	↓	0.603	↓	↓	↓			↓	0.021	↓	↓
	Ø	Surr	7/28/17-JL	①	NA	7/28/17	N	①	①	~~1~~	~~0.009~~	~~10~~	
PW	SH-Ref-1	↓		①	↓	↓	↓	①	①	~~1~~	~~0.012~~	~~10~~	
↓	Carr	↓	↓	3.8	20.0	↓	↓	7.3		1	0.009	10	0.09
↓	Carr/SH-Ref-1	↓	↓	5.1	↓	↓	↓	7.4	28	1	0.011	10	0.11
↓	SPI-22	↓	↓	6.0	↓	↓	↓	7.1	27	0.1	0.150	100	15.0
↓	SPI-30	↓	↓	8.5	↓	↓	↓	7.0	27	0.1	0.259	100	25.9
↓	SPI-31	↓	↓	5.3	↓	↓	↓	7.2	27	1	0.010	10	0.10

① Insufficient volume for analysis, UB 7/28 ② IE HE 8/16

✓

Ammonia and Sulfide Analysis Record

Page 1 of 1

Client/Project:	Organism:	Test Duration (days):
Anchor Shelton ②	eohs	10

PRETEST / ~~INITIAL~~ / [✓ FINAL] / OTHER (circle one)

DAY of TEST: 10

[✓ ~~OVERLYING (OV)~~] / [✓ ~~POREWATER~~] (PW) (circle one) / Comments:

Calibration Standards Temperature		
Date:	**Temperature:**	Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
8/4/17	19.8°C	

	Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV	Ov Q	Surr	8/7/17 KZ	0.00	20.4	KZ 8/7/17	N			10	0.020	1	
↓	SH-ref 1	↓	↓	0.588	↓	↓	↓			↓	0.005	↓	
	CARR			0.00							0.016		
	CARR/SH ref			0.163							0.010 ①		
	SPI 22			0.674							0.035		
	SPI 30			2.42							0.012		
	SPI 31			0.252							0.043		
PW	Q	Surr	8/7/17 KZ	③	19.3	KZ 8/7/17	N	③ →					
↓	SH-ref 1	↓	↓	2.61	↓	↓	↓	③7.6	28	③ →			
	CARR			1.46				7.3	28	10	0.069	1	—
	CARR/SH ref			1.43				7.6	28	10	0.122	1	—
	SPI 22			2.81				7.2	28	5	0.149	2	0.298
	SPI 30			2.90				7.1	28	5	0.099	2	0.198
	SPI 31			2.20				7.2	28	5	0.098	2	0.196

① 0.011 KZ 8/7 ② IQ Final a, PW KZ 8/7 ③ insufficient PW

CETIS QC Plot

Report Date: 04 Aug-17 13:48 (1 of 1)

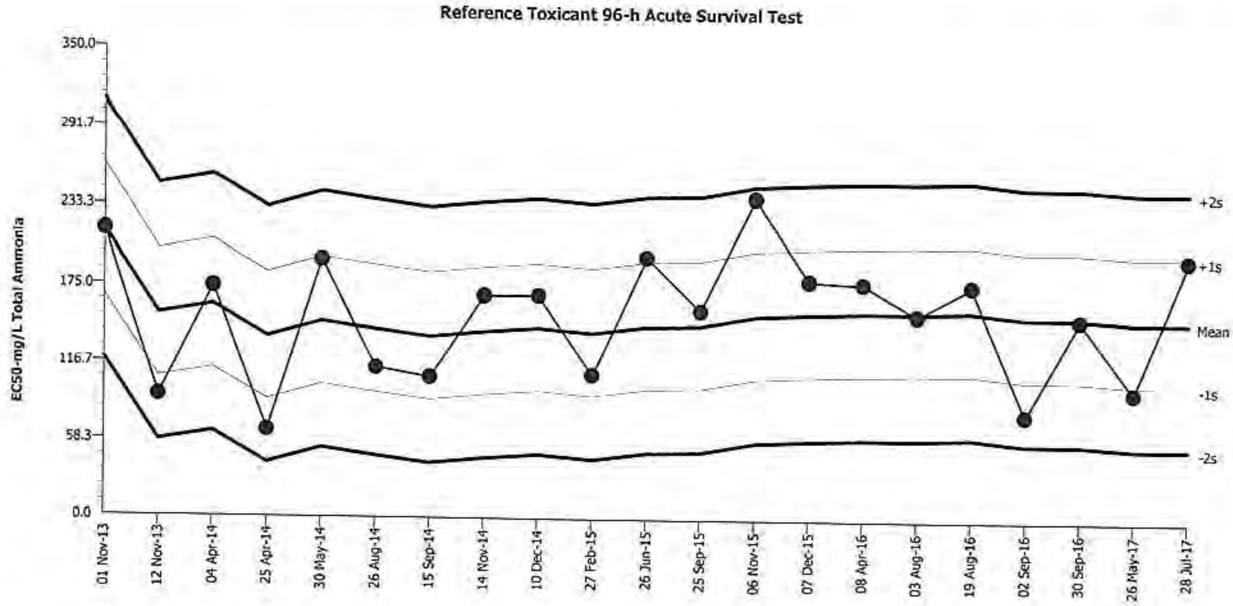
Reference Toxicant 96-h Acute Survival Test

All Matching Labs

Test Type: Survival
Protocol: EPA/600/R-94/025 (1994)

Organism: Eohaustorius estuarius (Amphipod)
Endpoint: Proportion Survived

Material: Total Ammonia
Source: Reference Toxicant-REF



Mean: 151.1
Sigma: 47.79

Count: 20
CV: 31.60%

-1s Warning Limit: 103.3
+1s Warning Limit: 198.9

-2s Action Limit: 55.51
+2s Action Limit: 246.7

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2013	Nov	1	13:30	215	63.91	1.337	(+)		15-9765-5224	08-6656-9431	NewFields
2			12	13:45	91.52	-59.58	-1.247	(-)		12-4327-2465	06-0504-8497	NewFields
3	2014	Apr	4	19:15	173.9	22.75	0.4761			13-5617-0473	14-6315-5154	Port Gamble Environment
4			25	13:00	65.78	-85.32	-1.785	(-)		11-2394-9115	16-6351-0798	Port Gamble Environment
5		May	30	15:30	193.9	42.82	0.896			11-1744-7543	02-6036-0984	ENVIRON
6		Aug	26	15:45	113.3	-37.78	-0.7905			15-5557-5937	00-0529-4993	ENVIRON
7		Sep	15	15:10	106.3	-44.76	-0.9365			07-1282-2061	01-5984-9612	ENVIRON
8		Nov	14	14:25	168	16.9	0.3535			09-0717-5355	19-7840-9499	ENVIRON
9		Dec	10	15:50	168.3	17.21	0.36			19-3485-9112	05-9978-3434	ENVIRON
10	2015	Feb	27	12:35	108.8	-42.3	-0.8851			19-3876-5860	21-0291-4043	ENVIRON
11		Jun	26	13:20	197.1	45.99	0.9623			00-5720-1886	11-7391-9309	ENVIRON
12		Sep	25	17:30	157.8	6.718	0.1406			05-7835-3625	14-8488-2762	ENVIRON
13		Nov	6	15:30	240.8	89.72	1.877	(+)		07-0462-4762	05-5994-4603	ENVIRON
14		Dec	7	15:58	180.1	28.98	0.6064			18-5380-2632	01-5604-1684	ENVIRON
15	2016	Apr	8	14:40	178.3	27.23	0.5697			20-3339-4511	20-5786-8614	ENVIRON
16		Aug	3	16:55	155	3.936	0.08236			15-5854-7986	14-0317-8212	ENVIRON
17			19	14:25	177	25.86	0.5411			10-0746-9736	13-2092-5186	ENVIRON
18		Sep	2	16:25	80.2	-70.9	-1.483	(-)		06-2389-4542	16-8119-8926	ENVIRON
19			30	15:00	152.6	1.548	0.03239			16-2341-4864	11-2277-7148	ENVIRON
20	2017	May	26	13:00	97.99	-53.11	-1.111	(-)		06-2743-8362	04-6967-6524	EcoAnalysts
21		Jul	28	14:20	196.9	45.76	0.9574			14-8451-4586	00-9100-0373	EcoAnalysts

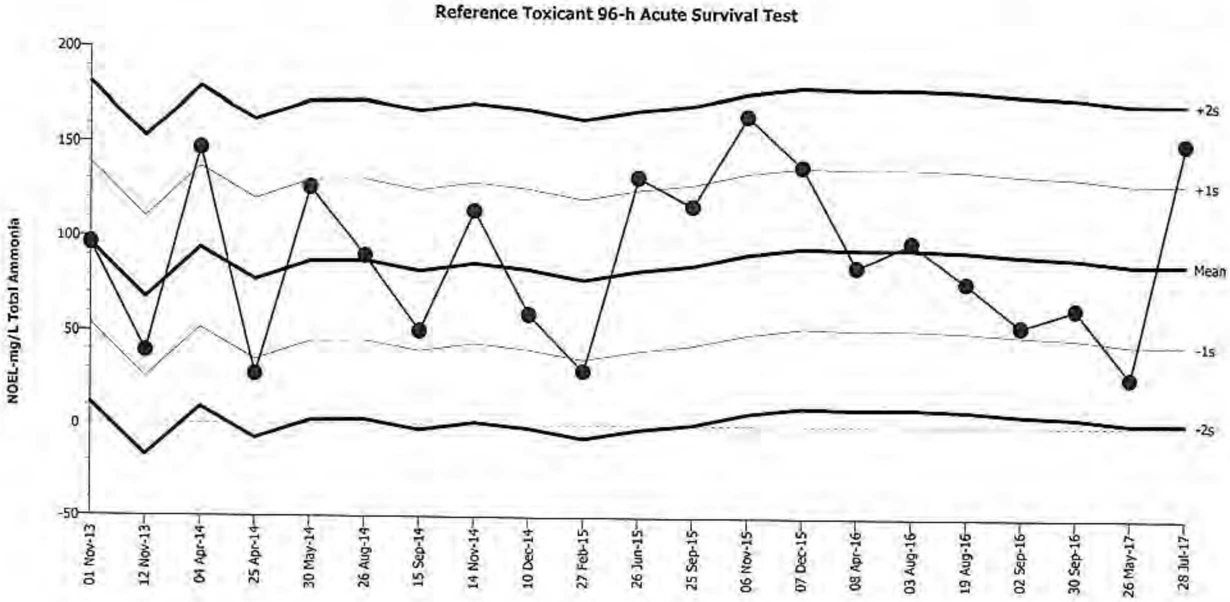
Analyst:______ QA:______

CETIS QC Plot

Report Date: 04 Aug-17 13:48 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type: Survival
Protocol: EPA/600/R-94/025 (1994)
Organism: Eohaustorius estuarius (Amphipod)
Endpoint: Proportion Survived
Material: Total Ammonia
Source: Reference Toxicant-REF


Reference Toxicant 96-h Acute Survival Test

Mean:	86.75	**Count:**	20	**-1s Warning Limit:**	44.21	**-2s Action Limit:**	1.67
Sigma:	42.54	**CV:**	49.00%	**+1s Warning Limit:**	129.3	**+2s Action Limit:**	171.8

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2013	Nov	1	13:30	96.4	9.65	0.2268			15-9765-5224	03-3609-7670	NewFields
2			12	13:45	39.3	-47.45	-1.115	(-)		12-4327-2465	09-6874-0351	NewFields
3	2014	Apr	4	19:15	147	60.25	1.416	(+)		13-5617-0473	16-0396-5073	Port Gamble Environment
4			25	13:00	27	-59.75	-1.405	(-)		11-2394-9115	19-2434-9439	Port Gamble Environment
5		May	30	15:30	126	39.25	0.9227			11-1744-7543	06-3985-7474	ENVIRON
6		Aug	26	15:45	90.1	3.35	0.07875			15-5557-5937	08-3094-4388	ENVIRON
7		Sep	15	15:10	50.5	-36.25	-0.8521			07-1282-2061	16-3885-0935	ENVIRON
8		Nov	14	14:25	114	27.25	0.6406			09-0717-5355	07-0500-8008	ENVIRON
9		Dec	10	15:50	59.4	-27.35	-0.6429			19-3485-9112	07-0579-1018	ENVIRON
10	2015	Feb	27	12:35	29.3	-57.45	-1.35	(-)		19-3876-5860	19-7961-3594	ENVIRON
11		Jun	26	13:20	132	45.25	1.064	(+)		00-5720-1886	15-3704-4199	ENVIRON
12		Sep	25	17:30	117	30.25	0.7111			05-7835-3625	21-0939-3919	ENVIRON
13		Nov	6	15:30	165	78.25	1.839	(+)		07-0462-4762	19-7906-3673	ENVIRON
14		Dec	7	15:58	138	51.25	1.205	(+)		18-5380-2632	00-7335-5231	ENVIRON
15	2016	Apr	8	14:40	85.2	-1.55	-0.03644			20-3339-4511	16-7438-0764	ENVIRON
16		Aug	3	16:55	98	11.25	0.2645			15-5854-7986	05-8855-9934	ENVIRON
17			19	14:25	76.9	-9.85	-0.2315			10-0746-9736	12-8850-4495	ENVIRON
18		Sep	2	16:25	54.1	-32.65	-0.7675			06-2389-4542	18-8647-7799	ENVIRON
19			30	15:00	63.2	-23.55	-0.5536			16-2341-4864	17-9345-6065	ENVIRON
20	2017	May	26	13:00	26.6	-60.15	-1.414	(-)		06-2743-8362	12-3565-7845	EcoAnalysts
21		Jul	28	14:20	151	64.25	1.51	(+)		14-8451-4586	09-8418-8824	EcoAnalysts

Analyst: MK QA:

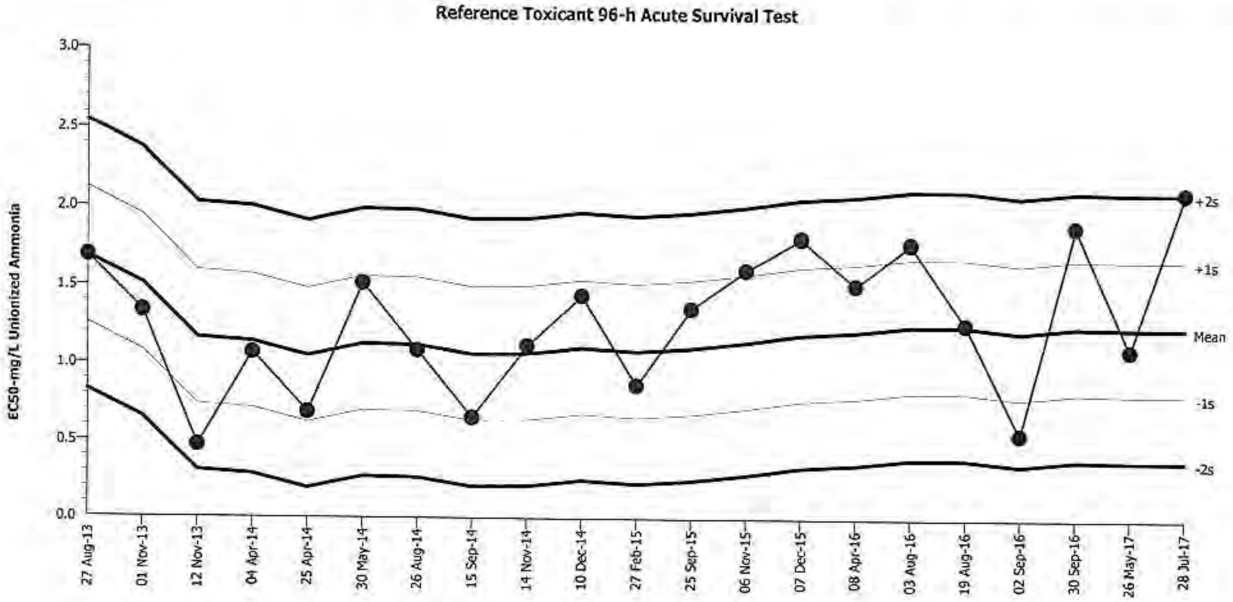
CETIS QC Plot

Report Date: 04 Aug-17 13:47 (1 of 1)

Reference Toxicant 96-h Acute Survival Test

All Matching Labs

Test Type: Survival
Protocol: EPA/600/R-94/025 (1994)
Organism: Eohaustorius estuarius (Amphipod)
Endpoint: Proportion Survived
Material: Unionized Ammonia
Source: Reference Toxicant-REF



Mean: 1.24
Sigma: 0.4295
Count: 20
CV: 34.60%
-1s Warning Limit: 0.8108
+1s Warning Limit: 1.67
-2s Action Limit: 0.3813
+2s Action Limit: 2.099

Quality Control Data

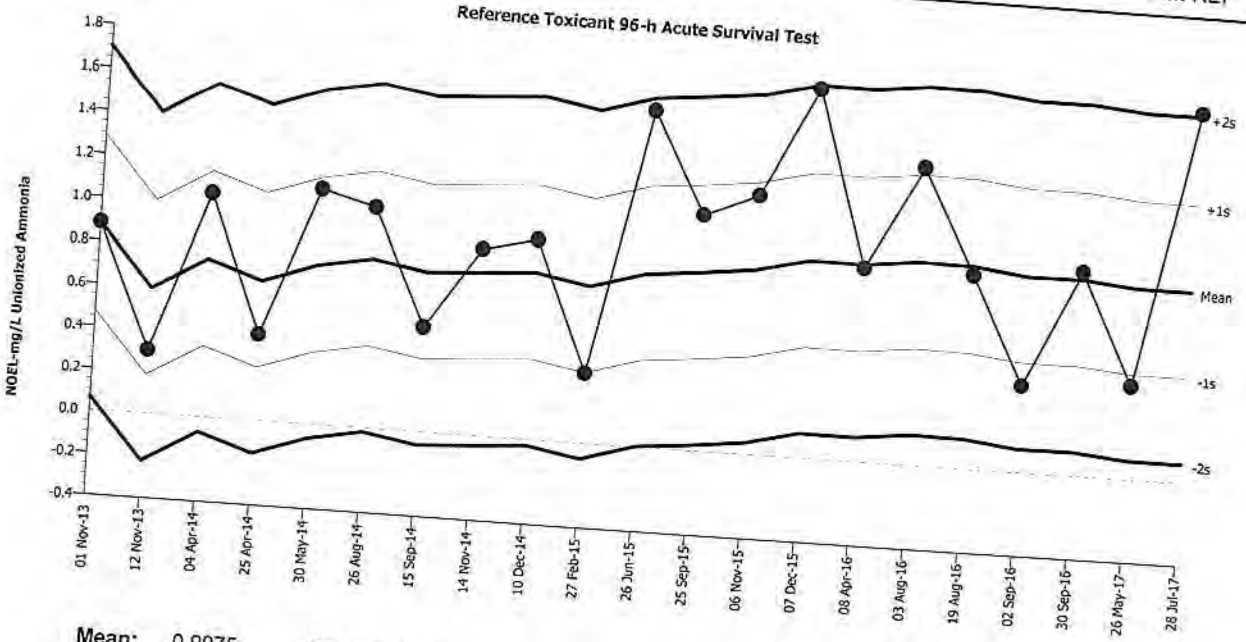
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2013	Aug	27	12:10	1.689	0.4493	1.046	(+)		18-3860-3992	18-0374-3993	NewFields
2		Nov	1	13:30	1.339	0.09855	0.2295			01-7225-6737	09-1642-9045	NewFields
3			12	13:45	0.4715	-0.7685	-1.789	(-)		15-7445-3893	06-3812-4989	NewFields
4	2014	Apr	4	19:15	1.072	-0.1684	-0.392			02-4910-1045	07-9486-3041	NewFields
5			25	13:00	0.6871	-0.5529	-1.287	(-)		05-3931-3196	11-2528-6540	Port Gamble Environment
6		May	30	15:30	1.517	0.2766	0.644			03-2348-8477	19-6287-3473	ENVIRON
7		Aug	26	15:45	1.087	-0.153	-0.3561			16-9917-4183	13-7453-5343	ENVIRON
8		Sep	15	15:10	0.6543	-0.5857	-1.364	(-)		04-2286-3837	03-1229-8693	ENVIRON
9		Nov	14	14:25	1.119	-0.1209	-0.2814			07-5753-6828	00-1415-6148	ENVIRON
10		Dec	10	15:50	1.441	0.2006	0.467			04-0714-3304	08-0742-5225	ENVIRON
11	2015	Feb	27	12:35	0.8668	-0.3732	-0.8688			10-1977-7129	06-3048-0232	ENVIRON
12		Sep	25	17:30	1.361	0.1208	0.2812			00-7510-8480	16-9779-9851	ENVIRON
13		Nov	6	15:30	1.605	0.3653	0.8506			14-1974-2437	14-7486-0204	ENVIRON
14		Dec	7	15:58	1.807	0.5666	1.319	(+)		12-1918-7694	00-1085-2209	ENVIRON
15	2016	Apr	8	14:40	1.512	0.2717	0.6325			17-7738-6530	02-5159-2977	ENVIRON
16		Aug	3	16:55	1.775	0.5345	1.245	(+)		15-5470-2613	20-0153-1348	ENVIRON
17			19	14:25	1.264	0.02369	0.05516			11-7594-3529	18-2266-1841	ENVIRON
18		Sep	2	16:25	0.5558	-0.6842	-1.593	(-)		20-2236-1025	01-7459-0032	ENVIRON
19			30	15:00	1.885	0.6449	1.501	(+)		12-0597-8760	12-1436-9613	ENVIRON
20	2017	May	26	13:00	1.101	-0.1394	-0.3246			15-8049-8093	00-1911-6893	EcoAnalysts
21		Jul	28	14:20	2.103	0.8628	2.009	(+)	(+)	11-4327-6237	03-7130-7368	EcoAnalysts

Analyst: MK QA:

CETIS QC Plot

Reference Toxicant 96-h Acute Survival Test **Report Date:** 04 Aug-17 13:47 (1 of 1)

Test Type: Survival
Protocol: EPA/600/R-94/025 (1994) **Organism:** Eohaustorius estuarius (Amphipod) **All Matching Labs**
Endpoint: Proportion Survived **Material:** Unionized Ammonia
Source: Reference Toxicant-REF



Mean: 0.9075 **Count:** 20 **-1s Warning Limit:** 0.4992 **-2s Action Limit:** 0.0909
Sigma: 0.4083 **CV:** 45.00% **+1s Warning Limit:** 1.316 **+2s Action Limit:** 1.724

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2013	Nov	1	13:30	0.882	-0.0255	-0.06245			01-7225-6737	17-4499-2761	NewFields
2			12	13:45	0.302	-0.6055	-1.483	(-)		15-7445-3893	14-8429-9092	NewFields
3	2014	Apr	4	19:15	1.05	0.1425	0.349			02-4910-1045	18-6624-7464	NewFields
4			25	13:00	0.409	-0.4985	-1.221	(-)		05-3931-3196	00-2785-8568	Port Gamble Environment
5		May	30	15:30	1.105	0.1975	0.4837			03-2348-8477	17-7984-3461	ENVIRON
6		Aug	26	15:45	1.037	0.1295	0.3172			16-9917-4183	01-4278-7622	ENVIRON
7		Sep	15	15:10	0.497	-0.4105	-1.005	(-)		04-2286-3837	01-4675-9354	ENVIRON
8		Nov	14	14:25	0.881	-0.0265	-0.0649			07-5753-6828	01-5478-5022	ENVIRON
9		Dec	10	15:50	0.943	0.0355	0.08695			04-0714-3304	12-5251-7122	ENVIRON
10	2015	Feb	27	12:35	0.334	-0.5735	-1.405	(-)		10-1977-7129	04-0485-4050	ENVIRON
11		Jun	26	13:20	1.578	0.6705	1.642	(+)		13-7504-6588	11-4090-1553	ENVIRON
12		Sep	25	17:30	1.111	0.2035	0.4984			00-7510-8480	05-3466-1859	ENVIRON
13		Nov	6	15:30	1.22	0.3125	0.7654			14-1974-2437	10-4251-0205	ENVIRON
14		Dec	7	15:58	1.733	0.8255	2.022	(+)	(+)	12-1918-7694	05-5204-9536	ENVIRON
15	2016	Apr	8	14:40	0.918	0.0105	0.02572			17-7738-6530	07-6987-7357	ENVIRON
16		Aug	3	16:55	1.404	0.4965	1.216	(+)		15-5470-2613	11-2111-0216	ENVIRON
17			19	14:25	0.919	0.0115	0.02817			11-7594-3529	06-9525-3086	ENVIRON
18		Sep	2	16:25	0.415	-0.4925	-1.206	(-)		20-2236-1025	20-1525-6837	ENVIRON
19			30	15:00	0.967	0.0595	0.1457			12-0597-8760	06-8089-0740	ENVIRON
20	2017	May	26	13:00	0.445	-0.4625	-1.133	(-)		15-8049-8093	18-0229-5291	EcoAnalysts
21		Jul	28	14:20	1.738	0.8305	2.034	(+)	(+)	11-4327-6237	11-4496-1419	EcoAnalysts

Analyst: MK QA:

CETIS Summary Report

Report Date: 04 Aug-17 13:39 (p 1 of 1)
Test Code: 587BE51A | 14-8451-4586

Reference Toxicant 96-h Acute Survival Test

EcoAnalysts

Batch ID:	17-7829-8487	**Test Type:**	Survival	**Analyst:**	
Start Date:	28 Jul-17 14:20	**Protocol:**	EPA/600/R-94/025 (1994)	**Diluent:**	Laboratory Seawater
Ending Date:	01 Aug-17 14:50	**Species:**	Eohaustorius estuarius	**Brine:**	Not Applicable
Duration:	4d 1h	**Source:**	Northwestern Aquatic Science, OR	**Age:**	

Sample ID:	12-1096-5815	**Code:**	482DDF37	**Client:**	Internal Lab
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Project:**	Reference Toxicant
Receive Date:		**Source:**	Reference Toxicant		
Sample Age:	74d 14h	**Station:**	p170515.19		

Sample Note: jl mk he lb

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
09-8418-8824	Proportion Survived	151	305	214.6	19.5%		Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	mg/L	95% LCL	95% UCL	TU	Method
00-9100-0373	Proportion Survived	EC5	83.8	N/A	126.7		Linear Interpolation (ICPIN)
		EC10	102.3	9.851	210.2		
		EC15	124.9	13.22	197.9		
		EC20	151.3	62.87	181.9		
		EC25	158.1	108.6	187.9		
		EC40	180.3	155.8	207.3		
		EC50	196.9	174.5	221.2		

Proportion Survived Summary

C-mg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	3	0.9333	0.7899	1	0.9	1	0.03333	0.05774	6.19%	0.0%
19.9		3	0.9667	0.8232	1	0.9	1	0.03333	0.05774	5.97%	-3.57%
40.4		3	0.9667	0.8232	1	0.9	1	0.03333	0.05774	5.97%	-3.57%
75.3		3	0.9333	0.6465	1	0.8	1	0.06667	0.1155	12.37%	0.0%
151		3	0.7667	0.4798	1	0.7	0.9	0.06667	0.1155	15.06%	17.86%
305		3	0	0	0	0	0	0	0		100.0%

Proportion Survived Detail

C-mg/L	Control Type	Rep 1	Rep 2	Rep 3
0	Dilution Water	0.9	1	0.9
19.9		1	0.9	1
40.4		1	0.9	1
75.3		1	1	0.8
151		0.9	0.7	0.7
305		0	0	0

Proportion Survived Binomials

C-mg/L	Control Type	Rep 1	Rep 2	Rep 3
0	Dilution Water	9/10	10/10	9/10
19.9		10/10	9/10	10/10
40.4		10/10	9/10	10/10
75.3		10/10	10/10	8/10
151		9/10	7/10	7/10
305		0/10	0/10	0/10

Analyst: MK QA:

CETIS Test Data Worksheet

Report Date: 04 Aug-17 13:39 (p 1 of 1)
Test Code: 14-8451-4586/587BE51A

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Start Date: 28 Jul-17 14:20
End Date: 01 Aug-17 14:50
Sample Date: 15 May-17
Species: Eohaustorius estuarius
Protocol: EPA/600/R-94/025 (1994)
Material: Total Ammonia
Sample Code: 482DDF37
Sample Source: Reference Toxicant
Sample Station: p170515.19

Sample Note: jl mk he lb

C-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	10	10	9	
0	D	2	12	10	10	
0	D	3	8	10	9	
19.9		1	11	10	10	
19.9		2	16	10	9	
19.9		3	14	10	10	
40.4		1	9	10	10	
40.4		2	13	10	9	
40.4		3	2	10	10	
75.3		1	3	10	10	
75.3		2	15	10	10	
75.3		3	5	10	8	
151		1	17	10	9	
151		2	6	10	7	
151		3	4	10	7	
305		1	18	10	0	
305		2	1	10	0	
305		3	7	10	0	

Analyst: MK

QA:

CETIS Summary Report

Report Date: 04 Aug-17 13:46 (p 1 of 1)
Test Code: 442502CD | 11-4327-6237

Reference Toxicant 96-h Acute Survival Test — **EcoAnalysts**

Batch ID: 17-7829-8487
Start Date: 28 Jul-17 14:20
Ending Date: 01 Aug-17 14:50
Duration: 4d 1h

Test Type: Survival
Protocol: EPA/600/R-94/025 (1994)
Species: Eohaustorius estuarius
Source: Northwestern Aquatic Science, OR

Analyst:
Diluent: Laboratory Seawater
Brine: Not Applicable
Age:

Sample ID: 00-7902-9980
Sample Date: 15 May-17
Receive Date:
Sample Age: 74d 14h

Code: 4B5E6DC
Material: Unionized Ammonia
Source: Reference Toxicant
Station: p170515.19

Client: Internal Lab
Project: Reference Toxicant

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
11-4496-1419	Proportion Survived	1.738	2.816	2.212	19.5%		Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	mg/L	95% LCL	95% UCL	TU	Method
03-7130-7368	Proportion Survived	EC5	1.436	0.3236	1.69		Linear Interpolation (ICPIN)
		EC10	1.534	0.7887	1.991		
		EC15	1.637	1.024	1.984		
		EC20	1.741	1.337	1.978		
		EC25	1.798	1.505	2.025		
		EC40	1.977	1.783	2.169		
		EC50	2.103	1.934	2.269		

Proportion Survived Summary

C-mg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	3	0.9333	0.7899	1	0.9	1	0.03333	0.05774	6.19%	0.0%
0.458		3	0.9667	0.8232	1	0.9	1	0.03333	0.05774	5.97%	-3.57%
0.924		3	0.9667	0.8232	1	0.9	1	0.03333	0.05774	5.97%	-3.57%
1.385		3	0.9333	0.6465	1	0.8	1	0.06667	0.1155	12.37%	0.0%
1.738		3	0.7667	0.4798	1	0.7	0.9	0.06667	0.1155	15.06%	17.86%
2.816		3	0	0	0	0	0	0	0		100.0%

Proportion Survived Detail

C-mg/L	Control Type	Rep 1	Rep 2	Rep 3
0	Dilution Water	0.9	1	0.9
0.458		1	0.9	1
0.924		1	0.9	1
1.385		1	1	0.8
1.738		0.9	0.7	0.7
2.816		0	0	0

Proportion Survived Binomials

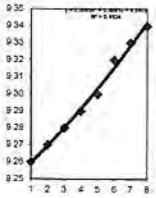
C-mg/L	Control Type	Rep 1	Rep 2	Rep 3
0	Dilution Water	9/10	10/10	9/10
0.458		10/10	9/10	10/10
0.924		10/10	9/10	10/10
1.385		10/10	10/10	8/10
1.738		9/10	7/10	7/10
2.816		0/10	0/10	0/10

Analyst: MK QA:

CLIENT:	Anchor	Test Date:	28-Jul-17
PROJECT:	Shelton Harbor	Test Type:	Eoh RT
COMMENTS:			

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer:	I-factor
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
	9.34



	Sample	Mod	*NH3T (mg/L)*	*salinity (ppt)*	*pH*	*temp (C)*	temp (K)	i-factor	Mod	**NH3U (mg/L)**
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		**#VALUE!**
	Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		**0.008**
1	0		0	29	8.10	15.3	288.46	9.3214		**0.000**
2	15		19.90	29	8.00	15.4	288.56	9.3214		**0.458**
3	30		40.40	29	8.00	15.3	288.46	9.3214		**0.924**
4	60		75.30	29	7.90	15.4	288.56	9.3214		**1.385**
5	120		151.00	29	7.70	15.2	288.36	9.3214		**1.738**
6	240		305.00	29	7.60	15.3	288.46	9.3214		**2.816**
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CETIS Test Data Worksheet

Report Date: 04 Aug-17 13:45 (p 1 of 1)
Test Code: 11-4327-6237/442502CD

Reference Toxicant 96-h Acute Survival Test **EcoAnalysts**

Start Date:	28 Jul-17 14:20	**Species:**	Eohaustorius estuarius	**Sample Code:**	4B5E6DC
End Date:	01 Aug-17 14:50	**Protocol:**	EPA/600/R-94/025 (1994)	**Sample Source:**	Reference Toxicant
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Sample Station:**	p170515.19

C-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	9	10	9	
0	D	2	1	10	10	
0	D	3	8	10	9	
0.458		1	10	10	10	
0.458		2	15	10	9	
0.458		3	2	10	10	
0.924		1	6	10	10	
0.924		2	17	10	9	
0.924		3	13	10	10	
1.385		1	3	10	10	
1.385		2	16	10	10	
1.385		3	5	10	8	
1.738		1	14	10	9	
1.738		2	4	10	7	
1.738		3	18	10	7	
2.816		1	11	10	0	
2.816		2	12	10	0	
2.816		3	7	10	0	

Analyst: MK QA:

ECOANALYSTS
LIFE IN WATER

Ammonia Reference Toxicant Test Water Quality Data Sheet

CLIENT Anchor	PROJECT Shelton Harbor	*Eohaustaurius Estuarius*		Laboratory Port Gamble .	PROTOCOL PSEP
TEST ID P170515.19	LOT #: 2986C510	TEST START DATE 28Jul17	TIME 1420	4-DAY END DATE 01Aug17	TIME 1450
CHAMBER SIZE/TYPE glass pint jar	EXPOSURE VOLUME 250 mL				

WATER QUALITY DATA

TEST CONDITIONS					DO (mg/L)		TEMP(C)		SAL (ppt)		pH		TECHNICIAN	AMMONIA					
					> 4.6		15 ± 1		28 ± 1		7.8 ± 0.5								
SAMPLE ID	CONCENTRATION		DAY	REP	D.O.		TEMP.		SALINITY		pH		WQ TECH/ DATE	AMMONIA		Tech			
	value	units			meter	mg/L	meter	°C	meter	ppt	meter	unit		METER	mg/L				
Ref.Tox.-ammonia	0	mg/L	0	Stock	8	7.9	8	15.3	8	29	8	8.1	JL 7/28	10	0.00				
			4	1	8	7.2	8 ①	~~15.5~~ 15.3	8	29	8	7.9	MK 8/1						
Ref.Tox.-ammonia	15	mg/L	0	Stock	8	7.9	8	15.4	8	29	8	8.0	JL 7/28	10	19.9				
			4	1	8	7.3	8	15.0	8	29	8	7.9	MK 8/1						
Ref.Tox.-ammonia	30	mg/L	0	Stock	8	7.9	8	15.3	8	29	8	8.0	JL 7/28	10	40.4				
			4	1	8	7.3	8	14.9	8	29	8	7.9	MK 8/1						
Ref.Tox.-ammonia	60	mg/L	0	Stock	8	7.9	8	15.4	8	29	8	7.9	JL 7/28	10	75.3				
			4	1	8	7.8	8	14.9	8	29	8	7.9	MK 8/1						
Ref.Tox.-ammonia	120	mg/L	0	Stock	8	7.9	8	15.2	8	29	8	7.7	JL 7/28	10	151				
			4	1	8	7.9	8	15.0	8	29	8	7.9	MK 8/1						
Ref.Tox.-ammonia	240	mg/L	0	Stock	8	7.9	8	15.3	8	29	8	7.6	JL 7/28	10	305				
			4	1															

① IE. MK 8/1.

EcoAnalysts
LIFE IN WATER

Ammonia Reference Toxicant Test Water Quality Data Sheet

		SPECIES Eohs		
CLIENT Anchor	PROJECT Shelton Harbor	PROJECT MANAGER B. Hester	LABORATORY Port Gamble .	PROTOCOL #VALUE!

SURVIVAL & BEHAVIOR DATA

OBSERVATION KEY
N = Normal
LOE = Loss of equilibium
Q = Quinscent
DC = Discoloration
NB = No body
F = Floating on surface

INITIAL # OF ORGANISMS 10

	DAY 1	DAY 2	DAY 3	DAY 4
DATE	7/29/17	7/30	7/31	8/1
TECHNICIAN	UB	HE	JL	UB

SAMPLE ID	CONC. value	CONC. units	REP	INITIAL NUMBER	DAY 1 #ALIVE	DAY 1 #DEAD	DAY 1 OBS	DAY 2 #ALIVE	DAY 2 #DEAD	DAY 2 OBS	DAY 3 #ALIVE	DAY 3 #DEAD	DAY 3 OBS	DAY 4 #ALIVE	DAY 4 #DEAD	DAY 4 OBS
Ref.Tox.- Ammonia	0	mg/L	1	10	9	1	N	9	0	N	9	0	N	9	0	N
			2	↓	10	0	N	10	0	↓	10	0	↓	10	0	↓
			3	↓	10	0	3F	10	0	↓	10	0	1F	9	1	↓
Ref.Tox.- Ammonia	15	mg/L	1	↓	10	0	2F	10	0	N	10	0	N	10	0	N
			2	↓	9	1	N	9	0	N	9	0	1F	9	0	↓
			3	↓	10	0	2F	10	0	2F	10	0	N	10	0	↓
Ref.Tox.- Ammonia	30	mg/L	1	↓	10	0	N	16	0	N	10	0	N	10	0	N
			2	↓	~~10~~ 9 ①	~~0~~ 1	~~N~~ 1F	~~10~~ 9 ②	0	1F	9	0	1F	9	0	1F
			3	↓	10	0	N	10	0	1F	10	0	N	10	0	N
Ref.Tox.- Ammonia	60	mg/L	1	↓	10	0	N	10	② ~~1~~ 0	N	10	0	N	10	0	N
			2	↓	10	0	4F	10	0	1F	10	0	↓	10	0	↓
			3	↓	10	0	N	10	0	2F	9	1	↓	8	1	1F
Ref.Tox.- Ammonia	120	mg/L	1	↓	10	0	4F	9	1	1F	9	0	Q	9	0	1F,Q
			2	↓	10	0	2F	10	0	1F	8	2	↓	7	1	Q
			3	↓	10	0	2F	9	1	1F	8	1	1F,Q	7	1	Q
Ref.Tox.- Ammonia	240	mg/L	1	↓	8	2	Q	0	8							
			2	↓	9	1	Q	0	9							
			3	↓	7	3	1F, Q	0	7							

① Wrong cell, UB 7/29 ② WC HE 7/30

Ammonia Reference Toxicant
Spiking Worksheet

Reference Toxicant ID: P170525.19

Date Prepared: 7/28/17

Technician Initials: JL

Amp/Eoh NH_3 RT

Assumptions in Model
Stock ammonia concentration is 10,000 mg/L = 10 mg/mL

Date: 7/28/2017
Measurement: 9453.3

Test Solutions			Volume of stock to reach desired concentration	
Measured Concentration	**Desired Concentration**	**Volume**		
mg/L	mg/L	mL	mL stock to increase	
			[redacted]	SALT WATER
305	**240**	750	[redacted]	**28.561**
151	**120**	750	[redacted]	**14.281**
75.3	**60**	750	[redacted]	**7.140**
40.4	**30**	750	[redacted]	**3.570**
19.9	**15**	750	[redacted]	**1.785**
0.00	**0**	750	[redacted]	**0.000**
			[redacted]	
			[redacted]	

2. *Neanthes arenaceodentata* 20-Day Test

ECOANALYSTS

CLIENT	PROJECT	JOB NO.	PROJECT MANAGER	LABORATORY / LOCATION	PROTOCOL	SPECIES
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble / Bath 8	PSEP 1995	*Neanthes arenaceodentata*

N = Normal
#E = Emergence
#M = Mortality
G = Growth (fungal, bacterial, or algal)
D = No Air Flow (DO?)
F = Floating on Surface
TC = Too Cloudy
U=Excess food

INITIAL # OF ORGANISMS: 5

ENDPOINT DATA & OBSERVATIONS

CLIENT/ ENVIRON ID	REP	JAR	INITIAL # (if differs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	NUMBER REMAINING	TARE WEIGHT (mg)	TOTAL WEIGHT (mg)	ASHED WEIGHT (mg)
Date and Initials				7/29 UB	7/30 LB	7/31 JL	8/01 JL	8/2 UB	8/3 UB	8/4 UB	8/5 UB	8/6 AK	8/7 AK	8/8 UB	8/9 JA	8/10 AK	8/11 UB	8/12 UB	8/13 AK	8/14 JL	8/15 AK	8/16 UB	8/17 JL				
Control /	1			N	N	U	U	U	G	G	G	UG	N	G U	G	G	G	G	G	U,G	1E G	1E G	N	5 ^{1}	361.14	428.57	387.02
	2								U	U	U	U		U	N	U	N	N	N	U	N	N		5 ^{2}	293.04	324.75	304.40
	3											U				G			N	U	N	U		5 ^{3}	168.74	206.64	178.97
	4											U				G			N	U,G	G	G,U		5 ^{4}	255.38	287.59	267.03
	5											U		~~G~~③ ~~U~~		U			G	U,G				5 ^{5}	241.88	274.09	251.29
SH-Ref-1 /	1										U	U		G	G	G	N	G		U,G			G	5 ^{6}	269.05	301.78	277.90
	2					G	G		G	G	G	G,U		G U	G	G	N	N		U,G				5 ^{7}	148.57	181.17	157.68
	3					U	U		U	U	U	U		U	G	G,U	U G	G		U,G				5 ^{8}	328.60	362.46	335.87
	4							G	G	G	G	G,U	G		G	G,U	U G	G		U,G				5 ^{9}	263.55	310.08	273.19
	5							U	U	U	U	U	N		G	G	N	G		U,G				5 ^{10}	140.95	179.06	150.88
CARR /	1											U		U	N	N	N	N	N	U,G			G	5 ^{11}	345.67	389.43	358.91
	2											U	G		N	G				U,G				5 ^{12}	229.11	271.54	238.05
	3								G			U	N		U	U				U				5 ^{13}	260.64	301.88	270.78
	4								U			G ^{U}	U	G U	N	G	G	G	G	U,G				5 ^{14}	264.62	310.57	277.17
	5								G			U	N	U	N	N	N	G	G	U,G				5 ^{15}	156.08	193.87	167.45

Initial Biomass	Rep	Number	Tare Weight (mg)	Dry Weight (mg)	Ashed Weight (mg)	Comments: Boat #
	1	5	50.65	51.12	50.72	② ~~29~~ 25
	2	5	50.52	50.94	50.56	139①
	3	5	50.30	51.08	50.51	123

Boats in oven at 1210 8/17/17, JL - oven temp. 124°C
Removed from oven at 1230 8/18/17 JL

① also looks like # 159, UB 7/29

② 1E, Boat # 25, UB 7/29

③ 1E, N, UB 8/8

8/21/15

Shelton 20d Neanthes

ECOANALYSTS

CLIENT	PROJECT	JOB NO.	PROJECT MANAGER	LABORATORY / LOCATION	PROTOCOL	SPECIES
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble / Bath 8	PSEP 1995	*Neanthes arenaceodentata*

N = Normal
#E = Emergence
#M = Mortality
G = Growth
(fungal, bacterial, or algal)
D = No Air Flow (DO?)
F = Floating on Surface
TC = Too Cloudy
U=Excess food

INITIAL # OF ORGANISMS: 5

ENDPOINT DATA & OBSERVATIONS

CLIENT/ ENVIRON ID	REP	JAR	INITIAL # (if differs)	Date and Initials: 7/29 UB 1	7/30 HR 2	7/31 JL 3	8/01 JL 4	8/2 UB 5	8/3 UB 6	8/4 UB 7	8/5 UB 8	8/6 HR 9	8/7 HR 10	8/8 UB 11	8/9 HR 12	8/10 HE 13	8/11 UB 14	8/12 UB 15	8/13 HR 16	8/14 JL 17	8/15 HR 18	8/16 UB 19	8/17 JL 20	NUMBER REMAINING	TARE WEIGHT (mg)	TOTAL WEIGHT (mg)	ASHED WEIGHT (mg)
CARR / SH-Ref-1 /	1			N	N	U	U	G	G	G	G	G	G	U	N	G	G	G	G	U,G	G	G,U	G	5^{16}	224.23	260.10	233.85
	2							U	U	U	G	U	N	↓	↓		G	G		U,G			G	4^{17}	273.62	308.19	281.78
	3											U,G		U G	G		G	G U		U,G			U	5^{18}	165.08	207.20	175.49
	4											U		U	N		N	U		U,G			G	5^{19}	196.91	239.02	210.50
	5							↓	↓	↓	↓	U	↓	U G	G	↓		G		U,G			G	5^{20}	169.56	213.96	180.47
SH-13A /	1							G	G	G	G	G,U	G	G U	G	G	↓	G		U,G			G	5^{21}	208.99	225.53	211.89
	2							U	G	U	U	U,G	N	G U			G	G	↓	U,G			↓	5^{22}	163.36	191.72	169.25
	3							G	G			U		U		↓	N	N	N	U,G			N	5^{23}	251.76	279.93	258.60
	4							U	G			U			U	N		G	N	U,G				5^{24}	166.19	195.02	172.51
	5								U	↓	↓	U	↓	↓	G	G	↓	N	N	U,G			↓	5^{25}	204.00	229.97	208.81
SH-19 /	1								G	U	U	G,U	U	U	N		G	G	G	U,G			G	5^{26}	191.96	221.98	196.66
	2								U			U					G	G		U,G				5^{27}	160.78	181.89	164.04
	3											U					N	G		U,G				5^{28}	205.48	234.21	④ ~~212~~ 211.94
	4											U			12			N		U,G				5^{29}	281.20	313.39	286.45
	5					↓			↓			U		↓	N		↓	G	↓	U,G			↓	5^{30}	289.47	311.25	293.18
SH-22 /	1			↓		② ~~G~~ U		G	↓	↓	U	U	N	G	G	U	G	G	12 G	U,G			G	5^{31}	275.22	315.45	284.92
	2			~~G~~ ①		~~G~~ U		G	G	G	G	U	N	U		G	G	G	G	U,G				5^{32}	188.52	226.88	198.98
	3			N		~~G~~ U		G	U	U	U	U,G	G	G U			G	G		U,G				5^{33}	257.03	288.93	263.17
	4					U		G	G		G	G	N	U			G	G		U,G				5^{34}	338.43	364.67	344.12
	5			↓	↓	~~G~~ U	↓	G	U	↓	G	U,G	G	G U	↓	↓	G	G	↓	U,G	↓	↓	↓	5 ~~35~~ ② 56	199.41	228.44	204.20

① N, mistook food for growth, UB 7/29 ② WC JL 7/31/17

④ IQ HR 8/21

② No boat 35, used boat 56, UB 8/16

ECOANALYSTS

CLIENT	PROJECT	JOB NO.	PROJECT MANAGER	LABORATORY / LOCATION	PROTOCOL	SPECIES
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble / Bath 8	PSEP 1995	*Neanthes arenaceodentata*

N = Normal
#E = Emergence
#M = Mortality
G = Growth
(fungal, bacterial, or algal)
D = No Air Flow (DO?)
F = Floating on Surface
TC = Too Cloudy
U=Excess food

INITIAL # OF ORGANISMS: 6

ENDPOINT DATA & OBSERVATIONS

CLIENT/ ENVIRON ID	REP	JAR	INITIAL # (if differs)	7/29 UB	7/30	7/31 JL	8/01 JL	8/2 UB	8/3 UB	8/4 UB	8/5 UB	8/6	8/7	8/8 LB	8/9	8/10	8/11 UB	8/12 UB	8/13	8/14 JL	8/15	8/16 UB	8/17 JL	NUMBER REMAINING	TARE WEIGHT (mg)	TOTAL WEIGHT (mg)	ASHED WEIGHT (mg)
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
SH-28 /	1			N	N	~~N~~ U ①	U	U	U	U	U	U	N	G	G	G	N	N	N	U	G	G,U	N	5 36	188.93	217.67	195.95
	2											U		U		N		G	N	U,G				5 37	262.29	306.66	276.92
	3											U				G		N	N	U				5 38	165.38	178.59	169.51
	4								G			U				②		N	N	U,G			G	5 39	291.81	318.73	298.62
	5								G			U,G	G	G				G	G	U,G			G	5 40	239.24	282.38	251.19
SPI-22 /	1					G	G	G	G	G	G	U,G	G	U	G		G	G		U/G			G	5 41	251.47	293.66	259.80
	2					G				U	U	G								U/G				5 42	289.51	343.73	300.62
	3					G				G		G		G						U,G				5 43	234.36	275.42	243.85
	4					G				U		U,G		U						U,G				5 44	225.44	264.54	232.80
	5					G				U		U,G		G						U,G				5 45	341.07	374.62	348.19
SPI-30 /	1			G		G		G	G	G	U	U,G	G	U	G		U	U		U			G	5 46	170.17	210.22	179.06
	2			N		G		G	G	G	G	U,G		G,U			N	G		U,G				5 47	238.03	291.27	247.56
	3			G		G		G	G	G	U	U,G		U			N	G		U,G				4 48	223.82	259.71	~~300.61~~ 231.51 ⑤
	4			N		G		G	G	G	G	G,U		G,U			G	G		U,G				5 49	230.77	272.19	239.~~5~~ 25 ④
	5					G		G	G	U	U	U		U			G	G	✓	U,G				5 50	248.41	285.69	256.07
SPI-31 /	1					U	U	U	G	U	G	U,G	G		G		G	G	G,U	U,G			G	5 51	224.62	265.38	235.46
	2								U	G	U	U,G							G	U,G				5 52	272.51	295.63	277.77
	3									U		U								U,G				5 53	197.19	~~229.5~~ 229.49 ③	204.64
	4									G		U								U,G				3 54	213.36	239.98	220.83
	5									U		U,G								U,G				3 55	202.74	217.19	205.15

① IE JL 7/31/17. ② WC HA 8/10 ④ IE HA 8/21 ⑤ IE HA 8/21

③ MR, 229.49, UB 8/18

ECOANALYSTS

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**START TIME/ END TIME** 1320 / 0900	**DILUTION WATER BATCH** FSW072617.02	**PROTOCOL** PSEP 1995	**TEST START DATE** 28-Jul-2017
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY / LOCATION** Port Gamble / Bath 8	**ORGANISM BATCH** ATS072817	**TEST SPECIES** *Neanthes arenaceodentata*	**TEST END DATE** 17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				**DO (mg/L)**		**TEMP (C)**		**SALINITY (ppt)**		**pH**				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
				D.O.		**TEMP**		**SALINITY**		**pH**		**WATER**		
SAMPLE ID	**DAY**	**REP**	**JAR**	**meter**	**mg/L**	**meter**	**°C**	**meter**	**ppt**	**meter**	**unit**	**RENEWAL**	**Feeding**	**TECH/DATE**
Control /	**0**	Surr	51	8	7.7	8	19.1	8	29	8	8.1		JL	BG 7/28/17
Control /	**1**	Surr		8	7.6	8	19.1	8	29	8	8.1			UB 7/29
Control /	**2**	Surr		8	7.3	8	19.8	8	29	8	8.1		HE	HE 7/30
Control /	**3**	Surr		8	7.6	8	19.5	8	29	8	8.1	JL/HE		JL 7/31
Control /	**4**	Surr		8	7.6	8	19.0	8	29	8	8.1		UB	JL 8/01
Control /	**5**	Surr		8	7.6	8	19.4	8	29	8	8.0			UB 8/2
Control /	**6**	Surr		8	7.6	8	19.5	8	29	8	8.1	UB/HE	UB	UB 8/3
Control /	**7**	Surr		8	7.5	8	19.5	8	29	8	8.1			UB 8/4
Control /	**8**	Surr		8	7.5	8	19.3	8	29	8	8.1		UB	UB 8/5
Control /	**9**	Surr		8	7.6	8	19.6	8	29	8	8.2	HE		HE 8/6
Control /	**10**	Surr		8	7.8	8	18.9	8	29	8	8.1		HE	HE 8/7
Control /	**11**	Surr		8	7.6	8	19.1	8	29	8	8.1			UB 8/8
Control /	**12**	Surr		8	7.6	8	19.2	8	29	8	7.2	UB/HE	UB	HE 8/9
Control /	**13**	Surr		8	7.5	8	19.1	8	29	8	8.1			HE 8/10
Control /	**14**	Surr		9	7.5	9	19.1	9	29	9	8.2		UB	UB 8/11
Control /	**15**	Surr		9	7.4	9	19.3	9	29	9	8.1	UB		UB 8/12
Control /	**16**	Surr		9	7.5	9	19.6	9	29	9	8.1		HE	HE 8/13
Control /	**17**	Surr		9	7.5	9	19.4	9	29	9	8.1			JL 8/14
Control /	**18**	Surr		9	7.5	9	19.2	9	29	9	8.1	JL/HE	UB	HE 8/15
Control /	**19**	Surr		9	7.6	9	19.1	9	29	9	8.0			UB 8/16
Control /	**20**	Surr		9	7.3	9	19.8	9	29	9	8.1			JL 8/17

ECOANALYSTS

CLIENT	PROJECT	JOB NO.	PROJECT MANAGER	LABORATORY / LOCATION	PROTOCOL	SPECIES
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble / Bath 8	PSEP 1995	*Neanthes arenaceodentata*

N = Normal
#E = Emergence
#M = Mortality
G = Growth
(fungal, bacterial, or algal)
D = No Air Flow (DO?)
F = Floating on Surface
TC = Too Cloudy
U=Excess food

INITIAL # OF ORGANISMS: 5

ENDPOINT DATA & OBSERVATIONS

CLIENT/ ENVIRON ID	REP	JAR	INITIAL # (if differs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	NUMBER REMAINING	TARE WEIGHT (mg)	TOTAL WEIGHT (mg)	ASHED WEIGHT (mg)
Date and Initials				7/29 UB	7/30 [illegible]	7/31 JL	8/01 JL	8/2 UB	8/3 UB	8/4 UB	8/5 UB	8/6 AK	8/7 AK	8/8 UB	8/9 AK	8/10 AK	8/11 UB	8/12 UB	8/13 AK	8/14 JL	8/15 AK	8/16 UB	8/17 JL				
Control /	1			N	N	U	U	U	G	G	G	OG	N	G U	G	G	G	G	G	U,G	1E G	1E G	N	5^{1}	361.14	428.57	387.02
	2								U	U	U	U		U	N	U	N	N	N	U	N	N		5^{2}	293.04	324.75	304.40
	3											U				G			N	U	N	U		5^{3}	168.74	206.64	178.97
	4											U				G			N	U,G	G	G,U		5^{4}	255.38	287.59	267.03
	5											U		~~G~~③ ~~U~~		U			G	U,G				5^{5}	241.88	274.09	251.29
SH-Ref-1 /	1										U	U		G	G	G	N	G		U,G			G	5^{6}	269.05	301.78	277.90
	2					G	G		G	G	G	G,U		G U	G	G	N	N		U,G				5^{7}	148.57	181.17	157.68
	3					U	U		U	U	U	U		U	G	G,U	U G	G		U,G				5^{8}	328.60	362.46	335.87
	4							G	G	G	G	G,U	G		G	G,U	U G	G		U,G				5^{9}	263.55	310.08	273.19
	5							U	U	U	U	U	N		G	G	N	G	✓	U,G				5^{10}	140.95	179.06	150.88
CARR /	1											U		U	N	N	N	N	N	U,G			G	5^{11}	345.67	389.43	358.91
	2											U,G	U		N	G				U,G				5^{12}	229.11	271.54	238.05
	3								G			U	N		U	U				U				5^{13}	260.64	301.88	270.78
	4								U			G,U	U	G U	N	G	G	G	G	U,G				5^{14}	264.62	310.57	277.17
	5								G			U	N	U	N	N	N	G	G	U,G	✓			5^{15}	156.08	193.87	167.45

Initial Biomass	Rep	Number	Tare Weight (mg)	Dry Weight (mg)	Ashed Weight (mg)	Comments: Boat #
	1	5	50.65	51.12	50.72	② ~~24~~ 25
	2	5	50.52	50.94	50.56	139①
	3	5	50.30	51.08	50.51	123

Boats in oven at 1210 8/17/17, JL - oven temp. 124°C
Removed from oven at 1230 8/18/17 JL

① also looks like # 159, UB 7/29

② 1E, Boat # 25, UB 7/29

③ 1E, N, UB 8/8

8/21/15

Shelton 20d Neanthes

ECO ANALYSTS

CLIENT	PROJECT	JOB NO.	PROJECT MANAGER	LABORATORY / LOCATION	PROTOCOL	SPECIES
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble / Bath 8	PSEP 1995	*Neanthes arenaceodentata*

N = Normal
#E = Emergence
#M = Mortality
G = Growth
(fungal, bacterial, or algal)
D = No Air Flow (DO?)
F = Floating on Surface
TC = Too Cloudy
U=Excess food

INITIAL # OF ORGANISMS: 5

ENDPOINT DATA & OBSERVATIONS

CLIENT/ ENVIRON ID	REP	JAR	INITIAL # (if differs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	NUMBER REMAINING	TARE WEIGHT (mg)	TOTAL WEIGHT (mg)	ASHED WEIGHT (mg)
Date and Initials				7/29 UB	7/30 HZ	7/31 JL	8/01 JL	8/2 UB	8/3 UB	8/4 UB	8/5 UB	8/6 HZ	8/7 12	8/8 UB	8/9 HZ	8/10 TTE	8/11 UB	8/12 UB	8/13 HZ	8/14 JL	8/15 HZ	8/16 UB	8/17 JL				
CARR / SH-Ref-1 /	1			N	N	U	U	G	G	G	G	G	G	U	N	G	G	G	G	U,G	G	G,U	G	5^{16}	224.23	260.10	233.85
	2			↓	↓	↓	↓	U	U	U	G	U	N	↓	↓	↓	G	G	↓	U,G	↓	↓	G	4^{17}	273.62	308.19	281.78
	3			↓	↓	↓	↓	↓	↓	↓	↓	U,G	↓	U G	G	↓	G	G U	↓	U,G	↓	↓	U	5^{18}	165.08	207.20	175.49
	4			↓	↓	↓	↓	↓	↓	↓	↓	U	↓	U	N	↓	N	U	↓	U,G	↓	↓	G	5^{19}	196.91	239.02	210.50
	5			↓	↓	↓	↓	↓	↓	↓	↓	U	↓	U G	G	↓	↓	G	↓	U,G	↓	↓	G	5^{20}	169.56	213.96	180.47
SH-13A /	1			↓	↓	↓	↓	G	G	G	G	G,U	G	G U	G	G	↓	G	↓	U,G	↓	↓	G	5^{21}	208.99	225.53	211.89
	2			↓	↓	↓	↓	U	G	U	U	U,G	N	G U	↓	↓	G	G	↓	U,G	↓	↓	↓	5^{22}	163.36	191.72	169.25
	3			↓	↓	↓	↓	G	G	↓	↓	U	↓	U	↓	↓	N	N	N	U,G	↓	↓	N	5^{23}	251.76	279.93	258.60
	4			↓	↓	↓	↓	U	G	↓	↓	U	↓	↓	U	N	↓	G	N	U,G	↓	↓	↓	5^{24}	166.19	195.02	172.51
	5			↓	↓	↓	↓	↓	U	↓	↓	U	↓	↓	G	G	↓	N	N	U,G	↓	↓	↓	5^{25}	204.00	229.97	208.81
SH-19 /	1			↓	↓	↓	↓	↓	G	U	U	G,U	U	U	N	↓	G	G	G	U,G	↓	↓	G	5^{26}	191.96	221.98	196.66
	2			↓	↓	↓	↓	↓	U	↓	↓	U	↓	↓	↓	↓	G	G	↓	U,G	↓	↓	↓	5^{27}	160.78	181.89	164.04
	3			↓	↓	↓	↓	↓	↓	↓	↓	U	↓	↓	↓	↓	N	G	↓	U,G	↓	↓	↓	5^{28}	205.48	234.21	④ ~~212~~ 211.94
	4			↓	↓	↓	↓	↓	↓	↓	↓	U	↓	↓	12	↓	↓	N	↓	U,G	↓	↓	↓	5^{29}	281.20	313.39	286.45
	5			↓	↓	↓	↓	↓	↓	↓	↓	U	↓	↓	N	↓	↓	G	↓	U,G	↓	↓	↓	5^{30}	289.47	311.25	293.18
SH-22 /	1			↓	↓	② ~~G~~ U	↓	G	↓	↓	U	U	N	G	G	U	G	G	12 G	U,G	↓	↓	G	5^{31}	275.22	315.45	284.92
	2			~~G~~ ①	↓	~~G~~ U	↓	G	G	G	G	U	N	U	↓	G	G	G	G	U,G	↓	↓	↓	5^{32}	188.52	226.88	198.98
	3			N	↓	~~G~~ U	↓	G	U	U	U	U,G	G	G U	↓	↓	G	G	↓	U,G	↓	↓	↓	5^{33}	257.03	288.93	263.17
	4			↓	↓	U	↓	G	G	↓	G	G	N	U	↓	↓	G	G	↓	U,G	↓	↓	↓	5^{34}	338.43	364.67	344.12
	5			↓	↓	~~G~~ U	↓	G	U	↓	G	U,G	G	G U	↓	↓	G	G	↓	U,G	↓	↓	↓	5 ~~35~~ ② 56	199.41	228.44	204.20

① N, mistook food for growth, UB 7/29 ② WC. JL 7/31/17

④ IQ HZ 8/21

② No boat 35, used boat 56, UB 8/16

ECOANALYSTS

CLIENT	PROJECT	JOB NO.	PROJECT MANAGER	LABORATORY / LOCATION	PROTOCOL	SPECIES
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble / Bath 8	PSEP 1995	*Neanthes arenaceodentata*

ENDPOINT DATA & OBSERVATIONS

N = Normal
#E = Emergence
#M = Mortality
G = Growth
(fungal, bacterial, or algal)
D = No Air Flow (DO?)
F = Floating on Surface
TC = Too Cloudy
U=Excess food

INITIAL # OF ORGANISMS: 5

CLIENT/ ENVIRON ID	REP	JAR	Date and Initials / INITIAL # (if differs)	7/29 UB 1	7/30 2	7/31 JL 3	8/01 JL 4	8/2 UB 5	8/3 UB 6	8/4 UB 7	8/5 UB 8	8/6 9	8/7 10	8/8 LB 11	8/9 12	8/10 13	8/11 UB 14	8/12 UB 15	8/13 16	8/14 JL 17	8/15 18	8/16 UB 19	8/17 JL 20	NUMBER REMAINING	TARE WEIGHT (mg)	TOTAL WEIGHT (mg)	ASHED WEIGHT (mg)
SH-28 /	1			N	N	U ①	U	U	U	U	U	U	N	G	G	G	N	N	N	U	G	G,U	N	5 36	188.93	217.67	195.95
	2											U		U		N		~~N~~ G	N	U,G				5 37	262.29	306.66	276.92
	3											U				G		N	N	U				5 38	165.38	178.59	169.51
	4								G			U				②		N	N	U,G			G	5 39	291.81	318.73	298.62
	5								G			U,G	G	G				G	G	U,G			G	5 40	239.24	282.38	251.19
SPI-22 /	1					G	G	G	G	G	G	U,G	G	U	G		G	G		U/G			G	5 41	251.47	293.66	259.80
	2					G				U	U	G								U/G				5 42	289.51	343.73	300.62
	3					G				G		G		G						U,G				5 43	234.36	275.42	243.85
	4					G				U		U,G		U						U,G				5 44	225.44	264.54	232.80
	5					G				U		U,G		G						U,G				5 45	341.07	374.62	348.19
SPI-30 /	1			G		G		G	G	G	U	U,G	G	U	G		U	U		U			G	5 46	170.17	210.22	179.06
	2			N		G		G	G	G	G	U,G		G,U			N	G		U,G				5 47	238.03	291.27	247.56
	3			G		G		G	G	G	U	U,G		U			N	G		U,G				4 48	223.82	259.71	~~300.61~~ 231.51 ⑤
	4			N		G		G	G	G	G	G,U		G,U			G	G		U,G				5 49	230.77	272.19	239.~~50~~ 25 ④
	5					G		G	G	U	U	U		U			G	G	✓	U,G				5 50	248.41	285.69	256.07
SPI-31 /	1					U	U	U	G	U	G	U,G	G		G		G	G	G,U	U,G			G	5 51	224.62	265.38	235.46
	2								U	G	U	U,G							G	U,G				5 52	272.51	295.63	277.77
	3									U		U								U,G				5 53	197.19	~~229.5~~ 229.49 ③	204.64
	4									G		U								U,G				3 54	213.36	239.98	220.83
	5									U		U,G								U,G				3 55	202.74	217.19	205.15

① IE JL 7/31/17. ② WC HH 8/10 ④ IE HH 8/21

③ MR, 229.49, UB 8/18

⑤ IE HH 8/21

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Anchor QEA	Shelton Harbor	1320 / 0900	FSW072617.02	PSEP 1995	28-Jul-2017
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1019	Brian Hester	Port Gamble / Bath 8	ATS072817	*Neanthes arenaceodentata*	17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L)		TEMP (C)		SALINITY (ppt)		pH				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
				D.O.		TEMP		SALINITY		pH		WATER RENEWAL	Feeding	TECH/DATE
SAMPLE ID	DAY	REP	JAR	meter	mg/L	meter	°C	meter	ppt	meter	unit			
Control /	0	Surr	51	8	7.7	8	19.1	8	29	8	8.1		JL	BG 7/28/17
Control /	1	Surr		8	7.6	8	19.1	8	29	8	8.1			UB 7/29
Control /	2	Surr		8	7.3	8	19.8	8	29	8	8.1		HE	HE 7/30
Control /	3	Surr		8	7.6	8	19.5	8	29	8	8.1	JL/HE		JL 7/31
Control /	4	Surr		8	7.6	8	19.0	8	29	8	8.1		UB	JL 8/01
Control /	5	Surr		8	7.6	8	19.4	8	29	8	8.0			UB 8/2
Control /	6	Surr		8	7.6	8	19.5	8	29	8	8.1	UB/HE	UB	UB 8/3
Control /	7	Surr		8	7.5	8	19.5	8	29	8	8.1			UB 8/4
Control /	8	Surr		8	7.5	8	19.3	8	29	8	8.1		UB	UB 8/5
Control /	9	Surr		8	7.6	8	19.6	8	29	8	8.2	HE		HE 8/6
Control /	10	Surr		8	7.8	8	18.9	8	29	8	8.1		HE	HE 8/7
Control /	11	Surr		8	7.6	8	19.1	8	29	8	8.1			UB 8/8
Control /	12	Surr		8	7.6	8	19.2	8	29	8	7.2	UB/HE	UB	HE 8/9
Control /	13	Surr		8	7.5	8	19.1	8	29	8	8.1			HE 8/10
Control /	14	Surr		9	7.5	9	19.1	9	29	9	8.2		UB	UB 8/11
Control /	15	Surr		9	7.4	9	19.3	9	29	9	8.1	UB		UB 8/12
Control /	16	Surr		9	7.5	9	19.6	9	29	9	8.1		HE	HE 8/13
Control /	17	Surr		9	7.5	9	19.4	9	29	9	8.1			JL 8/14
Control /	18	Surr		9	7.5	9	19.2	9	29	9	8.1	JL/HE	UB	HE 8/15
Control /	19	Surr		9	7.6	9	19.1	9	29	9	8.0			UB 8/16
Control /	20	Surr	↓	9	7.3	9	19.8	9	29	9	8.1			JL 8/17

Ammonia and Sulfide Analysis Record

Page 1 of 1

Client/Project: Anchor Shelton Harbor	Organism: Neanthes	Test Duration (days): 20

PRETEST / INITIAL / [✓ FINAL] / OTHER (circle one) DAY of TEST: 20

[✓ OVERLYING (OV)] / [✓ POREWATER (PW)] (circle one) / Comments:

Calibration Standards Temperature		Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
Date:	Temperature:	
8/17/17	20.5 °C	

	Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV	Q	Surr	KZ 8/17/17	1.94	19.9	KZ 8/17/17	N			10	0.017	1	
	SH-ref-1			0.00							0.006		
	CARR			0.103							0.011		
	CARR/SH-ref1			0.0062							0.026		
	SH-13A			0.00							0.014		
	SH-19			0.00							0.013		
	SH-22			0.00							0.006		
	SH-28			0.00							0.004		
	SPI-22			0.431							0.012		
	SPI-30			2.42							0.010		
	SPI-31			0.0662							0.003		
PW	SPI-31	Surr	KZ 8/17/17	0.995	20.8	KZ 8/17/17	N	7.2	29	5	0.067	2	0.134
PW	Q			1.39				7.2	27	10	0.043	1	
	SH-ref-1			1.01				7.3	27	10	0.111	1	
	CARR			1.21				6.9	27	10	0.037	1	
	CARR/SH-ref1			1.09				6.9	26	10	0.051	1	
	SH-13A			0.335				7.3	29	10	0.040	1	
	SH-19			0.566				7.1	29	5	0.052	2	0.104
	SH-22			1.94				7.4	29	5	0.026	2	0.052
	SH-28			0.586				7.4	29	5	0.033	2	0.066
	SPI-22			3.15				7.3	27	5	0.084	2	0.168
	SPI-30			3.86				7.1	28	5	0.091	2	0.182

ECOANALYSTS

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**START TIME/ END TIME** 1320 / 0900	**DILUTION WATER BATCH** FSW072617.02	**PROTOCOL** PSEP 1995	**TEST START DATE** 28-Jul-2017
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY / LOCATION** Port Gamble / Bath 8	**ORGANISM BATCH** ATS072817	**TEST SPECIES** *Neanthes arenaceodentata*	**TEST END DATE** 17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				**DO (mg/L)**		**TEMP (C)**		**SALINITY (ppt)**		**pH**				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
				D.O.		**TEMP**		**SALINITY**		**pH**		**WATER**		
SAMPLE ID	**DAY**	**REP**	**JAR**	**meter**	**mg/L**	**meter**	**°C**	**meter**	**ppt**	**meter**	**unit**	**RENEWAL**	**Feeding**	**TECH/DATE**
SH-Ref-1 /	**0**	Surr	40	8	7.7	8	19.0	8	29	8	8.1		JL	BG 7/28/17
SH-Ref-1 /	**1**	Surr		8	7.6	8	19.3	8	29	8	8.2			UB 7/29
SH-Ref-1 /	**2**	Surr		8	7.3	8	19.9	8	29	8	8.2		HE	HE 7/30
SH-Ref-1 /	**3**	Surr		8	7.6	8	19.5	8	29	8	8.3	JL/HE		JL 7/31
SH-Ref-1 /	**4**	Surr		8	7.6	8	19.1	8	29	8	8.3		UB	JL 8/01
SH-Ref-1 /	**5**	Surr		8	7.6	8	19.5	8	29	8	8.3			UB 8/2
SH-Ref-1 /	**6**	Surr		8	7.6	8	19.6	8	29	8	8.4	UB/HE	UB	UB 8/3
SH-Ref-1 /	**7**	Surr		8	7.5	8	19.6	8	29	8	8.3			UB 8/4
SH-Ref-1 /	**8**	Surr		8	7.5	8	19.4	8	29	8	8.3		UB	UB 8/5
SH-Ref-1 /	**9**	Surr		8	7.5	8	19.7	8	29	8	8.3	HE		HE 8/6
SH-Ref-1 /	**10**	Surr		8	7.7	8	19.0	8	29	8	8.2		HE	HE 8/7
SH-Ref-1 /	**11**	Surr		8	7.5	8	18.9	8	29	8	8.2			UB 8/8
SH-Ref-1 /	**12**	Surr		8	7.6	8	19.2	8	29	8	7.4	UB/HE	UB	HE 8/9
SH-Ref-1 /	**13**	Surr		8	7.4	8	19.2	8	29	8	8.1			HE 8/10
SH-Ref-1 /	**14**	Surr		9	7.5	9	19.0	9	29	9	8.2		UB	UB 8/11
SH-Ref-1 /	**15**	Surr		9	7.4	9	19.3	9	29	9	8.1	UB		UB 8/12
SH-Ref-1 /	**16**	Surr		9	7.5	9	19.6	9	29	9	8.1		HE	HE 8/13
SH-Ref-1 /	**17**	Surr		9	7.5	9	19.4	9	29	9	8.1			JL 8/14
SH-Ref-1 /	**18**	Surr		9	7.5	9	19.3	9	29	9	8.1	JL/HE	UB	HE 8/15
SH-Ref-1 /	**19**	Surr		9	7.6	9	19.0	9	29	9	8.0			UB 8/16
SH-Ref-1 /	**20**	Surr		9	7.5	9	19.8	9	29	9	8.1			JL 8/17

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Anchor QEA	Shelton Harbor	1320 / 0900	FSW072617.02	PSEP 1995	28-Jul-2017
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1019	Brian Hester	Port Gamble / Bath 8	ATS072817	*Neanthes arenaceodentata*	17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L)		TEMP (C)		SALINITY (ppt)		pH				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WATER RENEWAL	Feeding	TECH/DATE
CARR /	0	Surr	54	8	7.7	8	19.2	8	28	8	7.9		JL	BG 7/28/17
CARR /	1	Surr		8	7.7	8	19.2	8	29	8	8.0			UB 7/29
CARR /	2	Surr		8	6.7	8	19.8	8	29	8	8.0		HE	HE 7/30
CARR /	3	Surr		8	7.4	8	19.6	8	29	8	8.0	JL/HE		JL 7/31
CARR /	4	Surr		8	7.7	8	19.0	8	29	8	8.1		UB	JL 8/01
CARR /	5	Surr		8	7.6	8	19.5	8	29	8	8.0			UB 8/2
CARR /	6	Surr		8	7.5	8	19.6	8	29	8	8.1	UB/HE	UB	UB 8/3
CARR /	7	Surr		8	7.4	8	19.6	8	29	8	8.0			UB 8/4
CARR /	8	Surr		8	7.5	8	19.4	8	29	8	8.1		UB	UB 8/5
CARR /	9	Surr		8	7.4	8	19.7	8	29	8	8.1	HE		HE 8/6
CARR /	10	Surr		8	7.6	8	19.1	8	28	8	8.1		~~HE~~	HE 8/7
CARR /	11	Surr		8	7.4	8	19.2	8	28	8	8.0			UB 8/8
CARR /	12	Surr		8	7.6	8	19.2	8	29	8	7.1	UB/HE	UB	HE 8/9
CARR /	13	Surr		8	7.5	8	19.2	8	29	8	8.0			HE 8/10
CARR /	14	Surr		~~8~~ 9①	7.5	9	19.2	9	29	9	8.1		UB	UB 8/11
CARR /	15	Surr		9	7.3	9	19.3	9	29	9	8.1	UB		UB 8/12
CARR /	16	Surr		9	7.5	9	19.4	9	29	9	8.1		HE	HE 8/13
CARR /	17	Surr		9	7.5	9	19.5	9	29	9	8.0			JL 8/14
CARR /	18	Surr		9	7.4	9	19.4	9	29	9	8.1	JL/HE	UB	HE 8/15
CARR /	19	Surr		9	7.5	9	19.2	9	29	9	8.0			UB 8/16
CARR /	20	Surr		9	7.3	9	19.9	9	29	9	8.1			JL 8/17

① IE, curt 9 UB 8/11

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Anchor QEA	Shelton Harbor	1320 / 0900	FSW072617.02	PSEP 1995	28-Jul-2017
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1019	Brian Hester	Port Gamble / Bath 8	ATS072817	*Neanthes arenaceodentata*	17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L)		TEMP (C)		SALINITY (ppt)		pH				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
				D.O.		TEMP		SALINITY		pH		WATER		
SAMPLE ID	DAY	REP	JAR	meter	mg/L	meter	°C	meter	ppt	meter	unit	RENEWAL	Feeding	TECH/DATE
CARR / SH-Ref-1 /	0	Surr	43	8	7.7	8	19.1	8	29	8	8.1		JL	BG 7/28/17
CARR / SH-Ref-1 /	1	Surr		8	7.6	8	19.3	8	29	8	8.1			UB 7/29
CARR / SH-Ref-1 /	2	Surr		8	7.2	8	19.9	8	29	8	8.1		HE	HE 7/30
CARR / SH-Ref-1 /	3	Surr		8	7.5	8	19.6	8	29	8	8.1	JL/HE		JL 7/31
CARR / SH-Ref-1 /	4	Surr		8	7.6	8	19.1	8	29	8	8.1		LB	JL 8/01
CARR / SH-Ref-1 /	5	Surr		8	7.5	8	19.5	8	29	8	8.0			UB 8/2
CARR / SH-Ref-1 /	6	Surr		8	7.4	8	19.6	8	29	8	8.2	UB/HE	UB	UB 8/3
CARR / SH-Ref-1 /	7	Surr		8	7.4	8	19.7	8	29	8	8.1			UB 8/4
CARR / SH-Ref-1 /	8	Surr		8	7.5	8	19.4	8	29	8	8.2		UB	UB 8/5
CARR / SH-Ref-1 /	9	Surr		8	7.4	8	19.7	8	29	8	8.2	HE		① ~~8.2~~ 8/6 HE
CARR / SH-Ref-1 /	10	Surr		8	7.3	8	19.1	8	29	8	8.1		HE	HE 8/7
CARR / SH-Ref-1 /	11	Surr		8	7.4	8	19.1	8	29	8	8.1			UB 8/8
CARR / SH-Ref-1 /	12	Surr		8	7.6	8	19.2	8	29	8	7.3	UB/HE	LB	HE 8/9
CARR / SH-Ref-1 /	13	Surr		8	7.4	8	19.3	8	29	8	8.1			HE 8/10
CARR / SH-Ref-1 /	14	Surr		9	7.5	9	19.1	9	29	9	8.2		UB	UB 8/11
CARR / SH-Ref-1 /	15	Surr		9	7.3	9	19.4	9	29	9	8.1	UB		UB 8/12
CARR / SH-Ref-1 /	16	Surr		9	7.5	9	19.7	9	29	9	8.1		HE	HE 8/13
CARR / SH-Ref-1 /	17	Surr		9	7.5	9	19.5	9	29	9	8.0			JL 8/14
CARR / SH-Ref-1 /	18	Surr		9	7.5	9	19.3	9	29	9	8.1	JL/HE	LB	HE 8/15
CARR / SH-Ref-1 /	19	Surr		9	7.6	9	19.1	9	29	9	8.1			UB 8/16
CARR / SH-Ref-1 /	20	Surr		9	7.5	9	19.8	9	29	9	8.1			JL 8/17

① wrong date HE 8/6

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Anchor QEA	Shelton Harbor	1320 / 0900	FSW072617.02	PSEP 1995	28-Jul-2017
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1019	Brian Hester	Port Gamble / Bath 8	ATS072817	*Neanthes arenaceodentata*	17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L)		TEMP (C)		SALINITY (ppt)		pH				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O.		TEMP		SALINITY		pH		WATER RENEWAL	Feeding	TECH/DATE
				meter	mg/L	meter	°C	meter	ppt	meter	unit			
SH-13A /	0	Surr	31	8	7.7	8	19.2	8	29	8	8.1		JL	BG 7/28/17
SH-13A /	1	Surr		8	7.6	8	19.5	8	29	8	8.0			UB 7/29
SH-13A /	2	Surr		8	7.0	8	20.0	8	29	8	7.9		HE	HE 7/30
SH-13A /	3	Surr		8	7.5	8	19.7	8	29	8	8.0	JL/HE		JL 7/31
SH-13A /	4	Surr		8	7.6	8	19.3	8	28	8	8.0		UB	JL 8/01
SH-13A /	5	Surr		8	7.5	8	19.7	8	28	8	8.0			UB 8/2
SH-13A /	6	Surr		8	7.5	8	19.8	8	29	8	8.0	UB/HE	UB	UB 8/3
SH-13A /	7	Surr		8	7.4	8	19.7	8	28	8	8.0			UB 8/4
SH-13A /	8	Surr		8	7.5	8	19.6	8	28	8	8.0		UB	UB 8/5
SH-13A /	9	Surr		8	7.5	8	19.8	8	29	8	8.0	HE		HE 8/6
SH-13A /	10	Surr		8	7.6	8	19.2	8	28	8	8.0		HE	HE 8/7
SH-13A /	11	Surr		8	7.5	8	19.3	8	28	8	8.0			UB 8/8
SH-13A /	12	Surr		8	7.6	8	19.3	8	28	8	7.2	UB/HE	UB	HE 8/9
SH-13A /	13	Surr		8	7.3	8	19.4	8	29	8	8.1			HE 8/10
SH-13A /	14	Surr		9	7.5	9	19.2	9	29	9	8.1		UB	UB 8/11
SH-13A /	15	Surr		9	7.4	9	19.5	9	29	9	8.1	UB		UB 8/12
SH-13A /	16	Surr		9	7.4	9	19.8	9	29	9	8.1		HE	HE 8/13
SH-13A /	17	Surr		9	7.5	9	19.6	9	29	9	8.0			JL 8/14
SH-13A /	18	Surr		9	7.4	9	19.4	9	29	9	8.1	JL/HE	UB	HE 8/15
SH-13A /	19	Surr		9	7.5	9	19.2	9	29	9	8.0			UB 8/16
SH-13A /	20	Surr		9	7.5	9	19.9	9	29	9	8.1			JL 8/17

ECO ANALYSTS

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**START TIME/ END TIME** 1320 / 0900	**DILUTION WATER BATCH** FSW072617.02	**PROTOCOL** PSEP 1995	**TEST START DATE** 28-Jul-2017
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY / LOCATION** Port Gamble / Bath 8	**ORGANISM BATCH** ATS072817	**TEST SPECIES** *Neanthes arenaceodentata*	**TEST END DATE** 17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L)		TEMP (C)		SALINITY (ppt)		pH				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O.		TEMP		SALINITY		pH		WATER RENEWAL	Feeding	TECH/DATE
				meter	mg/L	meter	°C	meter	ppt	meter	unit			
SH-19 /	0	Surr	45	8	7.7	8	19.2	8	28	8	7.9		JL	BG 7/28/17
SH-19 /	1	Surr		8	7.5	8	19.3	8	28	8	7.7			UB 7/29
SH-19 /	2	Surr		8	7.1	8	19.9	8	27	8	7.8		HE	HE 7/30
SH-19 /	3	Surr		8	7.3	8	19.6	8	27	8	7.8	JL/HE		JL 7/31
SH-19 /	4	Surr		8	7.6	8	19.1	8	27	8	7.9		UB	JL 8/01
SH-19 /	5	Surr		8	7.4	8	19.5	8	27	8	7.8			UB 8/2
SH-19 /	6	Surr		8	7.6	8	19.5	8	27	8	8.1	UB/HE	UB	UB 8/3
SH-19 /	7	Surr		8	7.6	8	19.5	8	28	8	8.1			UB 8/4
SH-19 /	8	Surr		8	7.5	8	19.3	8	28	8	8.1		UB	UB 8/5
SH-19 /	9	Surr		8	7.5	8	19.6	8	28	8	8.1	HE		HE 8/6
SH-19 /	10	Surr		8	7.7	8	19.0	8	28	8	8.1		HE	HE 8/7
SH-19 /	11	Surr		8	7.6	8	19.1	8	28	8	8.0			UB 8/8
SH-19 /	12	Surr		8	7.7	8	19.2	8	28	8	7.2	UB/HE	UB	HE 8/9
SH-19 /	13	Surr		8	7.4	8	19.1	8	29	8	8.1			HE 8/10
SH-19 /	14	Surr		9	7.5	9	19.1	9	29	9	8.1		UB	UB 8/11
SH-19 /	15	Surr		9	7.4	9	19.3	9	29	9	8.1	UB		UB 8/12
SH-19 /	16	Surr		9	7.5	9	19.6	9	29	9	8.1		HE	HE 8/13
SH-19 /	17	Surr		9	7.5	9	19.4	9	29	9	8.1			JL 8/14
SH-19 /	18	Surr		9	7.4	9	19.3	9	29	9	8.1	JL/HE	UB	HE 8/15
SH-19 /	19	Surr		9	7.6	9	19.0	9	29	9	8.0			UB 8/16
SH-19 /	20	Surr		9	7.4	9	19.8	9	29	9	8.1			JL 8/17

ECO ANALYSTS

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**START TIME/ END TIME** 1320 / 0900	**DILUTION WATER BATCH** FSW072617.02	**PROTOCOL** PSEP 1995	**TEST START DATE** 28-Jul-2017
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY / LOCATION** Port Gamble / Bath 8	**ORGANISM BATCH** ATS072817	**TEST SPECIES** *Neanthes arenaceodentata*	**TEST END DATE** 17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				**DO (mg/L)**		**TEMP (C)**		**SALINITY (ppt)**		**pH**				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
				D.O.		**TEMP**		**SALINITY**		**pH**		**WATER**		
SAMPLE ID	**DAY**	**REP**	**JAR**	**meter**	**mg/L**	**meter**	**°C**	**meter**	**ppt**	**meter**	**unit**	**RENEWAL**	**Feeding**	**TECH/DATE**
SH-22 /	**0**	Surr	28	8	7.7	8	19.3	8	29	8	8.1		JL	BG 7/28/17
SH-22 /	**1**	Surr		8	7.5	8	19.6	8	29	8	8.1			UB 7/29
SH-22 /	**2**	Surr		8	7.1	8	20.1	8	29	8	8.2		HE	HE 7/30
SH-22 /	**3**	Surr		8	7.5	8	19.8	8	29	8	8.2	JL/HE		JL 7/31
SH-22 /	**4**	Surr		8	7.6	8	19.4	8	28	8	8.2		UB	JL 8/01
SH-22 /	**5**	Surr		8	7.4	8	19.8	8	28	8	8.2			UB 8/2
SH-22 /	**6**	Surr		8	7.4	8	20.0	8	28	8	8.3	UB/HE	UB	UB 8/3
SH-22 /	**7**	Surr		8	7.3	8	19.9	8	28	8	8.2			UB 8/4
SH-22 /	**8**	Surr		8	7.3	8	19.7	8	28	8	8.3		UB	UB 8/5
SH-22 /	**9**	Surr		8	7.3	8	19.9	8	28	8	8.3	HE		HE 8/6
SH-22 /	**10**	Surr		8	7.5	8	19.3	8	28	8	8.2		HE	HE 8/7
SH-22 /	**11**	Surr		8	7.2	8	19.5	8	28	8	8.2			UB 8/8
SH-22 /	**12**	Surr		8	7.5	8	19.4	8	28	8	7.5	UB/HE	UB	HE 8/9
SH-22 /	**13**	Surr		8	7.2	8	19.4	8	29	8	8.1			HE 8/10
SH-22 /	**14**	Surr		9	7.3	9	19.4	9	29	9	8.2		UB	UB 8/11
SH-22 /	**15**	Surr		9	7.2	9	19.7	9	29	9	8.2	UB		UB 8/12
SH-22 /	**16**	Surr		9	7.4	9	19.9	9	29	9	8.1		HE	HE 8/13
SH-22 /	**17**	Surr		9	7.3	9	19.7	9	29	9	8.1			JL 8/14
SH-22 /	**18**	Surr		9	7.3	9	19.5	9	29	9	8.2	JL/HE	UB	HE 8/15
SH-22 /	**19**	Surr		9	7.4	9	19.3	9	29	9	8.1			UB 8/16
SH-22 /	**20**	Surr		9	7.4	9	20.0	9	29	9	8.2			JL 8/17

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**START TIME/ END TIME** 1320 / 0900	**DILUTION WATER BATCH** FSW072617.02	**PROTOCOL** PSEP 1995	**TEST START DATE** 28-Jul-2017
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY / LOCATION** Port Gamble / Bath 8	**ORGANISM BATCH** ATS072817	**TEST SPECIES** *Neanthes arenaceodentata*	**TEST END DATE** 17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				**DO (mg/L)**		**TEMP (C)**		**SALINITY (ppt)**		**pH**				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
SAMPLE ID	**DAY**	**REP**	**JAR**	**D.O.**		**TEMP**		**SALINITY**		**pH**		**WATER RENEWAL**	**Feeding**	**TECH/DATE**
				meter	**mg/L**	**meter**	**°C**	**meter**	**ppt**	**meter**	**unit**			
SH-28 /	**0**	Surr	61	8	7.6	8	19.0	8	28	8	7.9		JL	BG 7/28/17
SH-28 /	**1**	Surr		8	7.6	8	19.3	8	29	8	7.9			UB 7/29
SH-28 /	**2**	Surr		8	7.0	8	19.9	8	29	8	7.9		HE	HE 7/30
SH-28 /	**3**	Surr		8	7.4	8	19.6	8	29	8	8.0	JL/HE		JL 7/31
SH-28 /	**4**	Surr		8	7.7	8	19.1	8	28	8	8.0		UB	JL 8/01
SH-28 /	**5**	Surr		8	7.6	8	19.5	8	28	8	8.0			UB 8/2
SH-28 /	**6**	Surr		8	7.5	8	19.7	8	29	8	8.0	UB/HE	UB	UB 8/3
SH-28 /	**7**	Surr		8	7.4	8	19.7	8	28	8	7.8			UB 8/4
SH-28 /	**8**	Surr		8	7.5	8	19.5	8	29	8	8.1		UB	UB 8/5
SH-28 /	**9**	Surr		8	7.5	8	19.7	8	29	8	8.1	HE		HE 8/6
SH-28 /	**10**	Surr		8	7.5	8	19.1	8	28	8	8.1		HE	HE 8/7
SH-28 /	**11**	Surr		8	7.6	8	19.2	8	28	8	8.1			UB 8/8
SH-28 /	**12**	Surr		8	7.6	8	19.3	8	29	8	7.2	UB/HE	UB	HE 8/9
SH-28 /	**13**	Surr		8	8.0	8	19.4	8	29	8	8.1			HE 8/10
SH-28 /	**14**	Surr		9	7.5	9	19.2	9	29	9	8.2		UB	UB 8/11
SH-28 /	**15**	Surr		9	7.4	9	19.5	9	29	9	8.2	UB		UB 8/12
SH-28 /	**16**	Surr		9	7.5	9	19.7	9	29	9	8.1		HE	HE 8/13
SH-28 /	**17**	Surr		9	7.4	9	19.6	9	29	9	8.1			JL 8/14
SH-28 /	**18**	Surr		9	7.4	9	19.4	9	29	9	8.2	JL/HE	UB	HE 8/15
SH-28 /	**19**	Surr		9	7.5	9	19.2	9	29	9	8.1			UB 8/16
SH-28 /	**20**	Surr		9	7.3	9	19.9	9	29	9	8.1			JL 8/17

ECO ANALYSTS

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	PROTOCOL	TEST START DATE
Anchor QEA	Shelton Harbor	1320 / 0900	FSW072617.02	PSEP 1995	28-Jul-2017
JOB NUMBER	**PROJECT MANAGER**	**LABORATORY / LOCATION**	**ORGANISM BATCH**	**TEST SPECIES**	**TEST END DATE**
PG1019	Brian Hester	Port Gamble / Bath 8	ATS072817	*Neanthes arenaceodentata*	17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L)		TEMP (C)		SALINITY (ppt)		pH				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
SAMPLE ID	DAY	REP	JAR	D.O.		TEMP		SALINITY		pH		WATER RENEWAL	Feeding	TECH/DATE
				meter	mg/L	meter	°C	meter	ppt	meter	unit			
SPI-22 /	0	Surr	6	8	7.6	8	19.2	8	29	8	7.9		JL	BG 7/28/17
SPI-22 /	1	Surr		8	6.8	8	19.4	8	29	8	7.8			UB 7/29
SPI-22 /	2	Surr		8	7.0	8	19.8	8	29	8	8.0		HE	HE 7/30
SPI-22 /	3	Surr		8	7.2	8	19.6	8	29	8	7.9	JL/HE		JL 7/31
SPI-22 /	4	Surr		8	7.4	8	19.1	8	28	8	8.1		UB	JL 8/01
SPI-22 /	5	Surr		8	6.9	8	19.5	8	28	8	8.0			UB 8/2
SPI-22 /	6	Surr		8	7.0	8	19.7	8	28	8	8.2	UB/HE	UB	UB 8/3
SPI-22 /	7	Surr		8	6.9	8	19.6	8	28	8	7.9			UB 8/4
SPI-22 /	8	Surr		8	7.0	8	19.6	8	28	8	8.0		UB	UB 8/5
SPI-22 /	9	Surr		8	7.0	8	19.8	8	28	8	8.0	HE		HE 8/6
SPI-22 /	10	Surr		8	7.2	8	19.3	8	28	8	8.0		HE	HE 8/7
SPI-22 /	11	Surr		8	7.0	8	19.4	8	28	8	7.9			UB 8/8
SPI-22 /	12	Surr		8	7.1	8	19.4	8	28	8	① ~~6.9~~ 7.2	UB/HE	UB	HE 8/9
SPI-22 /	13	Surr		8	6.8	8	19.2	8	29	8	7.9			HE 8/10
SPI-22 /	14	Surr		9	5.4	9	19.4	9	29	9	7.5		UB	UB 8/11
SPI-22 /	15	Surr		9	7.2	9	19.5	9	29	9	8.1	UB		UB 8/12
SPI-22 /	16	Surr		9	7.4	9	19.7	9	29	9	8.1		HE	HE 8/13
SPI-22 /	17	Surr		9	7.3	9	19.4	9	29	9	8.1			JL 8/14
SPI-22 /	18	Surr		9	7.4	9	19.2	9	29	9	8.1	JL/HE	UB	HE 8/15
SPI-22 /	19	Surr		9	7.4	9	19.1	9	29	9	8.0			UB 8/16
SPI-22 /	20	Surr		9	7.4	9	19.8	9	29	9	8.0			JL 8/17

① MR HE 8/9

ECOANALYSTS

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**START TIME/ END TIME** 1320 / 0900	**DILUTION WATER BATCH** FSW072617.02	**PROTOCOL** PSEP 1995	**TEST START DATE** 28-Jul-2017
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY / LOCATION** Port Gamble / Bath 8	**ORGANISM BATCH** ATS072817	**TEST SPECIES** *Neanthes arenaceodentata*	**TEST END DATE** 17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				**DO (mg/L)**		**TEMP (C)**		**SALINITY (ppt)**		**pH**				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
SAMPLE ID	**DAY**	**REP**	**JAR**	**D.O.**		**TEMP**		**SALINITY**		**pH**		**WATER RENEWAL**	**Feeding**	**TECH/DATE**
				meter	**mg/L**	**meter**	**°C**	**meter**	**ppt**	**meter**	**unit**			
SPI-30 /	0	Surr	66	8	7.6	8	19.2	8	28	8	8.0		JL	BG 7/28/17
SPI-30 /	1	Surr		8	7.5	8	19.3	8	29	8	7.9			UB 7/29
SPI-30 /	2	Surr		8	7.0	8	19.9	8	29	8	7.9		HE	HE 7/30
SPI-30 /	3	Surr		8	7.4	8	19.6	8	29	8	8.0	JL/HE		JL 7/31
SPI-30 /	4	Surr		8	7.6	8	19.3	8	28	8	8.1		UB	JL 8/01
SPI-30 /	5	Surr		8	7.2	8	19.6	8	28	8	8.0			UB 8/2
SPI-30 /	6	Surr		8	7.4 ~~7.6~~ ①	8	19.7	8	28	8	8.2	UB/HE	UB	UB 8/3
SPI-30 /	7	Surr		8	7.4	8	19.7	8	28	8	8.1			UB 8/4
SPI-30 /	8	Surr		8	7.4	8	19.5	8	28	8	8.3		UB	UB 8/5
SPI-30 /	9	Surr		8	7.2	8	19.8	8	28	8	8.3	HE		HE 8/6
SPI-30 /	10	Surr		8	7.6	8	19.1	8	28	8	8.3		~~HE~~	HE 8/7
SPI-30 /	11	Surr		8	7.4	8	19.3	8	28	8	8.2			UB 8/8
SPI-30 /	12	Surr		8	7.5	8	19.4	8	28	8	7.4	UB / HE	UB	HE 8/9
SPI-30 /	13	Surr		8	7.4	8	19.3	8	29	8	8.2			HE 8/10
SPI-30 /	14	Surr		9	7.3	9	19.4	9	29	9	8.2		UB	UB 8/11
SPI-30 /	15	Surr		9	7.2	9	19.5	9	29	9	8.2	UB		UB 8/12
SPI-30 /	16	Surr		9	7.4	9	19.8	9	29	9	8.1		HE	HE 8/13
SPI-30 /	17	Surr		9 ~~8~~ ②	7.3	9	19.6	9	29	9	8.0			JL 8/14
SPI-30 /	18	Surr		9	7.2	9	19.4	9	29	9	8.1	JL / HE	UB	HE 8/15
SPI-30 /	19	Surr		9	7.4	9	19.3	9	29	9	8.0			UB 8/16
SPI-30 /	20	Surr		9	7.2	9	19.9	9	29	9	8.1			JL 8/17

① MR, UB 8/3

② IE, JL 8/14/17

EcoAnalysts

CLIENT Anchor QEA	**PROJECT** Shelton Harbor	**START TIME/ END TIME** 1320 / 0900	**DILUTION WATER BATCH** FSW072617.02	**PROTOCOL** PSEP 1995	**TEST START DATE** 28-Jul-2017
JOB NUMBER PG1019	**PROJECT MANAGER** Brian Hester	**LABORATORY / LOCATION** Port Gamble / Bath 8	**ORGANISM BATCH** ATS072817	**TEST SPECIES** *Neanthes arenaceodentata*	**TEST END DATE** 17-Aug-2017

WATER QUALITY DATA

TEST CONDITIONS				**DO (mg/L)**		**TEMP (C)**		**SALINITY (ppt)**		**pH**				
				> 4.6		20 ± 1		28 ± 2		8.0±1.0				
				D.O.		**TEMP**		**SALINITY**		**pH**		**WATER**		
SAMPLE ID	**DAY**	**REP**	**JAR**	meter	**mg/L**	meter	**°C**	meter	**ppt**	meter	**unit**	**RENEWAL**	**Feeding**	**TECH/DATE**
SPI-31 /	**0**	Surr	22	8	7.5	8	19.2	8	28	8	7.9		JL	BG 7/28/17
SPI-31 /	**1**	Surr		8	6.7	8	19.6	8	29	8	7.7			UB 7/29
SPI-31 /	**2**	Surr		8	6.6	8	20.1	8	29	8	7.9		HE	HE 7/30
SPI-31 /	**3**	Surr		8	7.0	8	19.8	8	29	8	7.9	JL/HE		JL 7/31
SPI-31 /	**4**	Surr		8	7.2	8	19.4	8	28	8	8.2		UB	JL 8/01
SPI-31 /	**5**	Surr		8	6.9	8	19.8	8	28	8	8.1			UB 8/2
SPI-31 /	**6**	Surr		8	7.0	8	20.0	8	28	8	8.4	UB/HE	UB	UB 8/3
SPI-31 /	**7**	Surr		8	6.8	8	19.8	8	28	8	8.1			UB 8/4
SPI-31 /	**8**	Surr		8	7.0	8	19.7	8	28	8	8.2		UB	UB 8/5
SPI-31 /	**9**	Surr		8	6.8	8	19.9	8	28	8	8.1	HE		HE 8/6
SPI-31 /	**10**	Surr		8	7.1	8	19.3	8	28	8	8.2		HE	HE 8/7
SPI-31 /	**11**	Surr		8	6.9	8	19.5	8	28	8	8.0			UB 8/8
SPI-31 /	**12**	Surr		8	7.2	8	19.5	8	28	8	7.8	UB/HE	UB	HE 8/09
SPI-31 /	**13**	Surr		8	7.0	8	19.4	8	29	8	8.0			HE 8/10
SPI-31 /	**14**	Surr		9	6.8	9	19.4	9	29	9	8.0		UB	UB 8/11
SPI-31 /	**15**	Surr		9	6.6	9	19.7	9	29	9	7.9	UB		UB 8/12
SPI-31 /	**16**	Surr		9	7.4	9	19.8	9	29	9	8.1		HE	HE 8/13
SPI-31 /	**17**	Surr		9	7.3	9	19.5	9	29	9	8.1			JL 8/14
SPI-31 /	**18**	Surr		9	7.3	9	19.4	9	29	9	8.2	JL/HE	UB	HE 8/15
SPI-31 /	**19**	Surr		9	7.5	9	19.0	9	29	9	8.1			UB 8/16
SPI-31 /	**20**	Surr		9	7.4	9	19.8	9	29	9	8.1			JL 8/17

Ammonia and Sulfide Analysis Record

Client/Project: Anchor / Shelton Harbor	**Organism:** Neanthes Arenaceodentata	**Test Duration (days):** 20 - day

[✓ PRETEST] / INITIAL / FINAL / OTHER (circle one) **DAY of TEST:** 0

OVERLYING (OV) / POREWATER (PW) (circle one) / Comments:

Calibration Standards Temperature		Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
Date:	**Temperature:**	
7/28/17	19.4	

	Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV	0	Surr	7/28/17 UB	0.00	19.9	7/28/17 UB	N	8.1	29	10 mL	0	NA	NA
↓	SH-Ref-1	↓	↓	0.897	↓	↓	↓	8.1	29	↓	.035	↓	↓
↓	Carr	↓	↓	0.541	↓	↓	↓	7.9	28	↓	.014	↓	↓
↓	Carr/SH-Ref-1	↓	↓	0.549	↓	↓	↓	8.1	29	↓	.066	↓	↓
↓	SH-13A	↓	↓	0.426	↓	↓	↓	8.1	29	↓	.008	↓	↓
↓	SH-19	↓	↓	0.318	↓	↓	↓	7.9	28	↓	.021	↓	↓
↓	SH-22	↓	↓	1.59	↓	↓	↓	8.1	29	↓	.049	↓	↓
↓	SH-28	↓	↓	0.217	↓	↓	↓	7.9	28	↓	.018	↓	↓
↓	SPI-22	↓	↓	0.629	↓	↓	↓	7.9	29	↓	.014	↓	↓
↓	SPI-30	↓	↓	1.15	↓	↓	↓	8.0	28	↓	.035	↓	↓
↓	SPI-31	↓	↓	0.765	↓	↓	↓	7.9	28	↓	.014	↓	↓
PW	0	Surr	7/28/17 JL	②	NA	7/28/17	N	②	②	1 mL	0.001	10	0.01
↓	SH-Ref-1	↓	↓	②	↓	↓	↓	↓	↓	↓	0.018	↓	0.180
↓	Carr	↓	↓	②	↓	↓	↓	↓	↓	↓	0.005	↓	0.05
↓	Carr/SH-Ref-1	↓	↓	4.6	19.9	↓	↓	7.9	28	↓	0.013	↓	0.130
↓	SH-13A	↓	↓	3.04	↓	↓	↓	7.3	27	↓	0.006	↓	0.06
↓	SH-19	↓	↓	2.25	↓	↓	↓	7.3	21	↓	0.007	↓	0.07
↓	SH-22	↓	↓	12.9	↓	↓	↓	7.3	28	↓	0.014	↓	0.140
↓	SH-28	↓	↓	1.69	↓	↓	↓	7.4	28	↓	0.009	↓	0.09
↓	① ~~SPI-3~~ SPI-22	↓	↓	4.9	↓	↓	↓	7.2	28	↓	0.353	↓	3.53
↓	SPI-30	↓	↓	5.4	↓	↓	↓	7.2	27	↓	0.778	↓	7.78

① IE, SPI-22 ② Insufficient volume for analysis, UB 7/28

Ammonia and Sulfide Analysis Record

Page 2 of 2

Client/Project: Anchor/ Shelton Harbor	**Organism:** Neanthes arenaceodentata	**Test Duration (days):** 20

PRETEST / [✓ INITIAL] / FINAL / OTHER (circle one)

DAY of TEST: 0

OVERLYING (OV) / [✓ POREWATER (PW)] (circle one) / Comments:

Calibration Standards Temperature		
Date: 7/28/17	**Temperature:** 19.4°C	Sample temperature should be within ±1°C of standards temperature at time and date of analysis.

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
PW SP1-31	Surr	7/28/17 JL	7.6	19.9	7/28/17	N	7.3	27	1 mL	0.016	10	0.160

Ammonia and Sulfide Analysis Record

Client/Project: Anchor Shelton Harbor	Organism: Neanthes	Test Duration (days): 20

PRETEST / INITIAL / [✓ FINAL] / OTHER (circle one)

DAY of TEST: 20

[✓ ~~OVERLYING (OV)~~] / [✓ ~~POREWATER~~ (PW)] (circle one) / Comments:

Calibration Standards Temperature		
Date:	**Temperature:**	Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
8/17/17	20.5 °C	

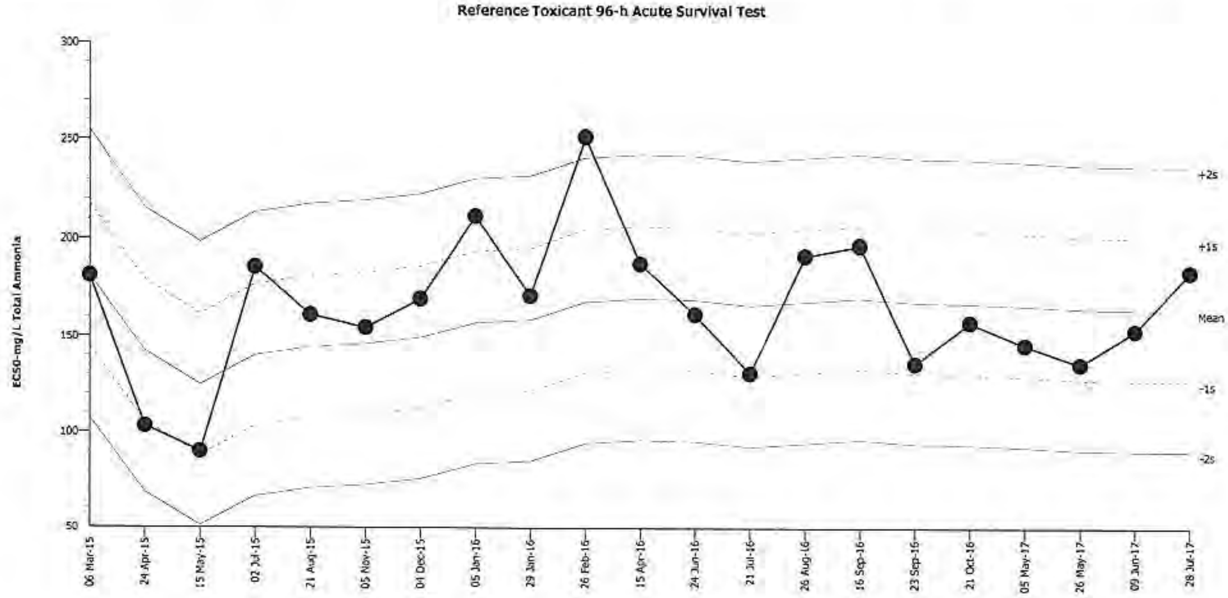
Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
OV Ø	Surr	HZ 8/17/17	1.94	19.9	HZ 8/17/17	N			10	0.017	1	
SH-ref-1			0.00							0.006		
CARR			0.103							0.011		
CARR/SH-ref1			0.0062							0.026		
SH-13A			0.00							0.014		
SH-19			0.00							0.013		
SH-22			0.00							0.006		
SH-28			0.00							0.004		
SPI-22			0.431							0.012		
SPI-30			2.42							0.010		
a/ SPI.31			0.0662							0.003		
PW SPI-31	Surr	HZ 8/17/17	0.995	20.8	HZ 8/17/17	N	7.2	29	5	0.067	2	0.134
PW Ø			1.39				7.2	27	10	0.043	1	
SH-ref-1			1.01				7.3	27	10	0.111	1	
CARR			1.21				6.9	27	10	0.037	1	
CARR/SH-ref1			1.09				6.9	26	10	0.051	1	
SH-13A			0.335				7.3	29	10	0.040	1	
SH-19			0.566				7.1	29	5	0.052	2	0.104
SH-22			1.94				7.4	29	5	0.026	2	0.052
SH-28			0.586				7.4	29	5	0.033	2	0.066
SPI-22			3.15				7.3	27	5	0.084	2	0.168
SPI-30			3.86				7.1	28	5	0.091	2	0.182

CETIS QC Plot

Report Date: 16 Aug-17 11:33 (1 of 1)

Reference Toxicant 96-h Acute Survival Test **All Matching Labs**

Test Type: Survival
Protocol: All Protocols
Organism: Neanthes arenaceodentata (Polycha
Endpoint: Proportion Survived
Material: Total Ammonia
Source: Reference Toxicant-REF



Mean: 163.7 **Count:** 20 **-1s Warning Limit:** 126.9 **-2s Action Limit:** 90.05
Sigma: 36.82 **CV:** 22.50% **+1s Warning Limit:** 200.5 **+2s Action Limit:** 237.3

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Mar	6	11:50	181.2	17.46	0.4741			09-2159-7453	09-1672-5355	ENVIRON
2		Apr	24	12:50	103.1	-60.62	-1.646	(-)		01-6315-9057	02-6990-5019	ENVIRON
3		May	15	14:00	89.83	-73.87	-2.006	(-)	(-)	15-1184-2734	08-8902-1629	ENVIRON
4		Jul	2	14:15	185.6	21.88	0.5942			18-8075-0902	16-6019-0259	ENVIRON
5		Aug	21	16:33	161	-2.715	-0.07374			18-5704-8732	08-2852-0434	ENVIRON
6		Nov	5	16:00	154.3	-9.364	-0.2543			15-0871-2744	12-3779-6972	ENVIRON
7		Dec	4	15:55	169.2	5.523	0.15			15-8650-5167	03-4063-5051	ENVIRON
8	2016	Jan	5	15:40	211.6	47.9	1.301	(+)		08-2089-5605	19-0377-2050	ENVIRON
9			29	10:55	170.9	7.209	0.1958			17-5198-4435	10-4316-4458	ENVIRON
10		Feb	26	13:05	251.9	88.2	2.396	(+)	(+)	12-4659-9912	05-2938-3515	ENVIRON
11		Apr	15	11:20	187.5	23.78	0.6459			14-5662-2397	01-2817-7421	ENVIRON
12		Jun	24	14:10	161.5	-2.192	-0.05952			18-4503-3329	10-8210-8087	ENVIRON
13		Jul	21	14:00	130.8	-32.87	-0.8926			03-2252-3368	14-5043-4569	ENVIRON
14		Aug	26	17:00	191.5	27.81	0.7553			03-0001-3671	08-4097-9552	ENVIRON
15		Sep	16	13:45	196.9	33.15	0.9005			15-1361-3636	10-0806-2573	ENVIRON
16			23	14:00	135.9	-27.83	-0.756			11-8849-2684	05-6423-6975	ENVIRON
17		Oct	21	12:20	157.3	-6.362	-0.1728			07-3517-7142	10-6382-3344	ENVIRON
18	2017	May	5	11:10	145.4	-18.26	-0.4959			19-9695-8635	12-9907-4132	EcoAnalysts
19			26	11:20	135.4	-28.28	-0.768			02-4398-8901	19-3251-4383	EcoAnalysts
20		Jun	9	13:12	152.9	-10.78	-0.2928			06-5936-3810	21-1385-6147	EcoAnalysts
21		Jul	28	10:45	183.1	19.38	0.5264			04-6413-3650	06-5419-2075	EcoAnalysts

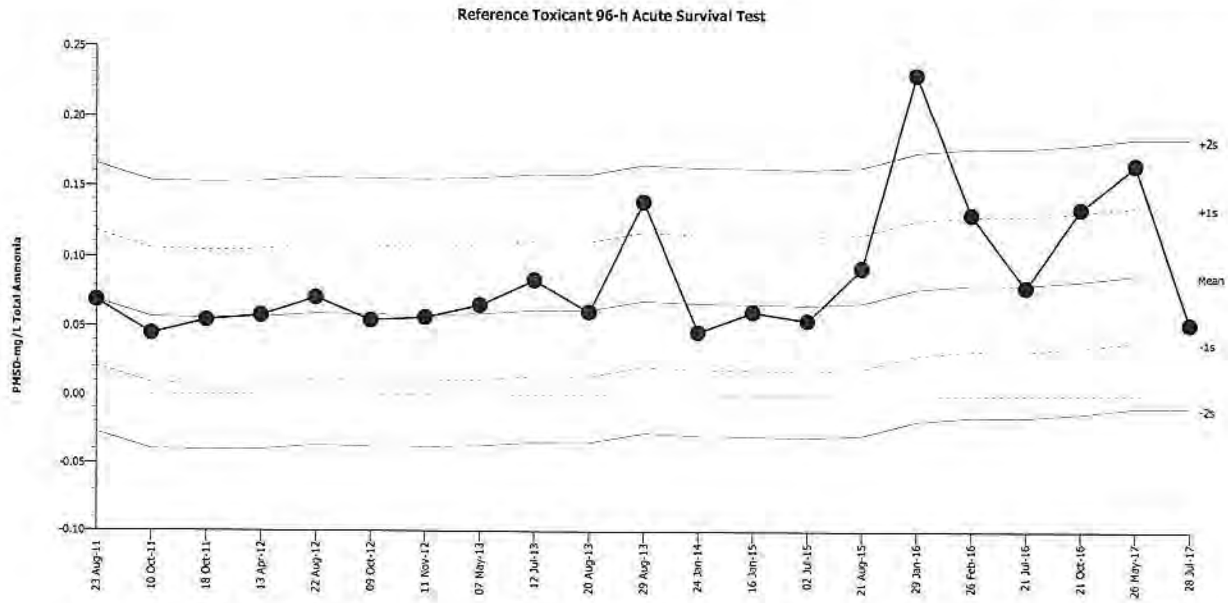
Analyst:________ QA:________

CETIS QC Plot

Report Date: 16 Aug-17 11:33 (1 of 1)

Reference Toxicant 96-h Acute Survival Test **All Matching Labs**

Test Type:	Survival	**Organism:**	Neanthes arenaceodentata (Polycha	**Material:**	Total Ammonia
Protocol:	All Protocols	**Endpoint:**	Proportion Survived	**Source:**	Reference Toxicant-REF



Mean:	0.0876	**Count:**	20	**-1s Warning Limit:**	0.03932	**-2s Action Limit:**	-0.009
Sigma:	0.04828	**CV:**	55.10%	**+1s Warning Limit:**	0.1359	**+2s Action Limit:**	0.1842

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2011	Aug	23	11:00	0.06897	-0.01863	-0.3859			19-2308-3344	00-4985-4824	NewFields
2		Oct	10	15:35	0.04485	-0.04275	-0.8854			06-7843-9085	04-4902-3567	NewFields
3			18	14:35	0.05459	-0.03301	-0.6838			20-2964-2236	18-1232-0295	NewFields
4	2012	Apr	13	14:00	0.05813	-0.02947	-0.6105			19-8365-3565	05-2732-2674	NewFields
5		Aug	22	11:00	0.07103	-0.01657	-0.3433			02-2456-0921	08-5116-1008	NewFields
6		Oct	9	14:00	0.05459	-0.03301	-0.6838			09-2476-6828	01-8486-9232	NewFields
7		Nov	11	16:00	0.0567	-0.0309	-0.64			05-7907-0031	20-7001-2062	NewFields
8	2013	May	7	13:00	0.06568	-0.02192	-0.454			03-6682-4675	13-3264-9963	NewFields
9		Jul	12	13:20	0.08381	-0.003793	-0.07856			14-1288-0905	07-0996-7321	NewFields
10		Aug	20	15:45	0.06086	-0.02674	-0.5539			00-0072-4465	04-2226-9652	NewFields
11			29	13:40	0.1391	0.0515	1.067	(+)		00-4506-4349	03-1605-8937	NewFields
12	2014	Jan	24	13:20	0.04635	-0.04125	-0.8543			20-9603-7883	15-6685-9407	NewFields
13	2015		16	11:15	0.06086	-0.02674	-0.5539			03-9642-9379	02-7191-1789	ENVIRON
14		Jul	2	14:15	0.05459	-0.03301	-0.6838			18-8075-0902	00-0324-0641	ENVIRON
15		Aug	21	16:33	0.09264	0.005044	0.1045			18-5704-8732	12-5806-5521	ENVIRON
16	2016	Jan	29	10:55	0.2298	0.1422	2.946	(+)	(+)	17-5198-4435	20-2746-8183	ENVIRON
17		Feb	26	13:05	0.1302	0.04263	0.8829			12-4659-9912	04-9112-4627	ENVIRON
18		Jul	21	14:00	0.07889	-0.008714	-0.1805			03-2252-3368	05-6001-6512	ENVIRON
19		Oct	21	12:20	0.1344	0.04684	0.9703			07-3517-7142	04-1673-2094	ENVIRON
20	2017	May	26	11:20	0.1659	0.07831	1.622	(+)		02-4398-8901	20-6641-5688	EcoAnalysts
21		Jul	28	10:45	0.05212	-0.03548	-0.7349			04-6413-3650	18-1225-7941	EcoAnalysts

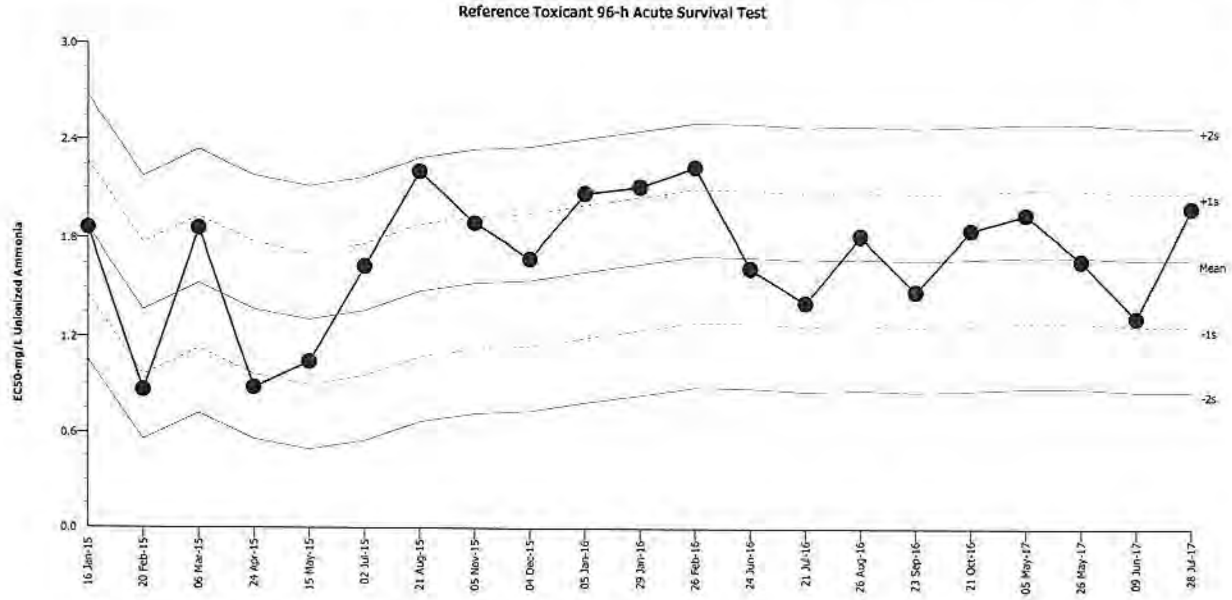
Analyst: QA:

CETIS QC Plot

Report Date: 16 Aug-17 11:32 (1 of 1)

Reference Toxicant 96-h Acute Survival Test **All Matching Labs**

Test Type:	Survival	**Organism:**	Neanthes arenaceodentata (Polycha	**Material:**	Unionized Ammonia
Protocol:	All Protocols	**Endpoint:**	Proportion Survived	**Source:**	Reference Toxicant-REF



Mean:	1.674	**Count:**	20	**-1s Warning Limit:**	1.269	**-2s Action Limit:**	0.8642
Sigma:	0.4048	**CV:**	24.20%	**+1s Warning Limit:**	2.079	**+2s Action Limit:**	2.483

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Jan	16	11:15	1.864	0.19	0.4693			18-9719-6747	15-5803-7088	ENVIRON
2		Feb	20	14:50	0.866	-0.808	-1.996	(-)		15-6687-7653	15-3894-5718	ENVIRON
3		Mar	6	11:50	1.861	0.1873	0.4627			11-3697-1780	11-9165-3524	ENVIRON
4		Apr	24	12:50	0.8832	-0.7908	-1.954	(-)		01-0867-6874	09-2102-1717	ENVIRON
5		May	15	14:00	1.043	-0.6313	-1.56	(-)		09-1275-9559	04-5482-9783	ENVIRON
6		Jul	2	14:15	1.633	-0.04146	-0.1024			12-0891-3679	07-1814-7730	ENVIRON
7		Aug	21	16:33	2.206	0.5316	1.313	(+)		12-1645-6634	17-4166-4421	ENVIRON
8		Nov	5	16:00	1.894	0.2197	0.5428			13-9158-6969	12-9319-1772	ENVIRON
9		Dec	4	15:55	1.68	0.005638	0.01393			05-0232-3049	00-1680-9936	ENVIRON
10	2016	Jan	5	15:40	2.076	0.4018	0.9926			16-5879-5239	14-7332-7904	ENVIRON
11			29	10:55	2.116	0.4424	1.093	(+)		02-3774-6836	17-0304-9971	ENVIRON
12		Feb	26	13:05	2.236	0.5617	1.388	(+)		18-2733-1978	16-1252-1654	ENVIRON
13		Jun	24	14:10	1.621	-0.053	-0.1309			14-5937-9292	12-2632-5647	ENVIRON
14		Jul	21	14:00	1.412	-0.262	-0.6472			13-0851-4355	08-2460-4906	ENVIRON
15		Aug	26	17:00	1.818	0.1439	0.3554			18-0730-6378	20-7585-3701	ENVIRON
16		Sep	23	14:00	1.482	-0.1924	-0.4752			16-0277-5330	13-3150-6775	ENVIRON
17		Oct	21	12:20	1.851	0.1774	0.4382			15-4953-5653	13-6771-5656	ENVIRON
18	2017	May	5	11:10	1.947	0.2731	0.6747			06-1983-2716	10-6060-2702	EcoAnalysts
19			26	11:20	1.668	-0.005988	-0.01479			11-9977-1019	12-2648-7955	EcoAnalysts
20		Jun	9	13:12	1.32	-0.3537	-0.8737			20-5746-1828	16-2628-9369	EcoAnalysts
21		Jul	28	10:45	1.989	0.3151	0.7784			11-9488-2902	14-7043-7154	EcoAnalysts

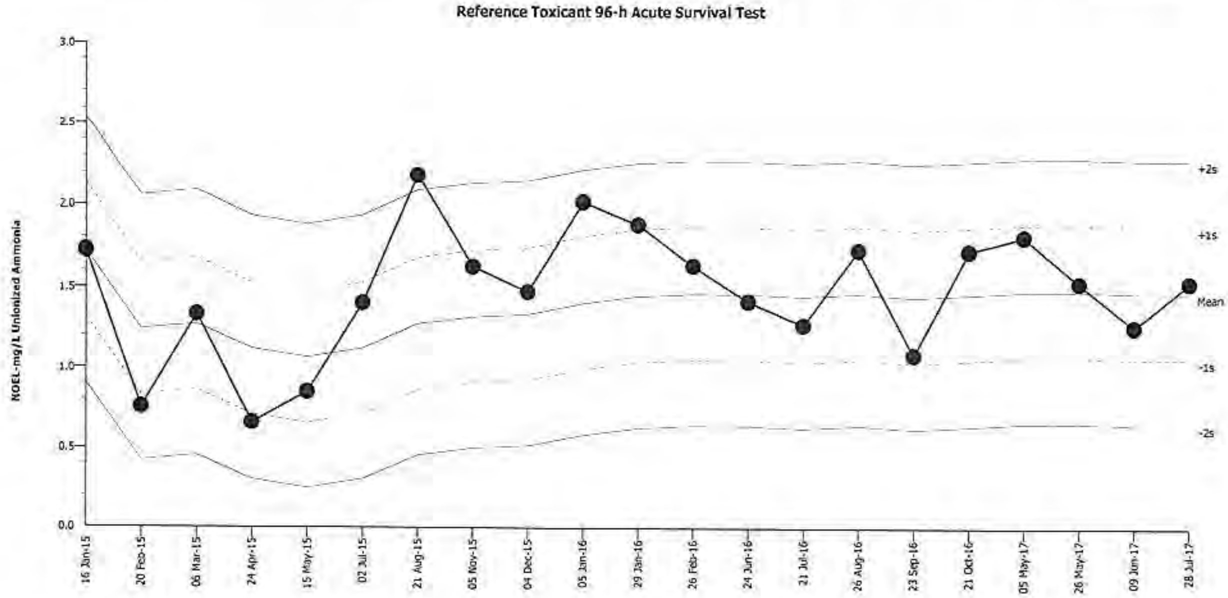
Analyst: QA:

CETIS QC Plot

Report Date: 16 Aug-17 11:33 (1 of 1)

Reference Toxicant 96-h Acute Survival Test — **All Matching Labs**

Test Type:	Survival	**Organism:**	Neanthes arenaceodentata (Polycha	**Material:**	Unionized Ammonia
Protocol:	All Protocols	**Endpoint:**	Proportion Survived	**Source:**	Reference Toxicant-REF



Mean:	1.469	**Count:**	20	**-1s Warning Limit:**	1.06	**-2s Action Limit:**	0.6521
Sigma:	0.4083	**CV:**	27.80%	**+1s Warning Limit:**	1.877	**+2s Action Limit:**	2.285

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Jan	16	11:15	1.723	0.254	0.6221			18-9719-6747	13-2446-7374	ENVIRON
2		Feb	20	14:50	0.756	-0.713	-1.746	(-)		15-6687-7653	19-8246-2320	ENVIRON
3		Mar	6	11:50	1.333	-0.136	-0.3331			11-3697-1780	05-2303-0535	ENVIRON
4		Apr	24	12:50	0.659	-0.81	-1.984	(-)		01-0867-6874	18-8094-8803	ENVIRON
5		May	15	14:00	0.85	-0.619	-1.516	(-)		09-1275-9559	12-8836-8785	ENVIRON
6		Jul	2	14:15	1.402	-0.067	-0.1641			12-0891-3679	17-1059-5211	ENVIRON
7		Aug	21	16:33	2.184	0.715	1.751	(+)		12-1645-6634	17-2823-4932	ENVIRON
8		Nov	5	16:00	1.627	0.158	0.387			13-9158-6969	18-5085-3785	ENVIRON
9		Dec	4	15:55	1.473	0.004	0.009797			05-0232-3049	09-1115-6716	ENVIRON
10	2016	Jan	5	15:40	2.023	0.554	1.357	(+)		16-5879-5239	13-0355-9173	ENVIRON
11			29	10:55	1.883	0.414	1.014	(+)		02-3774-6836	16-2829-1192	ENVIRON
12		Feb	26	13:05	1.635	0.166	0.4066			18-2733-1978	17-6331-1700	ENVIRON
13		Jun	24	14:10	1.415	-0.054	-0.1323			14-5937-9292	10-8537-0051	ENVIRON
14		Jul	21	14:00	1.27	-0.199	-0.4874			13-0851-4355	06-2505-9350	ENVIRON
15		Aug	26	17:00	1.732	0.263	0.6441			18-0730-6378	04-2606-0638	ENVIRON
16		Sep	23	14:00	1.085	-0.384	-0.9405			16-0277-5330	10-1484-1501	ENVIRON
17		Oct	21	12:20	1.725	0.256	0.627			15-4953-5653	10-3980-3312	ENVIRON
18	2017	May	5	11:10	1.812	0.343	0.8401			06-1983-2716	14-3198-2813	EcoAnalysts
19			26	11:20	1.529	0.06	0.147			11-9977-1019	08-2373-9544	EcoAnalysts
20		Jun	9	13:12	1.258	-0.211	-0.5168			20-5746-1828	13-3286-2330	EcoAnalysts
21		Jul	28	10:45	1.532	0.063	0.1543			11-9488-2902	00-8692-4177	EcoAnalysts

Analyst:

QA: UB

CETIS Summary Report

Report Date: 16 Aug-17 11:33 (p 1 of 1)
Test Code: 1BAA1E12 | 04-6413-3650

Reference Toxicant 96-h Acute Survival Test

EcoAnalysts

Batch ID:	00-8411-4166	**Test Type:**	Survival	**Analyst:**	
Start Date:	28 Jul-17 10:45	**Protocol:**	PSEP (1995)	**Diluent:**	Laboratory Seawater
Ending Date:	01 Aug-17 10:40	**Species:**	Neanthes arenaceodentata	**Brine:**	Not Applicable
Duration:	96h	**Source:**	Aquatic Toxicology Support	**Age:**	

Sample ID:	13-6614-0895	**Code:**	516DA7DF	**Client:**	Internal Lab
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Project:**	Reference Toxicant
Receipt Date:	15 May-16	**Source:**	Reference Toxicant		
Sample Age:	74d 11h	**Station:**	p170515.20		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	NOEL	LOEL	TOEL	TU	PMSD ✓
18-1225-7941	Proportion Survived	Equal Variance t Two-Sample Test	99.9	145	120.4		5.21%

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	Level	mg/L	95% LCL	95% UCL	TU ✓
06-5419-2075	Proportion Survived	Spearman-Kärber	EC50	183.1	169.9	197.2	

Proportion Survived Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
63.3		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
99.9		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
145		3	0.8000	0.5516	1.0000	0.7000	0.9000	0.0577	0.1000	12.50%	20.00%
210		3	0.4333	0.2899	0.5768	0.4000	0.5000	0.0333	0.0577	13.32%	56.67%
255		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%

Proportion Survived Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
63.3		1.0000	1.0000	1.0000
99.9		1.0000	1.0000	1.0000
145		0.7000	0.8000	0.9000
210		0.4000	0.4000	0.5000
255		0.0000	0.0000	0.0000

Proportion Survived Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
63.3		10/10	10/10	10/10
99.9		10/10	10/10	10/10
145		7/10	8/10	9/10
210		4/10	4/10	5/10
255		0/10	0/10	0/10

Analyst:________ QA:________

CETIS Test Data Worksheet

Report Date: 14 Aug-17 15:24 (p 1 of 1)
Test Code/ID: 04-6413-3650/1BAA1E12

Reference Toxicant 96-h Acute Survival Test

EcoAnalysts

Start Date: 28 Jul-17 10:45
End Date: 01 Aug-17 10:40
Sample Date: 15 May-17

Species: Neanthes arenaceodentata
Protocol: PSEP (1995)
Material: Total Ammonia

Sample Code: 516DA7DF
Sample Source: Reference Toxicant
Sample Station: p170515.20

Conc-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	10	10	10	
0	D	2	12	10	10	
0	D	3	14	10	10	
63.3		1	8	10	10	
63.3		2	17	10	10	
63.3		3	7	10	10	
99.9		1	13	10	10	
99.9		2	2	10	10	
99.9		3	1	10	10	
145		1	3	10	7	
145		2	11	10	8	
145		3	9	10	9	
210		1	15	10	4	
210		2	18	10	4	
210		3	4	10	5	
255		1	6	10	0	
255		2	5	10	0	
255		3	16	10	0	

Analyst:

QA: CB

CETIS Summary Report

Report Date: 16 Aug-17 11:32 (p 1 of 1)
Test Code: 47387756 | 11-9488-2902

Reference Toxicant 96-h Acute Survival Test **EcoAnalysts**

Batch ID:	00-8411-4166	**Test Type:**	Survival	**Analyst:**	
Start Date:	28 Jul-17 10:45	**Protocol:**	PSEP (1995)	**Diluent:**	Laboratory Seawater
Ending Date:	01 Aug-17 10:40	**Species:**	Neanthes arenaceodentata	**Brine:**	Not Applicable
Duration:	96h	**Source:**	Aquatic Toxicology Support	**Age:**	

Sample ID:	06-6813-0357	**Code:**	27D2DC35	**Client:**	Internal Lab
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Project:**	Reference Toxicant
Receipt Date:	15 May-17	**Source:**	Reference Toxicant		
Sample Age:	74d 11h	**Station:**	p170515.20		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	NOEL	LOEL	TOEL	TU	PMSD ✓
00-8692-4177	Proportion Survived	Equal Variance t Two-Sample Test	1.532	1.772	1.648		5.21%

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	Level	mg/L	95% LCL	95% UCL	TU ✓
14-7043-7154	Proportion Survived	Spearman-Kärber	EC50	1.989	1.917	2.064	

Proportion Survived Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
1.217		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
1.532		3	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.00%	0.00%
1.772		3	0.8000	0.5516	1.0000	0.7000	0.9000	0.0577	0.1000	12.50%	20.00%
2.044		3	0.4333	0.2899	0.5768	0.4000	0.5000	0.0333	0.0577	13.32%	56.67%
2.482		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%

Proportion Survived Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	1.0000	1.0000	1.0000
1.217		1.0000	1.0000	1.0000
1.532		1.0000	1.0000	1.0000
1.772		0.7000	0.8000	0.9000
2.044		0.4000	0.4000	0.5000
2.482		0.0000	0.0000	0.0000

Proportion Survived Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	10/10	10/10	10/10
1.217		10/10	10/10	10/10
1.532		10/10	10/10	10/10
1.772		7/10	8/10	9/10
2.044		4/10	4/10	5/10
2.482		0/10	0/10	0/10

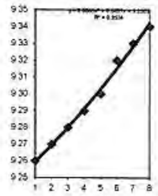
Analyst:______ QA:______

Un-ionized Ammonia Calculator

CLIENT:	Anchor	Date of Test:	28-Jul-17
PROJECT:	Shelton Harbor	Test Type:	*Neanthes NH3 RT*
COMMENTS:	P170515.20		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer:	I-factor
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	*NH3T (mg/L)*	*salinity (ppt)*	*pH*	*temp (C)*	temp (K)	i-factor	Mod	**NH3U (mg/L)**
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		**#VALUE!**
	Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		**0.008**
1	0									
2	60		63.30	29	7.8	19.1	292.26	9.3214		**1.217**
3	100		99.90	29	7.7	19.1	292.26	9.3214		**1.532**
4	140		145.00	29	7.6	19.1	292.26	9.3214		**1.772**
5	150		210.00	29	7.5	19.1	292.26	9.3214		**2.044**
6	220		255.0	29	7.5	19.1	292.26	9.3214		**2.482**
7										
8										
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CETIS Test Data Worksheet

Report Date: 14 Aug-17 15:26 (p 1 of 1)
Test Code/ID: 11-9488-2902/47387756

Reference Toxicant 96-h Acute Survival Test **EcoAnalysts**

Start Date: 28 Jul-17 10:45
End Date: 01 Aug-17 10:40
Sample Date: 15 May-17
Species: Neanthes arenaceodentata
Protocol: PSEP (1995)
Material: Unionized Ammonia
Sample Code: 27D2DC35
Sample Source: Reference Toxicant
Sample Station: p170515.20

Conc-mg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
0	D	1	12	10	10	
0	D	2	8	10	10	
0	D	3	17	10	10	
1.217		1	9	10	10	
1.217		2	4	10	10	
1.217		3	11	10	10	
1.532		1	1	10	10	
1.532		2	15	10	10	
1.532		3	10	10	10	
1.772		1	18	10	7	
1.772		2	2	10	8	
1.772		3	16	10	9	
2.044		1	6	10	4	
2.044		2	14	10	4	
2.044		3	5	10	5	
2.482		1	7	10	0	
2.482		2	3	10	0	
2.482		3	13	10	0	

Analyst:

QA:

Ammonia Reference Toxicant Test Survival Data Sheet

CLIENT Anchor	PROJECT Shelton Harbor	SPECIES *Neanthes arenaceodentata*	LABORATORY Port Gamble .	PROTOCOL PSEP
TEST ID P170525.20	LOT #: 2986C510	TEST START DATE 28Jul17 / TIME 1045	4-DAY END DATE 01Aug17	TIME 1040 ~~1045~~ ①
CHAMBER SIZE/TYPE glass pint jar	EXPOSURE VOLUME 250 mL			

WATER QUALITY DATA

TEST CONDITIONS					DO (mg/L) > 4.6		TEMP(C) 20 ± 1		SAL (ppt) 30 ± 2		pH 7.8 ± 0.5		TECHNICIAN	AMMONIA			SULFIDES		
CLIENT/ENVIRON ID	CONCENTRATION		DAY	REP	D.O.		TEMP.		SALINITY		pH		WQ TECH/ DATE	AMMONIA		Tech	SULFIDES		Tech
	value	units			meter	mg/L	meter	°C	meter	ppt	meter	unit		METER	mg/L		meter	mg/L	
Ref.Tox.-ammonia	0	mg/L	0	Stock	8	7.8	8	19.1	8	29	8	8.0	JL 7/28	10	0.00				JL
			4	1	8	6.9	8	19.2	8	29	8	8.0	JL 8/01						
Ref.Tox.-ammonia	60	mg/L	0	Stock	8	7.9	8	19.1	8	29	8	7.8	JL 7/28	10	63.3				JL
			4	1	8	7.5	8	19.3	8	29	8	8.0	JL 8/01						
Ref.Tox.-ammonia	100	mg/L	0	Stock	8	7.9	8	19.1	8	29	8	7.7	JL 7/28	10	99.9				JL
			4	1	8	7.6	8	19.0	8	29	8	7.9	JL 8/01						
Ref.Tox.-ammonia	140	mg/L	0	Stock	8	7.8	8	19.1	8	29	8	7.6	JL 7/28	10	145				JL
			4	1	8	7.5	8	18.8	8	29	8	7.9	JL 8/01						
Ref.Tox.-ammonia	180	mg/L	0	Stock	8	7.9	8	19.1	8	29	8	7.5	JL 7/28	10	210				JL
			4	1	8	7.5	8	19.3	8	30	8	7.9	JL 8/01						
Ref.Tox.-ammonia	220	mg/L	0	Stock	8	7.9	8	19.1	8	29	8	7.5	JL 7/28	10	255				JL
			4	1															

①WL. JL 7/28/17

Ammonia Reference Toxicant Test Survival Data Sheet

CLIENT Anchor	PROJECT 0	JOB NO. PG1014	SPECIES *Neanthes arenaceodentata* PROJECT MANAGER B. Hester	LABORATORY Port Gamble .	PROTOCOL #VALUE!

SURVIVAL & BEHAVIOR DATA

OBSERVATION KEY
N = Normal
LOE = Loss of equilibium
Q = Quinscent
DC = Discoloration
NB = No body
F = Floating on surface

INITIAL # OF ORGANISMS: 10

	DAY 1	DAY 2	DAY 3	DAY 4
DATE	7/29/17	7/30	7/31	8/01
TECHNICIAN	UB	Ha	JC	JC

CLIENT/ENVIRON ID	CONC. value	CONC. units	REP	INITIAL NUMBER	DAY 1 #ALIVE	DAY 1 #DEAD	DAY 1 OBS	DAY 2 #ALIVE	DAY 2 #DEAD	DAY 2 OBS	DAY 3 #ALIVE	DAY 3 #DEAD	DAY 3 OBS	DAY 4 #ALIVE	DAY 4 #DEAD	DAY 4 OBS
Ref.Tox.- Ammonia	0	mg/L	1	10	10	0	1F	10	0	N	10	0	N	10	0	N
			2	↓	10	0	1F	10	0	↓	10	0	↓	10	0	↓
			3	↓	10	0	2F	10	0	↓	10	0	1F	10	0	↓
Ref.Tox.- Ammonia	60	mg/L	1	↓	10	0	1F	10	0	N	10	0	N	10	0	N
			2	↓	10	0	N	10	0	↓	10	0	↓	10	0	↓
			3	↓	10	0	1F	10	0	↓	10	0	↓	10	0	↓
Ref.Tox.- Ammonia	100	mg/L	1	↓	10	0	N	10	0	N	10	0	Q	10	0	Q
			2	↓	10	0	1F	10	0	↓	10	0	↓	10	0	↓
			3	↓	10	0	N	10	0	↓	10	0	↓	10	0	↓
Ref.Tox.- Ammonia	140	mg/L	1	↓	10	0	Q	10	0	Q	10	0	Q	7	3	Q
			2	↓	10	0	Q	10	0	↓	10	0	↓	8	2	↓
			3	↓	10	0	Q	10	0	↓	10	0	↓	9	1	↓
Ref.Tox.- Ammonia	180	mg/L	1	↓	10	0	Q	7	3	Q	6	1	Q	4	2	Q
			2	↓	10	0	Q	10	0	↓	10	0	↓	4	6	↓
			3	↓	10	0	Q	10	0	↓	10	0	↓	5	5	↓
Ref.Tox.- Ammonia	220	mg/L	1	↓	10	0	Q	0	10							
			2	↓	10	0	Q	0	10							
			3	↓	10	0	Q	0	10							

Ammonia Reference Toxicant
Spiking Worksheet

Reference Toxicant ID: P170515.20

Date Prepared: 7/28/17

Technician Initials: JC

Neanthes NH_3 RT

Assumptions in Model
Stock ammonia concentration is 10,000 mg/L = 10 mg/mL

Date: 7/28/2017
Measurement: 9453.3

Test Solutions			Volume of stock to reach desired concentration	
Measured Concentration	**Desired Concentration**	**Volume**		
mg/L	mg/L	mL	mL stock to increase	
			FRESH WATER (mL)	SALT WATER (mL)
63.3	**60**	750	[redacted]	7.14
99.9	**100**	750	[redacted]	11.90
145	**140**	750	[redacted]	16.66
210	**180**	750	[redacted]	21.42
255	**220**	750	[redacted]	26.18
			[redacted]	
			[redacted]	
			[redacted]	

3. *Mytilus galloprovincialis* Bivalve Larval Test

ECO ANALYSTS

CLIENT	PROJECT	JOB NUMBER	PROJECT MANAGER	LABORATORY	PROTOCOL
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble Bath 6	PSEP (1995)

TEST ORGANISM SPAWNING DATA

SPECIES *Mytilus galloprovincialis*			
SUPPLIER Taylor Shellfish			**ORGANISM BATCH** TS2849
SPAWNING METHOD Heat Shock		**INITIAL SPAWNING TIME** 1130	**FINAL SPAWNING TIME** 1430
MALES 4	**FEMALES** 2	**SPERM VIABILITY** ✓	**EGG CONDITION** ✓
BEGIN FERTILIZATION 1432		**END FERTILIZATION** 1752	**CONDITION OF EMBRYOS** >90% div

SAMPLE STORAGE 4 Degrees Celsius - dark
SEDIMENT TREATMENT none
TEST CHAMBERS 1 L Mason Jars
EXPOSURE VOLUME 900mL seawater / 18g Sediment
TIME OF SHAKE 1445
TIME OF INITIATION 1752

SPECIAL CONDITIONS

UV LIGHT EXPOSURE (YES/NO)	AERATION FROM TEST INITIATION (YES/NO)
No	No
SCREEN TUBE TEST (YES/NO)	**OTHER (EXPLAIN)**
No	Resuspension @ end of test

EMBRYO DENSITY CALCULATIONS

60x100 = 6000 embryo/mL

Target
actual $\frac{27,000}{6000} = 4.5$

deliver 4.5mL of
egg stock to
each replicate

Ref Tox

Target $\frac{2700}{6000} = 0.45$

0.45 x 40mL =
18ml egg stock
22mL seawater

Deliver 0.100mL/vial

ECOANALYSTS

CLIENT	PROJECT	JOB NUMBER	SPECIES		
			Mytilus galloprovincialis		
			PROJECT MANAGER	LAB / LOCATION	PROTOCOL
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble / Bath 6	PSEP (1995)

LARVAL OBSERVATION DATA

CLIENT/ ID	REP	NUMBER NORMAL	NUMBER Abnormal	DATE	TECHNICIAN	COMMENTS
STOCKING DENSITY	1	▨	281	8/18	LB	
	2	▨	270			
	3	▨	289			
	4	▨	272			
	5	▨	282			
Control /	1	286	8	8/4/17	MK	
	2	253	15			
	3	236	17			
	4	252	12			
	5	271	10			
SH-Ref-1 /	1	224	5	8/5/17	MK	
	2	273	13			
	3	232	12			
	4	233	7			QA 226/15 CR 8/17
	5	232	4			
CARR/SH-Ref-1 /	1	224	28		LB	
	2	225	27			
	3	228	25			QA 235/19 CR 8/17
	4	236	43			
	5	209	34			
CARR /	1	228	8			
	2	257	7			
	3	240	7			
	4	225	7			
	5	233	11			

EcoAnalysts

CLIENT	PROJECT	JOB NUMBER	SPECIES		
			Mytilus galloprovincialis		
			PROJECT MANAGER	LAB / LOCATION	PROTOCOL
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble / Bath 6	PSEP (1995)

LARVAL OBSERVATION DATA

CLIENT/ ID	REP	NUMBER NORMAL	NUMBER	DATE	TECHNICIAN	COMMENTS
CR-022 /	1	211	9	8/7/17	UB	
	2	207	6			
	3	225	3			
	4	221	11			
	5	169	18			QA 183/9 CR 8/17
SH-04 /	1	218	13	8/9/17		
	2	252	7			
	3	264	8			
	4	213	8			
	5	234	8			
SH-14 /	1	233	18			
	2	230	13			②
	3	221	14			②
	4	228	9			②
	5	245	12			②
SH-19 /	1	188 ①	42 ①	8/10/17		
	2	189	24			QA 190/25 CR 8/17
	3	177	29			
	4	185	17			
	5	163	13			
SH-21 /	1	207	2			② QA 203/5 CR 8/17
	2	217	3			
	3	225	5			
	4	243	8			
	5	208	5			

① Recounted 196 normal, 32 abnormal, UB

② Crustacean nauplii present, should not affect larvae, UB 8/16

SPECIES					
			Mytilus galloprovincialis		
CLIENT	PROJECT	JOB NUMBER	PROJECT MANAGER	LAB / LOCATION	PROTOCOL
Anchor QEA	Shelton Harbor	PG1019	Brian Hester	Port Gamble / Bath 6	PSEP (1995)

LARVAL OBSERVATION DATA

CLIENT/ ID	REP	NUMBER NORMAL	NUMBER	DATE	TECHNICIAN	COMMENTS
SH-22 /	1	213	9	8/11/17	UB	
	2	190	8			
	3	247	13			QA 245/19 CR 8/17
	4	203	3			
	5	190	5			
SH-24 /	1	231	10			
	2	227	9			
	3	208	4			
	4	230	6			
	5	217	8			
SPI-22 /	1	174	19	8/15/17		
	2	184	10			
	3	175	12			
	4	194	13			
	5	161	7			
① SPI-31 ~~SPI-30 /~~	1	230	10			
	2	236	7			
	3	241	4			~~QA 218/20 CR 8/17~~ ①
	4	236	9			
	5	211	8			
① SPI-30 ~~SPI-31 /~~	1	214	8			
	2	210	11			
	3	229	13			QA 218/20 CR 8/17 ①
	4	224	9			
	5	182	6			

① Swapped counts for SPI-30 & 31 - transcription error, UB 8/18

ECO ANALYSTS

CLIENT	PROJECT	SPECIES	LAB / LOCATION	PROTOCOL
Anchor QEA	Shelton Harbor	*Mytilus galloprovincialis*	Port Gamble / Bath 6	PSEP (1995)

JOB NUMBER	PROJECT MANAGER	TEST START DATE	TIME	TEST END DATE	TIME
PG1019	Brian Hester	01Aug17	1752	03Aug17	1700

* Day 3&4 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) >5.0		Temp (°C) 16 ± 1		Sal (ppt) 28 ± 1		pH 7 - 9		Ammonia NA		Sulfide NA		TECH	DATE
				D.O.		TEMP.		SALINITY		pH		AMMONIA		SULFIDE			
SAMPLE ID	DAY	Random #	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit	Techn.	mg/L (total)	Techn.	mg/L (Total)		
Control /	0	18	WQ Surr	8	7.1	8	16.0	8	28	8	7.8	HK	0.00	UB	0.008	MK	8/1
Control /	1		WQ Surr	8	7.2	8	16.2	8	28	8	7.8					UB	8/2
Control /	2		WQ Surr	8	~~7.0~~ 7.2 ③	8	15.9	8	28	8	7.8	MK	0.00	JL	0.001	MK	8/3
Control /	3		WQ Surr														
Control /	4		WQ Surr														
① SH-Ref-1 /	0	71	WQ Surr	8	7.1	8	16.0	8	28	8	7.8	HK	0.00	UB	① 0.101	MK	8/1
SH-Ref-1 /	1		WQ Surr	8	5.6	8	16.3	8	28	8	7.7					UB	8/2
SH-Ref-1 /	2		WQ Surr	8	5.5	8	16.3	8	28	8	7.7	MK	0.00	JL	0.023	MK	8/3
SH-Ref-1 /	3		WQ Surr														
SH-Ref-1 /	4		WQ Surr														
① CARR/SH-Ref-1 /	0	6	WQ Surr	8	6.9	8	16.1	8	28	8	7.8	HK	0.00	UB	① 0.202	MK	8/1
CARR/SH-Ref-1 /	1		WQ Surr	8	6.1	8	16.0	8	28	8	7.7					UB	8/2
CARR/SH-Ref-1 /	2		WQ Surr	8	5.5	8	16.3	8	28	8	7.7	MK	0.00	JL	0.029	MK	8/3
CARR/SH-Ref-1 /	3		WQ Surr														
CARR/SH-Ref-1 /	4		WQ Surr														
① CARR /	0	28	WQ Surr	8	6.9	8	16.5	8	28	8	7.8	HK	0.00	UB	① 0.084	MK	8/1
CARR /	1		WQ Surr	8	6.2	8	16.0	8	28	8	7.8					UB	8/2
CARR /	2		WQ Surr	8	5.9	8	16.5	8	28	8	7.7	MK	0.00	JL	0.025	MK	8/3
CARR /	3		WQ Surr														
CARR /	4		WQ Surr														
① CR-022 /	0	43	WQ Surr	8	6.4	8	16.3	8	28	8	7.8	HK	0.00	UB	① 0.156	MK	8/1
CR-022 /	1		WQ Surr	8	6.3	8	② 16.0	8	28	8	7.8					UB	8/2
CR-022 /	2		WQ Surr	8	5.6	8	16.5	8	28	8	7.8	MK	0.00	JL	0.031	MK	8/3
CR-022 /	3		WQ Surr														
CR-022 /	4		WQ Surr														

① Precipitate occured in sample blank in references. 8/1

② If illegible: 16.0, UB 8/2 ③ meter not stabilized. MK 8/3.

ECOANALYSTS

CLIENT Anchor QEA
PROJECT Shelton Harbor
SPECIES *Mytilus galloprovincialis*
LAB / LOCATION Port Gamble / Bath 6
PROTOCOL PSEP (1995)
JOB NUMBER PG1019
PROJECT MANAGER Brian Hester
TEST START DATE 01Aug17
TIME 1752
TEST END DATE 03Aug17
TIME 1700

* Day 3&4 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) >5.0		Temp (°C) 16 ± 1		Sal (ppt) 28 ± 1		pH 7 - 9		Ammonia NA		Sulfide NA			
				D.O.		TEMP.		SALINITY		pH		AMMONIA		SULFIDE			
SAMPLE ID	DAY	Random #	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit	Techn.	mg/L (total)	Techn.	mg/L (Total)	TECH	DATE
SH-04 /	0	80	WQ Surr	8	6.2	8	16.0	8	28	8	7.6	Hk	0.00	UB	①	MK	8/1
SH-04 /	1		WQ Surr	8	6.3	8	16.7	8	28	8	7.7					UB	8/2
SH-04 /	2		WQ Surr	8	5.3	8	16.6	8	28	8	7.6	MK	0.00	JL	0.018	MK	8/3
SH-04 /	3		WQ Surr														
SH-04 /	4		WQ Surr														
SH-14 /	0	1	WQ Surr	8	6.8	8	16.1	8	28	8	7.7	Hk	0.00	UB	③ 0.003	MK	8/1
SH-14 /	1		WQ Surr	8	5.8	8	16.1	8	28	8	7.6					UB	8/2
SH-14 /	2		WQ Surr	8	6.0	8	16.7	8	28	8	7.7	MK	0.00	JL	0.024	MK	8/3
SH-14 /	3		WQ Surr														
SH-14 /	4		WQ Surr														
SH-19 /	0	8	WQ Surr	8	7.0	8	16.0	8	28	8	7.7	Hk	0.00	UB	③ 0.091	MK	8/1
SH-19 /	1		WQ Surr	8	5.7	8	16.0	8	28	8	7.6					UB	8/2
SH-19 /	2		WQ Surr	8	~~6~~ 5.0 ④	8	16.2	8	28	8	7.6	MK	0.00	JL	0.024	MK	8/3
SH-19 /	3		WQ Surr														
SH-19 /	4		WQ Surr														
SH-21 /	0	48	WQ Surr	8	6.2	8	15.9	8	28	8	7.8	Hk	0.00	UB	③ ①	MK	8/1
SH-21 /	1		WQ Surr	8	5.9	8	16.1	8	28	8	7.8					UB	8/2
SH-21 /	2		WQ Surr	8	④ ~~5.~~4.4	8	16.2	8	28	8	7.7	MK	0.00	JL	0.020	MK	8/3
SH-21 /	3		WQ Surr														
SH-21 /	4		WQ Surr														
SH-22 /	0	40	WQ Surr	8	6.5	8	16.3	8	28	8	7.7	Hk	0.00	UB	0.054 ② ~~①~~ ③	MK	8/1
SH-22 /	1		WQ Surr	8	6.7	8	16.0	8	28	8	7.7					UB	8/2
SH-22 /	2		WQ Surr	8	5.7	8	16.1	8	28	8	7.6	MK	0.00	JL	0.017	MK	8/3
SH-22 /	3		WQ Surr														
SH-22 /	4		WQ Surr														

① ND, UB 8/1 ② MR, 0.054, UB 8/1 ③ precipitate present in blank, UB 8/1
④ WC. MK 8/3.

EcoAnalysts

CLIENT	PROJECT	SPECIES		LAB / LOCATION	PROTOCOL
Anchor QEA	Shelton Harbor	*Mytilus galloprovincialis*		Port Gamble / Bath 6	PSEP (1995)
JOB NUMBER	**PROJECT MANAGER**	**TEST START DATE**	**TIME**	**TEST END DATE**	**TIME**
PG1019	Brian Hester	01Aug17	1752	03Aug17	1700

* Day 3&4 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) >5.0		Temp (°C) 16 ± 1		Sal (ppt) 28 ± 1		pH 7 - 9		Ammonia NA		Sulfide NA		TECH	DATE
				D.O.		TEMP.		SALINITY		pH		AMMONIA		SULFIDE			
SAMPLE ID	DAY	Random #	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit	Techn.	mg/L (total)	Techn.	mg/L (Total)		
SH-24 /	0	22	WQ Surr	8	6.2	8	15.8	8	28	8	7.7	Hk	0.00	UB	②	MK	8/1
SH-24 /	1	↓	WQ Surr	8	6.0	8	16.7	8	28	8	7.7					UB	8/2
SH-24 /	2		WQ Surr	8	5.3	8	16.3	8	28	8	7.6	MK	0.00	JL	0.013	MK	8/3
SH-24 /	3		WQ Surr														
SH-24 /	4		WQ Surr														
SPI-22 /	0	26	WQ Surr	8	6.3	8	16.6	8	28	8	7.7	Hk	0.0127	UB	②③	MK	8/1
SPI-22 /	1	↓	WQ Surr	8	6.3	8	16.1	8	28	8	7.7					UB	8/2
SPI-22 /	2		WQ Surr	8	~~5.2~~ ⑤	8	16.4	8	28	8	7.5	MK	0.00	JL	0.014	MK	8/3
SPI-22 /	3		WQ Surr														
SPI-22 /	4		WQ Surr														
SPI-30 /	0	7	WQ Surr	8	5.5④ ~~16.5~~①	8	16.5	8	28	8	7.7	Hk	0.141	UB	②③	MK	8/1
SPI-30 /	1	↓	WQ Surr	8	5.0	8	16.3	8	28	8	7.6					UB	8/2
SPI-30 /	2		WQ Surr	8	4.6	8	16.5	8	28	8	7.6	MK	0.00	JL	0.012	MK	8/3
SPI-30 /	3		WQ Surr														
SPI-30 /	4		WQ Surr														
SPI-31 /	0	35	WQ Surr	8	6.7	8	16.5	8	28	8	7.8	Hk	0.00	UB	②③	MK	8/1
SPI-31 /	1	↓	WQ Surr	8	6.8	8	15.9	8	28	8	7.7					UB	8/2
SPI-31 /	2		WQ Surr	8	5.0	8	16.2	8	28	8	7.7	MK	0.00	JL	0.029	MK	8/3
SPI-31 /	3		WQ Surr														
SPI-31 /	4		WQ Surr														

① WC. MK 8/1.

② ND, UB 8/1

③ precipitate present in blank, UB, 8/1

④ re-measured DO @ 1740, 6.0 mg/L, UB 8/1

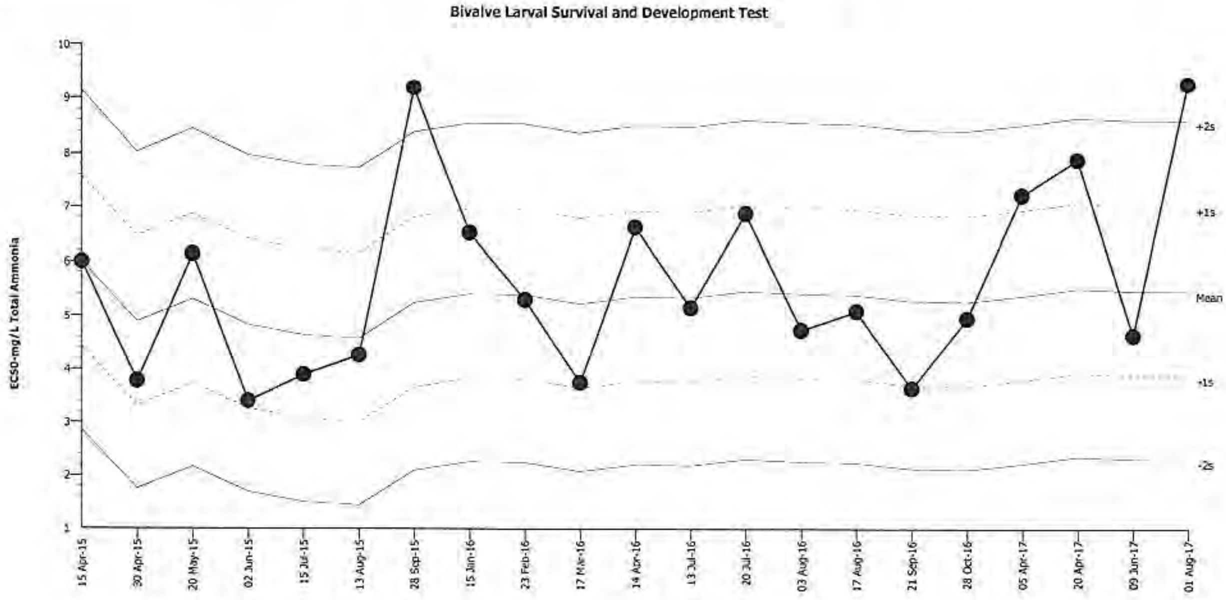
⑤ mf. meter not stabilized. Actual = 3.6 MK 8/3.

CETIS QC Plot

Report Date: 22 Aug-17 11:01 (1 of 1)

Bivalve Larval Survival and Development Test | **All Matching Labs**

Test Type:	Development-Survival	**Organism:**	Mytilus galloprovincialis (Bay Mussel	**Material:**	Total Ammonia
Protocol:	All Protocols	**Endpoint:**	Combined Proportion Normal	**Source:**	Reference Toxicant-REF



Mean:	5.448	**Count:**	20	**-1s Warning Limit:**	3.878	**-2s Action Limit:**	2.308
Sigma:	1.57	**CV:**	28.80%	**+1s Warning Limit:**	7.018	**+2s Action Limit:**	8.588

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Apr	15	19:10	5.993	0.5452	0.3473			13-8932-4228	19-6133-3160	ENVIRON
2			30	18:04	3.781	-1.667	-1.062	(-)		20-6119-4159	02-4196-3961	ENVIRON
3		May	20	17:25	6.135	0.6868	0.4374			09-2578-9028	09-4770-1274	ENVIRON
4		Jun	2	17:40	3.4	-2.048	-1.304	(-)		17-1514-2545	13-6694-9114	ENVIRON
5		Jul	15	17:28	3.896	-1.552	-0.9883			03-2854-6295	19-5139-2675	ENVIRON
6		Aug	13	17:12	4.263	-1.185	-0.7548			11-0008-2350	17-0708-6345	ENVIRON
7		Sep	28	19:46	9.184	3.736	2.379	(+)	(+)	13-4113-2133	05-9076-7384	ENVIRON
8	2016	Jan	15	18:45	6.515	1.067	0.6794			12-5434-0454	10-0079-7236	ENVIRON
9		Feb	23	17:50	5.292	-0.1562	-0.09948			18-1470-2153	19-1029-0373	ENVIRON
10		Mar	17	19:30	3.757	-1.691	-1.077	(-)		15-5000-9198	13-5264-4225	ENVIRON
11		Apr	14	17:15	6.621	1.173	0.7474			20-6935-4588	11-5576-6536	ENVIRON
12		Jul	13	19:55	5.147	-0.301	-0.1917			21-3594-7965	13-9208-2204	ENVIRON
13			20	19:37	6.871	1.423	0.9064			15-8198-2198	11-4931-7833	ENVIRON
14		Aug	3	18:20	4.732	-0.7161	-0.4561			01-0657-3943	18-0523-9298	ENVIRON
15			17	17:05	5.081	-0.3666	-0.2335			12-6418-6345	06-5970-9287	ENVIRON
16		Sep	21	17:05	3.644	-1.804	-1.149	(-)		12-2755-6335	12-7771-4113	ENVIRON
17		Oct	28	16:55	4.947	-0.5009	-0.3191			11-5556-2644	13-8974-7601	ENVIRON
18	2017	Apr	5	18:40	7.21	1.762	1.123	(+)		01-5481-7076	04-4954-7137	EcoAnalysts
19			20	17:20	7.867	2.419	1.541	(+)		10-4553-7194	08-5173-1627	EcoAnalysts
20		Jun	9	17:00	4.628	-0.8204	-0.5225			14-1261-0889	04-7911-3613	EcoAnalysts
21		Aug	1	17:25	9.266	3.818	2.432	(+)	(+)	06-8669-3676	12-0819-3140	EcoAnalysts

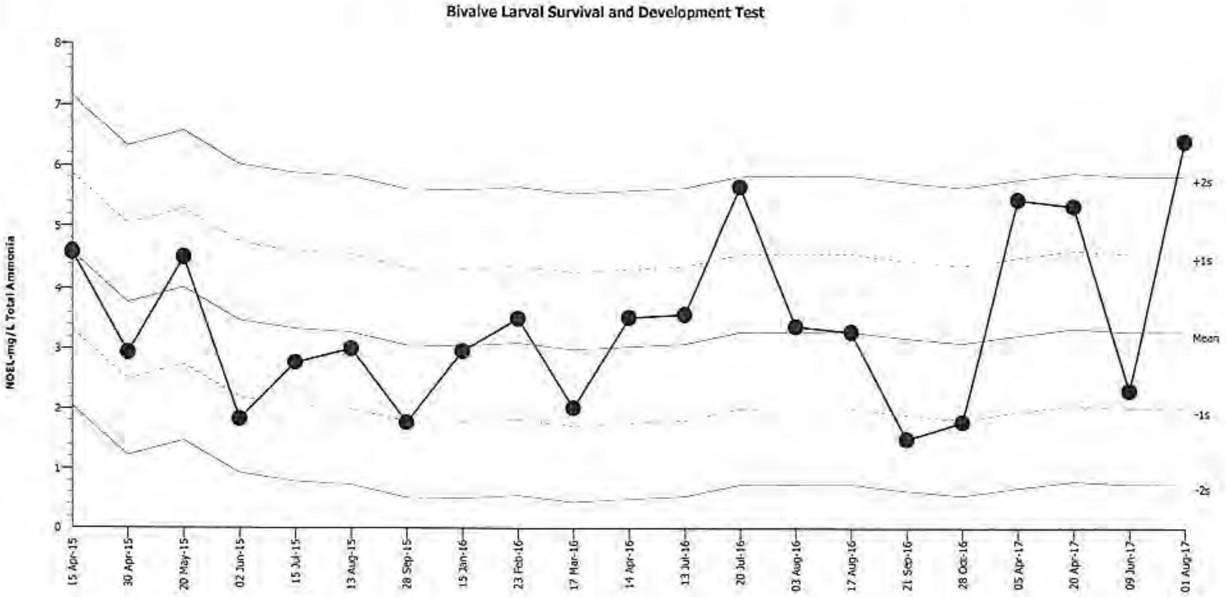
Analyst: QA:

CETIS QC Plot

Report Date: 22 Aug-17 11:01 (1 of 1)

Bivalve Larval Survival and Development Test **All Matching Labs**

Test Type:	Development-Survival	**Organism:**	Mytilus galloprovincialis (Bay Mussel	**Material:**	Total Ammonia
Protocol:	All Protocols	**Endpoint:**	Combined Proportion Normal	**Source:**	Reference Toxicant-REF



Mean:	3.281	**Count:**	20	**-1s Warning Limit:**	2.007	**-2s Action Limit:**	0.733
Sigma:	1.274	**CV:**	38.80%	**+1s Warning Limit:**	4.555	**+2s Action Limit:**	5.829

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Apr	15	19:10	4.59	1.309	1.027	(+)		13-8932-4228	17-9791-4217	ENVIRON
2			30	18:04	2.94	-0.341	-0.2677			20-6119-4159	17-0732-0588	ENVIRON
3		May	20	17:25	4.51	1.229	0.9647			09-2578-9028	13-7558-2393	ENVIRON
4		Jun	2	17:40	1.83	-1.451	-1.139	(-)		17-1514-2545	16-3284-8954	ENVIRON
5		Jul	15	17:28	2.77	-0.511	-0.4011			03-2854-6295	02-6331-6633	ENVIRON
6		Aug	13	17:12	3	-0.281	-0.2206			11-0008-2350	11-0317-1423	ENVIRON
7		Sep	28	19:46	1.77	-1.511	-1.186	(-)		13-4113-2133	01-4448-6063	ENVIRON
8	2016	Jan	15	18:45	2.96	-0.321	-0.252			12-5434-0454	00-8028-9046	ENVIRON
9		Feb	23	17:50	3.5	0.219	0.1719			18-1470-2153	12-0892-9662	ENVIRON
10		Mar	17	19:30	2.02	-1.261	-0.9898			15-5000-9198	10-0930-7275	ENVIRON
11		Apr	14	17:15	3.52	0.239	0.1876			20-6935-4588	02-5801-5963	ENVIRON
12		Jul	13	19:55	3.57	0.289	0.2268			21-3594-7965	00-8086-5441	ENVIRON
13			20	19:37	5.65	2.369	1.859	(+)		15-8198-2198	15-7963-0031	ENVIRON
14		Aug	3	18:20	3.37	0.089	0.06986			01-0657-3943	18-2881-4415	ENVIRON
15			17	17:05	3.28	-0.001	-0.000785			12-6418-6345	16-7479-3581	ENVIRON
16		Sep	21	17:05	1.49	-1.791	-1.406	(-)		12-2755-6335	04-9221-3739	ENVIRON
17		Oct	28	16:55	1.78	-1.501	-1.178	(-)		11-5556-2644	02-1682-8136	ENVIRON
18	2017	Apr	5	18:40	5.44	2.159	1.695	(+)		01-5481-7076	16-0123-9122	EcoAnalysts
19			20	17:20	5.33	2.049	1.608	(+)		10-4553-7194	12-0068-9010	EcoAnalysts
20		Jun	9	17:00	2.3	-0.981	-0.77			14-1261-0889	10-3249-5372	EcoAnalysts
21		Aug	1	17:25	6.4	3.119	2.448	(+)	(+)	06-8669-3676	14-4042-7171	EcoAnalysts

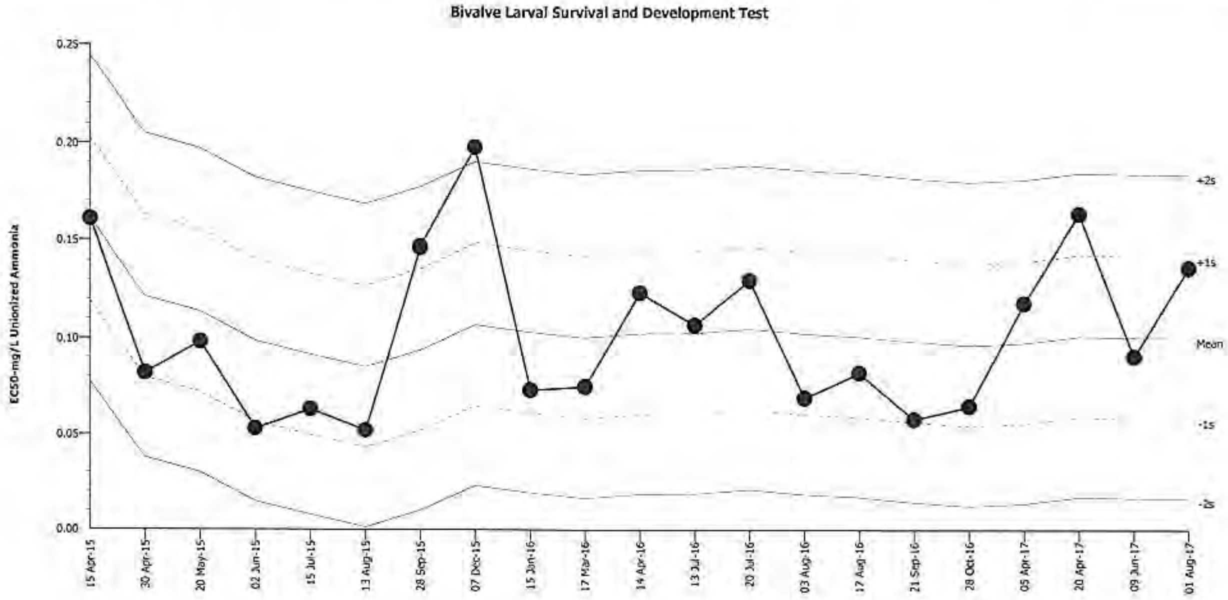
Analyst:________ QA:________

CETIS QC Plot

Report Date: 22 Aug-17 11:04 (1 of 1)

Bivalve Larval Survival and Development Test **All Matching Labs**

Test Type:	Development-Survival	**Organism:**	Mytilus galloprovincialis (Bay Mussel	**Material:**	Unionized Ammonia
Protocol:	All Protocols	**Endpoint:**	Combined Proportion Normal	**Source:**	Reference Toxicant-REF



Mean:	0.1002	**Count:**	20	**-1s Warning Limit:**	0.05843	**-2s Action Limit:**	0.01663
Sigma:	0.0418	**CV:**	41.70%	**+1s Warning Limit:**	0.142	**+2s Action Limit:**	0.1838

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Apr	15	19:10	0.1609	0.06068	1.452	(+)		16-8535-8797	10-1479-4973	ENVIRON
2			30	18:04	0.08192	-0.01828	-0.4374			03-9240-3383	09-4512-5047	ENVIRON
3		May	20	17:25	0.09802	-0.002183	-0.05224			02-2718-1762	05-2499-4463	ENVIRON
4		Jun	2	17:40	0.05293	-0.04727	-1.131	(-)		05-0395-8879	02-8689-2030	ENVIRON
5		Jul	15	17:28	0.06313	-0.03707	-0.8868			00-2296-0969	17-0196-9853	ENVIRON
6		Aug	13	17:12	0.05202	-0.04818	-1.153	(-)		20-0843-4308	07-3272-8799	ENVIRON
7		Sep	28	19:46	0.1464	0.04616	1.104	(+)		14-0799-9245	10-1527-0979	ENVIRON
8		Dec	7	18:00	0.1977	0.09755	2.334	(+)	(+)	14-1153-0185	08-9940-5879	ENVIRON
9	2016	Jan	15	18:45	0.07307	-0.02713	-0.649			14-3705-6085	19-2478-0688	ENVIRON
10		Mar	17	19:30	0.0747	-0.0255	-0.6099			04-9304-7933	11-8311-5806	ENVIRON
11		Apr	14	17:15	0.1231	0.02292	0.5482			21-0694-5716	16-1625-7449	ENVIRON
12		Jul	13	19:55	0.1066	0.006429	0.1538			17-3624-8523	09-8766-4801	ENVIRON
13			20	19:37	0.1295	0.02934	0.702			16-4492-6137	18-6316-6428	ENVIRON
14		Aug	3	18:20	0.0688	-0.0314	-0.7512			09-2291-5121	03-3596-0456	ENVIRON
15			17	17:05	0.08185	-0.01835	-0.4389			07-3188-3147	05-9364-3209	ENVIRON
16		Sep	21	17:05	0.05781	-0.04239	-1.014	(-)		12-6262-3928	08-6003-5732	ENVIRON
17		Oct	28	16:55	0.06459	-0.03561	-0.852			05-5636-6924	16-1083-2604	ENVIRON
18	2017	Apr	5	18:40	0.1177	0.01753	0.4193			07-6165-8877	17-4223-4248	EcoAnalysts
19			20	17:20	0.1634	0.06317	1.511	(+)		05-0815-7437	21-2956-9302	EcoAnalysts
20		Jun	9	17:00	0.09031	-0.009886	-0.2365			03-2543-7495	10-0892-9679	EcoAnalysts
21		Aug	1	17:25	0.1359	0.03575	0.8552			10-8097-0537	01-7132-8530	EcoAnalysts

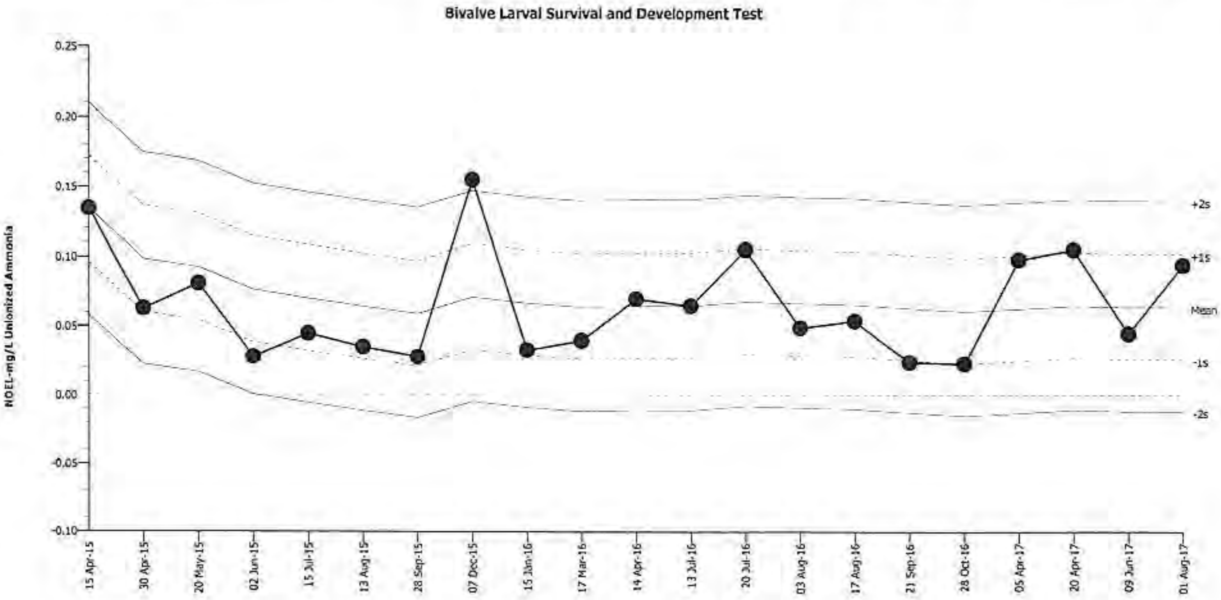
Analyst:________ QA:________

CETIS QC Plot

Report Date: 22 Aug-17 11:04 (1 of 1)

Bivalve Larval Survival and Development Test **All Matching Labs**

Test Type:	Development-Survival	**Organism:**	Mytilus galloprovincialis (Bay Mussel	**Material:**	Unionized Ammonia
Protocol:	All Protocols	**Endpoint:**	Combined Proportion Normal	**Source:**	Reference Toxicant-REF



Mean:	0.064	**Count:**	20	**-1s Warning Limit:**	0.02608	**-2s Action Limit:**	-0.0118
Sigma:	0.03792	**CV:**	59.20%	**+1s Warning Limit:**	0.1019	**+2s Action Limit:**	0.1398

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID	Laboratory
1	2015	Apr	15	19:10	0.134	0.07	1.846	(+)		16-8535-8797	14-3122-1198	ENVIRON
2			30	18:04	0.063	-0.001	-0.02637			03-9240-3383	00-2807-5882	ENVIRON
3		May	20	17:25	0.081	0.017	0.4483			02-2718-1762	04-5934-5151	ENVIRON
4		Jun	2	17:40	0.028	-0.036	-0.9494			05-0395-8879	14-7577-7111	ENVIRON
5		Jul	15	17:28	0.045	-0.019	-0.5011			00-2296-0969	19-0657-0188	ENVIRON
6		Aug	13	17:12	0.035	-0.029	-0.7648			20-0843-4308	02-2615-4019	ENVIRON
7		Sep	28	19:46	0.028	-0.036	-0.9494			14-0799-9245	09-3291-9362	ENVIRON
8		Dec	7	18:00	0.155	0.091	2.4	(+)	(+)	14-1153-0185	11-3892-1501	ENVIRON
9	2016	Jan	15	18:45	0.033	-0.031	-0.8175			14-3705-6085	10-1556-6538	ENVIRON
10		Mar	17	19:30	0.04	-0.024	-0.6329			04-9304-7933	18-2075-7796	ENVIRON
11		Apr	14	17:15	0.07	0.006	0.1582			21-0694-5716	12-4502-8479	ENVIRON
12		Jul	13	19:55	0.065	0.001	0.02637			17-3624-8523	04-6243-8640	ENVIRON
13			20	19:37	0.105	0.041	1.081	(+)		16-4492-6137	18-5505-5894	ENVIRON
14		Aug	3	18:20	0.049	-0.015	-0.3956			09-2291-5121	05-1896-5100	ENVIRON
15			17	17:05	0.054	-0.01	-0.2637			07-3188-3147	16-9734-3329	ENVIRON
16		Sep	21	17:05	0.024	-0.04	-1.055	(-)		12-6262-3928	13-9034-6853	ENVIRON
17		Oct	28	16:55	0.023	-0.041	-1.081	(-)		05-5636-6924	02-7414-4116	ENVIRON
18	2017	Apr	5	18:40	0.098	0.034	0.8966			07-6165-8877	17-6318-6320	EcoAnalysts
19			20	17:20	0.105	0.041	1.081	(+)		05-0815-7437	03-4135-8920	EcoAnalysts
20		Jun	9	17:00	0.045	-0.019	-0.5011			03-2543-7495	14-0954-3373	EcoAnalysts
21		Aug	1	17:25	0.094	0.03	0.7911			10-8097-0537	12-0420-5438	EcoAnalysts

Analyst:

QA:

Bivalve Larval Survival and Development Test **EcoAnalysts**

Batch ID:	18-5813-4668	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	01 Aug-17 17:25	**Protocol:**	PSEP (1995)	**Diluent:**	Laboratory Seawater
Ending Date:	03 Aug-17 15:50	**Species:**	Mytilus galloprovincialis	**Brine:**	
Duration:	46h	**Source:**	Taylor Shellfish	**Age:**	

Sample ID:	10-0320-5032	**Code:**	3BCBB1A8	**Client:**	Internal Lab
Sample Date:	15 May-17	**Material:**	Total Ammonia	**Project:**	Reference Toxicant
Receipt Date:	25 Jul-17 12:05	**Source:**	Reference Toxicant		
Sample Age:	78d 17h	**Station:**	P170515.21		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	NOEL	LOEL	TOEL	TU	PMSD ✓
14-4042-7171	Combined Proportion Norma	Dunnett Multiple Comparison Test	6.4	13.1	9.156		24.7%

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	Level	mg/L	95% LCL	95% UCL	TU	✓
12-0819-3140	Combined Proportion Norma	Spearman-Kärber	EC50	9.266	9.198	9.334		

Combined Proportion Normal Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	0.8980	0.8349	0.9611	0.8694	0.9179	0.0147	0.0254	2.83%	0.00%
0.63		3	0.8980	0.6477	1.0000	0.7985	1.0000	0.0582	0.1008	11.22%	0.00%
1.46		3	0.9502	0.8336	1.0000	0.9067	1.0000	0.0271	0.0470	4.94%	-5.82%
3.58		3	0.8644	0.6419	1.0000	0.7761	0.9552	0.0517	0.0896	10.36%	3.74%
6.4		3	0.9627	0.8401	1.0000	0.9067	1.0000	0.0285	0.0494	5.13%	-7.20%
13.1		3	0.0236	0.0000	0.0520	0.0112	0.0336	0.0066	0.0114	48.24%	97.37%
20.7		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%

Combined Proportion Normal Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	0.9179	0.8694	0.9067
0.63		1.0000	0.7985	0.8955
1.46		1.0000	0.9440	0.9067
3.58		0.8619	0.9552	0.7761
6.4		1.0000	0.9813	0.9067
13.1		0.0336	0.0261	0.0112
20.7		0.0000	0.0000	0.0000

Combined Proportion Normal Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	246/268	233/268	243/268
0.63		275/275	214/268	240/268
1.46		280/280	253/268	243/268
3.58		231/268	256/268	208/268
6.4		279/279	263/268	243/268
13.1		9/268	7/268	3/268
20.7		0/268	0/268	0/268

Analyst:________ QA:________

CETIS Test Data Worksheet

Report Date: 22 Aug-17 11:07 (p 1 of 1)
Test Code/ID: 06-8669-3676/28EE1D2C

Bivalve Larval Survival and Development Test **EcoAnalysts**

Start Date: 01 Aug-17 17:25 **Species:** Mytilus galloprovincialis **Sample Code:** 3BCBB1A8
End Date: 03 Aug-17 15:50 **Protocol:** PSEP (1995) **Sample Source:** Reference Toxicant
Sample Date: 15 May-17 **Material:** Total Ammonia **Sample Station:** P170515.21

Conc-mg/L	Code	Rep	Pos	Initial Density	Final Density	# Counted	# Normal	Notes
0	D	1	14	268	260	260	246	
0	D	2	12	268	244	244	233	
0	D	3	20	268	257	257	243	
0.63		1	6	268	286	286	275	
0.63		2	9	268	225	225	214	
0.63		3	1	268	247	247	240	
1.46		1	7	268	291	291	280	
1.46		2	3	268	264	264	253	
1.46		3	4	268	251	251	243	
3.58		1	19	268	239	239	231	
3.58		2	21	268	267	267	256	
3.58		3	16	268	227	227	208	
6.4		1	13	268	289	289	279	
6.4		2	15	268	285	285	263	
6.4		3	5	268	265	265	243	
13.1		1	8	268	284	284	9	
13.1		2	10	268	253	253	7	
13.1		3	17	268	268	268	3	
20.7		1	11	268	259	259	0	
20.7		2	2	268	254	254	0	
20.7		3	18	268	240	240	0	

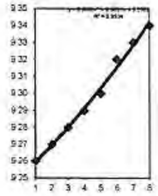
Analyst:____ QA:____

Un-ionized Ammonia Calculator

CLIENT:	Anchor	Date of Test:	01-Aug-17
PROJECT:	Shelton Harbor	Test Type:	*Mytilus RT*
COMMENTS:	P170515.21		

To convert Total Ammonia (mg/L) to Free (un-ionized) Ammonia (mg/L) enter the corresponding total ammonia, salinity, temperature, and pH.

Integer:	I-factor
1	9.26
2	9.27
3	9.28
4	9.29
5	9.30
6	9.32
7	9.33
8	9.34



	Sample	Mod	*NH3T (mg/L)*	*salinity (ppt)*	*pH*	*temp (C)*	temp (K)	i-factor	Mod	**NH3U (mg/L)**
	Target / Sample Name		Actual	22.9	8.0	24.1	297.26	9.3053		**#VALUE!**
	Example 3.5		2.000	10.0	7.5	5.0	278.16	9.2750		**0.008**
1	0									
2	0.75		0.63	27	7.7	15.5	288.66	9.3160		**0.008**
3	1.5		1.46	27	7.8	15.4	288.56	9.3160		**0.022**
4	3		3.58	27	7.8	15.2	288.36	9.3160		**0.052**
5	6		6.40	27	7.8	15.2	288.36	9.3160		**0.094**
6	12		13.1	27	7.8	15.2	288.36	9.3160		**0.192**
7	18		20.7	27	7.8	15.2	288.36	9.3160		**0.303**
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CETIS Summary Report

Report Date: 22 Aug-17 11:04 (p 1 of 1)
Test Code: 406E4D29 | 10-8097-0537

Bivalve Larval Survival and Development Test **EcoAnalysts**

Batch ID:	18-5813-4668	**Test Type:**	Development-Survival	**Analyst:**	
Start Date:	01 Aug-17 17:25	**Protocol:**	PSEP (1995)	**Diluent:**	Laboratory Seawater
Ending Date:	03 Aug-17 15:50	**Species:**	Mytilus galloprovincialis	**Brine:**	
Duration:	46h	**Source:**	Taylor Shellfish	**Age:**	

Sample ID:	16-8877-0420	**Code:**	64A89774	**Client:**	Internal Lab
Sample Date:	15 May-17	**Material:**	Unionized Ammonia	**Project:**	Reference Toxicant
Receipt Date:	25 Jul-17 13:07	**Source:**	Reference Toxicant		
Sample Age:	78d 17h	**Station:**	P170515.21		

Multiple Comparison Summary

Analysis ID	Endpoint	Comparison Method	NOEL	LOEL	TOEL	TU	PMSD ✓
12-0420-5438	Combined Proportion Norma	Dunnett Multiple Comparison Test	0.094	0.192	0.1343		24.7%

Point Estimate Summary

Analysis ID	Endpoint	Point Estimate Method	Level	mg/L	95% LCL	95% UCL	TU	✓
01-7132-8530	Combined Proportion Norma	Spearman-Kärber	EC50	0.1359	0.135	0.1369		

Combined Proportion Normal Summary

Conc-mg/L	Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	D	3	0.8980	0.8349	0.9611	0.8694	0.9179	0.0147	0.0254	2.83%	0.00%
0.008		3	0.8980	0.6477	1.0000	0.7985	1.0000	0.0582	0.1008	11.22%	0.00%
0.022		3	0.9502	0.8336	1.0000	0.9067	1.0000	0.0271	0.0470	4.94%	-5.82%
0.052		3	0.8644	0.6419	1.0000	0.7761	0.9552	0.0517	0.0896	10.36%	3.74%
0.094		3	0.9627	0.8401	1.0000	0.9067	1.0000	0.0285	0.0494	5.13%	-7.20%
0.192		3	0.0236	0.0000	0.0520	0.0112	0.0336	0.0066	0.0114	48.24%	97.37%
0.303		3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		100.00%

Combined Proportion Normal Detail

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	0.9179	0.8694	0.9067
0.008		1.0000	0.7985	0.8955
0.022		1.0000	0.9440	0.9067
0.052		0.8619	0.9552	0.7761
0.094		1.0000	0.9813	0.9067
0.192		0.0336	0.0261	0.0112
0.303		0.0000	0.0000	0.0000

Combined Proportion Normal Binomials

Conc-mg/L	Code	Rep 1	Rep 2	Rep 3
0	D	246/268	233/268	243/268
0.008		275/275	214/268	240/268
0.022		280/280	253/268	243/268
0.052		231/268	256/268	208/268
0.094		279/279	263/268	243/268
0.192		9/268	7/268	3/268
0.303		0/268	0/268	0/268

Analyst:________ QA:________

CETIS Test Data Worksheet

Report Date: 22 Aug-17 11:04 (p 1 of 1)
Test Code/ID: 10-8097-0537/406E4D29

Bivalve Larval Survival and Development Test EcoAnalysts

Start Date: 01 Aug-17 17:25 **Species:** Mytilus galloprovincialis **Sample Code:** 64A89774
End Date: 03 Aug-17 15:50 **Protocol:** PSEP (1995) **Sample Source:** Reference Toxicant
Sample Date: 15 May-17 **Material:** Unionized Ammonia **Sample Station:** P170515.21

Conc-mg/L	Code	Rep	Pos	Initial Density	Final Density	# Counted	# Normal	Notes
0	D	1	17	268	260	260	246	
0	D	2	4	268	244	244	233	
0	D	3	18	268	257	257	243	
0.008		1	7	268	286	286	275	
0.008		2	15	268	225	225	214	
0.008		3	2	268	247	247	240	
0.022		1	20	268	291	291	280	
0.022		2	19	268	264	264	253	
0.022		3	3	268	251	251	243	
0.052		1	5	268	239	239	231	
0.052		2	11	268	267	267	256	
0.052		3	13	268	227	227	208	
0.094		1	16	268	289	289	279	
0.094		2	1	268	285	285	263	
0.094		3	6	268	265	265	243	
0.192		1	12	268	284	284	9	
0.192		2	14	268	253	253	7	
0.192		3	21	268	268	268	3	
0.303		1	9	268	259	259	0	
0.303		2	10	268	254	254	0	
0.303		3	8	268	240	240	0	

Analyst: QA:

48 Hour Bivalve Development Reference Toxicant Test

Test ID: P170515.21	Replicates: 3	Study Director: BH	Location: Inc 1
Dilution Water Batch: FSW080117.01	Organism Batch: TS2849	Associated Test(s): Shelton	Organism: Mytilus
Chamber Size/Type: 30 ml shell vial	Exposure Volume: 10 ml		
Toxicant: Ammonium Chloride:	Lot #: 2986C510	Date Prepared: 8/1/17	Initials:
Target Concentrations: **See spiking worksheet**		Quantity of Stock: Target: See spiking worksheet	Quantity of Diluent: Target: 200 mL
See spiking worksheet		Actual: See spiking worksheet	Actual: 200 mL

0 Hours Date: 8.1.17 8/1/17 WQ Time: 1600 STOCK Start Time: 1725 Initials: BH

	Control	0.75	1.5	3	6	12	18
D.O. (%) (>4.9 mg/L)	7.4	7.2	7.6	7.6	7.7	7.7	7.7
Temperature (16 ± 1°C)	16.1	15.5	15.4	15.2	15.2	15.2	15.2
28±2 Salinity (~~30 ± 2~~ ppt)	27	27	27	27	27	27	27
pH (7.8 ± 0.5)	7.5	7.7	7.8	7.8	7.8	7.8	7.8

Day 1 Temperature (16 ± 1°C) 15.6 AE

Final Day Date: 8/3/17 WQ Time: ~~1630~~ ① 1530 MK STOCK End Time: 1550 Initials: MK/LB

	Control	0.75	1.5	3	6	12	18
D.O. (%) (>4.9 mg/L)	7.9	8.5	8.5	8.6	8.6	8.4	8.4
Temperature (16 ± 1°C)	① ~~16.0~~ 15.8	15.4	15.4	15.6	15.3	15.3	15.4
Salinity (30 ± 2 ppt)	28	28	28	27	28	28	29
pH (7.8 ± 0.5)	7.9	8.0	8.0	8.1	8.0	8.0	8.0

Notes: ① IE. MK 8/3.

48 Hour Bivalve Development Reference Toxicant Test

Conc.	Rep	Number Normal	Number Abnormal	Date	Initials
Control	1	246	14	8/8/17	UB
	2	233	11		
	3	243	14		
0.75	1	275	11		
	2	214	11		
	3	240	7		
1.5	1	280	11	8/9/17	
	2	253	11		
	3	243	8		
3	1	231	8		
	2	256	11		
	3	208	19		
6	1	279	10		
	2	263	22		
	3	243	22		
12	1	9	275	8/10/17	
	2	7	246		
	3	3	265		
18	1	0	259		
	2	0	254		
	3	0	240		

Stocking Density

Rep	Count	Init.
1	① ~~281~~ 294	UB
2	264	UB
3	295	UB
Mean:	268	JL

QA Count Checks: #1 conc/rep Ø/2 # normal 236 # abnormal 11	#2 conc/rep 1.5/3 # normal 242 # abnormal 7	#3 conc/rep 3/1 # normal 233 # abnormal 6	#4 conc/rep 18/1 # normal 0 # abnormal 272
Tech. Init. CR	Tech. Init. CR	Tech. Init. CR	Tech. Init. CR
Calc. $\frac{11}{236}$ = 4.7% $\frac{11}{233}$ = 4.7%	$\frac{7}{242}$ = 2.9% $\frac{8}{243}$ = 3.3%	$\frac{6}{233}$ = 2.6% $\frac{8}{231}$ = 3.5%	NC

QA Check Acceptability: ☑ <5% difference in means of QA & orig. counts

① IE, UB 8/18

Ammonia Reference Toxicant
Spiking Worksheet

Reference Toxicant ID: P170515.21

Date Prepared: 8/1/17

Technician Initials:

Biv / Echino NH_3 RT

Assumptions in Model
Stock ammonia concentration is 9,000 mg/L = 9 mg/mL

Date: 7/28/2017
Measurement: 9453.3

Test Solutions			Volume of stock to reach desired concentration	
Measured Concentration	**Desired Concentration**	**Volume**		
mg/L	mg/L	mL	mL stock to increase	
0.00			[redacted]	SALT WATER
0.630	**0.75**	200	[redacted]	**0.024**
1.46	**1.5**	200	[redacted]	**0.048**
3.58	**3**	200	[redacted]	**0.095**
6.40	**6**	200	[redacted]	**0.190**
13.1	**12**	200	[redacted]	**0.381**
20.7	**18**	200	[redacted]	**0.571**
			[redacted]	
			[redacted]	

APPENDIX B. STATISTICAL COMPARISONS

Statistical Results: *Eohaustorius estuarius* Test

Constant	Value
Experiment Date	7/28/2017
Experiment ID	Anchor Shelton Harbor
Notebook ID	
Project	Eohaustroius estuarius
Experimenter	
Protocol	Survival

	Group A	Group B	Group C	Group D	Group E	Group F
	Control	SH-Ref-1	CARR	CARR / SH-Ref-1	SPI-22	SPI-30
	Y	Y	Y	Y	Y	Y
1	100	90	100	100	100	100
2	95	95	95	100	85	85
3	100	90	90	100	90	100
4	100	100	100	100	90	75
5	100	100	95	95	90	95

	Group G
	SPI-31
	Y
1	90
2	85
3	95
4	90
5	100

Transform	A	B	C	D	E	F
	Control	SH-Ref-1	CARR	CARR / SH-Ref-1	SPI-22	SPI-30
	Y	Y	Y	Y	Y	Y
1	1.571	1.249	1.571	1.571	1.571	1.571
2	1.345	1.345	1.345	1.571	1.173	1.173
3	1.571	1.249	1.249	1.571	1.249	1.571
4	1.571	1.571	1.571	1.571	1.249	1.047
5	1.571	1.571	1.345	1.345	1.249	1.345

	G
	SPI-31
	Y
1	1.249
2	1.173
3	1.345
4	1.249
5	1.571

1way ANOVA ANOVA		
1	Table Analyzed	Transform of Data 1
2	Data sets analyzed	A : Control
3		
4	ANOVA summary	
5	F	1.781
6	P value	0.1394
7	P value summary	ns
8	Significant diff. among means (P < 0.05)?	No
9	R square	0.2762
10		
11	Brown-Forsythe test	
12	F (DFn, DFd)	0.9168 (6, 28)
13	P value	0.4976
14	P value summary	ns
15	Are SDs significantly different (P < 0.05)?	No
16		
17	Bartlett's test	
18	Bartlett's statistic (corrected)	3.792
19	P value	0.7048
20	P value summary	ns
21	Are SDs significantly different (P < 0.05)?	No
22		
23	ANOVA table	SS
24	Treatment (between columns)	0.262
25	Residual (within columns)	0.6865
26	Total	0.9486
27		
28	Data summary	
29	Number of treatments (columns)	7
30	Number of values (total)	35

1			
2	B : SH-Ref-1	C : CARR	D : CARR / SH-Ref-1
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23	DF	MS	F (DFn, DFd)
24	6	0.04367	F (6, 28) = 1.781
25	28	0.02452	
26	34		
27			
28			
29			
30			

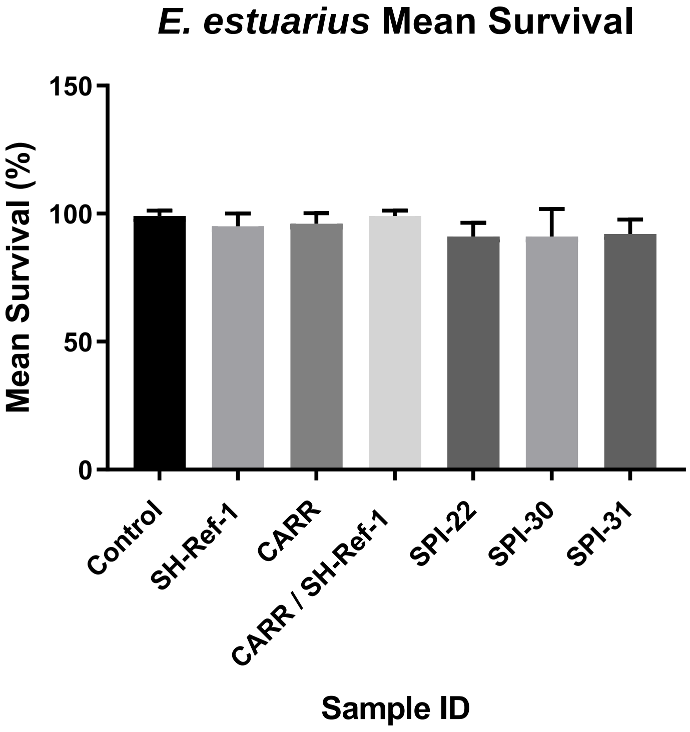
1	
2	E : SPI-22
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	P value
24	P=0.1394
25	
26	
27	
28	
29	
30	

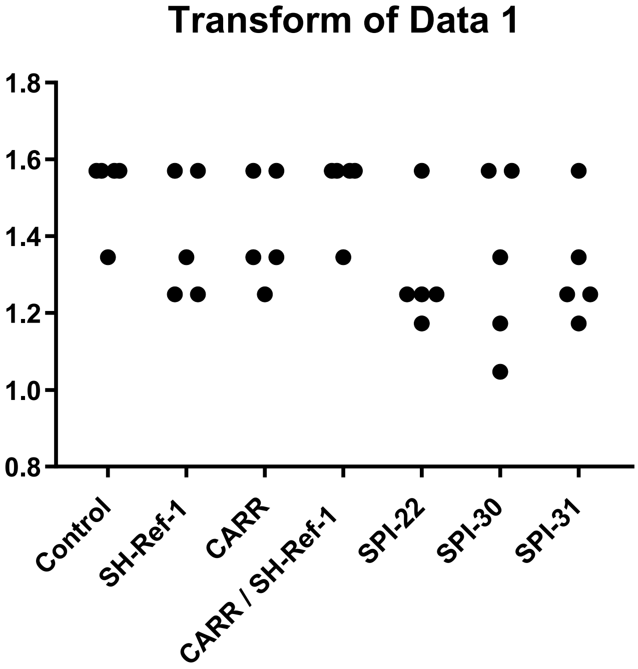
1way ANOVA Multiple comparisons					
1	Number of families	1			
2	Number of comparisons per family	3			
3	Alpha	0.05			
4					
5	Holm-Sidak's multiple comparisons test	Mean Diff.	Significant?	Summary	Adjusted P Value
6					
7	SH-Ref-1 vs. SPI-22	0.09879	No	ns	0.5472
8	CARR / SH-Ref-1 vs. SPI-30	0.1843	No	ns	0.2043
9	CARR vs. SPI-31	0.09879	No	ns	0.5472
10					
11					
12	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.
13					
14	SH-Ref-1 vs. SPI-22	1.397	1.298	0.09879	0.09903
15	CARR / SH-Ref-1 vs. SPI-30	1.526	1.341	0.1843	0.09903
16	CARR vs. SPI-31	1.416	1.317	0.09879	0.09903

1				
2				
3				
4				
5				
6				
7	B-E			
8	D-F			
9	C-G			
10				
11				
12	n1	n2	t	DF
13				
14	5	5	0.9975	28
15	5	5	1.861	28
16	5	5	0.9975	28

1way ANOVA Descriptive Statistics		Control	SH-Ref-1	CARR	CARR / SH-Ref-1	SPI-22
1	Number of values	5	5	5	5	5
2						
3	Minimum	1.345	1.249	1.249	1.345	1.173
4	25% Percentile	1.458	1.249	1.297	1.458	1.211
5	Median	1.571	1.345	1.345	1.571	1.249
6	75% Percentile	1.571	1.571	1.571	1.571	1.41
7	Maximum	1.571	1.571	1.571	1.571	1.571
8						
9	Mean	1.526	1.397	1.416	1.526	1.298
10	Std. Deviation	0.1009	0.1635	0.1465	0.1009	0.1559
11	Std. Error of Mean	0.0451	0.0731	0.0655	0.0451	0.06972
12						
13	Lower 95% CI	1.4	1.194	1.234	1.4	1.105
14	Upper 95% CI	1.651	1.6	1.598	1.651	1.492

	SPI-30	SPI-31
1	5	5
2		
3	1.047	1.173
4	1.11	1.211
5	1.345	1.249
6	1.571	1.458
7	1.571	1.571
8		
9	1.341	1.317
10	0.2346	0.1542
11	0.1049	0.06898
12		
13	1.05	1.126
14	1.633	1.509


E. estuarius Mean Survival
Mean Survival (%)
150
100
50
0
Control
SH-Ref-1
CARR
CARR / SH-Ref-1
SPI-22
SPI-30
SPI-31
Sample ID


Transform of Data 1
1.8
1.6
1.4
1.2
1.0
0.8
Control
SH-Ref-1
CARR
CARR / SH-Ref-1
SPI-22
SPI-30
SPI-31

Statistical Results: *Neanthes arenaceodentata* Test

Constant	Value
Experiment Date	7/28/2017
Experiment ID	Anchor Shelton Harbor
Notebook ID	
Project	Neanthes arenaceodentata
Experimenter	
Protocol	Survival

	Group A	**Group B**	**Group C**	**Group D**	**Group E**	**Group F**
	Control	SH-Ref-1	CARR	CARR / SH-Ref-1	SH-13A	SH-19
	Y	**Y**	**Y**	**Y**	**Y**	**Y**
1	100	100	100	100	100	100
2	100	100	100	80	100	100
3	100	100	100	100	100	100
4	100	100	100	100	100	100
5	100	100	100	100	100	100

	Group G	Group H	Group I	Group J	Group K
	SH-22	SH-28	SPI-22	SPI-30	SPI-31
	Y	Y	Y	Y	Y
1	100	100	100	100	100
2	100	100	100	100	100
3	100	100	100	80	100
4	100	100	100	100	60
5	100	100	100	100	60

	A	B	C	D	E	F
	Control	SH-Ref-1	CARR	CARR / SH-Ref-1	SH-13A	SH-19
	Y	Y	Y	Y	Y	Y
1	1.571	1.571	1.571	1.571	1.571	1.571
2	1.571	1.571	1.571	1.107	1.571	1.571
3	1.571	1.571	1.571	1.571	1.571	1.571
4	1.571	1.571	1.571	1.571	1.571	1.571
5	1.571	1.571	1.571	1.571	1.571	1.571

	G	H	I	J	K
	SH-22	SH-28	SPI-22	SPI-30	SPI-31
	Y	Y	Y	Y	Y
1	1.571	1.571	1.571	1.571	1.571
2	1.571	1.571	1.571	1.571	1.571
3	1.571	1.571	1.571	1.107	1.571
4	1.571	1.571	1.571	1.571	0.886
5	1.571	1.571	1.571	1.571	0.886

1way ANOVA
ANOVA

1	Table Analyzed	Transform of Data 1
2	Data sets analyzed	A : Control
3		
4	ANOVA summary	
5	F	1.772
6	P value	0.0946
7	P value summary	ns
8	Significant diff. among means (P < 0.05)?	No
9	R square	0.2871
10		
11	Brown-Forsythe test	
12	F (DFn, DFd)	1.772 (10, 44)
13	P value	0.0946
14	P value summary	ns
15	Are SDs significantly different (P < 0.05)?	No
16		
17	Bartlett's test	
18	Bartlett's statistic (corrected)	+infinity
19	P value	<0.0001
20	P value summary	****
21	Are SDs significantly different (P < 0.05)?	Yes
22		
23	ANOVA table	SS
24	Treatment (between columns)	0.3652
25	Residual (within columns)	0.9066
26	Total	1.272
27		
28	Data summary	
29	Number of treatments (columns)	11
30	Number of values (total)	55

1			
2	B : SH-Ref-1	C : CARR	D : CARR / SH-Ref-1
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23	DF	MS	F (DFn, DFd)
24	10	0.03652	F (10, 44) = 1.772
25	44	0.0206	
26	54		
27			
28			
29			
30			

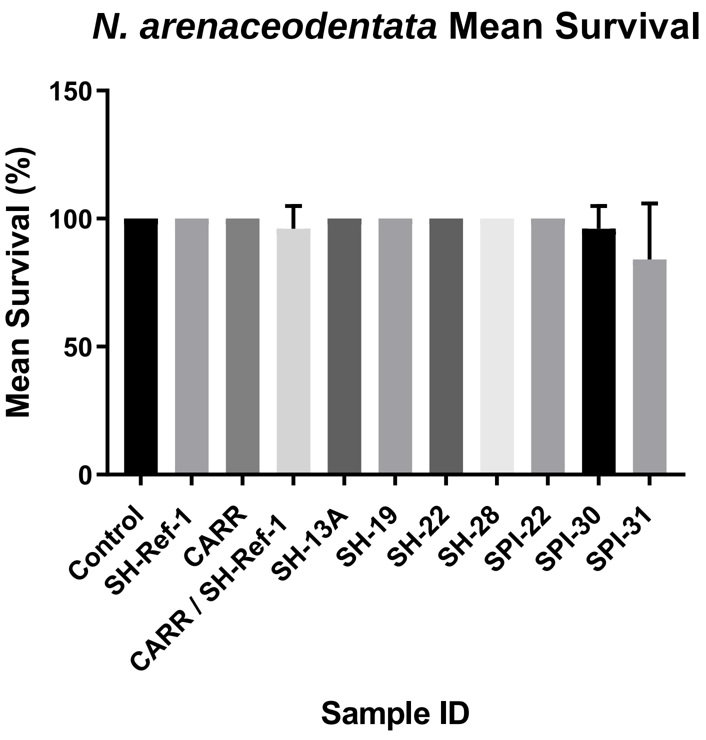
1	
2	E : SH-13A
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	P value
24	P=0.0946
25	
26	
27	
28	
29	
30	

1way ANOVA Multiple comparisons					
1	Number of families	1			
2	Number of comparisons per family	7			
3	Alpha	0.05			
4					
5	Holm-Sidak's multiple comparisons test	Mean Diff.	Significant?	Summary	Adjusted P Value
6					
7	SH-Ref-1 vs. SPI-22	0	No	ns	>0.9999
8	CARR vs. SH-13A	0	No	ns	>0.9999
9	CARR vs. SH-19	0	No	ns	>0.9999
10	CARR vs. SPI-31	0.2739	Yes	*	0.0293
11	CARR / SH-Ref-1 vs. SH-22	-0.09273	No	ns	0.8945
12	CARR / SH-Ref-1 vs. SH-28	-0.09273	No	ns	0.8945
13	CARR / SH-Ref-1 vs. SPI-30	0	No	ns	>0.9999
14					
15					
16	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.
17					
18	SH-Ref-1 vs. SPI-22	1.571	1.571	0	0.09078
19	CARR vs. SH-13A	1.571	1.571	0	0.09078
20	CARR vs. SH-19	1.571	1.571	0	0.09078
21	CARR vs. SPI-31	1.571	1.297	0.2739	0.09078
22	CARR / SH-Ref-1 vs. SH-22	1.478	1.571	-0.09273	0.09078
23	CARR / SH-Ref-1 vs. SH-28	1.478	1.571	-0.09273	0.09078
24	CARR / SH-Ref-1 vs. SPI-30	1.478	1.478	0	0.09078

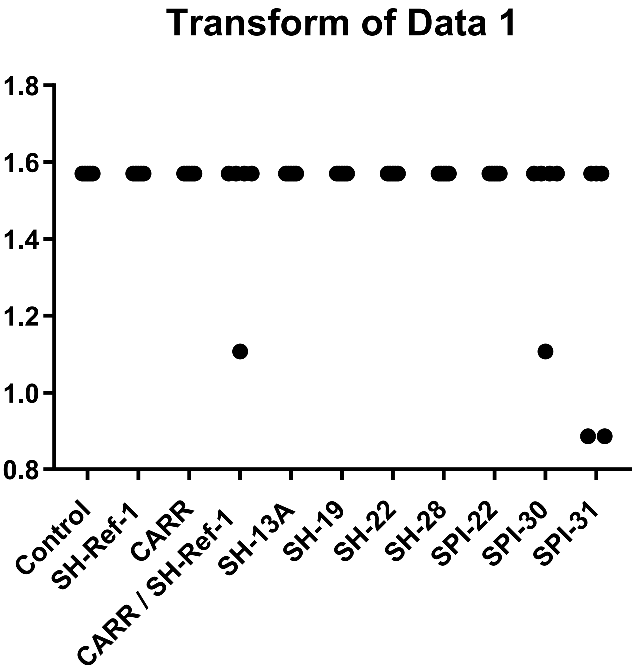
1				
2				
3				
4				
5				
6				
7	B-I			
8	C-E			
9	C-F			
10	C-K			
11	D-G			
12	D-H			
13	D-J			
14				
15				
16	n1	n2	t	DF
17				
18	5	5	0	44
19	5	5	0	44
20	5	5	0	44
21	5	5	3.017	44
22	5	5	1.021	44
23	5	5	1.021	44
24	5	5	0	44

1way ANOVA Descriptive Statistics		Control	SH-Ref-1	CARR	CARR / SH-Ref-1	SH-13A
1	Number of values	5	5	5	5	5
2						
3	Minimum	1.571	1.571	1.571	1.107	1.571
4	25% Percentile	1.571	1.571	1.571	1.339	1.571
5	Median	1.571	1.571	1.571	1.571	1.571
6	75% Percentile	1.571	1.571	1.571	1.571	1.571
7	Maximum	1.571	1.571	1.571	1.571	1.571
8						
9	Mean	1.571	1.571	1.571	1.478	1.571
10	Std. Deviation	0	0	0	0.2073	0
11	Std. Error of Mean	0	0	0	0.09273	0
12						
13	Lower 95% CI	1.571	1.571	1.571	1.221	1.571
14	Upper 95% CI	1.571	1.571	1.571	1.736	1.571

	SH-19	SH-22	SH-28	SPI-22	SPI-30	SPI-31
1	5	5	5	5	5	5
2						
3	1.571	1.571	1.571	1.571	1.107	0.8861
4	1.571	1.571	1.571	1.571	1.339	0.8861
5	1.571	1.571	1.571	1.571	1.571	1.571
6	1.571	1.571	1.571	1.571	1.571	1.571
7	1.571	1.571	1.571	1.571	1.571	1.571
8						
9	1.571	1.571	1.571	1.571	1.478	1.297
10	0	0	0	0	0.2073	0.375
11	0	0	0	0	0.09273	0.1677
12						
13	1.571	1.571	1.571	1.571	1.221	0.8312
14	1.571	1.571	1.571	1.571	1.736	1.763



N. arenaceodentata Mean Survival


Transform of Data 1
1.8
1.6
1.4
1.2
1.0
0.8
Control
SH-Ref-1
CARR
CARR / SH-Ref-1
SH-13A
SH-19
SH-22
SH-28
SPI-22
SPI-30
SPI-31

Constant	Value
Experiment Date	7/28/2017
Experiment ID	Anchor Shelton Harbor
Notebook ID	
Project	Neanthes arenaceodentata
Experimenter	
Protocol	Mean Individual Growth per Day (Dry Weight)

Constant	Value
Experiment Date	7/28/2017
Experiment ID	Anchor Shelton Harbor
Notebook ID	
Project	Neanthes arenaceodentata
Experimenter	
Protocol	Mean Individual Growth per Day (AFDW)

	Group A	**Group B**	**Group C**	**Group D**	**Group E**	**Group F**	**Group G**
	Control	SH-Ref-1	CARR	CARR / SH-Ref-1	SH-13A	SH-19	SH-22
	Y	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
1	0.411	0.234	0.301	0.258	0.132	0.249	0.301
2	0.199	0.230	0.330	0.326	0.220	0.174	0.275
3	0.272	0.261	0.307	0.313	0.209	0.218	0.253
4	0.201	0.364	0.330	0.281	0.221	0.265	0.201
5	0.224	0.277	0.260	0.330	0.207	0.176	0.238

	Group H	Group I	Group J	Group K
	SH-28	SPI-22	SPI-30	SPI-31
	Y	Y	Y	Y
1	0.213	0.334	0.307	0.295
2	0.293	0.427	0.433	0.174
3	0.086	0.311	0.348	0.244
4	0.197	0.313	0.325	0.315
5	0.307	0.260	0.292	0.196

1way ANOVA
ANOVA

1	Table Analyzed	Data 1				
2	Data sets analyzed	A : Control	B : SH-Ref-1	C : CARR	D : CARR / SH-Ref-1	E : SH-13A
3						
4	ANOVA summary					
5	F	3.465				
6	P value	0.0020				
7	P value summary	**				
8	Significant diff. among means (P < 0.05)?	Yes				
9	R square	0.4405				
10						
11	Brown-Forsythe test					
12	F (DFn, DFd)	0.6482 (10, 44)				
13	P value	0.7645				
14	P value summary	ns				
15	Are SDs significantly different (P < 0.05)?	No				
16						
17	Bartlett's test					
18	Bartlett's statistic (corrected)	10.77				
19	P value	0.3756				
20	P value summary	ns				
21	Are SDs significantly different (P < 0.05)?	No				
22						
23	ANOVA table	SS	DF	MS	F (DFn, DFd)	P value
24	Treatment (between columns)	0.1119	10	0.01119	F (10, 44) = 3.465	P=0.0020
25	Residual (within columns)	0.1421	44	0.00323		
26	Total	0.254	54			
27						
28	Data summary					
29	Number of treatments (columns)	11				
30	Number of values (total)	55				

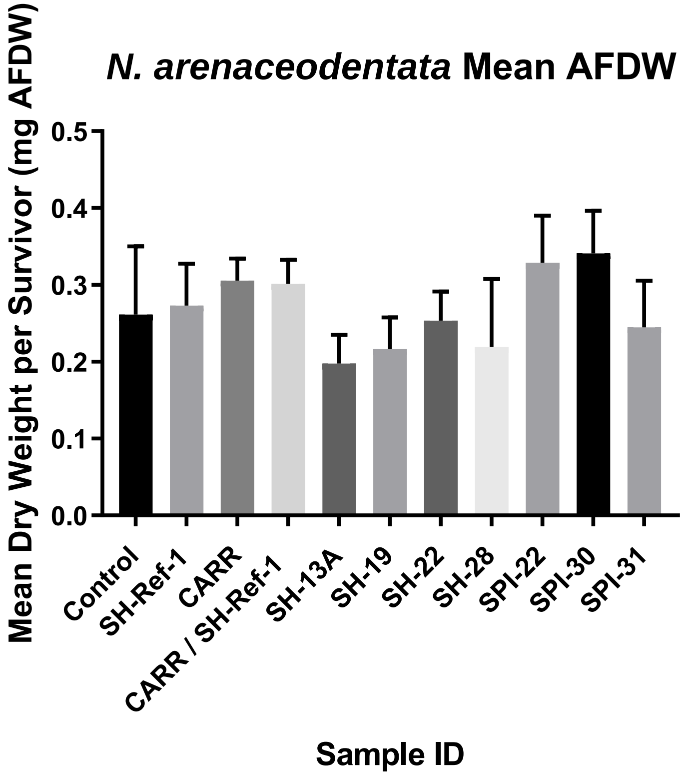
1way ANOVA
Multiple comparisons

1	Number of families	1				
2	Number of comparisons per family	7				
3	Alpha	0.05				
4						
5	Sidak's multiple comparisons test	Mean Diff.	95.00% CI of diff.	Significant?	Summary	Adjusted P Value
6						
7	SH-Ref-1 vs. SPI-22	-0.0558	-0.1569 to 0.04532	No	ns	0.6157
8	CARR vs. SH-13A	0.1078	0.00668 to 0.2089	Yes	*	0.0307
9	CARR vs. SH-19	0.0892	-0.01192 to 0.1903	No	ns	0.1129
10	CARR vs. SPI-31	0.0608	-0.04032 to 0.1619	No	ns	0.5134
11	CARR / SH-Ref-1 vs. SH-22	0.048	-0.05312 to 0.1491	No	ns	0.7684
12	CARR / SH-Ref-1 vs. SH-28	0.0824	-0.01872 to 0.1835	No	ns	0.1727
13	CARR / SH-Ref-1 vs. SPI-30	-0.0394	-0.1405 to 0.06172	No	ns	0.8987
14						
15						
16	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.	n1
17						
18	SH-Ref-1 vs. SPI-22	0.2732	0.329	-0.0558	0.03594	5
19	CARR vs. SH-13A	0.3056	0.1978	0.1078	0.03594	5
20	CARR vs. SH-19	0.3056	0.2164	0.0892	0.03594	5
21	CARR vs. SPI-31	0.3056	0.2448	0.0608	0.03594	5
22	CARR / SH-Ref-1 vs. SH-22	0.3016	0.2536	0.048	0.03594	5
23	CARR / SH-Ref-1 vs. SH-28	0.3016	0.2192	0.0824	0.03594	5
24	CARR / SH-Ref-1 vs. SPI-30	0.3016	0.341	-0.0394	0.03594	5

1			
2			
3			
4			
5			
6			
7	B-I		
8	C-E		
9	C-F		
10	C-K		
11	D-G		
12	D-H		
13	D-J		
14			
15			
16	n2	t	DF
17			
18	5	1.552	44
19	5	2.999	44
20	5	2.482	44
21	5	1.692	44
22	5	1.335	44
23	5	2.293	44
24	5	1.096	44

1way ANOVA Descriptive Statistics		Control	SH-Ref-1	CARR	CARR / SH-Ref-1	SH-13A	SH-19	SH-22
1	Number of values	5	5	5	5	5	5	5
2								
3	Minimum	0.199	0.23	0.26	0.258	0.132	0.174	0.201
4	25% Percentile	0.2	0.232	0.2805	0.2695	0.1695	0.175	0.2195
5	Median	0.224	0.261	0.307	0.313	0.209	0.218	0.253
6	75% Percentile	0.3415	0.3205	0.33	0.328	0.2205	0.257	0.288
7	Maximum	0.411	0.364	0.33	0.33	0.221	0.265	0.301
8								
9	Mean	0.2614	0.2732	0.3056	0.3016	0.1978	0.2164	0.2536
10	Std. Deviation	0.08865	0.05434	0.02869	0.03105	0.03732	0.0414	0.0378
11	Std. Error of Mean	0.03964	0.0243	0.01283	0.01389	0.01669	0.01852	0.0169
12								
13	Lower 95% CI	0.1513	0.2057	0.27	0.263	0.1515	0.165	0.2067
14	Upper 95% CI	0.3715	0.3407	0.3412	0.3402	0.2441	0.2678	0.3005

	SH-28	SPI-22	SPI-30	SPI-31
1	5	5	5	5
2				
3	0.086	0.26	0.292	0.174
4	0.1415	0.2855	0.2995	0.185
5	0.213	0.313	0.325	0.244
6	0.3	0.3805	0.3905	0.305
7	0.307	0.427	0.433	0.315
8				
9	0.2192	0.329	0.341	0.2448
10	0.08864	0.06118	0.05551	0.06092
11	0.03964	0.02736	0.02483	0.02724
12				
13	0.1091	0.253	0.2721	0.1692
14	0.3293	0.405	0.4099	0.3204


N. arenaceodentata Mean AFDW
Mean Dry Weight per Survivor (mg AFDW)
0.5
0.4
0.3
0.2
0.1
0.0
Control
SH-Ref-1
CARR
CARR / SH-Ref-1
SH-13A
SH-19
SH-22
SH-28
SPI-22
SPI-30
SPI-31
Sample ID

	Group A	Group B	Group C	Group D	Group E	Group F	Group G
	Control	SH-Ref-1	CARR	CARR / SH-Ref-1	SH-13A	SH-19	SH-22
	Y	Y	Y	Y	Y	Y	Y
1	0.669	0.322	0.432	0.353	0.160	0.295	0.397
2	0.312	0.320	0.419	0.427	0.278	0.206	0.378
3	0.373	0.333	0.407	0.416	0.276	0.282	0.313
4	0.317	0.460	0.454	0.416	0.283	0.316	0.257
5	0.317	0.376	0.372	0.438	0.254	0.212	0.285

	Group H	Group I	Group J	Group K
	SH-28	SPI-22	SPI-30	SPI-31
	Y	Y	Y	Y
1	0.282	0.416	0.395	0.402
2	0.438	0.537	0.527	0.226
3	0.127	0.405	0.443	0.317
4	0.264	0.385	0.409	0.438
5	0.426	0.330	0.367	0.235

1way ANOVA
ANOVA

1	Table Analyzed	Data 1				
2	Data sets analyzed	A : Control	B : SH-Ref-1	C : CARR	D : CARR / SH-Ref-1	E : SH-13A
3						
4	ANOVA summary					
5	F	3.102				
6	P value	0.0045				
7	P value summary	**				
8	Significant diff. among means (P < 0.05)?	Yes				
9	R square	0.4135				
10						
11	Brown-Forsythe test					
12	F (DFn, DFd)	0.7625 (10, 44)				
13	P value	0.6631				
14	P value summary	ns				
15	Are SDs significantly different (P < 0.05)?	No				
16						
17	Bartlett's test					
18	Bartlett's statistic (corrected)	18.79				
19	P value	0.0430				
20	P value summary	*				
21	Are SDs significantly different (P < 0.05)?	Yes				
22						
23	ANOVA table	SS	DF	MS	F (DFn, DFd)	P value
24	Treatment (between columns)	0.2065	10	0.02065	F (10, 44) = 3.102	P=0.0045
25	Residual (within columns)	0.2929	44	0.006657		
26	Total	0.4994	54			
27						
28	Data summary					
29	Number of treatments (columns)	11				
30	Number of values (total)	55				

1way ANOVA
Multiple comparisons

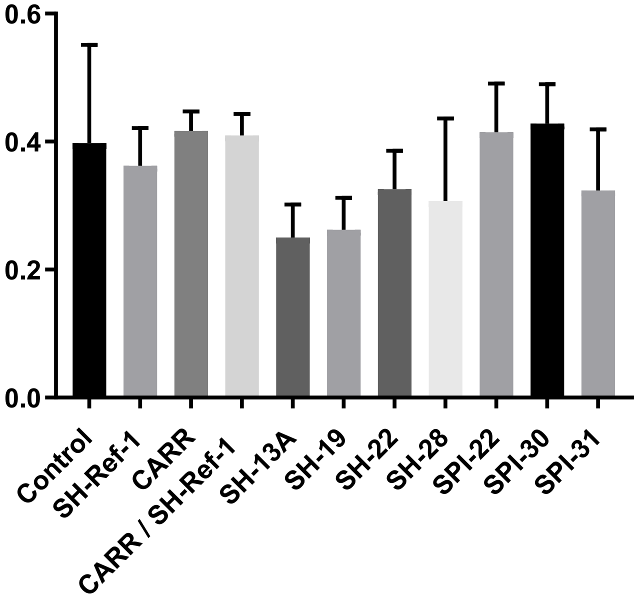
1	Number of families	1				
2	Number of comparisons per family	7				
3	Alpha	0.05				
4						
5	Sidak's multiple comparisons test	Mean Diff.	95.00% CI of diff.	Significant?	Summary	Adjusted P Value
6						
7	SH-Ref-1 vs. SPI-22	-0.0524	-0.1976 to 0.09278	No	ns	0.9296
8	CARR vs. SH-13A	0.1666	0.02142 to 0.3118	Yes	*	0.0164
9	CARR vs. SH-19	0.1546	0.00942 to 0.2998	Yes	*	0.0310
10	CARR vs. SPI-31	0.0932	-0.05198 to 0.2384	No	ns	0.4325
11	CARR / SH-Ref-1 vs. SH-22	0.084	-0.06118 to 0.2292	No	ns	0.5601
12	CARR / SH-Ref-1 vs. SH-28	0.1026	-0.04258 to 0.2478	No	ns	0.3171
13	CARR / SH-Ref-1 vs. SPI-30	-0.0182	-0.1634 to 0.127	No	ns	0.9999
14						
15						
16	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.	n1
17						
18	SH-Ref-1 vs. SPI-22	0.3622	0.4146	-0.0524	0.0516	5
19	CARR vs. SH-13A	0.4168	0.2502	0.1666	0.0516	5
20	CARR vs. SH-19	0.4168	0.2622	0.1546	0.0516	5
21	CARR vs. SPI-31	0.4168	0.3236	0.0932	0.0516	5
22	CARR / SH-Ref-1 vs. SH-22	0.41	0.326	0.084	0.0516	5
23	CARR / SH-Ref-1 vs. SH-28	0.41	0.3074	0.1026	0.0516	5
24	CARR / SH-Ref-1 vs. SPI-30	0.41	0.4282	-0.0182	0.0516	5

1			
2			
3			
4			
5			
6			
7	B-I		
8	C-E		
9	C-F		
10	C-K		
11	D-G		
12	D-H		
13	D-J		
14			
15			
16	n2	t	DF
17			
18	5	1.015	44
19	5	3.228	44
20	5	2.996	44
21	5	1.806	44
22	5	1.628	44
23	5	1.988	44
24	5	0.3527	44

1way ANOVA Descriptive Statistics		Control	SH-Ref-1	CARR	CARR / SH-Ref-1	SH-13A	SH-19	SH-22
1	Number of values	5	5	5	5	5	5	5
2								
3	Minimum	0.312	0.32	0.372	0.353	0.16	0.206	0.257
4	25% Percentile	0.3145	0.321	0.3895	0.3845	0.207	0.209	0.271
5	Median	0.317	0.333	0.419	0.416	0.276	0.282	0.313
6	75% Percentile	0.521	0.418	0.443	0.4325	0.2805	0.3055	0.3875
7	Maximum	0.669	0.46	0.454	0.438	0.283	0.316	0.397
8								
9	Mean	0.3976	0.3622	0.4168	0.41	0.2502	0.2622	0.326
10	Std. Deviation	0.1538	0.05917	0.03051	0.03314	0.05164	0.0501	0.05991
11	Std. Error of Mean	0.06877	0.02646	0.01364	0.01482	0.02309	0.02241	0.02679
12								
13	Lower 95% CI	0.2067	0.2887	0.3789	0.3688	0.1861	0.2	0.2516
14	Upper 95% CI	0.5885	0.4357	0.4547	0.4512	0.3143	0.3244	0.4004

	SH-28	SPI-22	SPI-30	SPI-31
1	5	5	5	5
2				
3	0.127	0.33	0.367	0.226
4	0.1955	0.3575	0.381	0.2305
5	0.282	0.405	0.409	0.317
6	0.432	0.4765	0.485	0.42
7	0.438	0.537	0.527	0.438
8				
9	0.3074	0.4146	0.4282	0.3236
10	0.1286	0.07601	0.06164	0.09573
11	0.05753	0.03399	0.02757	0.04281
12				
13	0.1477	0.3202	0.3517	0.2047
14	0.4671	0.509	0.5047	0.4425

Data 1


0.6
0.4
0.2
0.0
Control
SH-Ref-1
CARR
CARR / SH-Ref-1
SH-13A
SH-19
SH-22
SH-28
SPI-22
SPI-30
SPI-31

Statistical Results: *Mytilus galloprovnicialis* Larval Test

Constant	Value
Experiment Date	8/1/2017
Experiment ID	Anchor Shelton Harbor
Notebook ID	
Project	Mytilus galloprovincialis
Experimenter	
Protocol	

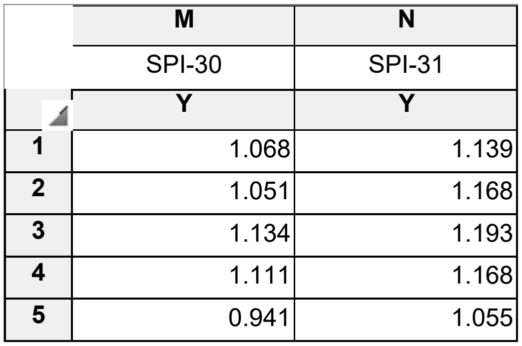
	Group A	Group B	Group C	Group D	Group E	Group F	Group G
	Control	SH-Ref-1	CARR/SH-Ref-1	CARR	CR-022	SH-04	SH-14
	Y	Y	Y	Y	Y	Y	Y
1	102.6	80.3	80.3	81.8	75.7	78.2	83.6
2	90.7	97.9	80.7	92.2	74.2	90.4	82.5
3	84.6	83.2	81.8	86.1	80.7	94.7	79.3
4	90.4	83.6	84.6	80.7	79.3	76.4	81.8
5	97.2	83.2	75.0	83.6	60.6	83.9	87.9

	Group H	Group I	Group J	Group K	Group L	Group M
	SH-19	SH-21	SH-22	SH-24	SPI-22	SPI-30
	Y	Y	Y	Y	Y	Y
1	70.3	74.2	76.4	82.9	62.4	76.8
2	67.8	77.8	68.1	81.4	66.0	75.3
3	63.5	80.7	88.6	74.6	62.8	82.1
4	66.4	87.2	72.8	82.5	69.6	80.3
5	58.5	74.6	68.1	77.8	57.7	65.3

	Group N
	SPI-31
	Y
1	82.5
2	84.6
3	86.4
4	84.6
5	75.7

	A	B	C	D	E	F
	Control	SH-Ref-1	CARR/SH-Ref-1	CARR	CR-022	SH-04
	Y	Y	Y	Y	Y	Y
1		1.111	1.111	1.130	1.055	1.085
2	1.261	1.425	1.116	1.288	1.038	1.256
3	1.168	1.148	1.130	1.189	1.116	1.338
4	1.256	1.154	1.168	1.116	1.098	1.064
5	1.403	1.148	1.047	1.154	0.892	1.158

	G	H	I	J	K	L
	SH-14	SH-19	SH-21	SH-22	SH-24	SPI-22
	Y	Y	Y	Y	Y	Y
1	1.154	0.994	1.038	1.064	1.144	0.911
2	1.139	0.967	1.080	0.971	1.125	0.948
3	1.098	0.922	1.116	1.226	1.043	0.915
4	1.130	0.952	1.205	1.022	1.139	0.987
5	1.216	0.871	1.043	0.971	1.080	0.863



	M	N
	SPI-30	SPI-31
	Y	Y
1	1.068	1.139
2	1.051	1.168
3	1.134	1.193
4	1.111	1.168
5	0.941	1.055

1way ANOVA
ANOVA

1	Table Analyzed	Transform of Data 1	
2	Data sets analyzed	A : Control	B : SH-Ref-1
3			
4	ANOVA summary		
5	F	7.12	
6	P value	<0.0001	
7	P value summary	****	
8	Significant diff. among means (P < 0.05)?	Yes	
9	R square	0.6273	
10			
11	Brown-Forsythe test		
12	F (DFn, DFd)	0.4923 (13, 55)	
13	P value	0.9197	
14	P value summary	ns	
15	Are SDs significantly different (P < 0.05)?	No	
16			
17	Bartlett's test		
18	Bartlett's statistic (corrected)	14.59	
19	P value	0.3334	
20	P value summary	ns	
21	Are SDs significantly different (P < 0.05)?	No	
22			
23	ANOVA table	SS	DF
24	Treatment (between columns)	0.5654	13
25	Residual (within columns)	0.336	55
26	Total	0.9014	68
27			
28	Data summary		
29	Number of treatments (columns)	14	
30	Number of values (total)	69	

1			
2	C : CARR/SH-Ref-1	D : CARR	E : CR-022
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23	MS	F (DFn, DFd)	P value
24	0.04349	F (13, 55) = 7.12	P<0.0001
25	0.006108		
26			
27			
28			
29			
30			

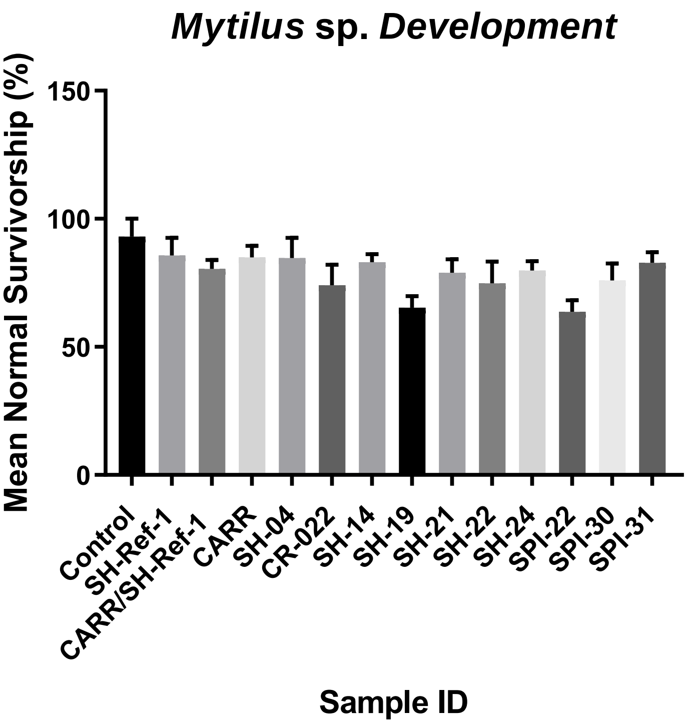
1way ANOVA Multiple comparisons					
1	Number of families	1			
2	Number of comparisons per family	9			
3	Alpha	0.1			
4					
5	Holm-Sidak's multiple comparisons test	Mean Diff.	Significant?	Summary	Adjusted P Value
6					
7	SH-Ref-1 vs. SPI-22	0.2728	Yes	****	<0.0001
8	CARR/SH-Ref-1 vs. SH-14	-0.03309	No	ns	0.9405
9	CARR/SH-Ref-1 vs. SH-22	0.06368	No	ns	0.7959
10	CARR/SH-Ref-1 vs. SH-24	0.008062	No	ns	0.9834
11	CARR/SH-Ref-1 vs. SPI-30	0.0534	No	ns	0.8349
12	CARR vs. SH-04	-0.004873	No	ns	0.9834
13	CARR vs. SH-19	0.2338	Yes	***	0.0001
14	CARR vs. SPI-31	0.03074	No	ns	0.9405
15	CR-022 vs. SH-21	-0.05634	No	ns	0.8349
16					
17					
18	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.
19					
20	SH-Ref-1 vs. SPI-22	1.197	0.9247	0.2728	0.04943
21	CARR/SH-Ref-1 vs. SH-14	1.114	1.147	-0.03309	0.04943
22	CARR/SH-Ref-1 vs. SH-22	1.114	1.051	0.06368	0.04943
23	CARR/SH-Ref-1 vs. SH-24	1.114	1.106	0.008062	0.04943
24	CARR/SH-Ref-1 vs. SPI-30	1.114	1.061	0.0534	0.04943
25	CARR vs. SH-04	1.175	1.18	-0.004873	0.04943
26	CARR vs. SH-19	1.175	0.9414	0.2338	0.04943
27	CARR vs. SPI-31	1.175	1.145	0.03074	0.04943
28	CR-022 vs. SH-21	1.04	1.096	-0.05634	0.04943

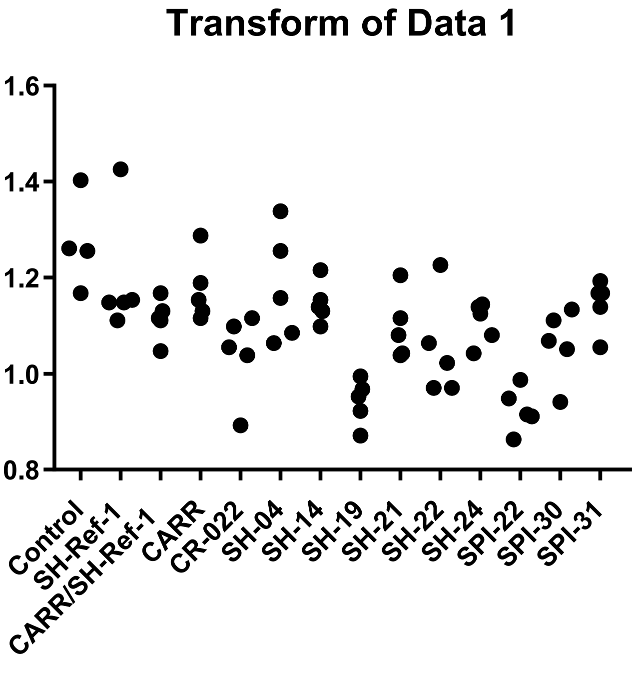
1				
2				
3				
4				
5				
6				
7	B-L			
8	C-G			
9	C-J			
10	C-K			
11	C-M			
12	D-F			
13	D-H			
14	D-N			
15	E-I			
16				
17				
18	n1	n2	t	DF
19				
20	5	5	5.518	55
21	5	5	0.6693	55
22	5	5	1.288	55
23	5	5	0.1631	55
24	5	5	1.08	55
25	5	5	0.09859	55
26	5	5	4.73	55
27	5	5	0.6218	55
28	5	5	1.14	55

1way ANOVA Descriptive Statistics		Control	SH-Ref-1	CARR/SH-Ref-1	CARR	CR-022
1	Number of values	4	5	5	5	5
2						
3	Minimum	1.168	1.111	1.047	1.116	0.8922
4	25% Percentile	1.19	1.13	1.079	1.123	0.9651
5	Median	1.258	1.148	1.116	1.154	1.055
6	75% Percentile	1.367	1.29	1.149	1.238	1.107
7	Maximum	1.403	1.425	1.168	1.288	1.116
8						
9	Mean	1.272	1.197	1.114	1.175	1.04
10	Std. Deviation	0.09726	0.1286	0.04358	0.06866	0.08841
11	Std. Error of Mean	0.04863	0.0575	0.01949	0.0307	0.03954
12						
13	Lower 95% CI	1.117	1.038	1.06	1.09	0.9302
14	Upper 95% CI	1.426	1.357	1.168	1.261	1.15

	SH-04	SH-14	SH-19	SH-21	SH-22	SH-24
1	5	5	5	5	5	5
2						
3	1.064	1.098	0.8708	1.038	0.9706	1.043
4	1.074	1.114	0.8965	1.04	0.9706	1.061
5	1.158	1.139	0.9525	1.08	1.022	1.125
6	1.297	1.185	0.9809	1.16	1.145	1.142
7	1.338	1.216	0.9944	1.205	1.226	1.144
8						
9	1.18	1.147	0.9414	1.096	1.051	1.106
10	0.1161	0.04314	0.04735	0.06842	0.1057	0.04366
11	0.05193	0.01929	0.02117	0.0306	0.04726	0.01953
12						
13	1.036	1.094	0.8827	1.011	0.9194	1.052
14	1.324	1.201	1	1.181	1.182	1.16

	SPI-22	SPI-30	SPI-31
1	5	5	5
2			
3	0.8627	0.9409	1.055
4	0.8867	0.9958	1.097
5	0.9148	1.068	1.168
6	0.9675	1.122	1.18
7	0.9868	1.134	1.193
8			
9	0.9247	1.061	1.145
10	0.04623	0.07483	0.05339
11	0.02067	0.03346	0.02388
12			
13	0.8673	0.968	1.078
14	0.9821	1.154	1.211


Mytilus sp. *Development*
Mean Normal Survivorship (%)
150
100
50
0
Control
SH-Ref-1
CARR/SH-Ref-1
CARR
SH-04
CR-022
SH-14
SH-19
SH-21
SH-22
SH-24
SPI-22
SPI-30
SPI-31
Sample ID



Transform of Data 1
1.6
1.4
1.2
1.0
0.8
Control
SH-Ref-1
CARR/SH-Ref-1
CARR
CR-022
SH-04
SH-14
SH-19
SH-21
SH-22
SH-24
SPI-22
SPI-30
SPI-31

APPENDIX C. Supporting Documents

Chain of Custody Record & Laboratory Analysis Request

ANCHOR QEA

Laborator mber:
Date:
Project Name: Shelton Harbor
Project Number: 110008-01.01
Project Manager: Nathan Soccorsy
Phone Number: 206-903-3385
Shipment Method:

Tes arameters

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	Larval Bioassay	Polychaete Bioassay	Full Suite Bioassay	Archive, 4°C	Comments/Preservation
1	SH-22-SG-170712	7/12/2017 0855	5→	4	X	X		X	11.7°C, 3.7°C ~~||||~~
2	SH-19-SG-170712	1225	5→	3	X	X		X	9.2°C, 11.4°C, 3.7°C ~~||||~~
3	SH-28-SG-170712	1620		3	X	X		X	9.0°C, 11.4°C |||
4	SH-14-SG-170712	1715		3	X			X	9.0°C, 11.4°C |||
5	SH-21-SG-170712	1800		3	X			X	9.2°C, 11.0°C |||
6	SH-04-SG-170713	7/13/2017 0740		3	X			X	9.2°C, 11.0°C |||
7	SH-13A-SG-170713	0820		3		X		X	9.2°C, 11.0°C |||
8	SPI-22-SG-170713	0900		1				X	9.0°C |
9	SPI-30-SG-170713	0940		1				X	9.0°C |
10	SH-24-SG-170713	1005		3	X			X	9.2°C, 9.0°C |||
11	SPI-31-SG-170713	1035		1				X	9.0°C |
12	~~SP[illegible]-SG-170713~~	~~1045~~							
13									
14									
15									

Notes:

Relinquished By: Eli Portmont
Company: Anchor QEA, LLC
Signature/Printed Name
Date/Time: 12:00 7/14/2017

Received By: Julia Baum Juli Baum
Company: EcoAnalysts
Signature/Printed Name
Date/Time: 7/15/17 1150

Relinquished By:
Company:
Signature/Printed Name
Date/Time

Received By:
Company:
Signature/Printed Name
Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Page___of____

Ammonia and Sulfide Analysis Record

Page 1 of 1

Client/Project:	Organism:	Test Duration (days):
SHelton Harbor	NA	NA

[✓ PRETEST] / INITIAL / FINAL / OTHER (circle one) DAY of TEST: NA

OVERLYING (OV) / [✓ POREWATER (PW)] (circle one) / Comments: Bulk

Calibration Standards Temperature		
Date:	Temperature:	Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
7/18/17	19.8°C	

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sample Volume (mL)	Measured Sulf. (mg/L)	Multi-plier	Calc-ulated Sulf. (mg/L)
SH-22	BUlK	7/18/17 UB/HE	5.61	20.1	7/18/17 UB/HE	N	7.4	27	1	0.022	10	0.22
SH-19			2.55	19.9			7.4	16	1	0.014	10	0.14
SH-28			2.98	20.0			7.3	26	1	0.012	10	0.12
SH-14			2.15	20.0			7.3	27	1	0.036		
SH-21			3.67	19.9			7.4	26	10	0.112		
SH-04			4.53	19.9			7.3	26	1	0.010	10	0.10
SH-13A			2.46	20.0			7.1	27	1	0.017		
SPI-22			6.72	20.4			7.3	26	② ~~10~~ 0.1	0.141	100	14.1
SPI-30			① ~~11.1~~ 11.8	20.2			7.1	26	0.1	0.590	100	59.0
SH-24			7.04	21.5			7.7	24	10	0.075	1	0.075
SPI-31	↓	↓	8.41	20.4	↓	↓	7.3	26	1	0.011		

① MR Hq 7/18

② Sample dilution required. JL 7/19/17.

Wet-Sieve Procedure for Determining Percent Fines (<63 µm) of Sediment

DATE:	CLIENT:	PROJECT:
7/18/~~18~~ 17 ①	Anchor	~~set~~ ② Shelton Harbor

Procedure:

1. Collect 50 mL of sediment to be analyzed
2. Transfer sediment to a #230 (63 µm) testing sieve
3. Rinse sieve thoroughly with a stream of water until water flowing through the sieve is clear
4. Transfer all retained material to a 100mL graduated cylinder using a small funnel and DI squirt bottle
5. Allow sediment to settle. Record the volume of sediment retained below.

SAMPLE ID:	INITIAL VOLUME OF SEDIMENT (mL)	VOLUME OF SEDIMENT RETAINED (mL)	(INIT VOL - VOL RETAINED) * 2		Estimated Percent Fines
19	50	26	(50-26)×2	=	48
22	↓	32	(50-32)×2	=	36
14		34	(50-34)×2	=	32
21		19	(50-19)×2	=	62
24		31	(50-31)×2	=	38
04		26	(50-26)×2	=	48
28		36	(50-36)×2	=	28
13		27	(50-27)×2	=	46
30		33	(50-33)×2	=	34
SPI-22		45	(50-45)×2	=	10
SPI-31		22	(50-22)×2	=	56
				=	
				=	
				=	
				=	
				=	
				=	
				=	
				=	
				=	
				=	
				=	
				=	
				=	

① wrong year AK 7/18 ② Ia HR 7/18

CHAIN OF CUSTODY

EcoA ALYSTS
LIF N WATER

EcoAnalysts, Inc.
4770 NE View Dr., Port ble, WA. 98364
: (360) 461-5784,

Destination: PG Lab	Sample Originator (Organization): EcoAnalysts	Report Results To:	Phone:
Destination Contact: Julia Baum	**PERSON WHO COLLECTED SAMPLE:** Lauren Brandkamp & Hillary Eikler	Contact Name:	Fax:
Date: 7/22/17	Address: 4770 NE View Dr, Port Gamble, WA 98364	Address:	Email:
Turn-Around-Time: N/A			
Project Name: Shelton Harbor	Phone: 360 297 6040	**Invoicing To:**	
	Fax:	**Comments or Special Instructions:**	
Contract/PO:	E-mail LBRANDKAMP@ECOANALYSTS.com		

No.	Sample ID	Matrix	Volume & Type of Container	Date & Time	Analyses:						Preservation	Sample Temp Upon Receipt	LAB ID
1	CARR	Sed	3 gal bag	7/22/17 1600							4°C		P170722.01
✓ 2	CR-22	↓	↓	↓							↓		P170722.02
3	SH-Ref-1												P17-0722.03
✓ 4	CR-0 22												P170722.04
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

Relinquished by:	Recieved by:	Relinquished by:	Recieved by:	Matrix Codes
Print Name:	Print Name:	Print Name:	Print Name:	
Signature:	Signature:	Signature:	Signature:	FW = Fresh Water
Affiliation:	Affiliation:	Affiliation:	Affiliation:	SB = Salt & Brackish Water
Date/Time:	Date/Time:	Date/Time:	Date/Time:	SS = Soil & Sediment

Wet-Sieve Procedure for Determining Percent Fines (<63 µm) of Sediment

DATE:	CLIENT:	PROJECT:
7/24/17	Anchor	Shelton

Procedure:

1. Collect 50 mL of sediment to be analyzed
2. Transfer sediment to a #230 (63 µm) testing sieve
3. Rinse sieve thoroughly with a stream of water until water flowing through the sieve is clear
4. Transfer all retained material to a 100mL graduated cylinder using a small funnel and DI squirt bottle
5. Allow sediment to settle. Record the volume of sediment retained below.

SAMPLE ID:	INITIAL VOLUME OF SEDIMENT (mL)	VOLUME OF SEDIMENT RETAINED (mL)	(INIT VOL - VOL RETAINED) * 2	Estimated Percent Fines
SH-ref	50	45	50-45= 5 x2 =	10
CARR	50	24	50-24 = 26 x2 =	52%
CR-22	50	46	50- 46 = 4x2 = =	8%
CR-022	50	14	50-14 = 36·2 =	72%
			=	
CARR/SH	50	36	50-36 =14·2 =	28%
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	
			=	

ORGANISM RECEIPT LOG

Date: 7/28/17

Time: 0845

Batch No. ATS

Organism: Neanthes arenaceodentata

Source / Supplier: Aquatic Tox Support

No. Ordered: 560

No. Received: 616

Source Batch: Collection date, hatch date, etc.): Emerged 7/10-14/17

Condition of Organisms: good

Approximate Size or Age: (Days from hatch, life stage, size class, etc.): 14-18 days

Shipper: Courier

B of L (Tracking No.) NA

Condition of Container: Good

Received By: UB

Container	D.O. (mg/L)	Temp. (°C)	Cond. or [✓ Sal.] (Include Units) ppt	pH (Units)	# Dead	% Dead*	Tech. (Initials)
① 1	13.5	18.8	30	② ~~3~~ 7.6	0	—	UB

**if >10% contact lab manager*

Notes: ① composite of containers, ub 7/28
② mr, ub, 7/28

Aquatic Toxicology Support
1849 Charleston Beach Road West
Bremerton, Washington 98312
(360) 813-1202

Order Summary

Species: *Neanthes arenaceodentata**	Emerge Date: 10-14 July '17
Number Ordered: 560	Number Shipped: 560 + 10%
Date Shipped: 28 July '17	Salinity (ppt): 30

*Smith 1964. CSU Long Beach strain. Feed upon arrival.

ORGANISM RECEIPT LOG

Date: 7/27/17

Time: 1230

Batch No. NAS 4950

Organism: Eohs

Source / Supplier: NAS

No. Ordered: 1000

No. Received: ~1100

Source Batch: Collection date, hatch date, etc.): collected 7/~~26~~/17 25 ①

Condition of Organisms: good

Approximate Size or Age: (Days from hatch, life stage, size class, etc.): 3-5 mm

Shipper: Fedex

B of L (Tracking No.) 4068 0541 4950

Condition of Container: good

Received By: Az

Container	D.O. (mg/L)	Temp. (°C)	Cond. or Sal. (Include Units)	pH (Units)	# Dead	% Dead*	Tech. (Initials)
② →					0	—	

if >10% contact lab manager

Notes: ① Ea Ha 7/27 ② shipped dry

Northwestern Aquatic Sciences
3814 Yaquina Bay Rd., P.O. Box 1437, Newport, OR 97365
Tel: 541-265-7225, Fax: 541-265-2799, www.nwaquatic.com

SUBJECT: Animal Collection Data Sheet (shipping)

SOLD TO: EcoAnalysts
4729 NE View Dr.
P.O. Box 216
Port Gamble WA 98364

FedEx# 1817-5747-7

Brian Hester/Collin Ray/Hillary Eicholer
360.297.6040
Julia Baum
360.509.4141

DATE OF SHIPMENT: 7-26-17

ANIMAL HISTORY

Species	**Age/Size**	**Number Shipped**
Eohaustorius estuarius	3-5mm	1000 + 10%

WATER QUALITY AT TIME OF SHIPMENT

Temperature (°C): 15.0	pH: 8.2	Salinity (ppt): 29.0	D.O. (mg/L): 8.0
Other:			

PACKAGED BY: Yves Nakahara **DATE:** 726-17

FIELD COLLECTION/CULTURE NOTES

Collected 7-25-17 from Yaquina Bay, OR.
Interstitial WQ: Temp: 13.5 °C, Salinity 32.0 ppt.; salinity adjusted up ~5 ppt.
Held at 15°C in aerated water.

ADDITIONAL COMMENTS

P.O. # PGL 1324

2-liters of 0.5 mm sieved home sediment included.

PLEASE RETURN ALL SHIPPING MATERIALS

If you have any questions, Please call Gary Buhler or Gerald Irissarri at (541) 265-7225. Thank You.

ORGANISM RECEIPT LOG

Date: 7/25/17

Time: 1300

Batch No. TS 2849

Organism: Mytilus

Source / Supplier: Taylor Shellfish

No. Ordered: 10 lbs

No. Received: 10 lbs

Source Batch: Collection date, hatch date, etc.): collected 7/24

Condition of Organisms: good

Approximate Size or Age: (Days from hatch, life stage, size class, etc.): Adult

Shipper: Fedex

B of L (Tracking No.) 7872 7434 2849

Condition of Container: good

Received By:

Container	D.O. (mg/L)	Temp. (°C)	Cond. or Sal. (Include Units)	pH (Units)	# Dead	% Dead*	Tech. (Initials)
①							

**if >10% contact lab manager*

Notes: ① shipped dry 7/25

MAINTENANCE LOG FOR CULTURES

ORGANISM: Eohaustorius

LOCATION: Bath 9

Batch Number: NAS4950	Date Received: 7/27/17	Initial # of Organisms: ~1100

Date	Feed AM/PM		Tub No.	D.O.	Temp (°C)	Cond/ [✓ Sal] ppt	pH	H_2O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
7/28/17	—		1	8.1	15.6	28	8.0	① ~~N~~ FT	Y	0	—	UB	
7/29/17	—		1	8.1	15.6	28	8.0	FT	Y	0	—	UB	

FT = Flow-through ①

**if >10% notify lab manager*

MAINTENANCE LOG FOR CULTURES

ORGANISM: Mytilus sp.
LOCATION: Bath 9

Batch Number: TS2849	Date Received: 7/25/17	Initial # of Organisms: 10 lbs

Date	Feed AM/PM		Tub No.	D.O.	Temp (°C)	Cond/[✓ Sal] ppt	pH	H₂O Change	Organisms appear healthy (Y/N)	# Mort	% Mort*	Init.	Comments
7/26/17	—		1	4.4①	14.2	30	7.5	FT	Y	0	—	UB	

FT = Flow-through
**if >10% notify lab manager*

① Increased air flow, UB 7/26

Appendix B

Interim Action Alternative Cost Estimates

Table B-1
Cost Estimate for Alternatives

Cost Element	Unit Cost	Unit	Basis	Quantities				Costs			
				Alt 1 Removal	Alt 2 Capping	Alt 3 ENR	Alt 4 MNR	Alt 1 Removal	Alt 2 Capping	Alt 3 ENR	Alt 4 MNR
Removal, Dewatering, Transportation, Transload, and Disposal											
Dredge to Barge and Dewater	$30	cy	Unit cost based on project experience in Puget Sound and recent bids. Quantities calculated in Table B-2.	80,800	0	0	0	$2,424,000	$0	$0	$0
Transport by Barge from Shelton to Lafarge (Seattle)	$16	cy	150 miles round trip. Costs based on 4 days round trip (including offload) for 2000 cy barge at $8,000/day for barge + tug.	80,800	0	0	0	$1,292,800	$0	$0	$0
Transload, Transport (Rail) and Tipping	$120	cy	Based on recent bids for transload at the Lafarge facility, transport, and tipping.	80,800	0	0	0	$9,696,000	$0	$0	$0
Subtotal Removal								**$13,412,800**	**$0**	**$0**	**$0**
Sand and Gravel Purchase, Delivery, Transload and Place											
Purchase from Local Quarry	$8	cy	Cost of pit run from Shelton-area pits, includes transport to the Shelton Harbor shoreline. Does not account for transload to barge. Quantities calculated in Table B-2.	80,800	23,100	5,900	0	$646,400	$184,800	$47,200	$0
Transload from Stockpile to Barge	$5	cy	Costs based on project experience and includes loading equipment and labor.	80,800	23,100	5,900	0	$404,000	$115,500	$29,500	$0
Material Placement From Barge	$25	cy	Unit cost based on project experience in Puget Sound and recent bids.	80,800	23,100	5,900	0	$2,020,000	$577,500	$147,500	$0
Subtotal Placement								**$3,070,400**	**$877,800**	**$224,200**	**$0**
Total Construction Costs											
Subtotal Construction								**$16,483,200**	**$877,800**	**$224,200**	**$0**
Additional Costs											
Mobilization/Demobilization	15%		Percentage of construction costs. Typical FS-level estimate.	1	1	1	0	$2,472,480	$131,670	$33,630	$0
Tax	8.5%		Tax rate in Shelton.					$1,401,072	$74,613	$19,057	$0
Design, Permitting, and Construction Support	20%		Percentage of construction costs. Typical FS-level estimate.					$3,296,640	$175,560	$44,840	$0
Contingency	30%		Percentage of construction costs. Typical FS-level estimate.					$4,944,960	$263,340	$67,260	$0
Post-Construction Monitoring	$70,000	per event	Based on project experience.	2	5	10	20	$140,000	$350,000	$700,000	$1,400,000
Total Costs											
Total								**$28,738,352**	**$1,872,983**	**$1,088,987**	**$1,400,000**
Total (Rounded)								**$29,000,000**	**$1,900,000**	**$1,100,000**	**$1,400,000**

Notes:
Alt: alternative
cy: cubic yard
ENR: enhanced natural recovery
MNR: monitored natural recovery

Table B-2
Volume Estimate for Alternatives

SMA	Area (acres)	Alternative 1 - Removal + Backfill				Alternative 2 - Capping		Alternative 3 - ENR	
		Contaminant Depth (Neatline) (ft)	Overdepth (ft)	Side Slope Allowance	Volume (cy)	Thickness Including Overplacement (ft)	Volume (cy)	Thickness (ft)	Volume (cy)
1	4.4	2	1	20%	25,500	1.5	10,600	0.5	3,500
2	0.6	2	1	20%	3,500	1.5	1,500	0.5	500
3 (Slope)	2.1	10	1	30%	49,400	3.0	10,400	0.5	1,700
3 (Flat)	1.4	4	1	20%	2,400	1.5	600	0.5	200
Total	**8.5**				**80,800**		**23,100**		**5,900**
Construction Duration (Days)					360		58		15
Construction Duration (Months)					18		3		1
Construction Duration (Seasons)					3		0.5		0.1

	Production Rate (cy/day)
Removal	500
Placement	400

Construction Season Days Calculation	
Start of Construction Season	15-Jul
End of Construction Season	15-Feb
Total Days	215
Weekend Days	61
Holidays	7
Delays (Permitting, Contracting, Mob/Demob, etc.)	20
Total Production Days	127

Notes:

cy: cubic yard

ENR: enhanced natural recovery

ft: foot

SMA: Sediment Management Area