IOSA Development Area Sampling and Analysis Plan

Port of Friday Harbor
Jensen's Marina

Project Number: 040-001

Prepared for:
The Port of Friday Harbor

September 24, 2020

Prepared by:

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Prepared for:
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Prepared by:

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Reviewed by:

Grant Hainsworth, P.E.

September 24, 2020

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1 Introduction

This document presents the Sampling and Analysis Plan (SAP) for completing an investigation in the eastern grass area at the Port of Friday Harbor's (Port) Jensen's Marina (site), shown on Figure 1. This field work is being performed under Agreed Order DE 18071 but will occur prior to development of the site-wide Remedial Investigation Work Plan (RIWP). Data collected during this work will further define potential soil contamination and will be incorporated into the data gaps analysis of the RIWP.

Work associated with this SAP will focus on the eastern portion of the site where near-term development of a new headquarters building is planned for the Islands' Oil Spill Association (IOSA). Soil data will be collected from within and surrounding the IOSA facility development footprint. The data will be used to evaluate whether any cleanup activities are required in conjunction with development of this portion of the property.

1.1 Site Conditions

The eastern side of the site is primarily a large grassy area. Near the northeastern shoreline, an area formerly used for dumping of miscellaneous boat parts or debris was observed during the Phase I Environmental Site Assessment by Whatcom Environmental Services (Whatcom, 2017). As indicated in the Conceptual Site Model (Shannon & Wilson, 2019), leaks from batteries could be a source of metals contamination, lubricants on engine parts could be a source of petroleum contamination, and leaks from old radiators could contain coolant which may be a source of lead and copper or other metal contamination.

Historical sample locations and analytical data for detected compounds are provided on Figure 2. Table 1 provides an analytical data summary for samples collected in this area and indicates that metals are potential constituents of interest. Surface soil and test pit sampling conducted in 2018 indicated elevated arsenic, copper, mercury, and zinc associated with the dumping area (Table 2).

1.2 Potential Data Gaps

There is limited soil data within the large grassy area in the immediate proximity of the planned IOSA facility footprint. This area is bounded to the north by the former underground storage tank (UST) area, oil shed, abandoned cabin, and former dumping area along the shoreline (shown on Figure 1).

Surface soil at MW-5 (Figure 2) had detections of copper, mercury, and zinc above screening levels (Table 1). Vadose soil samples collected at UST-1 and UST-2 (5 and 3 feet below ground surface [bgs], respectively), associated with the former UST, did not exhibit hydrocarbon impacts; however samples were not analyzed for metals. Arsenic, copper, and zinc were detected in a surface soil sample from FDA-2 (Figure 2) above screening levels. Mercury and zinc were detected in a vadose zone soil sample (2.5 feet bgs) from FDA-3 (Figure 2).

Test pits within the proposed IOSA facility footprint and areas immediately to the north (former UST area, former dumping area, oil shed) will provide visual soil characterization and soil sampling to better understand the extent of dumped materials. Test pits sample locations are proposed above ordinary high water and in areas to provide spatial distribution for soil characterization. Eight test pits are proposed to characterize and delineate the extent of potential contamination present in the footprint area of the IOSA facility and along the northeastern shoreline.

2 Sampling and Analysis Program

Additional soil data will be collected to refine the understanding of site conditions. The Quality Assurance Project Plan is included in Appendix A. Proposed sample locations are shown on Figure 3 and sample methods are detailed Section 2.1.2 and in the Standard Operating Procedures (SOPs) included in Appendix B. A site-specific Health and Safety Plan has been produced as a separate document.

2.1 Soil Sampling

Soil samples are proposed to assess the extent of buried debris and potentially contaminated soil within and near the proposed areas for the IOSA development. All sampling will be performed in accordance with SOP-2345 (Appendix A).

Test pit locations are shown on Figure 3. Eight test pit locations are proposed within and surrounding the proposed boundaries of the future IOSA facility as follows:

- Five (5) test pits are proposed in the eastern grassy area where the IOSA building will be constructed.
- Three (3) test pits are proposed along the northeastern shoreline to better understand the vertical and lateral extent of potential debris in the former dumping area.

2.2 Sampling Procedures

A Port-owned excavator/backhoe will be used to dig an elongate test pit to equipment limits (maximum depth of excavator/backhoe arm reach) or water table depth, whichever comes first. Test pits lengths will be on the order of 6-feet long. Excavation activities will cease at the water table. A profile of each test pit will be drafted in the field, noting debris, soil types, any discolorations or staining, and unusual features. Soil samples will be collected as follows:

- For test pits depths of up to 4 feet deep with no indication of a potential cave-in (as determined by a competent person), samples will be collected from the side walls or bottom of the test pit.
- For test pits 4 feet or deeper or where there is an indication of potential cave-in, samples will be collected using the excavator/backhoe bucket to scrape the bottom or sidewalls, obtaining bulk samples. When possible, the bulk samples will be pulled apart by hand to obtain a more representative untouched sample from in the interior of the larger bulk sample.

Soil will be field screened (with a photoionization detector [PID] and visual and olfactory observations) and. If field screening indicates potential soil contamination, then samples will be collected at depths where screening indicates hydrocarbon, solvent, or other potential contamination. If there is no indication of contamination, soil samples will be collected at 1, 3, and 5 feet bgs and from immediately above the water table; select samples will be analyzed as described in Section 2.3. Depths of each sample will be noted on the test pit profile.

During test pit excavation, soil removed from each test pit will be carefully and temporarily placed on plastic sheeting and returned to the corresponding test pit (backfilled) after each test pit investigation is completed. Test pits will be backfilled immediately after the sampling is completed. The excavator/backhoe used for test pit excavation will compact the soils during backfilling to account for soil fluff that occurs during in-situ soil removal. The excavator/backhoe bucket will be brushed clean of physical debris and residual soil over each corresponding trench location.

Prior to any excavation activities conducted at the site, a formal underground public utility locate request will be submitted through the Washington 811 utility locate request service and a private utility locating service will used to identify any private utilities in the proposed test pits areas.

2.3 Sample Analysis

At least one soil sample per test pit will be analyzed. Without evidence of potential contamination, the shallowest soil sample (1 foot bgs) will be analyzed to focus on testing soil that is most likely to be disturbed during development activities. If there is evidence of potential contamination, then soil samples representative of this potential contamination will be analyzed. At a minimum, soil samples will be analyzed for metals by EPA Method 6020 for arsenic, cadmium, copper, lead, mercury, nickel, and zinc. If at any given sample location, PID measurements or visual/olfactory observations indicate possible hydrocarbon or solvent contamination, then sample collection for hydrocarbon and associated constituents may be collected for, NWTPH-G/BTEX, NWTPH-Dx, PCBs, PAHs, and VOCs. Samples will be submitted to the laboratory on standard turn around.

2.4 Waste Management

Any investigation-derived waste (IDW), including waste/wastewater generated during decontamination of equipment, will be collected and managed in appropriate waste containers such as 55-gallon poly or steel drums. Soil waste is not expected to be generated, as soil removed from each test pit will be carefully and temporarily placed on plastic sheeting and returned to the corresponding test pit after each test pit investigation is completed. The excavator/backhoe used for test pit installation will compact the soils during backfilling to account for soil fluff that occurs during in-situ soil removal. The excavator/backhoe bucket will be brushed clean of physical debris and residual soil over each trench location, and, as needed, hosed or sprayed clean between test pit excavations, capturing any wash/decontamination water and transferring it to an approved drum(s) for storage. All waste will be appropriately characterized in accordance with applicable regulations based on the laboratory analytical results and historical knowledge. IDW stored in drums will remain at the site until the completion of the investigation, where any and all

IDW will be disposed of at facilities approved by the Port and in accordance with applicable regulations.

3 Schedule and Reporting

Field activities are planned to be completed in October 2020. After completion of all tasks, a summary memorandum will be prepared to document the results. The results will ultimately be incorporated into the RIWP and Remedial Investigation report for the site and will be submitted to Ecology's EIM database at that time.

4 References

Leon Environmental, LLC, August 2019. Intertidal and Subtidal Conceptual Site Model and Data Gaps Report, Jenson and Sons Boatyard and Marina, Friday Harbor, Washington.

Shannon and Wilson, August 2019. Draft Conceptual Site Model and Data Gaps Report, Former Jenson Shipyard, Friday Harbor, Washington.

Whatcom Environmental Services, November 21, 2017. Phase I Environmental Site Assessment, Jensen's Shipyard, 1293 Turn Point Road, Friday Harbor, Washington.

Whatcom Environmental Services, April 2, 2018. Draft Initial Investigation Report, Jensen's Shipyard, 1293 Turn Point Road, Friday Harbor, Washington.

Whatcom Environmental Services, October 15, 2018. Draft Remedial Investigation Report, Jensen's Shipyard and Marina, 1293 Turn Point Road, Friday Harbor, Washington.

Tables

Table 1 Historical Soil Sample Results

Sample ID	MW-5	MW-5	FDA-1	FDA-2	FDA-3	UST-1	UST-2
Sample Depth	2-6 inches	10 ft bgs	2 ft bgs	0-6 inches	2.5 ft bgs	5 ft bgs	3 ft bgs
Date	7/31/18	7/31/18	1/24/18	1/24/18	1/24/18	1/24/18	1/24/18
TPH (mg/kg)							
NWTPH-Gx Volatile Range	NA	NA	NA	NA	NA	ND(<3.0)	ND(<3.0)
NWTPH-Dx Diesel Range	ND(<25)	ND(<25)	ND(<25)	ND(<25)	ND(<25)	ND(<25)	ND(<25)
NWTPH-Dx Oil-Range	96	ND(<50)	ND(<50)	ND(<50)	420	ND(<50)	ND(<50)
EPA-8021 Benzene	NA	NA	NA	NA	NA	ND(<0.03)	ND(<0.03)
EPA-8021 Toluene	NA	NA	NA	NA	NA	ND(<0.05)	ND(<0.05)
EPA-8021 Ethylbenzene	NA	NA	NA	NA	NA	ND(<0.05)	ND(<0.05)
EPA-8021 Xylenes	NA	NA	NA	NA	NA	ND(<0.20)	ND(<0.20)
Metals (EPA-6020/7471) (mg/kg)							
Arsenic	4.9	2.4	3.5	8.7	3.5	NA	NA
Cadmium	0.7	ND(<0.22)	ND(<0.5)	ND(<0.5)	ND(<0.5)	NA	NA
Chromium	39	18	41	21	22	NA	NA
Copper	140	14	16	79	29	NA	NA
Lead	120	2.1	6.4	52	190	NA	NA
Mercury	0.1	ND(<0.02)	0.028	ND(<0.02)	0.16	NA	NA
Zinc	190	26	30	270	220	NA	NA
PCBs (EPA-8082) (mg/kg)							
Total PCBs	NA	NA	NA	NA	NA	NA	NA
Dioxins and Furans (EPA-1613B) (ug/kg)							
Chlorinated dibenzo-p-dioxins TEQ	NA	NA	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds (SVOCs) (EPA-8270 SIM) (mg/kg)							
Naphthalene	ND(<0.02)	ND(<0.02)	NA	NA	NA	NA	NA
2-Methylnaphthalene	ND(<0.02)	ND(<0.02)	NA	NA	NA	NA	NA
1-Methylnaphthalene	ND(<0.02)	ND(<0.02)	NA	NA	NA	NA	NA
Acenaphthylene	ND(<0.02)	ND(<0.02)	NA	NA	NA	NA	NA
Acenaphthene	ND(<0.02)	ND(<0.02)	NA	NA	NA	NA	NA
Fluorene	ND(<0.02)	ND(<0.02)	NA	NA	NA	NA	NA
Phenanthrene	0.031	ND(<0.02)	NA	NA	NA	NA	NA
Anthrancene	ND(<0.02)	ND(<0.02)	NA	NA	NA	NA	NA
Fluoranthene	0.096	ND(<0.02)	NA	NA	NA	NA	NA
Pyrene	0.088	ND(<0.02)	NA	NA	NA	NA	NA
Benzo[A]Anthracene	0.048	ND(<0.02)	NA	NA	NA	NA	NA
Chrysene	0.053	ND(<0.02)	NA	NA	NA	NA	NA
Benzo[B]Fluoranthene	0.09	ND(<0.02)	NA	NA	NA	NA	NA
Benzo[K]Fluoranthene	ND(<0.02)	ND(<0.02)	NA	NA	NA	NA	NA
Benzo[A]Pyrene	0.05	ND(<0.02)	NA	NA	NA	NA	NA
Indeno[1,2,3-Cd]Pyrene	0.039	ND(<0.02)	NA	NA	NA	NA	NA
Dibenz[A,H]Anthracene	ND(<0.02)	ND(<0.02)	NA	NA	NA	NA	NA
Benzo[G,H,I]perylene	0.048	ND(<0.02)	NA	NA	NA	NA	NA
Total cPAH Equivalent (TEQ)	0.070	ND(<0.02)	NA	NA	NA	NA	NA

mg/kg - milligrams per kilogram
ug/kg - microgram per kilogram
TPH - Total Petroleum Hydrocarbons
ft bgs - feet below ground surface
PCBs - Poly-Chlorinated Biphenyls
TEQ - Toxic Equivalcency
[a] - Cleanup level dependent on BTEX concentrations
[b] - indicates sum of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene
[c] - indicates cleanup level is dependant on Chromium(VI) concentrations.
[d] - indicates Method B direct contact cleanup level
ND - indicates analyte was not detected at level above reporting limit (shown in parentheses)
NA - indicates sample was not analyzed for the constituent
BOLD - indicates that the concentration in the sample exceeds the MTCA Method A or Method B target cleanup levels

Table 2 Summary Statistics for Planned IOSA Facility

Matrix	Parameter Group	Units	Maximum Detection	Initial Screening Level	Basis for Screening Level	# Samples	# Detections	# Non-Detections	Detect Frequency	# Screening Level Exceedances
Soil	NWTPH-Gx	mg/Kg	ND	100	MTCA Method A	2	0	2	0%	0
Soil	NWTPH-Dx	mg/Kg	420	2000	MTCA Method A	7	2	5	29%	0
Soil	Arsenic	mg/Kg	8.7	7.3	Natural Background	5	5	0	100%	**1**
Soil	Cadmium	mg/Kg	0.7	1.1	MTCA Soil Protective of Groundwater to Surface Water Quality	5	1	4	20%	0
Soil	Chromium	mg/Kg	41	48.2	Natural Background	5	5	0	100%	0
Soil	Copper	mg/Kg	140	36.4	Natural Background	5	5	0	100%	**2**
Soil	Lead	mg/Kg	190	250	MTCA Method A	5	5	0	100%	0
Soil	Mercury	mg/Kg	0.16	0.07	Natural Background	5	3	2	60%	**2**
Soil	Zinc	mg/Kg	270	100.9	MTCA Soil Protective of Groundwater to Surface Water Quality	5	5	0	100%	**3**
Soil	Dioxins/Furans (1613B)	mg/Kg	NA	0.000013	MTCA Method B	----	----	----	----	----
Soil	cPAHs (8270-SIM)	mg/Kg	0.07	0.1	MTCA Method A	2	1	1	50%	0
Soil	PCBs (8082)	mg/Kg	NA	1	MTCA Method A	----	----	----	----	----
Soil	BTEX	mg/Kg	No detections			2	0	2	0%	0
Groundwater	NWTPH-Gx	ug/L	<50	1000	MTCA Method A	2	0	2	0%	0
Groundwater	NWTPH-Dx	ug/L	<250	500	MTCA Method A	2	0	2	0%	0
Groundwater	Arsenic	ug/L	1.2	5	MTCA Method A	2	1	1	50%	0
Groundwater	Cadmium	ug/L	<1	1.2	Marine Surface Water Quality	2	0	2	0%	0
Groundwater	Chromium	ug/L		50	Marine Surface Water Quality for CrVI	1	0	1	0%	0
Groundwater	Copper	ug/L	3.07	3.1	Marine Surface Water Quality	2	1	1	50%	0
Groundwater	Lead	ug/L	<1	8.1	Marine Surface Water Quality	2	0	2	0%	0
Groundwater	Mercury	ug/L	<0.2	0.2	PQL	2	0	2	0%	0
Groundwater	Zinc	ug/L	<2.5	81	Marine Surface Water Quality	2	0	2	0%	0
Groundwater	cPAHs (8270-SIM)	ug/L	ND	0.02	PQL	1	1	0	100%	0
Groundwater	SVOCs (8270)	ug/L	No detections			1	0	1	0%	0
Groundwater	VOCs (8260)	ug/L	No detections			1	0	1	0%	0
Groundwater	BTEX	ug/L	No detections			1	0	1	0%	0

Notes:

mg/kg - milligram per kilogram

ug/L - microgram per liter

NWTPH-Gx - Gasoline Range Total Petroleum Hydrocarbons

NWTPH-Dx - Diesel Range Total Petroleum Hydrocarbons

cPAHS - Constituent Poly Aromatic Hydrobarbons

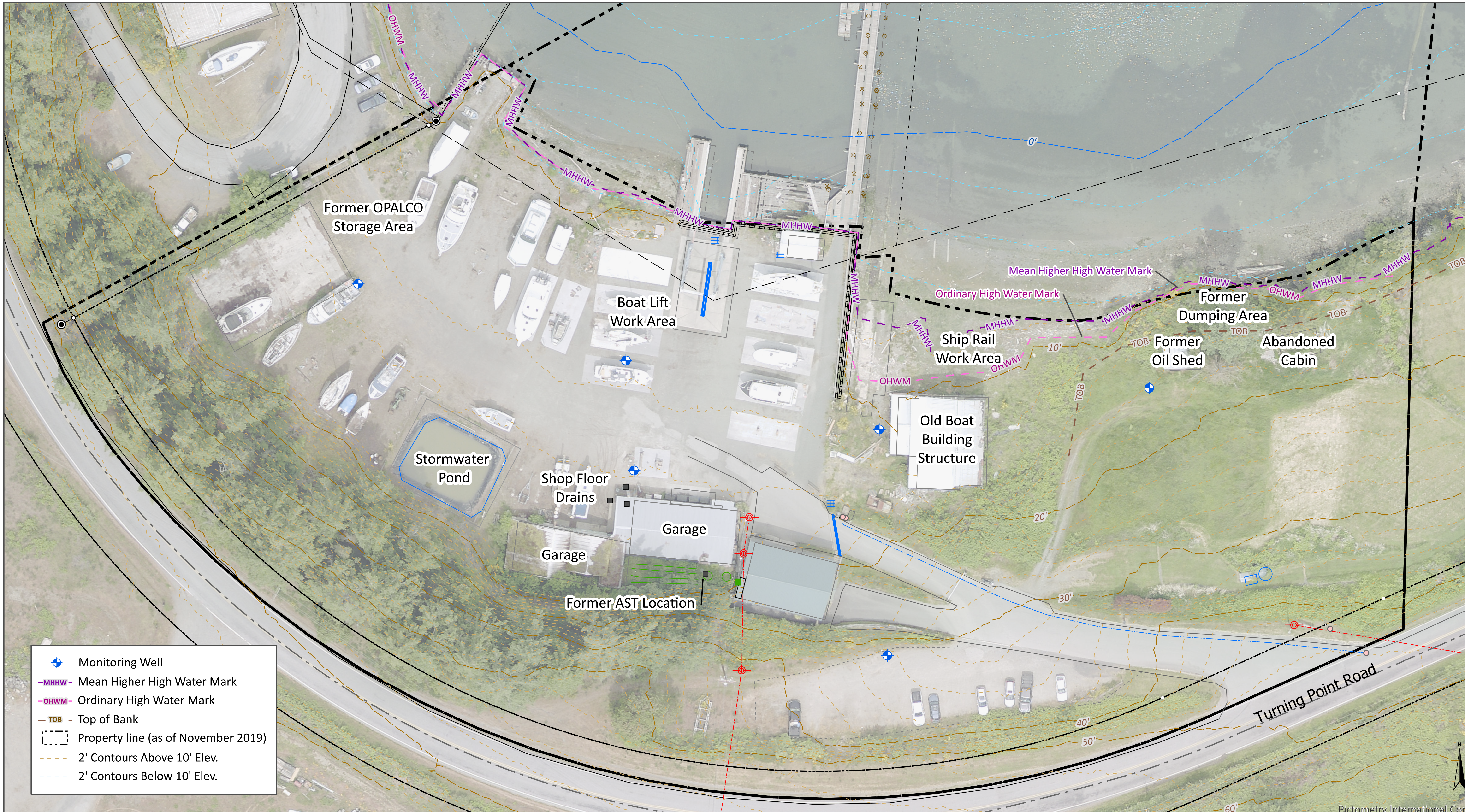
SVOCs - Semi-Volatile Organic Compounds

PCBs - Polychlorinated Biphenyls

BTEX - Benzene, Toluene, Ethyl Benzene, Xylenes

Figures

Filename: /Friday Harbor/GIS/UplandGIS/SAP_SiteLayout_202008 User: Springborn Version date: 8/27/2020



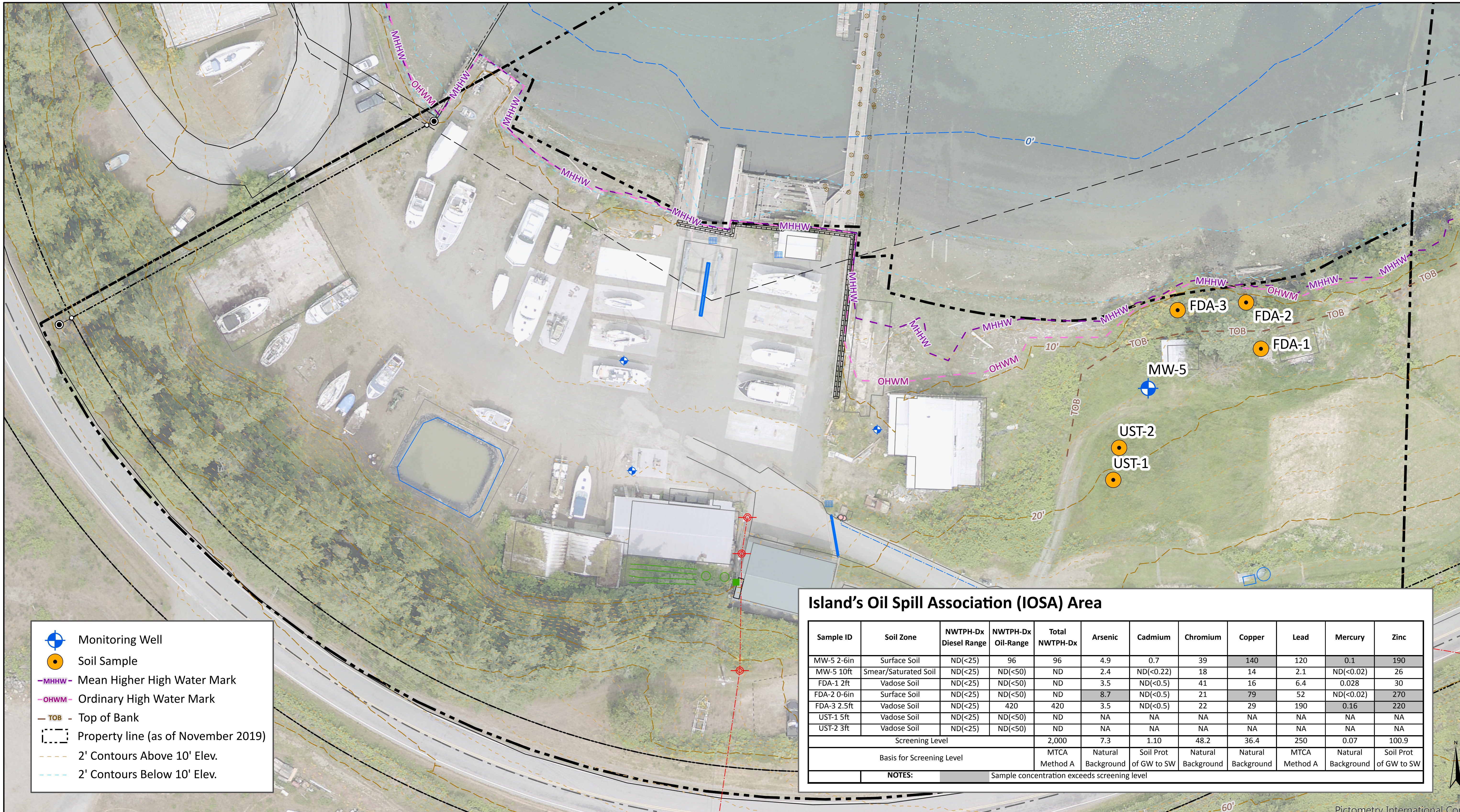
Port of Friday Harbor
Jensen and Sons Boatyard and Marina

Sampling and Analysis Plan
Figure 1. Site Layout

Data Sources:
San Juan Surveying (2019), Shannon and Wilson, Inc. (2019), Whatcom Environmental (2018)

0 25 50 100 Feet

CRETE CONSULTING, INC.



Island's Oil Spill Association (IOSA) Area

Sample ID	Soil Zone	NWTPH-Dx Diesel Range	NWTPH-Dx Oil-Range	Total NWTPH-Dx	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Zinc
MW-5 2-6in	Surface Soil	ND(<25)	96	96	4.9	0.7	39	140	120	0.1	190
MW-5 10ft	Smear/Saturated Soil	ND(<25)	ND(<50)	ND	2.4	ND(<0.22)	18	14	2.1	ND(<0.02)	26
FDA-1 2ft	Vadose Soil	ND(<25)	ND(<50)	ND	3.5	ND(<0.5)	41	16	6.4	0.028	30
FDA-2 0-6in	Surface Soil	ND(<25)	ND(<50)	ND	8.7	ND(<0.5)	21	79	52	ND(<0.02)	270
FDA-3 2.5ft	Vadose Soil	ND(<25)	420	420	3.5	ND(<0.5)	22	29	190	0.16	220
UST-1 5ft	Vadose Soil	ND(<25)	ND(<50)	ND	NA	NA	NA	NA	NA	NA	NA
UST-2 3ft	Vadose Soil	ND(<25)	ND(<50)	ND	NA	NA	NA	NA	NA	NA	NA
Screening Level				2,000	7.3	1.10	48.2	36.4	250	0.07	100.9
Basis for Screening Level				MTCA Method A	Natural Background	Soil Prot of GW to SW	Natural Background	Natural Background	MTCA Method A	Natural Background	Soil Prot of GW to SW
	NOTES:	[shaded]	Sample concentration exceeds screening level								

Filename: ./Friday Harbor/GIS/UplandGIS/SAP_HistoricalData_202008 User: Springborn Version date: 8/31/2020

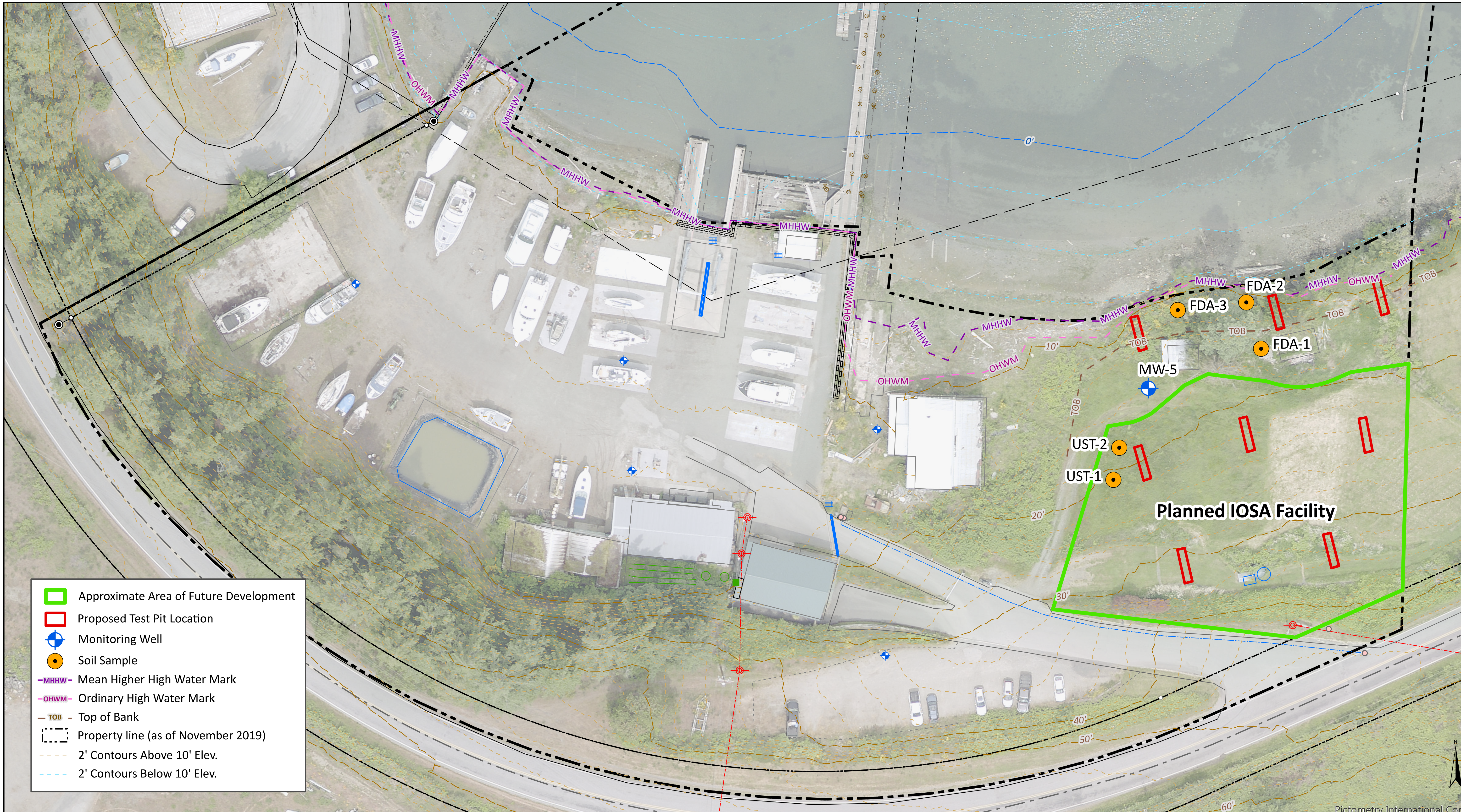
Port of Friday Harbor
Jensen and Sons Boatyard and Marina

Sampling and Analysis Plan
Figure 2. Historical Data

Data Sources:
CRETE Consulting, Inc. (2020), San Juan Surveying (2019), Whatcom Environmental (2018)

0 25 50 100 Feet

CRETE CONSULTING, INC.



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Port of Friday Harbor
Jensen and Sons Boatyard and Marina

Sampling and Analysis Plan
Figure 3. Test Pit Samples

Data Sources:
CRETE Consulting, Inc. (2020), San Juan Surveying (2019)

0 25 50 100 Feet

CRETE CONSULTING, INC.

Appendix A
Quality Assurance Project Plan

IOSA Revelopment Area
Sampling and Analysis Plan

Appendix A
Quality Assurance Project Plan

Port of Friday Harbor
Jensen's Marina

Project Number: 040-001

Prepared for:
The Port of Friday Harbor

September 24, 2020

Prepared by:

CRETE CONSULTING, INC.

Table of Contents

List of Tables

1 Introduction

This Quality Assurance Project Plan (QAPP) presents the project organization, objectives, activities, and quality assurance (QA) procedures to be implemented during data collection activities to support the test pit investigation at the Port of Friday Harbor (Port) Jensen's Marina (site), shown on Figure 1 of the Test Pit Sampling and Analysis Plan.

The field work will provide additional data to further define the potential soil contamination at the site. Work will focus on the areas of potential contamination in the immediate vicinity, future developments at the site, namely the proposed IOSA facility along the eastern end of the site and the proposed work bay on the western end of the site.

The QAPP was prepared following Ecology Guidance for Quality Assurance Project Plans (Lombard and Kirchmer 2004).

The remainder of this QAPP is organized into the following sections:

- Section 2 – Project Management
- Section 3 – Data Generation and Acquisition
- Section 4 – Assessments and Oversite
- Section 5 – Data Validation and Usability
- Section 6 – References

This QAPP is serves as an Appendix to the Sampling Analysis Plan (SAP), which details the test pit installation and soil sample collection procedures.

2 Project Management

This section identifies key project personnel, describes the rationale for conducting the monitoring studies, identifies the studies to be performed and their respective schedules, outlines project data quality objectives and criteria, lists training and certification requirements for sampling personnel, and describes documentation and record-keeping procedures.

2.1 Project Organization

Roles and responsibilities are defined in Table 1.

This project is being led by Leon Environmental and the Port of Friday Harbor (Port). The Project Manager for Leon Environmental is Peter Leon. The Port Project Manager is Todd Nicholson. The CRETE Consulting LLC (CRETE) Project Manager is Grant Hainsworth who is the direct line of communication between CRETE, Leon Environmental, and the Port, and is responsible for implementing activities described in this QAPP. Grant will also be responsible for producing all project deliverables on behalf of CRETE, and performing the administrative tasks needed to ensure timely and successful completion of these studies.

The organizational structure for the additional data collection activities will consist of the following key members: Field Manager, Site Safety Officer, Quality Assurance Officer, and Data Validator. Additional members of the project team include, but are not limited to the laboratories, design team sub-consultants, and subcontractors.

Friedman & Bruya will perform all of chemical analyses of the soil samples collected by CRETE Consulting, Inc.

2.2 Project Definition and Background

The Draft Conceptual Site Model and Data Gaps Report (Shannon, 2019) and Test Pit Sampling and Analysis Plan identified several data gaps such as additional soil data and known extent of buried debris or dump materials. The objectives and background information to address these needs are provided in the SAP.

2.3 Data Quality Objectives and Criteria

The overall data quality objective (DQO) for this project is to develop and implement procedures that will ensure the collection of representative data of known, acceptable, and defensible quality.

2.3.1 Precision

Field precision is estimated by collecting field duplicate samples at a frequency specified in this QAPP for each matrix collected and measured. Laboratory precision and accuracy can be measured through the analysis of matrix spike/matrix spike duplicate (MS/MSD) samples, laboratory duplicate samples and/or laboratory control samples/duplicates (LCS/LCSD). The laboratory will perform the analysis of one set of MS/MSD, LCS/LCSD and/or duplicate field samples per matrix measured at a frequency of one sample per 20 samples. Field and analytical precision will be evaluated by the relative percent difference (RPD) between field duplicate samples, laboratory duplicate samples; laboratory accuracy and precision will be determined by the spike recoveries and the RPDs of the MS/MSD and LCS/LCSD samples, respectively.

$$RPD = \frac{ABS(R1-R2)}{(R1+R2)/2} \times 100$$

Where:
R1 = Sample result or recovery for spiked compound
R2 = Duplicate sample result or recovery for spiked compound duplicate

Field chemistry duplicate precision will be screened against an RPD of 50 percent for soil samples. However, no data will be qualified based solely on field homogenization duplicate precision.

2.3.2 Accuracy

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Accuracy may be expressed as a percentage of the true or reference value for reference material, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equations used to express accuracy are as follows.

1. For reference materials:

   Percent of true value = (measured value/true value) x 100

2. For spiked samples:

   Percent recovery = (SQ - NQ)/(S) x 100
   SQ = quantity of spike or surrogate found in sample
   NQ = quantity found in native (unspiked) sample
   S = quantity of spike or surrogate added to native sample

Laboratory method reporting limits (MRL) are listed on Table 2.

2.3.3 Representativeness

Representativeness is the degree to which data from the project accurately represent a particular characteristic of the environmental matrix which is being tested. Representativeness of samples is ensured by adherence to standard field sampling protocols and standard laboratory protocols. The design of the sampling scheme and number of samples should provide a representativeness of each matrix or product of the chemical processes being sampled.

2.3.4 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relation to another data set. For this investigation, comparability of data will be established through the use of program-defined general methods and reporting formats and the use of common, traceable calibration and reference materials from the National Institute of Standards and Technology or other established sources.

2.3.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

Completeness =
(number of valid measurements/ total number of data points planned) x 100

Completeness will be calculated per matrix. The DQO for completeness for all components of this project is 90%. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

2.4 Special Training/Certifications

Specific training requirements for performing fieldwork, which may bring employees in contact with hazardous materials, are as follows:

- All field personnel assigned to the site must have successfully completed 40 hours of training for hazardous site work in accordance with Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(e)(3) and be current with their 8-hour refresher training in accordance with OSHA 29 CFR 1910.120(e)(8). Documentation of OSHA training is required prior to personnel being permitted to work on site.
- Personnel managing or supervising work on site will also have successfully completed 8-hours of manager/supervisor training meeting the requirements of OSHA 29 CFR1910.120(e)(4).
- Personnel assigned to the site must be enrolled in a medical surveillance program meeting the requirements of OSHA 29 CFR 1910.120(f). Personnel must have successfully passed an occupational physical during the past 12 months and be medically cleared to work on a hazardous waste site and capable of wearing

appropriate personal protective equipment (PPE) and respiratory protection as may be required.

- Personnel performing the sampling work must have extensive knowledge, skill, and demonstrated experience in the execution of the sampling methods.

2.5 Documentation and Records

Field investigators (including subcontractors) will maintain field notes in a bound notebook and all documents, records, and data collected will be kept in a case file in a secure records filing area. All Laboratory deliverables (both hard copy and electronic) with verifiable supporting documentation shall be submitted by the lab to the QA Officer. The following documents will be archived at the Laboratory: 1) signed hard copies of sampling and chain-of-custody records; and 2) electronic and hard copy of analytical data including extraction and sample preparation bench sheets, raw data and reduced analytical data. The laboratory will store all laboratory documentation for sample receipt, sample login, sample extraction, cleanup and analysis and instrument output documentation per laboratory's Standard Operating Procedure (SOP) or QA Manual.

Copies of all analytical reports will be retained in the laboratory files, and at the discretion of the QA Officer, the data will be stored on computer disks for a minimum of 1 year. After one year, or whenever the data become inactive, the files will be transferred to archives in accordance with standard laboratory procedure. Data may be retrieved from archives upon request.

Copies of all sub-consultant field notes, field logs, sample collection logs, and field photographs will be sent to the Field Manager within 2 weeks of completion of the field task.

2.6 Field Quality Control Requirement

Field quality control samples are useful in identifying problems resulting from sample collection or sample processing in the field related to analytical samples. The field QC samples to be collected include field duplicates and sampling equipment rinsate blanks (if non dedicated sample equipment is used).

A minimum of one duplicate sample will be collected from the material homogenized from one field sample and submitted for the same analyses as the field samples to evaluate heterogeneity attributable to sample handling. A minimum of one field duplicate will be submitted per 20 samples. The RPD for homogenate duplicate samples will be within 75% for soil.

At least one equipment rinsate sample will be collected after decontamination for every 20 soil samples collected. Equipment rinsate blanks will be collected for each type of sampling equipment that comes into contact with sample material. Duplicate and equipment rinsate samples will be analyzed for the same constituents as the environmental samples.

3 Data Generation and Acquisition

3.1 Sample Process Design

The rationale for the sampling design and assumptions for locating and selecting environmental samples is detailed in the SAP. The methods and procedures for collection of field samples are also provided in the SAP. All sampling will be conducted following standard procedures documented in the SAP.

3.2 Analytical Sampling Methods, Handling and Custody

3.2.1 Samples

All soil samples will be submitted for analysis described in Table 2. Collected samples for chemistry will be thoroughly homogenized and distributed to sample containers. Debris will be removed prior to distribution to sample containers; removed materials will be noted in the field logbooks.

All sample containers will be labeled on the outside in indelible ink with the sample identification number, date and time collected, and analysis to be performed.

3.2.2 Sampling Handling

Sample containers will be filled to minimize head space, and will be appropriately labeled and stored prior to shipment or delivery to the laboratory. Reusable sampling equipment such as stainless-steel spoons and bowls shall be decontaminated between sample locations.

Samples must be packed to prevent damage to the sample container and labeled to allow sample identification. All samples must be packaged so that they do not leak, break, vaporize or cause cross-contamination of other samples. Each individual sample must be properly labeled and identified. A chain-of-custody record must accompany each shipping container (see Section 3.2.3). When refrigeration is required for sample preservation, samples must be kept cool during the time between collection and final packaging.

All samples must be clearly identified immediately upon collection. Each sample bottle will be labelled and will include the following information:

- Client and project name
- A unique sample description
- Sample collection date and time.

Additionally, the sample bottle label may include:

- Sampler's name or initials
- Indication of addition of preservative, if applicable

- Analyses to be performed.

After collection, the samples will be maintained under chain-of-custody procedures as described below.

3.2.3 Chain of Custody

Chain-of-custody procedures are intended to document sample possession from the time of collection to disposal. Chain-of-custody forms must document transfers of sample custody. A sample is considered to be under custody if it is in one's possession, view, or in a designated secure area. The chain-of-custody record will include, at a minimum, the following information:

- Client and project name
- Sample collector's name
- Company's mailing address and telephone number
- Designated recipient of data (name and telephone number)
- Analytical laboratory's name and city
- Description of each sample (i.e., unique identifier and matrix)
- Date and time of collection
- Quantity of each sample or number of containers
- Type of analysis required
- Addition of preservative, if applicable
- Requested turn-around times
- Date and method of shipment.

When transferring custody, both the individual(s) relinquishing custody of samples and the individual(s) receiving custody of samples will sign, date, and note the time on the form. If samples are to leave the collector's possession for shipment to the laboratory, the subsequent packaging procedures will be followed. If an on-site lab is being used, a chain-of-custody must be completed but the following packing procedures do not apply. All samples will be stored appropriately by the laboratory.

3.3 Analytical Quality Control

Laboratory Quality Control Requirements

Internal quality control procedures are designed to ensure the consistency and continuity of data. A routine QC protocol is an essential part of the analytical process. The minimum requirements for each analytical run follow. Additional description of laboratory QA/QC procedures can be found in the laboratory’s QA Manual. A project narrative detailing analytical results must accompany all data packages submitted by the laboratory.

- **Initial and continuing calibration:** A calibration standard will be analyzed each time an instrument is calibrated. The instruments used to perform the various analyses will be calibrated and the calibrations verified as required by the respective EPA methodologies. For example, a standard five-point initial calibration will be utilized to determine the linearity of response with the gas chromatograph/electron capture detection. Once calibrated, the system must be verified every 12 hours. All relative response factors, as specified by the analytical method, must be greater than or equal to 0.05. All relative standard deviations, as specified by the analytical method, must be less than or equal to 30 percent for the initial calibration and less than or equal to 25 percent for the continuing calibration.
- **Laboratory control sample:** The laboratory control sample (LCS) will consist of a portion of analyte-free water or solid phase sample that is spiked with target analytes of known concentration. The LCS will be processed through the entire method procedure and the results examined for target analyte recovery (accuracy). Precision evaluations will be generated using a laboratory control sample duplicate (LCSD). The LCS and LCSD results will be used as a fall-back position by the laboratory in cases where the matrix spike has failed to achieve acceptable recovery and/or precision. Inability to obtain acceptable LCS results will be directly related to an inability to generate acceptable results for any sample. One LCS/LCSD pair will be analyzed for each extraction batch.
- **Method blank analysis:** The method blank is utilized to rule out laboratory-introduced contamination by reagents or method preparation. Compounds detected in the blank will be compared in concentration to those found in the samples. Any concentration of common laboratory contaminants (i.e., phthalates, acetone, methylene chloride, or 2-butanone) in a sample at less than 10 times that found in the blank will be considered a laboratory contaminant. For other contaminants, any compounds detected at less than five times that found in the blank will be considered laboratory contamination (EPA, 1994). Values reported for the method blanks are expected to be below the detection limits for all compounds, except the common laboratory contaminants. Deviations from this must be explained in the laboratory project narrative(s). One method blank will be analyzed for each extraction/digestion batch
- **Matrix spike analysis:** A matrix spike (MS) is the addition of a known amount of target analyte to a sample. Analysis of the sample that has been spiked and comparison with the results from unspiked sample (background) will give information about the ability of the test procedure to generate a correct result from the sample (accuracy). Precision evaluations will be generated using a matrix spike duplicate (MSD). One matrix spike and matrix duplicate will be analyzed per sample

delivery group (SDG) or per 20 samples. A SDG is defined as no more than 20 samples or a group of samples received at the laboratory within a two-week period

- **Surrogate evaluations (organic analyses):** Surrogate recovery is a quality control measure limited to use in organics analysis. Surrogates are compounds added to every sample at the beginning of the sample preparation to monitor the success of the sample preparation on an individual sample basis (accuracy). Although some methods have established surrogate recovery acceptance criteria that are part of the method or contract compliance, for the most part, acceptable surrogate recoveries need to be determined by the laboratory. Recoveries of surrogates will be calculated for all samples, blanks and quality control samples. Acceptance limits will be listed for each surrogate and sample type and will be compared against the actual result
- **Laboratory management review:** The QA Officer(s) will review all analytical results prior to final external distribution (preliminary results will be reported before this review). If the QA Officer(s) finds the data meet project quality requirements, the data will be released as “final” information. Data which are not acceptable will be held until the problems are resolved, or the data will be flagged appropriately.

3.4 Instrument/Equipment Testing, Inspection and Maintenance

The primary objective of an instrument/equipment testing, inspection, and maintenance program is to help ensure the timely and effective completion of a measurement effort by minimizing the downtime of crucial sampling and/or analytical equipment due to expected or unexpected component failure.

Testing, inspection, and maintenance will be carried out on all field and laboratory equipment in accordance with manufacturer’s recommendations and professional judgment. Analytical laboratory equipment preventative testing, inspection, and maintenance will be addressed in the laboratories’ QA manual, which will be kept on file at the contracted laboratory.

As appropriate, schedules and records of calibration and maintenance of field equipment will be maintained in the field notebook. Equipment that is out of calibration or is malfunctioning will be removed from operation until it is recalibrated or repaired.

3.5 Instrument/Equipment Calibration and Frequency

Measuring and test equipment used during environmental data collection activities will be subject to calibration requirements. These requirements are summarized below:

- Identification. Either the manufacturer's serial number or the calibration system identification number will be used to uniquely identify measuring and test equipment. This identification, along with a label indicating when the next calibration is due, will be attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference.
- Standards. Measuring and test equipment will be calibrated, whenever possible, against reference standards having known valid relationships to nationally recognized standards (e.g., National Institute of Standards and Technology) or accepted values of natural physical constraints. If national standards do not exist, the basis for calibration will be described and documented.
- Frequency. Measuring and test equipment will be calibrated at prescribed intervals and/or prior to use. Frequency will be based on the type of equipment, inherent stability, manufacturers' recommendations, intended use, and experience. All sensitive equipment to be used at the project site or in the laboratory will be calibrated or checked prior to use.
- Records. Calibration records (certifications, logs, etc.) will be maintained for all measuring and test equipment used on the project.

If measuring and test equipment are found to be out of calibration, an evaluation will be made and documented to determine the validity of previous measurements and/or corrective action will be implemented. The QA officer will lead the evaluation process.

All laboratory calibration requirements must be met before sample analysis can begin. The laboratory will follow the calibration procedures found in the analytical methods listed in this QAPP or in the laboratory's SOPs. If calibration non-conformances are noted, samples will be reanalyzed under compliant calibration conditions within method-specified holding times.

3.6 Inspection/Acceptance of Supplies and Consumables

The Field Manager will be responsible for material procurement and control. The Field Manager will verify upon receipt that materials meet the required specifications and that, as applicable, material or standard certification documents are provided and maintained. The Field Manager will also verify that material storage is properly maintained and contamination of materials is not allowed.

Laboratories contracted for this project must have procedures that are documented and followed that cover the following:

- Checking purity standards, reagent grade water, and other chemicals as appropriate versus intended use
- Preparation and storage of chemicals

- Requirements for disposable glassware (grade and handling).

For this project, the Field Manager or designee will be responsible for procuring and shipping the appropriate sample containers and preservatives to the sampling site. The containers will be pre-cleaned and certified by lot. Reagents provided will be of the appropriate grade for the analysis. Records of these certifications and grades of material will be maintained on file at the laboratory.

3.7 Non-Direct Measurements

Existing chemical data from previous site characterization efforts have been reviewed to assist in identifying proposed sampling locations, discussed in the SAP. All historical data were previously reviewed for quality assurance.

3.8 Data Management

All hard copies of project field documentation, analytical results, and reports will be filed and stored at the consultant's library.

Analytical laboratories are expected to submit data in both electronic and hard copy.
The Laboratory Project Manager should contact the Project QA/QC Coordinator prior to data delivery to discuss specific format requirements. A library of routines will be used to translate typical electronic output from laboratory analytical systems and to generate data analysis reports. The use of automated routines ensures that all data are consistently converted into the desired data structures and that operator time is kept to a minimum. In addition, routines and methods for quality checks will be used to ensure such translations are correctly applied.

Written documentation will be used to clarify how field and laboratory duplicates and QA/QC samples were recorded in the data tables and to provide explanations of other issues that may arise. The data management task will include keeping accurate records of field and laboratory QA/QC samples so that project team members who use the data will have appropriate documentation.

4 Assessment and Oversight

4.1 Assessment and Response Actions

Assessment of field sample collection methods will be evaluated using the sampling equipment rinsate blank results. If there is a detectable level of the compound of interest in the equipment rinsate blank, samples will be qualified based on possible contamination.

Assessment of the field and laboratory methods will be evaluated using the field duplicate results. A significant variation between the original sample and the field duplicate may be caused by laboratory error or due to field sampling conditions. This variation will be identified during data validation with results compared to both the laboratory reports and field notes.

Nonconforming items and activities are those which do not meet the project requirements or approved work procedures. Non-conformance may be detected and identified by any of the following groups:

- Project Staff: During the performance of field activities and testing, supervision of subcontractors, performance of audits, and verification of numerical analyses
- Laboratory Staff: During the preparation for and performance of laboratory testing, calibration of equipment, and QC activities
- QA Staff: During the performance of audits.

If possible, action will be taken in the field to correct any nonconformance observed during field activities. If necessary and appropriate, corrective action may consist of re-sampling. If implementation of corrective action in the field is not possible, the nonconformance and its potential impact on data quality will be discussed in the report.

Corrective action to be taken as a result of nonconformance during field activities will be situation-dependent. The laboratory will be contacted regarding any deviations from the QAPP, will be asked to provide written justification for such deviations, and in some instances, will be asked to reanalyze the sample(s) in question. An example of a laboratory nonconformance that would require corrective action is if holding times were exceeded prior to analysis. All corrective actions must be documented. The person identifying the nonconformance will be responsible for its documentation.

Documentation will include the following information:

- Name(s) of the individual(s) identifying or originating the nonconformance
- Description of the nonconformance
- Any required approval signatures
- Method(s) for correcting the nonconformance or description of the variance granted.

Documentation will be made available to project, laboratory, and/or QA management. Appropriate personnel will be notified by the management of any significant nonconformance detected by the project, laboratory, or QA staff. Implementation of corrective actions will be the responsibility of the PM or the QA Officer. Any significant recurring nonconformance will be evaluated by project or laboratory personnel to determine its cause. Appropriate changes will then be instituted in project requirements and procedures to prevent future recurrence. When such an evaluation is performed, the results will be documented. If there are unavoidable deviations from this QAPP, the Project Manager will document the alteration and track the change in the subsequent deliverables.

4.2 Reports to Management

Deliverables from this project include:

- Laboratory hardcopy results and EDDs
- Data validation reports
- Test pit logs
- Reports discussing the results.

5 Data Validation and Usability

5.1 Data Review, Verification, and Validation

EPA method control limits (or WA State method control limits for NWTPH methods) for surrogate and matrix spike recoveries will be used for the determination of data quality. If surrogate or matrix spike recoveries are not within their method-specific control limits, then the analysis must be repeated. If the re-analyzed values are within required limits and holding times, they will be reported as true values. If, in the repeated analysis, the values are still outside required limits, the data will be identified and the Data Validator will verify the representativeness of the data following EPA guidelines. Laboratory analysts are responsible for reviewing calibration integrity, sample holding times, method compliance, and completeness of tests, forms, and logbooks.

Analytes detected at concentrations between the MRL and the method detection limit (MDL) will be reported with a J qualifier to indicate that the value is an estimate (i.e., the analyte concentration is below the calibration range). Non-detects will be reported at the MRL. The MRL will be adjusted by the laboratory as necessary to reflect sample dilution or matrix interference.

Verification of completeness and method compliance, as well as raw data entry and calculations by analysts will be reviewed by a laboratory supervisor or the Laboratory Coordinator. The Laboratory Coordinator will be responsible for checking each group or test data package for precision, accuracy, method compliance, compliance to special client requirements, and completeness. The Laboratory Coordinator will also be responsible certifying that hardcopy and EDD data are identical prior to release from the laboratory.

Data validation will be completed by the Data Validator. Data validation will be completed within three weeks after receipt of the complete laboratory data package. A detailed report of the data validation results will be submitted to the Quality Assurance Officer and included in the final deliverable.

The analytical laboratories will generate a Level 4 CLP-like fully validatable data package (EPA, 1991).

5.2 Reconciliation with User Requirements

The QA Officer will review the field notebooks, laboratory report, and results of the data validation to determine if the data quality objectives have been met. Instances where the data quality objectives were not met will be documented. The usability of the data will depend on the magnitude of the data quality objective exceedance. Data that has been rejected will be flagged as “R” and maintained in the database but will not be used in any decision making. Data quality objectives are provided in Table 3.

6 References

Lombard, S.M. and C.J. Kirchmer. 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Washington State Department of Ecology Environmental Assessment Program. July 2004. Publication Number 04-03-030

Shannon and Wilson, August 2019. Draft Conceptual Site Model and Data Gaps Report, Former Jenson Shipyard, Friday Harbor, Washington.

U.S. Environmental Protection Agency (EPA) 1991. EPA Region V Model Quality Assurance Project Plan. U.S. Environmental Protection Agency, Region V, Office of Superfund.

U.S. Environmental Protection Agency (EPA) 1986. Test Methods for the Evaluation of Solid Waste: Physical/Chemical Methods, 3rd Edition. EPA SW-846, 1986.

Tables

Table 1 Project Roles and Responsibilities

Role	Person	Responsibilities
Project Manager	Grant Hainsworth (253-797-6323)	• Primary point of contact with the Port and Leon Environmental • Review all technical documents associated with the project for technical accuracy and feasibility, as well as adherence to budget and schedule.
Quality Assurance Officer	Jamie Stevens (206-799-2744)	• Monitor all aspects of the project to verify that work follows project plans • Review laboratory analytical data • Serve as liaison between the laboratory and Field Manager • Maintain a complete set of laboratory data • Evaluate conformance of the analyses with the specifications of this QAPP • Verify the reported results with the raw data • Check that EDDs match the analytical reports • Review compliance with field methods and procedures.
Field Manager	Rusty Jones (832-330-1359)	• Collect or direct collection of soil samples • Maintain a log (field log) for all sampling-related activities • Coordinate the sampling operations to verify that the this QAPP is followed • Identify any deviations from this QAPP • Prepare the field data and information for reporting • Maintain the integrity of the samples throughout sample collection and transport to the laboratory.
Laboratory Project Manager	Eric Young (206-285-8282)	• Conduct analysis of soil and water samples • Practice quality assurance methods per internal laboratory SOPs and this QAPP, and document such practices • Verify quality of samples (e.g., cooler temperature) as they're received at the laboratory • Verify accuracy and completeness of laboratory reports and EDDs.

Table 2 Sample Analytes

Analyte	Preparation Method	Analytical Method	Method Reporting Limit	Lowest Initial Screening Level	Holding Time	Sample Container
Soil Samples						
Metals (mg/kg)		6020/7471	Varies	Varies (0.07 to 101.9)	14 days	4-ounce glass
Diesel and Oil Range Organics (mg/kg)	3550	NWTPH-Dx	5 – 10	2,000	14 days	4-ounce glass
Gasoline Range Organics (mg/kg)	5035	NWTPH-G	5	TPH-Gx with benzene = 30	48 hours to freeze; 14 days to analysis	Three Unpreserved 40-ml VOA vials
VOCs/BTEX (ug/kg)	5035	8260C/8021	0.5 - 1	Trichloroethene = 2.4	48 hours to freeze; 14 days to analysis	Three Unpreserved 40-ml VOA vials
SVOCs/cPAHs (ug/kg)		8270/8270-SIM	5		14 days	4-ounce glass
PCBs (ug/kg)		8082	4		14 days	4-ounce glass

Table 3 Measurement Quality Objectives

Parameter	Precision (RPD; lab/field)	Accuracy	Completeness	Preservation/ Storage
Metals Petroleum Hydrocarbons VOCs (including BTEX) SVOCs (including cPAHs) PCBs	Soil: 20%/50%	70-130%	100%	Dark, 4^{o}C; freeze VOCs with 48 hours if not analyzed.

Appendix B
Standard Operating Procedures

1 INTRODUCTION

1.1 Purpose and Applicability

This Standard Operating Procedure (SOP) describes the methods for excavating, logging and collecting environmental samples from test pits or trenches. Test pits/trenches are generally excavated to visually determine subsurface soil and rock conditions and for environmental sampling. Test pits/trenches are generally excavated by a qualified subcontractor under the direction of the project geologist/engineer.

1.2 General Principles

Test pit/trench subsurface explorations generally involve use of backhoes or excavators to perform excavations for the purpose of visually assessing subsurface soil/fill conditions and to allow for collection of representative soil samples. The excavation subcontractor is directed by the project geologist/engineer to complete a test pit/trench at a designated location. The lateral extent and depth of the test pit/trench is dependent upon project objectives. Once excavated, the test pit/trench is logged and sampled, if required. Following this, the test pit/trench is backfilled with the excavated material or with clean fill.

1.3 Quality Assurance Planning Considerations

Project personnel should follow specific quality assurance guidelines for sampling as outlined in the site-specific Quality Assurance Project Plan (QAPP) and/or Sampling Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements typically suggest the collection of a sufficient quantity of field duplicate, field blank, and equipment blank samples.

1.4 Health and Safety Considerations

All utilities (electric, water, sewer, etc.) or property owners who may have equipment or transmission lines buried in the vicinity of proposed test pits should be notified. Sufficient time should be allowed after notification (typically 3 working days) for the utilities to respond and mark locations of any equipment that may be buried on site. The estimated location of utility installations, such as sewer, telephone/communications, electric, water, gas lines and other underground installations that may reasonably be expected to be encountered during excavation work, shall be verified by the site owner prior to opening an excavation and may require a private utility locate to verify location and or material present. The subcontractors will be made aware of the potential of encountering underground utilities at each test pit location.

To avoid the hazards associated with the cave-in or collapse of an excavation or trench, CRETE Consulting (CRETE) employees will not enter an excavation or trench to collect the required samples if the trench is greater than 4 feet deep. For excavation depths greater than 4 feet, samples will be collected remotely, using long-handled sampling tools, or directly from the bucket of the backhoe. If entry becomes necessary and the excavation is greater than 4 feet in depth, the contractor will be required to slope or shore the walls of the excavation. Specific requirements will depend on soil type and site constraints and will be addressed in the site-specific health and safety plan (HASP). All sloping or shoring must be conducted in compliance with OSHA's rules for trenching and excavation (29 CFR 1926.650-652.)

For safety reasons in case of sidewall collapse, all personnel and materials will be kept at least 2 feet from the edge of any open excavation. Open excavations can be viewed by the geologist/engineer from test pit endwalls which are more stable than test pit sidewalls.

If excavations are to be left open temporarily, the perimeter of the excavation must be marked with "Caution-Open Trench" tape. Other site-specific restrictions on leaving test pits open temporarily may be required by the property owner. Those requirements should be determined prior to startup of the excavation program.

Ambient air quality conditions should be periodically monitored both within and surrounding the excavation for potentially toxic and/or explosive atmospheric conditions.

The health and safety considerations for the site, including both potential physical and chemical hazards, will be addressed in the site-specific HASP. All field activities will be conducted in conformance to this HASP.

2 RESPONSIBILITIES

2.1 Project Manager

The project manager will be responsible for ensuring that the project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the work in accordance with this SOP and the project plan.

2.2 Project Geologist/Engineer

It will be the responsibility of the geologist/engineer to determine the location, total depth and overall size of each test pit/trench. It will also be his or her responsibility to collect representative samples from the test pit/trench and to log the test pit/trench according to the procedures described in this SOP.

2.3 Subcontractor

It will be the responsibility of subcontractors to construct test pits/trenches according to CRETE project-specific requirements and in accordance with OSHA safety requirements for trench construction.

3 REQUIRED MATERIALS

In addition to those materials provided by the subcontractor, the project geologist/sampling engineer may require:

- Stakes
- Fluorescent flagging tape/caution tape
- Sample kit (bottles, labels, custody records, cooler, ice, etc.)
- Measuring tape
- Sheet plastic
- Sampling Equipment: spoons, trowels, scoops, shovels
- Field records/logbook (test pit log, test pit profile log)
- Project plans (HASP, QAPP, Sampling Plan)
- Camera
- Global Positioning System (GPS) device
- Decontamination materials and solutions

4 METHOD

4.1 General Preparation

General locations for test pits or trenches should be marked with a stake and/or flagging tape prior to start of the excavation program. Final post-excavation locations should be documented by using topographic maps and/or other site plans. Final locations should also be measured from a fixed feature or surveyed or recorded by GPS device if necessary.

Excavation equipment should be properly decontaminated prior to initial use, between test pit/trench excavations, and following completion of the last excavation. It should be noted that excavation equipment may need to be brushed clean or fully decontaminated at the completed test pit location if the potential exists for spreading contaminated soils by transport of the excavation equipment.

4.2 Excavation

Test pits/trenches will be excavated to the depth specified in the project-specific plan. Test pit completion depths should be indicated to the subcontractor by the project geologist or engineer. The test pits or trenches will be excavated in compliance with applicable safety regulations. Walls should initially be cut as near vertical as possible to facilitate stratigraphic mapping. Proper sidewall sloping will, however, be required for test pits that extend beyond 4 feet in depth if sampling or logging personnel require access to the open excavation.

As the test pit/trench is excavated, the excavated soils should be placed to one side of the excavation and no closer than 2 feet from the excavation's edge. Depending on the project requirements, sheet plastic may be required to cover the ground surface before placing excavation soils on the ground.

Excavation should proceed slowly and with caution. The project geologist/engineer should view the excavation (from the far end wall) after each removed bucket of soil for the presence of unusual features such as waste accumulations, free liquids (water or free product), and buried utilities. The excavation subcontractor should continue the excavation only after receiving approval to proceed from the project geologist/engineer.

4.3 Logging

A test pit log will be prepared in the field by the geologist or engineer. The test pit log, which is similar to a boring log, will include notations on soil types and depth of stratigraphic changes, depth to water table, identification of waste materials, and the depth/location of any environmental samples that were collected. The dimensions and orientation of each test pit/trench will also be recorded on the test pit log.

A supplemental sketch is often necessary to depict the physical orientation of the strata encountered. These observations should be recorded on the test pit profile log of logbook. The test pit profile log allows for sketching a view of the test pit sidewall (i.e., a test pit cross section) and for listing of sample collection information.

The project geologist/engineer will measure the depth to the groundwater table in test pits, if encountered, only after sufficient time is allowed for stabilization of the groundwater table. If there is insufficient time to achieve stabilization, the depth to where groundwater is entering the test pit should be indicated on the logs.

If photographs are necessary, they can be taken at this time.

4.4 Sample Collection

Requirements for soil sampling will be determined by the project geologist/engineer in accordance with the project sampling plan.

Soil samples may be collected for several reasons including stratigraphic logging, field headspace organic vapor testing, and laboratory environmental testing. Soil samples may be collected from test pits/trenches from several locations: the test pit/trench sidewalls or base, the excavated soil pile, or directly from the backhoe bucket. Additional information regarding each sampling method are presented in the following subsections.

4.4.1 Test Pit/Trench Sidewall or Base Sampling

Test pit/trench sidewall or base sampling is generally the preferred method by regulatory agencies because it allows for in-situ sampling of soils. In-situ sampling limits the potential for sample contamination which can occur during the excavation procedures. This method, valid for any type of proposed analysis, is especially preferred for samples which will be analyzed for volatile organic compounds (VOC).

Sidewall or base sampling is considered to be somewhat more dangerous than sampling from the soil pile or backhoe bucket because it may require entry of sampling personnel into the excavation. A recommended option in place of entry into the excavation is to use long-handled sampling equipment. The use of long-handled sampling equipment allows for collection of samples without entry into the excavation and often from the excavation ends where it is generally considered safe. Long-handled sampling equipment can be fabricated using standard surface soil sampling equipment (trowels, scoops, etc.) attached to long wooden or aluminum extension handles with duct tape or clamps. When using duct tape, or any kind of tape, caution should be exercised during sampling not letting the sample come into contact with the tape or handle.

Regardless of whether entry into the excavation is required, sampling should be conducted in the following manner:

- Select the sampling location and “dress” the excavation surface by scraping to remove any loose surface soil or smearing residues.
- Replace the dressing tool with a clean sampling tool.
- Collect the soil sample with the sampling tool in accordance with the methods outlined within QAPP and/or sampling plan.
- Complete the test pit log and test pit profile log to provide description and location information for each sample collected.

4.4.2 Excavated Soil Pile Sampling

This method is considered favorable for soil logging and headspace VOC testing in the field. It is, however, generally considered unsuitable for collection of samples for laboratory analytical testing for the simple reason that it is difficult to determine the exact position in the test pit/trench from which the sample was obtained.

Sampling from the soil pile is recommended if single or composite soil samples are required for general soil quality testing or when larger quantities of soil are needed for testing.

4.4.3 Backhoe Bucket Sampling

Sampling from the backhoe bucket is an improvement on soil pile sampling in that the geologist/engineer is reasonably sure of the position where the soil was obtained. Backhoe bucket sampling is considered suitable for soil logging and headspace VOC testing; however, it is generally considered to be unsuitable for analytical testing. Sampling from the backhoe bucket may be considered suitable for analytical testing if, for instance, the base of the test pit is covered with water and use of standard sampling equipment has been unsuccessful in retrieving an acceptable sample.

Some care is required to obtain a sample which has been minimally disturbed. For example, if a cohesive block of soil is present within the bucket, the soil sample should be retrieved from within the block of soil as much as possible, breaking apart the bulk sample to access an interior portion of soil. Only soil that has not been in contact with the backhoe bucket should be taken for analytical testing.

4.4.4 General Sampling Procedures

Representative samples shall be collected for laboratory analysis by the project geologist/engineer using the appropriate equipment.

Sample bottling, handling and transport shall be conducted in accordance with the requirements of the project specific QAPP.

4.5 Backfilling

Prior to backfilling, all collected information will be reviewed to ensure that all the appropriate and/or required logs, photographs, measurements and samples have been collected.

After review of the records, backfilling and compaction of test pit/trenches will be accomplished according to contract specifications. If excavation sidewalls have been undermined, the excavation may require temporary expansion to backfill properly.

All test pits/trenches will be backfilled to original grade unless otherwise specified.

It should be noted that project-specific requirements may include the use of known clean backfill material. The requirements for clean backfill and the potential requirements for disposal of excavated soils should be defined within the project-specific plan.

5 QUALITY CONTROL

Quality control requirements for sample collection are dependent on project-specific sampling objectives. The QAPP will provide requirements for sample preservation and holding times, container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

6 DOCUMENTATION

Test pit locations shall be referenced on the site map. Sample locations shall be referenced on a plan view/vertical section of each test pit/trench.

Photographs of specific geologic features or exposed debris may be required for documentation purposes. A scale or an item providing a size perspective shall be placed in each photograph when possible. Photograph descriptions shall also be documented as appropriate, such as in the logbook.

The following records will be maintained:

- Test Pit Log and/or Test Pit Profile Log
- Sample collection records
- Field notebook
- Chain-of-custody forms
- Shipping receipts

All documentation will be placed in the project files and retained following completion of the project.

7 TRAINING/QUALIFICATIONS

Test pit/trench subsurface explorations require a moderate degree of training and experience as numerous situations may occur which will require field decisions to be made. It is recommended that inexperienced personnel be supervised for several test pit/trench explorations before working on their own. Experienced excavation subcontractors are also of great assistance with problem resolution in the field. Field personnel should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous materials may be present.

8 REFERENCES

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, Enforcement and Investigations Branch, Athens, GA. November 2001.

29 CFR 1910.120

29 CFR Part 1926.650-652