Appendix A

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February 9, 2017

Mohsen Kourehdar
Washington State Department of Ecology
Toxics Cleanup Program
300 Desmond Drive
Lacey, WA 98503-1274

Subject: Revised Feasibility Study Data Gap Investigation Work Plan
Former Arkema Manufacturing Site
2901 and 2920 Taylor Way, Tacoma, Washington
Agreed Order No. DE 5668, Facility/Site ID No. 1220, Cleanup Site ID No. 3405

Dear Mr. Kourehdar:

On behalf of the Port of Tacoma, PIONEER Technologies Corporation is submitting for your review a revised Feasibility Study (FS) Data Gap Investigation Work Plan (Work Plan) for the Former Arkema Manufacturing Site (Site) that addresses your September 12, 2016 comment letter. The July 2016 version of the Work Plan was revised consistent with the November 22, 2016 response to comments that you approved in a December 5, 2016 email.

If you have questions about the Work Plan that you would like to discuss, please do not hesitate to contact me at (360) 570-1700 or Scott Hooton at (253) 383-9428.

Respectfully,

Troy Bussey Jr.

Troy Bussey, Jr., P.E. (WA, CA, NC, SC), L.G. (WA, CA, NC, SC), L.HG. (WA)
Principal Engineer

Enclosures:

FS Data Gap Investigation Work Plan

cc: Andy Smith, Washington State Department of Ecology (electronic copy only)
Scott Hooton, Port of Tacoma (electronic copy only)
Rob Healy, Port of Tacoma (electronic copy only)
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Joel Massman, Keta Waters (electronic copy only)

FS Data Gap Investigation Work Plan

Former Arkema Manufacturing Site

Agreed Order No. DE 5668
Facility/Site ID No. 1220
Cleanup Site ID No. 3405

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February 2017

Professional Certification

This document was prepared under my direction. The information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I hereby certify that I was in responsible charge of the work performed for this document.

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Hydrogeologist
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February 9, 2017

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Date

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List of Acronyms

Acronym	Explanation
ARI	Analytical Resources, Inc.
bgs	Below Ground Surface
Brooks	Brooks Applied Labs
Caustic	Sodium Hydroxide
CB/NT	Commencement Bay/Nearshore Tide Flats
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CF	Chloroform
CSEM	Conceptual Site Exposure Model
CSM	Conceptual Site Model
COPC	Constituent of Potential Concern
CY	Cubic Yards
DOF	Dalton, Olmsted, & Fuglevand, Inc.
Ecology	Washington State Department of Ecology
Eh	Activity of Electrons
ERM	Environmental Resources Management
FS	Feasibility Study
GPS	Global Positioning System
IA	Interim Action
ICF	ICF Technology Incorporated
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MLLW	Mean Lower Low Water
MTCA	Model Toxics Control Act
MW	Monitoring Well
NSDS	Nylon-Screen Diffusion Sampler
NOAA	National Oceanic and Atmospheric Administration
PCE	Tetrachloroethylene
PCL	Preliminary Cleanup Level
Penite	Sodium Arsenite
PGG	Pacific Groundwater Group
pH	Activity of Hydrogen Ions
PIONEER	PIONEER Technologies Corporation
Port	Port of Tacoma
POC	Point of Compliance

Acronym	Explanation
PPS	Pushpoint Sampler
P&T	Pump & Treat
QAPP	Quality Assurance Project Plan
QC	Quality Control
Redox	Reduction-Oxidation
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
Site	Former Arkema Manufacturing Site
SQO	Sediment Quality Objectives
TCE	Trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
ug/L	Micrograms per Liter
USEPA	United States Environmental Protection Agency
USG	United States Gypsum
VC	Vinyl Chloride
VOC	Volatile Organic Compound
WAC	Washington Administrative Code
Work Plan	FS Data Gap Investigation Work Plan
Wypenn	Wypenn Property
XRF	X-ray Fluorescence

SECTION 1: INTRODUCTION

1.1 Purpose

The purpose of this Feasibility Study (FS) Data Gap Investigation Work Plan (Work Plan) is to present the plan for implementing investigation activities that will provide data and information to address FS data gaps identified for the Former Arkema Manufacturing Site (Site). The Site is associated with a former chemical manufacturing facility that operated from 1927 to 1997. This Model Toxics Control Act (MTCA) Site is currently in the FS phase, and a preliminary screening of potential remedial technologies has been completed (PIONEER Technologies Corporation [PIONEER] 2016). During the preliminary screening of potential remedial technologies, four high priority FS data gaps were identified. The FS data gap investigation activities presented in this Work Plan to address these four FS data gaps are needed to:

- Complete the remedial technology screening process;
- Design and implement treatability studies as necessary; and
- Complete the assembly of appropriate remedial alternatives and detailed evaluation of retained remedial alternatives.

Other FS data gaps may be identified in the future based on the results of the FS data gap investigation activities described in this Work Plan.

1.2 Site Location

The Site is located on Port of Tacoma (Port)-owned property in the Tacoma Tideflats along the Hylebos Waterway in Tacoma, Washington (see Figure 1-1).[1] The Site address is 2901 and 2920 Taylor Way, Tacoma, Washington.[2] The Site is bounded by the former United States Gypsum (USG) facility to the north, the Hylebos Waterway to the east, the Arkema Mound site to the south, Taylor Way to the west, the Blair Backup Property to the west, and the Former Reichhold Site to the west (see Figure 1-2).

Consistent with past practices at this Site, direction descriptions in this Work Plan are in relation to a "site north" that is parallel to the Site shoreline. "Site north" is approximately 45 degrees west (counter clockwise) from true north. Both "site north" and true north are shown on plan view figures.

The key areas/features within the approximately 48-acre Site frequently referenced in this Work Plan include the North Boundary Area, the former Central Manufacturing Area, the sheet pile wall, the former Penite Pits, the former Taylor Lake Area surface impoundments, and Wypenn (see Figure 1-3). Former manufacturing operations are discussed in Section 2. A triangular-shaped portion of the adjacent Arkema Mound site, which is a separate site that was not used for manufacturing operations, is also included within the Former Arkema Manufacturing Site boundary, but for the Intermediate Aquifer only (Dalton, Olmsted, & Fuglevand, Inc. [DOF] 2013).

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[1] The Port purchased the site from Arkema in May 2007.

[2] The associated tax parcel numbers are 0321351053 and 0321362056, respectively. 2920 Taylor Way is the Wypenn property (Wypenn).

1.3 Work Plan Organization

This Work Plan is organized as follows:

- Section 2: Site Background
- Section 3: Identification of FS Data Gaps
- Section 4: Sampling and Analysis Plan
- Section 5: Quality Assurance Project Plan
- Section 6: References

SECTION 2: SITE BACKGROUND

A brief overview of Site background information is presented in this section to provide context for the proposed FS data gap investigation activities. The information presented in this section is based on the Final Remedial Investigation Report (DOF 2013) and/or the Evaluation of Media and Chemicals of Potential Concern, Exposure Pathways, and Clean Up Standards – Part 1 (Malcolm Pirnie 2006) unless otherwise noted.

2.1 Site Setting

2.1.1 Climate

The Site is located in Western Washington, which is typified by relatively mild temperatures and a marine-influenced climate (Western Regional Climate Center 2016). The average annual precipitation for Tacoma is approximately 40 inches, with most precipitation falling between October and April (Western Regional Climate Center 2016).

2.1.2 Topography and Drainage

The Site is relatively flat, with the shoreline sloping to the Hylebos Waterway. With the exception of the shoreline, topographic elevations generally range between 15 feet and 20 feet mean lower low water (MLLW).

When the former manufacturing facility was operating, stormwater runoff was not considered a significant contaminant transport pathway (Ecology 1993). None of the stormwater infrastructure from the former manufacturing facility remains. Currently, virtually all stormwater infiltrates to Site soil.

2.1.3 Geology

The regional geology is dominated by Quaternary ice age glacial deposits. In general, regional glacial deposits include sand and gravel aquifers associated with glacial outwash and low permeability glacial till deposits containing clay and silt.

The Site is located within the tideflats of the Puyallup River delta. In general, the pre-development tideflats consisted of alternating layers of lower permeability silt/clay deposits and sandy deposits. Sediment dredged from Commencement Bay and its tributaries as well as other fill material were used to raise the land elevation during the industrial development of the tideflats.

The relevant geologic units at the Site from shallowest to deepest have been deemed:

- Fill Unit: The Fill Unit consists primarily of dredge sand and imported fill.
- Upper Silt: The Upper Silt consists primarily of clayey silt to fine sandy silt, with fibrous organic material associated with former tideflat vegetation at the top of the unit. The Upper Silt is absent in several locations at the Site, including a localized area immediately west of the sheet pile wall between Stations 124+00 and 125+50. The absence of the Upper Silt is likely associated with erosion in historical stream channels.

- Intermediate Sand: The Intermediate Sand consists primarily of a native fine to medium sand with shell fragments.
- Lower Silt: The Lower Silt consists primarily of clayey silt to fine sandy silt.
- Lower Sand: The Lower Sand primarily consists of a fine to medium sand with silt interbeds.

2.1.4 Hydrogeology

The relevant hydrostratigraphic units at the Site from shallowest to deepest correspond to a specific geologic unit and have been deemed:

- Upper Aquifer: The Upper Aquifer is the saturated portion of the Fill Unit. The Upper Aquifer thickness generally ranges from approximately four to 13 feet. Upper Aquifer groundwater is typically encountered at depths of less than six feet below ground surface (bgs) in most portions of the Site. The depth to Upper Aquifer groundwater can be less than two feet bgs in monitoring wells (MWs) near the former Penite Pits.
- First Aquitard: The First Aquitard is the Upper Silt. Where present, the First Aquitard thickness generally ranges from approximately four to 12 feet.
- Intermediate Aquifer: The Intermediate Aquifer is the Intermediate Sand. The Intermediate Aquifer thickness generally ranges from approximately eight to 17 feet.
- Second Aquitard: The Second Aquitard is the Lower Silt. The Second Aquitard thickness generally ranges from approximately eight to 15 feet.
- Deep Aquifer: The Deep Aquifer is the Lower Sand. The Deep Aquifer thickness appears to be at least 20 feet thick.

In general, the direction of groundwater flow in all three aquifers for the portion of the Site east of Taylor Way is towards the Hylebos Waterway. Groundwater in the Upper Aquifer and Intermediate Aquifer also flows around the north and south ends of the sheet pile wall. The Intermediate Aquifer and the Deep Aquifer are tidally influenced and can experience flow reversals. Significant tidal fluctuations and mixing occur seaward of the sheet pile wall in the Upper Aquifer. The Upper Aquifer inside of the sheet pile wall is not significantly affected by tidal fluctuations.

2.1.5 Hylebos Waterway

The Hylebos Waterway was formed in the 1930s by dredging Hylebos Creek to create a Waterway capable of accommodating ocean-going ships. The Hylebos Waterway was designed for industrial and port use with straight deep channels and developed and protected banks. The Hylebos Waterway is classified under the Clean Water Act as Class B marine water with the following designated uses (DOF 2013):[3]

- Fish (good quality salmon migration and rearing; other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish rearing and spawning)
- Recreation (secondary contact recreation, sport fishing, boating, and aesthetic recreation)
- Harvesting

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[3] The water is brackish and cannot be used for drinking water.

- Commerce and Navigation

2.1.6 *Site Land Use*

Historical land use at the Site was industrial; current land use at the Site is Port-owned vacant industrial land awaiting redevelopment. The Site is covered with vegetation, crushed rock, and some former building/tank foundations. The planned future land use for the Site is Port maritime industrial use consistent with the Port's Land Use Plan (Port 2014).

2.2 Overview of Operational History

Arkema operated a chemical manufacturing facility within the Site boundary and manufacturing activities were conducted within the former Central Manufacturing Area (see Figure 1-3).[4] The products that were manufactured within the former Central Manufacturing Area included chlorine, sodium hydroxide (caustic), sodium chlorate, hydrochloric acid, and sodium arsenite (Penite). Operations started in 1927 with the manufacturing of chlorine and caustic. Penite, which is the product most relevant to this Work Plan, was manufactured between circa 1939 and 1972. The remaining chlorine-based manufacturing operations at the facility ceased in 1997. Manufacturing facilities were dismantled and removed from the Site following plant shutdown in 1997. The Port removed all remaining aboveground structures in 2008. Some subsurface features remain (e.g., utilities, vaults, injection wells, extraction wells, and piping associated with a former pump-and-treat [P&T] system) at the Site.

2.3 Overview of Regulatory History

Investigation and cleanup work associated with the Site has been performed under three separate, but interrelated, regulatory programs:

- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): The Site is one of many source areas associated with the Commencement Bay/Nearshore Tide Flats (CB/NT) site. Cleanup of the Site shoreline and the Head of the Hylebos Waterway (the portion of the Waterway where Site groundwater discharges) were completed as part of remedial actions for the CB/NT CERCLA site.
- Clean Water Act: Previous upland Site investigations and remedial actions were completed pursuant to a 1987 Consent Decree between Arkema and the Washington State Department of Ecology (Ecology).
- MTCA: The recently-completed Remedial Investigation (RI) Report (DOF 2013; Ecology 2013) and the FS are being conducted pursuant to Agreed Order No. DE 5668 between the Port and Ecology (the Agreed Order became effective on July 25, 2011). The activities proposed in this Work Plan are being conducted per Agreed Order No. DE 5668.

A brief overview of the Site chronology is included in Section 2.4. Completed remedial actions are discussed in Section 2.5.

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[4] For simplicity, the term Arkema is used to represent Arkema's predecessor companies. Arkema's predecessor companies (i.e., Tacoma Electrochemical Company, Pennsylvania Salt Manufacturing Company of Washington, Pennwalt Corporation, Atochem Inc., Elf Atochem North America, and Atofina Inc.) operated the former manufacturing facility.

2.4 Overview of Site Chronology

A significant number of investigation, evaluation, and cleanup activities have been performed at this Site since 1981. Approximately $78 million dollars have been spent to date to investigate, evaluate, and cleanup this Site (Groff Murphy Trachtenberg & Everard, PLLC 2006; DOF 2011; PIONEER 2016). Hundreds of technical and regulatory documents have been prepared since the first Site investigation report was prepared in 1981 (only a small portion of the documents are included in the references of this Work Plan). Soil, groundwater, pore water, surface water, sediment, and air have been investigated and evaluated. Based on the results of these investigations and evaluations, arsenic (which was disposed of in two former Penite Pits near the southern boundary of the former Central Manufacturing Area) was identified as the primary constituent of potential concern (COPC) at the Site. Numerous remedial actions were conducted to address impacts from arsenic and other constituents (see Section 2.5). The general nature of the Site chronology is summarized in the following table. See the completed RI Report for a detailed description of the Site chronology (DOF 2013).

Regulatory Program	Completed Phases
CB/NT CERCLA Site (Head of Hylebos)	RI, FS, Remedial Design, Remedial Action Implementation
1987 Arkema Clean Water Act Consent Decree	RI, FS, Remedial Design, Remedial Action Implementation
2011 Arkema MTCA Agreed Order	RI Data Gaps, RI Report, Wypenn Interim Action (IA)

2.5 Overview of Completed Remedial Actions

A significant number of remedial actions have been completed for this Site, including completion of historical stormwater and wastewater improvements, completion of soil/sediment removals, installation of soil/sediment caps, installation of a sheet pile wall, installation and operation of a P&T system in the arsenic source area, in-situ stabilization in the arsenic source area, remediation of volatile organic compounds (VOCs) in the VOC source areas, and remediation of miscellaneous other releases. The completed remedial actions are summarized in the following table and shown on Figures 2-1A and 2-1B.[5]

Category	Completed Remedial Actions
Historical Stormwater and Wastewater Improvements	Three stormwater catch basins near the former Penite Pits were sealed in 1981 (AWARE Corporation 1981, Hart Crowser 1986). In addition, modifications to increase the stormwater collection system and the stormwater treatment system were made in 1981 and 1986. These stormwater improvements significantly decreased the arsenic mass discharge from the Site to the Hylebos Waterway. As discussed in Section 2.1, no stormwater infrastructure remains at the Site. The discharge of wastewater to all Taylor Lake Area surface impoundments ceased by 1990. This action significantly reduced recharge to the Upper Aquifer in this area, and decreased transport of elevated pH to groundwater.
Soil/Sediment Removal	Approximately 3,000 cubic yards (CY) of arsenic-impacted soil within and surrounding the former Penite Pits was excavated and disposed of off-site in 1990 (MPS Incorporated 1990; ICF Technology

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[5] The locations of the historical stormwater improvements are not shown on Figures 2-1A and 2-1B because the improvements affected undefinable areas.

Category	Completed Remedial Actions
	Incorporated [ICF] 1990b). The 10-foot-deep excavations extended to the top of the First Aquitard. Approximately 1,200 CY of asbestos-impacted and elevated pH sludge from the former Asbestos Ponds (two of the former Taylor Lake Area surface impoundments) was excavated and disposed of off-site in 1990 (ICF 1990b). An expansion of the 1990 Penite Pit area excavations was performed in 2003 (Environmental Resources Management [ERM] 2003b). Approximately 185 CY of arsenic-impacted soil was excavated and disposed of off-site. Soil and sediment along the shoreline in the North Boundary Area were excavated and disposed of off-site in 2003 as part of the reconfiguration of the shoreline in this area (DOF 2011). Hylebos Waterway sediment adjacent to the Site (including the areas where sediment caps were subsequently placed) was dredged and disposed of off-site between 2003 and 2005 (DOF 2011). Approximately 13,100 tons of arsenic-impacted soil, sediment, and debris in the intertidal zone of the Site shoreline were excavated and disposed of off-site in 2004 (DOF 2011). Approximately 2,200 tons of arsenic-impacted soil was excavated from Wypenn and disposed of off-site during a 2014 IA to achieve compliance with the MTCA Standard Method C industrial soil cleanup level for the soil direct contact pathway of 88 milligrams per kilogram (mg/kg) (DOF 2015b). Approximately 25,000 tons of arsenic-impacted soil was excavated and disposed of off-site at the Arkema Mound site between 2013 and 2014. This action is included since a small portion of the soil removal was from within the Site boundary (DOF 2015a).
Soil/Sediment Cap	All of the former Taylor Lake Area surface impoundments and the former Waggoner's Wallow surface impoundment in the North Boundary Area were backfilled with soil in 1990 (DOF 2013). The thickness of the soil cap is likely on the order of one to four feet based on the depth of the former surface impoundments (AWARE Corporation 1981). A three-foot-thick sediment cap was installed in the intertidal zone of the Site shoreline (seaward of the sheet pile wall) between 2004 and 2005 (DOF 2011) as part of the backfill of the 2004 intertidal soil removal. A four-foot-thick sediment cap was installed in the subtidal zone of the Site shoreline (seaward of the sheet pile wall) in 2006 to cap residual arsenic-impacted soil/sediment that could not feasibly be dredged (DOF 2011).
Sheet Pile Wall	A sheet pile wall was installed west of the Site shoreline in October 1990 to help achieve the source control goal of reducing arsenic mass discharge from the Site to the Hylebos Waterway (ICF 1990a, 1990b). The wall was constructed of interlocking steel sheet piles that were 21.6 inches wide, 0.315 inches thick, and 30 feet long. The wall was seated into the Second Aquifer. Every second joint was welded, and those joints not welded were sealed with an asphalt material. A small gap where the sheet pile wall does not extend all the way to the Second Aquitard may exist in the vicinity of Station 125+50 (Pacific Groundwater Group [PGG] 2004). In addition, two gaps in the top part of the sheet pile wall were discovered and filled in 2004 (see Appendix A). It is unsure whether these two gaps were caused by wall construction, earth movement during the 2001 Nisqually earthquake, or another reason. A southern extension of the sheet pile wall was installed circa February 1991 to April 1992 to improve containment of arsenic-impacted groundwater near the south end of the original wall (ICF 1991, 1992). A northern extension of the sheet pile wall was installed in August 1995 to improve containment of arsenic-impacted groundwater near the north end of the original wall (Elf Atochem 1995).

Category	Completed Remedial Actions
Arsenic P&T System	The northern portion of the sheet pile wall was further extended in June 1997 to improve containment of arsenic-impacted groundwater near the north end of the wall (DOF 2013). A groundwater P&T system was installed in the arsenic groundwater source area and operated between 1992 and 2003 (ICF 1990c, 1995; DOF 2013). The P&T system included 15 extraction wells in the Upper Aquifer, four extraction trenches in the Upper Aquifer, and five extraction wells in the Intermediate Aquifer. More than 22,000 pounds of arsenic was removed by the P&T system (Boateng 2003). Once the arsenic concentrations in extracted groundwater reached an asymptote, the P&T system was shut down as part of a planned transition from P&T to polishing with in-situ stabilization (ICF 1990c).
In-Situ Stabilization	As part of a planned use of in-situ stabilization for post-P&T polishing, in-situ stabilization was performed within the core of the arsenic groundwater plume between 2001 and 2004 (ICF 1990c; ERM 2003a, 2005). In-situ stabilization consisted of injecting hydrogen peroxide and ferric chloride into the Upper Aquifer and Intermediate Aquifer. These injections reduced the activity of hydrogen ions (pH), oxidized the more mobile arsenite form of arsenic into the less mobile arsenate form of arsenic, and provided ferric iron, which combined to facilitate sorption and co-precipitation of arsenic in groundwater onto soil. Approximately 139 tons of iron were injected (ERM 2005).
VOC Remediation	A soil vapor extraction system and a groundwater P&T system were installed and operated between 1996 and 2000 in order to remove VOCs in a few areas along the southern border of the North Boundary Area with localized VOC-impacted groundwater (Boateng 2002). In-situ chemical oxidation (using hydrogen peroxide) was performed in 2003 to treat VOCs in an area east of the former Taylor Lake Area surface impoundments with localized VOC-impacted groundwater (ERM 2003c).
Remediation of Miscellaneous Releases	Historical process-related (e.g., sodium chlorate, No. 2 fuel, hydrochloric acid) spills were remediated as necessary (DOF 2013).

These remedial actions have significantly reduced concentrations in the arsenic source area and the mass discharge of arsenic to the Hylebos Waterway. As a result, the United States Environmental Protection Agency (USEPA) and Ecology have considered source control actions associated with the Site to be functionally complete for the purpose of the CB/NT site. In 1999, Ecology determined that the Site "is no longer considered a source of problem chemicals to Hylebos Waterway sediments" (Ecology 1999). Sediment remediation in the Head of the Hylebos Waterway (the portion of the Waterway where Site groundwater discharges) began thereafter because "known source control actions were implemented and deemed to be complete enough to begin sediment remediation" (USEPA 2014). Although the ongoing Site FS was included as an action item for the CB/NT site in the latest CB/NT Five-Year Review Report because additional source control measures may be necessary, it was concluded that the results of the FS would not affect CB/NT remedy protectiveness because the source control remedy components were already determined to be protective (USEPA 2014).

2.6 Constituents of Potential Concern

The nine COPCs identified in 2013 RI were:[6]

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[6] Four constituents (chromium, selenium, zinc, and dichloro-diphenyl-trichloroethane) were identified in the 2013 RI as COPCs for the potential terrestrial ecological pathway only. However, the Site is excluded from a terrestrial ecological evaluation in

- Arsenic;
- Lead;
- Mercury;
- Copper;
- Nickel;
- Tetrachloroethylene (PCE);
- Trichloroethylene (TCE);
- Vinyl chloride (VC); and
- Chloroform (CF).

As determined in previous Site documents, arsenic is the key COPC for this Site. The magnitude and extent of arsenic impacts at the Site are significantly greater than the other COPCs. Impacts from arsenic also pose a greater potential risk and more regulatory concern than impacts from other COPCs. All of the proposed FS data gap investigation activities are associated with the potential migration of arsenic to the Hylebos Waterway.

2.7 Preliminary Arsenic Cleanup Standards

Although cleanup standards have not been established yet, preliminary cleanup levels (PCLs) for arsenic are included in this section in order to provide context for the FS data gaps (all of which are associated with arsenic impacts). Potential points of compliance (POC) options are also discussed to provide context for the FS data gap investigation activities. Cleanup levels for all COPCs and POCs will be established later in the FS process.

2.7.1 Soil

The arsenic soil PCL of 88 mg/kg is based on the protection of commercial/industrial workers for the soil direct contact pathway. The soil PCL is the MTCA Standard Method C industrial soil cleanup level for the soil direct contact pathway. This same arsenic soil PCL was used for the Wypenn IA (DOF 2015b) and other recent cleanups at nearby Sites such as Arkema Mound (DOF 2015a), Superlon (Pacific Environmental & Redevelopment Corporation and PIONEER 2014), and the Former Reichhold Site (Floyd Snider 2008).

The POC depth for the soil direct contact pathway depends on the type of remedial action. In accordance with WAC 173-340-740(6)(d), the standard POC depth is 15 feet; however, per WAC 173-340-740(6)(f), there is no depth requirement for a cap/cover action.

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accordance with Washington Administrative Code (WAC) 173-340-7491(1)(b) because the Site was previously developed for industrial use and it will be redeveloped in the future for Port maritime industrial use (e.g., grading activities and installation of a cap/cover, construction of buildings and operational areas for a container yard). Thus, these four constituents will not be considered COPCs during the FS phase.

2.7.2 Groundwater/Surface Water

The current arsenic groundwater/surface water PCL of 5 micrograms per liter (ug/L) is based on the protection of potential surface water receptors and the current Ecology-accepted background concentration for arsenic in groundwater. If appropriate, the arsenic PCL for groundwater/surface water may be adjusted up in the future to account for regional or site-specific background concentrations.

There are a number of groundwater/surface water POC options in MTCA regulations for the protection of potential surface water receptors that may be applicable to this Site. The standard groundwater POC per WAC 173-340-720(8)(b) is all groundwater across a site. However, this standard POC is typically not appropriate for complicated sites like this Site because it is not practicable to achieve cleanup levels throughout the site within a reasonable restoration time frame. There are three potentially applicable conditional POCs for this Site. Per WAC 173-340-720(8)(c), the first conditional POC option is "as close as practicable to the source of hazardous substances" but not exceeding the property boundary. Since this Site abuts surface water, a second conditional POC option per WAC 173-340-720(8)(d)(i) if certain criteria are met is “within the surface water as close as technically possible to the point or points where ground water flows into the surface water.” A third conditional POC option per WAC 173-340-730(6)(a) is "points at which hazardous substances are released to the surface waters of the state" (i.e., pore water sample locations at the groundwater/surface water interface where groundwater discharges to surface water).

2.8 Arsenic Current Conditions

The current extent of the arsenic contamination in soil, groundwater, surface water, and sediment at the Site are summarized in this section. This information provides context for the data gaps and data gap activities presented in Sections 3 and 4, respectively.

2.8.1 Soil

Existing arsenic soil concentrations between ground surface and 15 feet bgs are shown on Figure 2-2. In general, the highest arsenic soil concentrations are located in relatively deep samples surrounding and downgradient of the former Penite Pits (i.e., Upper Aquifer saturated zone or First Aquitard samples deeper than six feet bgs). Elevated arsenic soil concentrations are also located adjacent to former USG operations in the North Boundary Area.

2.8.2 Groundwater

Dissolved arsenic groundwater and pore water concentrations from 2012 for the Upper Aquifer, Intermediate Aquifer, and Deep Aquifer are presented on Figures 2-3, 2-4, and 2-5, respectively.[7] A cross-section of the dissolved arsenic concentrations along the center of the plume is presented on

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[7] MTCA surface water cleanup levels are based on Chapter 173-201A of the WAC, regulations developed pursuant to Section 304 of the Clean Water Act, and 40 Code of Federal Regulations 131. These regulations explicitly indicate that the criteria are intended for use with dissolved arsenic. Thus, dissolved arsenic concentrations are used for evaluating compliance.

Figure 2-6. In general, the highest dissolved arsenic concentrations are located around and downgradient of the former Penite Pits. Significant attenuation of arsenic occurs prior to the groundwater-to-surface water interface (see Figure 2-6). See the Conceptual Site Model (CSM) for the arsenic plume (Section 2.9) for additional discussion of arsenic fate and transport.

2.8.3 Surface Water and Sediment

Dissolved arsenic concentrations in the most recent Hylebos Waterway surface water samples collected adjacent to the Site (three 2004 locations and one 2012 location) are presented on Figures 2-3 through 2-5. Dissolved arsenic concentrations in these surface water samples ranged from non-detect at a reporting limit of 5 ug/L to a maximum detected concentration of 10 ug/L.

Since sediment is associated with the CB/NT CERCLA site, arsenic sediment concentrations are only presented in this Work Plan for context. Intertidal and subtidal sediment samples were collected from the biologically active zone of 0 – 10 centimeters along the Site shoreline in 2008 and 2012. The results from these samples compared to the CB/NT arsenic sediment quality objective (SQO) of 57 mg/kg are presented in Figure 2-7 (USEPA 1989). The arsenic concentrations in all sediment samples were less than the arsenic SQO and were consistent between 2008 and 2012. Furthermore, arsenic-impacted groundwater is not expected to re-contaminate sediment as discussed in a January 2015 meeting with Ecology (PIONEER 2015).

2.9 Conceptual Site Model for the Arsenic Plume

A summary of the CSM for the arsenic plume at the Site is presented below. The CSM includes a conceptual site fate and transport model (summarized in Sections 2.9.1 through 2.9.4) and a conceptual site exposure model (see Section 2.9.5). This CSM summary discussion is focused on the Upper Aquifer and Intermediate Aquifer since arsenic impacts are limited in the Deep Aquifer (see Figures 2-3 through 2-6). The CSM will be updated as new information is obtained and new data are evaluated.

2.9.1 Sources

The primary sources of the arsenic plume were the two former Penite Pits. Waste materials generated by the Penite manufacturing process in the former Penite Building were disposed of in the nearby former Penite Pits (see Figure 2-8). These wastes were placed within the Upper Aquifer saturated zone. The Penite Pit waste materials and surrounding soil have been excavated to the top of the First Aquitard and removed from the Site as discussed in Section 2.5. Secondary sources of the arsenic plume include arsenic that has leached from the waste materials and has sorbed to soil beyond the former Penite Pits.

The former Taylor Lake Area surface impoundments and the former Caustic Building and Tank Farm Area appear to be two potential sources of the pH that exacerbated the transport of arsenic in groundwater in certain upland areas (see Figure 2-8 and Section 2.9.2). Amongst other wastes, the Taylor Lake Area surface impoundments received high pH wastewater and brine muds. The pH values in 1989 sludge samples collected from the Taylor Lake Area surface impoundments ranged from 9.8 to 12.4 (Kennedy/Jenks/Chilton 1990). Discharge of high pH wastewater and brine muds to the Taylor Lake

Area surface impoundments ceased by 1990. The elevated pH sludge in the Asbestos Ponds was removed in 1990; however, a discrete layer of sludge with elevated pH may remain underneath the soil cap placed on the remaining former Taylor Lake Area surface impoundments in 1990.[8] Although a specific release of elevated pH in the former Caustic Building and Tank Farm Area has not been identified, some sort of elevated pH release likely occurred in this area given the presence of elevated pH concentrations in groundwater underneath this area and the fact that caustic manufacturing occurred in this area.

2.9.2 Plume Creation

The key historical fate and transport factors responsible for creating the arsenic plume in the Upper Aquifer and Intermediate Aquifer are summarized below:

- The Penite waste that was placed within the Upper Aquifer saturated zone in the former Penite Pits leached and dissolved, which caused arsenic impacts in Upper Aquifer groundwater surrounding the former Penite Pits.
- The historically high arsenic concentrations surrounding the former Penite Pits area oversaturated the available sorption sites, which enabled arsenic-impacted groundwater to spread beyond the former Penite Pits area.
- Arsenic-impacted Upper Aquifer groundwater surrounding the former Penite Pits area was transported via advection east towards the Hylebos Waterway along the primary groundwater flow direction prior to the installation of the sheet pile wall.
- Dispersion and diffusion enhanced by reverse gradients associated with tidal fluctuations caused the arsenic-impacted groundwater in the Upper Aquifer to also extend slightly in the north, south, and west directions prior to the installation of the sheet pile wall.
- Installation of the sheet pile wall resulted in vertical migration of arsenic-impacted groundwater from the Upper Aquifer to the Intermediate Aquifer (with thin or absent portions of the First Aquitard serving as potential preferred flow pathways), and at lower concentrations through the Second Aquitard into the Lower Aquifer.
- Installation of the sheet pile wall also increased the lateral spreading of arsenic-impacted groundwater to the north and south around the ends of the sheet pile wall. In addition, the arsenic-impacted groundwater migrating around the ends of the sheet pile wall encountered the less favorable attenuation conditions near the ends of the sheet pile wall, exacerbating historical transport of arsenic in these areas. As discussed further in Section 2.9.4, less favorable attenuation conditions include significantly elevated pH (see Figure 2-3) and less favorable reduction-oxidation (redox) conditions (e.g., activity of electron [Eh] values less than zero volts).

2.9.3 Current Attenuation of the Arsenic Plume

The completed remedial actions summarized in Section 2.5 and natural attenuation processes summarized in this section are working together to significantly attenuate arsenic-impacted groundwater prior to discharge to the Hylebos Waterway. The key attenuation factors that (1) keep the

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[8] The sludge thickness in the Taylor Lake Area surface impoundments prior to the installation of the cap ranged from 1.5 to 6.3 feet (AWARE Corporation 1981; Kennedy/Jenks/Chilton 1990).

plume stable (or potentially declining), and (2) minimize arsenic concentrations in groundwater prior to the shoreline are:

- The primary sources of arsenic (i.e., the Penite waste disposed of in the two former Penite Pits) were completely removed in 1990.
- The 11-year operation of the groundwater P&T system for the arsenic plume and the 2004 removal of arsenic-impacted soil in the intertidal zone removed a significant amount of mass associated with the secondary arsenic source (i.e., arsenic sorbed to soil between the former Penite Pits and the shoreline). The secondary arsenic source will continue to attenuate over time.
- Completed remedial actions have decreased pH impacts. Ceasing discharges of all wastewater to the former Taylor Lake Area surface impoundments eliminated a primary pH source. Elevated pH sludge from the two Asbestos Ponds, which are located approximately 100 feet south of the former Penite Pits, was removed in 1990. The in-situ stabilization actions between 2001 and 2004 neutralized elevated pH in portions of the Site. Any remaining pH sources will continue to attenuate over time.
- The sheet pile wall continues to significantly reduce arsenic mass discharge to the Hylebos Waterway. Even as the sheet pile wall deteriorates, it will still provide service as a vertical aquitard limiting transport of any remaining secondary arsenic source to the Hylebos Waterway.
- Installation of the sheet pile wall resulted in increased vertical and lateral spreading of the arsenic plume. While this action initially increased the overall size of the plume, it also provided more areas for ongoing natural attenuation to occur. For instance, the available sorption capacity of the soil near the edges of the plume is likely relatively high, allowing arsenic to bind to the soil in these areas.
- The mixing of surface water within groundwater in the transition zone along the Site shoreline causes significant hydraulic tidal dispersion. In other words, the proportion of fresh upland groundwater within the total amount of water discharged over time at the groundwater/surface water interface is relatively small. As a result, the arsenic concentrations at the groundwater/surface water interface are significantly lower than arsenic concentrations just upgradient of the transition zone. A recent literature review of field studies for tidally-influenced areas around the world indicated that fresh groundwater typically only accounts for 1% - 20% of the total water discharged to surface water (McKeon 2016). The remaining 80% - 99% of the water discharged to surface water is re-circulated surface water. The results from this literature review are consistent with the results from a previous site-specific evaluation, which concluded that surface water accounts for approximately 80% - 99% of the water in the Angled Shoreline MWs (DOF 2013).
- The mixing of marine surface water within groundwater in the transition zone along the Site shoreline significantly alters the geochemical conditions along the shoreline, which results in significant attenuation between the sheet pile wall and the Hylebos Waterway as discussed in Section 2.9.4.
- The engineered intertidal and subtidal caps enhance attenuation along the shoreline by providing sorption sites and enhancing marine surface water mixing within the transition zone, which increases hydraulic tidal dispersion and produces more favorable geochemical conditions.

- The in-situ stabilization actions between 2001 and 2004 provided additional ferric iron to complement native iron. As discussed in Section 2.9.4, ferric iron helps attenuate the arsenic plume via sorption and co-precipitation.
- Processes such as diffusion, dispersion, and aquifer recharge continue to help attenuate arsenic throughout the plume.

2.9.4 Role of Geochemistry in Arsenic Attenuation

The natural attenuation of arsenic in groundwater is highly dependent on several interrelated geochemical mechanisms and conditions (Argonne National Laboratory 2003; Savannah River National Laboratory 2011; USEPA 2007a, 2007b, 2015). The key geochemical mechanisms affecting arsenic attenuation are (1) sorption of arsenic from groundwater onto soil/sediment, (2) redox reactions, and (3) the co-precipitation of arsenic with non-arsenic minerals (or direct precipitation of arsenic minerals). The following geochemical conditions (pH, redox conditions, and ferric iron) have the greatest influence on these geochemical mechanisms (and therefore arsenic attenuation) as described below:

- pH: The ability of arsenic to attenuate increases when pH decreases from a significantly elevated pH to a neutral pH range because the ability of arsenic to sorb onto soil/sediment increases. In these pH ranges, aqueous arsenate in groundwater exists as negatively charged oxyanions, and aqueous arsenite exists as a neutrally charged species or a negatively charged oxyanion. Solid-phase sorption sites (e.g., oxides) are positively charged when pH is in a neutral range, but negatively charged when pH is significantly elevated. Therefore, the electrostatic attractions that facilitate sorption of arsenic onto sorption sites are more compatible in a neutral pH range than when pH is significantly elevated because the charges on the sorption sites and arsenic species are aligned to attract each other rather than repel each other.
- Redox Conditions: The ability of arsenic to attenuate generally increases as conditions become more oxidizing because (1) arsenic will be present as arsenate (which is negatively charged and less mobile than the neutrally charged arsenite present at neutral pH), and (2) iron will be present as ferric iron.
- Ferric Iron: The ability of arsenic to attenuate generally increases as the amount of ferric iron increases in the soil/sediment for three reasons. First, existing solid-phase ferric iron oxide minerals provide sorption sites for arsenic. The second and third reasons are due to the creation of fresh, solid-phase ferric iron oxide minerals in redox interfaces where redox conditions transition from reducing to oxidizing conditions. In this type of redox interface, ferrous iron dissolved in anoxic groundwater is oxidized to ferric iron and solid-phase ferric iron oxide minerals are formed. Arsenic can co-precipitate with these ferric iron oxide minerals as the minerals form, and the fresh ferric iron oxide minerals provide additional sorption sites for arsenic. Note that manganese and aluminum oxides can serve similar functions as iron oxides for arsenic attenuation (e.g., providing arsenic sorption sites).

Other geochemical conditions that can influence the geochemical mechanisms (and potentially affect arsenic attenuation) include:

- Ortho-phosphate and Silicate: The ability of arsenic to attenuate generally increases as the concentrations of competitive anions such as ortho-phosphate and silicate decrease because ortho-phosphate and silicate can compete with arsenic oxyanions for sorption sites.

- Ionic Strength: The ability of arsenic to attenuate generally increases as the ionic strength of the aqueous phase[9] increases because sorption sites are more positively charged at higher ionic strengths, which facilitates increased sorption of arsenic oxyanions.
- Sulfides: The ability of arsenic to attenuate can increase under reducing conditions when sulfide concentrations increase because of the increased potential for precipitation of arsenic sulfide minerals (e.g., arsenic trisulfide) and co-precipitation of arsenic with other non-arsenic sulfide minerals (e.g., pyrite).

As discussed in the January 2015 meeting between the Port and Ecology (PIONEER 2015), multiple lines of evidence demonstrate that significant natural attenuation is occurring along the Site shoreline because marine surface water mixing significantly alters the geochemical conditions in soil and groundwater near the shoreline. Specifically:

- The neutral pH in marine surface water decreases the groundwater pH to a more neutral range, which increases arsenic attenuation via sorption as described above. The pH decrease in groundwater near the Site shoreline also enables silicon and magnesium minerals (which were solubilized by the elevated pH) to re-precipitate and form a cemented layer along the shoreline (Intera 1995). This cementation decreases the aquifer permeability and likely increases arsenic sorption. Although the 2003 to 2005 CB/NT sediment dredging project removed some of the obvious shoreline cementation, the same geochemical conditions will create more cementation over time.
- The saline surface water increases the ionic strength of groundwater, which increases arsenic attenuation via sorption as described above.
- The dissolved oxygen in marine surface water increases the groundwater Eh, which favors arsenate over arsenite and ferric iron over ferrous iron, both of which facilitate arsenic attenuation as described above. It should be noted that the ferric iron in soil/sediment near the shoreline is probably native ferric iron that is not related to the ferric iron added during the 2001 to 2004 in-situ stabilization project given (1) the presence of the sheet pile wall between the injection locations and the shoreline and (2) the amount of time that has passed since the injections (this will be further evaluated pursuant to FS data gap activities).

Based on observed geochemical conditions at the Site, conceptual geochemical zones were developed for the Upper Aquifer and Intermediate Aquifer (see Figures 2-9 and 2-10). Geochemical zones were determined based on pH, Eh, and the anticipated presence of significant ferric iron concentrations in soil/sediment near the shoreline.[10] Since existing data are not available to directly evaluate the amount of ferric iron in soil/sediment near the shoreline, the determination that ferric iron concentrations are likely significant near the shoreline was based on existing groundwater data (e.g., Eh). Three types of conceptual geochemical zones were identified in both the Upper Aquifer and Intermediate Aquifer:

- Zone 1 is present between the sheet pile wall and the shoreline. This zone is favorable to natural attenuation of arsenic due to a neutral pH (pH generally between 6 and 8.5), relatively strong oxidizing conditions (i.e., Eh generally greater than 0.2 volts), and the anticipated

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[9] Total dissolved solids and electrical conductivity are indicators of the ionic strength of the aqueous phase.

[10] The generally less important geochemical conditions (i.e., ortho-phosphate and silicate concentrations, ionic strength, and sulfide concentrations) were not used to develop the current conceptual geochemical zones, but may be used to refine the conceptual geochemical zones after the data collected pursuant to this investigation are evaluated.

presence of significant ferric iron concentrations in soil/sediment near the shoreline. This zone is a redox interface where redox conditions transition to more oxidizing conditions, and therefore likely facilitates the ongoing precipitation of fresh ferric iron oxide minerals that can sorb and co-precipitate arsenic as described above.

- Zone 2 encompasses the majority of the Site west of the sheet pile wall. Natural attenuation of arsenic is fair in this zone due to a neutral pH (pH generally between 6 and 8.5) and slightly oxidizing conditions (i.e., Eh generally between 0 to 0.2 volts).
- Zone 3 is present near the ends of the sheet pile wall. Natural attenuation of arsenic is less favorable in this zone due to elevated pH (pH generally greater than 8.5) and reducing conditions (i.e., Eh generally less than 0 volts).

Data collected pursuant to this Work Plan will be used to refine the understanding of the geochemical mechanisms, geochemical conditions, and geochemical zones at the Site.

2.9.5 Conceptual Site Exposure Model

The conceptual site exposure model (CSEM) is a framework for understanding potential site exposures/risks based on current and planned future land use. For the purposes of the FS, potential current/future exposures/risks are included in the CSEM for the following scenarios:

1. Baseline Case – This scenario assesses exposures/risks assuming that no further action (e.g., additional remediation, engineering controls, and/or institutional controls) will be implemented at the Site, even though that is not a realistic scenario. The baseline case is not based on current conditions, but rather is used to determine the pathways of potential concern and compare risk reductions achieved by the post-remediation and post-redevelopment scenario.
2. Post-Remediation and Post-Redevelopment – This scenario assesses exposures/risks assuming that further action (e.g., additional remediation, engineering controls, and/or institutional controls) will be implemented at the Site. In other words, this scenario is based on an evaluation of the risks at the Site after remediation and redevelopment have occurred. Variations of this scenario may be evaluated in the FS based on the nature of the remedial alternatives evaluated.
3. Off-Site – This scenario assesses exposures/risks to receptors that are located off-site and may be exposed to COPCs in media that have migrated off-site. For this Site, the only potential off-site receptors are aquatic organisms and recreators/fishers located in the Hylebos Waterway.

The fundamental assumption for the Baseline Case and Post-Remediation and Post-Redevelopment scenarios is that the future land use at the Site will be Port maritime industrial use. As such, the potentially exposed populations (i.e., exposure scenarios) applicable to the Site are the same for both scenarios (see Figure 2-11):

- Commercial/Industrial Workers – This exposure scenario assumes that workers will be on the Site regularly (e.g., 250 days per year). It is assumed that these workers do not perform intrusive soil activities.
- Utility Workers – This exposure scenario assumes that utility workers may perform outdoor, intermittent, occasional intrusive soil activities intermittently at the Site (e.g., 14 days per year).
- Trespassers – This exposure scenario assumes that trespassers may be outdoors on the Site, intermittently (e.g., 14 days per year).

- Terrestrial Organisms – This exposure scenario is included in Figure 2-11 for completeness with MTCA requirements to evaluate potential terrestrial ecological exposures. However, the Site is excluded from a terrestrial ecological evaluation in accordance with WAC 173-340-7491(1)(b) because the Site was previously developed for industrial use and it will be redeveloped in the future for Port maritime industrial use (e.g., grading activities and installation of a cap/cover, construction of buildings and operational areas for a container yard). In other words, this exposure scenario is incomplete due to a lack of terrestrial ecological habitat. Thus, this exposure pathway is not discussed further in the CSEM.

While the exposed populations are identical for the Baseline Case and the Post-Remediation and Post-Redevelopment scenarios, the complete exposure pathways are different. A complete exposure pathway consists of the following four elements:

1. A source that released a COPC to the environment (e.g., a spill).
2. An environmental transport mechanism for the released COPC (e.g., soil, runoff, groundwater flow).
3. An exposure point (i.e., a point of potential receptor contact with the contaminated exposure medium) that includes a location where receptors are present and where this is activity that results in exposure (referred to as an exposure scenario).
4. An exposure route at the exposure point (i.e., ingestion, dermal contact, and/or inhalation).

If any one of these four elements is not present, then the pathway is considered incomplete and, there is no exposure and no risk associated with this pathway.

The only complete exposure pathways at the Site are (see Figure 2-11):

- Incidental ingestion, dermal contact, and inhalation of particulates from surface soil by commercial/industrial workers, utility workers, and trespassers in the baseline case.
- Incidental ingestion, dermal contact, and inhalation of particulates from subsurface soil by utility workers in the baseline case.
- Ingestion and dermal contact with surface water and sediment by aquatic organisms in the Hylebos Waterway.
- Consumption of seafood by aquatic organisms in the Hylebos Waterway.
- Consumption of seafood by recreators/fishers in the Hylebos Waterway.
- Incidental ingestion and dermal contact with surface water and sediment by recreators/fishers in the Hylebos Waterway.

The potentially complete exposure pathways for the Site are (see Figure 2-11):

- Incidental ingestion, dermal contact, and inhalation of particulates from surface soil by commercial/industrial workers, utility workers, and trespassers in the post-remediation and post-redevelopment scenario.
- Incidental ingestion, dermal contact, and inhalation of particulates from subsurface soil by utility workers in the post-remediation and post-redevelopment scenario.
- Inhalation of indoor air vapors by commercial/industrial workers for both the baseline case and post-remediation and post-redevelopment scenarios if an occupied building is constructed without vapor intrusion mitigation systems in the few isolated areas that have VOC impacts.

- Dermal contact with subsurface groundwater by utility workers in the baseline case and post-remediation and post-redevelopment scenarios.

Note that potentially complete pathways associated with the post-remediation and post-redevelopment scenario may or may not be complete under future land use. The "completeness" of the exposure pathways ultimately depends on the remedial alternatives (i.e., the combination of additional remediation, engineering controls, and institutional controls) that are selected at the Site. For example, if the selected remedy for the Site is to implement a soil cap/cover with engineering and institutional controls to address potential subsurface excavations, then the incidental ingestion, dermal contact, and inhalation of particulates pathways would be incomplete for all receptors because there would be no point of contact (i.e., exposure point) for the receptors with contaminated soil.

The following pathways are incomplete for the following reasons:

- Ingestion of groundwater is an incomplete pathway for all receptors because groundwater is not used for drinking water at the Site.
- Dermal contact with groundwater is an incomplete pathway for commercial/industrial workers and trespassers because groundwater is not used for drinking water and commercial/industrial workers and trespassers will not have access to groundwater at the Site.
- Indoor air inhalation of vapors is an incomplete pathway for utility workers and trespassers because they are assumed to be outdoors.

2.9.6 Summary of the Conceptual Site Model

The primary sources of the arsenic plume were the two former Penite Pits, where Penite waste was placed within the Upper Aquifer saturated zone. Arsenic-impacted Upper Aquifer groundwater was transported vertically into the Intermediate Aquifer (and into the Deep Aquifer to a lesser degree) and horizontally towards the Hylebos Waterway. Historical releases of elevated pH (e.g., the former Taylor Lake Area surface impoundments) exacerbated the transport of arsenic in groundwater in certain upland areas. Transport of arsenic-impacted groundwater is being attenuated by completed remedial actions and natural attenuation processes. The sheet pile wall, intertidal cap, and subtidal cap are particularly important ongoing remedial components that significantly attenuate arsenic in groundwater prior to discharge to surface water. Hydraulic tidal dispersion and changes in geochemical conditions due to marine surface water mixing in the transition zone along the Site shoreline are particularly important ongoing natural processes that significantly attenuate arsenic in groundwater prior to discharge to surface water. The key complete and potentially complete exposure pathways for the Site are:

- Incidental ingestion, dermal contact, and inhalation of particulates from surface soil by on-site workers and trespassers
- Incidental ingestion, dermal contact, and inhalation of particulates from subsurface soil by utility workers
- Inhalation of indoor air vapors by on-site workers if an occupied building is constructed without vapor intrusion mitigation systems in the few isolated areas that have VOC impacts
- Ingestion and dermal contact with surface water and sediment by aquatic organisms

- Consumption of seafood by aquatic organisms
- Consumption of seafood by recreators/fishers
- Incidental ingestion and dermal contact with surface water and sediment by recreators/fishers

The CSM is summarized in Figure 2-12.

SECTION 3: IDENTIFICATION OF FS DATA GAPS

Four high priority FS data gaps identified during a preliminary screening of potential remedial technologies were:

- Data Gap #1: Shoreline Concentrations
- Data Gap #2: Arsenic Plume Stability
- Data Gap #3: Wall Integrity
- Data Gap #4: Feasibility of Focused Soil Excavation Alternative

Details about the identification of each data gap (i.e., why it was identified) are presented on Table 3-1. Note that some of the data gaps are divided into sub-categories (e.g., by aquifer) to simplify the presentation of proposed locations. A sampling and analysis plan (SAP) and quality assurance project plan (QAPP) associated with the planned investigation activities to address each data gap are presented in Sections 4 and 5, respectively.

3.1 Data Gap #1: Shoreline Concentrations

Potential migration of arsenic from Upper Aquifer and Intermediate Aquifer groundwater to the Hylebos Waterway is a primary concern at this Site. However, existing data do not exist to know the current concentrations of arsenic (and other COPCs) along the shoreline where groundwater discharges to surface water. Current concentrations of arsenic (and other COPCs) in pore water and surface water where groundwater discharges to surface water are necessary to design and evaluate cleanup alternatives in the FS. Thus, installation of nylon-screen diffusion samplers (NSDSs) along the shoreline are proposed in order to collect representative pore water samples in the Upper Aquifer and Intermediate Aquifer, and representative surface water samples where Intermediate Aquifer groundwater discharges to surface water. The NSDSs installed pursuant to Data Gap #1 will be sampled pursuant to Data Gap #2.

3.2 Data Gap #2: Arsenic Plume Stability

The stability of arsenic in Upper Aquifer and Intermediate Aquifer groundwater and potential migration to the Hylebos Waterway are primary concerns at this Site. The completed remedial actions have significantly decreased the arsenic source strength and mass discharge to the Hylebos Waterway (see Section 2.5, Table 3-1, and PIONEER 2015). The completed remedial actions and natural attenuation processes (including geochemical conditions) are expected to continue to reduce dissolved arsenic concentrations near the shoreline over time (see Section 2.9). However, a comprehensive groundwater, pore water, and surface water sampling event has not been conducted since 2012 to verify if this is true. Thus, two groundwater, pore water, and surface water sampling events are proposed in order to help evaluate plume stability in the Upper, Intermediate, and Deep Aquifers (e.g., arsenic time-series trend graphs for MWs, changes in plume magnitude and extent, geochemical lines of evidence) in accordance with applicable guidance (e.g., USEPA 2007a, 2007b, 2015; Savannah River National Laboratory 2011).

In addition, soil and sediment geochemistry data will be collected to further evaluate the existing geochemical lines of evidence for the different conceptual geochemical zones at the Site.

3.3 Data Gap #3: Wall Integrity

The sheet pile wall was installed in 1990 to reduce the mass discharge of arsenic from the Upper Aquifer and Intermediate Aquifer to the Hylebos Waterway (see Table 3-1). The wall is currently 26 years old. Sheet pile walls corrode over time, with the greatest corrosion typically occurring in the splash zone (i.e., the top portion of the Upper Aquifer at this Site). Although the sheet pile wall appeared to be in relatively good condition when it was last uncovered in 2004, the current integrity of the wall is unknown. In addition, the current condition of two gaps in the top part of the sheet pile wall that were discovered and repaired in 2004 (see Appendix A) is unknown. Thus, inspections and measurements of the sheet pile wall by a corrosion engineer are proposed to evaluate the current integrity and anticipated life expectancy of the sheet pile wall.

3.4 Data Gap #4: Feasibility of Focused Soil Excavation Alternative

Excavating all Site soil to a depth of 15 feet to comply with the arsenic PCL of 88 mg/kg is not a feasible alternative due to disproportionate costs (PIONEER 2016). However, one or more remedial alternatives that will be evaluated in the FS will include focused excavation and off-site disposal in the immediate vicinity of the former Penite Pits (see Table 3-1). In addition, targeted removal of soil with elevated pH in the former Taylor Lake Area surface impoundments and/or the former Caustic Building and Tank Farm Area may be considered (see Table 3-1). Although previous soil investigations have characterized the nature and extent of arsenic and pH in Site soil, additional soil data is necessary to adequately evaluate the feasibility of a focused soil excavation alternative. Key initial questions include (1) whether or not focused locations where the majority of the remaining mass resides can be identified, and (2) the amount of hazardous waste that might be produced if soil were to be excavated. Thus, collection of additional arsenic, pH, and toxicity characteristic leaching procedure (TCLP) metal soil data near the Penite Pits, former Taylor Lake Area surface impoundments, and former Caustic Building and Tank Farm Area are proposed.

SECTION 4: SAMPLING AND ANALYSIS PLAN

4.1 Purpose

The purpose of this SAP is to present the methodology for collecting and analyzing samples pursuant to this Work Plan in accordance with WAC 173-340-820 and applicable components of Ecology guidance (Ecology 1995). Typical background contents of a stand-alone SAP are not repeated if included elsewhere in this Work Plan.

4.2 Sampling Design

The proposed approach and sampling design for addressing each data gap is presented in this section and in a corresponding table and figure as follows:

- Data Gap #1A: Shoreline Concentrations (Upper Aquifer Pore Water Samples) – See Table 4-1A and Figure 4-1A
- Data Gap #1B: Shoreline Concentrations (Intermediate Aquifer Pore Water Samples) – See Table 4-1B and Figure 4-1B
- Data Gap #1C: Shoreline Concentrations (Surface Water Samples) – See Table 4-1C and Figure 4-1C
- Data Gap #2A: Arsenic Plume Stability (Upper Aquifer) – See Table 4-2A and Figure 4-2A
- Data Gap #2B: Arsenic Plume Stability (Intermediate Aquifer) – See Table 4-2B and Figure 4-2B
- Data Gap #2C: Arsenic Plume Stability (Deep Aquifer) – See Table 4-2C and Figure 4-2C
- Data Gap #2D: Arsenic Plume Stability (Soil/Sediment Geochemistry) – See Table 4-2D and Figure 4-2D
- Data Gap #3: Wall Integrity – See Table 4-3 and Figure 4-3
- Data Gap #4A: Feasibility of Focused Soil Excavation Alternative (Arsenic) – See Table 4-4A and Figure 4-4A
- Data Gap #4B: Feasibility of Focused Soil Excavation Alternative (pH) – See Table 4-4B and Figure 4-4B

4.2.1 Data Gap #1: Shoreline Concentrations

This data gap will be addressed by installing five Upper Aquifer pore water NSDSs (see Table 4-1A and Figure 4-1A), three Intermediate Aquifer pore water NSDSs (see Table 4-1B and Figure 4-1B), and three surface water NSDSs where Intermediate Aquifer groundwater discharges to surface water (see Table 4-1C and Figure 4-1C). The NSDSs will be sampled as part of Data Gap #2. The conceptual spatial relationships of the various existing and proposed shoreline sampling locations are shown in Figure 4-1D.

4.2.2 Data Gap #2: Arsenic Plume Stability

This data gap will be addressed by performing two groundwater, pore water, and surface water sampling and analysis events. Samples will be collected from the Upper Aquifer (see Table 4-2A and Figure 4-2A), Intermediate Aquifer (see Table 4-2B and Figure 4-2B), and Deep Aquifer (see Table 4-2C and Figure 4-2C). In addition, soil and sediment geochemistry data will be collected to further evaluate the existing geochemical lines of evidence for the different conceptual geochemical zones at the Site (see Table 4-2D and Figure 4-2D). Multiple lines of evidence using existing and proposed data will be used to evaluate plume stability (e.g., arsenic time-series trend graphs for MWs, changes in plume magnitude and extent, geochemical lines of evidence) in accordance with applicable guidance (e.g., USEPA 2007a, 2007b, 2015; Savannah River National Laboratory 2011).

4.2.3 Data Gap #3: Wall Integrity

This data gap will be addressed by having a corrosion engineer visually inspect the top portion of the sheet pile wall and measure wall thickness and soil electrical resistance as necessary (see Table 4-3 and Figure 4-3). This information will be used to evaluate the current integrity and anticipated life expectancy of the sheet pile wall.

4.2.4 Data Gap #4: Feasibility of Focused Soil Excavation Alternative

This data gap will be addressed by collecting soil samples collected near the Penite Pits, former Taylor Lake Area surface impoundments, and former Caustic Building and Tank Farm Area (see Table 4-4A, Table 4-4B, Figure 4-4A, and Figure 4-4B). Existing and proposed soil data will be used to evaluate the feasibility of a focused soil excavation alternative for arsenic (and perhaps pH) and determine (1) whether or not focused locations where the majority of the remaining mass resides can be identified, and (2) the amount of hazardous waste that might be produced if soil were to be excavated. In addition, bench-scale treatability tests for ex-situ soil stabilization will be conducted to initiate the evaluation of the site-specific effectiveness of ex-situ soil stabilization. Ecology will be informed about the progress and results of the bench-scale treatability tests on a regular basis.

4.2.5 Sampling Design Summary

A summary of the sampling design and key implementation notes from Tables 4-1A through 4-4B are presented in Table 4-5.

4.3 Field Investigation Procedures

The majority of the field investigation procedures necessary to implement this Work Plan are standard Site procedures that are already included in the Ecology-approved SAP (DOF 2012). The previously approved DOF field investigation procedures relevant to this Work Plan are listed in Table 4-6 and are included in Appendix B. These previously approved procedures are:

- Pore Water Sampling with PPSs
- Measuring Water Levels in MWs
- Groundwater Sampling from MWs and Angled Shoreline MWs
- Sediment Sampling
- Equipment Decontamination
- Investigation-Derived Waste
- Sample Handling and Shipment and Chain-of-Custody Documentation

- Field Recordkeeping
- Health and Safety Plan

Additional field investigation procedures are included in this Work Plan because either (1) the procedure was not included in the Ecology-approved SAP (DOF 2012), or (2) the procedure has been modified. These "new" procedures are:

- Pore Water Sampling with NSDSs (see procedure description in Table 4-6)
- Global Positioning System (GPS) Surveying (see procedure description in Table 4-6)
- Surface Water Sampling with NSDSs (see procedure description in Table 4-6)
- Soil Sampling from Soil Borings (see procedure description in Table 4-6)
- X-Ray Fluorescence (XRF) Field Screening (see procedure description in Appendix C)
- Anoxic Soil/Sediment Sample Preservation (see procedure description in Table 4-6)
- Excavating Test Pits to Evaluate Wall Integrity (see procedure description in Table 4-6)
- Sample Identification Schema (see procedure description in Appendix D)

The field investigation procedures that are unique to each particular data gap investigation activity are included in Tables 4-1A through 4-4B. In addition, the following standard procedures apply to all data gap investigation activities:

- Equipment Decontamination
- Investigation-Derived Waste
- Sample Identification Schema
- Sample Handling and Shipment and Chain-of-Custody Documentation
- Field Recordkeeping
- Health and Safety Plan

4.4 Laboratory Analyses and Sample Containers

Groundwater, pore water, surface water, soil, and sediment samples will be collected pursuant to this Work Plan. The laboratory analyses that are relevant to each particular data gap investigation activity are included in Tables 4-1A through 4-4B. The analytical methods, sample container expectations, preservation and storage requirements, and holding times for analytes listed in Tables 4-1A through 4-4B for water samples (i.e., groundwater, pore water, and surface water) are presented in Table 4-7. The analytical methods, sample container expectations, preservation and storage requirements, and holding times for analytes listed in Tables 4-1A through 4-4B for soil and sediment samples are presented in Table 4-8.

4.5 Implementation

4.5.1 Investigation Roles and Responsibilities

A diverse and multi-disciplined team has been assembled to implement this Work Plan. Key organizations involved in the implementation of this Work Plan include Ecology, Port, DOF, PIONEER, Tinnea & Associates, Analytical Resources, Inc. (ARI), Brooks Applied Labs (Brooks), QA/QC Solutions, Keta Waters, the University of Washington, and various field contractors (e.g., divers, licensed driller, excavation contractor). The specific roles and responsibilities that are anticipated for key personnel involved in this investigation project are summarized in Table 4-9.

4.5.2 Pre-Mobilization Tasks

Prior to the implementation of this Work Plan, several pre-mobilization contracting tasks will need to be completed. The Port will need to obtain additional funding authorization and revise its existing contract with DOF to implement this Work Plan. DOF will need to modify existing and/or develop new contract agreements with PIONEER, Tinnea & Associates, ARI, QA/QC Solutions, Keta Waters, and the various field contractors (e.g., divers, licensed driller, excavation contractor).

Prior to the implementation of this Work Plan, a number of important pre-mobilization coordination tasks will need to be completed. Key pre-mobilization coordination tasks for the DOF On-Site Field Project Manager (or delegate) to complete include:

- Coordinate with the PIONEER Project Manager about the objectives and sampling design for the investigation activities.
- Coordinate the anticipated field schedule with the Port and PIONEER.
- Coordinate the scope of work and field schedule with all on-site personnel.
- Coordinate with DOF, PIONEER, on-site contractors, and the Port regarding health and safety details specific to this project (e.g., field team organization and communication, potential hazards and associated controls, work zones, decontamination, personal protective equipment, air monitoring).
- Obtain necessary health and safety paperwork from team members (e.g., training records).
- Call the Washington Call Before You Dig phone number for all proposed excavation and drilling locations.
- If necessary, conduct a private utility locate for excavation and drilling locations.
- If necessary, core through asphalt/concrete to facilitate drilling activities.
- Ensure the licensed driller submits the necessary notices of intent and associated fees to the Ecology Water Resources Program for proposed drilling locations.
- Coordinate with the PIONEER Project Manager regarding sample containers, sample volumes, and vendor shipping information for the bench-scale treatability tests for ex-situ soil stabilization.
- Coordinate with the PIONEER Project Manager, the licensed driller, and XRF Field Screening staff to ensure that sample volume, sample preparation, and sample preservation requirements can be met for the field measurements and the laboratory analyses associated with Data Gaps #2D, #4A, and #4B.
- Coordinate with the project laboratories on key elements of the SAP/QAPP (e.g., sample preservation, analytical methods and analytes, field quality control samples, target reporting limits).
- Obtain sample containers from the project laboratories.
- Obtain the necessary equipment and supplies (e.g., NSDS supplies, water quality multimeter, Hach DR900 Handheld Colorimeter or equivalent, dry ice, XRF, soil pH field meter, 0.45-micron filters, compressed gas for anoxic field preservation).

- Coordinate access with the Port.

4.5.3 *Reporting*

Investigation activities and results associated with this Work Plan will be documented and submitted to Ecology. The exact nature of this documentation will depend on a variety of to be determined factors such as (1) the scope in the revised Port contract with DOF, (2) when the field and laboratory activities are completed, and (3) the nature and schedule of other ongoing FS-related work. However, it is currently envisioned that the fieldwork will be documented in one or more field implementation tech memos, and that the investigation results will be documented in one or more data gap evaluation reports.

4.5.4 *Schedule*

As discussed in the sampling design (Section 4.2), several of the data gap activities are intertwined and have inter-related schedules. Specifically:

- Sediment samples pursuant to Data Gap #2D will be collected when NSDSs are first installed pursuant to Data Gaps #1A, #1B, and #1C (prior to the first water sampling event).
- Soil samples from select soil borings being advanced pursuant to Data Gaps #4A and #4B will be submitted for additional laboratory analyses pursuant to Data Gap #2D.

The specific schedule for implementing this Work Plan will be developed and submitted to Ecology once the Port revises its existing contract with DOF. In general, it is currently envisioned that the fieldwork will be conducted as follows:

- Fieldwork for Data Gaps #3, #4A, #4B, and the soil boring portion of Data Gap #2D: 2Q17
- Fieldwork for Data Gaps #1A, #1B, #1C, and the sediment portion of Data Gap #2D: Late 2Q17
- Fieldwork for Data Gaps #2A, #2B, and #2C: 3Q17 (since dissolved arsenic concentrations have historically been highest during the 3rd quarter) and 1Q18

SECTION 5: QUALITY ASSURANCE PROJECT PLAN

5.1 Purpose

The purpose of this QAPP is to summarize the methodology for ensuring usable sampling and analysis data of acceptable quality are generated. This QAPP was prepared in general accordance with WAC 173-340-820 and Ecology guidance (Ecology 2004).

Typical contents of a stand-alone QAPP are not repeated if included elsewhere in this Work Plan. For instance, requirements for field measurements, laboratory analytical methods, sample containers, sample preservation and storage, and analysis holding times are already described in the SAP. Likewise, field procedures associated with quality assurance (e.g., equipment decontamination, sample identification schema, sample handling and shipment and chain-of-custody documentation, field recordkeeping) are already described in the SAP.

5.2 Field Measurements and Calibration

Field measurements and notes (e.g., diver notes, NSDS installation notes, static water level measurements, water quality measurements, measurements with the Hach DR900 Handheld Colorimeter or equivalent, corrosion engineer measurements and notes, lithologic logging of soil borings, XRF field screening, pH field screening) are of vital importance to this Work Plan and will be documented in accordance with standard field procedures (see Section 4.3). In addition, representative photographs will be taken as necessary to support documentation of the procedures used to collect field measurements. Field meters will be calibrated in accordance with the manufacturer's recommendations, and the calibration will be documented in the field notes.

5.3 Field Quality Control Samples

Field quality control (QC) samples will include field duplicates, matrix spike/matrix spike duplicates, equipment rinsate blanks, trip blanks, and cooler temperature blanks. The frequency expectation for each type of field QC sample is shown in Table 5-1. Field duplicates and matrix spike/matrix spike duplicates will be collected at random locations selected by the field sampling team. Equipment rinsate blanks will be collected by pouring deionized water on non-dedicated sampling equipment following its decontamination. Trip blanks and cooler temperature blanks will be prepared and provided by the project laboratory.

5.4 Laboratory Quality Control Samples

ARI and Brooks will be responsible for conducting laboratory QC procedures and reporting laboratory QC results in accordance with the analytical methods and their standard operating procedures. Laboratory QC samples provide important qualitative results used to evaluate the laboratory QC procedures. Laboratory QC samples for almost all of the analyses in this Work Plan will include method blanks, laboratory control samples (also known as blank spikes), matrix spikes, and matrix spike duplicates once per batch of analyses. Expectations for laboratory control limits for these laboratory QC samples are presented in Tables 5-2 and 5-3 for water samples and soil/sediment samples, respectively. In addition, it is also expected that ARI will perform and report results of surrogate recovery for every VOC water sample. Expectations for laboratory control limits for surrogate recoveries with VOC samples are shown in Table 5-2.

5.5 Laboratory Target Reporting Limits

The target reporting limits for the planned analyses associated with water and soil/sediment samples are presented in Tables 5-4 and 5-5, respectively. The target reporting limits for the analyses of COPCs in the water samples are less than the most stringent screening level in the RI Report (DOF 2013) as shown in Table 5-4, with the following exception. ARI's target reporting limit for the mercury analyses it will perform is slightly higher than the RI screening level (a 0.1 ug/L target reporting limit compared to a 0.025 ug/L screening level). This ARI target reporting limit is acceptable since Brooks will be analyzing all samples from MWs and water sampling locations near the shoreline, and the Brooks target reporting limit for mercury is less than the RI screening level. The target reporting limits for the analyses of arsenic and TCLP metals in the soil/sediment samples are less than applicable regulatory criteria as shown in Table 5-5. Thus, it is expected that target reporting limits for water and soil/sediment analyses will be sufficiently sensitive for the purposes of this investigation.

5.6 Data Quality Review and Validation

An evaluation of data quality will be performed for all field and lab data. Specifically, field records will be reviewed by DOF and/or PIONEER for completeness, accuracy, and legibility. The laboratories will review their results relative to method criteria and laboratory QC procedures as the data are generated. The laboratories will report their QC results and qualify data as necessary in a report suitable for a Level II data validation. An independent data quality validator will evaluate precision, accuracy, representativeness, comparability, completeness, and sensitivity by reviewing the following items relative to analytical method criteria, laboratory control limits, and national functional guidelines (USEPA 2016a, 2016b) as necessary:

- Comparison of actual analyses versus requested analyses
- Comparison of consistency between laboratory reports and associated electronic data deliverables
- Holding times
- Field QC sample frequency
- Field QC sample results
- Lab QC sample frequency
- Lab QC sample results
- Actual reporting limits

The data quality validator may reject data or add other qualifications in addition to the laboratory qualifications. The data quality validation documentation will be included with the applicable laboratory reports for reporting purposes.

5.7 Corrective Action

The need for corrective action will be evaluated as appropriate for deviations from the SAP/QAPP and other potential data quality issues that arise in the field or the laboratory. Relatively minor field issues will be discussed, resolved, and documented by the On-Site Field Project Manager and/or the PIONEER Project Manager. Relatively minor laboratory issues will be discussed, resolved, and documented by the laboratory, the PIONEER Project Manager, and/or the independent data quality validator. Corrective action decisions will be situation-dependent. Potential corrective action decisions may include one or more of the following:

- Revising the sampling and analysis methodology
- Collecting a new sample
- Reanalyzing an existing sample
- Accepting the data with a recognized level of uncertainty
- Revising the sampling design

In the event of a significant data quality issue, the PIONEER Project Manager will call a meeting to discuss, resolve, and document the situation with the Port and Ecology.

SECTION 6: REFERENCES

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References are included in the CD provided in the hardcopy or can be accessed from the hyperlink.

Figures

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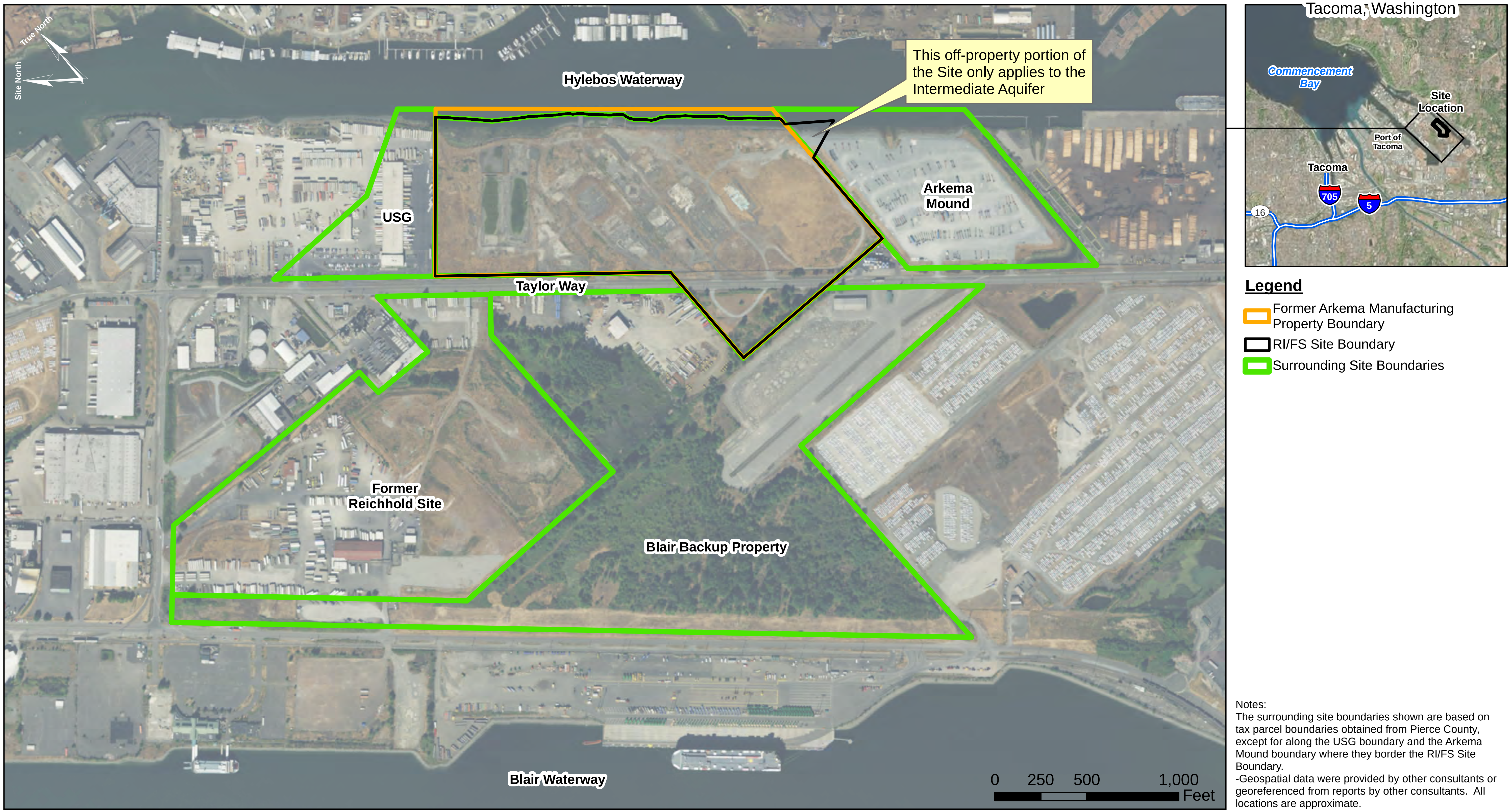
Vicinity Map
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 1-1

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Fig 1-1_Vicinity Map.mxd; Author: SM; Date Saved: 7/12/2016



This off-property portion of the Site only applies to the Intermediate Aquifer

Legend

🟧 Former Arkema Manufacturing Property Boundary

⬛ RI/FS Site Boundary

🟩 Surrounding Site Boundaries

Notes:
The surrounding site boundaries shown are based on tax parcel boundaries obtained from Pierce County, except for along the USG boundary and the Arkema Mound boundary where they border the RI/FS Site Boundary.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-1-2_Site Location.mxd; Author: SM; Date Saved: 2/9/2017

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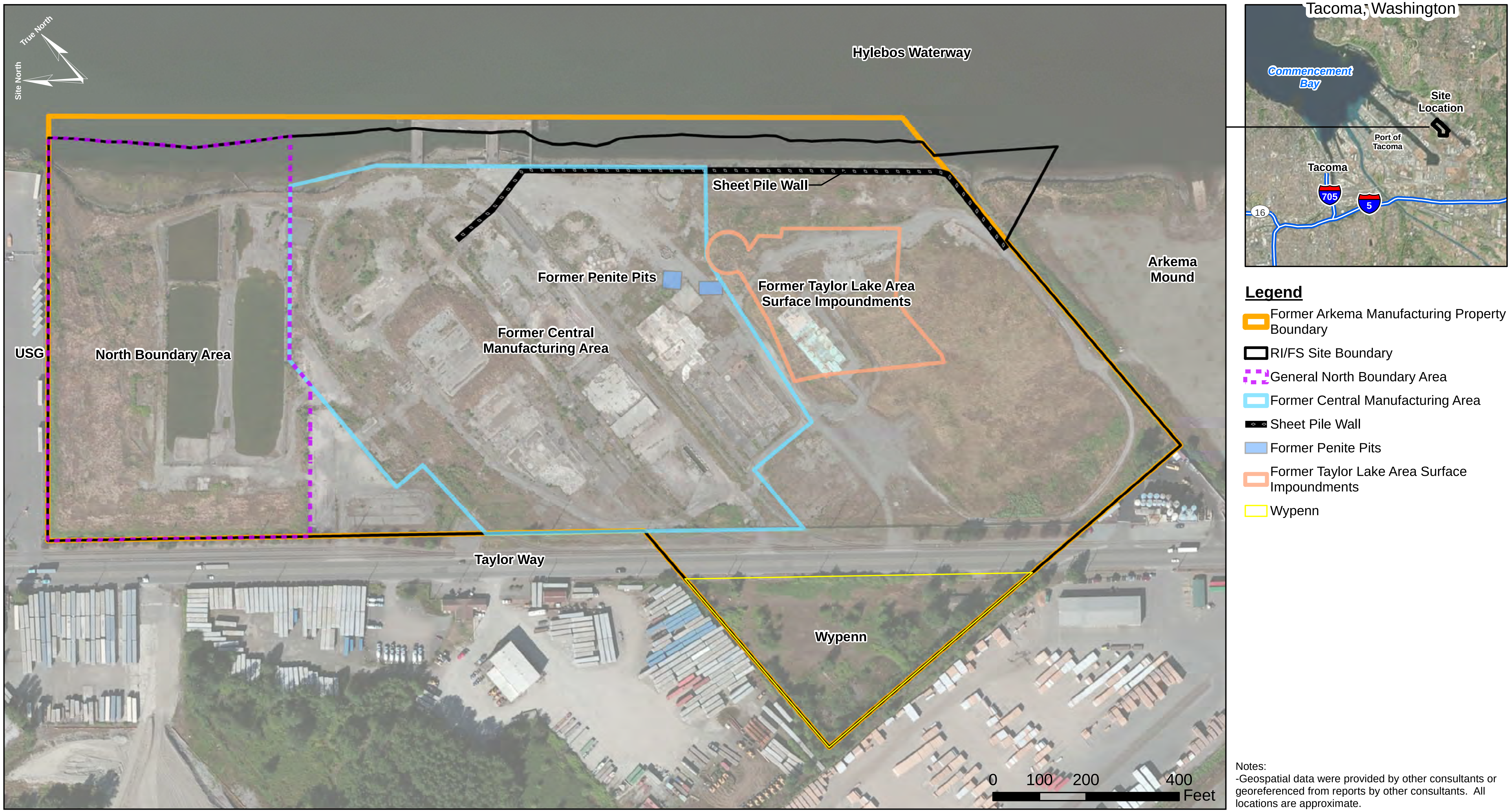
Site Location
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 1-2



Notes:
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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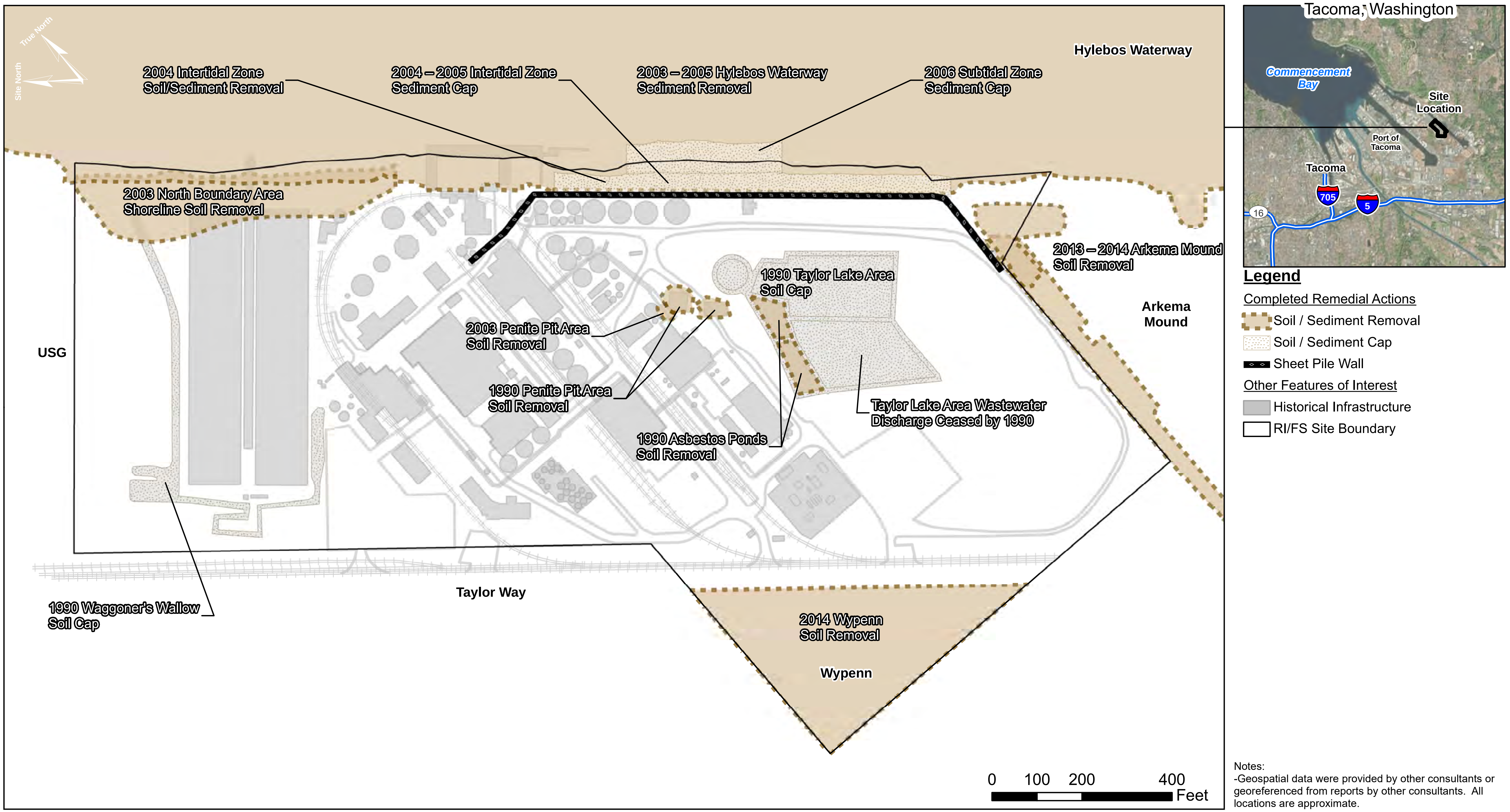
Site Areas
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 1-3

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-1-3_Site_Areas.mxd; Author: SM; Date Saved: 2/9/2017



Notes:
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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Completed Remedial Actions – Part A
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-1A

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-2-1A_Completed_Remedial_Actions.mxd; Author: SM; Date Saved: 2/9/2017

Notes:
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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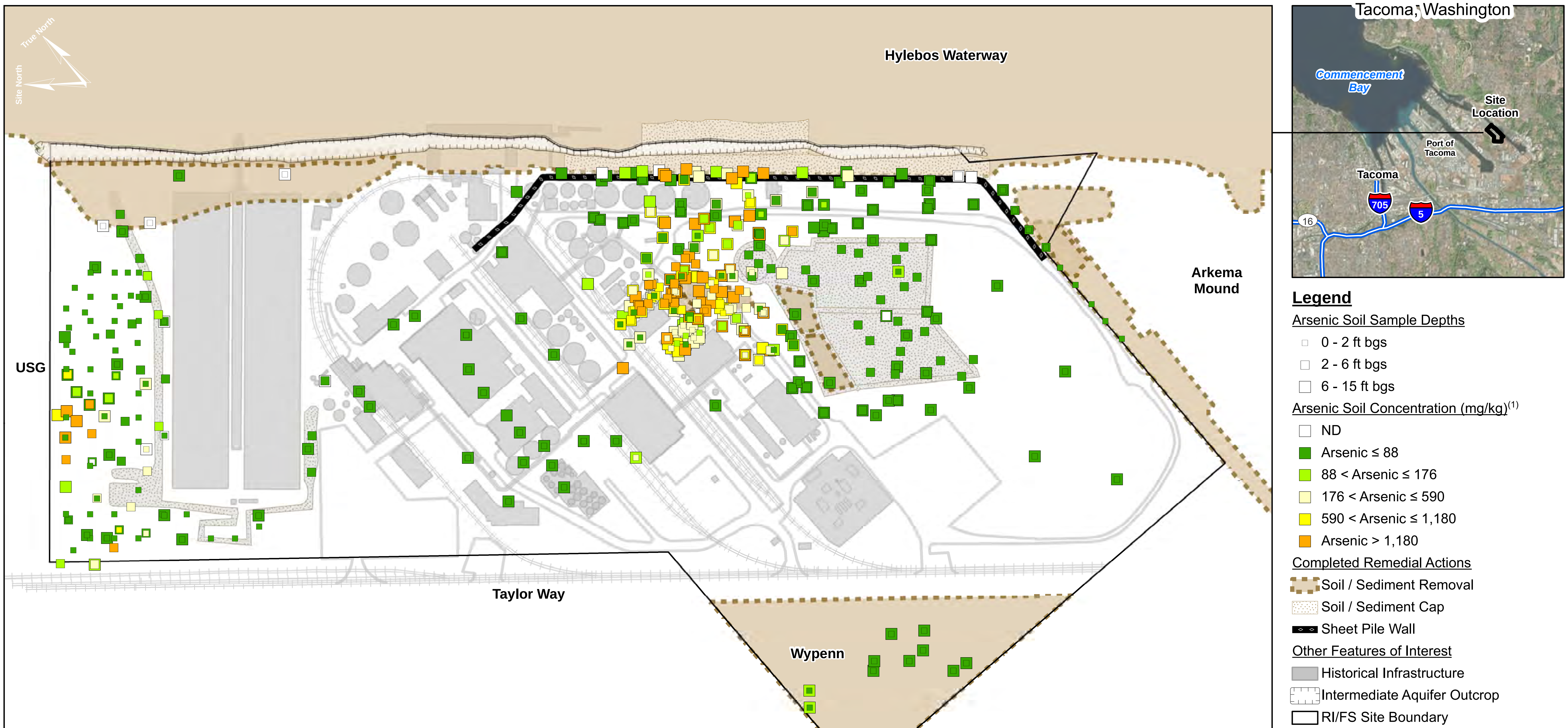
Completed Remedial Actions – Part B
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-1B



Notes:
[1] Soil data shown on this figure were collected between 1987 and 2012. Older soil concentrations may not be representative of current conditions. Only in-place soil data (i.e., not removed during excavation) are shown.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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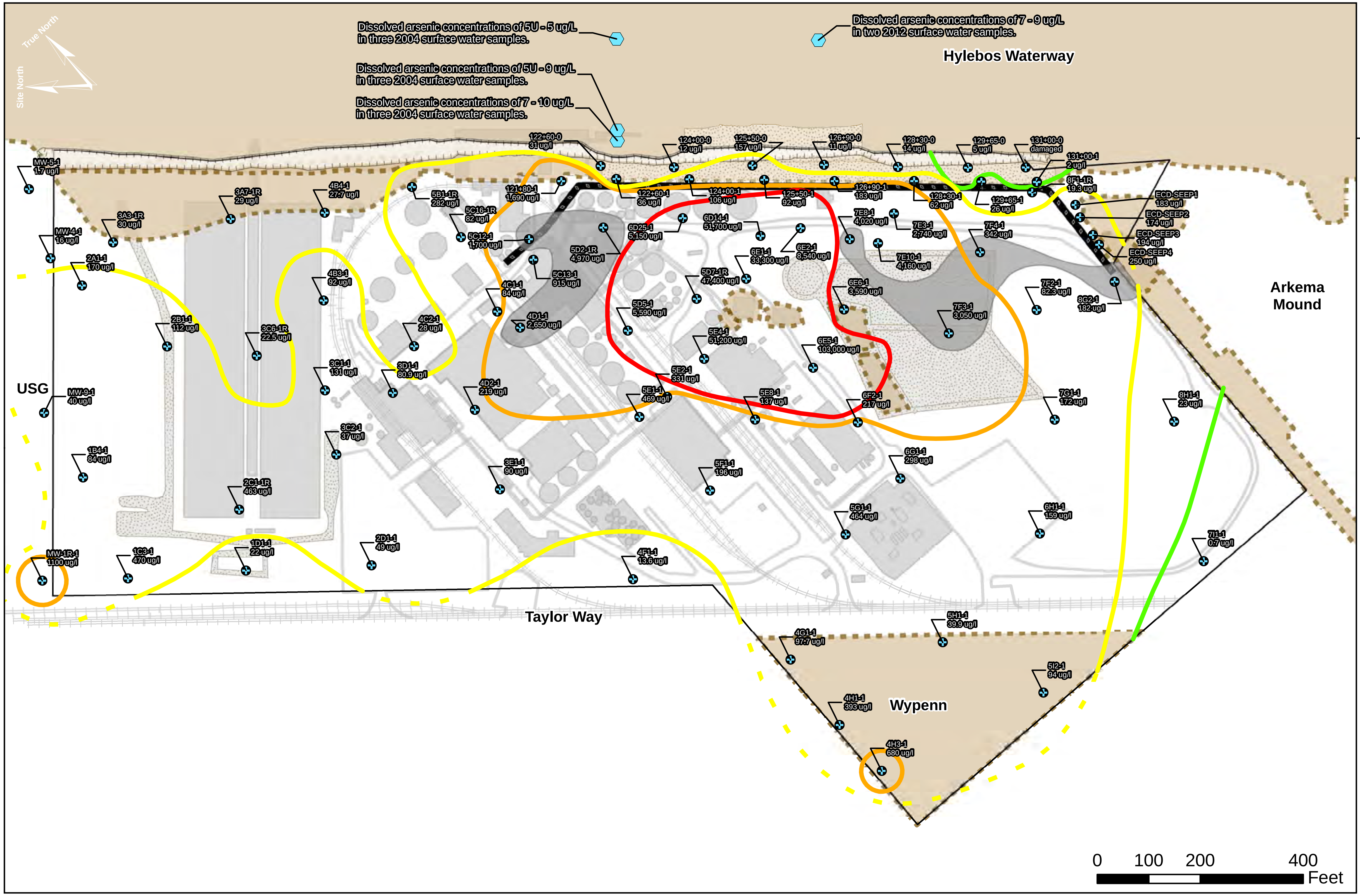
Arsenic Soil Concentrations (0-15 Feet)
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-2

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-2-2_Arsenic_Soil_Concentrations.mxd; Author: SM; Date Saved: 2/9/2017



Legend

- ⊕ Existing Upper Aquifer Monitoring Well or Seep Sampler$^{(1)}$
- ⬡ Existing Surface Water Sample Location
- ▨ Upper Aquifer Groundwater pH > 11

Upper Aquifer Dissolved Arsenic Groundwater Isoconcentration Contours$^{(1)}$

- 🟩 5 ug/L
- 🟨 36 ug/L
- 🟧 500 ug/L
- 🟥 5,000 ug/L

Completed Remedial Actions

- ▨ Soil / Sediment Removal
- ▨ Soil / Sediment Cap
- ▬ Sheet Pile Wall

Other Features of Interest

- ▨ Historical Infrastructure
- ☐ Intermediate Aquifer Outcrop
- ☐ RI/FS Site Boundary

Notes:

$^{(1)}$The dissolved arsenic groundwater concentrations presented on this figure are from 2012. If 2012 data were not available, 2008 data were used.

-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

-Dashed isoconcentration contours are inferred.

U = Not detected at shown reporting limit.

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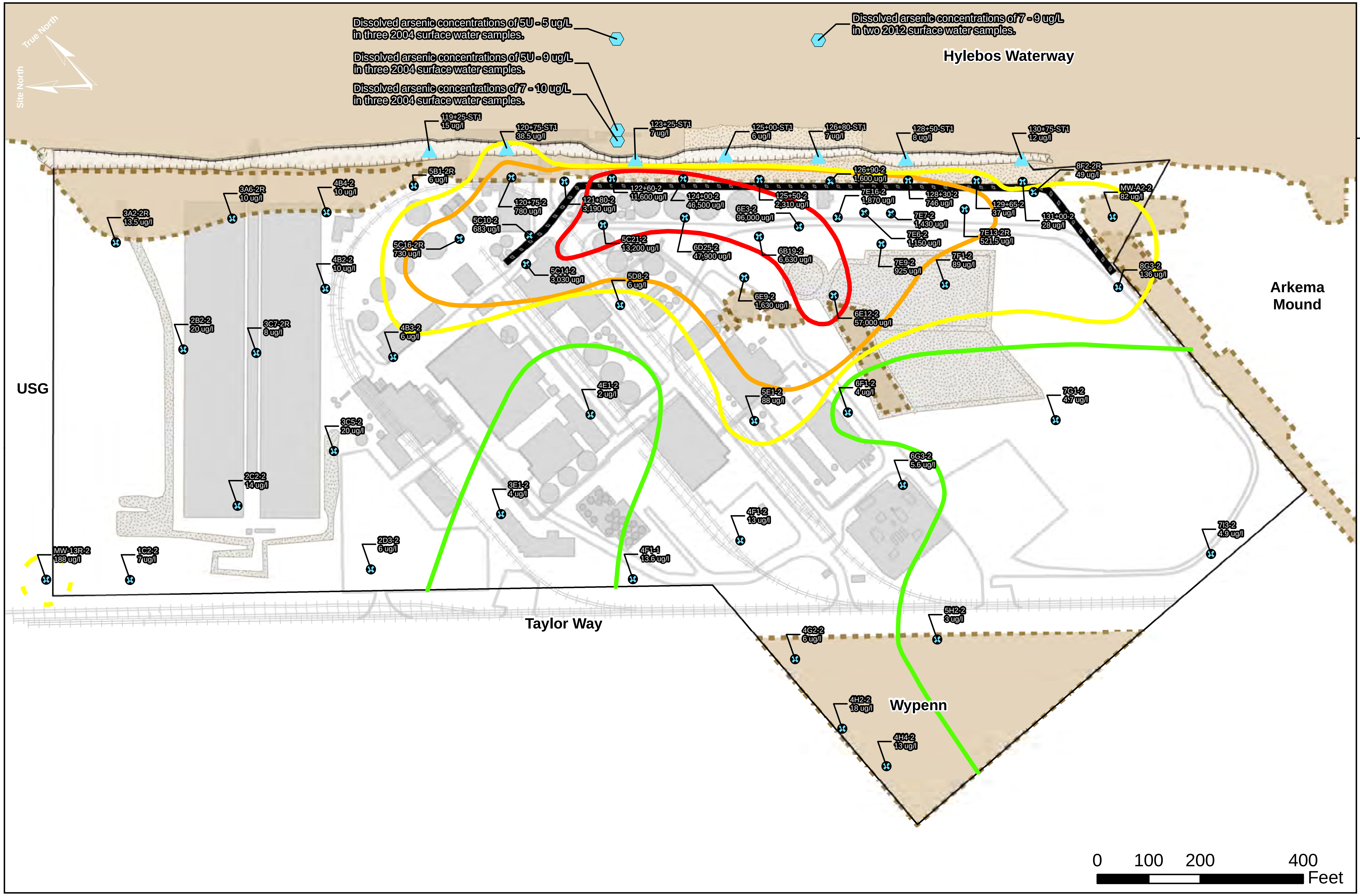
Dissolved Arsenic Concentrations in the Upper Aquifer
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-3

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-2-3_UpperAquifer_DissolvedArsenicConc.mxd; Author: SM; Date Saved: 2/9/2017



Legend

⊗ Existing Intermediate Aquifer Monitoring Well and Seep Sampler[(1)]

▲ Existing Intermediate Aquifer Pore Water PPS

⬡ Existing Surface Water Sample Location

Intermediate Aquifer Dissolved Arsenic Groundwater Isoconcentration Contours[(1)]

🟩 5 ug/L

🟨 36 ug/L

🟧 500 ug/L

🟥 5,000 ug/L

Completed Remedial Actions

▨ Soil / Sediment Removal

▨ Soil / Sediment Cap

■ Sheet Pile Wall

Other Features of Interest

▨ Historical Infrastructure

☐ Intermediate Aquifer Outcrop

☐ RI/FS Site Boundary

Notes:

(1)The dissolved arsenic groundwater concentrations presented on this figure are from 2012. If 2012 data were not available, 2008 data were used.

-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

-Dashed isoconcentration contours are inferred.

U = Not detected at shown reporting limit.

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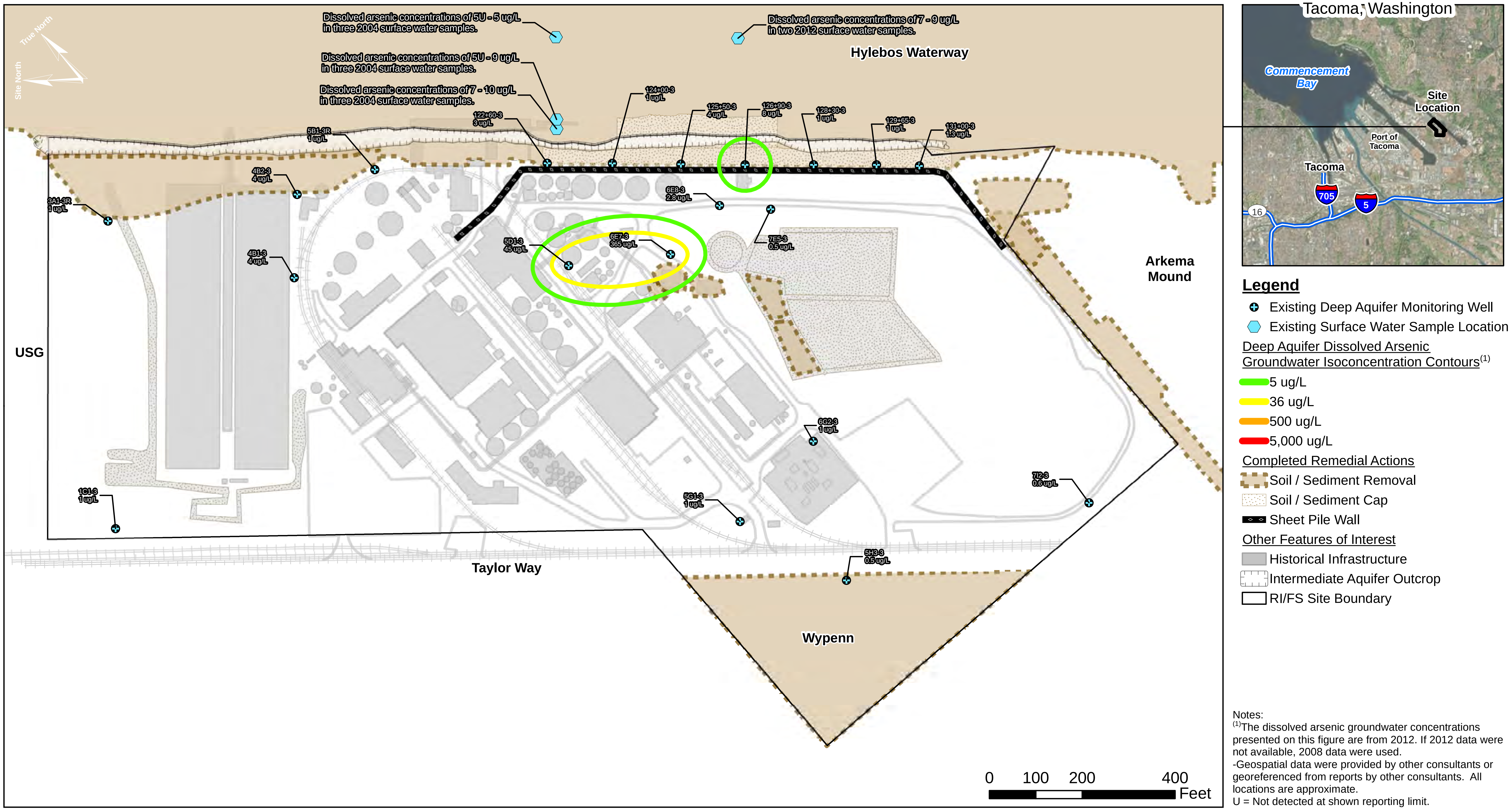
Dissolved Arsenic Concentrations in the Intermediate Aquifer
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-4



Notes:
[1] The dissolved arsenic groundwater concentrations presented on this figure are from 2012. If 2012 data were not available, 2008 data were used.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.
U = Not detected at shown reporting limit.

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-2-5_DeepAquifer_DissolvedArsenicConc.mxd; Author: SM; Date Saved: 2/9/2017

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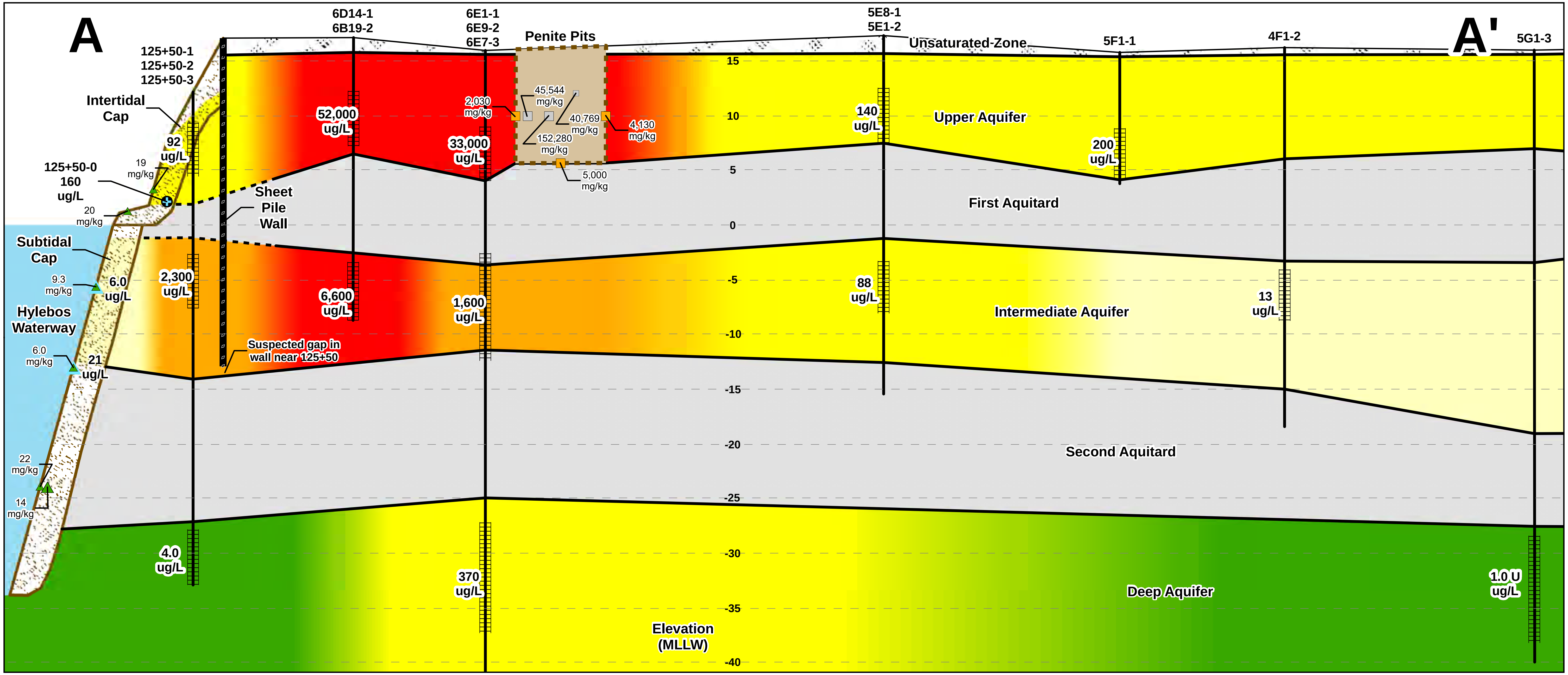
Dissolved Arsenic Concentrations in the Deep Aquifer
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-5



Legend

Dissolved Arsenic Groundwater Concentration[1]

- 🟩 Arsenic ≤ 5.0 ug/L
- 🟨 5.0 ug/L < Arsenic ≤ 36 ug/L
- 🟨 36 ug/L < Arsenic ≤ 500 ug/L
- 🟧 500 ug/L < Arsenic ≤ 5,000 ug/L
- 🟥 Arsenic > 5,000 ug/L

Lithologic Units

- ▨ Intertidal / Subtidal Caps
- ⬜ First / Second Aquitard
- ⬜ Unsaturated Zone
- ▨ Penite Pits Excavation

Sample Media

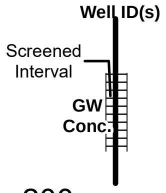
- 🟧 Soil - In Place (with arsenic concentrations > 1,180 mg/kg)
- ⬜ Soil - No Longer In Place
- ▲ Sediment (all arsenic concentrations ≤ 57 mg/kg)
- ⊕ Upper Aquifer Seep Sampler
- △ Pore Water

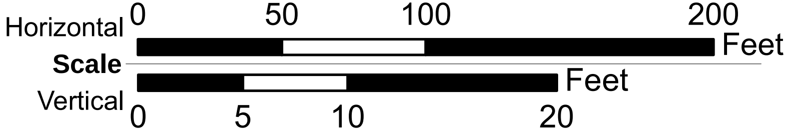
Notes:

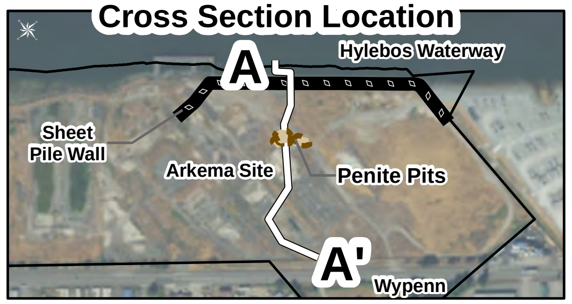
[1] The dissolved arsenic concentration data shown on this figure are from 2012. If 2012 data were not available, 2008 data were used.

-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

-Vertical exaggeration is 7x.







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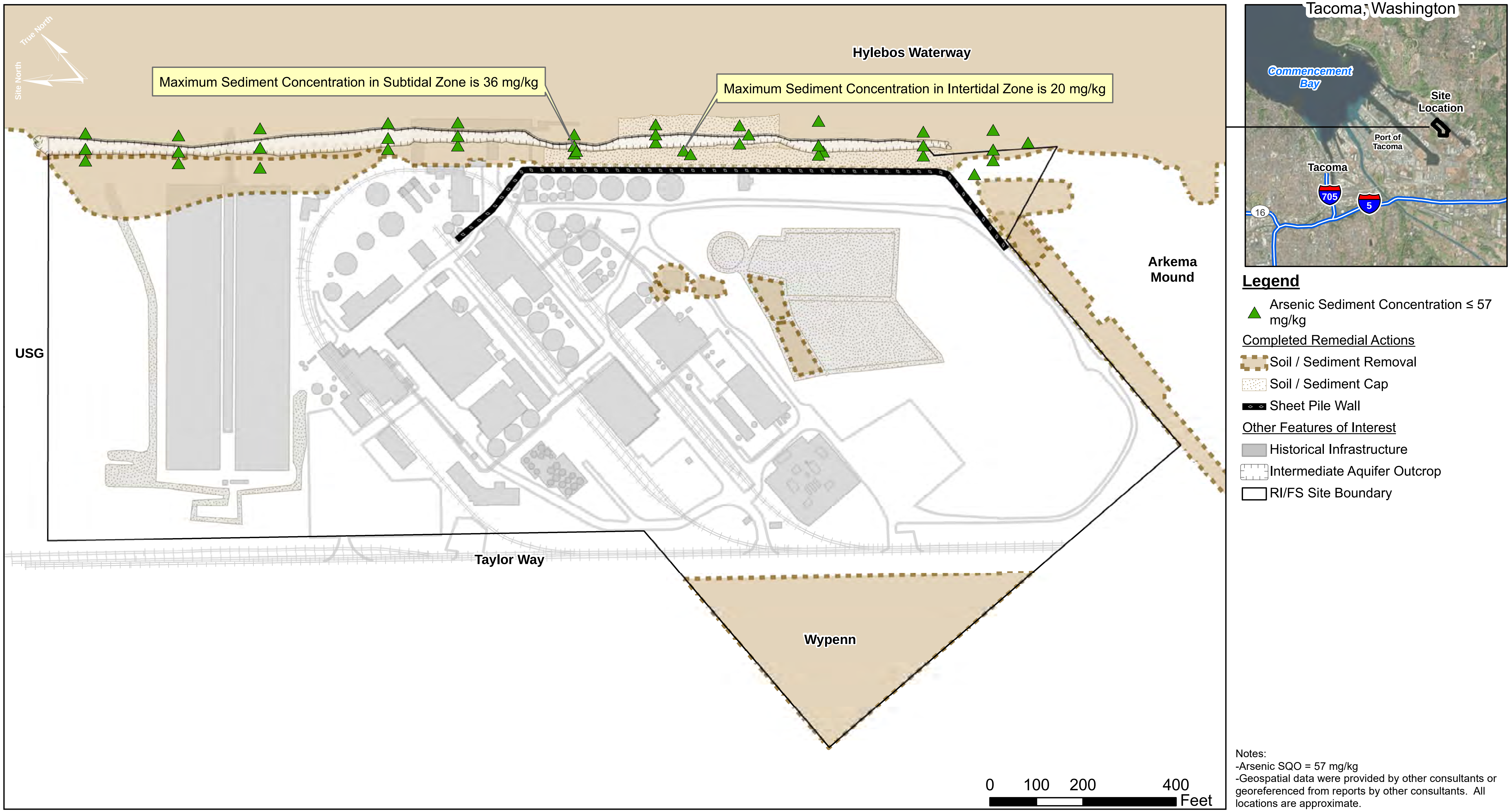
Conceptual Cross Section of Dissolved Arsenic Concentrations
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-6

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure 2-6_CrossSection_Dissolved_Arsenic.mxd; Author: SM; Date Saved: 1/6/2017



Notes:
-Arsenic SQO = 57 mg/kg
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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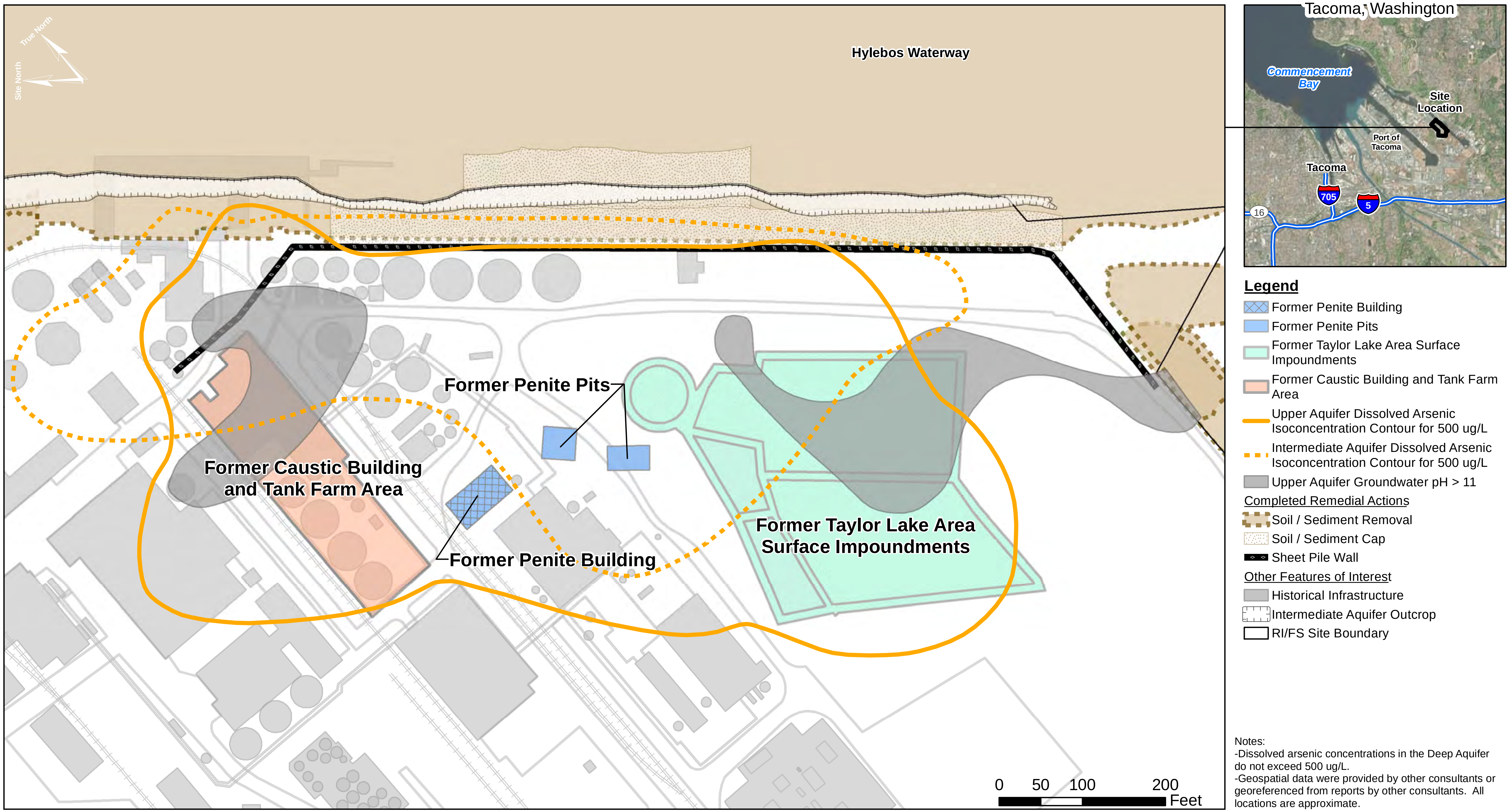
Arsenic Sediment Concentrations
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-7

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-2-7_Arsenic_Sediment_Concentrations.mxd; Author: SM; Date Saved: 2/9/2017



Notes:
-Dissolved arsenic concentrations in the Deep Aquifer do not exceed 500 ug/L.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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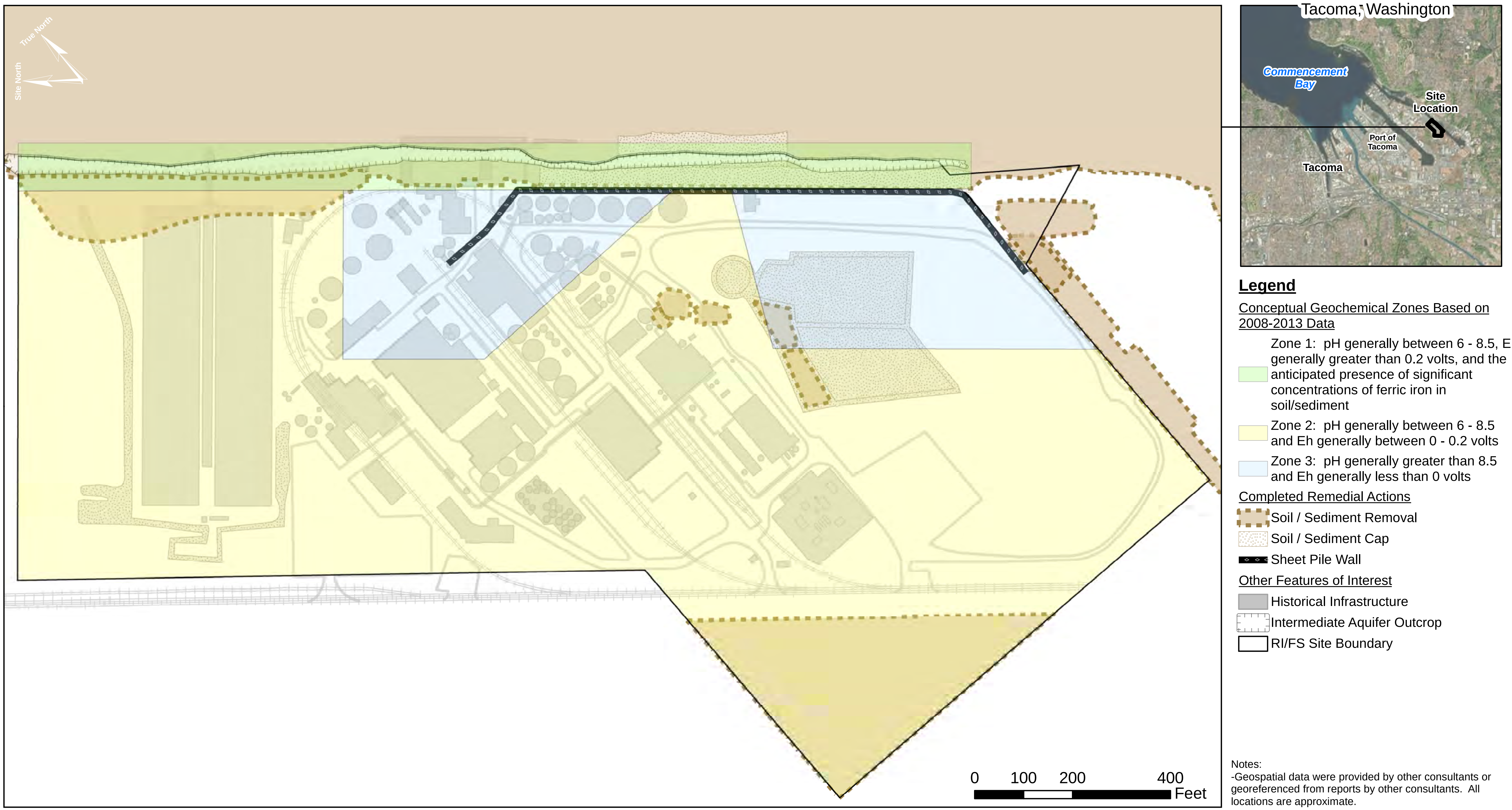
Key Historic Features Associated With Arsenic Plume
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-8

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-2-8_Key_Arsenic_Source_Features.mxd; Author: SM; Date Saved: 7/21/2016



Legend

Conceptual Geochemical Zones Based on 2008-2013 Data

- 🟩 Zone 1: pH generally between 6 - 8.5, Eh generally greater than 0.2 volts, and the anticipated presence of significant concentrations of ferric iron in soil/sediment
- 🟨 Zone 2: pH generally between 6 - 8.5 and Eh generally between 0 - 0.2 volts
- 🟦 Zone 3: pH generally greater than 8.5 and Eh generally less than 0 volts

Completed Remedial Actions

- ▨ Soil / Sediment Removal
- ▨ Soil / Sediment Cap
- ▬ Sheet Pile Wall

Other Features of Interest

- ▨ Historical Infrastructure
- ☐ Intermediate Aquifer Outcrop
- ☐ RI/FS Site Boundary

Notes:
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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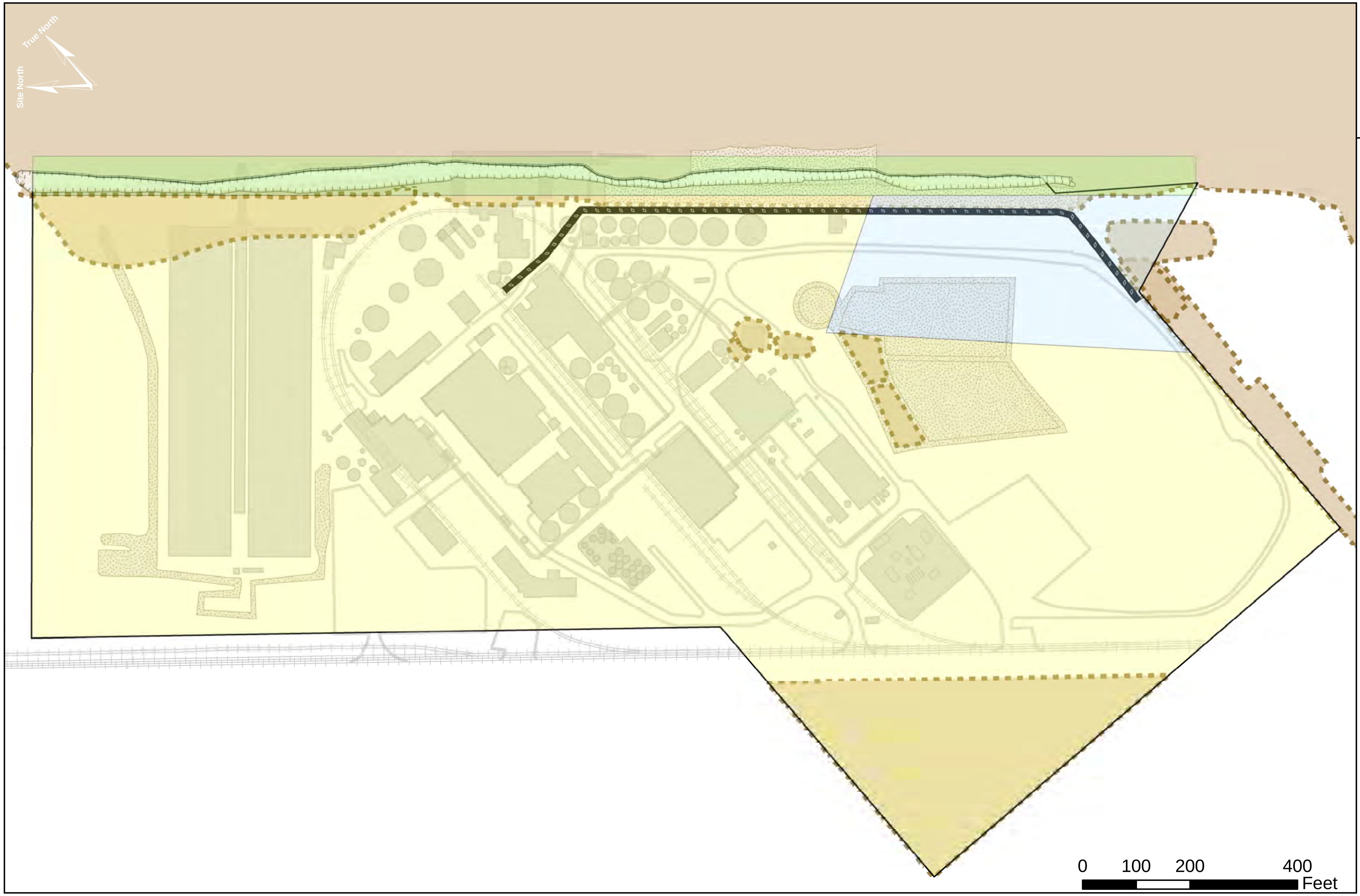
Conceptual Geochemical Zones for the Upper Aquifer
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-9

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-2-9_Conceptual_Geochemical_UpperAquifer.mxd; Author: SM; Date Saved: 2/9/2017



Legend

Conceptual Geochemical Zones Based on 2008-2013 Data

🟩 Zone 1: pH generally between 6 - 8.5, Eh generally greater than 0.2 volts, and the anticipated presence of significant concentrations of ferric iron in soil/sediment

🟨 Zone 2: pH generally between 6-8.5 and Eh generally between 0 - 0.2 volts

🟦 Zone 3: pH generally greater than 8.5 and Eh generally less than 0 volts

Completed Remedial Actions

▨ Soil / Sediment Removal

░ Soil / Sediment Cap

▬ Sheet Pile Wall

Other Features of Interest

▩ Historical Infrastructure

⬚ Intermediate Aquifer Outcrop

☐ RI/FS Site Boundary

Notes:
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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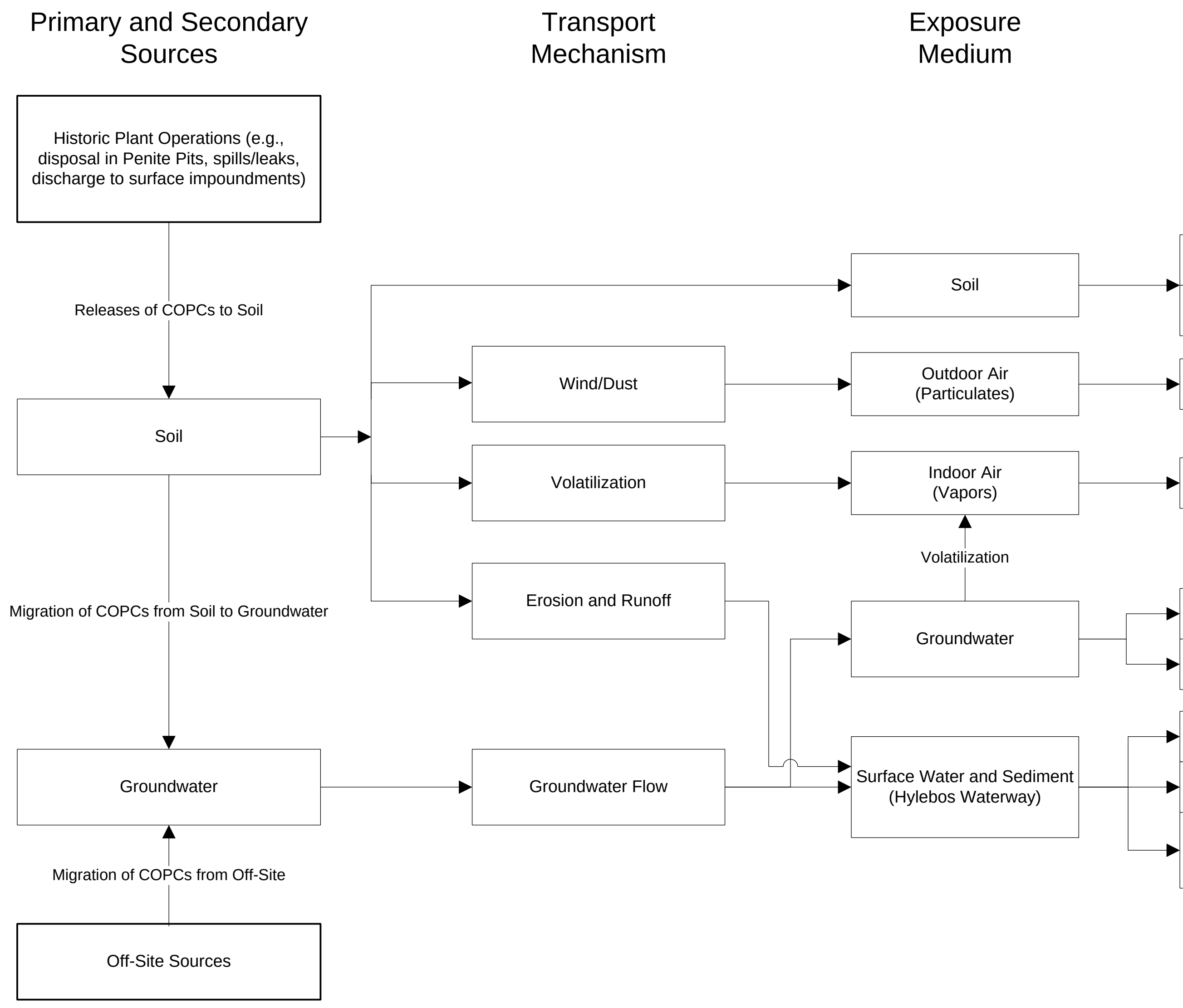
Conceptual Geochemical Zones for the Intermediate Aquifer
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-10

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-2-10_Conceptual_Geochemical_IntermedAquifer.mxd; Author: SM; Date Saved: 2/9/2017



Exposure Medium	Exposure Route	Receptor									
		Baseline Case (Assuming No Further Action)[1]				Post-Remediation and Post-Redevelopment[4]				Off-Site (Hylebos Waterway)	
		Commercial/ Industrial Workers	Utility Workers	Trespassers	Terrestrial Organisms	Commercial/ Industrial Workers	Utility Workers	Trespassers	Terrestrial Organisms	Aquatic Organisms	Recreators/ Fishers
Soil	Ingestion	●	●	●	○	◐	◐	◐	○	▨	▨
	Dermal Contact	●	●	●	○	◐	◐	◐	○	▨	▨
Outdoor Air (Particulates)	Inhalation	●	●	●	○	◐	◐	◐	○	▨	▨
Indoor Air (Vapors)	Inhalation	◐[2]	○	○	○	◐	○	○	○	▨	▨
Groundwater	Ingestion	○	○	○	○	○	○	○	○	▨	▨
	Dermal Contact	○	◐[3]	○	○	○	◐	○	○	▨	▨
Surface Water and Sediment (Hylebos Waterway)	Ingestion	▨	▨	▨	▨	▨	▨	▨	▨	●	●
	Dermal Contact	▨	▨	▨	▨	▨	▨	▨	▨	●	●
	Consumption of Seafood from Hylebos Waterway	▨	▨	▨	▨	▨	▨	▨	▨	●	●

Key

● = Complete Pathway

◐ = Potentially Complete Pathway

○ = Incomplete Pathway

Notes:

These exposure scenarios are reasonable maximum exposures and are considered protective of other similar exposure scenarios (e.g., the off-site recreator scenarios are more protective than other off-site human exposure scenarios). All potential receptors are on-site unless otherwise noted. The shaded boxes represent exposure pathways that are not applicable.

Potential exposures for remediation construction workers and redevelopment construction workers will be addressed as necessary during remedy implementation and redevelopment activities, respectively. Specifically, it is expected that these potential exposures will be controlled with institutional and engineering controls designed to prevent unacceptable exposures. For instance, it is expected that all applicable workers will be contractually required to comply with Occupational Safety & Health Administration regulations as appropriate (e.g., Hazardous Waste Operations and Emergency Response training, health and safety plan, dust control measures, personnel monitoring, personal protective equipment).

The terrestrial ecological pathway is not a complete and significant pathway at the Site per WAC 173-340-7491(1) since the Site does not have any meaningful terrestrial habitat because it was previously developed for industrial use and it will be redeveloped in the future for Port maritime industrial use (e.g., grading activities and installation of a cap/cover, construction of buildings and operational areas for a container yard).

1. This baseline scenario was used to determine the pathways of potential concern. It was assumed that the Site will be redeveloped without any controls or further remedial action, even though this is not a realistic scenario. The baseline scenario is not representative of current exposures (e.g., there are no current commercial/industrial worker exposures since there are no commercial/industrial workers currently at the site and there are no current trespasser exposures since an existing perimeter fence and signs prevent access to the site).
2. This pathway is considered potentially complete; however, it could be complete if new buildings are constructed without vapor intrusion mitigation systems at locations with applicable groundwater VOC exceedances. Since the VOC exceedance footprints in the Upper Aquifer are relatively small, the pathway would be incomplete if buildings are not constructed over these relatively small areas.
3. Although this pathway could hypothetically be complete in the baseline case, it is more likely that this pathway would be incomplete since (1) utilities are ideally installed in the unsaturated zone, and (2) any saturated zone work would involve dewatering the utility excavation prior to anyone entering the utility excavation.
4. The potentially complete pathways may be complete or incomplete depending on the final site remedy. For example, if the final remedy includes installing a cap/cover over applicable soil exceedances, then soil ingestion, soil dermal contact, and particulate inhalation exposures for post-remediation and post-redevelopment commercial/industrial workers and trespassers will be incomplete. Likewise, if vapor intrusion mitigation systems are installed in new buildings constructed in locations with applicable groundwater VOC exceedances, then indoor air inhalation exposures for post-remediation and post-redevelopment commercial/industrial workers will be incomplete. Similarly, if the final remedy includes institutional and engineering controls designed to prevent unacceptable exposures (as outlined above for remediation construction workers and redevelopment construction workers), then soil ingestion, soil dermal contact, particulate inhalation, and groundwater dermal contact exposures for post-remediation and post-redevelopment utility workers will be controlled.

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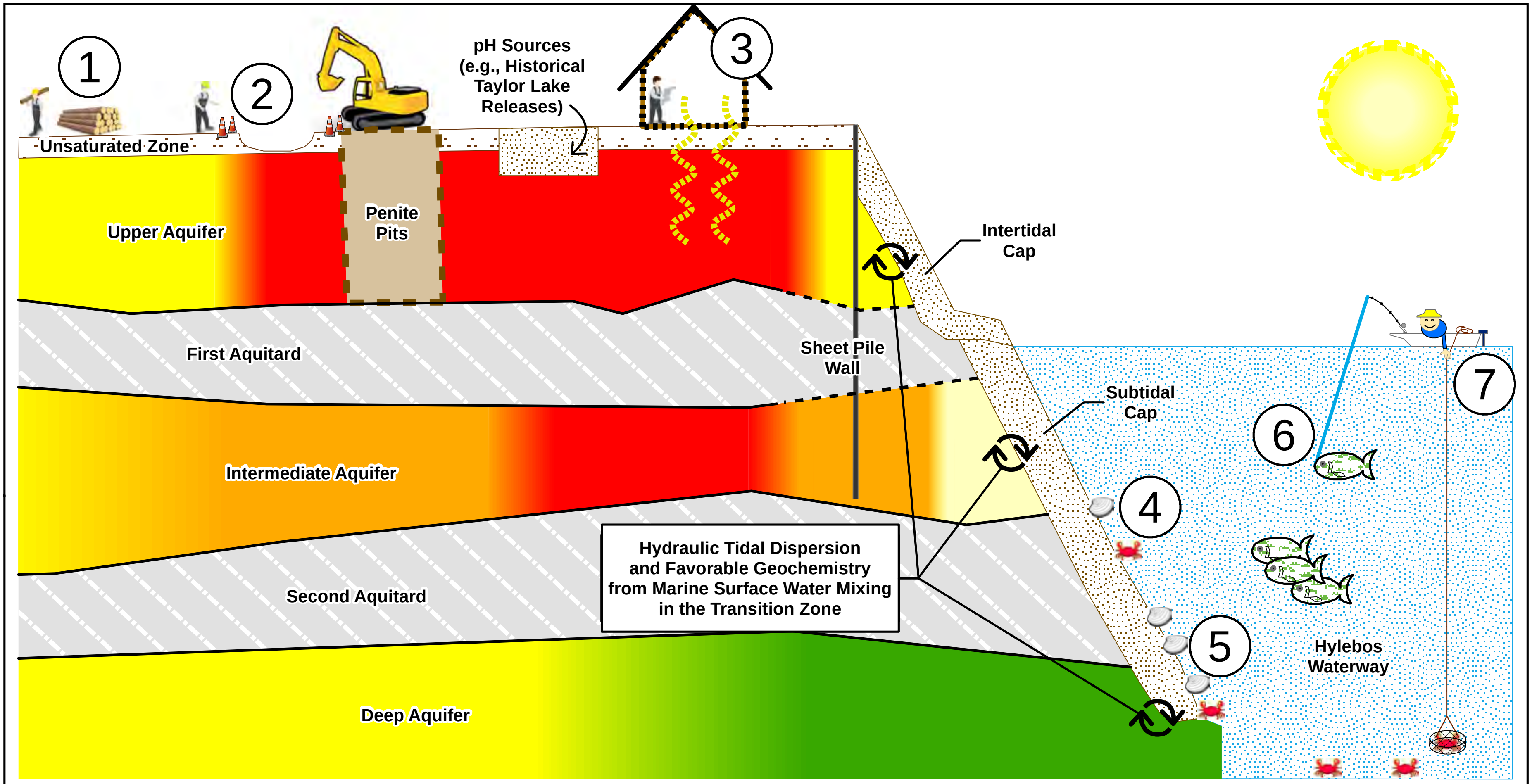
Conceptual Site Exposure Model
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-11



① Incidental ingestion, dermal contact, and inhalation of particulates from surface soil by on-site workers and trespassers.

② Incidental ingestion, dermal contact, and inhalation of particulates from subsurface soil by utility workers.

③ Inhalation of indoor air vapors by on-site workers if occupied building is constructed without vapor instrusion mitigation systems in the few isolated areas that have VOC impacts.

④ Ingestion and dermal contact with surface water and sediment by aquatic organisms.

⑤ Consumption of seafood by aquatic organisms.

⑥ Consumption of seafood by recreators/ fishers.

⑦ Incidental ingestion and dermal contact with surface water and sediment by recreators/ fishers.

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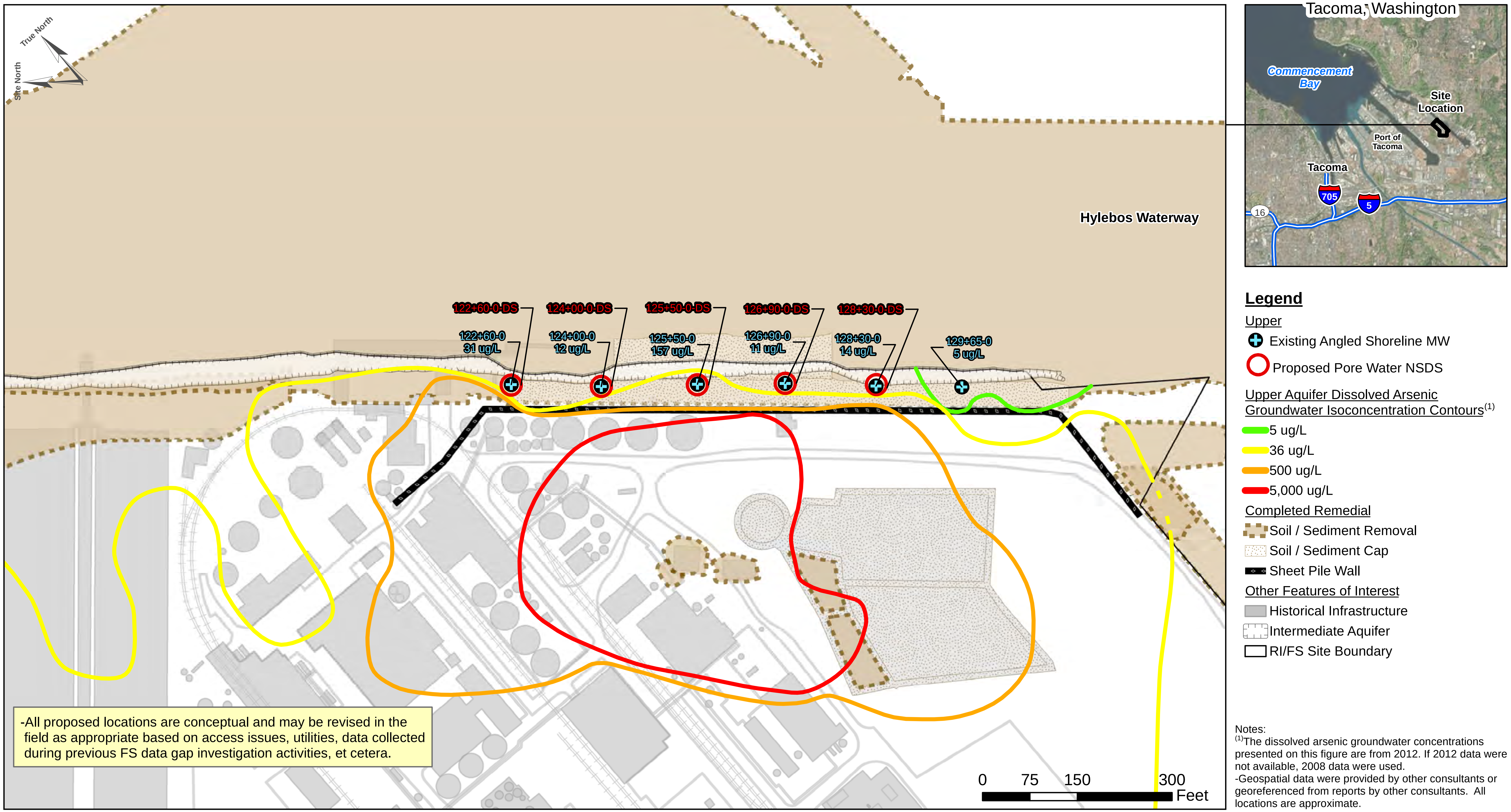
Overview of the Conceptual Site Model
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 2-12

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-2-12_CSM_Summary.mxd; Author: SM; Date Saved: 2/9/2017



-All proposed locations are conceptual and may be revised in the field as appropriate based on access issues, utilities, data collected during previous FS data gap investigation activities, et cetera.

Notes:

[1] The dissolved arsenic groundwater concentrations presented on this figure are from 2012. If 2012 data were not available, 2008 data were used.

-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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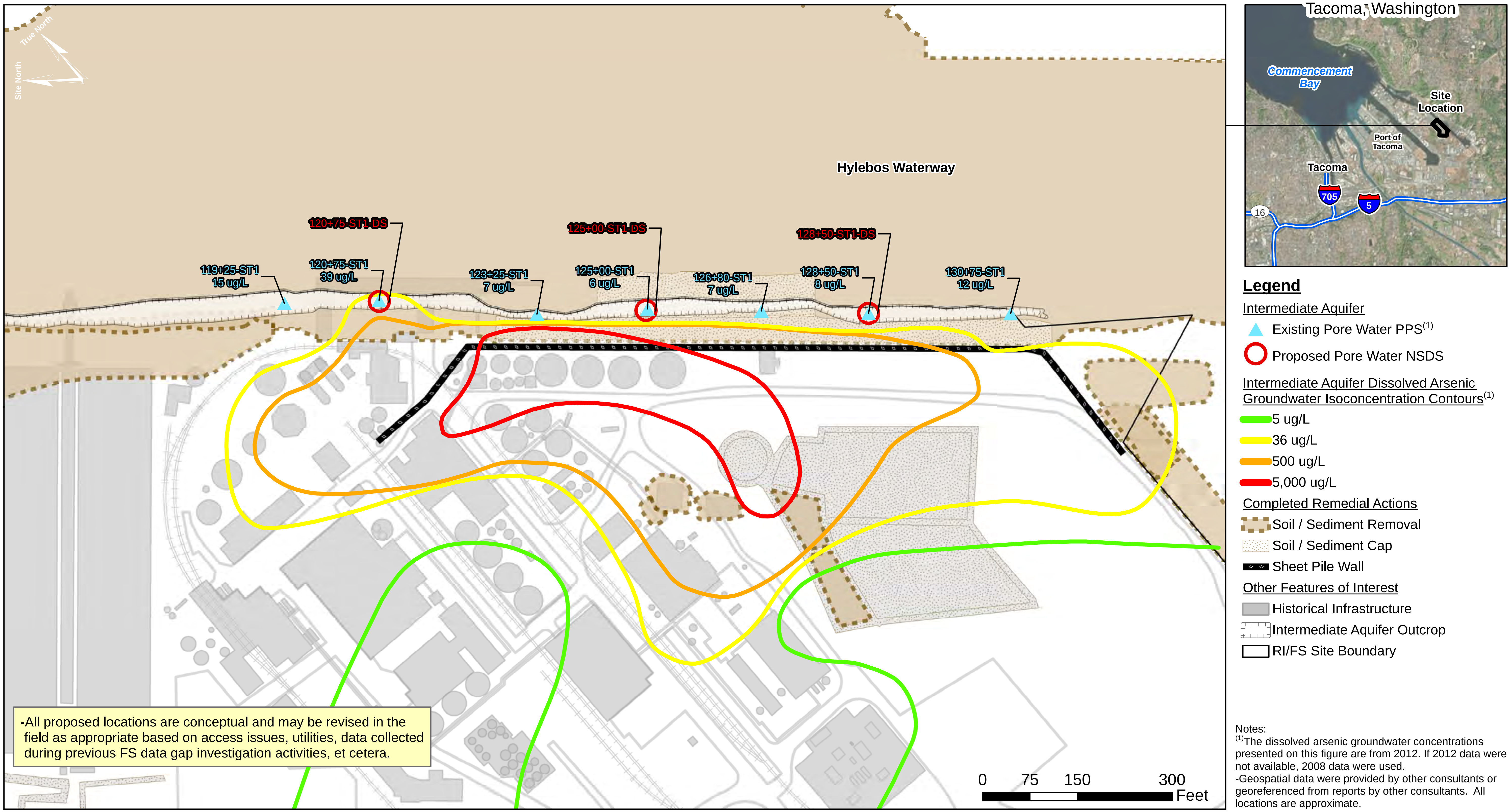
Investigation Locations for Data Gap #1A
Shoreline Concentrations (Upper Aquifer Pore Water Samples)
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-1A

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-4-1A_UA_Infra_DataGap#1A.mxd; Author: SM; Date Saved: 12/28/2016



-All proposed locations are conceptual and may be revised in the field as appropriate based on access issues, utilities, data collected during previous FS data gap investigation activities, et cetera.

Notes:

[1] The dissolved arsenic groundwater concentrations presented on this figure are from 2012. If 2012 data were not available, 2008 data were used.

-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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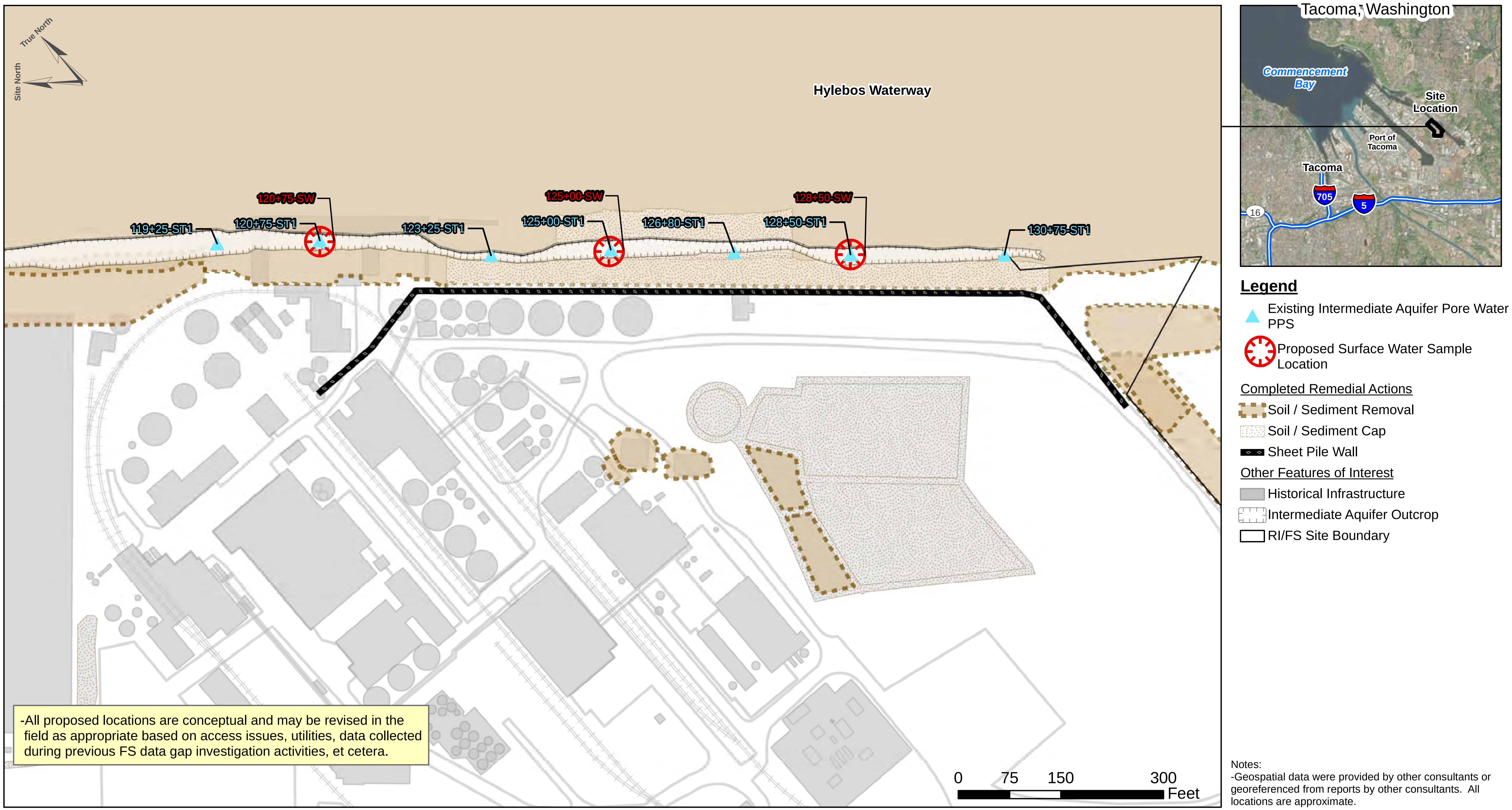
Investigation Locations for Data Gap #1B
Shoreline Concentrations (Intermediate Aquifer Pore Water Samples)
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-1B

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-4-1B_IA_Infra_DataGap#1B.mxd; Author: SM; Date Saved: 12/19/2016



-All proposed locations are conceptual and may be revised in the field as appropriate based on access issues, utilities, data collected during previous FS data gap investigation activities, et cetera.

Notes:
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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Investigation Locations for Data Gap #1C
Shoreline Concentrations (Surface Water Samples)
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-1C

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-4-1C_SurfaceWater_DataGap#4.mxd; Author: SM; Date Saved: 2/9/2017

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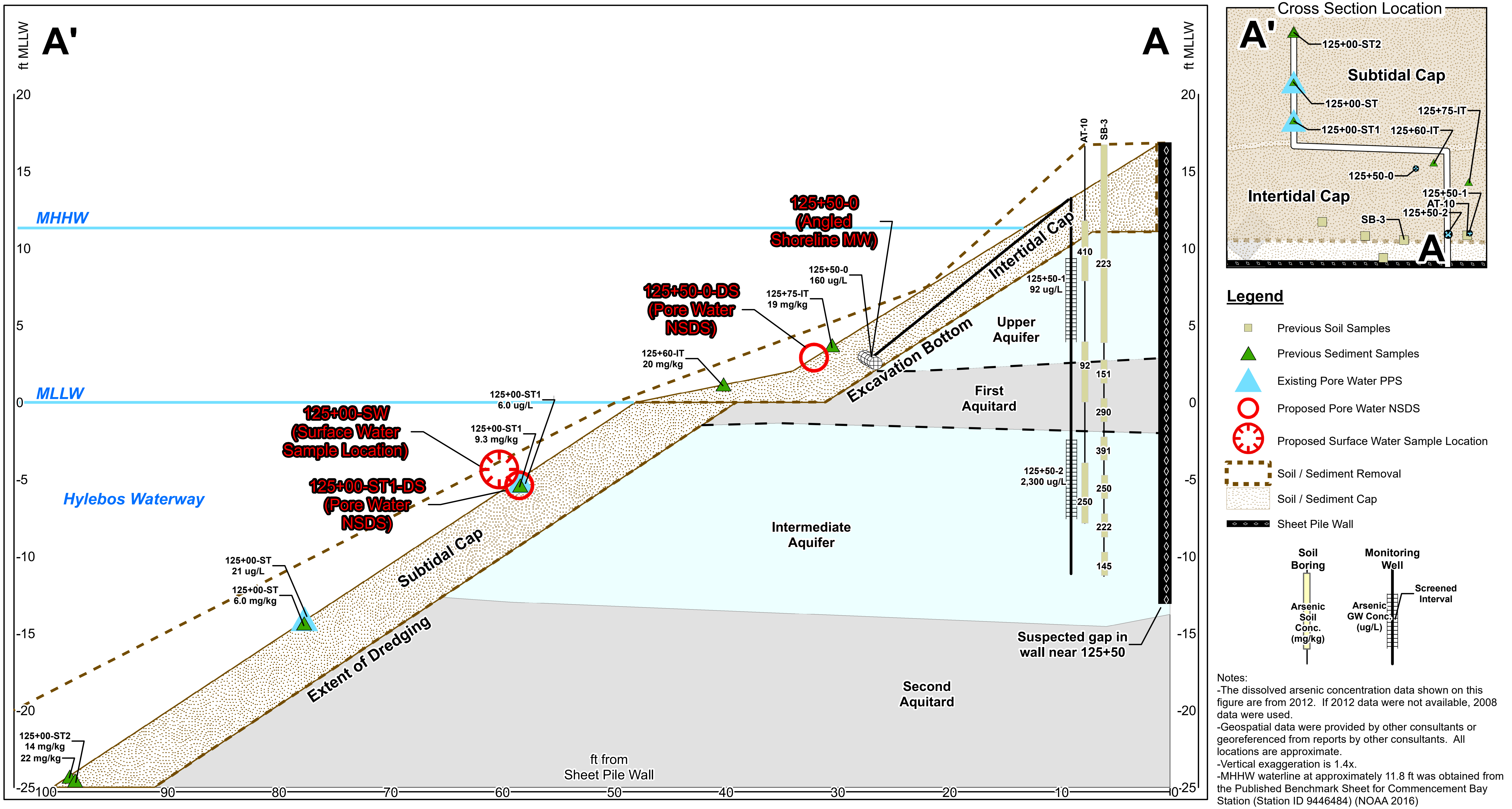

Notes:
-The dissolved arsenic concentration data shown on this figure are from 2012. If 2012 data were not available, 2008 data were used.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.
-Vertical exaggeration is 1.4x.
-MHHW waterline at approximately 11.8 ft was obtained from the Published Benchmark Sheet for Commencement Bay Station (Station ID 9446484) (NOAA 2016)

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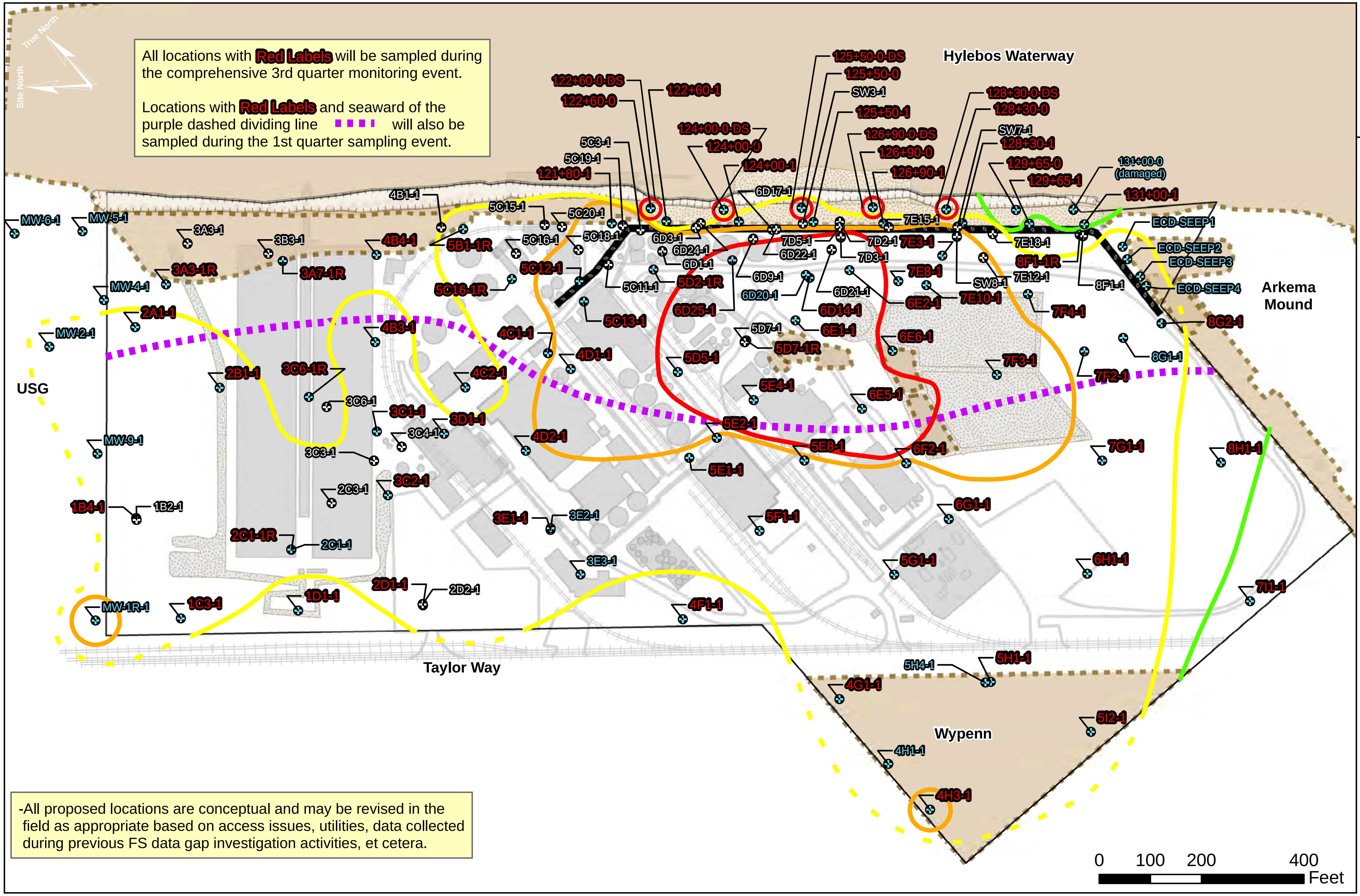
Conceptual Cross Section of Shoreline Sampling Locations
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-1D



All locations with **Red Labels** will be sampled during the comprehensive 3rd quarter monitoring event.

Locations with **Red Labels** and seaward of the purple dashed dividing line ▪ ▪ ▪ ▪ will also be sampled during the 1st quarter sampling event.

-All proposed locations are conceptual and may be revised in the field as appropriate based on access issues, utilities, data collected during previous FS data gap investigation activities, et cetera.

Legend

⊕ Existing Monitoring Well or Angled Shoreline Monitoring Well

⊕ Decommissioned Monitoring Well

○ Proposed Pore Water NSDS

Upper Aquifer Dissolved Arsenic Groundwater Isoconcentration Contours[(1)]

- 5 ug/L
- 36 ug/L
- 500 ug/L
- 5,000 ug/L

Completed Remedial Actions

- ▨ Soil / Sediment Removal
- ▨ Soil / Sediment Cap
- ■ Sheet Pile Wall

Other Features of Interest

- ■ Historical Infrastructure
- ☐ Intermediate Aquifer Outcrop
- ☐ RI/FS Site Boundary

Notes:
[(1)]The dissolved arsenic groundwater concentrations presented on this figure are from 2012. If 2012 data were not available, 2008 data were used.
- **Red label** indicates a proposed sample location.
Blue label indicates an existing location that will not be sampled.
White label indicates a decommissioned well.
- Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.
- Dashed isoconcentration contours are inferred.

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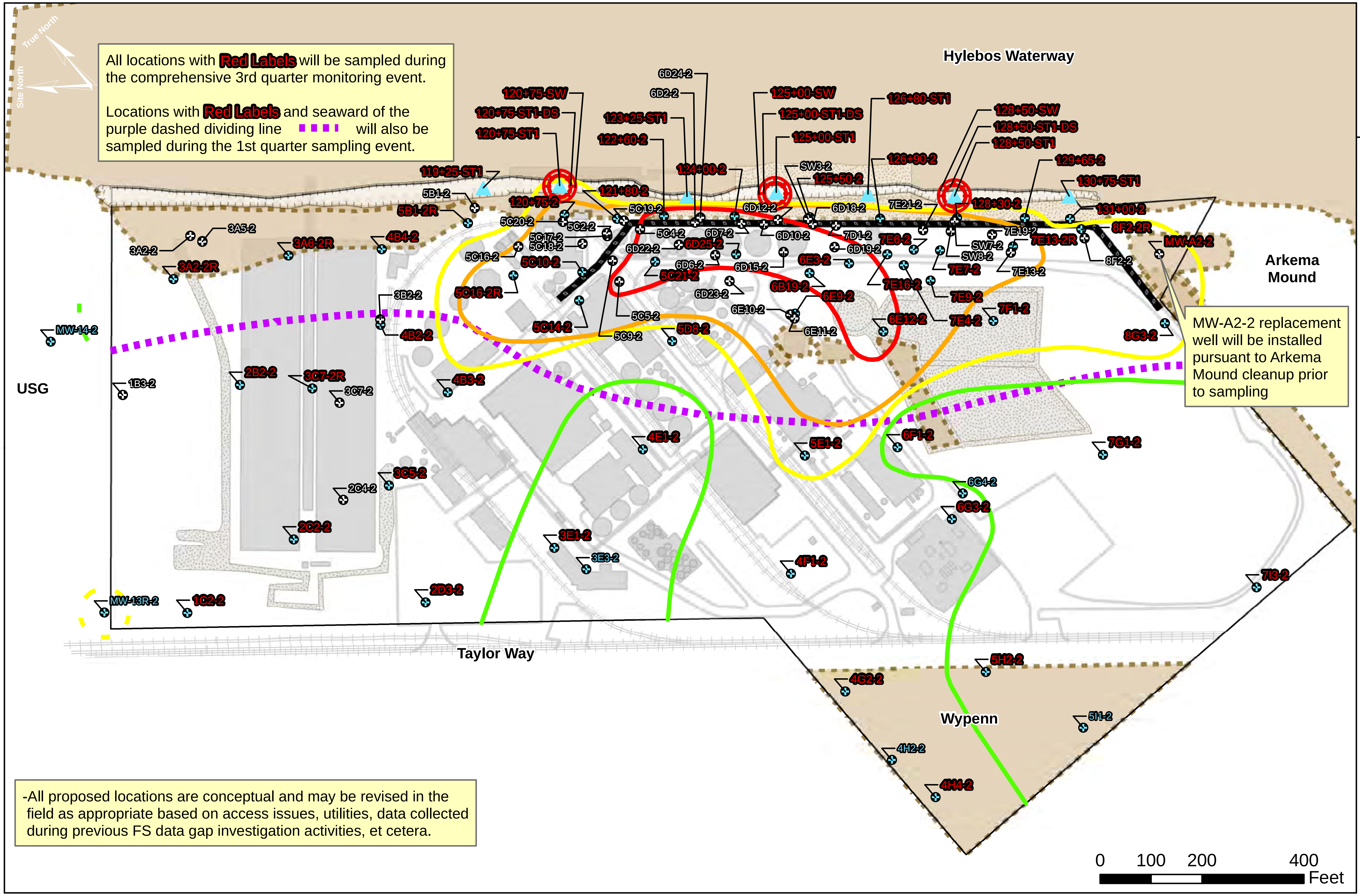
Investigation Locations for Data Gap #2A
Arsenic Plume Stability (Upper Aquifer)
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-2A

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-4-2A_UpperAquiferGW_DataGap#2A.mxd; Author: SM; Date Saved: 2/9/2017

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-4-2B_IntermediateAquiferGW_DataGap#2B.mxd; Author: SM; Date Saved: 2/9/2017



All locations with **Red Labels** will be sampled during the comprehensive 3rd quarter monitoring event.

Locations with **Red Labels** and seaward of the purple dashed dividing line ▪▪▪▪ will also be sampled during the 1st quarter sampling event.

MW-A2-2 replacement well will be installed pursuant to Arkema Mound cleanup prior to sampling

-All proposed locations are conceptual and may be revised in the field as appropriate based on access issues, utilities, data collected during previous FS data gap investigation activities, et cetera.

Legend

- ⊕ Existing Monitoring Well
- ⊕ Decommissioned Monitoring Well
- ▲ Existing Pore Water PPS
- ○ Proposed Pore Water NSDS
- ◎ Proposed Surface Water Sample Location

Intermediate Aquifer Dissolved Arsenic Groundwater Isoconcentration Contours[(1)]

- 🟩 5 ug/L
- 🟨 36 ug/L
- 🟧 500 ug/L
- 🟥 5,000 ug/L

Completed Remedial Actions

- ▨ Soil / Sediment Removal
- ▨ Soil / Sediment Cap
- ■ Sheet Pile Wall

Other Features of Interest

- ■ Historical Infrastructure
- ☐ Intermediate Aquifer Outcrop
- ☐ RI/FS Site Boundary

Notes:

(1) The dissolved arsenic groundwater data shown on this figure are from 2012. If no data was available from 2012 for a MW, data from 2008 was used instead.

-Red label indicates a proposed sample location.
Blue label indicates an existing location that will not be sampled.
White label indicates a decommissioned well.

- Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.
- Dashed isoconcentration contours are inferred

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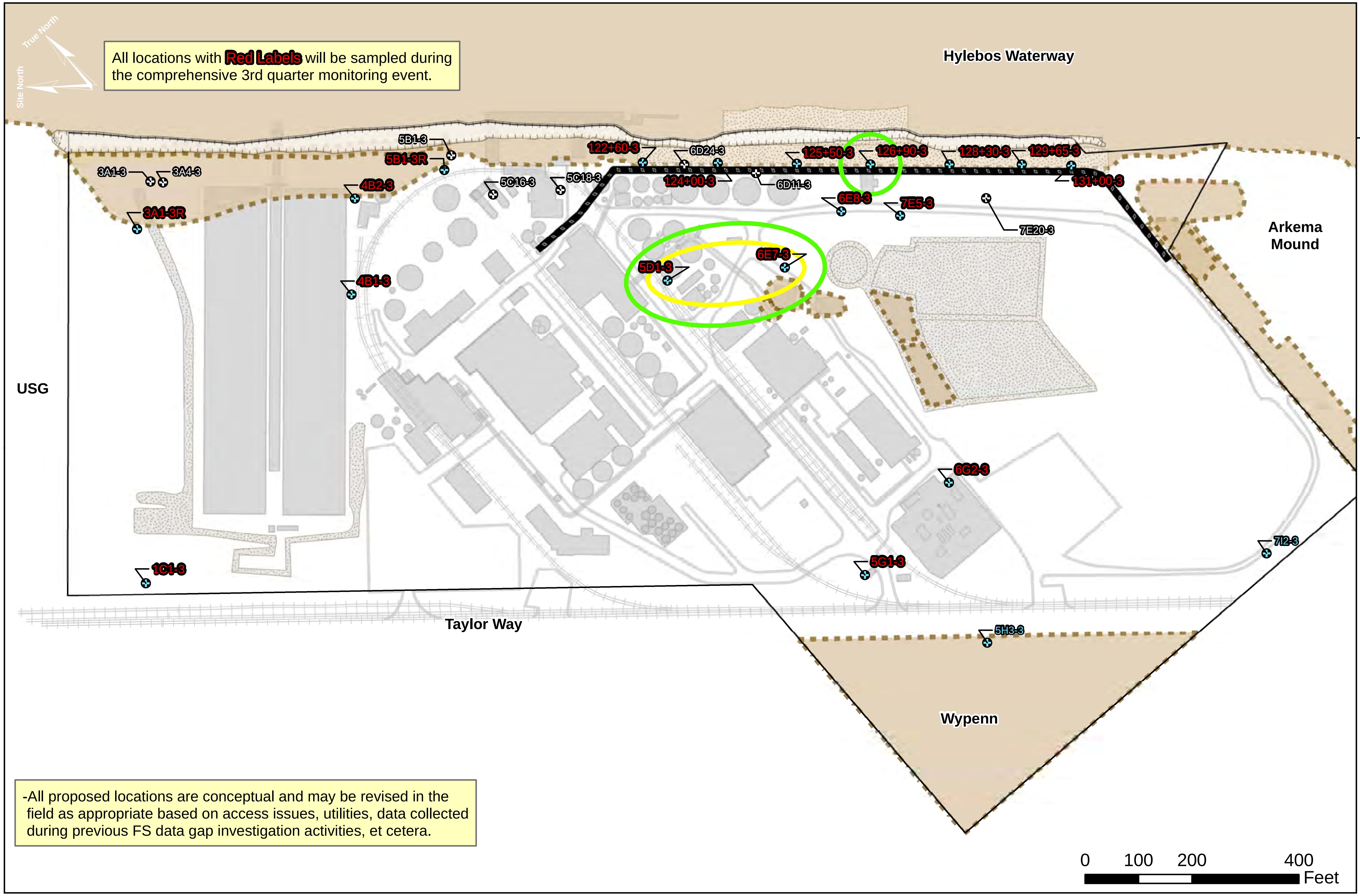
Investigation Locations for Data Gap #2B
Arsenic Plume Stability (Intermediate Aquifer)
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-2B

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-4-2C_DeepAquiferGW_DataGap#2C.mxd; Author: SM; Date Saved: 2/9/2017



All locations with **Red Labels** will be sampled during the comprehensive 3rd quarter monitoring event.

-All proposed locations are conceptual and may be revised in the field as appropriate based on access issues, utilities, data collected during previous FS data gap investigation activities, et cetera.

Legend

⊕ Existing Monitoring Well

⊕ Decommissioned Monitoring Well

Deep Aquifer Dissolved Arsenic Groundwater Isoconcentration Contours[(1)]

🟩 5 ug/L

🟨 36 ug/L

🟧 500 ug/L

🟥 5,000 ug/L

Completed Remedial Actions

▨ Soil / Sediment Removal

▨ Soil / Sediment Cap

▬ Sheet Pile Wall

Other Features of Interest

▨ Historical Infrastructure

☐ Intermediate Aquifer Outcrop

☐ RI/FS Site Boundary

Notes:
(1) The dissolved arsenic groundwater data shown on this figure are from 2012. If no data was available from 2012 for a MW, data from 2008 was used instead.
-Red label indicates a proposed sample location.
Blue label indicates an existing location that will not be sampled.
White label indicates a decommissioned well.
- Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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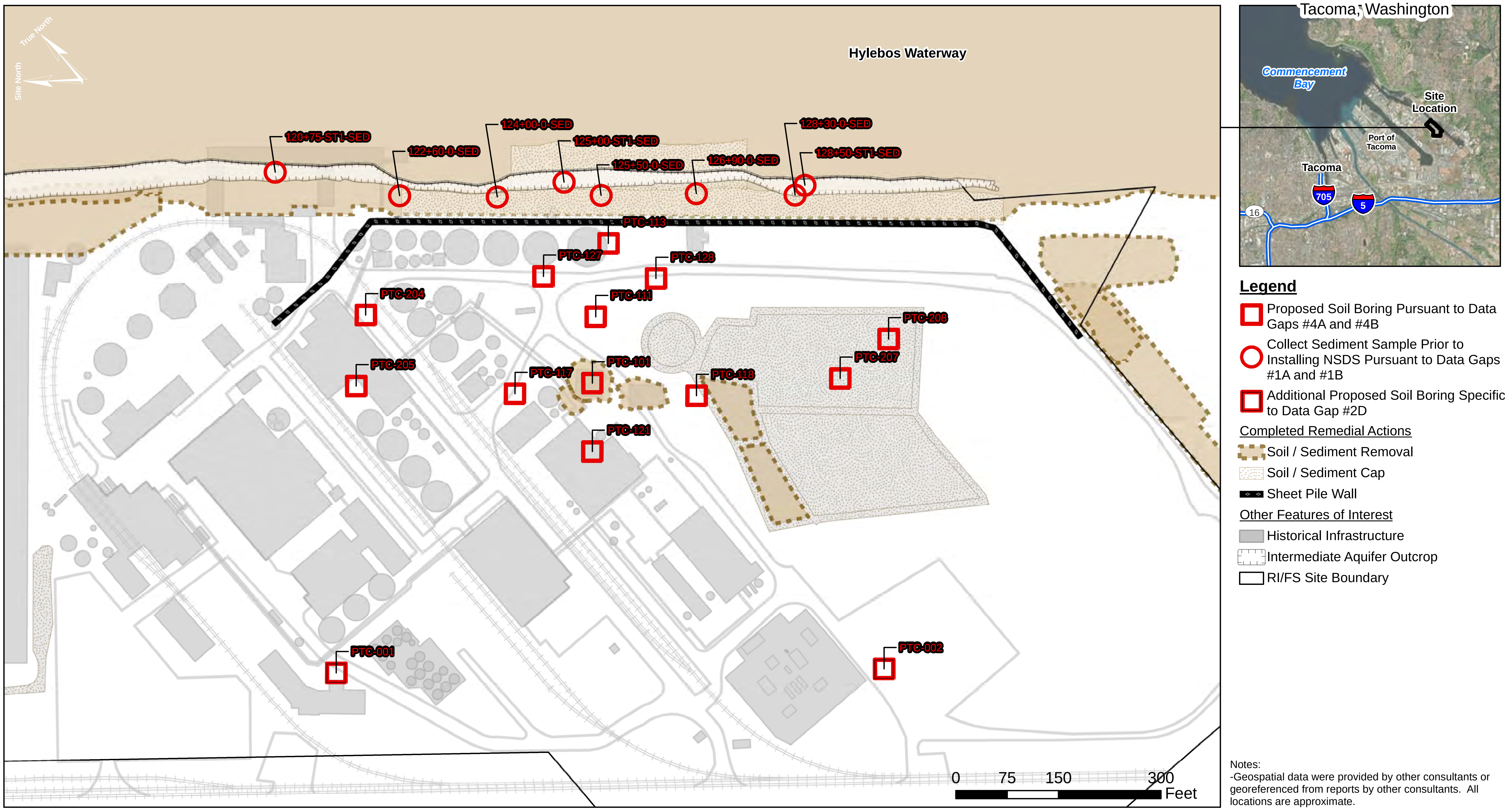
Investigation Locations for Data Gap #2C
Arsenic Plume Stability (Deep Aquifer)
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-2C

Document Path: G:\Projects\Arkema\Maps\2016\FS Data Gap Work Plan\Figure-4-2D_SoilDataforPlumeStability_DataGap#2D.mxd; Author: SM; Date Saved: 2/9/2017



Notes:
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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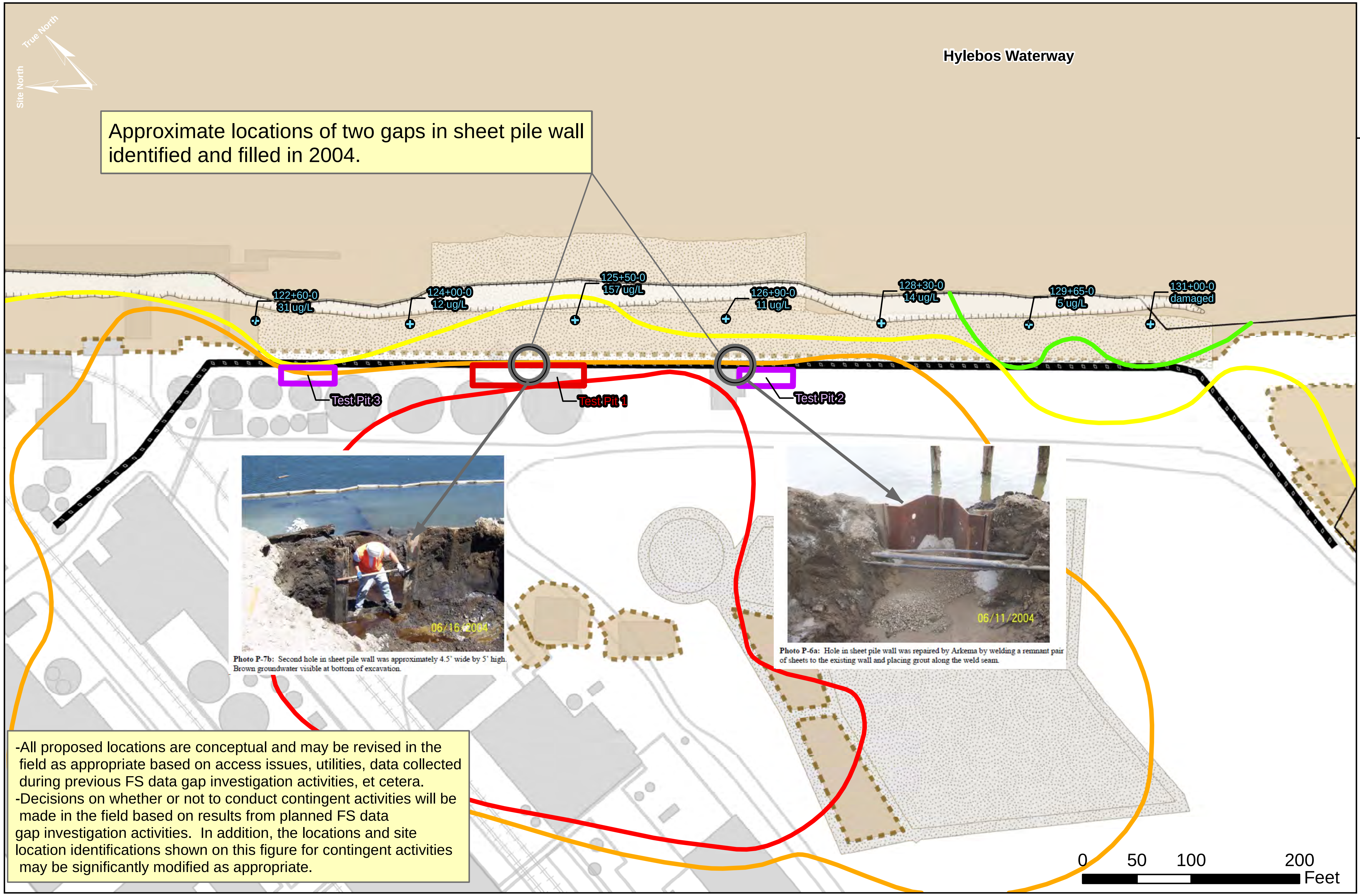
Investigation Locations for Data Gap #2D
Arsenic Plume Stability (Soil/Sediment Geochemistry)
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-2D



Approximate locations of two gaps in sheet pile wall identified and filled in 2004.

Photo P-7b: Second hole in sheet pile wall was approximately 4.5' wide by 5' high. Brown groundwater visible at bottom of excavation.

Photo P-6a: Hole in sheet pile wall was repaired by Arkema by welding a remnant pair of sheets to the existing wall and placing grout along the weld seam.

-All proposed locations are conceptual and may be revised in the field as appropriate based on access issues, utilities, data collected during previous FS data gap investigation activities, et cetera.
-Decisions on whether or not to conduct contingent activities will be made in the field based on results from planned FS data gap investigation activities. In addition, the locations and site location identifications shown on this figure for contingent activities may be significantly modified as appropriate.

Legend

- ⊕ Existing Upper Aquifer Angled Shoreline Monitoring Well(1)
- 🟥 Proposed Test Pit Location (Planned)
- 🟪 Proposed Test Pit Location (Contingent)

Upper Aquifer Dissolved Arsenic Groundwater Isoconcentration Contours(1)

- 🟩 5 ug/L
- 🟨 36 ug/L
- 🟧 500 ug/L
- 🟥 5,000 ug/L

Completed Remedial Actions

- ▨ Soil / Sediment Removal
- ▨ Soil / Sediment Cap
- ■ Sheet Pile Wall

Other Features of Interest

- ▨ Historical Infrastructure
- ☐ Intermediate Aquifer Outcrop
- ☐ RI/FS Site Boundary

Notes:
(1)The dissolved arsenic groundwater concentrations presented on this figure are from 2012. If 2012 data were not available, 2008 data were used.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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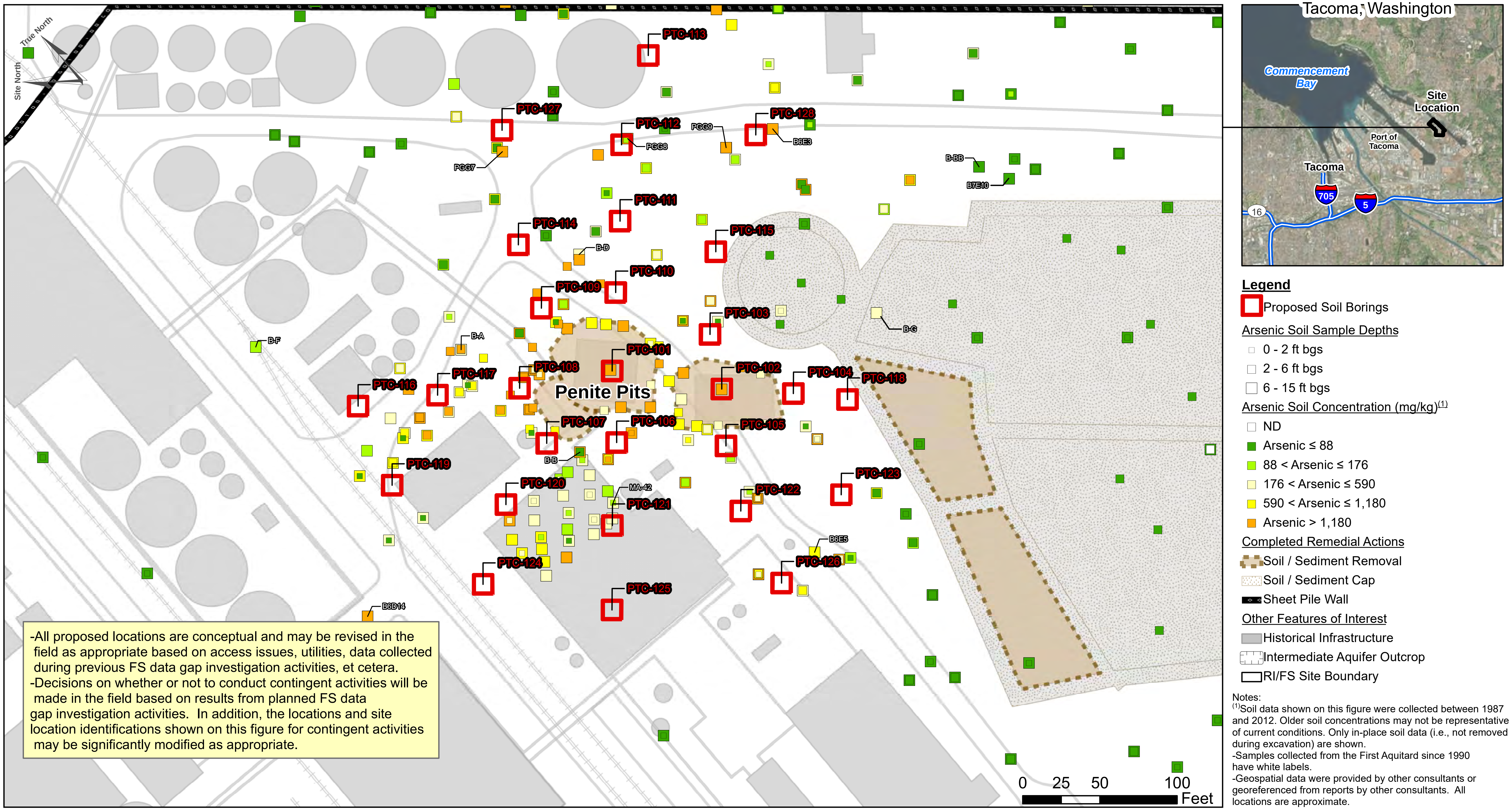
Investigation Locations for Data Gap #3
Wall Integrity
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-3



-All proposed locations are conceptual and may be revised in the field as appropriate based on access issues, utilities, data collected during previous FS data gap investigation activities, et cetera.
-Decisions on whether or not to conduct contingent activities will be made in the field based on results from planned FS data gap investigation activities. In addition, the locations and site location identifications shown on this figure for contingent activities may be significantly modified as appropriate.

Legend

🟥 Proposed Soil Borings

Arsenic Soil Sample Depths
- ☐ 0 - 2 ft bgs
- ☐ 2 - 6 ft bgs
- ☐ 6 - 15 ft bgs

Arsenic Soil Concentration (mg/kg)[(1)]
- ☐ ND
- 🟩 Arsenic ≤ 88
- 🟩 88 < Arsenic ≤ 176
- ☐ 176 < Arsenic ≤ 590
- 🟨 590 < Arsenic ≤ 1,180
- 🟧 Arsenic > 1,180

Completed Remedial Actions
- ▨ Soil / Sediment Removal
- ▨ Soil / Sediment Cap
- ▬ Sheet Pile Wall

Other Features of Interest
- ▨ Historical Infrastructure
- ☐ Intermediate Aquifer Outcrop
- ☐ RI/FS Site Boundary

Notes:
[(1)]Soil data shown on this figure were collected between 1987 and 2012. Older soil concentrations may not be representative of current conditions. Only in-place soil data (i.e., not removed during excavation) are shown.
-Samples collected from the First Aquitard since 1990 have white labels.
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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Investigation Locations for Data Gap #4A
Feasibility of Focused Soil Excavation Alternative (Arsenic)
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-4A

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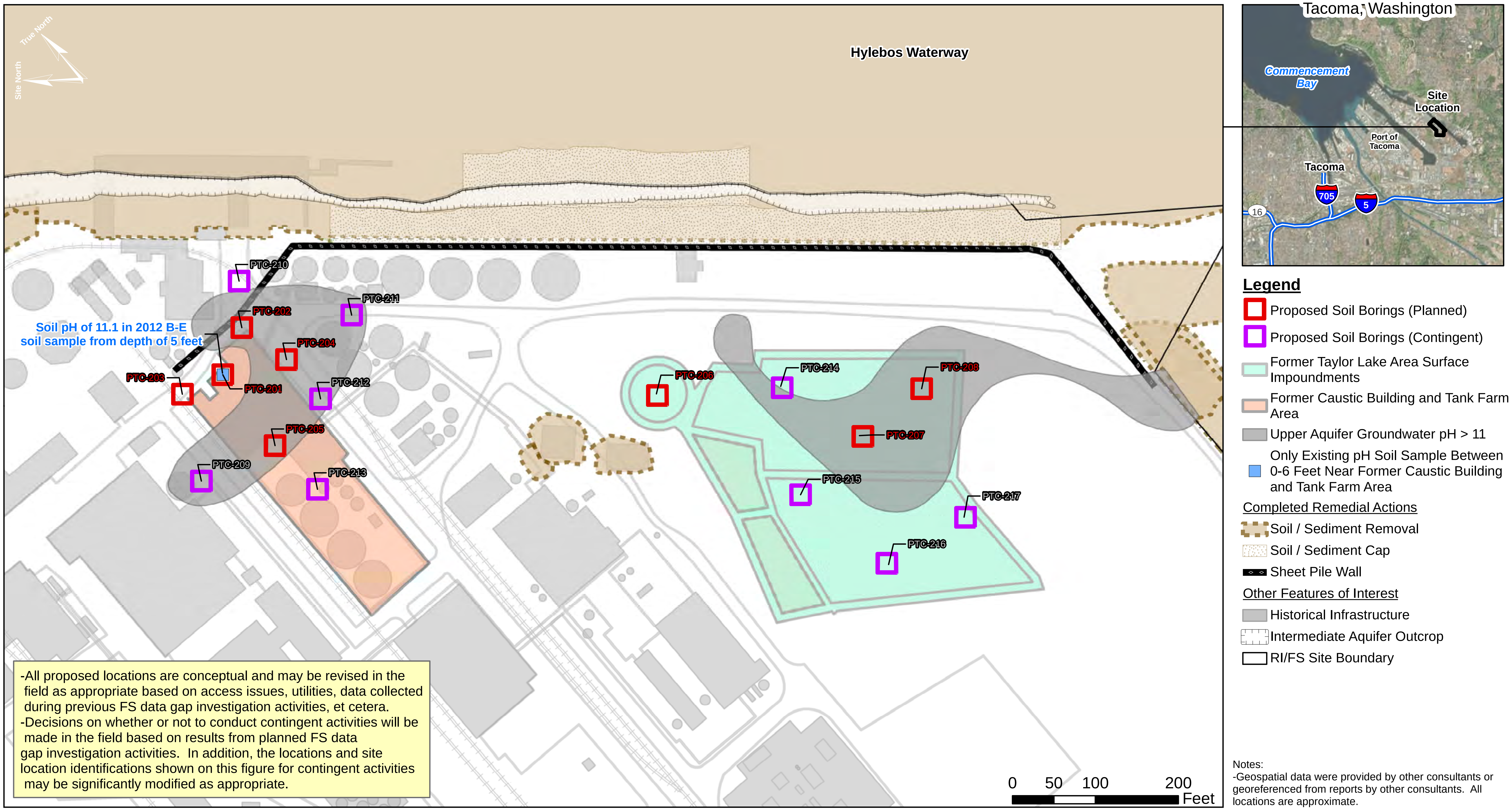

-All proposed locations are conceptual and may be revised in the field as appropriate based on access issues, utilities, data collected during previous FS data gap investigation activities, et cetera.
-Decisions on whether or not to conduct contingent activities will be made in the field based on results from planned FS data gap investigation activities. In addition, the locations and site location identifications shown on this figure for contingent activities may be significantly modified as appropriate.

Notes:
-Geospatial data were provided by other consultants or georeferenced from reports by other consultants. All locations are approximate.

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Investigation Locations for Data Gap #4B
Feasibility of Focused Soil Excavation Alternative (pH)
FS Data Gap Investigation Work Plan
Former Arkema Manufacturing Site

Figure 4-4B

Tables

Table 3-1: Identification of Data Gaps

Data Gap Name	FS Need (What We Need to Know for the FS)	Existing Information (What We Know/Think)	Data Gap (What We Don't Know)	Data Gap Objectives (What We Want to Achieve)
Data Gap #1: Shoreline Concentrations	Data Gap #1A for Upper Aquifer Pore Water Samples: Current concentrations of arsenic (and other COPCs) in pore water where groundwater discharges to surface water are necessary to design and evaluate cleanup alternatives.	• Seven Angled Shoreline MWs are located within the intertidal cap between the sheet pile wall and the Hylebos Waterway (see Figure 2-3). • The screens for the Angled Shoreline MWs are approximately two feet inland of the groundwater/surface water interface for the Upper Aquifer. Additional attenuation is expected in the approximately two feet between the Angled Shoreline MWs and the groundwater/surface water interface based on the design of the intertidal cap. • No shoreline pore water or seep samples have been collected from the Upper Aquifer for at least 10 years.	• Current concentrations of arsenic (and other COPCs) in Upper Aquifer pore water at the groundwater/surface water interface.	Install NSDSs at select Upper Aquifer shoreline locations to collect representative pore water samples at the groundwater/surface water interface.
	Data Gap #1B for Intermediate Aquifer Pore Water Samples: Current concentrations of arsenic (and other COPCs) in pore water where groundwater discharges to surface water are necessary to design and evaluate cleanup alternatives.	• Pushpoint samplers (PPSs) have been used at seven existing Site locations to sample Intermediate Aquifer pore water at the groundwater/surface water interface (see Figure 2-4). • PPSs collect grab samples, which provide a snapshot of conditions. Conditions along the tidal shoreline are complex and vary over time. • NSDSs are left in place over a period of time and are therefore representative of a wider range of conditions.	• Current concentrations of arsenic (and other COPCs) in Intermediate Aquifer pore water at the groundwater/surface water interface over a more representative sampling duration.	Install NSDSs at select Intermediate Aquifer shoreline locations to collect more representative pore water samples at the groundwater/surface water interface.
	Data Gap #1C for Surface Water Samples: Current concentrations of arsenic (and other COPCs) in surface water where groundwater discharges to surface water are necessary to design and evaluate cleanup alternatives.	• The number of surface water samples collected adjacent to the Site is relatively limited. The last surface water sampling was conducted in 2012. Dissolved arsenic concentrations in the most recent Hylebos Waterway surface water samples collected adjacent to the Site ranged from non-detect at a reporting limit of 5 ug/L to a maximum detected concentration of 10 ug/L (see Figures 2-3 through 2-5). • Surface water samples have never been collected where Intermediate Aquifer groundwater discharges to surface water.	• Current concentrations of arsenic (and other COPCs) in surface water where Intermediate Aquifer groundwater discharges to surface water.	Install NSDSs at select Intermediate Aquifer shoreline locations to collect representative surface water samples at the groundwater/surface water interface.
Data Gap #2: Arsenic Plume Stability	Data Gap #2A for the Upper Aquifer: Whether or not completed remedial actions and natural attenuation processes will continue to reduce dissolved arsenic concentrations in the Upper Aquifer near the shoreline over time as expected.	• The completed remedial actions have significantly decreased the arsenic source strength and mass discharge to the Hylebos Waterway (see Section 2.5 and PIONEER 2015). • With the exception of the Angled Shoreline MW at 125+50-0, dissolved arsenic concentrations in the Angled Shoreline MWs do not significantly exceed 5 ug/L and are less than 36 ug/L (see Figure 2-3). • The screens for the Angled Shoreline MWs are approximately two feet inland of the groundwater/surface water interface for the Upper Aquifer. Additional attenuation is expected in the approximately two feet between the Angled Shoreline MWs and the groundwater/surface water interface based on the design of the intertidal cap. • Dissolved arsenic concentrations in the Upper Aquifer near the shoreline are expected to decrease over time for the reasons presented in the CSM (see Section 2.9). • The last comprehensive groundwater, pore water, and surface water sampling event was conducted in 2012. • The average dissolved arsenic concentration for all Upper Aquifer sample locations within the current 500 ug/L isoconcentration contour has historically been highest during the 3rd quarter.	• Whether or not dissolved arsenic concentrations in the Upper Aquifer remain stable.	Conduct two groundwater and pore water sampling events (one in the 3rd quarter and one in the 1st quarter) for the Upper Aquifer in order to help evaluate plume stability (e.g., arsenic time-series trend graphs for MWs, changes in plume magnitude and extent, geochemical lines of evidence) in accordance with applicable guidance (e.g., USEPA 2007a, 2007b, 2015; Savannah River National Laboratory 2011).
	Data Gap #2B for the Intermediate Aquifer: Whether or not completed remedial actions and natural attenuation processes will continue to reduce dissolved arsenic concentrations in the Intermediate Aquifer near the shoreline over time as expected.	• The completed remedial actions have significantly decreased the arsenic source strength and mass discharge to the Hylebos Waterway (see Section 2.5 and PIONEER 2015). • With the exception of the PPS at 120+75-ST1, dissolved arsenic concentrations in the PPSs do not significantly exceed 5 ug/L and are less than the 36 ug/L (see Figure 2-4). • PPSs collect grab samples, which provide a snapshot of conditions. Conditions along the tidal shoreline are complex and vary over time. NSDSs are left in place over a period of time and are therefore representative of a wider range of conditions. • Dissolved arsenic concentrations in the Intermediate Aquifer near the shoreline are expected to decrease over time for the reasons presented in the CSM (see Section 2.9). • The last comprehensive groundwater, pore water, and surface water sampling event was conducted in 2012. • The average dissolved arsenic concentration for all Intermediate Aquifer sample locations within the current 500 ug/L isoconcentration contour has historically been highest during the 3rd quarter.	• Whether or not dissolved arsenic concentrations in the Intermediate Aquifer remain stable.	Conduct two groundwater, pore water, and surface water sampling events (one in the 3rd quarter and one in the 1st quarter) for the Intermediate Aquifer in order to help evaluate plume stability (e.g., arsenic time-series trend graphs for MWs, changes in plume magnitude and extent, geochemical lines of evidence) in accordance with applicable guidance (e.g., USEPA 2007a, 2007b, 2015; Savannah River National Laboratory 2011).
	Data Gap #2C for the Deep Aquifer: Whether or not completed remedial actions and natural attenuation processes will continue to reduce dissolved arsenic concentrations in the Deep Aquifer near the shoreline over time as expected.	• The magnitude and extent of dissolved arsenic PCL exceedances in the Deep Aquifer are limited (see Figure 2-5). • With the exception of a dissolved arsenic concentration of 8 ug/L at 126+90-3, dissolved arsenic concentrations in the MWs located closest to the shoreline are less than 5 ug/L. • The last comprehensive groundwater, pore water, and surface water sampling event was conducted in 2012. • The average dissolved arsenic concentrations for all Upper Aquifer and Intermediate Aquifer sample locations within the current 500 ug/L isoconcentration contours have historically been highest during the 3rd quarter.	• Whether or not dissolved arsenic concentrations in the Deep Aquifer remain stable.	Conduct one groundwater sampling event (in the 3rd quarter) for the Deep Aquifer in order to help evaluate plume stability (e.g., arsenic time-series trend graphs for MWs, changes in plume magnitude and extent, geochemical lines of evidence) in accordance with applicable guidance (e.g., USEPA 2007a, 2007b, 2015; Savannah River National Laboratory 2011).
	Data Gap #2D for Soil/Sediment Geochemistry: Whether or not soil and sediment geochemistry in the conceptual geochemical zones match CSM expectations.	• The completed remedial actions have significantly decreased the arsenic source strength and mass discharge to the Hylebos Waterway (see Section 2.5 and PIONEER 2015). • Changes in geochemical conditions near the shoreline due to marine water mixing are important attenuation mechanisms (see Section 2.9.4). • Soil geochemical data have not previously been collected to supplement the existing geochemical lines of evidence associated with groundwater data.	• Whether or not soil and sediment geochemical data support the existing CSM (e.g., elevated ferric chloride along the shoreline).	Collect soil and sediment geochemical data in order to help evaluate plume stability (e.g., site-specific ferric iron concentrations in soil/sediment) in accordance with applicable guidance (e.g., USEPA 2007a, 2007b, 2015; Savannah River National Laboratory 2011).

Table 3-1: Identification of Data Gaps

Data Gap Name	FS Need (What We Need to Know for the FS)	Existing Information (What We Know/Think)	Data Gap (What We Don't Know)	Data Gap Objectives (What We Want to Achieve)
Data Gap #3: Wall Integrity	The current integrity and anticipated life of the sheet pile wall.	• The sheet pile wall was installed in order to reduce the mass discharge of arsenic from the Upper Aquifer and Intermediate Aquifer to the Hylebos Waterway (ICF 1990b). The sheet pile wall was originally designed to provide some hydraulic containment until the arsenic groundwater P&T system was operational. • The sheet pile wall is an important factor in the attenuation of arsenic between the former Penite Pits and the shoreline (see Section 2.9). • Sheet pile walls corrode over time. Corrosion is typically greatest in the splash zone, which is just above mean high water (URS Greiner and CH2M Hill 2004). Based on tidal data (DOF 2013), the splash zone at this Site is likely between approximately 10 feet MLLW (a typical high tide) and 15 feet MLLW (the top of the wall). Ground surface by the sheet pile wall is approximately 17 feet MLLW. • Photos of the sheet pile wall were taken in 2004 during the removal of intertidal soil (See Appendix A). The photos indicate that although some limited corrosion had occurred along the wall, the wall was in relatively good condition. • Two gaps in the top part of the sheet pile wall were discovered and filled in 2004 (see Appendix A). It is unsure whether these two gaps were caused by wall construction, earth movement during the 2001 Nisqually earthquake, or another reason. • The elevated dissolved arsenic concentration of157 ug/L in the Angled Shoreline MW at 125+50-0 may be indicative of leakage through the sheet pile wall. • It is not practicable to excavate deeper than approximately five to ten feet to physically inspect the sheet pile wall because the physical removal of the stabilizing lateral loads could result in structural failure and the attendant release of groundwater and solids into the Hylebos. Other issues associated with deep excavations include excavation safety for workers, dewatering, and management of excavation and dewatering wastes.	• Current integrity of the sheet pile wall (i.e., corrosion on the sheet pile wall, condition of the wall joints, and condition of the gaps that were repaired in 2004).	Have a corrosion engineer inspect and measure the top portion of the sheet pile wall to evaluate the current integrity and anticipated life expectancy of the sheet pile wall.
Data Gap #4: Feasibility of Focused Soil Excavation Alternative	Data Gap #4A for Arsenic: Whether or not a focused excavation of elevated arsenic soil concentrations in the vicinity of the former Penite Pits is a feasible remedial alternative. .	• Excavating all Site soil to a depth of 15 feet to comply with the arsenic PCL of 88 mg/kg is not a feasible alternative due to disproportionate costs (PIONEER 2016). • The highest remaining arsenic soil concentrations at the Site are in the vicinity of the former Penite Pits. • The data density for arsenic soil concentrations surrounding the former Penite Pits and underneath the former Penite Pits in the First Aquitard is relatively low. In addition, a significant amount of the existing arsenic soil data were collected prior to 1990 remedial activities; therefore, these data may no longer be representative of current Site conditions. • The feasibility of a focused soil excavation alternative for arsenic in the vicinity of the former Penite Pits depends on (1) the ability to identify a focused location where the majority of the remaining arsenic mass resides, (2) potential excavation volumes, (3) potential excavation depths, (4) the amount of hazardous waste that might be generated, and (5) whether or not excavated soil that exceeds toxicity characteristic leaching procedure (TCLP) criteria for hazardous waste can be efficiently treated so that the amount of excavated soil that can be disposed of as non-hazardous waste can be maximized. • Based on the previous removals near the former Penite Pits, soil excavated in this area is expected to exceed TCLP criteria for hazardous waste (MPS Incorporated 1990). Ex-situ stabilization is a proven technology for treating excavated soil to maximize the amount of soil that can be disposed of as non-hazardous waste. However, the effectiveness of ex-situ stabilization depends on site-specific conditions (e.g., geochemistry).	• The locations and depths of the highest arsenic soil concentrations in the vicinity of the former Penite Pits. • The amount of soil in the vicinity of the former Penite Pits that exceeds the TCLP criteria for hazardous waste. • The site-specific effectiveness of ex-situ stabilization to treat potential excavated soil.	Collect arsenic soil samples in the vicinity of the former Penite Pits to (1) identify the locations and depths with the highest arsenic concentrations, (2) evaluate potential hazardous waste quantities if soil was excavated and designated for disposal, and (3) begin to evaluate the site-specific effectiveness of ex-situ soil stabilization.
	Data Gap #4B for pH: Whether or not a focused excavation of potentially elevated pH in soil in the vicinity of the former Taylor Lake Area surface impoundments and/or the former Caustic Building and Tank Farm Area is a feasible remedial alternative.	• Elevated pH has exacerbated the transport of arsenic in certain upland areas of the Site (see Section 2.9). • Completed remedial actions (e.g., ceasing discharge of wastewater to the Taylor Lake Area surface impoundments, removal of elevated pH sludge from the two Asbestos Ponds) addressed some of the elevated pH at the Site (see Section 2.9.3). • Remaining sludge in the former Taylor Lake Area surface impoundments and an unknown source in the former Caustic Building and Tank Farm Area appear to be two potential sources of remaining elevated pH at the Site (see Section 2.9.1). • The feasibility of a focused soil excavation alternative for pH depends on (1) the ability to identify a focused location where the majority of the remaining pH mass resides, (2) potential excavation volumes, and (3) potential excavation depths. • If soil were to be excavated in the former Taylor Lake Area surface impoundments, it would be expected to be non-hazardous based on previous sludge data. The maximum pH value in the sludge was less than the hazardous waste criterion of 12.5, and metals concentrations were relatively low (Kennedy/Jenks/Chilton 1990).	• Whether or not a distinct layer of elevated pH soil remains in the former Taylor Lake Area surface impoundments. • Whether or not a source of elevated pH in the former Caustic Building and Tank Farm Area can be identified. • An approximate extent of elevated pH in the former Taylor Lake Area surface impoundments and the former Caustic Building and Tank Farm Area.	Collect pH soil data to (1) determine if a distinct layer of elevated pH soil remains in the former Taylor Lake Area surface impoundments, (2) determine if a source of elevated pH in the former Caustic Building and Tank Farm Area can be identified, and (3) confirm that any excavated soil in these areas would be non-hazardous.

Notes:

PPS: Pushpoint sampler

TCLP: Toxicity characteristic leaching procedure

Table 4-1A: Sampling Design for Data Gap #1A – Shoreline Concentrations (Upper Aquifer Pore Water Samples)

Sampling Design Component	Details
Data Gap	Current concentrations of arsenic (and other COPCs) in Upper Aquifer pore water at the groundwater/surface water interface.
Objective	Install NSDSs at select Upper Aquifer shoreline locations to collect representative pore water samples at the groundwater/surface water interface.
Media	Pore Water
Unique Field Procedures (see Table 4-6)	▪ Pore Water Sampling with NSDSs ▪ GPS Surveying
Planned Locations	5 Pore Water NSDS Locations: 122+60-0-DS, 124+00-0-DS, 125+50-0-DS, 126+90-0-DS, and 128+30-0-DS
Contingent Locations	Not Applicable
Target Depths/Aquifer	Upper Aquifer
Sample Intervals	Not Applicable
Field Measurements	Not Applicable
Planned Laboratory Analytes	Not Applicable
Contingent Laboratory Analytes	Not Applicable
Deciding Contingent Actions	Not Applicable
Association with Other Data Gaps	▪ Sediment samples associated with Data Gap #2D will be collected while installing NSDSs for the first water sampling event (see Table 4-2D). ▪ Sampling and analyses of NSDSs will be conducted pursuant to Data Gap #2A (see Table 4-2A).
Other / Miscellaneous	Not Applicable

Table 4-1B: Sampling Design for Data Gap #1B – Shoreline Concentrations (Intermediate Aquifer Pore Water Samples)

Sampling Design Component	Details
Data Gap	Current concentrations of arsenic (and other COPCs) in Intermediate Aquifer pore water at the groundwater/surface water interface over a more representative sampling duration.
Objective	Install NSDSs at select Intermediate Aquifer shoreline locations to collect more representative pore water samples at the groundwater/surface water interface.
Media	Pore Water
Unique Field Procedures (see Table 4-6)	Pore Water Sampling with NSDSs
Planned Locations	3 Pore Water NSDS Locations: 120+75-ST1-DS, 125+00-ST1-DS, and 128+50-ST1-DS.
Contingent Locations	Not Applicable
Target Depths/Aquifer	Intermediate Aquifer
Sample Intervals	Not Applicable
Field Measurements	Not Applicable
Planned Laboratory Analytes	Not Applicable
Contingent Laboratory Analytes	Not Applicable
Deciding Contingent Actions	Not Applicable
Association with Other Data Gaps	▪ Sediment samples associated with Data Gap #2D will be collected while installing NSDSs for the first water sampling event (see Table 4-2D). ▪ Sampling and analyses of NSDSs will be conducted pursuant to Data Gap #2B (see Table 4-2B).
Other / Miscellaneous	Not Applicable

Table 4-1C: Sampling Design for Data Gap #1C – Shoreline Concentrations (Surface Water Samples)

Sampling Design Component	Details
Data Gap	Current concentrations of arsenic (and other COPCs) in surface water where Intermediate Aquifer groundwater discharges to surface water.
Objective	Install NSDSs at select Intermediate Aquifer shoreline locations to collect representative surface water samples at the groundwater/surface water interface.
Media	Surface Water
Unique Field Procedures (see Table 4-6)	Surface Water Sampling with NSDSs
Planned Locations	3 Surface Water NSDS Locations: 120+75-SW, 125+00-SW, and 128+50-SW
Contingent Locations	Not Applicable
Target Depths/Aquifer	Intermediate Aquifer outcrop
Sample Intervals	Not Applicable
Field Measurements	Not Applicable
Planned Laboratory Analytes	Not Applicable
Contingent Laboratory Analytes	Not Applicable
Deciding Contingent Actions	Not Applicable
Association with Other Data Gaps	Sampling and analyses of NSDSs will be conducted pursuant to Data Gap #2B (see Table 4-2B).
Other / Miscellaneous	Not Applicable

Table 4-2A: Sampling Design for Data Gap #2A – Arsenic Plume Stability (Upper Aquifer)

Sampling Design Component	Details
Data Gap	Whether or not dissolved arsenic concentrations in the Upper Aquifer remain stable.
Objective	Conduct two groundwater and pore water sampling events (one in the 3rd quarter and one in the 1st quarter) for the Upper Aquifer in order to help evaluate plume stability (e.g., arsenic time-series trend graphs for MWs, changes in plume magnitude and extent, geochemical lines of evidence) in accordance with applicable guidance (e.g., USEPA 2007a, 2007b, 2015; Savannah River National Laboratory 2011).
Media	Groundwater and Pore Water
Unique Field Procedures (see Table 4-6)	▪ Pore Water Sampling with NSDSs ▪ Measuring Water Levels in MWs ▪ Groundwater Sampling from MWs and Angled Shoreline MWs
Planned Locations	▪ 66 MW Locations (3rd Quarter Event): 121+80-1, 122+60-1, 124+00-1, 125+50-1, 126+90-1, 128+30-1, 129+65-1, 131+00-1, 1B4-1, 1C3-1, 1D1-1, 2A1-1, 2B1-1, 2C1-1R, 2D1-1, 3A3-1R, 3A7-1R, 3C1-1, 3C2-1, 3C6-1R, 3D1-1, 3E1-1, 4B3-1, 4B4-1, 4C1-1, 4C2-1, 4D1-1, 4D2-1, 4F1-1, 4G1-1, 4H3-1, 5B1-1R, 5C12-1, 5C13-1, 5C16-1R, 5D2-1R, 5D5-1, 5D7-1R, 5E1-1, 5E2-1, 5E4-1, 5E8-1, 5F1-1, 5G1-1, 5H1-1, 5I2-1, 6D14-1, 6D25-1, 6E1-1, 6E2-1, 6E5-1, 6E6-1, 6F2-1, 6G1-1, 6H1-1, 7E10-1, 7E3-1, 7E8-1, 7F2-1, 7F3-1, 7F4-1, 7G1-1, 7I1-1, 8F1-1R, 8G2-1, and 8H1-1 ▪ 36 MW Locations (1st Quarter Event): 121+80-1, 122+60-1, 124+00-1, 125+50-1, 126+90-1, 128+30-1, 129+65-1, 131+00-1, 2A1-1, 3A3-1R, 3A7-1R, 4B4-1, 4C1-1, 4D1-1, 5B1-1R, 5C12-1, 5C13-1, 5C16-1R, 5D2-1R, 5D5-1, 5D7-1R, 5E4-1, 6D14-1, 6D25-1, 6E1-1, 6E2-1, 6E5-1, 6E6-1, 7E10-1, 7E3-1, 7E8-1, 7F2-1, 7F3-1, 7F4-1, 8F1-1R, and 8G2-1 ▪ 6 Angled Shoreline MW Locations (Both Events): 122+60-0, 124+00-0, 125+50-0, 126+90-0, 128+30-0, and 129+65-0 ▪ 5 Pore Water NSDS Locations (Both Events): 122+60-0-DS, 124+00-0-DS, 125+50-0-DS, 126+90-0-DS, and 128+30-0-DS
Contingent Locations	Not Applicable
Target Depths/Aquifer	Upper Aquifer
Sample Intervals	Not Applicable
Field Measurements	▪ Static water levels will be measured in all existing on-property MWs (i.e., more than the 66 MWs listed above). ▪ Water quality measurements for pH, conductivity, temperature, dissolved oxygen, oxidation reduction potential, and turbidity will be obtained at each sampling location (e.g., at the end of purging for MWs and Angled Shoreline MWs). ▪ A Hach DR900 Handheld Colorimeter or similar will be used to measure field concentrations of total iron, ferrous iron, sulfate, and sulfide at each sampling location (e.g., at the end of purging for MWs and Angled Shoreline MWs).
Planned Laboratory Analytes	▪ Dissolved Metals COPCs (Arsenic, Copper, Lead, Nickel, and Mercury) for all samples ▪ Total Metals COPCs (Arsenic, Copper, Lead, Nickel, and Mercury) for all samples during the 3rd Quarter Event and for select samples during the 1st Quarter Event (see note below) ▪ VOC COPCs (PCE, TCE, VC, and CF) for all samples during the 3rd Quarter Event and for select samples during the 1st Quarter Event (see note below) ▪ Dissolved Arsenic Species (Arsenate, Arsenite, Monomethylarsonic Acid, and Dimethylarsinic Acid) for all samples during the 3rd Quarter Event and for select samples during the 1st Quarter Event (see note below) ▪ Dissolved Conventionals (Iron, Aluminum, Calcium, Magnesium, Manganese, Potassium, Silicon, Sodium, Sulfate, Ortho-Phosphorus, Bromide, Chloride, Fluoride, Nitrate, Nitrite, Alkalinity as Carbonate, Alkalinity as Bicarbonate, Total Dissolved Solids, and Dissolved Organic Carbon) for all samples during the 3rd Quarter Event and for select samples during the 1st Quarter Event (see note below)

Table 4-2A: Sampling Design for Data Gap #2A – Arsenic Plume Stability (Upper Aquifer)

Sampling Design Component	Details
Contingent Laboratory Analytes	Not Applicable
Deciding Contingent Actions	Not Applicable
Association with Other Data Gaps	▪ Pore water NSDSs will be installed pursuant to Data Gap #1A prior to conducting the activities for Data Gap #2A (see Table 4-1A). ▪ Sediment samples associated with Data Gap #2D will be collected while installing NSDSs for the first water sampling event (see Table 4-2D).
Other / Miscellaneous	▪ See Table B-1 in Appendix B of the RI Report for MW construction details (DOF 2013) ▪ Consistent with the field procedures for measuring water levels in MWs (see Appendix B), high-tide and low-tide measurements will be obtained ▪ To the extent practicable, samples will be collected from angled shoreline MWs on a falling tide near low tide ▪ Consistent with the field procedures (see Appendix B), samples identified for dissolved analyses will be field filtered with an in-line 0.45 micron filter if practicable. If it is not practicable to field filter some samples (e.g., NSDSs), then the field team will request the laboratory to filter the sample in an expedited fashion. ▪ All samples collected during the 3rd Quarter Event will be analyzed for all analytes. All samples collected during the 1st Quarter Event will be analyzed for Dissolved Metals COPCs. Only select samples collected during the 1st Quarter Event will be analyzed for Total Metals COPCs, VOC COPCs, Dissolved Arsenic Species, and Dissolved Conventionals. The select samples will be determined based on an evaluation of results from the 3rd Quarter Event.

Table 4-2B: Sampling Design for Data Gap #2B – Arsenic Plume Stability (Intermediate Aquifer)

Sampling Design Component	Details
Data Gap	Whether or not dissolved arsenic concentrations in the Intermediate Aquifer remain stable.
Objective	Conduct two groundwater, pore water, and surface water sampling events (one in the 3rd quarter and one in the 1st quarter) for the Intermediate Aquifer in order to help evaluate plume stability (e.g., arsenic time-series trend graphs for MWs, changes in plume magnitude and extent, geochemical lines of evidence) in accordance with applicable guidance (e.g., USEPA 2007a, 2007b, 2015; Savannah River National Laboratory 2011).
Media	Groundwater, Pore Water, and Surface Water
Unique Field Procedures (see Table 4-6)	▪ Pore Water Sampling with NSDSs ▪ Surface Water Sampling with NSDSs ▪ Pore Water Sampling with PPSs ▪ Measuring Water Levels in MWs ▪ Groundwater Sampling from MWs and Angled Shoreline MWs
Planned Locations	▪ 52 MW Locations (3rd Quarter Event): 120+75-2, 121+80-2, 122+60-2, 124+00-2, 125+50-2, 126+90-2, 128+30-2, 129+65-2, 131+00-2, 1C2-2, 2B2-2, 2C2-2, 2D3-2, 3A2-2R, 3A6-2R, 3C5-2, 3C7-2R, 3E1-2, 4B2-2, 4B3-2, 4B4-2, 4E1-2, 4F1-2, 4G2-2, 4H4-2, 5B1-2R, 5C10-2, 5C14-2, 5C16-2R, 5C21-2, 5D8-2, 5E1-2, 5H2-2, 6B19-2, 6D25-2, 6E12-2, 6E3-2, 6E9-2, 6F1-2, 6G3-2, 7E13-2R, 7E16-2, 7E4-2, 7E6-2, 7E7-2, 7E9-2, 7F1-2, 7G1-2, 7I3-2, 8F2-2R, 8G3-2, and MW-A2-2 ▪ 33 MW Locations (1st Quarter Event): 120+75-2, 121+80-2, 122+60-2, 124+00-2, 125+50-2, 126+90-2, 128+30-2, 129+65-2, 131+00-2, 3A2-2R, 3A6-2R, 4B4-2, 5B1-2R, 5C10-2, 5C14-2, 5C16-2R, 5C21-2, 5D8-2, 6B19-2, 6D25-2, 6E12-2, 6E3-2, 6E9-2, 7E13-2R, 7E16-2, 7E4-2, 7E6-2, 7E7-2, 7E9-2, 7F1-2, 8F2-2R, 8G3-2, and MW-A2-2 ▪ 7 PPS Locations (Both Events): 119+25-ST1, 120+75-ST1, 123+25-ST1, 125+00-ST1, 126+80-ST1, 128+50-ST1, and 130+75-ST1 ▪ 3 Pore Water NSDS Locations (Both Events): 120+75-ST1-DS, 125+00-ST1-DS, and 128+50-ST1-DS ▪ 3 Surface Water NSDS Locations (Both Events): 120+75-SW, 125+00-SW, and 128+50-SW
Contingent Locations	Not Applicable
Target Depths/Aquifer	Intermediate Aquifer
Sample Intervals	Not Applicable
Field Measurements	▪ Static water levels will be measured in all existing on-property MWs (i.e., more than the 52 MWs listed above). ▪ Water quality measurements for pH, conductivity, temperature, dissolved oxygen, oxidation reduction potential, and turbidity will be obtained at each sampling location (e.g., at the end of purging for MWs and PPSs). ▪ A Hach DR900 Handheld Colorimeter or similar will be used to measure field concentrations of total iron, ferrous iron, sulfate, and sulfide at each sampling location (e.g., at the end of purging for MWs and PPSs).

Table 4-2B: Sampling Design for Data Gap #2B – Arsenic Plume Stability (Intermediate Aquifer)

Sampling Design Component	Details
Planned Laboratory Analytes	▪ Dissolved Metals COPCs (Arsenic, Copper, Lead, Nickel, and Mercury) for all samples ▪ Total Metals COPCs (Arsenic, Copper, Lead, Nickel, and Mercury) for all samples during the 3rd Quarter Event and for select samples during the 1st Quarter Event (see note below) ▪ VOC COPCs (PCE, TCE, VC, and CF) for all samples during the 3rd Quarter Event and for select samples during the 1st Quarter Event (see note below) ▪ Dissolved Arsenic Species (Arsenate, Arsenite, Monomethylarsonic Acid, and Dimethylarsinic Acid) for all samples during the 3rd Quarter Event and for select samples during the 1st Quarter Event (see note below) ▪ Dissolved Conventionals (Iron, Aluminum, Calcium, Magnesium, Manganese, Potassium, Silicon, Sodium, Sulfate, Ortho-Phosphorus, Bromide, Chloride, Fluoride, Nitrate, Nitrite, Alkalinity as Carbonate, Alkalinity as Bicarbonate, Total Dissolved Solids, and Dissolved Organic Carbon) for all samples during the 3rd Quarter Event and for select samples during the 1st Quarter Event (see note below)
Contingent Laboratory Analytes	Not Applicable
Deciding Contingent Actions	Not Applicable
Association with Other Data Gaps	▪ Pore water NSDSs will be installed pursuant to Data Gap #1B prior to conducting the activities for Data Gap #2B (see Table 4-1B). ▪ Sediment samples associated with Data Gap #2D will be collected while installing NSDSs for the first water sampling event (see Table 4-2D). ▪ Surface water NSDSs will be installed pursuant to Data Gap #1C prior to conducting the activities for Data Gap #2B (see Table 4-1C).
Other / Miscellaneous	▪ See Table B-1 in Appendix B of the RI Report for MW construction details (DOF 2013) ▪ Consistent with the field procedures for measuring water levels in MWs (see Appendix B), high-tide and low-tide measurements will be obtained ▪ To the extent practicable, samples will be collected from PPSs on a falling tide near low tide ▪ Consistent with the field procedures (see Appendix B), samples identified for dissolved analyses will be field filtered with an in-line 0.45 micron filter if practicable. If it is not practicable to field filter some samples (e.g., NSDSs), then the field team will request the laboratory to filter the sample in an expedited fashion. ▪ All samples collected during the 3rd Quarter Event will be analyzed for all analytes. All samples collected during the 1st Quarter Event will be analyzed for Dissolved Metals COPCs. Only select samples collected during the 1st Quarter Event will be analyzed for Total Metals COPCs, VOC COPCs, Dissolved Arsenic Species, and Dissolved Conventionals. The select samples will be determined based on an evaluation of results from the 3rd Quarter Event.

Table 4-2C: Sampling Design for Data Gap #2C – Arsenic Plume Stability (Deep Aquifer)

Sampling Design Component	Details
Data Gap	Whether or not dissolved arsenic concentrations in the Deep Aquifer remain stable.
Objective	Conduct one groundwater sampling event (in the 3rd quarter) for the Deep Aquifer in order to help evaluate plume stability (e.g., arsenic time-series trend graphs for MWs, changes in plume magnitude and extent, geochemical lines of evidence) in accordance with applicable guidance (e.g., USEPA 2007a, 2007b, 2015; Savannah River National Laboratory 2011).
Media	Groundwater
Unique Field Procedures (see Table 4-6)	▪ Measuring Water Levels in MWs ▪ Groundwater Sampling from MWs and Angled Shoreline MWs
Planned Locations	18 MW Locations (3rd Quarter Event): 122+60-3, 124+00-3, 125+50-3, 126+90-3, 128+30-3, 129+65-3, 131+00-3, 1C1-3, 3A1-3R, 4B1-3, 4B2-3, 5B1-3R, 5D1-3, 5G1-3, 6E7-3, 6E8-3, 6G2-3, and 7E5-3
Contingent Locations	Not Applicable
Target Depths/Aquifer	Deep Aquifer
Sample Intervals	Not Applicable
Field Measurements	▪ Static water levels will be measured in all existing on-property MWs (i.e., more than the 18 MWs listed above). ▪ Water quality measurements for pH, conductivity, temperature, dissolved oxygen, oxidation reduction potential, and turbidity will be obtained at each sampling location (e.g., at the end of purging for MWs). ▪ A Hach DR900 Handheld Colorimeter or similar will be used to measure field concentrations of total iron, ferrous iron, sulfate, and sulfide at each sampling location (e.g., at the end of purging for MWs).
Planned Laboratory Analytes	▪ Dissolved Metals COPCs (Arsenic, Copper, Lead, Nickel, and Mercury) for all samples ▪ Total Metals COPCs (Arsenic, Copper, Lead, Nickel, and Mercury) for all samples ▪ VOC COPCs (PCE, TCE, VC, and CF) for all samples ▪ Dissolved Arsenic Species (Arsenate, Arsenite, Monomethylarsonic Acid, and Dimethylarsinic Acid) for all samples ▪ Dissolved Conventionals (Iron, Aluminum, Calcium, Magnesium, Manganese, Potassium, Silicon, Sodium, Sulfate, Ortho-Phosphorus, Bromide, Chloride, Fluoride, Nitrate, Nitrite, Alkalinity as Carbonate, Alkalinity as Bicarbonate, Total Dissolved Solids, and Dissolved Organic Carbon) for all samples
Contingent Laboratory Analytes	Not Applicable
Deciding Contingent Actions	Not Applicable
Association with Other Data Gaps	Not Applicable
Other / Miscellaneous	▪ See Table B-1 in Appendix B of the RI Report for MW construction details (DOF 2013) ▪ Consistent with the field procedures for measuring water levels in MWs (see Table 4-6), high-tide and low-tide measurements will be obtained.

Table 4-2D: Sampling Design for Data Gap #2D – Arsenic Plume Stability (Soil/Sediment Geochemistry)

Sampling Design Component	Details
Data Gap	Whether or not soil and sediment geochemical data support the existing CSM (e.g., elevated ferric chloride along the shoreline).
Objective	Collect soil and sediment geochemical data in order to help evaluate plume stability (e.g., site-specific ferric iron concentrations in soil/sediment) in accordance with applicable guidance (e.g., USEPA 2007a, 2007b, 2015; Savannah River National Laboratory 2011).
Media	Soil and Sediment
Unique Field Procedures (see Table 4-6)	▪ Soil Sampling from Soil Borings ▪ XRF Field Screening ▪ Sediment Sampling ▪ Anoxic Soil/Sediment Sample Preservation ▪ GPS Surveying
Planned Locations	▪ 8 Soil Boring Locations Pursuant to Data Gap #4A: PTC-101, PTC-111, PTC-113, PTC-117, PTC-118, PTC-121, PTC-127, and PTC-128 ▪ 4 Soil Boring Locations Pursuant to Data Gap #4B: PTC-204, PTC-205, PTC-207, and PTC-208 ▪ 5 Intertidal (Upper Aquifer) Sediment Sample Locations Where NSDSs Will be Installed Pursuant to Data Gap #1A: 122+60-0-SED, 124+00-0-SED, 125+50-0-SED, 126+90-0-SED, and 128+30-0-SED ▪ 3 Subtidal (Intermediate Aquifer) Sediment Sample Locations Where NSDSs Will be Installed Pursuant to Data Gap #1B: 120+75-ST1-SED, 125+00-ST1-SED, and 128+50-ST1-SED ▪ 2 Soil Boring Locations Specific to Data Gap #2D: PTC-001 and PTC-002
Contingent Locations	Not Applicable
Target Depths/Aquifer	▪ Each soil boring associated with this data gap will be advanced approximately 5 feet into the Second Aquitard. ▪ One sediment sample will be collected (prior to NSDS installation) at the same depth in which the NSDS will be installed (i.e., at a depth of approximately 0 to 10 centimeters below the shoreline).
Sample Intervals	▪ For each soil boring, at least 1 soil sample will be collected for XRF field screening and potential laboratory analyses every 2.5 feet (assuming a 5-foot-long core). ▪ For each soil boring, at least 1 Upper Aquifer soil sample, at least 1 First Aquitard soil sample (if encountered), at least 1 Intermediate Aquifer soil sample, and at least 1 Second Aquitard soil sample (if encountered) will be submitted for the laboratory analyses associated with this data gap.
Field Measurements	▪ XRF field screening for arsenic will be performed for soil borings as described in the XRF Field Screening procedures (see Appendix B). ▪ Field screening results and lithologic observations will be used to select soil samples for laboratory analyses.
Planned Laboratory Analytes	▪ Total Arsenic for all samples ▪ Conventionals (pH, Iron, Aluminum, Manganese, Sulfate, Ortho-Phosphorus, Total Organic Carbon, Total Inorganic Carbon, and Sulfide) for all samples ▪ Sequential Extraction and Follow-on Analyses (Arsenic, Iron, Aluminum, Manganese, and Silicon) for select samples (see note below) ▪ Arsenic Species (Arsenate, Arsenite, Monomethylarsonic Acid, and Dimethylarsinic Acid) for select samples (see note below) ▪ Batch Adsorption Tests and Follow-on Analyses (Arsenic, pH) for select samples (see note below)

Table 4-2D: Sampling Design for Data Gap #2D – Arsenic Plume Stability (Soil/Sediment Geochemistry)

Sampling Design Component	**Details**
Contingent Laboratory Analytes	Not Applicable
Deciding Contingent Actions	Not Applicable
Association with Other Data Gaps	▪ A sediment sample will be collected at each location where a pore water NSDS is installed for the first water sampling event pursuant to Data Gaps #1A and #1B (see Tables 4-1A and 4-1B). ▪ All but two soil borings associated with this gata gap will be advanced pursuant to Data Gaps #4A and #4B. In addition to the laboratory analyses associated with this data gap, the soil samples will be submitted for the extra laboratory analyses (e.g., TCLP metals) as necessary pursuant to Data Gaps #4A and #4B (see Tables 4-4A and 4-4B).
Other / Miscellaneous	▪ A field plan will be developed prior to mobilization to ensure sample volume, sample preparation, and sample preservation requirements can be met for the field measurements and the laboratory analyses. ▪ For (1) Sequential Extraction and Follow-on Analyses and (2) Arsenic Species, laboratory analyses will be performed for all samples except those samples collected from PTC-117, PTC-118, PTC-127, and PTC-128. ▪ Batch Adsorption Tests and Follow-on Analyses will only be performed for samples collected from PTC-001, PTC-002, 122+60-0-SED, 125+50-0-SED, 120+75-ST1-SED, and 125+00-ST1-SED. ▪ All soil and sediment samples submitted for the laboratory analyses will be archived for potential additional analyses in the future (e.g., mineralogy by x-ray diffraction).

Table 4-3: Sampling Design for Data Gap #3 – Wall Integrity

Sampling Design Component	Details
Data Gap	Current integrity of the sheet pile wall (i.e., corrosion on the sheet pile wall, condition of the wall joints, and condition of the gaps that were repaired in 2004).
Objective	Have a corrosion engineer inspect and measure the top portion of the sheet pile wall to evaluate the current integrity and anticipated life expectancy of the sheet pile wall.
Media	Soil
Unique Field Procedures (see Table 4-6)	▪ Excavating Test Pits to Evaluate Wall Integrity ▪ GPS Surveying
Planned Locations	1 Test Pit Location: Test Pit 1
Contingent Locations	2 Test Pit Locations: Test Pit 2 and Test Pit 3
Target Depths/Aquifer	To be determined based on conditions encountered in the field and the amount of soil that can be excavated without posing a safety hazard.
Sample Intervals	Not Applicable
Field Measurements	Not Applicable
Planned Laboratory Analytes	Not Applicable
Contingent Laboratory Analytes	Not Applicable
Deciding Contingent Actions	Decisions about contingent test pits will be made in the field after the planned test pit is excavated. Decisions will be based on field conditions, field measurements, results from data gap investigation activities completed prior to initiating this data gap, and whether or not the data gap objective was achieved with field information obtained from the planned test pit.
Association with Other Data Gaps	Not Applicable
Other / Miscellaneous	▪ The exact location of the sheet pile wall will be identified with metal detector, ground penetrating radar, a careful exploratory excavation, or other suitable method prior to conducting activities associated with this data gap. The location of the sheet pile wall and the extent of the test pit(s) will be marked and surveyed with a GPS in accordance with the procedures presented in Table 4-6. ▪ Each test pit will be backfilled with soil excavated from the test pit. The backfill material will be placed in appropriate lifts and compacted with the excavator/backhoe bucket or another appropriate method.

Table 4-4A: Sampling Design for Data Gap #4A – Feasibility of Focused Soil Excavation Alternative (Arsenic)

Sampling Design Component	Details
Data Gap	The locations and depths of the highest arsenic concentrations in the vicinity of the former Penite Pits. The amount of soil in the vicinity of the former Penite Pits that exceeds the TCLP criteria for hazardous waste. The site-specific effectiveness of ex-situ stabilization to treat potential excavated soil.
Objective	Collect arsenic soil samples in the vicinity of the former Penite Pits to (1) identify the locations and depths with the highest arsenic concentrations, (2) evaluate potential hazardous waste quantities if soil was excavated and designated for disposal, and (3) begin to evaluate the site-specific effectiveness of ex-situ soil stabilization.
Media	Soil
Unique Field Procedures (see Table 4-6)	▪ Soil Sampling from Soil Borings ▪ XRF Field Screening ▪ GPS Surveying
Planned Locations	28 Soil Boring Locations: PTC-101 through PTC-128.
Contingent Locations	Not Applicable
Target Depths/Aquifer	Each soil boring will be advanced approximately 5 feet into the Second Aquitard.
Sample Intervals	▪ For each soil boring, at least 1 soil sample will be collected for XRF field screening and potential laboratory analyses every 2.5 feet (assuming a 5-foot-long core). ▪ For each boring, at least 1 Upper Aquifer soil sample and at least 1 First Aquitard soil sample (if encountered) will be submitted for the laboratory analyses associated with this data gap. ▪ Intermediate Aquifer and Second Aquitard soil samples may be submitted for the laboratory analyses associated with this data gap.
Field Measurements	▪ XRF field screening for arsenic will be performed as described in the XRF Field Screening procedures (see Appendix B). ▪ Field screening results and lithologic observations will be used to select soil samples for the laboratory analyses.
Planned Laboratory Analytes	▪ Total Arsenic for all samples ▪ TCLP Metals (Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver) for all samples ▪ pH for all samples
Contingent Laboratory Analytes	Not Applicable
Deciding Contingent Actions	Not Applicable
Association with Other Data Gaps	Soil samples from select borings will also be submitted for additional laboratory analyses pursuant to Data Gap #2D (see Table 4-2D).

Table 4-4A: Sampling Design for Data Gap #4A – Feasibility of Focused Soil Excavation Alternative (Arsenic)

Sampling Design Component	Details
Other / Miscellaneous	▪ A field plan will be developed prior to mobilization to ensure sample volume, sample preparation, and sample preservation requirements can be met for the field measurements and laboratory analyses. ▪ Select soil samples will be submitted to up to three ex-situ soil stabilization vendors (e.g., Premier Magnesia, Sevenson Environmental, and Free Flow Technologies) for bench-scale treatability tests of ex-situ soil stabilization. Co-located soil borings may need to be advanced once the sample interval is identified to obtain sufficient sample volume for the bench-scale tests. Depending on the bench-scale results, samples may be collected to analyze arsenic soil concentrations following a grain-size analysis to start evaluating soil washing as another potential ex-situ treatment technology to minimize potential hazardous waste volumes. ▪ All soil samples submitted for laboratory analyses will be archived for potential additional analyses in the future.

Table 4-4B: Sampling Design for Data Gap #4B – Feasibility of Focused Soil Excavation Alternative (pH)

Sampling Design Component	Details
Data Gap	Whether or not a distinct layer of elevated pH soil remains in the former Taylor Lake Area surface impoundments. Whether or not a source of elevated pH in the former Caustic Building and Tank Farm Area can be identified. An approximate extent of elevated pH in the former Taylor Lake Area surface impoundments and the former Caustic Building and Tank Farm Area.
Objective	Collect pH soil data to (1) determine if a distinct layer of elevated pH soil remains in the former Taylor Lake Area surface impoundments, (2) determine if a source of elevated pH in the former Caustic Building and Tank Farm Area can be identified, and (3) confirm that any excavated soil in these areas would be non-hazardous.
Media	Soil
Unique Field Procedures (see Table 4-6)	▪ Soil Sampling from Soil Borings ▪ XRF Field Screening ▪ GPS Surveying
Planned Locations	8 Soil Boring Locations: PTC-201 through PTC-208
Contingent Locations	9 Soil Boring Locations: PTC-209 through PTC-217
Target Depths/Aquifer	Each soil boring will be advanced approximately 5 feet into the First Aquitard, with the exception that the 4 select soil borings associated with Data Gap #2D (see Table 4-2D) will be advanced approximately 5 feet into the Second Aquitard.
Sample Intervals	▪ For each soil boring, at least 1 soil sample will be collected for pH field screening, XRF field screening, and potential laboratory analyses every 2.5 feet (assuming a 5-foot-long core). ▪ For each boring, at least one Upper Aquifer soil sample will be submitted for the laboratory analyses associated with this data gap. ▪ First Aquitard soil samples may be submitted for the laboratory analyses associated with this data gap.
Field Measurements	▪ A soil pH meter (e.g., HI 99121 Direct Soil pH Meter) will be used to measure the pH of each soil sample. ▪ XRF field screening for arsenic will be performed as described in the XRF Field Screening procedures (see Appendix B). ▪ Field screening results and lithologic observations will be used to select soil samples for laboratory analyses.
Planned Laboratory Analytes	▪ Total Arsenic for all samples ▪ TCLP Metals (Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver) for all samples ▪ pH for all samples
Contingent Laboratory Analytes	Not Applicable
Deciding Contingent Actions	Decisions about contingent locations will be made in the field after the planned locations are completed. Decisions will be based on field conditions, field measurements, results from data gap investigation activities completed prior to initiating this data gap, and whether or not the data gap objective was achieved with field data obtained from the planned locations.
Association with Other Data Gaps	Soil samples from select borings will also be submitted for additional laboratory analyses pursuant to Data Gap #2D (see Table 4-2D).
Other / Miscellaneous	▪ A field plan will be developed prior to mobilization to ensure sample volume, sample preparation, and sample preservation requirements can be met for the field measurements and laboratory analyses. ▪ All soil and sediment samples submitted for laboratory analyses will be archived for potential additional analyses in the future.

Table 4-5: Sampling and Analysis Summary

Data Gap	Objective Summary	#	Activity Summary	Field Measurement Summary	Lab Analyses?	Key Notes for the Field Team
1. Shoreline Concentrations	Install NSDSs to collect representative Upper Aquifer pore water, Intermediate Aquifer pore water, and surface water samples at the groundwater/surface water interface.	1A	Upper Aquifer: Install 5 NSDSs (at same waterway station as existing Angled Shoreline MWs)	N/A	No	▪ Sediment samples associated with Data Gap #2D will be collected while installing the Upper Aquifer and Intermediate Aquifer NSDSs for the 3rd quarter 2017 event ▪ See Table 4-6 for NSDS installation procedures ▪ See Figure 4-1D for the spatial relationship of existing and proposed shoreline sample locations ▪ Sampling and analyses of Upper Aquifer, Intermediate Aquifer, and surface water NSDSs will be pursuant to Data Gaps #2A and #2B
		1B	Intermediate Aquifer: Install 3 NSDSs (co-located with PPSs)			
		1C	Surface Water: Install 3 NSDSs (adjacent to Intermediate Aquifer PPSs and NSDSs)			
2. Arsenic Plume Stability	Conduct two groundwater, pore water, and surface water sampling events in order to help evaluate plume stability in accordance with applicable guidance.	2A	Upper Aquifer: Collect 77 primary water samples in a 3rd quarter 2017 event, and collect 47 water samples in a 1st quarter 2018 event	▪ Static water levels ▪ pH, conductivity, temperature, dissolved oxygen, oxidation reduction potential, and turbidity ▪ Total iron, ferrous iron, sulfate, and sulfide	Yes, water analyses per Tables 4-2A, 4-2B, 4-2C, and 4-7	▪ Samples collected during the 3rd quarter 2017 event will be analyzed for all analytes while samples collected during the 1st quarter 2018 event will be analyzed for select analytes ▪ Some analyses (e.g., arsenic) will be performed by ARI or Brooks depending on the sample location (see Footnote 1 on Table 4-7) ▪ Other analyses (e.g., VOCs) will be performed by ARI regardless of sample location (see Table 4-7) ▪ All water analyses will be on the dissolved fraction (i.e., filtered), with the following exceptions: o Metal COPCs will be analyzed for both total and dissolved o VOCs will be analyzed for total
		2B	Intermediate Aquifer: Collect 65 primary water samples in a 3rd quarter 2017 event, and collect 46 water samples in a 1st quarter 2018 event			
		2C	Deep Aquifer: Collect 18 primary water samples in a 3rd quarter 2017 event			
	Collect soil and sediment geochemical data in order to help evaluate plume stability in accordance with applicable guidance.	2D	▪ Add additional analyses to soil samples collected from 8 select soil borings advanced per Data Gap #4A ▪ Add additional analyses to soil samples collected from 4 select soil borings advanced per Data Gap #4B ▪ Collect 8 sediment samples when the NSDSs are installed per Data Gaps #1A and #1B ▪ Collect soil samples from 2 soil borings advanced per this data gap	XRF (arsenic) to help select sample intervals for lab analyses	Yes, soil and sediment analyses per Tables 4-2D and 4-8	▪ Each soil boring associated with this data gap will be advanced approximately 5 feet into the Second Aquitard ▪ See Table 4-2D for sample interval expectations ▪ Sample containers for some of the analyses will require special anoxic preservation methods (see Tables 4-6 and 4-8) ▪ A field plan will be developed prior to mobilization to ensure sample volume, sample preparation, and sample preservation requirements can be met for the field measurements and lab analyses ▪ Some analyses (e.g., batch adsorption) will only be performed in select samples ▪ Some analyses will be performed by ARI and some analyses will be performed by Brooks

Table 4-5: Sampling and Analysis Summary

Data Gap	Objective Summary	#	Activity Summary	Field Measurement Summary	Lab Analyses?	Key Notes for the Field Team
3. Wall Integrity	Have a corrosion engineer inspect and measure the top portion of the sheet pile wall to evaluate the current integrity and anticipated life expectancy of the sheet pile wall.	**3**	▪ Excavate 1 test pit for a corrosion engineer to visually inspect the wall and measure wall thickness and soil electrical resistance as necessary ▪ Excavate additional contingent test pits for additional visual inspections and measurements as necessary	No	No	▪ Implement appropriate health and safety measures to address potential excavation hazards ▪ The corrosion engineer will evaluate corrosion on the wall, the condition of the wall joints, and the condition of the patched gap in the wall
4. Feasibility of Focused Soil Excavation Alternative	Collect arsenic soil samples in the vicinity of the former Penite Pits to (1) identify the locations and depths with the highest arsenic concentrations, (2) evaluate potential hazardous waste quantities if soil was excavated and designated for disposal, and (3) begin to evaluate the site-specific effectiveness of ex-situ soil stabilization.	**4A**	Collect soil samples from 28 soil borings	XRF (arsenic) to help select sample intervals for lab analyses	Yes, soil analyses per Tables 4-4A and 4-8	▪ Each soil boring will be advanced approximately 5 feet into the Second Aquitard ▪ See Table 4-4A for sample interval expectations ▪ Soil samples from select borings will also be submitted for additional laboratory analyses pursuant to Data Gap #2D, and the sample containers for some of the Data Gap #2D analyses will require special anoxic preservation methods ▪ All analyses associated with just Data Gap #4A will be performed by ARI ▪ Select soil samples will also be submitted to ex-situ soil stabilization vendors for bench-scale treatability tests of ex-situ soil stabilization (see Table 4-4A)
	Collect pH soil data to (1) determine if a distinct layer of elevated pH soil remains in the former Taylor Lake Area surface impoundments, (2) determine if a source of elevated pH in the former Caustic Building and Tank Farm Area can be identified, and (3) confirm that any excavated soil in these areas would be non-hazardous.	**4B**	▪ Collect soil samples from 8 soil borings ▪ Collect soil samples from 9 contingent soil borings as necessary	▪ pH meter to help select sample intervals for lab analyses and the potential need for contingent borings ▪ XRF (arsenic) to help select sample intervals for lab analyses and the potential need for contingent borings	Yes, soil analyses per Tables 4-4B and 4-8	▪ Each soil boring will be advanced approximately 5 feet into the First Aquitard, with the exception that the 4 select soil borings associated with Data Gap #2D will be advanced approximately 5 feet into the Second Aquitard ▪ See Table 4-4B for sample interval expectations ▪ Soil samples from select borings will also be submitted for additional laboratory analyses pursuant to Data Gap #2D, and the sample containers for some of the Data Gap #2D analyses will require special anoxic preservation methods ▪ All analyses associated with just Data Gap #4B will be performed by ARI

Table 4-6: Field Investigation Procedures

Procedure	Procedure Included in Previously Approved Site SAP (DOF 2012)?	Procedure Description
Pore Water Sampling with NSDSs	No	Consistent with established procedures (USGS 2002, 2005; Peijnenburg *et al* 2013; GSI 2016), pore water sampling with NSDSs will be conducted as described herein. Each NSDS, which consists of (1) a clean polyethylene sample jar with a threaded rim, (2) deoxygenated, deionized water, (3) a 120 to 250 micron nylon screen mesh, and (4) a threaded jar ring, will be prepared prior to deployment. The deionized water will be deoxygenated with nitrogen, argon, or helium gas. Following deoxygenation, the nylon screen mesh will be placed over the mouth of the jar and secured in place by the jar ring. To deploy each NSDS, a small trench will be carefully dug at the target location with a non-metal hand trowel or equivalent in order to minimize disturbed sediment. The NSDS will be placed in the small trench as close as practical to the surface water interface, targeting approximately 0 to 10 centimeters of embedment below the mudline. Since multiple NSDSs will be necessary at each sample location to provide the required volume of water for field measurements (i.e., pH, conductivity, temperature, dissolved oxygen, oxidation reduction potential, and turbidity, total iron, ferrous iron, sulfate, and sulfide) and laboratory analyses (see Table 4-7), multiple NSDSs will be placed adjacent to each other (at the same elevation), with the mesh sides of the NSDSs facing the Site. The NSDSs will be covered with native sediment and marked with flags or equivalent to assist in retrieval of NSDSs. The NSDSs will be allowed to equilibrate for a minimum of two weeks prior to retrieval. Following retrieval, water samples will be collected from the NSDSs using either (1) a disposable syringe and hypodermic needle, or (2) a peristaltic pump equipped with a 0.45-micron filter. Intermediate Aquifer NSDSs will be installed and retrieved by divers. Samples for total and dissolved analyses should be collected from the same NSDS jar to the extent practicable.
GPS Surveying	No	The locations of all new sample locations, with the exception of new sample locations collected by divers, will be collected with a Trimble GeoXH or similar GPS unit. The GPS accuracy will be within +/- one meter.
Surface Water Sampling with NSDSs	No	NSDSs for surface water sampling will prepared prior to deployment in the same manner described above for pore water NSDSs. NSDSs for surface water sampling will be deployed by divers by securing the necessary number of NSDSs in a plastic-coated, wire mesh mussel cage. NSDSs will be secured to the mussel cage with heavy duty mesh bags and plastic cable ties or equivalent. As with pore water sampling with NSDSs, multiple NSDSs will be necessary at each sample location to provide the required volume of water for field measurements and laboratory analyses. The mesh sides of the NSDSs will be placed facing the Site. The mussel cage will be secured to the shoreline with a screw anchor or equivalent, and the mussel cage will be marked with flags or equivalent to assist in retrieval of NSDSs. The equilibrium time and sample collection procedures will be the same as described above for pore water NSDSs.
Pore Water Sampling with PPSs	Yes	See Appendix B of this Work Plan
Measuring Water Levels in MWs	Yes	See Appendix B of this Work Plan
Groundwater Sampling from MWs and Angled Shoreline MWs (Seep Samplers)	Yes	See Appendix B of this Work Plan
Soil Sampling from Soil Borings	No	Soil borings will be advanced by a licensed driller using a direct-push, hollow stem auger, sonic, or similar rig. Soil samples will be collected from soil borings using a split-spoon sampler, dual tube sampler, or similar. See the applicable sampling design tables (i.e., Tables 4-2D, 4-4A, and 4-4B) for details regarding the target drilling depths, sample intervals, field measurements, and other soil sampling-related details. The soil lithology will be described in the field in general accordance with American Society for Testing and Materials D2488. The presence of stains, coatings, or other indications of potential contamination will be noted. Co-located soil borings may need to be advanced for select locations to obtain sufficient sample volume. Water will be decanted from the sample to the extent practicable. Particles larger than approximately ¼-inch will be removed from the containerized sample (this will be performed by the lab if the sample has an anoxic preservation requirement; otherwise it will be performed in the field).
XRF Field Screening	No	See Appendix C of this Work Plan
Sediment Sampling	Yes	See Appendix B of this Work Plan

Table 4-6: Field Investigation Procedures

Procedure	Procedure Included in Previously Approved Site SAP (DOF 2012)?	Procedure Description
Anoxic Soil/Sediment Sample Preservation	No	Consistent with the concepts in *Mineral Preservation of Solid Samples Collected from Anoxic Subsurface Environments* (USEPA 2006), field preservation for sample containers requiring anoxic preservation will be conducted to the extent practicable in order to minimize oxidation of metals in soil and sediment samples. The field procedure includes the following steps: (1) capping both ends of the soil sample interval, (2) placing the sample interval in a Mylar bag (e.g., Mitsubishi Chemical), (3) adding oxygen-absorbing packets to the Mylar bag, (4) purging the Mylar bag with nitrogen, helium, or argon gas, (5) manually expressing as much gas as possible from the Mylar bag, (6) sealing the Mylar bag with a portable heat sealer, (7) placing the sealed Mylar bag in a re-sealable plastic bag, (8) manually expressing as much air as possible from the plastic bag, and (9) storing the sample in a cooler with dry ice.
Excavating Test Pits to Evaluate Wall Integrity	No	A trained operator will excavate each test pit with an excavator or backhoe. An amendment to the existing Health and Safety Plan and/or a Job Hazard Analysis will be prepared as necessary to address potential hazards associated with excavating and potentially entering test pits (e.g., excavation caving). If the excavation needs to extend deeper than five feet, slope stability measures will be taken (e.g., benching, shoring). A corrosion engineer will visually inspect the sheet pile wall to evaluate corrosion on the wall, the condition of the wall joints, and the condition of the patched gap in the wall. In addition, the corrosion engineer will measure wall thickness (e.g., ultrasonic gauge) and soil electrical resistance as necessary.
Equipment Decontamination	Yes	See Appendix B of this Work Plan
Investigation-Derived Waste	Yes	See Appendix B of this Work Plan
Sample Identification Schema	No	See Appendix D of this Work Plan
Sample Handling and Shipment and Chain-of-Custody Documentation	Yes	See Appendix B of this Work Plan
Field Recordkeeping	Yes	See Appendix B of this Work Plan
Health and Safety Plan	Yes	See Appendix B of this Work Plan

Table 4-7: Analytical Methods, Containers, Preservation, and Holding Times for Water Samples

Category	Analyte	Lab	Analytical Method	Sample Container Expectations	Preservation and Storage Requirements	Extraction Holding Time (days)	Analysis Holding Time (days)
Dissolved and Total Metal COPCs	Arsenic	Brooks(1)	USEPA 1638 Mod (ICP-QQQ-MS)(1)	One 125 mL HDPE	Cool to ≤ 4°C +/- 2°C, HNO_3 in lab to pH < 2 within 14 days of collection	N/A	180
	Copper		USEPA 1640 Mod (column chelation)(1)				
	Lead						
	Nickel						
	Mercury		USEPA 1631E(1)	One 125 mL FLPE	Cool to ≤ 4°C +/- 2°C, BrCl in lab within 28 days of collection	N/A	90
	Arsenic	ARI(1)	USEPA SW846-6020A(1)	One 500 mL HDPE	Pre-preserved with HNO3, cool to ≤ 4°C +/- 2°C	N/A	180
	Copper						
	Lead						
	Nickel						
	Mercury		USEPA SW846-7470A(1)				
VOC COPCs	PCE	ARI	USEPA SW846-8260C	Two 40 mL glass VOA vials with Teflon septa lids	Pre-preserved with HCl, cool to ≤ 4°C +/- 2°C	N/A	14
	TCE						
	VC						
	Chloroform						
Dissolved Arsenic Species	Arsenate	Brooks	Brooks SOP #BAL-4100 (IC-ICP-MS)	Two 6 mL Vacutainers	Pre-preserved with EDTA, collect samples in carbon dioxide atmosphere (created in an open-top cooler containing dry ice), minimize contact with air, minimize headspace, store in dark, cool to ≤ 4°C +/- 2°C	N/A	28
	Arsenite						
	Monomethylarsonic Acid						
	Dimethylarsinic Acid						

Table 4-7: Analytical Methods, Containers, Preservation, and Holding Times for Water Samples

Category	Analyte	Lab	Analytical Method	Sample Container Expectations	Preservation and Storage Requirements	Extraction Holding Time (days)	Analysis Holding Time (days)
Dissolved Conventionals(2)	Iron	Brooks(1)	USEPA 1638 Mod(1)	In same container as metal COPCs analyses	Same as metal COPC analyses	N/A	180
	Aluminum						
	Calcium						
	Magnesium						
	Manganese						
	Potassium						
	Silicon						
	Sodium						
	Iron	ARI(1)	USEPA SW846-6010C(1)	In same container as metal COPCs analyses	Same as metal COPC analyses	N/A	180
	Aluminum						
	Calcium						
	Magnesium						
	Manganese						
	Potassium						
	Silicon						
	Sodium						
	Sulfate	ARI	USEPA 300.0	One 500 mL HDPE	Cool to ≤ 4°C +/- 2°C	N/A	28
	Ortho-Phosphorus					N/A	28
	Bromide					N/A	28
	Chloride					N/A	28
	Fluoride					N/A	28
	Nitrate					N/A	2
	Nitrite					N/A	2
	Alkalinity as Carbonate	ARI	USEPA 2320	One 500mL HDPE	Minimize headspace, cool to ≤ 4°C +/- 2°C	N/A	14
	Alkalinity as Bicarbonate						
	Total Dissolved Solids	ARI	SM 2540 C/USEPA 160.1	One 500mL HDPE	Cool to ≤ 4°C +/- 2°C	N/A	7
	Dissolved Organic Carbon	ARI	SM 5310 B	One 250 mL amber glass bottle with teflon-lined cap	If field-filtered: Pre-preserved with H2SO4, cool to ≤ 4°C +/- 2°C	N/A	28
					If will be lab-filtered: Cool to ≤ 4°C +/- 2°C	N/A	2

Notes:

BrCl: Bromine monochloride, EDTA: Ethylenediamine tetraacetic acid, FLPE: Fluorinated polyethylene, H2SO4: Sulfuric acid, HCl: Hydrochloric acid, HDPE: High density polyethylene, HNO_3: Nitric acid, IC: Ion chromatograph, ICP: Inductively coupled plasma, MS: Mass spectrometry, N/A: Not applicable, QQQ: Triple quadrupole, SM: Standard Method, SOP: Standard Operating Procedure, VOA: Volatile organic analysis

(1)Samples collected for metals/cation analyses will be analyzed by different labs, depending on the potential for and significance of saline interferences at a given sampling location. The following sampling locations will be analyzed by Brooks: all 3 Surface Water NSDS locations, all 8 Pore Water NSDS locations, all 7 PPS locations, all 6 Angled Shoreline MW locations, 12 Upper Aquifer MWs (121+80-1, 122+60-1, 124+00-1, 125+50-1, 126+90-1, 128+30-1, 129+65-1, 131+00-1, 3A3-1R, 3A7-1R, 4B4-1, and 5B1-1R), 14 Intermediate Aquifer MWs (120+75-2, 121+80-2, 122+60-2, 124+00-2, 125+50-2, 126+90-2, 128+30-2, 129+65-2, 131+00-2, 3A2-2R, 3A6-2R, 4B4-2, 5B1-2R, and MW-A2-2) and 10 Deep Aquifer MWs (122+60-3, 124+00-3, 125+50-3, 126+90-3, 128+30-3, 129+65-3, 131+00-3, 3A1-3R, 4B2-3, and 5B1-3R). The remaining samples will be analyzed by ARI.

(2)Field measurements of pH, conductivity, temperature, dissolved oxygen, oxidation reduction potential, turbidity, total iron, ferrous iron, sulfate, and sulfide will be obtained at each sampling location (see Tables 4-2A through 4-2C).

Table 4-8: Analytical Methods, Containers, Preservation, and Holding Times for Soil and Sediment Samples

Category	Analyte	Lab	Analytical Method	Sample Container Expectations	Preservation and Storage Requirements	Extraction Holding Time (days)	Analysis Holding Time (days)
Total Arsenic	Arsenic	ARI	USEPA SW846-3050B followed by USEPA SW846-6010C	One 16 oz. amber glass	Cool to ≤ 4°C +/- 2°C	N/A	180
TCLP Metals	Arsenic	ARI	USEPA SW846-1311 followed by USEPA SW846-6010C/7470A	In same container as total arsenic analysis	Same as total arsenic analysis	N/A	180
	Barium						
	Cadmium						
	Chromium						
	Lead						
	Mercury						
	Selenium						
	Silver						
Conventionals	pH	ARI	USEPA SW846-9045	In same container as total arsenic analysis	Same as total arsenic analysis	N/A	7
	Iron		USEPA SW846-3050B followed by USEPA SW846-6010C			N/A	180
	Aluminum						
	Manganese						
	Sulfate		Water extraction followed by USEPA 300.0			N/A	14
	Ortho-Phosphorus						
	Total Organic Carbon		USEPA SW846-9060A Mod			N/A	28
	Total Inorganic Carbon					N/A	28
	Sulfide		SM 4500-S2(PSEP)	One 2 oz. glass jar	ZnAc with instructions provided by lab on how to preserve in field	N/A	7

Table 4-8: Analytical Methods, Containers, Preservation, and Holding Times for Soil and Sediment Samples

Category	Analyte	Lab	Analytical Method	Sample Container Expectations	Preservation and Storage Requirements	Extraction Holding Time (days)	Analysis Holding Time (days)
Sequential Extraction and Follow-on Analyses(2)	Arsenic	Brooks	Sequential Extraction(2) followed by USEPA SW846-6020 Mod (ICP-QQQ-MS)	Mylar bag collected with anoxic field procedures described in Table 4-6 and minimum sample volume of approximately 8 oz.	Anoxic preservation(1)	N/A	365
	Iron						
	Aluminum						
	Manganese						
	Silicon						
Arsenic Species	Arsenate	Brooks	Brooks SOPs #BAL-4100, BAL-4111, and BAL-4112 (phosphoric acid and phosphate extractions followed by IC-ICP-MS)			N/A	365
	Arsenite						
	Monomethylarsonic Acid						
	Dimethylarsinic Acid						
Batch Adsorption Tests and Follow-on Analyses(3,4)	Arsenic	Brooks	USEPA SW846-6020 Mod (ICP-QQQ-MS)(3,4)			N/A	365
	pH		USEPA 150.1(3,4)			N/A	1

Notes:

N/A: Not applicable, IC: Ion chromatograph, ICP: Inductively coupled plasma, MS: Mass spectrometry, QQQ: Triple quadrupole, SM: Standard Method, SOP: Standard Operating Procedure, ZnAc: Zinc acetate

(1) See Table 4-6 for field procedures for anoxic preservation with these analyses that are sensitive to oxidation. Lab anoxic preservation procedures will include (1) storing samples at a minimum of -15 degrees Celsius, (2) deoxygenating deionized water being used with nitrogen, helium, or argon, and (3) processing of solids in an anaerobic glove box.

(2) Sequential extraction will be in accordance with BAL standard procedures using a modified version of the *Wenzel et al 2001* methodology. The five sequential extraction steps will be (1) NH4H2PO4, (2) NH2OH*HCl, (3) NH4+-oxalate, (4) HNO3/H2O2, and (5) HCl/HF/HNO_3. Each analyte in this category will be analyzed after each extraction step.

(3) The batch adsorption tests will be conducted using the same methodology presented in Attachment 2A of the April 2016 *Draft Sampling and Analysis Plan* for the Parcel 15 (Portac) Site (GSI Water Solutions, Inc. 2016), which was developed based on *Batch Type Procedures for Estimating Soil Adsorption of Chemicals* (USEPA 1992), with the following minor exceptions: (1) the follow-on analyses are described in this table, (2) an equilibrium time of 168 hours will be used instead of the 120 hour equilibrium time, (3) only 40 mL of unimpacted groundwater will be necessary for each test, and (4) Steps 8.5.9 and 8.5.10 of the soil:solution procedure will be switched. Each analyte in this category will be analyzed for each of the four soil:solution ratios.

(4) The unimpacted groundwater for use in the batch adsorption tests will be collected from MWs 7I1-1 and/or 7I3-2. Approximately 4 liters of unimpacted groundwater will be collected using standard low-flow sampling procedures and will be field filtered. In order to minimize oxidation of this unimpacted groundwater, the sample containers will be collected using the preservation and storage requirements for arsenic species samples in Table 4-7.

Table 4-9: Investigation Roles and Responsibilities

Role	Name	Contact Information	Key Investigation Responsibilities
Key Oversight Personnel			
Port Program Manager	Rob Healy	rhealy@portoftacoma.com 253-428-8643 (O)	▪ Provide overall technical direction ▪ Participate in FS data gap investigation process
Ecology Site Manager	Mohsen Kourehdar	mkou461@ecy.wa.gov 360-407-6256 (O)	▪ Review and approve Work Plan ▪ Field oversight as necessary
Ecology Unit Supervisor	Andy Smith	ansm461@ecy.wa.gov 360-407-6316 (O)	▪ Participate in FS data gap investigation process
Key Implementation Personnel			
Port Project Manager	Scott Hooton	shooton@portoftacoma.com 253-383-9428 (O)	▪ Communicate and coordinate with Ecology ▪ Communicate and coordinate within Port ▪ Manage team performance, budget, and schedule
DOF Project Manager	Paul Fuglevand	pfuglevand@dofnw.com 425-827-4588 (O) 206-660-3079 (C)	▪ Manage all contracts
PIONEER Project Manager	Troy Bussey	busseyt@uspioneer.com 360-570-1700 (O) 360-810-0640 (C)	▪ Prepare Work Plan ▪ Communicate and coordinate with Port Project and Program Managers ▪ Coordinate and provide guidance to On-Site Field Project Manager ▪ Prepare data gap evaluation report(s) as necessary
On-Site Field Project Manager (DOF)	Dave Cooper	dcooper@dofnw.com 425-827-4588 (O) 206-660-3466 (C)	▪ Complete pre-mobilization coordination activities in consultation with the PIONEER Project Manager ▪ Supervise and overall administration of all Site field operations ▪ Prepare technical memo(s) documenting field implementation
Site Health and Safety Officer	Steve Frost	stephenfrost18@hotmail.com 206-214-8990 (O and C)	▪ Ensure appropriate implementation of Health and Safety Plan
Field Technical Staff (DOF)	To be determined		▪ Conduct variety of field implementation tasks
XRF Field Screening and GPS Surveying (PIONEER)	Stacy Munson	munsons@uspioneer.com 360-570-1700 (O) 206-579-4707 (C)	▪ Conduct XRF field screening ▪ Conduct GPS surveying
Field Corrosion Engineer (Tinnea & Associates)	Jack Tinnea or Ryan Tinnea	jackt@tinnea.net or rtinnea@tinnea.net 206-328-7872 (O)	▪ Inspect sheet pile wall pursuant to Data Gap #3
Divers (Ballard Marine Construction)	Adam Litt	adam.litt@ballardmc.com 360-695-5163 (O) 360-518-4864 (C)	▪ Install NSDSs pursuant to Data Gap #1B ▪ Collect sediment samples pursuant to Data Gap #2D ▪ Collect pore water samples pursuant to Data Gap #2B
Licensed Driller	To be determined		▪ Advance soil borings pursuant to Data Gaps #2D, #4A, and #4B
Excavation Contractor	To be determined		▪ Excavate test pit(s) pursuant to Data Gap #3
Primary Laboratory (ARI)	Amanda Volgardsen	amandav@arilabs.com 206-695-6220 (O)	▪ Review laboratory content in this Work Plan ▪ Perform some of the analyses associated with Data Gaps #2A through #2D ▪ Analyze soil samples associated with Data Gaps #4A and #4B ▪ Perform associated laboratory quality control
Specialty Laboratory (Brooks)	Elizabeth Madonick	Elizabeth@brooksapplied.com 206-632-6206 (O)	▪ Review laboratory content in this Work Plan ▪ Perform some of the analyses associated with Data Gaps #2A through #2D ▪ Perform associated laboratory quality control
Data Quality Validator (QA/QC Solutions)	James McAteer	jjmcateer@msn.com 503-763-6948	▪ Perform independent data quality validation for all laboratory data

Table 4-9: Investigation Roles and Responsibilities

Role	Name	Contact Information	Key Investigation Responsibilities
Database Manager (PIONEER)	Troy Sykes	sykest@uspioneer.com 360-570-1700 (O)	■ Input laboratory electronic data deliverables and data quality review qualifiers into project database ■ Load data into Ecology's Environmental Information Management database
Other Key Project Team Members			
Investigation Procedures Support (DOF)	Matt Dalton	mdalton@dofnw.com 206-498-6616 (O and (C)	■ Provide information and context for previously-approved field investigation procedures as necessary
Data Management and Risk Assessment Support (PIONEER)	Chris Waldron	waldronc@uspioneer.com 360-570-1700 (O)	■ Provide data management support as necessary ■ Provide risk assessment support as necessary
Groundwater Modeling Lead (Keta Waters)	Joel Massmann	joel@ketawaters.com 206-236-6225 (O)	■ Provide groundwater modeling support as necessary
Geochemistry Support (University of Washington)	Rebecca Neumann	rbneum@uw.edu 206-221-2298 (O)	■ Review geochemistry content in this Work Plan ■ Help evaluate geochemistry data ■ Provide geochemistry support as necessary

Table 5-1: Field Quality Control Sample Requirements

Field Quality Control Sample	Frequency Expectation[(1)]
Field Duplicate	One sample per 20 samples per matrix
MS/MSD	One sample per 20 samples per matrix
Equipment Rinsate Blank	One sample per 20 samples per matrix per equipment type
VOA Trip Blank	One sample for each cooler that contains samples for VOC analyses
Cooler Temperature Blank	One sample per cooler

Notes:

MS/MSD: Matrix spike/matrix spike duplicate, VOA: Volatile organic analysis

(1) Field quality control samples will not be collected for soil/sediment analyses associated with (1) sequential extraction and follow-on analyses, (2) arsenic species, and (3) batch adsorption tests and follow-on analyses.

Table 5-2: Laboratory Control Limits for Water Samples

Category	Analyte	Lab	Analytical Method	LCS	MS/MSD		Surrogates
				% Recovery	% Recovery	RPD %	% Recovery
Dissolved and Total Metal COPCs	Arsenic	Brooks⁽¹⁾	USEPA 1638 Mod (ICP-QQQ-MS)⁽¹⁾	75-125	70-130	20	N/A
	Copper		USEPA 1640 Mod (column chelation)⁽¹⁾	70-130	70-130	30	N/A
	Lead			70-130	70-130	30	N/A
	Nickel			70-130	70-130	30	N/A
	Mercury		USEPA 1631E⁽¹⁾	80-120	71-125	24	N/A
	Arsenic	ARI⁽¹⁾	USEPA SW846-6020A⁽¹⁾	80-120	75-125	20	N/A
	Copper			80-120	75-125	20	N/A
	Lead			80-120	75-125	20	N/A
	Nickel			80-120	75-125	20	N/A
	Mercury		USEPA SW846-7470A⁽¹⁾	80-120	75-125	20	N/A
VOC COPCs	PCE	ARI	USEPA SW846-8260C	80-120	80-120	30	80-129⁽²⁾
	TCE			80-120	80-120	30	
	VC			66-133	66-133	30	
	Chloroform			80-122	80-122	30	
Dissolved Arsenic Species	Arsenate	Brooks	Brooks SOP #BAL-4100 (IC-ICP-MS)	75-125	75-125	25	N/A
	Arsenite			75-125	75-125	25	N/A
	Monomethylarsonic Acid			75-125	75-125	25	N/A
	Dimethylarsinic Acid			75-125	75-125	25	N/A

Table 5-2: Laboratory Control Limits for Water Samples

Category	Analyte	Lab	Analytical Method	LCS	MS/MSD		Surrogates
				% Recovery	% Recovery	RPD %	% Recovery
Dissolved Conventionals	Iron	Brooks(1)	USEPA 1638 Mod(1)	70-130	70-130	30	N/A
	Aluminum			70-130	70-130	30	N/A
	Calcium			70-130	70-130	30	N/A
	Magnesium			70-130	70-130	30	N/A
	Manganese			70-130	70-130	30	N/A
	Potassium			70-130	70-130	30	N/A
	Silicon			70-130	70-130	30	N/A
	Sodium			70-130	70-130	30	N/A
	Iron	ARI(1)	USEPA SW846-6010C(1)	80-120	75-125	20	N/A
	Aluminum			80-120	75-125	20	N/A
	Calcium			80-120	75-125	20	N/A
	Magnesium			80-120	75-125	20	N/A
	Manganese			80-120	75-125	20	N/A
	Potassium			80-120	75-125	20	N/A
	Silicon			80-120	75-125	20	N/A
	Sodium			80-120	75-125	20	N/A
	Sulfate	ARI	USEPA 300.0	75-125	75-125	20	N/A
	Ortho-Phosphorus			75-125	75-125	20	N/A
	Bromide			75-125	75-125	20	N/A
	Chloride			75-125	75-125	20	N/A
	Fluoride			75-125	75-125	20	N/A
	Nitrate			75-125	75-125	20	N/A
	Nitrite			75-125	75-125	20	N/A
	Alkalinity as Carbonate	ARI	USEPA 2320	N/A	N/A	20	N/A
	Alkalinity as Bicarbonate			N/A	N/A	20	N/A
	Total Dissolved Solids	ARI	SM 2540 C/USEPA 160.1	90-110	N/A	20	N/A
	Dissolved Organic Carbon	ARI	SM 5310 B	90-110	75-125	20	N/A

Notes:

IC: Ion chromatograph, ICP: Inductively coupled plasma, LCS: Laboratory control sample, MS: Mass spectrometry, MS/MSD: Matrix spike/matrix spike duplicate, N/A: Not applicable, QQQ: Triple quadrupole, RPD: Relative percent difference, SM: Standard Method, SOP: Standard Operating Procedure

(1) See Table 4-7 for which lab will analyze which samples.

(2) Control limits are 80-120% for dibromofluoromethane, toluene-d8, 4-bromofluorobenzene, and 1,2-dichlorobenzene-d4, and 80-129% for 1,2-dichloroethane-d4.

Table 5-3: Laboratory Control Limits for Soil and Sediment Samples

				LCS	MS/MSD		Surrogates
Category	Analyte	Lab	Analytical Method	% Recovery	% Recovery	RPD %	% Recovery
Total Arsenic	Arsenic	ARI	USEPA SW846-3050B followed by USEPA SW846-6010C	80-120	75-125	20	N/A
TCLP Metals	Arsenic	ARI	USEPA SW846-1311 followed by USEPA SW846-6010C/7470A	80-120	75-125	20	N/A
	Barium			80-120	75-125	20	N/A
	Cadmium			80-120	75-125	20	N/A
	Chromium			80-120	75-125	20	N/A
	Lead			80-120	75-125	20	N/A
	Mercury			80-120	75-125	20	N/A
	Selenium			80-120	75-125	20	N/A
	Silver			80-120	75-125	20	N/A
Conventionals	pH	ARI	USEPA SW846-9045	N/A	N/A	20	N/A
	Iron		USEPA SW846-3050B followed by USEPA SW846-6010C	80-120	75-125	20	N/A
	Aluminum			80-120	75-125	20	N/A
	Manganese			80-120	75-125	20	N/A
	Sulfate		Water extraction followed by USEPA 300.0	90-110	75-125	20	N/A
	Ortho-Phosphorus			75-125	75-125	20	N/A
	Total Organic Carbon		USEPA SW846-9060A Mod	90-110	75-125	20	N/A
	Total Inorganic Carbon			90-110	75-125	20	N/A
	Sulfide		SM 4500-S2(PSEP)	75-125	75-125	20	N/A
Sequential Extraction and Follow-on Analyses	Arsenic	Brooks	Sequential Extraction followed by USEPA SW846-6020 Mod (ICP-QQQ-MS)	N/A(1)	N/A(1)	N/A(1)	N/A
	Iron			N/A(1)	N/A(1)	N/A(1)	N/A
	Aluminum			N/A(1)	N/A(1)	N/A(1)	N/A
	Manganese			N/A(1)	N/A(1)	N/A(1)	N/A
	Silicon			N/A(1)	N/A(1)	N/A(1)	N/A
Arsenic Species	Arsenate	Brooks	Brooks SOPs #BAL-4100, BAL-4111, and BAL-4112 (phosphoric acid and phosphate extractions followed by IC-ICP-MS)	75-125	75-125	25	N/A
	Arsenite			75-125	75-125	25	N/A
	Monomethylarsonic Acid			75-125	75-125	25	N/A
	Dimethylarsinic Acid			75-125	75-125	25	N/A
Batch Adsorption Tests and Follow-on Analyses	Arsenic	Brooks	USEPA SW846-6020 Mod (ICP-QQQ-MS)	75-125	70-130	30	N/A
	pH		USEPA 150.1	N/A	N/A	N/A	N/A

Notes:

IC: Ion chromatograph, ICP: Inductively coupled plasma, LCS: Laboratory control sample, MS: Mass spectrometry, MS/MSD: Matrix spike/matrix spike duplicate, N/A: Not applicable, QQQ: Triple quadrupole, RPD: Relative percent difference, SM: Standard Method, SOP: Standard Operating Procedure

(1) Typical laboratory control limits are not applicable due to the nature of sequential extraction. However, other QC measures (e.g., method duplicates, post spikes) are implemented as appropriate.

Table 5-4: Target Reporting Limits for Water Samples

Category	Analyte	Lab	Analytical Method	Target Reporting Limit(2) (ug/L)	RI Screening Level(3) (ug/L)
Dissolved and Total Metal COPCs	Arsenic	Brooks(1)	USEPA 1638 Mod (ICP-QQQ-MS)(1)	2	5.0
	Copper		USEPA 1640 Mod (column chelation)(1)	0.5	2.4
	Lead			0.1	8.1
	Nickel			1.4	8.2
	Mercury		USEPA 1631E(1)	0.0004	0.025
	Arsenic	ARI(1)	USEPA SW846-6020A(1)	0.5	5.0
	Copper			0.5	2.4
	Lead			0.1	8.1
	Nickel			0.5	8.2
	Mercury		USEPA SW846-7470A(1)	0.1	0.025
VOC COPCs	PCE	ARI	USEPA SW846-8260C	0.2	3.3
	TCE			0.2	4.2
	VC			0.2	2.4
	Chloroform			0.2	12
Dissolved Arsenic Species	Arsenate	Brooks	Brooks SOP #BAL-4100 (IC-ICP-MS)	1	N/A(4)
	Arsenite			1	N/A(4)
	Monomethylarsonic Acid			1.2	N/A(4)
	Dimethylarsinic Acid			2.5	N/A(4)
Dissolved Conventionals	Iron	Brooks(1)	USEPA 1638 Mod(1)	50	N/A(4)
	Aluminum			200	N/A(4)
	Calcium			700	N/A(4)
	Magnesium			100	N/A(4)
	Manganese			50	N/A(4)
	Potassium			500	N/A(4)
	Silicon			5000	N/A(4)
	Sodium			500	N/A(4)
	Iron	ARI(1)	USEPA SW846-6010C(1)	50	N/A(4)
	Aluminum			50	N/A(4)
	Calcium			50	N/A(4)
	Magnesium			50	N/A(4)
	Manganese			1.0	N/A(4)
	Potassium			500	N/A(4)
	Silicon			60	N/A(4)
	Sodium			500	N/A(4)
	Sulfate	ARI	USEPA 300.0	100	N/A(4)
	Ortho-Phosphorus			100	N/A(4)
	Bromide			100	N/A(4)
	Chloride			100	N/A(4)
	Fluoride			100	N/A(4)
	Nitrate			100	N/A(4)
	Nitrite			100	N/A(4)
	Alkalinity as Carbonate	ARI	USEPA 2320	1000	N/A(4)
	Alkalinity as Bicarbonate			1000	N/A(4)
	Total Dissolved Solids	ARI	SM 2540 C/USEPA 160.1	5000	N/A(4)
	Dissolved Organic Carbon	ARI	SM 5310 B	500	N/A(4)

Notes:

IC: Ion chromatograph, ICP: Inductively coupled plasma, MS: Mass spectrometry, N/A: Not applicable, QQQ: Triple quadrupole, SM: Standard Method, SOP: Standard Operating Procedure

(1)See Table 4-7 for which lab will analyze which samples.

(2)It may not be possible to achieve these reporting limits in all samples (e.g., samples requiring extra dilution beyond the target dilution, interferences).

(3)These values are the most stringent screening levels included in the Ecology-approved RI Report. Cleanup levels will be developed pursuant to the FS. The screening levels do not account for potential cleanup level adjustments that may be necessary during the FS (e.g., updated toxicity values, natural background adjustments, site-specific risk evaluations).

(4)These analytes are being collected for geochemical purposes. These analytes are not COPCs, and do not have associated RI screening levels.

Table 5-5: Target Reporting Limits for Soil and Sediment Samples

Category	Analyte	Lab	Analytical Method	Target Reporting Limit(1)	Applicable Regulatory Criteria (mg/kg)(2)
Total Arsenic	Arsenic	ARI	USEPA SW846-3050B followed by USEPA SW846-6010C	5 mg/kg	88 mg/kg / 57 mg/kg
TCLP Metals	Arsenic	ARI	USEPA SW846-1311 followed by USEPA SW846-6010C/7470A	0.25 mg/L	5.0 mg/L
	Barium			0.015 mg/L	100 mg/L
	Cadmium			0.01 mg/L	1.0 mg/L
	Chromium			0.025 mg/L	5.0 mg/L
	Lead			0.1 mg/L	5.0 mg/L
	Mercury			0.0001 mg/L	0.2 mg/L
	Selenium			0.25 mg/L	1.0 mg/L
	Silver			0.25 mg/L	5.0 mg/L
Conventionals	pH	ARI	USEPA SW846-9045	0.01 pH Units	N/A(3)
	Iron		USEPA SW846-3050B followed by USEPA SW846-6010C	5 mg/kg	N/A(3)
	Aluminum			20 mg/kg	N/A(3)
	Manganese			0.5 mg/kg	N/A(3)
	Sulfate		Water extraction followed by USEPA 300.0	1.0 mg/kg	N/A(3)
	Ortho-Phosphorus			1.0 mg-P/kg	N/A(3)
	Total Organic Carbon		USEPA SW846-9060A Mod	0.02%	N/A(3)
	Total Inorganic Carbon			0.02%	N/A(3)
	Sulfide		SM 4500-S2(PSEP)	0.5 mg/kg	N/A(3)
Sequential Extraction and Follow-on Analyses	Arsenic	Brooks	Sequential Extraction followed by USEPA SW846-6020 Mod (ICP-QQQ-MS)	TBD(4)	N/A(3)
	Iron			TBD(4)	N/A(3)
	Aluminum			TBD(4)	N/A(3)
	Manganese			TBD(4)	N/A(3)
	Silicon			TBD(4)	N/A(3)
Arsenic Species	Arsenate	Brooks	Brooks SOPs #BAL-4100, BAL-4111, and BAL-4112 (phosphoric acid and phosphate extractions followed by IC-ICP-MS)	TBD(4)	N/A(3)
	Arsenite			TBD(4)	N/A(3)
	Monomethylarsonic Acid			TBD(4)	N/A(3)
	Dimethylarsinic Acid			TBD(4)	N/A(3)
Batch Adsorption Tests and Follow-on Analyses	Arsenic	Brooks	USEPA SW846-6020 Mod (ICP-QQQ-MS)	TBD(4)	N/A(3)
	pH		USEPA 150.1	TBD(4)	N/A(3)

Notes:

IC: Ion chromatograph, ICP: Inductively coupled plasma, MS: Mass spectrometry, N/A: Not applicable, QQQ: Triple quadrupole, SM: Standard Method, SOP: Standard Operating Procedure, TBD: To be determined

(1) It may not be possible to achieve these reporting limits in all samples (e.g., samples requiring extra dilution beyond the target dilution, interferences).

(2) The 88 mg/kg criterion for total arsenic is the soil PCL (see Section 2.7.1). The 57 mg/kg criterion for total arsenic is the CB/NT SQO (see Section 2.8.3). The TCLP metals criteria are hazardous waste toxicity characteristic criteria in WAC 173-303-090(8).

(3) These analytes are being collected for geochemical purposes. These analytes are not COPCs, and do not have associated RI screening levels or regulatory criteria.

(4) TBD on a batch-specific basis at the time of analysis.

Appendix A

Photo P-1a (07-02-2004): Sheet pile wall on the former Arkema site starts just to the southwest of the dock on the site and extends for approximately 900 feet along the bank of the Hylebos Waterway.

Photo P-1b (07-02-2004): The top of the sheet pile wall was exposed during the 2004 shoreline remediation work. As the wall nears the East-West Ditch, it turns parallel to the ditch and continues for approximately 300’ along the ditch.

Photo P-2a: Top of sheet pile wall varied in elevation by several feet.

Photo P-2b: Workers removing soil from inshore sheet pairs to identify sheets that were driven low. Two pair driven 4’-5’ low were discovered and repaired by Arkema.

Photo P-3a: Close-up of white substance observed on sheets along the length of the wall. Substance was similar to a white precipitate observed along the shoreline prior to remediation

Photo P-3b: During shoreline remediation approximately the upper 6' of the sheet pile wall on the waterway side was exposed.

Photo P-4a: Worker removing soil from inshore pair of sheet pile.

Photo P-4b: Worker clearing around a timber pile at sheet pile wall.

Photo P-5a: First hole at top of sheet pile wall resulting from sheet pair being driven too low.

Photo P-5b: Hole was approximately 3.5' wide by 4.2' tall.

Photo P-6a: Hole in sheet pile wall was repaired by Arkema by welding a remnant pair of sheets to the existing wall and placing grout along the weld seam.

Photo P-6b: Hole around repair was backfilled.

Photo P-7a: During shoreline work, a second hole at the top of the wall was discovered that required repair.

Photo P-7b: Second hole in sheet pile wall was approximately 4.5’ wide by 5’ high. Brown groundwater visible at bottom of excavation.

Photo P-8a: Hole repaired by Arkema by welding a plate onto the existing sheet pile wall and backfilling excavation with concrete.

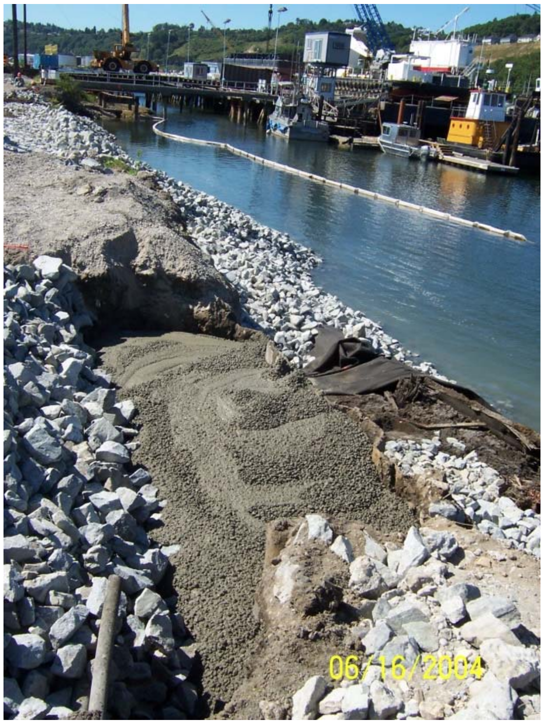


Photo P-8b: Groundwater and soil outside of the repair was removed and backfilled with spalls. Soil was placed over the concrete once it cured.

Appendix B

Pore Water Sampling with PPSs

The shoreline work will attempt to collect porewater from within the subtidal cap and at the outcrop of the Intermediate Aquifer. Porewater samples will be collected on a falling tide near low tide using a similar sampling procedure as was used to collect the 2008 subtidal cap porewater sample (see Appendix E of Data Report).

- Porewater sampling will be completed near the end of a low tide where water flow would be expected to be from the cap/aquifer, into the water column.
- A diver will be used to install a sampling device approximately 12 inches into the materials to be sampled. A low permeability cap will be placed over the sampling area to minimize the possibility of "short-circuiting" of sea water into the sample.
- The inlet device will be attached to a shoreline based peristaltic pump that will be used to draw out porewater at a low rate (less than 50 ml/minute). Sufficient volume will be drawn from the sampler to purge the tubing at least three volumes. The samples will be placed into laboratory supplied containers.
- Samples for metals analysis will be field filtered using a 0.45 micron filter.

Measuring Water Levels in MWs

3.2 Measure Water Levels

Water levels will be measured in wells located on and adjacent to the Arkema Manufacturing Plant. Two sets of measurements will be made; at low and high tides, respectively. Water levels will be made as follows:

- Measurements will be made in as short a time period as practical to minimize the effects of tides (primarily in wells located near the shoreline that are screened in the Intermediate and Deep Aquifers).
- Measurements will begin near the end of a falling or rising tide so that as much as the slack tidal period as possible can be incorporated into the measurement period.
- Wells closest to the shoreline will be initially measured followed by in-land wells.
- A calibrated electronic well probe will be used to measure water levels to +/- 0.01 feet.
- The measurements, including the time the measurements were made, will be recorded on the Water Level Measurement Field Form in Attachment A.

Groundwater Sampling from MWs and Angled Shoreline MWs (Seep Samplers)

3.3.1 Monitoring Well Sampling

Prior to sampling, water levels will be made at all locations except the OMMP seep locations. Measurements will be made using a calibrated electric well probe. Depth to water measurements will be recorded on the Water Sampling Field Form (Attachment A).

Groundwater samples will be collected using a peristaltic pump. The OMMP and a number of other wells already have ¼-inch polyethylene tubing installed in the screen section for use of the peristaltic pump. New dedicated tubing will be installed in the remaining wells as necessary.

Low flow sampling techniques (0.5 to 2 liters/minute) will be used to minimize sample turbidity. The wells will be purged until pH, temperature and electrical conductivity stabilize to within 10% or three casing volumes have been removed from the well casing and screen. Field observations and measurements will be documented on the Water Sampling Field Form (Attachment A). Samples for dissolved metals analysis will be field filtered. Field filtering will consist of using in-line 0.45 micron filters. Samples will be collected using anaerobic technique as much as possible to minimize introduction of air (oxygen) during sampling. This includes filling of all sample containers to eliminate headspace.

Field measurements will be made during the groundwater sampling for pH, electrical conductivity, temperature, dissolved oxygen (DO), oxidation/reduction potential (ORP), ferrous iron and turbidity using the following:

- pH – Meter
- DO – Meter
- ORP - Meter
- Temperature/Electrical Conductivity – Meter
- Ferrous iron – Hach Kit
- Turbidity - Meter

The field instruments (meters) will be calibrated on a daily basis. Field measurements will be documented on a Water Sampling Field Form (Attachment A).

Groundwater samples will be pumped directly into labeled containers, with the appropriate preservatives, provided by the project laboratory.

Filled sample containers will be placed in chilled coolers for transport to the laboratory. Samples will be delivered to the laboratory generally within 48 hours of collection. For constituents with short holding times (e.g. hexavalent chromium, arsenic speciation), arrangements will be made to deliver the samples to the laboratory the same day or within 24 hours. Sample handling will be documented using standard chain-of-custody (COC) procedures. COC forms will be included with the laboratory data packages.

Sediment Sampling

3.5 Collect Sediment and Porewater Samples From Arkema Shoreline.

Sediment samples will be collected from the biologically active zone (0 to 10 cm).

The intertidal cap samples will be collected using conventional "surface grab" sampling equipment near the end of a low tide. Samples will be obtained near the water edge using stainless steel spoons. A 0 to 10 cm sample will be transferred to a stainless steel or aluminum mixing pan and be mixed to a consistent consistency. The sample will be placed in laboratory provided glass containers.

Subtidal sediment samples will be collected using divers and/or a Van Veen sampler deployed from a boat (note: samples from the top of the subtidal cap will be collected by divers). Bulk sediment samples collected by divers will be collected using box cores, small core tubes or stainless steel spoons to collect the samples. It may not be possible to collect a 0 to 10 cm sample from top of the subtidal cap because of its coarse nature. If this proves to be the case, accumulated sediment will be scrapped into a container from the top of the cap as practical.

At locations where samples are not collected by divers, surface sediment samples will be collected from a boat using a modified van Veen sampler as follows:

- The sampler will be deployed/recovered from a boat using a hydraulic winch.
- The sampler will be lowered at a controlled speed. Under no circumstances will the sampler be allowed to free fall. The sampler should contact the bottom gently and only its weight should be used to penetrate into sediment.
- A position fix will be taken the first time the sampler hits bottom. After impact, the sampler closing arms will be raised slowly to allow the sampler to close properly and the sampler will be slowly raised to the surface.
- Sample run acceptability will be judged based on the following criteria:
  - Significant sediment does not extrude from the upper surface of the sampler and is not pressed against the top of the sampler.
  - The sediment surface in the sampler is relatively flat and undisturbed.
  - Overlying water is present to indicate minimal leakage.
  - Overlying water is not excessively turbid.
  - The penetration depth is at least 10.5 cm for a 10 cm sample.
- The top 10 cm of sediment will be collected using a clean stainless steel spoon, being careful to exclude sediment in contact with the edges or bottom of the sampler.
- Sediment will be transferred to a stainless steel or aluminum bowl and mixed to a consistent texture and color.
- The mixed sample will be placed into clean glass jars provided by the receiving laboratory.
- The material type will be described and documented.

Equipment Decontamination

5.0 DECONTAMINATION

Drilling tools (augers, rods, samplers etc.) will be hot-water pressured washed between drilling locations. A cleaning area will be set-up on site that will allow cleaning water to be contained and collected. The water will be tested and disposed of in an appropriate fashion.

During sampling, samplers will be washed with a laboratory grade detergent and tap water and rinsed with tap water between each sampling run. Wash and rinse water will be collected for proper disposal.

Personnel will follow decontamination procedures outlined in the site Health and Safety Plan.

Equipment Decontamination

All equipment that may come into contact with potentially contaminated soil or ground water will be decontaminated prior to and after use. Decontamination may consist of "steam cleaning" (high-pressure, hot water washing), laboratory-grade detergent (Alconox or equivalent) and water wash, and distilled, deionized, or clean water rinse, as appropriate. Acetone rinses may be used if very oily material adhere to the samplers. Decontamination will be conducted in such a manner that cleaning solutions and rinse water can be handled and disposed of as described below.

Drilling, sampling, well-installation, and monitoring equipment will be decontaminated as follows:

- Downhole equipment on drill rigs, such as augers, drill rods, samplers, and drill bits, will be steam cleaned to remove visible soil and grease prior to use at each drill site.

- Casing, screen, couplings, and caps (if not factory cleaned and in factory-sealed containers) to be used in monitoring well installations will be steam-cleaned or washed to remove visible foreign matter prior to installation.

- The exterior surfaces of submersible pumps (Gundfos or equivalent) and associated lines will be washed with a laboratory-grade detergent (Alconox or equivalent) and water solution, rinsed with clean water, and then rinsed with deionized water. The interior portions will be cleaned by pumping approximately one-gallon of a laboratory-grade detergent (Alconox or equivalent) and water solution, followed by pumping approximately two gallons of clean rinse water. This procedure will be used prior to use of the pump.

- Non-disposable bailers will be washed in a laboratory-grade detergent (Alconox or equivalent) and water solution, rinsed twice with clean water, and then rinsed with deionized water prior to each use. Line used to lower and retrieve the bailer will be discarded after each use. Disposable, previously cleaned and factory-sealed, HDPE bailers will not require the above cleaning, however, they will be discarded after each use.

- Steel tapes, electric well sounders, and water quality probes will be rinsed in distilled or deionized water and wiped clean after each use.

Investigation-Derived Waste

6.0 HANDLING OF SAMPLING AND WELL DEVELOPMENT WASTE MATERIALS

Drill cuttings (should they be produced) will be segregated and placed on-site in plastic lined and covered piles. Water resulting from the decontamination of equipment and personnel, monitoring well development and sampling purge water, and other miscellaneous materials such as used tubing will be placed in DOT 55 gallon or other suitable containers and held for proper disposal. A plan to dispose of drill cuttings and waste waters will be prepared and submitted to Ecology within 90 days of the completion of the field work.

Handling and Disposal of Investigation-Derived Wastes

Handling and disposal of all investigation-derived wastes will be in accordance with applicable regulations of the EPA and Ecology, as appropriate. Temporary storage of these materials will be in approved bins, lined and covered temporary storage areas, tanks, or 55-gallon DOT-approved drums until analyses are complete and an acceptable means of disposal has been determined. All bins, storage areas, tanks, or DOT drums will be clearly labeled and stored in a secure location until final disposal is arranged. An inventory of all such material on-site at any time will be maintained and documentation of the ultimate disposition of all material removed from the site will be maintained. A plan to dispose of these wastes will be submitted to Ecology within 90 days of completion of the field work as outlined in the SAP.

Sample Handling and Shipment

&

Chain-of-Custody Documentation

FIELD SAMPLE CUSTODY PROCEDURES

Sample custody procedures will be followed through sample collection, transfer, analysis, and ultimate disposal. The purpose of these procedures is to assure that :

- The integrity of samples is maintained during their collection, transportation, and storage prior to analysis, and
- Sample material is properly disposed after analysis.

Sample custody begins with the shipment of the empty sampling containers to the facility. All sample containers are shipped or delivered from or by the laboratory in sealed coolers or cartons with appropriate seals and custody documentation.

Sample quantities, types, and locations will be determined before field work commences. The field sampler will be responsible for the care and custody of the samples until properly transferred. Custody transfer will be documented on the chain of custody form.

Field Documentation

Each sample will be labeled immediately after collection. Sample identification documents will be prepared so that identification and chain of custody records are maintained and sample disposition is controlled. Forms will be filled out with waterproof ink. The following identification documents will be utilized during the field investigation:

- Sample Labels
- Daily Report
- Field Boring and Well Completion Log
- Field Test Pit Log
- Water Quality Sampling/Well Development Record
- Chain of Custody Form

Sample Labels

Sample labels will be used to identify samples. Preprinted sample labels will be provided. Each label will contain the following information:

- Project/Client identification
- Project name & job number
- Sample identification number or description (e.g. boring number and depth)
- Date and time of collection
- Name of collector

Chain of Custody Record

A chain of custody record will be filled out and will accompany every sample to the analytical laboratory to establish the documentation necessary to trace sample possession from the time of collection. A copy of the chain of custody form will be retained in the project files according to the Project Number. The record will contain the following information:

- Client Name
- Project name and number
- Names and signatures of sampler(s)
- Sample identification (number or description)
- Sampling date and time
- Sample matrix (**W**ater, **S**oil, **O**ther)
- Number of containers
- Analyses requested
- Comments & preservatives used for each sample
- Laboratory sample number (added by laboratory after delivery)
- Total number of containers
- Requested laboratory results turn-around time
- Name of person to whom results are to be reported (Project Managers Name)

- Date and time of relinquishing samples
- Signature of person relinquishing samples
- Date and time of receipt of samples
- Signature of person receiving samples

Sample Transfer and Shipment

Samples will always be accompanied by a chain of custody record. When transferring samples, the individuals relinquishing and receiving the samples will enter the date and time and sign the chain of custody record. Samples will be packaged property for shipment, including isolation of samples thought to have high chemical concentrations, and dispatched to the appropriate laboratory for analysis. Custody seals are not deemed necessary when the samples will be in the continuous possession of the technical or laboratory personnel. Custody seals will be used when samples are shipped via courier service or commercial carriers. The chain of custody record will accompany each shipment. The method of shipment, courier name(s), and other pertinent information will be entered in the chain of custody record.

Field Recordkeeping

ATTACHMENT SAP-A
Field Forms

Dalton, Olmsted & Fuglevand, Inc.

DAILY FIELD REPORT

Sheet __ of __

Project Name: Arkema Site

Project Number: POT-001-00

Field Rep:________________________

Date:________________________

Weather:________________________

Chronological Log of Daily Activities and Visitors:

Signature of Field Rep:________________________

Dalton, Olmsted & Fuglevand, Inc.
Environmental Consultants

MONITORING WELL NO. - DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION (SHEET 1 OF)

Field Rep:
Drilling Co.:
Driller:
Drill Type:
Size/Type Casing:

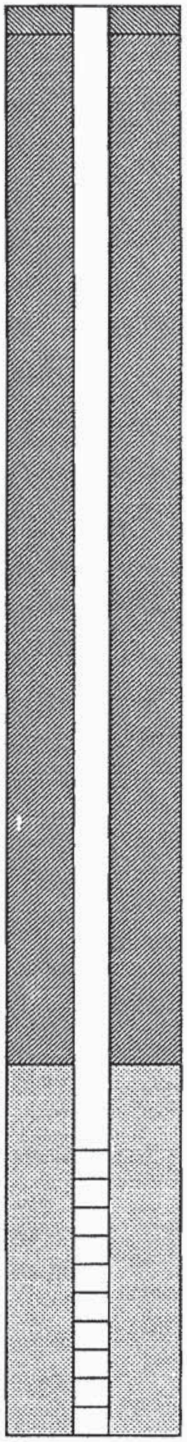
Location:
Elevation:
Date :
Weather:

Spl.No.	Type	Drill Action	Spl Depth (Ft.) From - To	Blows/ 6 inches	Spl ength	Time	Sample Description

MONITORING WELL NO.___________ - DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION (Sheet__ of__)

Depth(ft.) SUMMARY LOG

MONITORING WELL DIAGRAM



(Bottom of Well)

NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

MONITORING WELL INFORMATION

Riser Length:	Seal:
Sandpack:	type
type: 10-20 Sand	depth (top/bot)
depth (top/bot)	Monument:
Screen:	
type/slot	
length: Depth (Top/Bot):	

Dalton, Olmsted & Fuglevand, Inc.

WATER SAMPLING /WELL-DEVELOPMENT RECORD

Client:

Date:

Location:

Job No.:

Sampled/Developed by:

Signature:

LOCATION / DATA

Well No.						
well depth						
water level						
water depth						
time						
Casing/Volume						
type:2" PVC						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
time						
Water Sample						
Sample No.						
Sample Method						
Time						
No. Cont.						
Cont. Type						
Initials						
Sp Cond						
value						
time						
value						
time						
pH						
value						
time						
value						
time						
Temp. (Celsius)						
value						
time						
value						
time						

Sp. Cond. Calibration

Meter Type/No.		
1st Cal.Std./exp.date		
2nd Cal.Std./exp.date		
time		

pH Calibration

Meter Type/No.		
1st Cal.Std./exp.date		
2nd Cal.Std./exp.date		
time		

D.O Calibration

Meter Type/No.		
time		

Turbidity Calibration

Meter Type/No.		
time		

Note: 2" dia. PVC has 0.164 gal/ft; bail 0.5 gal/ft for 3 casing volumes

COMMENTS:

Dalton, Olmsted & Fuglevand, Inc.

WATER LEVEL RECORD

Sheet __ of __

Project Name: Arkema Site
Project Number: POT-001-00
Field Rep:________________

Date:________________
Weather:________________
Sounder Type/Model________________

WELL IDENTIFICATION	***Elevation Top of Casing***	***Height of Casing Above Ground***	***Depth to Water from Top of Casing***	***Time of Measurement***

Signature of Field Rep:________________

Dalton, Olmsted & Fuglevand, Inc.

FIELD SAMPLE SCREENING RECORD

Sheet __ of __

Project Name: Former Arkema Site
Project Number: POT-001-00
Field Rep:___________________________

Date:_____________________________
Weather:__________________________

Sample Identification	***Odor***	***Sheen*** (None, Light, Moderate, Heavy)	***PID/OVA*** (Type____________) (Model No.______)	***XRF*** (Type____________) (Model No.______)

Signature of Field Rep:____________________________________

Dalton, Olmsted & Fuglevand, Inc.
Environmental Consultants

TEST PIT NO. ______ - DESCRIPTION OF SAMPLES, AND TESTS (SHEET 1 OF __)

Field Rep:
Location:
Project : Arkema Site Project Number: POT-001-00
Elevation of Ground Surface:
Contractor:
Date :
Excavator Operator:
Weather:
Ecavator Type:

Spl.No.	Type	Spl Depth (Ft.) From - To	Time	Sample Description

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TEST PIT NO. ____ ______ - SKETCH OF TEST PIT (SHEET 2 OF__)

Field Rep:	Location:
Project : Arkema Site Project Number: POT-001-00	Elevation of Ground Surface:
Contractor:	Date :
Excavator Operator:	Weather:
Ecavator Type:	

SKETCH OF TEST PIT, PLAN VIEW (Scale 1" = ___')

SKETCH OF TEST PIT WALL (__________ Side)

Depth in Ft.

Horizontal Distance in Ft.

Dalton, Olmsted & Fuglevand, Inc. *Environmental Consultants*

19017 120th Avenue N.E., Suite 107 • Bothell, Washington 98011
Telephone (206) 486-7905 (FAX 486-7651)

CHAIN OF CUSTODY REPORT

CLIENT:

ADDRESS:

PHONE: FAX:

REPORT TO:

BILLING TO:

P.O. NUMBER:

NCA QUOTE #:

SAME DAY (2-8 HR.) RUSH	(+150%)	
NEXT DAY RUSH	(+100%)	
2 DAY RUSH	(+80%)	
3 DAY RUSH	(+60%)	
5 DAY RUSH	(+40%)	
10 DAY STANDARD	(LIST PRICE)	

PROJECT NAME:

PROJECT NUMBER:

SAMPLED BY:

SAMPLE IDENTIFICATION: NUMBER OR DESCRIPTION	SAMPLING DATE / TIME	MATRIX (W,S,O)	# OF CONT.				ANALYSIS REQUESTED							COMMENTS & PRESERVATIVES USED	LABORATORY NUMBER
1															
2															
3															
4															
5															
6															
7															
8															
9														TOTAL # OF CONTAINERS	
10														RECEIVED?	

RELINQUISHED BY: DATE:
FIRM: TIME:

RECEIVED BY: DATE:
FIRM: TIME:

RELINQUISHED BY: DATE:
FIRM: TIME:

RECEIVED BY: DATE:
FIRM: TIME:

SAMPLE RECEIPT INFORMATION: CONTAINER CONDITION?: GOOD VIOLATED COOL (4° C)? YES NO

Health and Safety Plan (HASP)

Health and Safety Plan
Site Characterization Activities
Former Arkema Manufacturing Plant
Port of Tacoma, Washington

Prepared for:
Port of Tacoma

Dalton, Olmsted & Fuglevand, Inc. *Environmental Consultants*
September 2011

Health and Safety Plan
Site Characterization Activities
Former Arkema Manufacturing Plant
Port of Tacoma, Washington

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Health and Safety Plan
Site Characterization Activities
Former Arkema Manufacturing Plant
Port of Tacoma, Washington

1. INTRODUCTION

This Health and Safety Plan (HASP) addresses the health and safety practices and controls that will be implemented by Dalton, Olmsted & Fuglevand Inc. (DOF) during their site characterization work at the Port of Tacoma's Arkema property. Activities addressed in this plan include:

- Conducting a functional inventory of groundwater monitoring wells located on adjacent properties,
- Measuring water levels in monitoring wells,
- Collecting soil, sediment, surface water and groundwater samples.

The safety and health directives discussed herein apply only to DOF employees and their subcontractors engaged in the work activities mentioned above. Furthermore, this plan has been developed specifically for this project and should not be used in whole or in part for any other project unless such application is reviewed and approved by DOF management. This plan, however, will be updated as appropriate to account for changes in the scope of work and for new hazards discovered at the jobsite once work is underway.

Site work activities will comply with WAC 1730340-810 (of the Model Toxics Control Act) and applicable sections of WAC 296-62-300 and other relevant WISHA construction industry health and safety regulations. Where appropriate, specific WISHA standards will be referenced within the plan to highlight additional health and safety requirements not otherwise discussed. These standards are available on WISHA's web-based homepage. The content of this plan and any relevant WISHA standards will be discussed with DOF project personnel before work begins. However, DOF management, its subcontractors, and its client do not guarantee the health or safety of any person entering this site. Because of the nature of this site and the many different activities occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict adherence to the safety and health guidelines set forth herein will reduce, but not eliminate, the potential for injury at this site.

2. DESCRIPTION OF PROJECT

The Arkema property is currently contaminated with several chemical constituents that were released into the soil and groundwater from a chemical manufacturing plant that once occupied the site. To facilitate cleanup and development of the property it will be necessary to address identified site characterization data gaps by collecting new data on the site. These data collection efforts will involve a well inventory and collecting sediment, soil, surface water and groundwater samples. This field work will be implemented by DOF personnel and their subcontractors.

3. DOF PROJECT ORGANIZATION

DOF employees and their subcontractors working on site are expected to maintain vigilance at all times to ensure that the work is conducted in a safe and efficient manner. To provide an organizational structure that supports this objective, the following individuals are assigned specific responsibilities and lines of communication for the duration of this project.

3.1 On-site Field Project Manager (FPM)

The On-site Field Project Manager (FPM), David Cooper of DOF is responsible for overall administration of site field operations. His duties include directing DOF technical staff, coordinating the activities of on-site subcontractors, tracking budget, ensuring adequate resources are available to complete the work, resolving site safety and health issues as they arise, project planning, and maintaining communications between contractors, regulatory agencies, client, and off-site resources. The Field Project Manager reports directly to the Project Manager, Matt Dalton of DOF, and indirectly to the Port of Tacoma project management.

3.2 Technical Lead

A technical lead may be assigned to each field team to supervise the well inventory and environmental sample collection work. The Technical Lead will also monitor compliance with applicable environmental regulations, WISHA standards, and other client-specific requirements. The Technical Lead will coordinate any DOF-related spill response activities that may be needed during the sampling work, inform site management of health and safety issues as they arise, document site activities, and verify that site personnel are adequately trained and qualified for the work. The Technical Lead reports directly to the FPM.

3.3 Site Health and Safety Officer

The FPM will act as DOF's Site Health and Safety Officer (SHSO) on the project. He is responsible for verification and overall compliance with this site health and safety plan (HASP). His duties include: 1) on site monitoring to determine appropriate levels and use of Personal Protective Equipment (PPE); 2) site surveillance, hazard identification, and health risk analysis; 3) implementation of procedures and programs to eliminate risk to site personnel including initiating changes to the HASP; 4) implementation of site control measures; 5) conducting and documenting daily health and safety briefings; 6) tracking health and safety issues in DOF field note book; 7) conducting incident investigations; 8) informing DOF site personnel of the contents of the HASP; 9) maintaining medical clearance letters and training documentation for site personnel; 10) conducting regular site safety inspections and; 11) exercising stop work authority when warranted by conditions. The Site Health and Safety Officer reports directly to DOF's Project Manager.

3.4 DOF Technical Staff

Each member of DOF's technical staff has the responsibility to report any unsafe or potentially hazardous situations to the FPM . They will maintain knowledge of the information, instructions, and emergency response actions contained in the HASP and comply with rules, regulations, and procedures established for the site. Site employees are expected to stop work and contact their supervisor whenever they believe their work, or that of their coworkers, poses an uncontrolled hazard or unreasonable risk of injury or illness. Furthermore, each project participant is expected and encouraged to participate in the implementation of the environmental safety and health process through participation in meetings, incident reporting and investigations, inspections, hazard identification and hazard analyses.

3.5 Visitors

On occasion, appropriately authorized visitors may come to the site to observe the site characterization operations. Visitors may be from city, state, and federal regulatory and resource agencies that have a specific interest in the project. Before accessing the site, visitors will be briefed on the hazards of the site, contents of the HASP, site safety rules, hazard control measures, and required personal protective equipment. This orientation session will be documented on the Daily Site Briefing form. Visitors will also be expected to follow the direction of the FPM while on-site.

4. DOF WORK PLAN

As indicated in Section 2 above, DOF personnel will inventory groundwater monitoring wells located on site. This inventory will involve visually inspecting the wells for damage and gauging the water level in each well. Depending on the results of the well inventory, water levels may be measured to assess groundwater flow directions.

Push-probe or mini sonic core sampling will also be used to collect soil samples near the north property line. Sediment samples potentially contaminated with arsenic will also be collected from the inter-tidal and subtidal region of the Hylebos Waterway that borders the eastern boundary of the Arkema property. This sampling will largely be conducted during low tides. Some sediment and pore water sampling will be conducted by commercial divers and some sediment samples may be collected from a boat. Note because of the very specialized nature of commercial diving, the divers will be responsible for preparing there own health and safety plan. It is expected that sediments collected by the divers and/or from a boat will not be highly contaminated and the primary health and safety issues will be associated with sampling over and in water.

Groundwater monitoring wells located on and off-site – estimated to be around 120- will be gauged and sampled on a periodic schedule. Water samples will be collected using peristaltic pumps, submersible pumps, or by hand bailing the wells. These water samples will be sent to an off-site laboratory for analysis. The data collected during these field monitoring activities will be used, along with the site’s existing environment assessment data, to draft a Remedial Investigation (RI) Report.

5. SITE CHARACTERIZATION

This section presents an assessment of the chemical and physical hazards that may be encountered during the tasks specified in Section 4.0 of this HASP. Additional hazard control information can be found in the Activity Hazard Analyses table in Appendix A and in the listing of General Site Work Rules found in Appendix B. Site personnel will be informed of these hazards and the means that will be taken to control them prior to beginning work

5.1 Chemical Contaminants

Extensive environmental sampling of soil and groundwater has been conducted at the Arkema Site in the past by various environmental contractors. These samples were analyzed for a wide array of potential environmental pollutants, including metals, high and low molecular weight polycyclic aromatic hydrocarbons (PAHs), chlorinated and non-chlorinated volatile organic compounds, polychlorinated biphenyls (PCBs), pesticides, and petroleum hydrocarbons. It is highly unlikely, though, that most of these contaminants could present an exposure hazard to site personnel when compared that is, to WISHA's permissible exposure limits (PELs) where inhalation of the offending chemical agent is the exposure route of concern. This evaluation is based on the fact that the majority of site contaminants are relatively non-volatile (PCBs, lube oil) or for the most part consist of solids (metals, PAHs, pesticides, asbestos) and, at least with respect to the volatile organic and chlorinated compounds, are likely to be adsorbed onto the surface of the soil particles or are dissolved in the groundwater. The site is also well ventilated.

In addition, the majority of contaminants are present in soil and groundwater at relatively low concentrations. The volatile organic hydrocarbons detected in the site soils, for example, all have concentrations less than 1 ppm except for xylenes and isopropyltoluene, whose concentrations are 5 ppm and 8 ppm respectively. The maximum soil concentrations of the PAH's were all less than 2 ppm while PCB levels were all less than 0.2 ppm.

Pesticide soil concentrations range from a high of 30 ppm for DDT to a low of 1.9 ppm for DDE. And likewise, petroleum hydrocarbon soil levels are 4700 ppm (max.) for lube oil and 1800 ppm (min.) for gasoline. Even at these soil concentrations, though, airborne exposure levels could not reasonably be expected to exceed the PELs of these contaminants even under extreme ambient dust conditions (> 10 mg/m^3 total dust). The same can be said for all of the metals detected in the site soils except one – arsenic. Certain "hot spots" (Attachment A) in the waste disposal area contain arsenic in the site soils at a maximum concentration of 25,000 ppm while it's most common concentration throughout the site is less than 1,000 ppm. These hot spot areas are shown on Attachment A.

Several of the site contaminants present in the soil and groundwater, however, are substances which if exposed to the skin can to some degree be cutaneously absorbed into the body (see American Conference of Governmental Industrial Hygienists Threshold Limit Values with "Skin" notations) or produce other adverse dermal effects (i.e., dermatitis, skin cancer). These materials include PAHs, arsenic, nickel, mercury, antimony, and PCBs. Fortunately, the actual concentrations of these materials in these contaminated substrates are relatively low (ppm range) and, as such, are not likely to be hazardous from a skin absorption standpoint. Nonetheless, appropriate chemical protective clothing will be worn whenever the potential for significant dermal contact with these materials exists. Decontamination measures will also be instituted to further reduce contaminant contact and to minimize the spread of contamination in the work area.

A listing of current occupational exposure limits, primary toxicological effects, and relevant physical properties for each of the skin absorbable contaminates is presented in Table 5-1. It is important to note when reviewing this table that the physical and toxicological data contained therein are derived from studies on concentrated (pure) forms of the contaminants and do not accurately represent the low level (ppm) exposure conditions which will be encountered by site personnel working on the project.

Table 5-1. Chemical Data

CHEMICAL	ACGIH TLV	WISHA PEL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
			Inhalation	Skin and eye	Kidneys, liver,	Sp.G.=3.74 BP= 869F MP=599F

CHEMICAL	ACGIH TLV	WISHA PEL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Arsenic	10 ug/m^3	10 ug/m^3	Ingestion Skin contact	irritation, resp. tract irritation, lung and skin cancer.	skin, lungs, bone marrow, and lymph.	Reactivity: acids, bases, oxidizers, iron solutions, and zinc.
Antimony	0.5 mg/m^3	0.5 mg/m^3	Inhalation Ingestion Skin contact	Irritation of eyes, skin, nose, throat, mouth; cough, dizziness, headache, nausea, diarrhea, stomach cramps, insomnia, anorexia.	Eyes, skin, respiratory system, cardiovascular system.	Sp.G.=6.69 BP= 2975F MP=1166F Reactivity: acids, oxidizers,
Nickel	1.5 mg/m^3	1.0 mg/m^3	Inhalation Ingestion Skin contact	Resp. tract irritation, allergic contact dermatitis, conjunctivitis, asthma, lung and nasal cancer.	Skin, lungs, and sinuses,	Sp.G.=4.84 Reactivity: H_2O_2
Mercury	0.025 mg/m^3	0.1 mg/m^3	Inhalation Ingestion Skin contact	Resp. tract irritation, allergic contact dermatitis, asthma, skin and eye irritation, bronchitis, dyspnea, GI tract irritation, tremor, and weakness.	Central nervous system, kidneys, skin, lungs, and eyes.	Sp.G.=13.6 BP= 674 F Reactivity: Acetylene, ammonia, azides, calcium, sodium carbide, and copper
PAHs	0.2 mg/m^3 as coal tar pitch.	0.2 mg/m^3 as coal tar pitch volat.	Inhalation Ingestion Skin contact	Skin, eye, and respir. tract irritation, nervous system effects, skin cancer, teratogenesis.	Skin, eyes, respiratory tract, and nervous system.	Pyrene example: Sp.G.=1.27 BP=759F MP=313F Reactivity: acids and oxidizers.
PCBs	0.5 mg/m^3	0.5 mg/m^3	Inhalation Ingestion Skin contact	Eye irritation, liver damage, chloracne, Reproductive effects, potential human carcinogen.	Skin, eyes, liver, and reproductive system.	Sp.G.=1.38 BP=689 – 734 F VP=0.00006 Reactivity: Oxidizers.

LEL= Lower Explosive Limit F.Pt.=Flash Point VP=Vapor Pressure BP=Boiling Point
UEL= Upper Explosive Limit React.=Reactivity Sp.G.=Specific Gravity MP=Melting Pt.

5.2 Physical Hazards

Several physical hazards are anticipated to be associated with the planned work. These hazards included working around heavy equipment (i.e. drill rigs, backhoes), noise, thermal stress, slips, trips and falls, adverse contact with mechanical equipment and power tools, drilling, and physical injury from heavy lifting. A general discussion of the aforementioned hazards and the work practices that will be used to control them is presented below. A more detailed listing of hazard control strategies for specific tasks is included in the Activity Hazard Analysis (AHA) in Appendix A. This discussion is intended to point out the more obvious hazards reasonably anticipated on this project and assumes that any DOF subcontractor will be responsible for, and meet, all applicable OSHA/WISHA regulations and requirements to their work.

5.2.1 Noise

Noise levels in excess of 85 dBs are likely to exist near motorized equipment, such as, drill rigs and portable generators, operating in the work area. To evaluate and control this hazard, sound level measurements may be collected around each work area periodically throughout the duration of the project. If noise levels exceed 85 dBs and DOF personnel are exposed to these noise levels for the majority of their shift, then they will be required to wear hearing protection and comply with the hearing conservation requirements of WAC 296-817.

5.2.2 Slips, Trips and Falls

Tripping on equipment, uneven walking surfaces, and on debris left on the ground is likely to be a concern on this project. There are likely to be slip, trip, and fall hazards on-board the work boats from wet walkways, unsecured equipment left on deck, open hatches, and pitching and rolling actions of the vessels in rough water. These hazards may also exist on the dock where boats will be moored. In addition, there is a risk that workers could fall from equipment. Slip, trip, and fall hazards will be controlled by keeping the work area free of debris and other litter. Site workers will wear steel-toed safety boots and pay careful attention to surface conditions to prevent trip and fall injuries. The work area will be inspected before the start of work each day to identify any hazards that could cause injury. The results of these inspections will be communicated to site personnel during the daily tailgate safety briefings. Workers will wear personal fall protection whenever they must work at heights 6 ft. or greater above the ground. These situations will be evaluated beforehand by the SSHO and an activity-specific fall protection plan will be drafted.

5.2.3 Thermal Stress

Because all site work will be conducted outside where temperature conditions vary, there is a risk that site workers could develop heat or cold stress. The likelihood of this occurring is dependent on environmental conditions, the level of work activity, and the personal control measures that are used to manage heat loads (work/rest cycles, use of clothing and/or cooling devices, hydration, etc.).

The planned soil and groundwater sampling work, however, is not likely to subject workers to significant heat stress risks unless low-permeability protective clothing is worn (i.e. Tyvek, raingear, etc.) during periods of warm weather. As such, modified Level D and Level C protective clothing will be worn only as necessary and for as short a time period as possible. In addition, workers will be encouraged to self-limit their exposures to heat stress conditions and have co-workers watch for signs and symptoms of heat strain in others. Shaded rest areas and chilled beverages will also be provided.

If visual monitoring indicates that a worker is suffering from heat stress, or if conditions/PPE requirements warrant, workers will be evaluated for heat strain by monitoring their heart rate, body core temperature, and heat strain symptomology. Excessive heat strain may be marked by one or more of the following measures, and an individual’s exposure to heat stress will be discontinued when any of the following occur:

- Sustained heart rate is in excess of 180 beats per minute (bpm) minus the individual’s age in years, for individuals with assessed normal cardiac performance, or
- Recovery heart rate at one minute after a peak work effort is greater than 110 bpm, or
- Body core temperature - as measured with an infrared ear drum scanner - is greater than 100.4°F, or

- There are symptoms of sudden and severe fatigue, nausea, dizziness, or lightheadedness.

Workers who appear to be disoriented or confused, or suffer inexplicable irritability, malaise, or flu-like symptoms will also stop work and rest in a cool location with rapidly circulating air and kept under skilled observation.

5.2.4 Drilling and Heavy Equipment Hazards

Light duty pickup trucks and drill rigs will be used on site during the project. There is a potential for workers to be struck by these vehicles or to be injured by contact with exposed moving parts on mechanical equipment. To control these hazards, safe distances will be maintained between workers and mechanical equipment. Mobile equipment will be equipped with backup alarms and spotters will be utilized as necessary to direct equipment operators when moving and placing equipment. Personnel needing to approach heavy equipment while in operation will observe the following protocols:

- Make eye contact with the operator (and spotter).
- Signal the operator to cease heavy equipment activity.
- Approach the equipment and inform the operator of intentions.

All site workers will wear American National Standards Institute (ANSI) / International Safety Equipment Association (ISEA) 107-2004 Class II compliant reflective road vests when heavy equipment or vehicular traffic is in the vicinity. Workers will avoid standing in the blind areas behind vehicles, particularly when they are backing up.

The drilling subcontractor will ensure that the equipment they bring to the site is in proper working order and that all exposed, mechanical moving parts are appropriately guarded. The driller will also follow such safe work practices as: conducting an underground utility search before drilling, parking their drill rig on level, stable ground with outriggers fully extended, keeping the drill rig's mast at least 15 ft. away from overhead power lines, not moving the rig while its mast is extended, keeping hands clear of the drilling auger, making sure emergency kill switches are operational, inspecting the drill rig before use, using only experienced drill rig operators, and shutting down and securing the drill rig when not in use.

Ambient dust conditions in the work area will also be evaluated with a direct-reading, MiniRam dust monitor. Action levels for these dust measurements are listed in Table 12-1. It may be necessary to collect full-shift personal exposure samples for arsenic on representative members of the drilling crew should the MiniRam results indicate ambient dust conditions are excessive. Results will be compared to arsenic's action (AL) level of 5 ug/m^3 and applicable sections of WISHA's arsenic standard (WAC 296-62-07347). Necessary exposure control measures will be implemented should the AL be exceeded. This exposure monitoring approach will also be applied to other dust producing work activities on-site.

To control dermal exposures to the contaminated drill cuttings, drill rig operators will wear the chemical protective clothing listed in Section 10.0.

5.2.6 Heavy Lifting

Site personnel will be cautioned not to lift or exert themselves beyond their physical ability and to apply proper ergonomic principles when doing their work. Each contractor on site will be responsible for monitoring the work practices of their employees to ensure that they are not over-exerting themselves or engaging in high risk, heavy lifting or repetitive motion activities. Mechanical lifting devices, such as, winches, pulleys, forklifts, hand carts, and dollies, should be used to lift and move equipment whenever feasible. Also, workers should enlist the help of others when lifting and moving exceptionally heavy loads whenever the use of mechanical lifting devices is not feasible. As a matter of policy, DOF employees will not lift more than 50 lbs. individually. Other contractors on-site are encouraged to follow this rule, as well.

5.2.7 Hand and Power Tools

Heavy equipment operators may have occasion to use hand and power tools to operate or repair the equipment they bring to the site. They will ensure that their tools are inspected before use and are used in the proper manner by qualified individuals. Damaged tools must be tagged-out and removed from service. Only non-sparking or intrinsically safe tools must used in locations where sources of ignition may cause fire or explosion. Electrically powered tools using AC current must be GFCI protected. If portable generators are used to power tools and equipment, they must be placed outdoors, downwind and away from workers. Refueling will be done with the generator shut off. Internal combustion engines will be equipped with spark arresters.

5.2.8 Sediment Sampling From Boat

Operating boats or vessels on the water carries the risk of having a crew member fall overboard and possibly drown, striking or being struck by other vessels operating in the area, losing power or steering and drifting into hazardous areas (i.e. shore, marine facilities etc.) and encountering severe weather and dangerous seas, to name a few. The risk of a boating accident can be reduced by ensuring that boat operators are experienced; operating the vessel in compliance with Coast Guard rules and regulations; maintaining the vessel in good mechanical order; avoiding bad weather and dangerous seas; and ensuring emergency equipment is available on-board (i.e. life vests, life rings, life boats, fire extinguishers, communication equipment etc.)

To address these concerns, all work conducted from the sediment sampling boat will comply with all applicable Coast Guard regulations. Boats, will be operated by experienced crewmembers and all equipment will be inspected prior to use to ensure that it is in proper working order. The boat operator will be responsible for the safety of all personnel on the boat and for the integrity of the vessel and its safety equipment.

Prior to the start of field activities, the boat operator will give a detailed health and safety briefing on the location and use of all vessel safety equipment and the procedures for addressing on-board emergencies (i.e. fire, mechanical failure, man overboard situation, etc.). All sample boats will meet U.S. Coast Guard license and registration requirements and be equipped to safely support maximum rated crew and passenger sizes. The maximum number of passengers and weight shall be conspicuously posted on each vessel. The number of passengers shall not exceed the number of PFDs (personal flotation devices). Personnel working from the sample boat will be required to wear a Type II or equivalent PFD at all times. The sample boat will have at least one sound signaling device (air horn), a fire extinguisher, and at least one vessel mounted or hand held radio to communicate with shore-based support facilities and other vessels operating in the waterway. To avoid collision with other vessels operating in the area, boat operators will look for and avoid other vessels operating in the area at all times. Boating operations will be suspended during severe weather or rough seas.

5.2.9 Dermal Contact with Contaminated Soil and Groundwater

Certain areas of the site contain significantly higher levels of contamination then the site in general. Such areas present a higher risk of dermal contact with the site contaminants depending on the nature and extent of the work activity (i.e. degree of contact with contaminated soil and groundwater). These areas will be identified before work begins and are illustrated on the attached site diagram, Attachment A. The SHSO will evaluate all work activities occurring within these work areas and determine if dermal contact with the soil and groundwater is excessive. If so, personnel working in these areas will be required to wear the chemical protective clothing specified in Section 10. They will also undergo decontamination before leaving the regulated area and they will wash their hands before eating, smoking or exiting the site.

6. SITE CONTROL MEASURES

6.1 Property Access and Site Security

Except for the shoreline that borders the Hylebos Waterway, the entire Arkema property is secured with cyclone fencing or other access controls. The fencing incorporates several gates with access roads that open to Taylor Way. DOF site management will control access to the work site by requiring all project personnel and visitors to check with site management and sign the Daily Site Briefing form for the day. These individuals will receive a site orientation briefing on site hazards, controls, emergency procedures, and general site rules, before they will be allowed to enter the jobsite. Visitors will be escorted by an authorized site representative at all times while on-site. They will also stay within designated walkways and behind fenced-off areas including work zones that have been secured with barricades, boundary tape or rope.

Regular site workers will receive site orientation training when first entering the site and attend daily site safety meetings thereafter. They will also follow the " buddy rule" (work with or in close proximity to another worker) when doing their work.

6.2 Regulated Work Areas

Because access to the Arkema site is controlled, and because there are no regular activities on the site, there is little chance of exposing the public to the anticipated work activity of soil/sediment/groundwater sampling. Consequently there generally will not be a requirement to establish additional regulated work areas while performing these activities. At soil/sediment/groundwater sampling locations were respirators are required, or where significant risk is associated with exposure to chemicals, then specific exclusion zones, contamination reduction zones, and support zones will be established as described below. These zones will be clearly marked and only properly trained and medically qualified personnel will be allowed to enter them. Smoking, eating, or drinking will only be allowed in the support zone.

6.2.1 Exclusion Zones

As required by site conditions, exclusion zones (EZs) will be placed around work areas as described below. As a minimum, EZs will be established around each drilling site and active groundwater monitoring and soil / sediment sampling location. EZs will be demarcated with warning tape or other equivalent means (for example cones, barricade, stanchions) and marked with warning signs. Only Hazardous Waste Operations and Emergency Response (HAZWOPER) trained and medically qualified workers wearing the necessary PPE as described in Section 10.0 will be allowed to enter the EZ. All site personnel will be accompanied by another crewmember when working in the EZ. Upon exiting the EZ, site workers will doff personal protective equipment (PPE) and wash their hands and face prior to eating, drinking, smoking or performing any other hand-to-mouth activity.

EZ locations will be altered to account for changing site conditions.

6.2.2 Contamination Reduction Zones

As required by site conditions, Contamination Reduction Zone (CRZ) will be established adjacent to each EZ to provide a secure area for decontaminating and removing the protective clothing worn by those site workers working in the EZs. The CRZs will be equipped with the following equipment, as necessary.

- Chairs or benches for the workers to sit on when removing their clothing
- Wash buckets and brushes for cleaning protective clothing and tools
- First Aid Kit
- Bloodborne pathogen kit
- Air horn (or other emergency alert signal)
- Fire Extinguisher (ABC Type, at least five pound size)
- Spill Kit
- Eyewash station
- Hand wash station (or equivalent materials)
- Containers appropriate for containing used PPE
- Additional PPE components (for example, additional disposable gloves or hearing protection)

6.2.3 Support Zone

As required by site conditions, all areas outside of the exclusion and contamination reduction areas will be considered the support zone (SZ). The SZ will include equipment and material storage areas, employee break areas, temporary office facilities, etc. and will be considered open access for site personnel. No special access requirements other than the general security requirements will be required for access to the SZ.

7. COMMUNICATIONS

Communications at the jobsite will be by verbal command, hand signals, cell phone, or a combination of all three. DOF personnel will carry with them cellular telephones and a listing of emergency telephone numbers. These phone numbers are listed in Section 13 of this plan. Copies of these phone numbers will be available at each operational work area. In the event of an emergency requiring evacuation, the Emergency Coordinator will verbally alert each contractor working on-site to immediately proceed to the designated staging location for a head count and for further instructions on exiting the site.

8. TRAINING AND RECORDKEEPING REQUIREMENTS

Site personnel directly involved in soil, sediment, surface water and groundwater sampling or other site workers who could potentially incur significant dermal or inhalation exposures to the site contaminants will have completed at least 40 hours of hazardous waste operations training, as required by 29 CFR 1910.120/1926.65. These individuals must also have received a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. Those personnel who completed the 40-hour training more than 12 months prior to the start of the project will have attended an 8-hour refresher course within the past 12 months. The Field Project Manager, Site Supervisor (including subcontractor supervisors), and the SHSO must have completed an additional 8 hours of hazardous waste site supervisor training.

A copy of the training completion certificates for each employee (including subcontractors) working in either the EZ or CRZ will be maintained at the project site. All personnel working on site will receive site orientation training that will include a discussion of each element of this HASP and all of its attachments. At least one site worker, who has current first aid/cardiopulmonary resuscitation (CPR) training, will be on site at all times when work is underway. The aforementioned training requirements and other mandatory training and certifications required for this project are summarized in Table 8-1.

Table 8-1 Summary of Training Requirements

Personnel	**Requirements**
SHSO, Field Project Manager, and Site Supervisors	• 40-Hour HAZWOPER, 3 days of supervised field experience training, current 8-hour refresher training • Bloodborne pathogens awareness • Fire extinguisher training [29 CFR 1910.157(g)] • 8 Hr. Site Supervisor Course (29 CFR 1910.120 p. (e)(8)) • First Aid/CPR training • Hearing protection training [29 CFR 1910.95(i),(k)] and hearing conservation program • Site- specific training (including hazcom training)
Technicians working in the EZ or CRZ (includes laborers, scientists, engineers, technicians, etc.)	• 40-Hour HAZWOPER, 3 days of supervised field experience training, current 8-hour refresher training • Hearing protection training [29 CFR 1910.95(i),(k)] and hearing conservation program • Bloodborne pathogens awareness • Fire extinguisher training [29 CFR 1910.157(g)] • Site specific training (including hazcom training)
General site workers **not** working in the EZ or CRZ (includes laborers, scientists, engineers, technicians, etc.)	• Hearing protection training [29 CFR 1910.95(i),(k)] and hearing conservation program • Bloodborne pathogens awareness • Fire extinguisher training [29 CFR 1910.157(g)] • Site specific training (including hazcom training)
Subcontractors and Visitors (not operating in an area where a potential for exposure to contamination exists)	• Site safety brief / safety awareness training

CPR = cardiopulmonary resuscitation

Personnel	**Requirements**

8.1 Site Specific Training

Prior to starting work, each employee will receive site specific health and safety training. The SHSO, or designee, will provide and document site-specific orientation training during the project site kickoff meeting and whenever new workers arrive on site. No site workers will be allowed to begin work on site until the site-specific training is completed and documented by the SHSO. This training will address this HASP and health and safety requirements and procedures pertinent to site operations.

As part of the site-specific orientation training, the following topics will be covered:

- Project introduction and orientation
- Potential site hazards (chemical, physical, and biological)
- Hazard Communication as per 29 CFR 1910.1200 (particularly arsenic hazard awareness training)
- Selection, use, and limitation of PPE
- Emergency procedures
- Contents of the HASP

8.2 Hazard Communication Training

Material Data Safety Sheets (MSDS) will be kept in Appendix C of this HASP for each hazardous chemical used during the project. These MSDSs will be made available to each employee on request. Employees will also be informed about any site operations involving the use of hazardous chemicals, the hazardous nature of the chemicals used, and the location of the MSDSs. Workers who are exposed to hazardous chemicals will be trained to recognized chemical contact hazards in the workplace, the physical properties and health hazards of hazardous chemicals, and the personal protective measures that will be taken to control exposures. All chemical containers used to store hazardous chemicals will also be marked or labeled with the name of the chemical and its hazard warning.

8.3 Emergency Response Training

Personnel on this project will not respond to off-site releases of hazardous materials, structural or major fires, or other catastrophic incidents. Project personnel will only respond to on-site incidents within their training and competency. On-site response training during initial orientation, as well as periodic drills and reviews at each work area will include:

- Employee alarm system
- Evacuation procedures, routes, meeting places, and accountability
- Control of fuel sources
- Fire extinguisher education (No employee is permitted to attempt to fight a fire beyond incipient stage.)
- Minor spill control/cleanup on site in accordance with the plan. This may include source control (e.g., shutoffs, repositioning containers); containment (e.g., drum overpacks, sorbent booms, earthen dikes); and non-emergency cleanup (e.g., sweeping, digging, pumping, and containerization of spills and residues).
- Rescue operations, as necessary

8.4 First Aid and CPR Training

At a minimum, one site worker per work shift will have received first aid and CPR training taught by a certified instructor and approved by an organization such as the American Red Cross. Persons trained in first aid and CPR shall have received instruction on bloodborne pathogens according to 29 CFR 1910.1030. Site-specific briefings will include information about bloodborne pathogen hazards, and the SHSO will keep a record of all site personnel having such training.

On-site medical emergencies will be handled as discussed in the Emergency Response Plan (Section 13). Type III, 16-unit first aid kits that comply with the criteria contained in ANSI Z308.1-1998 will be located on site and in each of the site vehicles, where possible. Bloodborne pathogen barrier kits containing latex gloves, CPR barrier, masks, and eye protectors will also be staged with the first aid kits. They will be inspected weekly and replenished as necessary.

8.5 Tools and Equipment

Any worker using a specific tool must have had training on the proper use of the tool. For tools having common use in construction activities, a visual observation by a supervisor is sufficient to document that worker is knowledgeable of general trade tools (screwdrivers, hammers, pliers, wrenches, etc.). Workers operating heavy equipment must have training or equivalent experience in operating that equipment Training in the operation of forklifts requires training specified in 29 CFR 1910.178, which includes recertification on a periodic basis. A certificate of training in compliance with this regulation is required in the employee's training record.

8.6 Safety Meetings

Site safety briefings will be conducted prior to the start of work each day. During these sessions, each worker (subcontractors included) will be encouraged to share their observations, thoughts, and experiences on safety and health-related issues pertinent to the jobsite. This venue also allows site management to share important hazard communication topics with the workers, such as plan-of-the-day activities and associated hazards and controls, required use of PPE, decontamination procedures, emergency procedures, safe work practices, and HASP changes.

The SHSO will conduct these briefings at the start of each shift. Site briefings may be repeated during the day if new hazards arise, which must be communicated to site personnel, or if other workers arrive at the jobsite later in the day. It is at this meeting that site workers will review the AHA for the tasks to be performed that day. A Daily

Site Briefing form will be used to document these meetings and will include a listing of topics discussed, hazards identified, recommended remedial controls, other pertinent issues, and the names of all attendees. The information gathered in these sessions will be used to correct any unsafe conditions or work practices at the jobsite and amend the SSHP as appropriate. Copies of Daily Site Briefing forms will be maintained in the project files. A copy of this form is included in Attachment C.

8.7 Recordkeeping Requirements

In accordance with the recordkeeping requirements of 29 CFR 1910 and 1926, and DOF's Health and Safety Program, the following health and safety documents will be generated and maintained at the jobsite:

- Daily Tailgate Safety Briefings
- Medical clearance letters
- Training course certificates (i.e. 40Hr. Hazwoper, 8Hr. Refresher, First Aid/CPR, etc.)
- Respirator fit test forms
- Accident report and investigation forms.
- MSDS sheets
- DOF project field notebook
- HASP review declaration
- Weekly and monthly site inspection forms

Copies of these forms are included in Appendix C.

8.8 Inspections

The SHSO will conduct informal daily inspections of the jobsite. The results of these inspections will be recorded in the DOF project field notebook. Safety and health inspections will also be conducted each week by the Field Project Manager and every month by the Project Manager or their designee. Inspection results will be recorded on the “Project Inspection Checklist” found in Appendix C. Copies of the inspection reports will be kept on file for review by the PHSM.

Deficiencies noted during these inspections will be recorded in DOF’s project field notebook . Each deficiency will be corrected by a designated authority according to a pre-assigned completion date. Copies of the inspection findings will be sent to the Project Manager for evaluation and correction of any deficiencies.

9. MEDICAL SURVEILLANCE

DOF site personnel and subcontractors who are exposed to hazardous substances on this project will participate in either DOF’s Medical Surveillance program or in a comparable surveillance program chosen by their employer that meets the requirements of 29 CFR 1910.120(f). This program requires a complete pre-employment physical with associated laboratory tests and a drug screen. DOF site personnel must have passed this examination and have a copy of their medical clearance on file at the site before they will be allowed to enter the EZ or CRZ. This clearance letter, applicable to both DOF and subcontractor personnel, must include the physician’s opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee’s health from work in hazardous waste operations or emergency response or from respirator use. It must also list any limitations upon the employee’s assigned work.

An annual or biennial physical examination (as determined by the occupational health physician) is also required for all personnel participating in this program. Additional physical exams will be made available to program participants who terminate their employment with DOF or who are reassigned to a job position, which does not require participation in the program.

The medical examinations will be provided by a licensed physician, preferably one knowledgeable in occupational medicine, in accordance with 29 CFR 1910.120 (f)(5).

10. PERSONAL PROTECTIVE EQUIPMENT

Prior to the start of work, the SHSO will review the applicable work plans, site historical records, remedial investigation results, etc. and evaluate each major work activity to determine the appropriate level of PPE needed for the work. This evaluation will include a consideration of potential chemical, physical, and biological hazards present; work operations to be performed; potential routes of exposure; concentrations of contaminants present; and characteristics, capabilities, and limitations of PPE, including any hazards that the PPE may create or exacerbate (i.e., heat stress). Evaluation findings and recommendations for the project, to date, are listed in the AHA tables found in Appendix A.

The SHSO will also evaluate PPE usage at the jobsite on a daily basis and determine the necessary PPE for specific activities or portions of activities not included in the AHAs. If necessary, the HASP will be amended to reflect new or modified PPE requirements. All PPE changes will be communicated to site personnel during the daily site briefings and hazard communication training sessions. At a minimum, though, all field activities will require the use of ANSI-approved hard hats, safety glasses, safety-toe footwear; short-sleeve shirts; and long pants and ANSI / International Safety Equipment Association (ISEA) 107-2004 Class II compliant reflective road vests.

Three different levels of PPE—Level D, modified Level D, and Level C —will be available for use during the planned project activities. The PPE components that make up these levels are listed below.

10.1 Level D

For activities not presenting a risk of significant contact with contaminated sediment, soil or groundwater, site personnel will wear Level D consisting of:

- Standard work clothing (long pants and short or long sleeve shirt), gloves (as appropriate), ANSI-approved hard hat and safety glasses
- Chemical-resistant boots or leather work boots with safety toe (as appropriate)
- Hearing protection as required
- ANSI/ISEA 107-2004 Class II reflective road vests where equipment traffic is present
- Leather work gloves

Site operations that are likely to result in minimal contact with contaminated soil and groundwater include operating mobile equipment, working in the SZ, and working in areas where airborne contaminant levels are below PELs. Personnel performing these tasks will wear Level D PPE unless the SHSO determines an upgrade is necessary.

10.2 Modified Level D

Modified Level D will be worn by those site personnel directly engaged in activities that could result in significant skin contact to contaminated sediment, soil, and groundwater. Also, personnel assigned to assist in decontaminating these individuals will wear the same level of PPE. Modified Level D will consist of the following items:

- Disposable Tyvek coveralls or lightweight neoprene raingear or PolyTyvek coveralls if contact with liquid is possible.
- Nitrile gloves
- Rubber boots with steel toes or leather steel toe boots with chemical resistant boot covers.
- Hard hat
- Safety glasses

- Hearing protection as required
- ANSI/ISEA 107-2004 Class II reflective road vests worn on the outside of the coveralls in areas of equipment traffic.

Workers directly engaged in manually handling contaminated sediment, soil or groundwater (such as, drillers and sampling technicians) in the designated exclusion zones and those who repair equipment that is soiled have the greatest potential for contacting site contaminants.

10.3 Level C

Level C will be worn if the air monitoring results described in Section 12.0 indicate that an inhalation exposure hazard (in addition to a skin contact hazard) to volatile organic vapors or arsenic contaminated dust in excess of the specific action levels listed in Table 12-1 exist at the site. Level C will consist of the Modified Level D clothing specified above plus a full-face air purifying respirator (APR) equipped with organic vapor / HEPA cartridges. Cartridges will not be used beyond their calculated end-of-service-life and at a minimum will be discarded at the end of each day.

Efforts will be made to eliminate airborne exposure hazards before resorting to the use of respiratory protection by, for example, allowing vapor emissions to dissipate before resuming work, using water to wet the ground to control dust release, and using exhaust fans to dilute potentially toxic or explosive atmospheres.

10.4 Respirator Use Requirements

All DOF personnel who must wear half-face air purifying respirators (APR) will receive a qualitative fit test in the exact same model, type, and size respirator to be used on the project prior to starting work. Fit test records will be kept on-file at the jobsite. Fit testing will be repeated every twelve months. Only medically qualified personnel will be allowed to use respiratory protective equipment. Medical clearance letters indicating the worker's ability to a wear respirator will be maintained at the jobsite.

Respirator users will also be trained in the selection, use, limitations, and maintenance of the respirators they have been assigned. This training is typically included in the worker's 40 Hr. Hazwoper training course and 8 Hr. Refresher training. Re-training on this subject, however, will be offered to anyone unfamiliar with the aforementioned topics.

Each respirator user on the project will be issued and fit tested in their own respirator which will be issued to them before work begins. They will be responsible for properly cleaning, inspecting, maintaining, repairing, and storing this equipment. Respirators will be cleaned in the manufacturer's recommended cleaning and disinfecting solution after each use. They will then be dried, placed in plastic bags and stored on-site for future use. Each storage bag will be identified with the respirator user's name. The Site Safety and Health Officer will conduct periodic inspections of all operations requiring the use of respirators to ensure the aforementioned respirator use requirements are being implemented.

10.5 PPE Use and Maintenance

Employees assigned to use PPE are required to inspect the equipment before and after each use, discard any equipment that is defective, clean and maintain the equipment according to manufacturer's recommendations, and store their PPE in a clean, secure area. Specific PPE inspection, cleaning, and maintenance procedures vary according to the type of equipment being used. Employees will be informed of these equipment-specific use and maintenance procedures prior to being assigned to their jobs. Training in PPE equipment inspection, cleaning, and maintenance protocols will be provided during the requisite 40-Hour Hazardous Waste Operations course and in the site-specific orientation training conducted by the SHSO. Employees will practice use and inspection of PPE before entering an EZ.

At the end of each shift, the SHSO will examine the inside of a representative sample of protective garments before they are discarded or cleaned to identify evidence of breakthrough. Such evidence would include any discoloration or staining of the clothing; thinning, blistering, or cracking of the clothing material; and the presence of torn seams and perforations. The SHSO will also note if the workers themselves have become contaminated while wearing the PPE. If, based on this examination, it is apparent that the PPE designated for the work is not adequately controlling worker exposures, the level of personal protection will be upgraded.

11. DECONTAMINATON

11.1 Personnel Decontamination

Decontamination for site personnel wearing Level D PPE will consist of having workers remove their hard hats, safety glasses, leather gloves, hearing protectors, and outer protective garments prior to leaving the site and storing them in a clean area for reuse the next day.

Site personnel engaged in activities requiring Modified Level D and Level C PPE will be required to wash their boots and remove their gloves when leaving the EZ. Disposable coveralls will be placed in a designated container for disposal. Workers will wash their hands and face before leaving the CRZ. Respirators, if worn, will be removed last and placed in plastic bags for later inspection, cleaning, and storage. Separate areas for storing street clothing and changing into and out of chemical protective clothing will be determined at the jobsite should level C or modified level C be required.

Personnel decontamination will be conducted in a CRZ situated adjacent to and contiguous with the EZ. A washtub will be placed in the CRZ for workers to use during the decontamination process. Scrub brushes and soap solution may be used to remove soil from clothing. Wash and rinse water will be managed and disposed of as discussed in the Site Work Plan.

The SHSO will ensure that the above-mentioned decontamination procedures are effectively controlling the spread of contamination in the work area by periodically inspecting the recently cleaned clothing and equipment for evidence of residual contamination. The work area also will be examined to detect any sign of contamination outside of the work zones. Should it become apparent that contamination is being dispersed into clean areas of the site, work activities will cease until more effective decontamination methods can be devised.

11.2 Equipment Decontamination

Decontamination of hand tools and heavy machinery will be performed prior to leaving the site or at the conclusion of site activities. Equipment will be cleaned of gross materials using hand tools and brushes and will then be sprayed with water, as necessary. To the greatest extent possible, rinsates will be maintained within the consolidation area or containments. General cleaning of equipment and tools where contact with contaminated materials has not occurred will not be considered decontamination and will not require containment of rinsates. Generation of dust will be minimized to the greatest extent possible.

12. AIR MONITORING

Ambient air measurements for volatile organic vapors will be collected in the breathing zone of site workers when sampling monitoring wells and collecting soil core samples in areas that are known to be contaminated with volatile organic hydrocarbons. The purpose of this monitoring is to ensure that: 1) vapor levels do not pose an inhalation hazard to site personnel, 2) the appropriate level of PPE is being used, and 3) potentially explosive environments do not exist.

Organic vapor levels will be measured with an organic vapor analyzer, such as a PID or FID. As indicated in Table 12-1, total organic vapor levels equal to or less than background will be considered acceptable. Vapor levels in excess of this limit will require that work temporarily stop until vapors dissipate, effective engineering controls are implemented, or workers wear Level C PPE.

Ambient, dust levels in the work area will be measured with a direct-reading, MiniRam dust monitor. For the site, in general, dust concentrations at or below 2.5 mg/m3 will be considered acceptable, requiring no special personal protective controls. If, however, ambient dust exceeds this limit, dust control measures will be implemented and/or site personnel will wear Level C PPE. In the arsenic "hot spot" areas of the site where arsenic levels as high as 25,000 ppm exist, this action level will be lowered to 0.2 mg/m3 ambient dust.

Also, because arsenic has been identified in the site soils at elevated concentrations, particularly in the waste disposal area, it may be necessary to collect 8-hour Time Weighted Average exposure measurements on representative workers involved in dust producing activities to verify that arsenic exposures are below it's action level and to comply with the initial air monitoring requirements of WAC 296-62-07347(5)(b). This sampling will be conducted by Stephen Frost CIH on representative workers.

Air sampling for arsenic will be conducted as per the National Institute for Occupational Safety and Health (NIOSH) Sampling and Analytical Method 7300. Exposure monitoring samples will be sent to an American Industrial Hygiene Association (AIHA) accredited laboratory, NVL Laboratories, Inc. in Seattle, Washington for analysis. Air monitoring results will be recorded in the site field logbook and will be made available for review by all site personnel. Personnel will be notified of any levels of concern verbally upon receipt of the results or through discussions during the next daily safety meeting. Employees who had their personal exposures to arsenic measured will receive a written letter with their test results. This letter will be delivered no later than five days after receipt of air monitoring results.

Calibration and maintenance of monitoring equipment will be done by the SHSO in compliance with the manufacturer's specifications and will be performed prior to daily monitoring. Calibration records will be kept in the project health and safety files. All direct reading air sampling results from the previous day will be discussed with the site crews at the morning tailgate safety meeting.

The above-mentioned instrument readings will be compared to the actions levels listed in Table 12-1.

Table 12-1 Air Monitoring Action Levels

Monitoring Instruments	Activity	Action Level	Site Action
Organic Vapor Analyzer (PID or FID)	• Drilling soil borings. • Constructing groundwater monitoring wells. • Purging and sampling wells. • Working in VOC contaminated soils	≤ background	• Continue working
		> background but ≤ 40 ppm.	• Wear Level C PPE or stop work until vapors are ≤ background.
		>40 ppm	• Discontinue work • Shut down equipment • Evacuate area • Call Project Manager
Personal exposure monitoring for arsenic	• Drilling soil borings. • Constructing groundwater monitoring wells. • Other dust generating activities.	≤ 0.005 mg/m^3 As	Wear Modified Level D
		> 0.005 mg/m^3 As but ≤ 0.01 mg /m^3 As	Medical Monitoring Biological Monitor. Hazcom Training Decontamination and Change areas
		> 0.01 mg/m^3 As but ≤ 0.03 mg/m^3 As	Wear Level C Comply with WAC 296-62-07347.
		>0.03 mg/m^3 As	Suspend work and call PHSM.

Combustible Gas / H_2S Indicator	Drilling soil borings and installing wells in slag pile.	< 10% LEL	Continue or resume working
		> 10% LEL	Stop work, shut down equipment, isolate ignition sources, evacuate immediate work area. Inert auger as appropriate to control explosive atmosphere.
		< 20 ppm H_2S	Continue or resume working
		≥ 20 ppm H_2S	Evacuate imrmediate work area.
MiniRam Dust Monitor	All work activities throughout the site.	< 2.5 mg/m^3	Continue working
		> 2.5 mg/m^3 but < 10 mg/m^3.	Implement dust control measure and/or have site personnel wear Level C PPE.
		> 10 mg/m^3.	Stop work and evacuate site.
	Working in arsenic hot spot areas.	< 0.2 mg/m^3	Continue working
		> 0.2 mg/m^3 but < 2.0 mg/m^3.	Implement dust control measure and/or have site personnel wear Level C PPE.
		> 2.0 mg/m^3.	Stop work and evacuate immediate work area.

13. EMERGENCY RESPONSE

There is a possibility that DOF personnel or their contractors could experience a medical emergency in the normal course of their work or, perhaps, spill fuels and lubricants used to service their equipment. For these emergencies, the following emergency response plan has been drafted. It will be discussed with all project personnel during their initial site orientation training. A copy of the Emergency Response Plan (this section) and a map to the emergency medical facility (Appendix D) will be readily available in each work area.

A listing of emergency response contacts for this project is presented in following table:

13-1. Emergency Response Contacts	
Site Address: 2901 Taylor Way Tacoma, WA	
Hospital:	
St. Joseph's Medical Center 1717 South J Street Tacoma, WA 98405	(253) 426-4100
EMT/Ambulance	911
Pierce County Sheriff's Dept.:	
Emergency	911
Business	(253) 798-4721
Tacoma Fire Dept.:	
Emergency	911
Business	
US Coast Guard	(206) 217-6000 or VHF chnl 16
DOF Field Project Manager, Dave Cooper	Cell: (206) 660-3466
DOF Emergency Coordinator, Dave Cooper	Cell: (206) 660-3466
DOF Project Manager, Matt Dalton	Cell: (206) 498-6616
Port of Tacoma Security (after hours)	(253) 383-9472
Port of Tacoma Security (Agnes TooToo)	Cell: (253) 571-8872
National Response Center	800-424-8802
Dept. of Ecology	800-258-5990

13.1 Emergency Coordinator

DOF's Technical Lead will be the designated emergency coordinator responsible for implementing this emergency response plan. This person will notify emergency responders during a medical emergency (ambulance, hospital, etc.) or spill incident and ensure that the client and all affected project contractors are made aware of any emergencies occurring on-site. DOF's Technical Lead will initiate emergency evacuation procedures, as appropriate, and ensure that injured DOF employees are given emergency medical treatment and are transported to the hospital for follow-up treatment.

The emergency coordinator will conduct an inspection of emergency response equipment every month. This equipment includes fire extinguishers, first aid kits, and spill control equipment. As part of the daily site walk-through, he/she will pay close attention to potential fire hazards, spill potentials, and individual work practices. Emergency response equipment will be stored at an easily accessible location in the work area. Monthly fire extinguisher checks will be documented, either on the fire extinguisher or in the SHSO logbook.

13.2 Site Evacuation

Should a serious or catastrophic situation arise on site, such as but not limited to, an uncontrollable fire, airborne release of flammable or toxic chemical, hazardous liquid spill, significant injury to site personnel, and major earthquake or explosion, the jobsite will be evacuated. Site personnel will be notified of an evacuation through direct communication.

If an evacuation is necessary, all site personnel will proceed immediately to the entry gate to the site on Taylor Way. The emergency coordinator will be informed of the emergency and a head count of all assembled site personnel will be taken. Once everyone is accounted for, they will evacuate further to a safe area designated during site orientation training and the emergency coordinator will assess the situation and outline the actions to be taken.

During the emergency, the emergency coordinator will:

- Ensure injured personnel are given first aid treatment, as appropriate.
- Shut down equipment that could cause a hazard or act as an ignition source;
- Notify applicable emergency response services.
- Prohibit unauthorized personnel from entering the evacuated area by calling Port of Tacoma Security.
- Provide emergency equipment as appropriate; and
- Notify the project manager and client of the incident.

13.3 Environmental Incident (Spill)

Each contractor working on-site will be responsible for containing, controlling, and cleaning up any spills they create. Except for collecting environmental samples, DOF will not be engaged in any work activities that could result in the significant release of hazardous materials into the environment. Spills associated with drilling activities would likely result from the release of diesel fuel, lubricants, or hydraulic fluid into the water from the refueling or maintenance of their equipment. Should such an event occur, the Technical Lead will isolate the spill area; identify the nature and hazardous properties of the spilled material (i.e. reference MSDS sheets); notify site management of the situation; don appropriate personal protective equipment and; contain and control the spill using plugs, patches, containment boom and absorbants, etc.

A small spill, less than 5 gallons, will be handled by the responsible contractor. For spills greater than 5 gallons, the responsible contractor or DOF will call the local emergency response hazmat team (Fire Dept.) for assistance. The heavy equipment contractor will have on hand appropriate spill control equipment consisting of sorbent pads, sorbent boom, vermiculite, duct tape, large plastic bags, shovel, and one 55-gallon drum (or two 35-gallon drums). This spill kit will also include personal protective equipment, such as, disposable PolyTyvek coveralls or lightweight PVC raingear, nitrile gloves, PVC boot covers, and chemical protective goggles. This equipment will be staged at each major work area.

Any spills that occur in the water will be reported to the appropriate regulatory authorities (i.e. Coast Guard, EPA, Dept. of Ecology, etc.) They will direct on-site cleanup resources and efforts.

13.4 Explosion

In the event of an explosion, all non-essential personnel will be evacuated from the site and the work area will be secured. No one will be allowed to re-enter the site, except to possibly save a life, until cleared by the emergency coordinator. If adjacent properties are threatened by the explosion, local emergency response authorities will be called to evaluate the situation and possibly initiate an evacuation of the surrounding community.

13.5 Personal Injury

In the event of serious personnel injury (fatality, patient unconscious, possibility of broken bones, severe bleeding, burns, blood loss, shock, or trauma), the first person on-scene will immediately:

- Administer first aid if qualified; if not qualified, seek out a person qualified to administer first aid; and
- Notify the emergency coordinator of the name of the individual involved, their location, and the nature of injury.

The emergency coordinator, upon receipt of notification of the injury, will immediately:

- Notify emergency medical services and give the appropriate patient information and their location.
- Assist the injured party as deemed appropriate.
- Designate someone to accompany the injured party to the hospital and to provide chemical data sheets to the emergency medical team.
- Notify DOF's project manager.
- Complete an injury report (see Appendix C.)

If the emergency coordinator determines that emergency medical services are not necessary (minor injury such as sprain or abrasion, patient is conscious and can be moved), he/she may direct someone to transport the patient by vehicle to the hospital. A hospital route map will be located in DOF's field vehicle which will be present at each major work area.

13.6 Adverse Weather

Weather conditions in Washington State are typically punctuated by severe winds and rain. In the event of adverse weather, the SHSO working with the site superintendent will determine if work can continue without sacrificing the health and safety of field personnel. Some of the items to be considered prior to determining if work should continue are:

- Extreme cold and wind,
- Heavy precipitation,
- Limited visibility, and
- Potential for accidents.

13.7 Emergency Equipment

The following emergency response equipment will be stored at DOF's field vehicle:

- First aid kits for 5 people,
- 5-pound ABC fire extinguishers (to be inspected monthly),
- Portable, emergency eyewash.
- Cellular phones and/or radios.

This equipment will be inspected monthly by the FPM. It will be cleaned, inspected, and replenished immediately after each use.

Postings related to the Emergency Response Plan will be placed in the DOF field vehicle, sediment sampling boat, or each major work area. The following information from the Emergency Response Plan will be highlighted on these postings:

- Emergency telephone numbers for fire, ambulance, hospitals, police
- Location of fire extinguishers and emergency equipment
- Map to the hospital.

14. HEALTH AND SAFETY PLAN CERTIFICATION

By their signature, the following undersigned certify that this plan has been read, or otherwise communicated to them. They further certify that they completely understand this plan and will follow its procedures for the protection of the health and safety of all persons entering this site.

NAME	**DATE**
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Appendix C

Memo

PIONEER
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To: Troy Bussey, Field Team Members

From: Stacy Munson

Date: July 18, 2016

Subject: XRF Field Screening Procedures, Former Arkema Manufacturing Site, Tacoma, Washington

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The purpose of this memo is to describe the field-portable X-Ray Fluorescence (XRF) unit procedures for real-time analysis of arsenic and other metals in soil at the former Arkema manufacturing site in the Port of Tacoma, Washington during Feasibility Study (FS) Data Gap Investigation field activities.

Introduction

The XRF sample preparation and analysis procedures were developed using United States Environmental Protection Agency (USEPA) Method SW846-6200 (USEPA 2007), the Innov-X Alpha/Delta XRF user instruction manuals (Olympus 2010), and the USEPA and Interstate Technology Regulatory Council (ITRC) Advanced Design Application & Data Analysis for Field-Portable XRF guidance (USEPA 2010). The Innov-X Alpha/Delta XRF unit (or equivalent) meets EPA SW846-6200 requirements and will be used to analyze samples.

XRF Unit Calibration

Calibration checks will be made on the XRF unit by the vendor supplying the unit, and before, during, and after field sample preparation and analysis. Calibration checks ensure that the precision, accuracy, and quantitation limits of the XRF unit are within quality assurance/quality control (QA/QC) standards. Standardization procedures details and frequency are presented in Table 1 and discussed below.

The vendor supplying the unit will be consulted to ensure it is factory-calibrated for analysis of arsenic and other metals in soil. A standard Alloy 316 energy calibration procedure will be performed before, during, and after all field sample preparation activities. Standard reference materials (SRMs) with the range of concentrations likely to be observed at the site will be utilized during calibration procedures in the field to ensure precision and accuracy in the data generated. Standard reference materials will be obtained from the XRF unit manufacturer, the vendor supplying the XRF unit, and/or the National Institute of Standards and Technology.

XRF Sample Preparation - Drying

Soil XRF analytical results can be biased low due to excess moisture because as soil moisture content increases, XRF-estimated metal concentrations will decrease. Therefore, soil samples will be dried to less than 20% moisture content in order to increase data quality (USEPA 2010).

Samples selected for XRF analysis will be placed into a dedicated convection-oven-safe metal pie pan (or equivalent) container and dried to less than 20% moisture in a convection oven before being homogenized and placed into a plastic bag for XRF analysis. A minimum of 5g of soil will be obtained for each sample. Moisture will be measured using a calibrated, decontaminated Decagon EC-5 (or equivalent) soil moisture probe and samples with moisture content greater than 20% will be dried further.

XRF Sample Preparation - Homogenizing

To ensure that soil XRF analytical results are not biased high or low, the soil samples will be sieved and homogenized to increase data quality. Dried samples will be passed through a decontaminated 1/4 in. (6.35 mm) sieve in order to remove large rocks and debris. The sample will be pushed through the screen using a decontaminated pestle. Large debris (e.g., sticks, roots, rocks, trash) that does not pass through the screen will be discarded. As samples pass through the 1/4 in. sieve, the samples will fall onto a piece of butcher or parchment paper. To homogenize the samples, the paper will be folded over by lifting alternating corners, one at a time, for a minimum of 20 corner lifts. Additionally, the mortar and pestle will be used to homogenize soils which may have adhered together while drying. Following homogenization the dried, sieved, homogenized samples will be placed in clear plastic sandwich bags for XRF analysis.

XRF Analysis Procedures

The drying and homogenizing sample preparation steps described above may be modified in the field, if other laboratory analyses are to be requested for a sample and drying activities would impact the soil matrix such that the analyses cannot be performed. In those cases, an initial homogenization and sample splitting step may be performed to preserve the original soil matrix conditions.

To ensure that quality arsenic and other metals analytical results are collected, the XRF unit will be secured in a "stand" that will hold it in place and reduce the chance for operator error. Square sample bags will be "shot" by the XRF four times, once in each quadrant. Two readings will be collected from diagonal quadrants, then the bag will be flipped over and readings will be collected from the other two quadrants. Each XRF analysis shot will be for 60 seconds. All readings (and the detection limits for those readings) will be recorded. Any sample with intra-quadrant readings with a difference greater than 40% will be re-homogenized and re-analyzed. If intra-quadrant analytical results still have a difference greater than 40%, it will be assumed that the variability was due to natural heterogeneity in soil.

The representative arsenic and other metals concentrations in a sample may be determined by calculating the 95% Upper Confidence Limit (UCL) on the mean using the four readings (USEPA 2010).

Following collection of XRF sample readings, the samples will be double-bagged. Additional analyses (if requested) will be documented on a chain-of-custody form and samples will be prepared for transport and submitted to the laboratory. Samples not identified for other analyses may still be sent to the laboratory for archive purposes.

XRF QA/QC Procedures

Data collection procedures and QA/QC procedures were identified to address XRF QA/QC metrics including bias, precision, accuracy, detection limits, quantitation limits, representativeness, and comparability. The QA/QC procedures presented in Table 1 will be performed at the frequency indicated and logged in the daily field notes. All QA/QC procedures that require XRF shots will be run for 60 seconds.

References

Olympus. 2010. User Manual. Delta Family: Handheld XRF Analyzers.

USEPA. 2007. SW-846 Test Method 6200: Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment.

USEPA. 2010. USEPA and Interstate Technology Regulatory Council (ITRC) Advanced Design Application & Data Analysis for Field-Portable XRF guidance.

Table 1: XRF QA/QC Procedures

			Frequency				
Procedure Name	**QA/QC Metric**	**Procedure Notes**	**Every Sample**	**Beginning of Day**	**1 in 20 Samples**	**Every 4 Hours**	**End of Day**
Sample Drying	Reduce bias by reducing soil moisture content to an acceptable level	Dry sample to less than 20% moisture content	X				
Sample Homogenization	Reduce bias by homogenizing sample	Sieve (1/4 in. or 6.35 mm) to achieve a uniform particle size and remove debris. Homogenize by folding the soil over on itself and mortar and pestle (as necessary).	X				
Default Instrument Calibration Procedure	Accuracy	Self-calibration is conducted during Innov-X Alpha/Delta startup using Standard Alloy 316 will be supplied by the XRF manufacturer.		X	X	X	X
Instrument Calibration Procedure Using Standard Reference Materials	Precision, Accuracy, and Quantitation Limits	SRMs will be sourced from standards agencies and arsenic and other metals concentrations will be consistent with Site conditions. Seven readings will be taken of all SRMs. SRM readings will be no greater than 20% different.		X	X	X	X
Determining Detection Limits	Detection Limits	Take readings of blank sample material (silicon dioxide sand) 7 times, find standard deviation, multiply by 3.143 to determine the minimum detection limits for arsenic and other metals and make sure they are less than action levels.		X			
XRF Shot Duration	Precision	Each XRF shot will be for 60 seconds.	X				
Number of XRF Shots per Sample	Accuracy	Four shots per sample	X				
Instrument Correction Factor for Elemental Interference	Quantitation Limit	Innov-X Alpha/Delta algorithm is run automatically.	X				
Sample Replicate Analysis	Precision and Representativeness	Take 3 readings from a sample at the same location on the baggie. All three sample results should be no greater than 40% different.			X		
Analytical Confirmatory Analysis	Comparability	Samples will be submitted for analytical analysis of total arsenic.			X		

Appendix D

Memo

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To: Arkema Team Members

From: PIONEER

Date: July 13, 2016

Subject: PIONEER Technologies Corporation Sample Number Schema

All:

The following sample number schema should be used on all PIONEER Technologies Corporation (PTC) projects:

MediaCode-SiteID-DateCode-TopDepth-BotDepth-(PTCTypeCode) – Be sure to use Dashes and Not Underscores

- Media Code = 2 Letter Code for Media Sampled At Location (see Table 1)
- Site ID = 1 to 10 Letter/Number Code for Site ID (with Dash between Site ID and Site ID # (e.g., MW-01)
- DateCode = 6 Number Code for Date (no slashes between monthdayyear)
- TopDepth = Optional but must have 1 decimal point max.
- BotDepth = Optional but must have 1 decimal point max.
- PTCSampTypeCode = Optional (see below)
    - (01) – For Field Duplicate/Replicate #1/Test Case #1
    - (02) – Replicate #2 or Test Case #2
    - (03) – Replicate #3 or Test Case #3
    - (04) – Replicate #4 or Test Case #4
    - (05) – Replicate #5 or Test Case #5
    - (06) – Replicate #6 or Test Case #6
    - (07) – Replicate #7 or Test Case #7
    - (08) – Replicate #8 or Test Case #8
    - (09) – Replicate #9 or Test Case #9
    - (10) – Leachate Sample
    - (20) – Dissolved Sample (i.e., filtered in the field or by the lab)

Note: PTCSampTypeCodes can be combined. For example, a PTCSampTypeCode of “(11)” indicates that the sample is a field duplicate of a leachate sample and a PTCSampTypeCode of “(21)” indicates that the sample is a field duplicate of a dissolved/filtered sample.

Examples:

- EF-EF-01-100112 – No Depth Interval
- EF-EF-01-100112-(01) – No Depth Interval & Field Duplicate Sample of EF-EF01-100112
- GW-MW-01-100112-10.5-20.5 – With Depth Intervals (10.5 to 20.5 feet)

- SO-SS-01-100112-0-0.5 – With Depth Intervals (0 to 0.5 feet)

Note: Examples of leachate and dissolved samples that require field duplicates or replicates:

- SO-SS-01-100112-0-0.5-(11) – Field Duplicate of Leachate sample with depth Intervals (0 to 0.5 feet).
- SO-SS-01-100112-0-0.5-(14) – Replicate #4 of Leachate sample with depth Intervals (0 to 0.5 feet).
- GW-MW-01-100112-10.5-20.5-(21) – Field Duplicate of Dissolved/Filtered groundwater sample with depth intervals (10.5 to 20.5 feet)
- GW-MW-01-100112-10.5-20.5-(23) – Replicate #3 Triplicate of Dissolved/Filtered groundwater sample with depth Intervals (10.5 to 20.5 feet).

Table 1 – PTC Media Codes for Sample Numbers

Media	Media Code for Sample Number	Description
Ambient Air	AA	Ambient Air
Asphalt	AS	Asphalt
Bituminous Coating	BC	Bituminous Coating
Brick	BR	Brick
Concrete	CO	Concrete
Dust	DT	Dust
Equipment Blank	EB	Equipment Blank
Effluent	EF	Effluent
Field Blank	FB	Field Blank
Field Spike	FS	Field Spike Sample
Groundwater	GW	Groundwater
Indoor Air	IA	Indoor Air
Influent	IN	Influent
Midpoint Between IN and EF	MD	Midpoint Between Influent and Effluent Samples
Other Liquid	OL	Non-specified Liquid
Other Solid	OS	Non-specified Solid
Performance Evaluation	PE	Performance Evaluation Sample
Perched Water	PP	Perched Water
Paint	PT	Paint, Paint Chips, Paint Flakes
Pore Water	PW	Sediment Pore Water
Sierra-Crete	SC	Sierra-Crete
Sediment	SD	Sediment
Stack Sample (Emissions)	SE	Stack Sample (Emissions)
Soil Gas	SG	Soil Gas, Soil Vapors, Sub-Slab Soil Gas
Sludge	SL	Sludge
Soil	SO	Soil
Seep Water	SP	Seep Water from Bank Samples
Surfacewater	SW	Surfacewater

Table 1 – PTC Media Codes for Sample Numbers		
Media	**Media Code for Sample Number**	**Description**
Trip Blank	TB	Trip Blank
Tap Water	TW	Tap Water, Drinking Water
Wood	WD	Wood Debris, Wood Waste
Waste Solid	WS	Investigation Derived Waste Solid
Waste Water	WW	Investigation Derived Waste Liquid
Treated Water	XW	Treated Water from Pilot Test, Treatability Study

Sincerely,

Chris Waldron

Appendix B

Description of Field Procedures
FS Data Gap Investigation
2017 Field Measurements/Sampling

Former Arkema Manufacturing Site
Tacoma, Washington

January 2019

Prepared by:

Dalton, Olmsted, & Fuglevand
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Prepared for:

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Pioneer Technologies Corporation

DALTON
OLMSTED
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APPENDICIES

1.0 GENERAL

This report summarizes the field measurements and samples that were collected in support of the Feasibility Study (FS) Data Gap Investigation between August 2017 and November 2017. Procedures used to accomplish the field measurements and sampling followed those described in the Washington State Department of Ecology (Ecology) approved FS Data Gap Investigation Work Plan (WP) prepared by Pioneer Technologies Corporation (Pioneer). Field activities associated with Data Gaps #1A through #1C, #2A through #2D, #3, #4A and #4B are described in this document. Anticipated 2018 field activities associated with Data Gaps #4A as well as a follow-up groundwater sampling event per Data Gaps #2A and #2B will be documented separately.

Samples of various media were collected including surface and subsurface soils, groundwater, pore water, marine water from the Hylebos Waterway, and intertidal / subtidal sediment from the Arkema shoreline. Collection of samples from various media used the same general procedures (e.g. geologic logging) that are described below. Procedures specific to the media being sampled are described in the following sections.

1.1 Deviations from the WP

Fieldwork was completed in general accordance with the WP. There were only a few minor fieldwork deviations from the WP, and all of the deviations were either directed by or approved by Pioneer. The fieldwork deviations were:

- A smaller mesh size (22 microns) was used for constructing the nylon screen diffusion samplers (NSDSs). This was based on similar site experience and reduced the potential for turbid samples.
- A water sample was not collected from a MW-A2-2 replacement monitoring well. This well was planned, but never installed at the Former Dunlap Mound Site.
- Field water quality measurements of total iron and sulfate were not collected, a simplification of the WP.
- A few high density polyethylene (HDPE) and fluorinated high density polyethylene (FLPE) sample containers submitted to Brooks Applied Labs (BAL) were accidentally switched. The Lab was notified in a timely manner and no data was compromised.
- A static water level monitoring event was not conducted during low tide (a high tide event was conducted). This was a planned simplification of the WP.
- An additional soil boring was advanced and sampled pursuant to Data Gap #2D (PTC-129). This was a planned addition to the WP.
- Soil samples pursuant to Data Gap #2D were not collected from PTC-117, PTC-118, PTC-127, and PTC-128. This was a planned simplification of the WP.

1.2 Field Documentation and Geologic Logging

Field measurements, sample collection and documentation of the field work were completed by or under the supervision of David Cooper, a licensed geologist with DOF. Field data was recorded using field forms that were included in the SAPs.

Soil samples were described in the field using American Society for Testing and Materials (ASTM) D-2488 as a general guide. Samples were field screened for visual indications of contamination (color, staining etc.). Soil borings for Data Gap #2D were screened for arsenic by X-ray fluorescence (XRF) and are described in a more detail in Section 4. Select soil borings for Data Gap #2D were also screened for pH.

Geologic logs were prepared based on the sample descriptions and field screening; these are included in Appendix A. Completed field forms are included in Appendix B.

1.3 Sample Handling

Sample labeling was completed as described in the approved WP. Filled sample containers were placed in chilled coolers for transport to the laboratory. Samples were delivered to the laboratory generally the same day or within 48 hours (soil and sediment samples) and 24 hours (water samples) of collection. Sample handling was documented using standard chain-of-custody (COC) procedures. The samples remained in the immediate possession of DOF personnel at all times, or securely stowed (i.e. locked vehicle) before delivery to the laboratory by the sample collection team, or under custody seal by Thunderdog Messengers. A COC record accompanied the samples at all times which included the site and sample identification, date of collection, analysis requested, and the name and signature of the sampling technician. Analytical Resources Inc. (ARI) of Tukwila, Washington and BAL of Bothell, Washington performed the laboratory analyses.

Samples for sequential extraction analyses, arsenic speciation analyses, and batch adsorption testing required anoxic preservation.

Water samples requiring anoxic preservation were decanted into laboratory prepared vacutainers within a carbon dioxide atmosphere created inside a cooler containing dry ice.

Soil and sediment samples requiring anoxic preservation were immediately removed from the core and placed into laboratory prepared containers using the following procedure:

(1) Transferred the sample to an 8 oz. jar with little or no headspace, using decontaminated stainless steel spoons,
(2) Placed the sealed sample jar in a zip-loc Mylar bag,
(3) Added oxygen-absorbing packets to the Mylar bag,
(4) Purged the Mylar bag with nitrogen gas introduced by flexible hose from a portable cylinder
(5) Manually expressed the majority of gas from the Mylar bag,

(6) Sealed the Mylar bag,
(7) Loosened the threads of the inner jar lid to allow oxygen absorption packets to work,
(8) Placed the sealed Mylar bag in a re-sealable plastic bag,
(9) Manually expressed the majority of air from the plastic bag, and
(10) Stored and transported the sample in a cooler with dry ice.

Following preservation of the anoxic samples, additional sample volume was collected for conventional analyses and placed into laboratory prepared jars.

1.4 Surveying

Survey reference datums used for this project are listed below:

- Horizontal coordinates – 0.1 feet tolerance
  North American Datum [NAD] 1983 (2007)
  Based on National Geodetic Survey (NGS) continuously operation reference stations (CORS)
  WA – State Plane Zone South 4602, U.S. Survey Feet

- Vertical elevation – 0.01 feet tolerance
  Datum: Mean Lower Low Water [MLLW] as defined by the National Ocean Service Commencement Bay, Bench Mark *"Tide 22 1933"* = 19.39 feet for time period 1960-1978 Epoch.

The horizontal coordinates of sampling locations were determined by professional survey or using a Trimble Geo XH Differential Global Positioning System (DGPS). The vertical elevations for the monitoring well top of casings were determined by professional survey to the above datum/tolerance. Vertical elevations for the upland borings, intertidal and subtidal samples were estimated based on existing mapping data or relative to predicted tides.

1.5 Decontamination Protocol

Downhole drilling equipment was steamed cleaned prior to use and between each boring to avoid cross contamination. Other sampling equipment was decontaminated between each sample interval using soap (Liquinox) and a double rinse with tap water.

1.6 Investigation Derived Waste (IDW)

Decontamination water and residual soils from sample cores were placed in sealed barrels and appropriately marked for waste profile and disposal. Purge-water generated from groundwater monitoring wells sampling was placed in 350 gallon totes onsite, appropriately marked, and profiled for disposal. The IDW consisted of:

- 4 -55 gallon drums of soil cuttings
- 600 gallons of purge water

The waste was picked up on April 6, 2018 and transported for disposal at the Greater Wenatchee Regional Landfill, Wenatchee, Washington. (Manifests are included as Appendix D).

2.0 DATA GAPS 1A, 1B, 1C - ARKEMA SHORELINE SAMPLING

Pore water and surface water samples were collected during October and November of 2017 and consisted of seven pore water push point samplers (PPSs) and eight locations using NSDSs. Surface water samples were collected from three locations using NSDSs.

2.1 PPS Sampling

Subtidal pore water samples were collected using PPSs on October 4-6, 2017. The PPS samples were generally taken during an outgoing/falling tide, or near low tide. Samples from seven locations were collected at the following stations:

Shoreline PPS Pore Water Sampling Locations

Station	Elevation (feet MLLW)[a]	Location
119+25-ST1	-5	Intermediate aquifer outcrop
120+75-ST1	-5	Intermediate aquifer outcrop
123+25-ST1	-5	Intermediate aquifer outcrop
125+00-ST1	-5	Subtidal Cap
126+80-ST1	-5	Subtidal Cap
128+50-ST1	-5	Intermediate aquifer outcrop
130+75-ST1	-5	Intermediate aquifer outcrop

Note: (a) Elevation based on diver depth gauge relative to tide at time of sampling

A PPS sampling device constructed by DOF was deployed by divers from Northwest Underwater Construction LLC under subcontract to DOF. Each PPS consisted of a ½” diameter stainless steel probe with a retractable stainless steel screened tip, capable of penetrating 9-12 inches into the sediment/cap and shielded by a 24” diameter pan with a 3” lip to impede short-circuiting of surface water. The probe was connected to ¼” polyethylene tubing which ran up to the shoreline and was connected to a peristaltic pump.

PPS shield

PPS probe with Screen

Once the diver seated the sampler into the surface sediment/cap and retracted the probe to expose the screen, pore water was purged by pumping at a rate of 100-500 ml/min. Approximately two to three gallons were purged prior to sampling. Field measurements were made during the purging for pH, electrical conductivity, temperature, dissolved oxygen (DO), oxidation/reduction potential (ORP), total dissolved solid (TDS), turbidity, ferrous iron, and sulfides (as described in Section 3.0). Samples were decanted directly into laboratory prepared containers. Samples slated for dissolved metals analyses were field filtered using a 0.45 micron filter prior to decanting into the laboratory prepared container. Arsenic speciation samples were collected under anoxic conditions in accordance with the WP (e.g., creating a carbon dioxide atmosphere in a cooler containing dry ice). All samples were placed in coolers packed with wet ice to chill the samples below 4 degrees Celsius, during transport to the laboratory.

2.2 NSDS Sampling

Pore water and surface water sampling using NSDSs was conducted between October and November 2017. The samplers were deployed during the week of October 2 to 6, 2017 and retrieved on November 15, 2017 during an outgoing/falling tide or near low tide. Shoreline samples representative of Upper Aquifer pore water, Intermediate Aquifer pore water and Hylebos surface water were collected.

NSDS Locations

Station	Elevation (feet MLLW)[a]	Location
120+75-SW	-5	Surface water
120+75-ST1-DS	-5	Intermediate Aquifer outcrop
122+60-0-DS	+3	Upper Aquifer outcrop
124+00-0-DS	+3	Upper Aquifer outcrop
125+00-ST1-DS	-5	Subtidal Cap
125+00-SW	-5	Surface water
125+50-0-DS	+3	Upper Aquifer outcrop
126+90-0-DS	+3	Upper Aquifer outcrop
128+30-0-DS	+3	Upper Aquifer outcrop
128+50-ST1-DS	-5	Intermediate Aquifer outcrop
128+50-SW	-5	Surface water

Note: (a) Elevation based on diver depth gauge and/or relative to tide at time of sampling.

NSDS Samplers were fabricated consistent with established procedures (USGS 2002, 2005; Peijnenburg et al 2013; GSI 2016). Each NSDS consisted of (1) a clean polyethylene sample jar with a threaded rim, (2) deoxygenated, deionized water, (3) a 22 micron nylon screen mesh, and (4) a threaded jar ring, prepared prior to deployment. The NSDS jars and screen mesh were acid washed and certified for trace metals by BAL. The deionized water used to fill each container was also deoxygenated with nitrogen gas and supplied by BAL.

NSDSs with Anoxic Transport Chamber/Bucket

To deploy each pore water NSDS, a shallow trench was excavated at the target location with a decontaminated non-metal hand trowel in order to minimize disturbed sediment. The NSDSs were placed in the small trench, targeting approximately 0 to 10 centimeters of embedment below the mudline. Eight-8 oz. NSDSs were necessary at each sample location to provide the required volume of water for field measurements and laboratory analyses. The multiple NSDSs were placed adjacent to each other (at the same elevation), with the mesh sides of the NSDSs facing the Site. Each NSDS was equipped with dedicated heavy fishing-line ties that were secured to a nearby metal stake for easier retrieval. The NSDSs were covered with native sediment and the stake marked with a yellow float to assist in retrieval.

NSDSs for surface water sampling were prepared prior to deployment in the same manner described above for pore water NSDSs. NSDSs for surface water sampling were deployed by securing eight-8 oz. NSDSs in a new heavy duty nylon mesh oyster bag. The oyster bag was secured to the shoreline with plastic anchor stakes and marked with a yellow float to assist in retrieval of NSDSs. Intermediate Aquifer and surface water NSDSs were installed and retrieved by divers from Northwest Underwater Construction LLC under subcontract to DOF.

Surface Water NSDS in Oyster bags

The NSDSs were allowed to equilibrate for approximately five weeks prior to retrieval. Following retrieval at each sample location, the set of eight, 8 ounce NSDS jars were carried directly to the onsite mobile field office for sampling, maintaining an anoxic atmosphere. The water samples were withdrawn from each of the NSDSs by plunging a decontaminated stainless steel dispensing needle through the nylon membrane which was connected to polyethylene tubing and using a peristaltic pump. Samples were decanted from the pump tubing into the appropriate laboratory prepared containers. Samples for total and dissolved metals analyses were collected from the same NSDS jar.

Field measurements were made during the sampling for pH, electrical conductivity, temperature, DO, ORP, TDS, turbidity, ferrous iron and sulfides using the same instrumentation described in Section 3.1. Due to limited sample volume, the measurements were made directly in the open water, without using a flow-through cell. Samples slated for dissolved metals analyses were field filtered using a 0.45 micron filter prior to decanting into laboratory prepared containers. Arsenic speciation samples were collected under anoxic conditions in accordance with the WP (e.g., creating a carbon dioxide atmosphere in a cooler containing dry ice). All samples were placed in chilled coolers for transport to the laboratory.

NSDS Water Sampling Apparatus

3.0 DATA GAPS 2A, 2B, 2C - GROUNDWATER SAMPLING

For this 3rd quarter sampling event, primary water samples were collected from:

- 66 - Upper Aquifer monitoring wells, including 8 OMMP wells.
- 6 - Upper Aquifer angled shoreline wells.
- 51 - Intermediate Aquifer monitoring wells, including 8 OMMP wells.
- 18 - Deep Aquifer Monitoring wells, including 7 OMMP wells.

Sampling was conducted between October 11, 2017 and November 3, 2017. In addition to the groundwater sampling, a bulk sample was collected for Batch Absorption testing from monitoring well 7I3-2.

3.1 Groundwater Sample Collection

Prior to sampling, static water levels were measured at all locations except the angled shoreline wells. Groundwater samples were collected using peristaltic pumps. The majority of the wells already had ¼-inch polyethylene tubing installed in the screen section for use of the peristaltic pump. New dedicated tubing was installed in other wells as necessary. Samples obtained from the angled shoreline monitoring wells were collected during a falling tide or near low tide.

Low flow sampling techniques (0.5 liters/minute) were used to minimize sample turbidity. The wells were purged until pH, temperature and electrical conductivity generally stabilized to within 10%. Field observations and measurements were documented on the Water Sampling Field Form (see Appendix B).

Field measurements were made during the groundwater sampling for pH, electrical conductivity, temperature, DO, ORP, TDS, turbidity, ferrous iron and sulfides using the following equipment:

- Flow-thru cell equipped with an In-Situ SmartTROLL Multiparameter Handheld Probe that directly measured:
  - pH
  - DO (polarographic cell)
  - ORP (Ag Ag/Cl reference electrode, stabilized with 4M KCl)
  - Temperature
  - Conductivity
  - TDS (derived from conductivity)
- LaMotte 2020 Turbidity Meter used to measure:
  - Turbidity
- Hach DR 900 Colorimeter used to measure:
  - Ferrous iron – up to 3.0 mg/l without dilution (with field dilution – limit 20X or maximum 60 mg/l)
  - Sulfide - up to 0.70 mg/l without dilution (with field dilution - limit 50X or maximum 35 mg/l)

The field instruments (meters) were calibrated on a daily basis. Water quality measurements are summarized in Table 1 (see Appendix C).

Groundwater samples were pumped directly into labeled containers, with the appropriate preservatives, provided by ARI and BAL, as outlined in the WP. Samples for dissolved analytes were field filtered using disposable in-line 0.45 micron filters. Arsenic speciation samples were collected under anoxic conditions in accordance with the WP (e.g., creating a carbon dioxide atmosphere in a cooler containing dry ice). Sample labeling was completed as described in the WP.

To assist in assessing the quality of data, field quality control samples (e.g. field duplicates, equipment rinsate blanks) were collected in accordance with the WP.

Purge water was collected in a mobile 250 gallon tank and routinely transferred to 350 gallon cube tanks for temporary storage onsite.

3.2 Water Level Measurement

Water levels were measured using calibrated electric well probes (recorded accuracy to +/- 0.01 feet). Measurements were made as part of assessing groundwater flow gradient directions and during groundwater sampling. In November, a single set of measurements were made at high tide in wells located onsite. Water level measurement protocols included:

- Measurements were made in as short a time period as practical to reduce the effects of the tide (primarily in wells located near the shoreline that are screened in the Intermediate and Deep Aquifers).
- Measurement started with the wells closest to the shoreline and advanced inland with time.
- Measurement started near the end of a rising tide so that a greater portion of the slack tidal period could be incorporated into the measurement period. The measuring event generally spanned approximately three hours.
- Measurements were made relative to the top of well casing mark or highest spot on an uneven casing, previously surveyed.
- The measurements, including the time the measurements were made, were recorded on the Water Level Measurement Field Form and are summarized in Table 2 (see Appendix C).

The high tide measurements were made on November 28, 2017, when high tide was 12.0 feet MLLW at 12:24 PM (based on NOAA published prediction at station 9446484 Commencement Bay).

4.0 DATA GAPS 1A, 1B, 2D, 4A, 4B - SOIL BORINGS / SEDIMENT SAMPLING

Soil and sediment samples were collected for geochemical data in order to help evaluate plume stability during September and October 2017.

A total of 11 upland soil borings were completed and eight sediment samples collected:

- Five Soil Boring locations pursuant to Data Gap #4A: PTC-101, PTC-111, PTC-113, PTC-121, and PTC-129
- Four Soil Boring locations pursuant to Data Gap #4B: PTC-204, PTC-205, PTC-207, and PTC-208
- Two Soil Boring locations pursuant to Data Gap #2D: PTC-001 and PTC-002
- Five Intertidal (Upper Aquifer) Sediment Sample Locations where NSDSs were also installed pursuant to Data Gap #1A: 122+60-0-SED, 124+00-0- SED, 125+50-0-SED, 126+90-0-SED, and 128+30-0-SED
- Three Subtidal (Intermediate Aquifer) Sediment Sample Locations where NSDSs were also installed pursuant to Data Gap #1B: 120+75-ST1-SED, 125+00-ST1-SED, and 128+50-ST1-SED

Field procedures unique to this task and described in the following subsections include:

- Soil Sampling from Soil Borings
- XRF Field Screening
- Sediment Sampling
- Anoxic Soil/Sediment Sample Preservation

4.1 Soil Borings

The soil borings were advanced using a Geoprobe 6600 truck-mounted, direct-push drill rig, operated by a licensed driller from Cascade Drilling, Inc. of Woodinville, Washington. Soil samples were collected from soil borings on a continuous basis using a dual-tube or macro sampler equipped with an acrylic liner. The borings ranged in depth from 40 to 45 feet below ground surface. The soil lithology was described in the field in general accordance with ASTM D2488. The presence of stains, coatings, or other indications of potential contamination was also noted. In general, two borings were co-located at each planned location – the first in order to field screen and the second to obtain sufficient sample volume with minimal exposure to ambient air.

Push-Probe Equipment and Mobile Field Office

Field screening and sampling included:

- At least one soil sample was collected for XRF field screening every 2.5 feet.
- Select borings (PTC-204, PTC-205, PTC-207, and PTC-208) were field screened for pH on 1-foot intervals.

Based on field screening results and lithologic observations for each soil boring, four soil samples were submitted for laboratory analyses:

- 1 Upper Aquifer
- 1 First Aquitard
- 1 Intermediate Aquifer

- 1 Second Aquitard

Representative soil samples were collected for analyses designated in the WP.

Field Sampling Station Layout

4.2 Field Screening

Field screening of soil samples utilized the following equipment and procedures.

pH Field Screening – The sample cores from borings PTC-204, PTC-205, PTC-207, and PTC-208 were field screened for pH on 1-foot intervals using a HANNA 99121 Direct Soil pH Meter. The meter probe was inserted into the soil core for a direct reading. If there was not enough soil moisture for a reading, a small amount of deionized water was spritzed on the core location to allow better contact.

XRF Field Screening – A portable XRF unit (INNOV-X Alpha) was used to field screen for arsenic. This field screening method was used to provide a vertical profile of arsenic concentrations within the soils of the boring and assist in selecting samples for laboratory analysis. The instrument was calibrated and operated by a representative of Pioneer working with staff from DOF.

Soil collected from each sample interval was screened using the following the procedure:

(1) Samples were placed into an aluminum pie pan and dried to less than 20% moisture in a convection oven before being homogenized.
(2) Sieved samples by passing sample through a decontaminated 1/4 in. (6.35 mm) sieve in order to remove large rocks and debris and placed onto a piece of parchment paper.
(3) Homogenize samples by folding the parchment paper, lifting and folding alternating corners, one at a time, for a minimum of 20 corner lifts. Additionally, a mortar and pestle were used to homogenize soils which adhered together while drying.
(4) Following homogenization, the dried, sieved, homogenized samples were placed in clear plastic sandwich bags for XRF analysis.

(5) Each sample was analyzed by the XRF four times, once on each of the four quadrants of the plastic bag. The representative arsenic concentration of each sample was determined by calculating the 95% upper confidence limit on the mean for the four quadrants.
(6) Data collection procedures and QA/QC procedures were completed as described in the WP to address XRF QA/QC metrics including bias, precision, accuracy, detection limits, quantitation limits, representativeness, and comparability.

Field XRF Analysis

4.3 Boring Completion and Surveying

Following sampling, each boring was backfilled with bentonite chip or grout in accordance with Chapter 173-160 Washington Administrative Code (WAC). Boring locations were surveyed, establishing horizontal coordinates using a DGPS. Based on the sample descriptions and field screening, geologic logs were prepared and are included in Appendix A.

4.4 Intertidal Sediment Samples from Arkema Shoreline

Intertidal sediment samples were collected (prior to NSDS installation) on October 2 to 3, 2017 by DOF during a low tide. A representative surface grab sample of sediment (upper 10 centimeters [cm]) was collected by hand using a decontaminated stainless steel spoon and mixed in a stainless steel bowl. The sample was transferred to laboratory prepared containers for transport to ARI. Samples were collected at the following five locations:

Intertidal Sediment Locations

Station	Elevation (feet MLLW)[a]	Type Location	Description
122+60-SED	+3	Intertidal Cap	Brown, coarse sandy, GRAVEL
124+00-SED	+3	Intertidal Cap	Brown, coarse sandy, GRAVEL
125+50-SED	+3	Intertidal Cap	Brown, gravelly, coarse SAND
126+90-SED	+3	Intertidal Cap	Brown, gravelly, coarse SAND
128+30-SED	+3	Intertidal Cap	Brown, gravelly, coarse SAND, with trace silt

Note: (a) Elevation based relative to tide at time of sampling

4.5 Subtidal Sediment Samples from Arkema Shoreline

Subtidal samples were collected on October 4-6, 2017 by divers from Northwest Underwater Construction LLC under subcontract to DOF. A representative grab sample of the subtidal sediment (upper 0 to 10 cm) was collected by hand under water using a stainless steel spoon to scrape a sample directly into a glass jar which was immediately capped. Once on shore, standing water was decanted from the sampling device/container and the remaining sediment transferred to laboratory prepared containers for transport to the laboratory. Samples were collected at the following three locations:

Subtidal Sediment Locations

Station	Elevation (feet MLLW)[a]	Type Location	Description
120+75-ST1-SED	-5	Subtidal sediment	Brown, silty, SAND, with gravel
125+00-ST1-SED	-5	Subtidal Cap	Brown, coarse sandy, GRAVEL
128+50-ST1-SED	-5	Subtidal Sediment	Brown, silty, SAND

Note: (a) Elevation based on diver depth gauge relative to tide at time of sampling

5.0 DATA GAP #3 - WALL INTEGRITY

Two test pits were excavated on September 28, 2017 to enable a corrosion engineer from Tinnea & Associates of Seattle, Washington, to inspect and measure the top portion of the sheet pile wall in order to evaluate the integrity and anticipated life expectancy of the sheet pile wall.

The location of the sheet pile wall was identified with a combination of metal detector and careful exploratory excavation. The location of the sheet pile wall and the extent of the test pits were marked and surveyed with a DGPS in accordance with the WP.

A tracked mini-excavator, operated by Holt Services as a subcontractor to DOF, excavated two test pits exposing the wall for testing. The pits were approximately 3.5 feet in depth below the top of wall and sloped to allow safe ingress/egress. One pit extended from approximately station 124+70 to 125+50 and the other extended from approximately 127+65 to 127+85. The first test pit was extended until a repair plate (installed in 2004) was exposed at station 124+75.

Each test pit was backfilled with soil excavated from the test pit. The backfill material was placed in appropriate lifts and compacted with the excavator bucket and track--rolled.

6.0 REFERENCES

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USGS. 2005. Field Tests of Nylon-Screen Diffusion Samplers and Pushpoint Samplers for Detection of Metals in Sediment Pore Water, Ashland and Clinton, Massachusetts, 2003.

USGS. 2002. Field Tests of Diffusion Samplers for Inorganic Constituents in Wells and at a Ground-Water Discharge Zone.

APPENDIX A
GEOLOGIC LOGS

FS DATA GAP INVESTIGATION 2017
FIELD MEASUREMENTS/SAMPLING
FORMER ARKEMA MANUFACTURING SITE
TACOMA, WASHINGTON

DALTON
OLMSTED
FUGLEVAND

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. **PTC-001**

Field Rep: D. Cooper
Drilling Co.: Cascade
Driller: M. Waters
Drill Type: Geoprobe 6600 - Direct Push Probe
Location: N710817 E1174624 NAD83
Ground surface elevation:
Date Completed: 9/15/2017
Weather: Clear 70F
Size/Type Casing: 3" Dual tube and/or 2" Macro with acrylic liner, 5' intervals. Two pushes -1st for screening, 2nd for Lab sample, within 18" horizontally.

Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
UA	2.5-4.5	1150	1	-	25.7	0-1.5	42	0-1.5' Damp, Brown, gravelly, SAND, w/some silt
			2	-	22.4	1.5-2.5	dual	1.5-2.5' Moist, Black, gravelly, SAND, w/asphalt concrete chips
			3	-	17.2	2.5-3.5	54	2.5-4.5' Moist, Gray, Fine to Medium SAND
			4	-			macro	
			5	-				
			6	6.9	<7	5-8	36	5-8' As above, becomes saturated
			7	-				
			8	-				
			9	-				
			10	5.8				
FA	11.5-13.5	1200	11	5.0	<7	10-11.5	60	10-10.5' Saturated, Brown, PEAT, with an acrid sulfurous odor
			12	6.1	<7	11.5-13		10.5-11.5' Saturated, Dark Bwn, Organic SILT
			13	6.4	<7	13-15		11.5-15' Wet, Gray, Clayey, SILT, w/fine organic soils, root casts
			14	6.4				
			15	6.5				
			16	-	<7	15-18.2	60	15-18.2' Wet, Gray, Clayey, SILT, plastic, uniform
			17	-				18.2-20' Saturated, Dark Gry, Fine to Medium SAND
			18	-	<7	18.2-20		
			19	-				
			20	6.6				
IA	23-25	1220	21	-	<7	20-22.5	60	20-25 As Above
			22	-				
			23	-	<7	22.5-25		
			24	-				
			25	6.4				
			26	-	<7	25-28	60	25-28.0' As Above
			27	-				28.0-28.8' Wet, Gray, SILT
			28	-	<7	28-30		28.8-30 Saturated, Gray, Fine SAND
			29	-				
			30	6.5				
SA	31.5-33.5	1120	31	-	<7	30.4-31.3	60	30-30.4' As above
			32	-	<7	31.5-33.5		30.4-31.3' Wet, Gray-Brown, Organic, SILT
			33	-	<7	33.5-35		31.3-35' Wet, Gray, Clayey, SILT, w/trace organic soils, thin root casts
			34	-				
			35	6.9				

Bottom of boring @ 35.0'
Backfilled with bentonite chip

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-001

SUMMARY LOG

Depth(ft.)	
	Poorly Graded Sand with Gravel (SP)
2.5	moist, brown, with scattered asphalt
	Poorly Graded Sand (SP) moist to saturated, gray, fine to medium
10.0	-Peat
11.5	Organic Silt (OL)
	Silt (ML) wet, gray, with organic soils, fine roots, plastic
18.2	
	Poorly Graded Sand (SP) saturated, dark gray, fine
28-28.8	-Silt (ML)
30.4	
	Silt (ML) wet, gray, with trace organic soils, thin root casts
35.0	

NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. **PTC-002**

Field Rep: D. Cooper
Location: N710299 E1175164 NAD83
Drilling Co.: Cascade
Ground surface elevation:
Driller: M. Waters
Date Completed: 9/12/2017
Drill Type: Geoprobe 6600 - Direct Push Probe
Weather: Clear 75F
Size/Type Casing: 3" Dual tube and/or 2" Macro with acrylic liner, 5' intervals. Two pushes -1st for screening, 2nd for Lab sample, within 18" horizontally.

Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
			1	-	21.3	0-2	42	0-0.5' Damp, Brown, gravelly, SAND, w/trace silt
			2	-			dual	0.5-2.0' Moist, Brown, gravelly, SAND, with some silt
UA	2.0-4.0	0830	3	-	34.2	2-3.5	50	2.0-4.2' Wet, Gray, Fine to Medium SAND, with trace silt
			4	-			macro	
			5	-				
			6	-	27.1	5-7	60	5-6.7' As above, becomes saturated
			7	-				6.7-7.3' Saturated, Gray, Silty, Fine SAND
			8	-	<7	7-9		7.3-9' Saturated, Gray, Fine SAND, grading silty
			9	-				9-10' Wet, Gray, SILT, soft, plastic
			10	-	<7	9-10		
			11	-	<7	10-11	60	10-10.8' As Above
			12	-	7.9	11-12		10.8-11.8' Wet, Brown, PEAT
FA	13.0-15.0	0840	13	-	<7	12-15		11.8-15.0' Wet, Gray, Clayey, SILT, with organics (marsh grass)
			14	-				
			15	-				
			16	-	<7	15.5-17	60	15-15.5' As Above
			17	-				15.5-18.8' Saturated, Gray, interbedded Fine Sandy SILT with Silty Fine SAND
			18	-	<7	17-19		18.8-20' Saturated, Dark Gray, Fine to Medium SAND
			19	-				
			20	-	<7	19-20		
			21	-	<7	20-22.5	60	20-25 As Above
			22	-				
IA	23-25	0850	23	-	<7	22.5-25		
			24	-				
			25	-				
			26	-	<7	25-26	60	25-26.0' As Above
			27	-	<7	26-27.5		26.0-27.0' Wet, Brown, Organic SILT
			28	-	<7	27.5-30		27.0-27.5' Wet, Gray, Clayey, SILT
			29	-				27.5-30' Saturated, Gray, Fine SAND
			30	-				
			31	-			60	30-35' Wet, Gray, Clayey SILT with fine root casts
SA	31.0-33.0	0920	32	-	<7	31-32		
			33	-				
			34	-	<7	33.5-35		
			35	-				
			36	-	<7	35-37.5	60	35-38.8' Wet, Gray, SILT, stiff, uniform
			37	-				38.8- 39.2' Saturated, Dark gray, Silty, Fine SAND
			38	-	<7	37.5-39		39.2-40' Saturated, Dark gray, Fine SAND, with some silt
			39	-				
			40	-	<7	39-40		

Bottom of boring @ 40.0'
Backfilled with bentonite chip

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-002

SUMMARY LOG

Depth(ft.)	
2	Poorly Graded Sand with Gravel (SP) moist, brown, trace to some silt
9.0	Poorly Graded Sand (SP) moist to saturated, gray, fine to medium
15.5	-Peat Silt (ML) wet, gray, with organics (marsh grass)
18.8	Poorly Graded Sand with Silt (SP-SM) saturated, gray, interbedded
26-27.5	Poorly Graded Sand (SP) saturated, dark gray, fine -Organic Silt (OL)
30	
38.8	Silt (ML) wet, gray, with trace organic soils, thin root casts
40.0	Poorly Graded Sand (SP) saturated, dark gray, some silt

NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. PTC-101

Field Rep: D. Cooper
Drilling Co.: Cascade
Driller: M. Waters
Drill Type: Geoprobe 6600 - Direct Push Probe
Location: N710871 E1175187 NAD83
Ground surface elevation:
Date Completed: 9/14/2017
Weather: Clear 75F
Size/Type Casing: 3" Dual tube. 5' intervals. Two pushes -1st for screening, 2nd for Lab sample, within 18" horizontally.

Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
			1	-	816.0	0-2	24	0-2.0' Damp, Brown, Gravelly, SAND, with some silt
			2	-			poor	
			3	-				
			4	-				
			5	-				
			6	-	3160.0	6-8.2	60	5-8.2' As Above, saturated
			7	-				8.2-8.5' Wet, Gray, SILT, with trace organic soils, roots
UA	8.2-10.2	1350	8	-	5479.0	8.2-8.5		8.5-10' Saturated, Gray, Fine to Medium SAND
			9	-	1057.0	8.5-10		
			10	-				
			11	-	1407.0	10-13	60	10-13.0' As Above
			12	-				13.0-14.0' Wet, gray-brown, Organic SILT
FA	13.0-15.0	0840	13	-	10746.0	13-15		14.0-15.0' Wet, Gray, SILT, with organics (marsh grass)
			14	-				
			15	-				
			16	-	1287.0	15-17.5	60	15-19.3' As Above
			17	-	5599.0	17.5-19.3		19.3-20' Saturated, Dark gray, Fine to Medium SAND
			18	-				
IA	19.3-20.3	1405	19	-	1369.0	19.5-20		
			20	-				
			21	-	84	20-22.5	60	20-24.5' Saturated, Gray, Silty, Fine SAND / Sandy Fine SILT
			22	-				24.5-25' Saturated, Dark gray, Fine SAND
			23	-	160	22.5-24.5		
			24	-				
			25	-				
			26	-	7.8	25-27.5	60	25-25.5' Wet, brown, Organic SILT
			27	-				25.5-27.5' Saturated, Dark Gray, Fine Sand, with trace silt, grading siltier
			28	-	57.1	27.5-29		27.5-29.0' Wet, gray, Clayey, SILT, with trade fine sand
			29	-				29.0-30' Saturated, Dark Gray, Fine SAND
			30	-				
			31	-	<7	30-32.5	60	30-30.5' Saturated, Gray, Fine Sandy, SILT, with trace organic soils
			32	-				30.5-35' Saturated, Dark Gray, Fine SAND, with silty fine sand interbeds
			33	-	<7	32.5-35		
			34	-				
			35	-				
			36	-			60	35-35.8' Saturated, Gray, Silty, Fine SAND
SA	36.0-38.0	1500	37	-	<7	36-38.5		35.8-36.5' Wet, brown, Organic, SILT
			38	-				36.5-38.6' Wet, Gray, Clayey, SILT, with trace organic soils
			39	-	<7	38.5-40		38.6-40' Saturated, Gray, silty, Fine SAND
			40	-				
			41	-	<7	40-41.6	60	40-41.6' Saturated, Dark Gray, Fine SAND
			42	-				41.6-44.0' Saturated, Dark Gray, Fine Sandy, SILT
			43	-	<7	41.6-44		44.0-45' Saturated, Dark Gray, Silty, Fine SAND
			44	-				
			45	-	<7	44-45		

Bottom of boring @ 45.0'
Backfilled with tremmied high-solids grout

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-101

SUMMARY LOG

Depth(ft.)	
	Poorly Graded Sand with Gravel (SP) damp to saturated, gray, some silt
8.2	-Silt (ML)
	Poorly Graded Sand (SP) saturated, gray, fine to medium
13.0	
	Silt (ML) wet, gray, with organics (marsh grass)
19.3	
	Poorly Graded Sand (SP) saturated, dark gray, fine
25-25.5	-Organic Silt (OL)
27.5-29	-Clayey Silt (ML)
	fine sandy silt interbeds
35.8	
	Silt (ML) wet, gray, organic soils
38.6	
	Poorly Graded Sand (SP) saturated, dark gray, with silty sand, sandy silt interbeds
45.0	

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. **PTC-111**

Field Rep: D. Cooper
Drilling Co.: Cascade
Driller: M. Waters
Drill Type: Geoprobe 6600 - Direct Push Probe
Location: N710939 E1175257 NAD83
Ground surface elevation:
Date Completed: 9/18/2017
Weather: Rain 65F
Size/Type Casing: 3" Dual tube. 5' intervals. Two pushes -1st for screening, 2nd for Lab sample, within 18" horizontally.

Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
			1	-	64.2	0-2	48	0-2.0' Damp, Brown, Gravelly, SAND, w/some silt
			2	-				2.0-4.0' Wet, Dark gray, Fine to Medium SAND
			3	-	126.1	2-4		
			4	-				
			5	-				
			6	-	1307.0	5-6	48	5.0-6.0' Saturated, orange-brown, Fine to Medium SAND, w/trace silt
UA	6.0-8.0	1500	7	-	1492.0	6-9		orange precipitate
			8	-				6.0-9.0' Saturated, Dark gray, Fine to Medium SAND
			9	-				
			10	-				
			11	-	423.0	10-11.6	60	10-11.6' As Above
			12	-	812.2	11.6-12.4		11.6-12.4' Saturated, black, Fine SAND
			13	-	2621.0	12.4-13.1		12.4- 13.1' Wet, Gray, SILT, with thin roots, yellow precipitate
FA	13.1-15.1	1420	14	-	13248.0	13.1-15		cemented, top and bottom
			15	-				13.1- 15' Wet, Brown, Organic, SILT, organic soils, marsh grass, grading clayey
			16	-	2379.0	15-17.9	60	15-17.9' Wet, Gray, Clayey, SILT, with organics (marsh grass)
			17	-				17.9-20' Saturated, Dark gray, Silty, Fine SAND
			18	-	55.3	17.9-20		
			19	-				
			20	-				
			21	-			60	20-23.3' Saturated, Dark gray, Fine to Medium SAND
IA	20-.0-22.0	1510	22	-	62.4	20-23.3		23.3-25' Saturated, Gray, silty, Fine SAND, with trace organic soils
			23	-				
			24	-	18.8	23.3-25.5		
			25	-				
			26	-			60	25-28' Wet, Gray, Clayey, SILT, grading fine sandy
			27	-	21.8	25.5-28		28-30' Saturated, Dark gray, Fine SAND
			28	-				
			29	-	12.1	28-30		
			30	-				
			31	-			60	30-35' Saturated, Dark gray, Fine SAND, with silty fine sand interbeds
			32	-	9.0	30-32.5		
			33	-				
			34	-	<7	32.5-35		
			35	-				
			36	-	<7	35-37.3	60	35-37.3' As Above
			37	-				37.3-39.5' Wet, Gray, SILT, with scattered organic soils
SA	37.3-39.5	1430	38	-	<7	37.3-40		39.5-40' Saturated, Gray, Silty, Fine SAND
			39	-				
			40	-				

Bottom of boring @ 40.0'
Backfilled with tremmied high solids grout

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-111
SUMMARY LOG

Depth(ft.)	
	Poorly Graded Sand with Gravel (SP) moist, brown, some silt
2	
5-6	-Orange Precipitate
	Poorly Graded Sand (SP) moist to saturated, dark gray, fine to medium
12.4	
12.4-13.1	-Yellow precipitate, cemented
	Silt (ML) wet, gray, clayey, with organics (marsh grass)
17.9	
	Poorly Graded Sand (SP) saturated, dark gray, fine
25	
	Silt (ML) wet, gray, clayey grading fine sandy
28	
	Poorly Graded Sand (SP) saturated, dark gray, fine with fine sandy silt interbeds
37.3	
	Silt (ML) wet, gray, organic soils
40.0	

NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. PTC-113

Field Rep: D. Cooper
Drilling Co.: Cascade
Driller: M. Waters
Drill Type: Geoprobe 6600 - Direct Push Probe
Location: N711005 E1175344 NAD83
Ground surface elevation:
Date Completed: 9/20/2017
Weather: Rain 65F
Size/Type Casing: 3" Dual tube or 2" macro w/ acrylic liner. 5' intervals. Two pushes -1st for screening, 2nd for Lab sample, within 18" horizontally.

Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
			1	-	56.7	0-1.8	48	0-1.8' Damp, Brown, Gravelly, SAND, w/trace silt
			2	-	18.5	1.8-4		1.8-4.0' Wet, Brown, Fine to Medium SAND, with trace silt
			3	-				
			4	-				
			5	-				
			6	-	990.0	5-7.5	60	5.0-5.5' As Above becoming gray
UA	7.5-10	1020	7	-				5.5-10' Wet to Saturated, Dark Gray, Fine to Medium SAND
			8	-	6846.0	7.5-10		orange oxidation banding @9.5'
			9	-				
			10	-				
			11	-	2834.0	10-11.3	60	10-11.3' Saturated, Black, Fine SAND, with some silt
			12	-				Yellow precipitate
FA	12.3-14.3	1000	13	-	7415.0	11.3-12.5		11.3-15.0' Wet, Gray-brown, Clayey, SILT, with organics (marsh grass)
			14	-	4369.0	12.5-15		
			15	-				
			16	-	1863.0	15-17	60	15-18.0' As above, with fine roots
			17	-	2369.0	17-18		Yellow precipitate in root casts
IA	18.0-20.0	1035	18	-	2395.0	18-20		18.0-20' Saturated, Dark gray, Fine SAND
			19	-				
			20	-				
			21	-			60	20-23' Saturated, Dark gray, Fine SAND
			22	-				23-25' Saturated, Gray, silty, Fine SAND, with trace organic soils
			23	-	1596.0	23-25		
			24	-				
			25	-				
			26	-	241.5	25-27.5	60	25-30' Saturated, Dark gray, Fine to medium SAND,
			27	-				Cemented Zone 29.5-30.0'
			28	-	152.2	27.5-30		
			29	-				
			30	-				
			31	-	9.0	30-32.5	60	30-35' Saturated, Dark gray, Fine SAND
			32	-				
			33	-	11.2	32.5-35		
			34	-				
			35	-				
			36	-	21.8	35-37	60	35-37.0' As Above
			37	-				37.0-39.5' Wet, Gray-brown, SILT, with scattered organic soils
SA	37.0-39.0	0945	38	-	<7	37-40		39.5-40' Saturated, Gray, Silty, Fine SAND
			39	-				
			40	-				

Bottom of boring @ 40.0'
Backfilled with bentonite chip

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-113
SUMMARY LOG

Depth(ft.)	
	Poorly Graded Sand with Gravel (SP) moist, brown, some silt
1.8	
	Poorly Graded Sand (SP) moist to saturated, dark gray, fine to medium
11.3	-Yellow Precipitate
	Silt (ML) wet, gray, clayey, with organics (marsh grass)
18.0	-Yellow precipitate in root casts
	Poorly Graded Sand (SP) saturated, dark gray, fine
29.5-30	-Cemented Zone
37.0	
	Silt (ML) wet, gray, organic soils
40.0	

NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. **PTC-121**

Field Rep: D. Cooper
Drilling Co.: Cascade
Driller: M. Waters
Drill Type: Geoprobe 6600 - Direct Push Probe
Location: N710798 E1175119 NAD83
Ground surface elevation:
Date Completed: 9/20/2017
Weather: Rain 60F
Size/Type Casing: 3" Dual tube. 5' intervals. Two pushes -1st for screening, 2nd for Lab sample, within 18" horizontally.

Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
			1	-	285.9	1.5-3.5	50	0-1.5' Concrete Slab
			2	-				1.5-3.8' Wet, Dark gray, Fine to Medium SAND
			3	-				3.8-4.2' Wet, Gray, Fine Sandy, SILT
			4	-				
			5	-				
			6	-	236.9	6.3-8.3	60	5.0-6.3' Saturated, Gray, Fine to Medium SAND, with silt interbeds
			7	-				6.3-10' Saturated, Dark gray, Fine to Medium SAND
			8	-	264.3	8.3-10		
			9	-				
			10	-				
UA	11.0-13.0	1150	11	-	455.7	10-11.2	60	10-11.2' As Above
			12	-	1739.0	11.2-13.1		11.2-13.1' Saturated, Gray- brown, Fine to medium SAND, with white grains
FA	13.1-15.0	1100	13	-	1451.0	13.1-15.0		13.1-15' Wet, Gray, Clayey, SILT, with trace organic soils
			14	-				
			15	-				
			16	-	1216.0	15-17	60	15-18.2' As Above
			17	-				18.2-20' Wet, Gray, Fine Sandy, SILT
			18	-	1503.0	17-18.2		
			19	-	1130.0	18.2-20		
			20	-				
			21	-	630.8	21.3-22.4	60	20-25' Saturated, Dark gray, Fine SAND, interbedded with Fine Sandy, SILT
IA	22.0-24.0	1200	22	-	214.6	22.4-23.7		
			23	-	<7	23.7-25		
			24	-				
			25	-				
			26	-	<7	25-26.7	60	25-26.7' Saturated, Dark gray, Fine SAND
			27	-	<7	26.7-28.2		26.7-27.0' Wet, Dark brown, Organic, SILT
			28	-	<7	28.2-30		27.0-28.2' Wet, Gray, Very silty, Fine SAND
			29	-				28.2-30' Saturated, Dark gray, Fine SAND
			30	-				
			31	-	<7	30-32.6	60	30-32.6' Saturated, Dark gray, Fine SAND
			32	-	<7	32.6-33.7		32.6-33.7' Wet, Gray, Very silty, Fine SAND
			33	-	12.1	33.7-35		33.7-35' Wet, Gray-brown, Organic, SILT
			34	-				
			35	-				
			36	-	<7	35-36	60	35-36' Saturated, Gray, Fine SAND
SA	36.0-38.0	1025	37	-	<7	36-38.6		36-38.6' Wet, Gray, Clayey, SILT
			38	-	<7	38.6-40		38.6-40' Saturated, Gray, Silty, Fine SAND
			39	-				
			40	-				

Bottom of boring @ 40.0'
Backfilled with Bentonite chip

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-121

SUMMARY LOG

Depth(ft.)	
	Concrete Slab
1.5	
	Poorly Graded Sand (SP) moist to saturated, dark gray, fine to medium
	-White Grains
13.1	
	Silt (ML) wet, gray, clayey, with trace organic soils
18.2	
	Poorly Graded Sand (SP) saturated, dark gray, fine
26.7-27	-Organic Silt (OL)
	fine sandy silt interbeds
33.7-35	-Organic Silt (OL)
36.0	
	Silt (ML) wet, gray, clayey
38.6	
40.0	Poorly Graded Sand (SP)

NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. **PTC-129**

Field Rep: D. Cooper
Drilling Co.: Cascade
Driller: M. Waters
Drill Type: Geoprobe 6600 - Direct Push Probe
Size/Type Casing: 2" Macro with acrylic liner. 5' intervals.

Location: N711038 E1175380 NAD83
Ground surface elevation: Shoreline embankment
Date Completed: 9/18/2017
Weather: Rain 60F

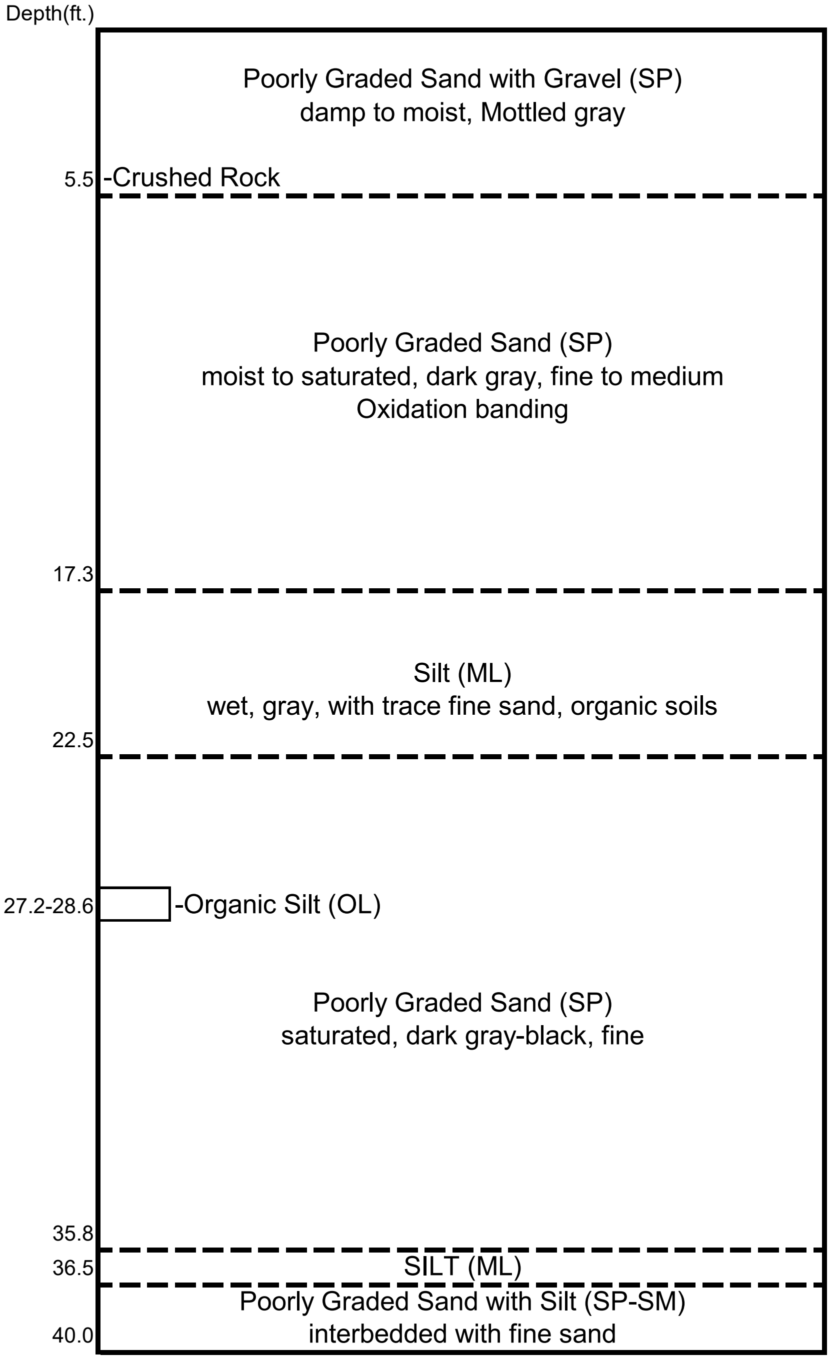
Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
			1	-	28.5	0-2	48	0-4' Damp to moist, Mottled gray-brown, Gravelly, SAND, with trace silt
			2	-				
			3	-	66.8	2-4		
			4	-				
			5	-				
			6	-	511.6	5.5-8.2	40	5-5.5' Gray, Crushed Rock
			7	-				5.5-8.2' Saturated, Red-brown, Fine to Medium SAND, with oxidation banding
			8	-				
			9	-				
			10	-				
UA	10.0-12.0	1315	11	-	1066.0	10-12	60	10-12.0' As Above
			12	-				12.0-15' Saturated, Dark gray, Fine to medium SAND
			13	-	88.8	12-15		
			14	-				
			15	-				
			16	-	38.1	15-17.3	60	15-17.3' As Above
FA	17.3-20	1320	17	-	89.4	17.3-20		17.3-20' Wet, Gray, SILT, stiff, slightly plastic
			18	-				
			19	-				
			20	-				
			21	-	1816.0	20-22.5	60	20-22.5' Wet, Gray, SILT, with trace fine sand, organic soils, yellowish fluid
IA	22.5-25.0	1325	22	-				22.5-25' Saturated, Dark Gray, Fine to Medium SAND
			23	-	657.3	22.5-25		
			24	-				
			25	-				
			26	-	101.4	25-27.2	60	25-27.2' Saturated, Black, Fine SAND, anoxic
			27	-				27.2-28.6' Wet, Gray, SILT, with trace fine sand, organic soils
			28	-	82.2	27.2-28.6		28.6-30' Saturated, Dark Gray, Fine SAND, cemented
			29	-	11.8	28.6-30		
			30	-				
			31	-			60	30-35' Saturated, Dark gray, Fine SAND
			32	-	19.2	33-35		
			33	-				
			34	-				
			35	-				
			36	-	<7	35-35.8	60	35-35.8' Saturated, Black, Fine SAND
SA	35.8-36.5	1500	37	-	<7	35.8-36.5		35.8-36.5' Wet, Gray-brown, SILT, with organics (marsh grass)
			38	-	<7	36.5-40		36.5-40.0' Saturated, Gray, Silty, Fine SAND, with fine sandy interbeds
			39	-				
			40	-				

Bottom of boring @ 40.0'
Backfilled with Bentonite chip

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-129

SUMMARY LOG



Depth(ft.)	
	Poorly Graded Sand with Gravel (SP) damp to moist, Mottled gray
5.5	-Crushed Rock
	Poorly Graded Sand (SP) moist to saturated, dark gray, fine to medium Oxidation banding
17.3	
	Silt (ML) wet, gray, with trace fine sand, organic soils
22.5	
27.2-28.6	-Organic Silt (OL)
	Poorly Graded Sand (SP) saturated, dark gray-black, fine
35.8	
36.5	SILT (ML)
	Poorly Graded Sand with Silt (SP-SM) interbedded with fine sand
40.0	

NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. **PTC-204**

Field Rep: D. Cooper
Location: N711170 E1175012 NAD83
Drilling Co.: Cascade
Ground surface elevation:
Driller: M. Waters
Date Completed: 9/19/2017
Drill Type: Geoprobe 6600 - Direct Push Probe
Weather: Rain 60F
Size/Type Casing: 3" Dual tube or 2" Macro with acrylic liner. 5' intervals. Two pushes -1st for screening, 2nd for Lab sample, within 18" horizontally.

Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
			1	8.9	33.1	0-1.5	56	0-1.2' Damp, Mottled gray-brown, Gravelly, SAND, with some silt
			2	8.9				1.2-1.5' Asphalt Concrete
			3	8.2	<7	1.5-5		1.5-4.5' Moist, Gray, Fine to Medium SAND
			4	8.6				
			5	10.6				
			6	9.3	34.3	5-7.5	60	5.0-10' Wet to saturated, Dark gray, Fine to Medium SAND
			7	11.0				
			8	11.1	58.3	7.5-10		
			9	11.0				
			10	11.1				
UA	10.8-12.8	1100	11	11.2	40.3	10-12.8	60	10-10.8' As Above with some organic soils
			12	11.1				10.8-12.8' Saturated, Dark gray, Fine SAND, with white grains, cemeted
FA	12.8-14.8	1050	13	9.1	63.9	12.8-15		12.8-15' Wet, Gray, Clayey, SILT, with organics (marsh grass)
			14	8.5				
			15	7.8				
			16	6.9	8.0	15-17.5	60	15-16.0' Saturated, Dark Gray, Fine SAND
			17	6.9				16.0-19.0' Saturated, Gray, Silty, Fine SAND, with fine sand interbeds
			18	7.0	<7	17.5-20		19.0-20.0' Wet, gray, Fine Sandy, SILT
			19	7.2				
			20	7.3				
			21	-			60	20-25' Saturated, Dark gray, Fine to Medium SAND
IA	23.0-25.0	1015	22	7.8	30.3	22-23.5		
			23	7.2	61.9	23.5-25		
			24	6.8				
			25	9.8				
			26	9.2	131.9	25-26	60	25-26.0' Saturated, Dark gray, Fine SAND, cemented, very hard
			27	7.8	<7	26-27.5		26.0-27.5' Wet, Gray-brown, SILT, with organic soils
			28	7.2	<7	27.5-30		27.5-30.0' Saturated, Gray, Fine SAND, with trace silt
			29	7.7				
			30	7.2				
			31	6.7	<&	30-32.3	60	30-32.3' Saturated, Dark gray, Fine SAND
SA	32.3-34.2	1030	32	6.7				32.3-33.4' Wet, Gray, Fine Sandy, SILT
			33	6.7	<7	32.3-35		33.4-35' Wet, Gray-brown, Organic, SILT
			34	6.5				
			35	6.5				
			36	6.8	<7	35-37.5	60	35-40' Saturated, Gray, Silty Fine SAND, with fine sand interbeds
			37	6.6				
			38	6.4	<7	37.5-40		
			39	6.6				
			40	6.9				

Bottom of boring @ 40.0'
Backfilled with Bentonite chip

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-204

SUMMARY LOG

Depth(ft.)	
	Poorly Graded Sand with Gravel (SP) with asphalt concrete
1.5	
	Poorly Graded Sand (SP) moist to saturated, dark gray, fine to medium
10.8	-White Grains, cemented
12.8	
	Silt (ML) wet, gray, clayey, with organics (marsh grass)
15.0	
	Poorly Graded Sand (SP) saturated, dark gray, fine
25-26	-Cemented
26-27.5	☐ -Organic Silt (OL)
	fine sandy silt interbeds
32.3	
	Silt (ML) wet, gray-brown, organic soils
35.0	
	Poorly Graded Sand with Silt (SP-SM) saturated, gray, fine sand interbeds
40.0	

NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. **PTC-205**

Field Rep: D. Cooper		Location:	N711133 E1174935 NAD83
Drilling Co.: Cascade		Ground surface elevation:	
Driller: M. Waters		Date Completed:	9/19/2017
Drill Type: Geoprobe 6600 - Direct Push Probe		Weather:	Rain 60F

Size/Type Casing: 3" Dual tube or 2" Macro with acrylic liner. 5' intervals. Two pushes -1st for screening, 2nd for Lab sample, within 18" horizontally.

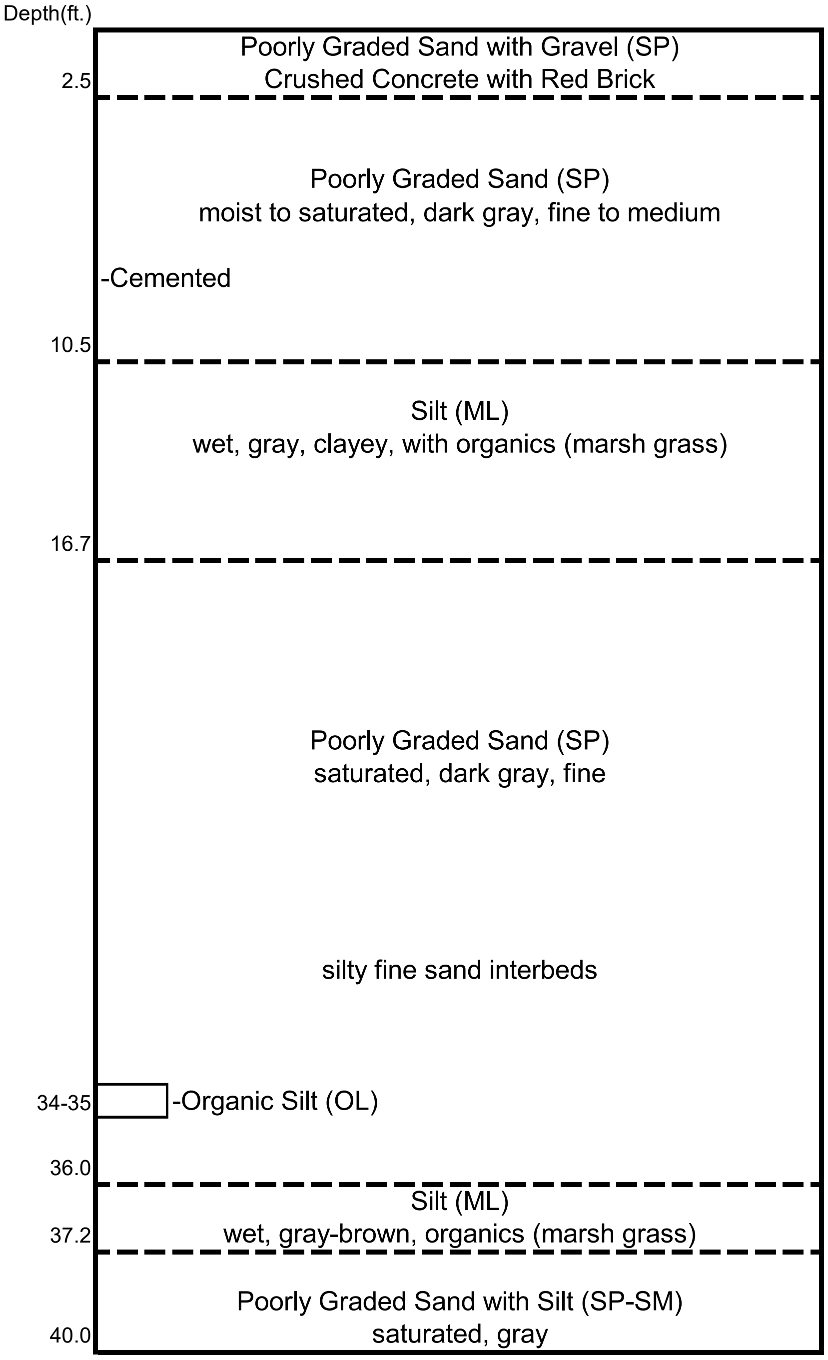
Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
			1	10.8	43.2	0-2	40	0-0.8' Damp, Brown, Gravelly, SAND, with some silt
			2	11.1	29.7	2-3		0.8-2.5' Crushed Concrete with Red Brick
			3	11.4				2.5-3.5' Wet, Dark gray, Fine SAND
			4	-				
			5	11.2				
			6	11.3	17.0	5-7.5	60	5.0-10' Wet to saturated, Gray, Fine to Medium SAND
			7	11.4				Cemented zone from 7.5-8.0'
UA	8.0-10.0	1430	8	11.3	20.5	7.5-10		
			9	11.4				
			10	11.4				
FA	10.5-12.4	1440	11	11.5	39.1	10.5-12.4	60	10-10.5' As Above, cemeted clasts
			12	11.4	15.9	12.4-15		10.5-12.4' Wet, Gray, SILT, with organics (marsh grass), soft
			13	11.0				12.4-15.0' Wet, Gray, Clayey, SILT, with organics (marsh grass)
			14	10.3				
			15	9.5				
			16	9.2	<7	15-16.7	60	15-16.7' As above
			17	9.8	<7	16.7-20		16.7-20.0' Saturated, Gray, Silty, Fine SAND, with fine sand interbeds
			18	10.4				
			19	10.7				
			20	10.7				
IA	20.0-22.0	1500	21	10.7	<7	20-22.5	60	20-25' As Above
			22	10.7				
			23	10.5	14.5	22.5-25		
			24	10.5				
			25	10.3				
			26	9.2	17.5	25-27.5	60	25-29.5' Saturated, Dark gray, Fine SAND
			27	9.0				29.5-30.0' Saturated, Gray, Silty, Fine SAND
			28	9.0	23.8	27.5-29.5		
			29	9.3				
			30	9.2				
			31	7.3	10.5	30-34	60	30-31.0' Saturated, Dark gray, Fine SAND
			32	7.2				31.0-34.0' Saturated, Gray, Silty, Fine SAND
			33	6.7				34.0-35' Wet, Gray-brown, SILT, with trace organic soils
			34	6.6	<7	34-35		
			35	6.6				
			36	7.1	20.2	35-36	60	35-36' Saturated, Dark gray, Fine SAND
SA	36.0-37.2	1530	37	6.4	<7	36-37.2		36.0-37.2' Wet, gray-brown, SILT, with organics (marsh grass)
			38	6.4	<7	37.2-40		37.2-40.0' Saturated, Gray, Silty, SAND
			39	6.4				
			40	6.3				

Bottom of boring @ 40.0'
Backfilled with Bentonite chip

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-205

SUMMARY LOG



NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. **PTC-207**

Field Rep: D. Cooper
Drilling Co.: Cascade
Driller: M. Waters
Drill Type: Geoprobe 6600 - Direct Push Probe
Location: N710629 E1175457 NAD83
Ground surface elevation:
Date Completed: 9/15/2017
Weather: Clear 75F
Size/Type Casing: 3" Dual tube or 2" Macro with acrylic liner. 5' intervals. Two pushes -1st for screening, 2nd for Lab sample, within 18" horizontally.

Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
			1	10.9	53.4	1-1.5	48	0-1.5' Damp, Brown, Crushed Concrete
			2	9.0	<6	1.5-4		1.5-4.0' Moist, Gray, Gravelly, SAND, with some silt
			3	9.1				
			4	9.6				
			5	9.5				
			6	7.6	11.5	5.5-7	24	5-5.5' As Above
			7	8.7				5.5-7.0' Wet, Gray, Silty, SAND, with trace gravel, organic soils
			8	-				
			9	-				
			10	-				
UA	10.0-12.0	1550	11	8.7	<7	10-11	60	10-11.0' Saturated, Brown, Fine SAND, with pink flecs of presipitate
			12	9.1	<7	11-13		11.0-12.8' Saturated, Gray, Fine to Medium SAND
			13	10.8	12.0	13-15		12.8-15' Saturated, Gray, Silty, Fine SAND, with scattered organic soils
			14	11.2				
			15	10.5				
			16	9.7	<7	15-16.5	60	15-15.5' As above
FA	16.5-17.5	1600	17	8.8	<7	16.5-18		15.5-16.5' Wet, brown, Fiberous PEAT
			18	8.4				16.5-17.5' Wet, mottled Gray, SILT, with scattered organic soils
			19	6.8				17.5-18.0' Saturated, Dark Gray, Fine SAND
			20	7.7				18.0-20.0' Wet, Gray, SILT, with organics (marsh grass)
			21	7.2	<7	20-23	60	20-23.1' As Above
			22	7.2				23.1-25.0' Saturated, Gray, Silty Fine SAND or Fine Sandy, SILT
			23	7.7	<7	23-25		
			24	7.8				
			25	7.5				
			26	5.8	<7	25-27.5	60	25.0-30.0' Saturated, Gray, Silty, Fine SAND, with fine sand interbeds
			27	6.8				
IA	28.0-30.0	1620	28	7.4	<7	27.5-30		
			29	7.4				
			30	7.3				
			31	-			60	30-32.0' Saturated, Dark gray, Fine SAND
			32	6.0	<7	32-33		32.0-32.5' Wet, Gray-brown, Organic, SILT
			33	6.9				32.5-33.0' Wet, Gray, SILT, with some organic soils
			34	6.8	<7	33-35		33.0-35.0' Saturated, Gray, Fine SAND
			35	7.9				
			36	7.3	<7	35-37.5	60	35-37.5' As Above
			37	7.5				37.5-39.0' Wet, gray-brown, SILT
SA	37.5-39.0	1530	38	7.4	<7	37.5-39		39.0-40.0' Saturated, Dark gray, Fine SAND
			39	7.1				
			40	7.3				

Bottom of boring @ 40.0'
Backfilled with Bentonite chip

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-207

SUMMARY LOG

Depth(ft.)	
	Crushed Concrete
	Poorly Graded Sand with Gravel (SP) damp to moist, some silt
5.5	Poorly Graded Sand (SP) moist to saturated, dark gray, fine to medium
10-11	-Pink Flecs of precipitate
15.5	
15.5-16.5	-Peat
17.5-18.0	-Fine Sand (SP)
	Silt (ML) wet, gray, clayey, with organics (marsh grass)
23.1	Poorly Graded Sand (SP) saturated, dark gray, fine
	silty fine sand interbeds
32-33	-Organic Silt (OL)
37.5	Silt (ML) wet, gray-brown
39.0	Poorly Graded Sand (SP)
40.0	

NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DESCRIPTION OF SAMPLES, TESTS, AND INSTALLATION - BORING NO. **PTC-208**

Field Rep: D. Cooper	Location: N710623 E1175548 NAD83
Drilling Co.: Cascade	Ground surface elevation:
Driller: M. Waters	Date Completed: 9/13/2017
Drill Type: Geoprobe 6600 - Direct Push Probe	Weather: Clear 80F

Size/Type Casing: 3" Dual tube or 2" Macro with acrylic liner. 5' intervals. Two pushes -1st for screening, 2nd for Lab sample, within 18" horizontally.

Unit	Lab Sample Interval (Ft.)	Time	Depth (Ft.)	Field pH	Field As by XRF (mg/kg)	XRF Sample Interval (Ft.)	Sample Recovery length (inches)	Sample Description
			1	10.5	55.3	0.5-3	36	0-3.0' Damp to moist, Brown, Gravelly, SAND, with some silt
			2	8.0				
			3	7.6				
			4	8.4				
			5	8.7				
			6	8.4	55.3	5.8-6	24	5-5.3' As Above
			7	10.3	<7	6-7.5		5.3-6.0' Wet, Mottled gray, Silty, SAND, with trace gravel, white precipitate
			8	10.7	<7	7.5-10		6.0-7.5' Saturated, Brown, Fine SAND, with some silt
			9	11.1				7.5-8.0' Wet, Gray, SILT, soft
			10	7.6				8.0-10' Saturated, Brown, Silty, SAND, with some gravel
			11	7.2	<7	10-12.5	60	10-11.5' As Above becoming stained black
UA	12.0-14.0	1350	12	10.6				11.0-15.0' Saturated, Black, Fine to Medium SAND
			13	10.8	<7	12.5-15		cemented, chunky from 12-14'
			14	10.8				
			15	10.8				
			16	7.1	<7	15-17	24	15-16.0' As above
FA	16.0-18.0	1400	17	7.1				16.0-20.0' Wet, SILT, with organics (marsh grass)
			18	-				
			19	-				
			20	7.2				
			21	7.2	<7	20-22	60	20-22.0' Wet, Gray, SILT, with scattered organic soils
			22	7.1				22.0-25' Saturated, Gray, Silty, Fine SAND, with fine sand interbeds
IA	23.0-25.0	1430	23	8.1	<7	22-25		
			24	9.7				
			25	9.1				
			26	8.0	<7	25-27	60	25-26.7' Wet, Gray, Fine sandy, SILT or Silty Fine SAND
			27	7.2				26.7-27.7' Wet, brown, Organic, SILT
			28	7.0	<7	28-30		27.2-30' Saturated, Dark Gray, Fine SAND
			29	7.0				
			30	7.0				
			31	7.0	<7	30-32.5	60	30-32.8' As Above
			32	7.1				32.8-35' Wet, gray, SILT,with scattered organic soils
			33	7.0	<7	32.5-35		
SA	33.0-35.0	1430	34	6.9				
			35	6.8				
			36	7.0	<7	35-37.5	60	35-37.0' As above
			37	7.1				37.0-40' Saturated, Gray, Silty, Fine SAND, interbedded with silt
			38	7.2	<7	37.5-40		
			39	7.1				
			40	7.2				

Bottom of boring @ 40.0'
Backfilled with Bentonite chip

Lithologic Units:
UA = Upper aquifer
FA = First Aquitard
IA = Intermediate Aquifer
SA = Second Aquitard

PTC-208

SUMMARY LOG

Depth(ft.)	
	Crushed Concrete
	Poorly Graded Sand with Gravel (SP) damp to moist, some silt
5.3	
5.8-6	-White Precipitate
12-14	-Cemented
	Poorly Graded Sand (SP) moist to saturated, brown, some silt
16.0	
	Silt (ML) wet, gray, with organics (marsh grass)
22.0	
26.7-27.7	-Organic Silt (OL)
	Poorly Graded Sand (SP) saturated, dark gray, fine
	silty fine sand interbeds
32..8	
	Silt (ML) wet, gray-brown, scattered organic soils
37.0	
	Poorly Graded Sand with Silt (SP-SM)
40.0	saturated, gray

NOTE: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

APPENDIX B
FIELD FORMS

FS DATA GAP INVESTIGATION 2017
FIELD MEASUREMENTS/SAMPLING
FORMER ARKEMA MANUFACTURING SITE
TACOMA, WASHINGTON

- Shallow Wells
- Angled Shoreline Wells
- Intermediate Wells
- Deep Wells
- Pore Water & Surface Water

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Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: J Horner & D. Browning
Date: 10-26-2017

Well No. 1B4-1

well depth (top PVC)	8.2'					
water level(top PVC)	6.0'					
water height	2.2'					
time	11:00					
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	1.436					
3 x vol	4.31					
Purge Volume						
gallons purged	—					
purge/bail/type						
Water Sample						
Sample No.	GW-1B4-1-102617-2.9-7.1					
Sample Method	Paristaltic					
Time	11:45					
No. Cont.	10					
Initials	JNH					
pH						
value	6.93					
time						
Conductivity (S/cm)						
value	860.4					
time						
Temp. (Celsius)						
value	15.33					
time						
DO (mg/l)						
value	2.59					
time						
ORP (mV)						
value	5.4					
time						
TDS (ppt)						
value	1					
time						
Turbidity (ntu)						
value	4.01					
time	12:05					
Ferrous Iron (mg/l)						
value	0.72					
time	12:10					
Sulfide (mg/l)						
value	0.04					
time	12:05					

COMMENTS: * Dissolved Metals Field Filtered 0.45μm
* well went Dry

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 11 OCTOBER 2017

Well No. LC3-1

well depth (top PVC)	8.4	8.4				
water level(top PVC)	6.2	6.7				
water height	2.2	1.7				
time	15:05	15:24				
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	~~2.15~~ 1.436					
3 x vol	4.3G					
Purge Volume						
gallons purged	0.5		1.0	1.25	1.5	
purge/bail/type	PERISTALTIC		PER	PER	PER	
Water Sample						
Sample No.						GW-LC3-1
Sample Method						PERISTALTIC
Time						15:35-16:10
No. Cont.						11
Initials						DB
pH						
value	7.54		7.29	7.34	7.29	
time	15:21		15:27	15:32	15:37	
Conductivity (S/cm)						
value	2229.8		2717.8	2243.7	2162.7	
time	15:21		15:27	15:32	15:37	
Temp. (Celsius)						
value	17		17	16.91	16.98	
time	15:21		15:27	15:32	15:37	
DO (mg/l)						
value	0.05		0	0.02	0.02	
time	15:21		15:27	15:32	15:37	
ORP (mV)						
value	-178.3		-200.1	-186.4	-174.7	
time			15:27	15:32	15:37	
TDS (ppt)						
value	1		2	1	1	
time	15:21		15:27	15:32	15:37	
Turbidity (ntu)						
value					15.7 NTU	
time					1540	
Ferrous Iron (mg/l)						
value					3.0 mg/L	
time					1540	
Sulfide (mg/l)						
value					0.06 mg/L	
time					1540	

COMMENTS:
15:05 START, TUBE ≈1.FT ABOVE BOTTOM OF WELL, 15:25 MOVED TUBE TO 0.5' ABOVE BOTTOM.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/12/17

Well No. ID1-1

well depth (top PVC)	14.9					
water level(top PVC)	7.9					
water height	7					
time	10:30					
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol						
3 x vol						
Purge Volume						
gallons purged	~0.5	1.0	1.5	2.0		
purge/bail/type						
Water Sample						
Sample No.	GW-ID1-1-101217-9.6-14.6					
Sample Method	Peristaltic					
Time	1045					
No. Cont.	11					
Initials	DJP					
pH						
value	7.83	9.0	9.17	7.24		
time	1050					
Conductivity (S/cm)						
value	5885.0	4757.9	4608.5	4571.5		
time	1050	1100	1110	1120		
Temp. (Celsius)						
value	13.61	15.12	15.39	15.51		
time	1050					
DO (mg/l)						
value	0.30	0.03	0.02	0.01		
time	1050					
ORP (mV)						
value	-109.6	-102.4	-76.5	-67.9		
time	1050					
TDS (ppt)						
value	4	3	3	3		
time	1050					
Turbidity (ntu)						
value				7.2 NTU		
time				1100		
Ferrous Iron (mg/l)						
value				0.38 mg/L		
time				1100		
Sulfide (mg/l)						
value				0.27 mg/L		
time				1100		

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 13 OCTOBER 2017

Well No. 2A1-1

well depth (top PVC)	14.3	14.3	14.3	14.3	14.3	
water level(top PVC)	9.65	9.9	10.1	10.3	10.4	
water height	4.65	4.4	4.2	4	3.9	
time	10:04	10.14	10:24	10:34	10:44	
Casing/Volume						
type:	4"					
type: other	SCH40 PVC					
vol/ft	0.653g/ft					
tot. vol	3.04					
3 x vol	9.12					
Purge Volume						
gallons purged		0.6	1.12	1.5	2.5	
purge/bail/type		PERISTALTIC	10:24	10:34	PEP	
Water Sample						
Sample No.					GW-2A1-1	
Sample Method					PERISTALTIC	
Time					10:50-11:20	
No. Cont.					11	
Initials					DB	
pH						
value		7.63	7.07	6.92	6.82	
time		10:14	10:24	10:34	10:44	
Conductivity (S/cm)						
value		1895.9	1890	1826	1830.2	
time		10:14	10:24	10:34	10:44	
Temp. (Celsius)						
value		14.8	15.36	15.3	15.56	
time		10:14	10:24	10:34	10:44	
DO (mg/l)						
value		0.09	0.06	0.06	0.05	
time		10:14	10:24	10:34	10:44	
ORP (mV)						
value		-31.9	-42.9	-46.3	-50	
time		10:14	10:24	10:34	10:44	
TDS (ppt)						
value		1	1	1	1	
time		10:14	10:24	10:54	10:44	
Turbidity (ntu)						
value					4.82 NTU	
time					1115	
Ferrous Iron (mg/l)						
value					7.7 mg/L	
time					1115	
Sulfide (mg/l)						
value					0.08mg/L	
time					1115	

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 13 OCTOBER 2017

Well No. 2BI-1

well depth (top PVC)	15.2	15.2	15.2	15.2	15.2	
water level(top PVC)	9.7	9.9	10	10.1	10.15	
water height	5.5'	5.3	5.2	5.1	5.05	
time	8:25	8:35	8:45	8:55	9:25	
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	3.59					
3 x vol	10.77					
Purge Volume						
gallons purged		0.5	1.25	2.0	3.0+SAMPLE	
purge/bail/type		PERISTALTIC →				
Water Sample						
Sample No.					2BI-1	
Sample Method					PERISTACTIC	
Time					09:00-09:25	
No. Cont.					11	
Initials					DB	
pH						
value		6.81	6.76	6.74	6.22	
time		8:35	8:45	8:55	9:25	
Conductivity (S/cm)						
value		17043.6	16871	16756.8	17040	
time		8:35	8:45	8:55	9:25	
Temp. (Celsius)						
value		15.08	15.72	16.02		
time		8:35	8:45	8:55		
DO (mg/l)						
value		0.04	0.01	0.01		
time		8.35	8:45	8:55		
ORP (mV)						
value		-134.3	-141.9	144.4		
time		8:35	8:45	8:55		
TDS (ppt)						
value		11	11	11		
time		8:35	8:45	8:55		
Turbidity (ntu)						
value					1.12 NTU	
time					0930	
Ferrous Iron (mg/l)						
value					14.8 mg/L	
time					0930	
Sulfide (mg/l)						
value					0.3 mg/L	
time					0930	

COMMENTS: 8:25 START PURGE; TUBE 0.5' ABOVE BOTTOM OF WELL

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 11 OCTOBER 2017

Well No. 2C1-1R

well depth (top PVC)	10.2	10.2	10.2			
water level(top PVC)	6.85	7.25	7.5			
water height	3.35	2.95	2.7			
time	13:15	13:40	14:20			
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	~~2.0~~ 0.653					
tot. vol	2.187					
3 x vol	7 (6.56)					
Purge Volume						
gallons purged	2 G		2 G			
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	GW 2C1-1R-101117-5.1-10.1					
Sample Method	PERISTALTIC					
Time	13:45					
No. Cont.	11					
Initials	DB					
pH						
value	7.17	7.19	7.17			
time	13:37	13:50	14:17			
Conductivity (S/cm)						
value	3940.9		3640.9			
time	13:37		14:17			
Temp. (Celsius)						
value	20.31	20.28	21.87			
time	13:37	13:50				
DO (mg/l)						
value	0.01		0.01			
time	13:37		14:17			
ORP (mV)						
value	-145.6		-154.5			
time	13:37		14:17			
TDS (ppt)						
value	3		2			
time	13:37		14:17			
Turbidity (ntu)						
value			3.88 NTU			
time			1420			
Ferrous Iron (mg/l)						
value			7.4 mg/L			
time			1420			
Sulfide (mg/l)						
value			0.63 mg/L			
time			1420			

COMMENTS:

TUBE 2 ft ABOVE WELL BOTTOM; SOME SILT AT WELL BOTTOM.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/12/17

Well No. 2D1-1

well depth (top PVC)	7.1					
water level(top PVC)	3.43					
water height	3.7					
time	0830					
Casing/Volume						
type:	4" PVC					
type: other						
vol/ft						
tot. vol	~2.4					
3 x vol	7.4					
Purge Volume						
gallons purged	~1/2	~1.0	~1.5			
purge/bail/type						
Water Sample						
Sample No.	GW-2D1-1-101217-7.5-12.5					
Sample Method	Perastaltic					
Time	0900					
No. Cont.	11					
Initials	DJP					
pH						
value	6.82	6.96	7.12			
time	0850	0900	0900			
Conductivity (S/cm)						
value	4755.0	3681.3	3253.4			
time	0850	0900	0900			
Temp. (Celsius)						
value	18.29	18.43	18.36			
time	0850	0900	0900			
DO (mg/l)						
value	0.08	0.06	0.07			
time	0850	0900	0900			
ORP (mV)						
value	-129.0	-136.7	-127.8			
time	0850	0900	0900			
TDS (ppt)						
value	3	2	2			
time	0850	0900	0900			
Turbidity (ntu)						
value			4.88 NTU			
time			0900			
Ferrous Iron (mg/l)						
value			0.7 mg/L			
time			0900			
Sulfide (mg/l)						
value			0.14 mg/L			
time			0900			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/16/2017

Well No. 3A3-1(R)

well depth (top PVC)	12.7					
water level(top PVC)	10.9					
water height	1.8					
time	0950					
Casing/Volume						
type:	2" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	0.3					
3 x vol	0.9					
Purge Volume						
gallons purged	~0.7	~1.5	~2.25	~3.25		
purge/bail/type						
Water Sample						
Sample No.	GW-2A3-1R-101617-8.2-13.2					
Sample Method	Parastaltic					
Time	10:5					
No. Cont.	15					
Initials	DJP					
pH						
value	7.77	7.41	7.74	7.32	7.31	
time	10:10	10:20	10:30	10:40	1050	
Conductivity (S/cm)						
value	77325.5	79414.3	144.1	114.5	108.5	
time	10:10	10:20	10:30	1040	1050	
Temp. (Celsius)						
value	13.47	13.60	14.99	18.36	19.90	
time	10:10	10:20	10:30	1040	1050	
DO (mg/l)						
value	~~43.5~~ 0.07	0.06	8.73	9.32	9.04	
time	10:10	10:20	10:30	1040	1050	
ORP (mV)						
value	-43.5	-47.8	-70.5	-8.2	1.4	
time	10:10	10:20	10:30	1040	1050	
TDS (ppt)						
value	50	52	0	0	0	
time	10:10	10:20	10:30	1040	1050	
Turbidity (ntu)						
value					1.76 NTU	
time					1100	
Ferrous Iron (mg/l)						
value					8.2 mg/L	
time					1100	
Sulfide (mg/l)						
value					0.04 mg/L	
time					1100	

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 16 OCTOBER 2017

Well No. 3A7-1R

well depth (top PVC)	13.5	13.5	13.5	13.5	13.5	
water level(top PVC)	10.8	11.4	11.4	11.5	11.2	
water height	2.7	2.1	2.1	2	2.3	
time	11:15	11:25	11:35	11:45	12:30	
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	0.44					
3 x vol	1.32					
Purge Volume						
gallons purged		~~0.75~~ 0.5	0.75	1.25	2	
purge/bail/type		PERISTALTIC	"			
Water Sample						
Sample No.					3A7-1R	
Sample Method					PERISTALTIC	
Time					11:35-12:45	
No. Cont.					15	
Initials					DB	
pH						
value		10.05	9.38	8.58		
time		11:25	10:35	11:45		
Conductivity (S/cm)						
value		1152.5	1098.2	1242.9		
time		11:25	10:35	11:45		
Temp. (Celsius)						
value		19.8577	18.87	18.82		
time		11:15	10:35	11:45		
DO (mg/l)						
value		0.07	0.03	0.01		
time		11:25	10:35	11:45		
ORP (mV)						
value		-135.8	-146.9	-157		
time		11:25	10:35	11:45		
TDS (ppt)						
value		1	1	1		
time		11:25	10:35	10:45		
Turbidity (ntu)						
value				5.42 NTU		
time				1230		
Ferrous Iron (mg/l)						
value				7.9mg/L		
time				1230		
Sulfide (mg/l)						
value				0.45mg/L		
time				1230		

COMMENTS: START PUMP @ 11:05: ADJUSTED FLOW DOWNWARD @ 11:15 ; HAD TO CHANGE FILTER ON DISSOLVED SAMPLES AS FLOW WAS RESTRICTED BY BLOCKED FILTER TO THE POINT OF BACKPRESSURE POPPING TUBING OFF

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Luke Kenso
Date: 10/12/17

Well No. 3C1-1

well depth (top PVC)						
water level(top PVC)	9.8					
water height						
time	1300					
Casing/Volume						
type:	4"					
type: other	SCV 40 PVC					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1.5	3	4.5			
purge/bail/type						
Water Sample						
Sample No.						
Sample Method						
Time						
No. Cont.						
Initials						
pH						
value	7.50	7.62 ~~7.57~~ LK	8.04			
time	1310	1320	1335			
Conductivity (S/cm)						
value	8976.1	7461.7	7185			
time						
Temp. (Celsius)						
value	12.87	15.26	16.20			
time						
DO (mg/l)						
value	0.22	0.02	0.04			
time						
ORP (mV)						
value	-80	-134	-180.4			
time						
TDS (ppt)						
value	6	5	5			
time						
Turbidity (ntu)						
value			Opaque - No reading			
time			1340			
Ferrous Iron (mg/l)						
value			8.5 mg/L			
time			1340			
Sulfide (mg/l)						
value			3.1 mg/L			
time			1340			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/12/17

Well No. 3C2-1

well depth (top PVC)	14					
water level(top PVC)	6.4					
water height	7.6					
time	1200					
Casing/Volume						
type:	4" PVC					
type: other	Sch 40					
vol/ft						
tot. vol						
3 x vol	15.2					
Purge Volume						
gallons purged	~0.28	~1.3	~2.0			
purge/bail/type						
Water Sample						
Sample No.	GW-3C2-1-101217-28-12					
Sample Method	Peristaltic					
Time	1115					
No. Cont.	11					
Initials	DTP					
pH						
value	9.59	9.75	9.81			
time	1210	1220	1230			
Conductivity (S/cm)						
value	10594.8	10550.1	10457.4			
time	1210	1220	1230			
Temp. (Celsius)						
value	15.66	15.92	15.93			
time	1210	1220	1230			
DO (mg/l)						
value	0.05	0.06	0.04			
time	1210	1220	1230			
ORP (mV)						
value	-182.8	-170.3	-166.8			
time	1210	1220	1230			
TDS (ppt)						
value	7	7	7			
time	1210	1220	1230			
Turbidity (ntu)						
value			2.16 NTU			
time			1230			
Ferrous Iron (mg/l)						
value			1.0 mg/L			
time			1230			
Sulfide (mg/l)						
value			3.1 mg/L			
time			1230			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/11/2017

Well No. 3C6-1(R)

well depth (top PVC)	9.8					
water level(top PVC)	~~7'4"~~ 7.4					
water height	2.4					
time	0945					
Casing/Volume						
type:	2"					
type: other	Sch 40 PVC					
vol/ft						
tot. vol						
3 x vol	1.2					
Purge Volume						
gallons purged	1/3	2/3	1.2			
purge/bail/type						
Water Sample						
Sample No.	GW-3C6-	1R-101117	-4.5-9.5			
Sample Method	Parastaltic					
Time	0945					
No. Cont.						
Initials	DJP					
pH						
value	6.64	6.51	6.52			
time	1010	1020	1030			
Conductivity (S/cm)						
value	10870.4	10529.2	10430.0			
time	1010	~~10~~ 1020	1030			
Temp. (Celsius)						
value	18.43	18.92	18.74			
time	1010	1020	1030			
DO (mg/l)						
value	0.0[illegible]	0.01	0.00			
time	1010	1020	1030			
ORP (mV)						
value	-134.1	-138.3	-142.6			
time	1010	1020	1030			
TDS (ppt)						
value	7	7	7			
time	1010	1020	1030			
Turbidity (ntu)						
value	0.1 NTU	→	→			
time	1030	→	→			
Ferrous Iron (mg/l)						
value	~~1.5 mg/L~~	→	1.18 mg/L			
time			1100			
Sulfide (mg/l)						
value			1.5 mg/L			
time			1100			

COMMENTS:

Dark Brown Color

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 12 OCTOBER 2017

Well No. 3D1-1

well depth (top PVC)	14.8	14.8	14.8	14.8		
water level(top PVC)	6.8	6.9	7			
water height	8.0	7.9	7.8			
time	13:45	14:10	14:15	14:25		
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	5.2					
3 x vol	15.2					
Purge Volume						
gallons purged	1	2	2.75	5		
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.					3D1-1	
Sample Method					PER.	
Time					14:45-15:05	
No. Cont.					11	
Initials					DB	
pH						
value	10.56	9.2	8.27	7.18		
time	13:51	14:05	14:15	14:45		
Conductivity (S/cm)						
value	1103.5	955.9	892.6	875.5		
time	13:51	14:05	14:15	14:45		
Temp. (Celsius)						
value	14.63	15.57	15.88	16.35		
time	13:51	14:05	14:15	14:45		
DO (mg/l)						
value	0.09	0.05	0.08	0.29		
time	13:51	14:05	14:15	14:45		
ORP (mV)						
value	-133.4	-130.1	-128.9	-115		
time	13:51			14:45		
TDS (ppt)						
value	1	1	1	1		
time	13:51	14:05	14:15	14:45		
Turbidity (ntu)						
value				39.8 NTU		
time				1445		
Ferrous Iron (mg/l)						
value				9.5 mg/L		
time				1445		
Sulfide (mg/l)						
value				0.04 mg/L		
time				1445		

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 12 oct 2017

Well No. 3E1-1

well depth (top PVC)	12.4'	12.4	12.4	12.4	12.4	
water level(top PVC)	5.9	5.95	6.0	6.0	6.0	
water height	6.5	6.45	6.4	6.4	6.4	
time	15:30	15:40	15:50	16:00	16:10	
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653/ft					
tot. vol	4.2					
3 x vol	12.6					
Purge Volume						
gallons purged		0.5	2.0	2.75	3.5	
purge/bail/type		PERISTALTIC	"			
Water Sample						
Sample No.						3E1-1
Sample Method						PERISTALTIC
Time						16:10-16:30
No. Cont.						11
Initials						DB
pH						
value		6.65	6.56	6.62	6.79	
time		15:40	15:50	16:00	16:10	
Conductivity (S/cm)						
value		1060.2	985.4	807.8	772.0	
time		15:40	15:50	16:00	16:10	
Temp. (Celsius)						
value		15.11	15.4	15.61	15.69	
time		15:40	15:50	16:00	16:10	
DO (mg/l)						
value		0.08	0.05	0.04	0.04	
time		15:40	15:50	16:00	16:10	
ORP (mV)						
value		-40.4	-45.4	-67.1	-75.9	
time		15:40	15:50	16:00	16:10	
TDS (ppt)						
value		1	1	1	1	
time		15:40	15:50	16:00	16:10	
Turbidity (ntu)						
value					8.28 NTU	
time					1630	
Ferrous Iron (mg/l)						
value					1.7 mg/L	
time					1630	
Sulfide (mg/l)						
value					0.1 mg/L	
time					1630	

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/16/2017

Well No. 4B4-1

well depth (top PVC)	10.3					
water level(top PVC)	8.7					
water height	1.6					
time	1320					
Casing/Volume						
type:	2" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	~0.263					
3 x vol	0.8					
Purge Volume						
gallons purged	1.0					
purge/bail/type						
Water Sample						
Sample No.	GW-4B4-1-101617					
Sample Method	Peristaltic					
Time						
No. Cont.						
Initials	DJP					
pH						
value	7.19	7.22	7.22			
time	1330	1340	1350			
Conductivity (S/cm)						
value	678	540	502.2			
time	1330	1340	1350			
Temp. (Celsius)						
value	18.71	18.79	18.74			
time	1330	1340	1350			
DO (mg/l)						
value	0.09	0.12	0.69			
time	1330	1340	1350			
ORP (mV)						
value	-86.5	-83.2	-82.0			
time	1330	1340	1350			
TDS (ppt)						
value	0	0	0			
time	1330	1340	1350			
Turbidity (ntu)						
value			0.54 NTU			
time			1400			
Ferrous Iron (mg/l)						
value			4.5 mg/l			
time			1400			
Sulfide (mg/l)						
value			0.04 mg/L			
time			1400			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/13/17

Well No. 4B3-1

well depth (top PVC)	14.8					
water level(top PVC)	7.5					
water height	7.3					
time	1005					
Casing/Volume						
type:	4" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	~4.8					
3 x vol	14.6					
Purge Volume						
gallons purged	~1	~2				
purge/bail/type	1020					
Water Sample						
Sample No.	GW-4B3-1-101317-4.5-10.5					
Sample Method	Peristaltic					
Time	1030					
No. Cont.	11					
Initials	DJT					
pH						
value	7.41	7.40	7.39			
time	1015	1025	1035			
Conductivity (S/cm)						
value	562.4	558.0	558.3			
time	1015	1025	1035			
Temp. (Celsius)						
value	17.70	17.91	17.91			
time	1015	1025	1035			
DO (mg/l)						
value	0.05	0.04	0.03			
time	1015	1025	1035			
ORP (mV)						
value	-124.3	-101.4	-105.1			
time	1015	1025	1035			
TDS (ppt)						
value	0	0	0			
time	1015	1025	1035			
Turbidity (ntu)						
value			46.1 NTU			
time			1100			
Ferrous Iron (mg/l)						
value			3.3 mg/L			
time			1100			
Sulfide (mg/l)						
value			0.17 mg/L			
time			1100			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/17/2017

Well No. ~~S~~ 4C1-1

well depth (top PVC)	15.0					
water level(top PVC)	6.3	8.2	8.6	8.7		
water height	8.7					
time	1155	1205	1215	1225		
Casing/Volume						
type:	4" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	5.8					
3 x vol	17.4					
Purge Volume						
gallons purged	~1.0	~2.0				
purge/bail/type						
Water Sample						
Sample No.	GW-4C1-	1-101717				
Sample Method	Parastalter					
Time	1230					
No. Cont.	10					
Initials	DTP					
pH						
value	10.10	10.14	10.27			
time	1205	1215	1225			
Conductivity (S/cm)						
value	3624	3611	3605			
time	1205					
Temp. (Celsius)						
value	16.43	16.65	16.78			
time	1205					
DO (mg/l)						
value	0.03	0.05	0.02			
time	1205					
ORP (mV)						
value	-241.2	-150.6	410.0			
time	1205					
TDS (ppt)						
value	2	2	2			
time	1205					
Turbidity (ntu)						
value			19.6 NTU			
time			1240			
Ferrous Iron (mg/l)						
value			0 mg/L			
time			1240			
Sulfide (mg/l)						
value			5.0 mg/L			
time			1240			

COMMENTS: Observe ~~at~~ bubbling on surface of water in well. Replaced tubing and bubbles stopped. Burgandy/Brown colored water

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/20/2017

Well No. 4C2-1

well depth (top PVC)	9.8					
water level(top PVC)	6.0	6.1	6.06			
water height	3.8					
time	1420	1430				
Casing/Volume						
type:	2" PVC					
type: other	sch 40					
vol/ft						
tot. vol	0.63					
3 x vol	1.9					
Purge Volume						
gallons purged	1.25	2.5	3.75			
purge/bail/type						
Water Sample						
Sample No.	GW-4C2-1-102017				~~9.97~~	
Sample Method	Parastaltic					
Time	1445					
No. Cont.	10					
Initials	DTP					
pH						
value	10.22	10.47	10.56		9.97 *	
time	1430	1440	1450		15:26	
Conductivity (S/cm)						
value	1998	1820	1743.7			
time	1430	1440	1450			
Temp. (Celsius)						
value	18.19	18.34	18.45			
time	1430	1440	1450			
DO (mg/l)						
value	0.02	0.01	0.01			
time	1430	1440	1450			
ORP (mV)						
value	-70.6	-75.5	-75.5			
time	1430	1440	1450			
TDS (ppt)						
value	1	1	1			
time	1430	1440	1450			
Turbidity (ntu)						
value				1.45 NTU		
time				15:15		
Ferrous Iron (mg/l)						
value				0.8 mg/l		
time				15:25		
Sulfide (mg/l)						
value				4.9 mg/L		
time				15:20		

COMMENTS:
HAD TO X10 DILUTE SULFIDE SAMPLE.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

* SECOND SONDE, ALIQUOT MEASURE

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/18/17

Well No. 4DI-1

well depth (top PVC)	14.9					
water level(top PVC)	5.9	6.3	6.25	6.25		
water height	9.0					
time	0830	0845	8:55	0905		
Casing/Volume						
type:	4" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	6.0					
3 x vol	18.0					
Purge Volume						
gallons purged	2.0	~3.5	~5.0	~6.5		
purge/bail/type						
Water Sample						
Sample No.	GW-4DI-1-101817					
Sample Method	Parastaltic					
Time	0900					
No. Cont.	10					
Initials	DEP					
pH						
value	10.86	11.09	11.11	11.10		
time	0845	0855	0905	0915		
Conductivity (S/cm)						
value	11244	10653	9339	9184		
time						
Temp. (Celsius)						
value	15.44	15.88	16.02	16.02		
time						
DO (mg/l)						
value	0.01	0.00	0.0	0.0		
time						
ORP (mV)						
value	-233.5	-213.1	-200.5	-197.2		
time						
TDS (ppt)						
value	7	7	6	6		
time						
Turbidity (ntu)						
value				0.21 NTU		
time				930		
Ferrous Iron (mg/l)						
value				0 mg/L		
time				930		
Sulfide (mg/l)						
value				Out of Range at 20x dilution		
time				930		

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 10/12/17

Well No. 4D2-1

well depth (top PVC)		~~12.3'~~	12.3			
water level(top PVC)	~~7.80~~	~~7.75'~~	7.75			
water height		~~4.8~~	4.45			
time	~~10 1325~~	~~550~~	1450			
Casing/Volume						
type:	~~4"~~	2"				
type: other	~~SCH 40 PVC~~	SCH 40 PVC				
vol/ft		.163				
tot. vol		.73 gall				
3 x vol		2.17 gall				
Purge Volume						
gallons purged	0.5	1	1.5	2	3	
purge/bail/type			~~150~~			
Water Sample						
Sample No.						
Sample Method						
Time						
No. Cont.						
Initials						
pH						
value	0 02	9.03	8.99	8.86	8.86	
time	1455	1500	1505	1510	1515	
Conductivity (S/cm)						
value	1767.3	1767.5	2169.5	2493	2469	
time	1455	1600	1505	1510	1515	
Temp. (Celsius)						
value	17.14	18.27	19.61	19.39	19.33	
time	1455	1500	1505	1510	1515	
DO (mg/l)						
value	0.15	0.09	0.04	0.04	0.04	
time	1465	1500	15.05	1510	1515	
ORP (mV)						
value	-102.7	-111.1	-172.7	-176.1	-168.8	
time	1455	1500	15.05	1510	1515	
TDS (ppt)						
value	1	1	1	2	2	
time	1455	~~100~~ 1500	1505	1510	1515	
Turbidity (ntu)						
value					2.16 NTU	
time					1520	
Ferrous Iron (mg/l)						
value					0.2 mg/L	
time					1520	
Sulfide (mg/l)						
value					0.62 mg/L	
time					1520	

COMMENTS:
Field Filter 0.45 µm for Dissolved Metals

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: David Browning
Date: 13 oct 2017

Well No. 4F1-1

well depth (top PVC)	9.8	9.8	9.8	9.8		
water level(top PVC)	6.4	6.7	6.7	6.7		
water height	3.4	3.1	3.1	3.1		
time	13:15	13:24	13:40	13:50		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	0.5542					
3 x vol	1.663					
Purge Volume						
gallons purged		0.5	0.75	1.25		
purge/bail/type			PERISTALTIC			
Water Sample						
Sample No.				GW4F1-1		
Sample Method				PERISTALTIC		
Time				13:50-14:30		
No. Cont.				11		
Initials				DB		
pH						
value		7.13	5.53	5.34		
time		13:25	13:40	13:50		
Conductivity (S/cm)						
value		592.3	303.6	290.9		
time		13:25	13:40	13:50		
Temp. (Celsius)						
value		17.18	17.63	17.45		
time		13:25	13:40	13:50		
DO (mg/l)						
value		0.14	0.15	0.19		
time		13:25	13:40	13:50		
ORP (mV)						
value		64.4	~~17.65~~	80.6		
time		13:25	78.4	13:50		
TDS (ppt)						
value		0	0	0		
time		13:25	13:40	13:50		
Turbidity (ntu)						
value				9.75 NTU		
time				1420		
Ferrous Iron (mg/l)						
value				13.4 mg/L		
time				1420		
Sulfide (mg/l)						
value				0.05 mg/L		
time				1420		

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 11-01-17

Well No. 4G1-1

well depth (top PVC)	14.1					
water level(top PVC)	5.31	6.89				
water height	6.69					
time	10:17	10:90				
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653 gal/ft.					
tot. vol	4.37 gal					
3 x vol	13.1 gal					
Purge Volume						
gallons purged	1 gal	2.5 gal	3.5 gal			
purge/bail/type	Peristaltic					
Water Sample						
Sample No.	GW-4G1-1-110117					
Sample Method	Peristaltic					
Time	10:50					
No. Cont.	10					
Initials	LNK					
pH						
value	7.10	7.16	7.20			
time	10:30	10:90	10:50			
Conductivity (S/cm)						
value	838.1	826.0	833.9			
time µS/cm						
Temp. (Celsius)						
value	13.95	13.95	13.95			
time						
DO (mg/l)						
value	0.08	0.05	0.05			
time						
ORP (mV)						
value	-127.1	-131.0	-136.9			
time						
TDS (ppt)						
value	1	1	1			
time						
Turbidity (ntu)						
value			3.88 NTU			
time			1105			
Ferrous Iron (mg/l)						
value			0.98 mg/L			
time			1105			
Sulfide (mg/l)						
value			0.14 mg/L			
time			1105			

COMMENTS: - START PUMPING @ 10:18
- Dissolved Metals/Solids Field Filtered 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 11-01-2017

Well No. 4H3-1

well depth (top PVC)	~~79.6~~ 14.6'					
water level(top PVC)	2.8'					
water height	11.8'					
time	1710					
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653 gal/ft					
tot. vol	7.7 gal					
3 x vol	23.1 gal					
Purge Volume						
gallons purged	1 gal	2.25 gal	3.5 gal			
purge/bail/type	Peristaltic					
Water Sample						
Sample No.	GW-4H3-1-110117					
Sample Method	Peristaltic					
Time	12:35					
No. Cont.	10					
Initials	JNK					
pH						
value	11.59	11.59	11.59			
time	1220	1230	1240			
Conductivity (S/cm)						
value µS/cm	19,496.3	19,445.0	19,401.3			
time						
Temp. (Celsius)						
value	12.49	12.59	12.64			
time						
DO (mg/l)						
value	0.09	0.03	0.07			
time						
ORP (mV)						
value	-426.9	-439.8	-444.8			
time						
TDS (ppt)						
value	13	13	13			
time						
Turbidity (ntu)						
value			Out of Range due to opacity			
time			1240			
Ferrous Iron (mg/l)						
value			0 mg/L			
time			1240			
Sulfide (mg/l)						
value			Exceeds range @ 50x dilution			
time			1240			

COMMENTS:
- Begin Pumping @ 12:10.
- Dissolved metals/Solids Field Filtered 0.45µm.
- Foul odor

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/16/17

Well No. SB1-1R

well depth (top PVC)	9.6					
water level(top PVC)	8.3	8.4	8.45			
water height	1.3					
time	1450					
Casing/Volume						
type:	2" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	0.216					
3 x vol	0.65					
Purge Volume						
gallons purged	~1.0	~2.0	~3.0			
purge/bail/type						
Water Sample						
Sample No.	GW-SB1-1R-101617					
Sample Method	Perastaltic					
Time	1515					
No. Cont.	15					
Initials	DTP					
pH						
value	10.0	9.95	9.94			
time	1500	1510	1520			
Conductivity (S/cm)						
value	2319.1	2252.3	2202.6			
time	1500	1510	1520			
Temp. (Celsius)						
value	17.95	17.99	~~1520~~ 18.00			
time	1500	1510	1520			
DO (mg/l)						
value	0.06	0.06	0.06			
time	1500	1510	1520			
ORP (mV)						
value	-163.2	-112.2	-104.1			
time	1500	1510	1520			
TDS (ppt)						
value	2	1	1			
time	1500	1510	1520			
Turbidity (ntu)						
value			1.6 NTU			
time			1530			
Ferrous Iron (mg/l)						
value			0.07 mg/L			
time			1530			
Sulfide (mg/l)						
value			4.3 mg/L			
time			1430			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 17 OCTOBER 2017

Well No. 5C12-1

well depth (top PVC)	17.2	17.2	17.2	17.2	17.2	
water level(top PVC)	6.55	6.6	6.6	6.6	6.6	
water height	10.65	10.6	10.6	10.6	10.6	
time	10:35	10:43	10:53	11:03	11:13	
Casing/Volume						
type:	4"					
type: other	PVC SCH 40					
vol/ft	0.653					
tot. vol						
3 x vol						
Purge Volume						
gallons purged		0.5	1.5	2	2.75	
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.						5C12-1
Sample Method						PERISTALTIC
Time						11:15-11:35
No. Cont.						10
Initials						DB
pH						
value		9.69	11.29	11.62	11.65	
time		10:43	10:53	11:03	11:13	
Conductivity (S/cm)						
value		11690.0	9154.9	6606.	5805.6	
time		10:43	10:53	11:03	11:23	
Temp. (Celsius)						
value		17.54	18.07	18.20	18.25	
time		10:43	10:53	11:03	11:23	
DO (mg/l)						
value		0.07	0.02	0.03	0.04	
time		10:43	10:53	11:03	11:23	
ORP (mV)						
value		-374.4	-304.0	-235.6	-169.4	
time		10:43	10:53	11:03	11:23	
TDS (ppt)						
value		7	5	4	4	
time		10:43	10:53	11:03	11:23	
Turbidity (ntu)						
value					1.44 NTU	
time					1150	
Ferrous Iron (mg/l)						
value					0 mg/L	
time					1150	
Sulfide (mg/l)						
value					2.7mg/L	
time					1160	

COMMENTS: PUMP ON 10:38;

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 17 OCTOBER 2017

Well No. 5C13-1

well depth (top PVC)	13.9	13.9	13.9	13.9	13.9	
water level(top PVC)	5.8	6.6	6.9	6.9	6.9	
water height	8.1	7.3	7	7	7	
time	13:23	13:30	13:40	13:50	14:00	
Casing/Volume						
type:	4"		4"			
type: other	SCH 40 PVC		SCH 40 PVC			
vol/ft	0.653		0.653			
tot. vol	5.1289					
3 x vol	15.868					
Purge Volume						
gallons purged		0.5	1.25	2.25	2.75	
purge/bail/type						
Water Sample						
Sample No.						5C13-1
Sample Method						PERISTALTIC
Time						14:00 -14:30
No. Cont.						10
Initials						DB
pH						
value			~~0~~10.4	10.75	10.9	
time			13:40	13:50	14:00	
Conductivity (S/cm)						
value			17950.3	11535.0	8126.6	
time			13:40	13.50	14:00	
Temp. (Celsius)						
value			18.57	18.92	18.7	
time			13:40	13:50	14:00	
DO (mg/l)						
value			0.02	0.00	0.01	
time			13:40	13:50	14:00	
ORP (mV)						
value			~~0~~ -214.5	-167.0	- 98.5	
time			13:40		14:00	
TDS (ppt)						
value			11	7	5	
time			13.40	13:50	14:00	
Turbidity (ntu)						
value					2.35 NTU	
time					1415	
Ferrous Iron (mg/l)						
value					0.69 mg/L	
time					1415	
Sulfide (mg/l)						
value					0.35 mg/L	
time					1415	

COMMENTS:

START PUMP 13:24. pH/ORP sensor was loose for 13:30 measurement. Reseated and all worked.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/17/2017

Well No. SC16-1R

well depth (top PVC)	9.7					
water level(top PVC)	7.2					
water height	2.5"					
time	0910					
Casing/Volume						
type:	2" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	~0.4					
3 x vol	1.25					
Purge Volume						
gallons purged	~0.8	~1.6				
purge/bail/type						
Water Sample						
Sample No.	GW-SC16-1R-101717					
Sample Method	Peristaltic					
Time	0945					
No. Cont.	11					
Initials	DJP					
pH						
value	8.24	8.25	8.26			
time	0925	0935	0945			
Conductivity (S/cm)						
value	1858	1726	1676			
time	0925	0935	0945			
Temp. (Celsius)						
value	16.34	16.55	16.58			
time	0925	0935	0945			
DO (mg/l)						
value	0.08	0.07	0.06			
time	0925	0935	0945			
ORP (mV)						
value	-68.7	-93.0 ~~0935~~	-109.5			
time	0925	0935	0945			
TDS (ppt)						
value	1	1	1			
time	0925	0935	0945			
Turbidity (ntu)						
value			0.48NTU			
time			1000			
Ferrous Iron (mg/l)						
value			0.08mg/L			
time			1000			
Sulfide (mg/l)						
value			0.18mg/L			
time			1000			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-25-2017

Well No. 5D2-1R

well depth (top PVC)	14.9"					
water level(top PVC)	5.60	5.8				
water height	9.3					
time	12:10	12:20				
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	1.52 gal					
3 x vol	4.5 gal					
Purge Volume						
gallons purged	1gal	2.25	3. 4gal			
purge/bail/type	Paristaltic					
Water Sample						
Sample No.	GW-5D2-1R					
Sample Method	Paristaltic					
Time	12:35					
No. Cont.	10					
Initials	LNK					
pH						
value	10.76	10.49	10.42			
time	12:20	12:30	12:40			
Conductivity (S/cm)						
value	9418.4	6,719.6	6,207.1			
time						
Temp. (Celsius)						
value	17.65	17.85	17.90			
time						
DO (mg/l)						
value	0.06	0.02	0.02			
time						
ORP (mV)						
value	-212.6	-160.8	-137.6			
time						
TDS (ppt)						
value	6	6	4			
time						
Turbidity (ntu)						
value			2.7 NTU			
time			1245			
Ferrous Iron (mg/l)						
value			0.02 mg/L			
time			1245			
Sulfide (mg/l)						
value			3.0 mg/L			
time			1245			

COMMENTS: + Brown Color

- Dissolved Metals Field Filtered w/ 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: ~~19/4~~ 10-19-17

Well No. 5D5-1

well depth (top PVC)	~~10~~ 17.50					
water level(top PVC)	6.20					
water height	11.3'					
time	8:34					
Casing/Volume						
type:	4"					
type: other	40 PVC					
vol/ft	0.653					
tot. vol	7.38					
3 x vol	22.14					
Purge Volume						
gallons purged	3	4.5	6			
purge/bail/type	purge					
Water Sample						
Sample No.					GW-5D5-1-101917-(20)	
Sample Method	Paristaltic				Paristaltic	
Time					9:10	
No. Cont.	10				10	
Initials	LK				LK	
pH						
value	6.43	6.51	6.67			
time	855	905	915			
Conductivity (S/cm)	↓	↓	↓			
value	17782	16,261.1	17810			
time						
Temp. (Celsius)						
value	18.03	18.28	18.30			
time						
DO (mg/l)						
value	0.05	0.03	0.03			
time						
ORP (mV)						
value	-108.1	-118.7	-139			
time						
TDS (ppt)						
value	11	10	9			
time						
Turbidity (ntu)						
value			72.4 NTU			
time			930			
Ferrous Iron (mg/l)						
value			No reading at 20x dilution (too high)			
time			930			
Sulfide (mg/l)						
value			0.03 mg/L			
time			930			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 19 OCTOBER 2017

Well No. SD7-1R

well depth (top PVC)	9.8	9.8	9.8	9.8	9.8	
water level(top PVC)	6.2	6.2	6.2	6.2	6.2	
water height	3.6	3.6	3.6	3.6	3.6	
time	8:35	8:45	8:55	9:05	9:15	
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol						
3 x vol						
Purge Volume						
gallons purged		0.25	1.25	2.25	3.25	
purge/bail/type						
Water Sample						
Sample No.		↑				915-9130 DB
Sample Method						aw-SD7-1R DB
Time						PERISTALTIC DB
No. Cont.						10
Initials						DB
pH						
value		7.82	7.85	7.76	7.72	
time		8:45	8:55	9:05	9:15	
Conductivity (S/cm)						
value		1367.7	962.8	966.4	1025.0	
time		8:45	8:55	9:05	9:15	
Temp. (Celsius)						
value		16.96	17.59	17.85	17.67	
time		8:45	8:55	9:05	9:15	
DO (mg/l)						
value		0.75	0.34	0.20	0.14	
time		8:45	8:55	9:05	9:15	
ORP (mV)						
value		-12.9	-74.8	-94.3	-108.1	
time		8:45	8:55	9:05	9:15	
TDS (ppt)						
value		1	1	1	1	
time		8:45	8:55	9:05	9:15	
Turbidity (ntu)						
value		X			6.26 NTU	
time					930	
Ferrous Iron (mg/l)						
value					4.0 mg/L	
time					930	
Sulfide (mg/l)						
value					0.03 mg	
time						

COMMENTS: BOTTOM WELL MEASURED @ 13.2', PUMP START 8:39

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 18 OCTOBER 2017

Well No. SEI-1

well depth (top PVC)	12.3	12.3	12.3	12.3		
water level(top PVC)	7.7	7.8	7.9	7.9		
water height	4.6	4.5	4.4	4.4		
time	9:50	10:00	10:15	10:25		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	0.75					
3 x vol	2.25					
Purge Volume						
gallons purged		0.25	1.5	2.25		
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.					GW-SEI-1	
Sample Method					PERISTALTIC	
Time					10:20-11:00	
No. Cont.					10	
Initials					DB	
pH						
value		7.82	7.12	7.00		
time		10:00	10:15	10:25		
Conductivity (S/cm)						
value		440.8	468.8	470.7		
time		10:00	10:15	10:25		
Temp. (Celsius)						
value		16.96	17.32	17.32		
time		10:00	10:15	10:25		
DO (mg/l)						
value		0.12	0.08	0.09		
time		10:00	10:15	10:25		
ORP (mV)						
value		16.98	15.5	-24.8		
time		10:00	10:15	10:25		
TDS (ppt)						
value		0	0	0		
time		10:00	10:15	10:25		
Turbidity (ntu)						
value				20.8 NTU		
time				1030		
Ferrous Iron (mg/l)						
value				11.8 mg/L		
time				1030		
Sulfide (mg/l)						
value				0.05 mg/L		
time				1030		

COMMENTS: START PUMPING 9:55

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 10 OCTOBER 2017

Well No. SE2-1

well depth (top PVC)	11.5	11.5	11.5	11.5	11.5	
water level(top PVC)	5.6	5.9	5.9	5.9	5.9	
water height	5.9	5.6	5.6	5.6	5.6	
time	8:25	8:31	8:40	8:50	9:00	
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	0.9617					
3 x vol	2.8851					
Purge Volume						
gallons purged		0.5	1.0	1.5	2.5	
purge/bail/type						
Water Sample						
Sample No.						SE2-1
Sample Method						PERISTALTIC
Time						9:00-9:30
No. Cont.						10
Initials						DB
pH						
value		9.44	8.68	8.11	7.82	
time		8:31	8:40	8:50	9:00	
Conductivity (S/cm)						
value		2411.4	2065.5	2136.5	2466.0	
time		8:31	8:40	8:60	9:00	
Temp. (Celsius)						
value		17.56	18.41	18.47	18.60	
time		8:31	8:40	8:50	9:00	
DO (mg/l)						
value		0.17	0.09	0.06	0.05	
time		8:31	8:40	8:50	9:00	
ORP (mV)						
value		-32.6	-58.5	-76.6	-85.3	
time		8:31	8:40	8:50	9:00	
TDS (ppt)						
value		2	1	1	1	
time		8:31	8:40	8:50	9:00	
Turbidity (ntu)						
value					2.29 NTU	
time					9:40	
Ferrous Iron (mg/l)						
value					3.1 mg/L	
time					9:40	
Sulfide (mg/l)						
value					0.32 mg/L	
time					9:40	

COMMENTS: START PUMP 8:25, CALIBRATED CONDUCTIVITY SENSOR PRIOR TO STATION.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: LKerner
Date: ~~19-10-17~~ 10-19-17

Well No. 5E4-1

well depth (top PVC)	11.8					
water level(top PVC)	2.5					
water height	9.3					
time	1010					
Casing/Volume						
type:	2"					
type: other						
vol/ft	0.163					
tot. vol	1.18					
3 x vol	3.5					
Purge Volume						
gallons purged	1 g	2 g	3g			
purge/bail/type	Purge	Purge	Purge			
Water Sample						
Sample No.	GW-5E4-1-101917					
Sample Method	Paristaltic					
Time	10:30					
No. Cont.	10					
Initials	LNK					
pH						
value	8.25	8.75	8.95			
time	1020	10:30	10:40			
Conductivity (S/cm)	↓	↓	↓			
value	5209.5	6177.2	6462			
time						
Temp. (Celsius)						
value	17.67	17.81	17.85			
time						
DO (mg/l)						
value	0.01	0.00	0.00			
time						
ORP (mV)						
value	-179.4	-195.4	-200			
time						
TDS (ppt)						
value	3	4	4			
time						
Turbidity (ntu)						
value			2.15 NTU			
time			1100			
Ferrous Iron (mg/l)						
value			8.9 mg/L			
time			1100			
Sulfide (mg/l)						
value			0.22 mg/L			
time			1100			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: David Browning
Date: 18 OCTOBER 2017

Well No. SE8-1

well depth (top PVC)	10.4	10.4	10.4	10.4	10.4	
water level(top PVC)	7.0	7.0	7.0	7.1	7.0	
water height	3. 4	3.4	3.4	3.3	3.4	
time	11:10	11:15	11:25	11:35	11:45	
Casing/Volume						
type:	2"					
type: other	SCH40 PVC					
vol/ft	0.163					
tot. vol	0.55					
3 x vol	1.65					
Purge Volume						
gallons purged		0.25	1.0	1.75	2.5	
purge/bail/type						
Water Sample						
Sample No.						GW-SE8-1
Sample Method						PERISTALTIC
Time						1145 -1210S
No. Cont.						10
Initials						DB
pH						
value		7.28	7.6	7.69	7.72	
time		11:15	11:25	11:35	11:45	
Conductivity (S/cm)						
value		505.2	496.3	495.4	496.2	
time		11:15	11:25	11:35	11:45	
Temp. (Celsius)						
value		17.76	17.54	17.58	17.62	
time		11:15	11:25	11:35	11:45	
DO (mg/l)						
value		0.17	0.08	0.07	0.07	
time		11:15	11:25	11:35	11:45	
ORP (mV)						
value		-65.2	-91.7	-97.7	-100.4	
time		11:15	11:25	11:35	11:45	
TDS (ppt)						
value		0	0	0	0	
time		11:15	11:25	11:35	11:45	
Turbidity (ntu)						
value					3.37 NTU	
time					1200	
Ferrous Iron (mg/l)						
value					1.6mg/L	
time					1200	
Sulfide (mg/l)						
value					0.04 mg/L	
time					1700	

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc. ***Water Sampling Record*** Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/18/17

Well No. SF1-1

well depth (top PVC)	~~13.1~~ 16.6					
water level(top PVC)	5.8	7.2	8.1	8.3		
water height	7.3					
time	1100	1110	1120	1130		
Casing/Volume						
type:	4" PVC					
type: other	sch 40					
vol/ft						
tot. vol	~4.8					
3 x vol	14.6					
Purge Volume						
gallons purged	1.0	1.75	~2.25			
purge/bail/type						
Water Sample						
Sample No.	GW-SF1-1-101817					
Sample Method	Perastaltic					
Time	1130					
No. Cont.	10					
Initials	DTP					
pH						
value	6.56	6.56	6.74			
time	1110	1120				
Conductivity (S/cm)						
value	18746	18678	18197			
time						
Temp. (Celsius)						
value	16.05	16.37	16.52			
time						
DO (mg/l)						
value	0.06	0.05	0.05			
time						
ORP (mV)						
value	-55.2	-60.8	-71.8			
time						
TDS (ppt)						
value	12	12	12			
time						
Turbidity (ntu)						
value			7.49 NTU			
time			1220			
Ferrous Iron (mg/l)						
value			6.5 mg/L			
time			1220			
Sulfide (mg/l)						
value			0.13 mg/L			
time			1220			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10/20/17

Well No. SG1-1

well depth (top PVC)	11.8					
water level(top PVC)	5.0'					
water height	6.8					
time	11:34					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	.163					
tot. vol	1.0 gal					
3 x vol	3.3 gal					
Purge Volume						
gallons purged	.75 gal	1.5 gal	2.5 gal			
purge/bail/type						
Water Sample						
Sample No.	GW-SG1-1-10 2017 -(1 20)					
Sample Method	Peristaltic					
Time	12:10					
No. Cont.	10					
Initials	LMK					
pH						
value	6.87	6.81	6.77			
time	11:45	11:55	12:05			
Conductivity (S/cm)						
value	7427	6831.1	6104.9			
time						
Temp. (Celsius)						
value	16.16	16.93	16.52			
time						
DO (mg/l)						
value	0.12	0.04	0.11			
time						
ORP (mV)						
value	-34.0	-53.9	-54.7			
time						
TDS (ppt)						
value	5	~~8~~ 4	4			
time						
Turbidity (ntu)						
value				0.20 NTU		
time				12:45		
Ferrous Iron (mg/l)						
value				3.8 mg/L		
time				12:50		
Sulfide (mg/l)						
value				0.77 mg/L		
time				12:42		

COMMENTS: Field Filtered w/ .45 µm = Dissolved.
+ Brown/Purple color

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 1 NOVEMBER 2017

Well No. SH1-1

measured

well depth (top PVC)	6.9/8.6	8.6	8.6	8.6		
water level(top PVC)	6.3	7.7	6.9	7.5		
water height	0.6/2.3	1.1	1.7	1.1		
time	10:25	10:35	10:45	11:00		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	0.3749					
3 x vol	1.1247					
Purge Volume						
gallons purged		0.5	0.75	1.25		
purge/bail/type						
Water Sample						
Sample No.					GW SH1-1	
Sample Method					PERISTALTIC	
Time					11:00-1130	
No. Cont.					13	MS/MSD
Initials					DB	
pH						
value	6.53 →	~~8.02~~	6.51	6.5		
time						
Conductivity (S/cm)						
value		952.77	934.41	945.13		
time		10:35	10:45	11:00		
Temp. (Celsius)						
value		14.05	13.94	14.04		
time		10:35	10:45	11:00		
DO (mg/l)						
value		0.38	0.62	0.22		
time		10:35	10:45	11:00		
ORP (mV)						
value		-100.6	-94.0	-95.7		
time		10:35	10:45	11:00		
TDS (ppt)						
value		0.62	0.63	0.61		
time		10:35	10:45	11:00		
Turbidity (ntu)						
value				4.83 NTU		
time				1115		
Ferrous Iron (mg/l)						
value				11.28 mg/L		
time				1115		
Sulfide (mg/l)						
value				0.13 mg/L		
time				1115		

COMMENTS: START PUMP 10:25; REDUCED PUMP RATE @ 10:35 DURING PURGE, HAD TO STOP & LET RECHARGE FINAL PURGE VOLUME AFTER SAMPLING WA 2.25 G

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 1 NOVEMBER 2017

Well No. SI2-1

well depth (top PVC)	14.1	14.1	14.1	14.1		
water level(top PVC)	3.9	4.2	4.4	4.5		
water height	10.2	9.9	9.7	9.6		
time	12:45	12:55	13:05	13:15		
Casing/Volume						
type:	4"					
type: other	sch 40 pvc					
vol/ft	0.653					
tot. vol	6.6606					
3 x vol	19.9818					
Purge Volume						
gallons purged		1	2.25	3.5		
purge/bail/type						
Water Sample						
Sample No.						
Sample Method						
Time						
No. Cont.						
Initials						
pH						
value		11.53	11.51	11.49		
time		12:55	13:05	13:15		
Conductivity (S/cm)						
value		19601	19433	19327		
time		12:55	13:05	13:15		
Temp. (Celsius)						
value		13.13	13.13	13.32		
time		12:55	13:05	13:15		
DO (mg/l)						
value		0.03	0.02	0.00		
time		12:55	13:05	13:15		
ORP (mV)						
value		-344.5	-379.5	-386.9		
time		12:55	13:05	13:15		
TDS (ppt)						
value		12.74	12.62	12.56		
time		12:55	13:05	13:15		
Turbidity (ntu)						
value				Out of Range due to opacity		
time				1330		
Ferrous Iron (mg/l)						
value				0 mg/L		
time				1330		
Sulfide (mg/l)						
value				41 mg/L		
time				1330		

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 25 OCTOBER 2017

Well No. 6D14-1

well depth (top PVC)	13.0	13.0	13	13		
water level(top PVC)	4.5	4.7	4.7	5.2		
water height	8.5	8.3	8.3	7.8		
time	09:10:00	10:05	10:15	10:25		
Casing/Volume						
type:	1 1/2"					
type: other	SCH 40 PVC					
vol/ft	0.04					
tot. vol	0.34					
3 x vol	1.02					
Purge Volume						
gallons purged		0.25	0.75	1.25		
purge/bail/type		L				
Water Sample						
Sample No.					GW6D14-1	
Sample Method					PERISTALTIC	
Time					10:30-11:00	
No. Cont.					10	
Initials					DB	
pH						
value		6.28	6.26	6.31		
time		10:05	10:15	10:25		
Conductivity (S/cm)						
value		18224	16882	15289		
time		10:05	10:15	10:25		
Temp. (Celsius)						
value		13.47	15.21	15.24		
time		10:05	10:15	10:25		
DO (mg/l)						
value		0.78	0.10	0.08		
time		10:05	10:15	10:25		
ORP (mV)						
value		-113.2	-120.2	-122.1		
time		10:05	10:15	10:25		
TDS (ppt)						
value		11.66	10.96	9.27		
time		10:05	10:15	10:25		
Turbidity (ntu)						
value				89.4 NTU		
time				1040		
Ferrous Iron (mg/l)						
value				3.3 mg/L		
time				1040		
Sulfide (mg/l)						
value				0.05 mg/L		
time				1040		

COMMENTS: START PUMP 10:00

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date:

Well No. GW 6D25-1

well depth (top PVC)	13.4	13.4	13.4	13.4		
water level(top PVC)	6.8	6.9	6.9	6.9		
water height	6.6	6.5	6.5	6.5		
time	12:18	12:30	12:40	12:50		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	1.0758					
3 x vol	3.2274					
Purge Volume						
gallons purged		0.75	1.25	2		
purge/bail/type						
Water Sample						
Sample No.					GW 6D25-1	
Sample Method					PERISTALTIC	
Time					12:50 - 13:10	
No. Cont.					10	
Initials					DB	
pH						
value		898	8.90	8.85		
time		12:30	12:40	12:50		
Conductivity (S/cm)						
value		2786.0	2550.0	2449.7		
time		12:30	12:40	12:50		
Temp. (Celsius)						
value		17.92	17.9	17.99		
time		12:30	12:40	12:50		
DO (mg/l)						
value		0.13	0.24	0.20		
time		12:30	12:40	12:50		
ORP (mV)						
value		-273.3	-247.2	-253.5		
time		12:30	12:40	12:50		
TDS (ppt)						
value		1.8	1.66	1.58		
time		12:30	12:40	12:50		
Turbidity (ntu)						
value				3.85NTU		
time				1300		
Ferrous Iron (mg/l)						
value				0 mg/L		
time				1300		
Sulfide (mg/l)						
value				0.44mg/L		
time				1300		

COMMENTS:

pump on 12:20

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 10-25-17

Well No. 6E1-1

well depth (top PVC)	15.0					
water level(top PVC)	5.74	5.93	5.90 TOC	5.89		
water height	9.26					
time	11:00	11:10	11:20	11:30		
Casing/Volume						
type:	4"					
type: other	SCH 40PVC					
vol/ft	0.653 gal/ft					
tot. vol	6.05"					
3 x vol	18.14"					
Purge Volume						
gallons purged	1.5 gal	2.5 gal	3.5 gal			
purge/bail/type	Paristaltic →					
Water Sample						
Sample No.	GW-6E1-1-102517					
Sample Method	Paristaltic					
Time	11:20					
No. Cont.	10					
Initials	LNK					
pH						
value	7.07	7.10	7.09			
time	11:10	11:20	11:30			
Conductivity (S/cm)	↓	↓	↓			
value	3314.9	1,989.8	1542.1			
time						
Temp. (Celsius)						
value	16.16	16.34	16.47			
time						
DO (mg/l)						
value	0.11	0.08	0.28			
time						
ORP (mV)						
value	-6.8	-13.0	-16.1			
time						
TDS (ppt)						
value	2	1	1			
time						
Turbidity (ntu)						
value			2.24 NTU			
time			1145			
Ferrous Iron (mg/l)						
value			0 mg/L			
time			1145			
Sulfide (mg/l)						
value			0.02 mg/L			
time			1145			

COMMENTS: & Dissolved Metals Field Filtered with 0.45μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-24-17

Well No. 6EZ-1

well depth (top PVC)	14.8					
water level(top PVC)	3.33					
water height	11.47					
time	9:35					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163 gal/ft					
tot. vol	1.87gal					
3 x vol	5.6 gal					
Purge Volume						
gallons purged	1gal	2gal	3gal			
purge/bail/type	purged/Paristaltic					
Water Sample						
Sample No.	GW-GEZ-1-102417					
Sample Method	Paristaltic					
Time	10:05					
No. Cont.	10					
Initials	LNK					
pH						
value	6.25	6.35	6.42			
time	9:45	9:55	10:05			
Conductivity (S/cm)						
value	8,660.5	7573.1	6522.2			
time	//	//	//			
Temp. (Celsius)						
value	14.58	14.36	14.38			
time	//	//	//			
DO (mg/l)						
value	0.23	0.24	0.22			
time	//	//	//			
ORP (mV)						
value	-45.3	-50.9	-53.2			
time	//	//	//			
TDS (ppt)						
value	6	5	4			
time	//	//	//			
Turbidity (ntu)						
value			26.5 NTU			
time			1030			
Ferrous Iron (mg/l)						
value			22.1 mg/L			
time			1030			
Sulfide (mg/l)						
value			0.06 mg/L			
time			1030			

COMMENTS: - Dissolved Metals Field Filtered w/ 0.45µm
- Relatively clear, light/small sheen

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: ~~20~~ 10/20/17

Well No. 6ES-1

well depth (top PVC)	9.8					
water level(top PVC)	2.98					
water height	6.82					
time	8:50					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163 ~~ft/gal~~ g/f					
tot. vol	1.111					
3 x vol	3.33					
Purge Volume						
gallons purged	1g	2g	3g			
purge/bail/type						
Water Sample						
Sample No.	GW-6ES-1-102017					
Sample Method	Peristaltic					
Time	9:15					
No. Cont.	10					
Initials	LNK					
pH						
value	6.99	6.98	6.98			
time	9.00	910	920			
Conductivity (S/cm) µS/cm	↓	↓	↓			
value	3657	3720.5	38869			
time						
Temp. (Celsius)						
value	17.04	17.42	17.51			
time						
DO (mg/l)						
value	0.14	0.12	0.13			
time						
ORP (mV)						
value	-116.8	-129.1	-136.1			
time						
TDS (ppt)						
value	2	2	3			
time						
Turbidity (ntu)						
value				9.33 NTU		
time				9:45		
Ferrous Iron (mg/l)						
value				24.1 mg/L		
time				9:45		
Sulfide (mg/l)						
value				0.03 mg/l		
time				9:45		

COMMENTS: Field Filtered w/ .45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 10-24-17

Well No. 6E6-1

well depth (top PVC)	13.3'					
water level(top PVC)	4.82'					
water height	8.48					
time	10:40					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163gal/ft					
tot. vol	1.38					
3 x vol	4.14					
Purge Volume						
gallons purged	1 gallon	2 gallon	3 gallon			
purge/bail/type						
Water Sample						
Sample No.	GW-6E6-1-102417					
Sample Method	Paristaltic					
Time	11:00					
No. Cont.	10					
Initials	LNL					
pH						
value	10.38	10.77	10.80			
time	1050	11:00	11:10			
Conductivity (S/cm)						
value	5965.6	11,518.9	11,883.0			
time	〃					
Temp. (Celsius)						
value	15.64	15.66	15.71			
time	〃					
DO (mg/l)						
value	0.07	0.01	0.00			
time	〃					
ORP (mV)						
value	-303.8	-295.8	-254.4			
time	〃					
TDS (ppt)						
value	4	8	8			
time	〃					
Turbidity (ntu)						
value			1.81 NTU			
time			1110			
Ferrous Iron (mg/l)						
value			0mg/L			
time			1110			
Sulfide (mg/l)						
value			Exceeds range @ 40x dilution			
time			11:10			

COMMENTS: - Dissolved Metals Field Filtered w/ 0.45 µm
- High pH, ~~clear~~ color, Started off clear, Now @ END is Brown.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/~~19~~ 20/2017

Well No. 6FZ-1

well depth (top PVC)	9.8					
water level(top PVC)	0.3	0.5	0.6	0.6		
water height	9.5					
time	1100	1110	1120	1130		
Casing/Volume						
type:	2" PVC					
type: other	Sch 40					
vol/ft						
tot. vol						
3 x vol	4.75					
Purge Volume						
gallons purged	1.0	1.75	3.25			
purge/bail/type						
Water Sample						
Sample No.	GW-6FZ-1-102017					
Sample Method	Peristaltic					
Time	1140					
No. Cont.	10					
Initials	DTP					
pH						
value *	9.03	8.76	8.57		7.94	
time	1110	1120	1130		12:53	
Conductivity (S/cm)						
value	458.1	419.7	404.6			
time	1110	1120	1130			
Temp. (Celsius)						
value	13.99	13.49	13.40			
time	1110	1120	1130			
DO (mg/l)						
value	3.91	3.85	3.79			
time	1110	1120	1130			
ORP (mV)						
value	26.7	35.0	33.1			
time	1110	1120	1130			
TDS (ppt)						
value	0	0	0			
time	1110	1120	1130			
Turbidity (ntu)						
value				3.79 NTU		
time				12:15		
Ferrous Iron (mg/l)						
value				5.9 mg/L		
time				12:15		
Sulfide (mg/l)						
value				0.11 mg/L		
time				12:15		

COMMENTS: pH check at start of day was off by more than 1.0. Tried to 3 pt calibrate but did not want to calibrate. pH value recorded but final pH verified using other pH meter in use by other sampler.

12:53 measurement average of 3 measures on other SONDE.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/20/17

Well No. 641-1

well depth (top PVC)	6.0					
water level(top PVC)	0.2	3.2	3.3	3.3		
water height	5.8					
time	1215	1230	1240	1250		
Casing/Volume						
type:	2" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	0.99					
3 x vol	2.9					
Purge Volume						
gallons purged	1.0	~~2.0~~ 1.75	~~3.0~~ 2.5	3.25		
purge/bail/type						
Water Sample						
Sample No.	GW-641-1-102017					
Sample Method	Peristaltic					
Time	1240					
No. Cont.	10					
Initials	DP					
pH						
value	9.02	9.68	9.8	9.87		
time	1230	1240	1250	1300		
Conductivity (S/cm)						
value	420.6	361.0	~~458~~ 449	500		
time	1230	1240	1250	1300		
Temp. (Celsius)						
value	15.08	15.30	15.52	15.48		
time	1230	1240	1250	1300		
DO (mg/l)						
value	5.74	4.21	3.19	2.90		
time	1230	1240	1250	1300		
ORP (mV)						
value	17.1	5.8	22.3	21.7		
time	1230	1240	1250	1300		
TDS (ppt)						
value	0	0	0	0		
time	1230	1240	1250	1300		
Turbidity (ntu)						
value					86 NTU	
time					~~13~~ 14:10	
Ferrous Iron (mg/l)						
value					2.4 mg/L	
time					14:15	
Sulfide (mg/l)						
value					0.45 mg/l	
time					14:10	

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-25-17

Well No. 6H1-1

well depth (top PVC)	11.1					
water level(top PVC)	5.72					
water height	5.38					
time	8:10					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163 gal/ft					
tot. vol	0.88					
3 x vol	2.63					
Purge Volume						
gallons purged	1 gallon	1.5 gal	2 gal			
purge/bail/type						
Water Sample						
Sample No.	GW-6H1-1-102517					
Sample Method	Peristaltic					
Time	8:35					
No. Cont.	10					
Initials	LNK					
pH						
value	8.37	8.43	8.78			
time	8:20	8:30	8:40			
Conductivity (S/cm)	↓	↓	↓			
value	1425.5	1039.8	962.4			
time	8:20	8:30	8:40			
Temp. (Celsius)						
value	14.41	14.40	14.65			
time	8:20	8:30	8:40			
DO (mg/l)						
value	0.10	0.04	0.03			
time	8:20	8:30	8:40			
ORP (mV)						
value	-143.0 ~~-143.0~~	-155.6	-193.7			
time	8:20	8:30	8:40			
TDS (ppt)						
value	1	1	1			
time	8:20	8:30	8:40			
Turbidity (ntu)						
value			19.2 NTU			
time			0900			
Ferrous Iron (mg/l)						
value			0 mg/L			
time			0900			
Sulfide (mg/l)						
value			0.92 mg/L			
time			0900			

COMMENTS: Dissolved Metals field Filtered w/ 0.45μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D-BROWNING
Date: 24 OCTOBER 2017

Well No. 7E3-1

well depth (top PVC)	12.6	12.6	12.6	12.6		
water level(top PVC)	4.5	4.6	4.6	4.6		
water height	8.1	8	8	8		
time	10:50	11:05	11:15	11:30		
Casing/Volume						
type:	4"	~~0.75~~				
type: other	sch 40 PVC					
vol/ft	0.653					
tot. vol						
3 x vol						
Purge Volume						
gallons purged		0.75	2	3		
purge/bail/type						
Water Sample						
Sample No.					GW-7E3-1	
Sample Method					PERISTALTIC	
Time					11:35-11:50	
No. Cont.					10	
Initials					DB	
pH						
value		7.5	7.58	7.58		
time		11:05	11:15	11:25		
Conductivity (S/cm) *						
value		15244	12169	10869		
time		11:05	11:15	11:25		
Temp. (Celsius)						
value		16.23	15.66	15.62		
time		11:05	11:15	11:25		
DO (mg/l)						
value		0.09	0.03	0.07		
time		11:05	11:15	11:25		
ORP (mV)						
value		-137.4	-137.3	-144.4		
time		11:05	11:15	11:25		
TDS (ppt)						
value		9.6	7.65	7.02		
time		11:05	11:15	11:25		
Turbidity (ntu)						
value				6.04 NTU		
time				1145		
Ferrous Iron (mg/l)						
value				2.0 mg/L		
time				1145		
Sulfide (mg/l)						
value				0.04 mg/L		
time				1145		

COMMENTS: * specific conductivity

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-24-17

Well No. 7E8-1

well depth (top PVC)	13.3'					
water level(top PVC)	4.06'					
water height	9.24 ft					
time	8:30					
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653 gal/ft					
tot. vol	6.0377					
3 x vol	18.10					
Purge Volume						
gallons purged	1.5 gal	2.75 gal	4 gal			
purge/bail/type						
Water Sample						
Sample No.	GW-7E8-1-102417					
Sample Method	Paristaltic					
Time	9:00					
No. Cont.	10					
Initials	LNK					
pH						
value	11.13	11.0	10.92			
time	8:40	8:50	9:00			
Conductivity (S/cm)						
value	23,842.7	19,815.9	17,727.6			
time	"					
Temp. (Celsius)						
value	14.31	14.50	14.45			
time	"					
DO (mg/l)						
value	0.05	0.06	0.05			
time	"					
ORP (mV)						
value	-262.8	-256.4	-241.6			
time	"					
TDS (ppt)						
value	15	13	12			
time	"					
Turbidity (ntu)						
value			0.97 NTU			
time			0910			
Ferrous Iron (mg/l)						
value			Out of range due to dark color			
time			0910			
Sulfide (mg/l)						
value			Exceeds range @ 40x dilution			
time			0910			

COMMENTS: - Dissolved Metals Field Filtered w/ 0.45 μm
- High pH, Brown Color
- Maximum Pumping Rate

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Herner
Date: 10-23-17

Well No. 7E10-1

well depth (top PVC)	11.5					
water level(top PVC)	4.2					
water height	~~4.2~~ 7.3					
time	12:25					
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653 gal/ft					
tot. vol	4.77					
3 x vol	14.3007					
Purge Volume						
gallons purged		1 Gal	2.5 g	4 gal		
purge/bail/type						
Water Sample						
Sample No.	GW-7E10-1-102317					
Sample Method	Paristaltic					
Time	1300					
No. Cont.	10					
Initials	LNH					
pH						
value		9.93	9.86	9.81		
time	~~12:30~~	12:40	12:50	1300		
Conductivity (S/cm)						
value		18182.3	15206.7	13,390.5		
time						
Temp. (Celsius)						
value		17.23	17.11	17.10		
time						
DO (mg/l)						
value		0.01	-0.00	-0.00		
time						
ORP (mV)						
value		-193.5	-181.8	-158.2		
time						
TDS (ppt)						
value		12	10	9		
time						
Turbidity (ntu)						
value				0 NTU		
time				13 20		
Ferrous Iron (mg/l)						
value				0 mg/L		
time				1320		
Sulfide (mg/l)						
value				8.8 mg/L		
time				1320		

COMMENTS: * Field filtered dissolved Metals w/ 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L.Kerner
Date: 10-23-2017

Well No. 7F2-1

well depth (top PVC)	9.8'					
water level(top PVC)	4.4					
water height	5.4					
time	9:00					
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	3.53					
3 x vol	10.58					
Purge Volume						
gallons purged	1.5	2.5	4'			
purge/bail/type						
Water Sample						
Sample No.	GW-7F21-102317-102317-(20)					
Sample Method	Parishltic					
Time	9:25					
No. Cont.	10					
Initials	LNK					
pH						
value	6.95	7.50	7.52			
time	910	920	930			
Conductivity (S/cm)	↓	↓	↓			
value	2886.2	1693.6	1735.6			
time						
Temp. (Celsius)						
value	14.58	13.90	13.88			
time						
DO (mg/l)						
value	0.03	4.83	5.22			
time						
ORP (mV)						
value	-145.2	-122.2	-84.9			
time						
TDS (ppt)						
value	0	1 ppt	1			
time						
Turbidity (ntu)			~~3.~~			
value			3.57NTU			
time			945			
Ferrous Iron (mg/l)						
value			0.12 mg/L			
time			945			
Sulfide (mg/l)						
value			0.04 mg/L			
time			945			

COMMENTS: No tubing in well. Added ≈ 12' of 1/4" OD. Dissolved Metals

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. Browning
Date: 23 OCTOBER 2017

Well No. 7F3-1

well depth (top PVC)	16.5	16.5	16.5	16.5		
water level(top PVC)	4.8	11.5	10.4	9.0		
water height	11.7	5	6.1	7.5		
time	8:55	9:05	9:20	9.25		
Casing/Volume						
type:	1 1/4"					
type: other	Sch 40 PVC					
vol/ft	0.041					
tot. vol	0.477					
3 x vol	1.43					
Purge Volume						
gallons purged		0.5	0.75			
purge/bail/type		peristaltic				
Water Sample						
Sample No.					GW7F3-1	
Sample Method					PER	
Time					9:40-11:00	
No. Cont.					10	
Initials					DB	
pH						
value		9.96	10.96			
time						
Conductivity (S/cm)						
value		34566	44815			
time						
Temp. (Celsius)						
value		12.84	12.67			
time						
DO (mg/l)						
value		1.23	0.67			
time						
ORP (mV)						
value		-196.0	-292.2			
time						
TDS (ppt)						
value		29	30			
time						
Turbidity (ntu)						
value			Opaque - No reading			
time						
Ferrous Iron (mg/l)						
value			Out of Range due to opacity			
time						
Sulfide (mg/l)						
value			Out of Range due to opacity			
time						

COMMENTS: LOW FLOW, HAVE TO INTERMITENTLY STOP PUMPING FOR RECHARGE, SALT CRYSTALS ON TUBING, DURING FILLING OF BOTTLES: NEED TO GO 3-4 min Rest per 1 min of sampling.

= 9.42 cu in / ft

1 1/4" well Sch 40

231 cu in / gallon

.041 g / ft.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 23 OCTOBER 2017

Well No. 7F4-1

well depth (top PVC)	14.3	14.3	14.3	14.3		
water level(top PVC)	6.3	6.5	6.8	6.5		
water height	8	7.8	7.5	7.8		
time	11:20	11:35	11.45	11:55		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	1.304					
3 x vol	3.912					
Purge Volume						
gallons purged		1	2	2.75		
purge/bail/type						
Water Sample						
Sample No.					GW7F4-1	
Sample Method					PER	
Time					12:00-12:25	
No. Cont.						
Initials						
pH						
value *		12.07/11.31	12.13	12.22		
time		11:35	11:45	11:55		
Conductivity (S/cm)						
value		62087	57308	49374		
time		11:35	11:45			
Temp. (Celsius)						
value		17.09	17.23	17.09		
time		11:35	11:45			
DO (mg/l)						
value		0.01	0.00	0.00		
time		11:35	11:45			
ORP (mV)						
value		-411.5	-418.8	-418.6		
time		11:35	11:45	11:55		
TDS (ppt)						
value		31	31	32		
time		11:35	11:45	11:55		
Turbidity (ntu)						
value				Opaque - No Reading		
time				1215		
Ferrous Iron (mg/l)						
value				Out of range due to opacity		
time				1215		
Sulfide (mg/l)						
value				Out of range at 40x dilution		
time				1215		

COMMENTS: START PUMP 11:25; WATER IS BROWN/PURPLE.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL

* SONDE/PH METER

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D·BROWNING
Date: 27 OCTOBER 2017

Well No. 7G1-1

well depth (top PVC)	10.7	10.7	10.7	10.7		
water level(top PVC)	7.8	8.1	8.2	8.1		
water height	2.9	2.6	2.5	2.6		
time	10:25	10:35	10:45	10:55		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	0.4727					
3 x vol	1.4181					
Purge Volume						
gallons purged		0.5	1	1.5		
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.					GW 7G1-1	
Sample Method					PERISTALTIC	
Time					11:00 - 11:20	
No. Cont.					10	
Initials					DB	
pH						
value		8.23	8.25	8.43		
time		10:35	10:45	10:55		
Conductivity (S/cm)						
value		3362	3346.3	3277.5		
time		10:35	10:45	10:55		
Temp. (Celsius)						
value		15.00	15.11	15.12		
time		10:35	10:45	10:55		
DO (mg/l)						
value		0.07	0.06	0.06		
time		10:35	10:45	10:55		
ORP (mV)						
value		-86.5	-109.8	-145.3		
time		10:35	10:45	10:55		
TDS (ppt)						
value		2.19	2.18	2.11		
time		10:35	10:45	10:55		
Turbidity (ntu)						
value				L44 NTU		
time				1105		
Ferrous Iron (mg/l)						
value				0.12 mg/L		
time				1105		
Sulfide (mg/l)						
value				0.39 mg/L		
time				1105		

COMMENTS:

START PUMP @ 10:25

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 27 OCTOBER 2017

Well No. 712-1

well depth (top PVC)	10.5	10.5	10.5	10.5		
water level(top PVC)	4.4	4.8	4.9	4.8		
water height	6.1	5.7	5.6	5.7		
time	8:10	8:20	8:30	8:40		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	0.9943					
3 x vol	2.9829					
Purge Volume						
gallons purged		0.25	1	1.75		
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.					GW712-1	GW712-(4)
Sample Method					PERISTALTIC	"
Time					08:40-9:20	"
No. Cont.					13	10
Initials					DB	DB
pH						
value		6.84	6.85	6.85		
time	8:20 →	PERISTALTIC	8:30	8:40		
Conductivity (S/cm)						
value		1476.3	1429.2	1382.2		
time	8:20 →	PERISTALTIC	8:30	8:40		
Temp. (Celsius)						
value		15.59	15.97	16.02		
time	8:20 →	PERISTALTIC	8:30	8:40		
DO (mg/l)						
value		0.38	0.17	0.11		
time	8:20 →	PERISTALTIC	8:30	8:40		
ORP (mV)						
value		-115.3	-99.4	- 93.5		
time	8:20 →	PERISTALTIC	8:30	8:40		
TDS (ppt)						
value	8:20 →	0.96	0.93	0.90		
time		PERISTALTIC	8:30	8:40		
Turbidity (ntu)						
value				2.4NTU		
time				900		
Ferrous Iron (mg/l)						
value				3.6mg/L		
time				900		
Sulfide (mg/l)						
value				0.02 mg/L		
time				900		

COMMENTS: START PUMP 8:15

*N.S.D. ON VOCS
TIMED
8:45

DUPLICATE
TIMED
08:55

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 25 OCTOBER 2017

Well No. 8FI-1R

well depth (top PVC)	13.6	13.6	13.6	13.6		
water level(top PVC)	4.7	5.4	5.5	5.6		
water height	8.9	8.2	8.1	8		
time	13:50	14:00	14:10	14:20		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	1.4507					
3 x vol	4.3521					
Purge Volume						
gallons purged		0.75	1.5	3		
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.					GW8FI-1R	
Sample Method					PERISTALTIC	
Time					14:20-14:40	
No. Cont.					10	
Initials					DB	
pH						
value		10.27	10.32	10.33		
time		14:00	14:10	14:20		
Conductivity (S/cm)						
value		11184	11823	12091		
time		14:00	14:10	14:20		
Temp. (Celsius)						
value		16.19	15.71	15.67		
time		14:00	14:10	14:20		
DO (mg/l)						
value		0.02	0.00	0.01		
time		14:00	14:10	14:20		
ORP (mV)						
value		-319.1	-335.0	-342.9		
time		14:00	14:10	14:20		
TDS (ppt)						
value		7.31	7.70	7.86		
time		14:00	14:10	14:20		
Turbidity (ntu)		14				
value				0.36 NTU		
time				1430		
Ferrous Iron (mg/l)						
value				0 mg/L		
time				1430		
Sulfide (mg/l)						
value				exceeds range @ 40x dilution		
time				1430		

COMMENTS: START PUMP 13:55

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: J Kerns
Date: 10-27-17

Well No. 8G2-1

well depth (top PVC)	14.8					
water level(top PVC)	2.85					
water height	11.95					
time	10:25					
Casing/Volume						
type:	4"					
type: other	0.653 gal/ft					
vol/ft	SCH40 PVC					
tot. vol	7.803					
3 x vol	23.41					
Purge Volume						
gallons purged	0.75	1.5	3gal			
purge/bail/type						
Water Sample						
Sample No.	GW-8G2-1-102717-					
Sample Method	Peristaltic					
Time	11:00					
No. Cont.	10					
Initials	JNK					
pH						
value	10.04	10.92	10.30			
time	10:35	10:45	1055			
Conductivity (S/cm)	↓	↓	↓			
value	30,343.7	29,288.4	27,508			
time						
Temp. (Celsius)						
value	15.13	15.46	15.55			
time						
DO (mg/l)						
value	0.12	0.05	0.03			
time						
ORP (mV)						
value	-315.6	-301.8	-253.0			
time						
TDS (ppt)						
value	20	19	18			
time						
Turbidity (ntu)						
value			1.07 NTU			
time			1115			
Ferrous Iron (mg/l)						
value			0 mg/L			
time			1115			
Sulfide (mg/l)						
value			25.2 mg/L			
time			1115			

COMMENTS: - Dissolved Metals/Alkalinity Field Filtered 0.45µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-27-17

Well No. 8H1-1

well depth (top PVC)	11.9					
water level(top PVC)	7.24					
water height	4.66					
time	~~9:17~~ 9:15					
Casing/Volume						
type:	2.0'					
type: other	SCH 40PVC					
vol/ft	0.163 gal/ft					
tot. vol	0.76 gal					
3 x vol	2.28 gal					
Purge Volume						
gallons purged	~~0.7~~ 0.75 gal	1.5 gallons	2.25			
purge/bail/type						
Water Sample						
Sample No.	GW-8H1-1					
Sample Method	Paristaltic					
Time	9:50					
No. Cont.	10					
Initials	LNK					
pH						
value	6.53	6.57	6.59			
time	9:25	9:35	9:45			
Conductivity (S/cm)	↓	↓				
value	21,186.5	19,956.5	20,704.1			
time						
Temp. (Celsius)						
value	15.00	15.05	15.05			
time						
DO (mg/l)						
value	0.20	0.09	0.07			
time						
ORP (mV)						
value	-52.9	-74.0	-77.8			
time						
TDS (ppt)						
value	14	13	13			
time						
Turbidity (ntu)						
value			Out of Range			
time			1000			
Ferrous Iron (mg/l)						
value			11.26 mg/L			
time			1000			
Sulfide (mg/l)						
value			Out of range due to turbidity			
time			1000			

COMMENTS: Dissolved Metals Field Filtered 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D BROWNING
Date: 3 NOV 2017

Well No. 121+80-1

well depth (top PVC)	13.5	13.5	13.5	13.5		
water level(top PVC)	7.9	8.1	8.1	8.1		
water height	5.6	5.4	5.4	5.4		
time	8:25	8:40	8:50	9:00		
Casing/Volume						
type:	2"					
type: other	SS					
vol/ft	0.163					
tot. vol	0.9128					
3 x vol	2.7384					
Purge Volume						
gallons purged		0.25	0.75	1.25		
purge/bail/type						
Water Sample						
Sample No.					GW-121+80-1	
Sample Method					PERISTALTIC	
Time					9:00-9:20	
No. Cont.					14	
Initials					DB	
pH						
value		10.14	10.06	9.93		
time		8:40	8:50	9:00		
Conductivity (S/cm)						
value		2694.3	1237.6	1207.3		
time		8:40	8:50	9:00		
Temp. (Celsius)						
value		12.54	13.67	13.71		
time		8:40	8:50	9:00		
DO (mg/l)						
value		0.64	0.31	0.21		
time		8:40	8:50	9:00		
ORP (mV)						
value		~~0~~ 176.6	-112.9	~~-108~~ -98.2		
time		8:40	8:50	9:00		
TDS (ppt)						
value		1.70	0.77	0.69		
time		8:40	8:50	9:00		
Turbidity (ntu)						
value				6.97 NTU		
time				905		
Ferrous Iron (mg/l)						
value				0.10 mg/L		
time				905		
Sulfide (mg/l)						
value				0.43 mg/L		
time				905		

COMMENTS: START PUMPING 8:30

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 11-3-2017

Well No. 122+60-1

well depth (top PVC)	14.7'					
water level(top PVC)	6.80					
water height						
time						
Casing/Volume						
type:	2"					
type: other	SS					
vol/ft	0.163					
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type	Peristalte					
Water Sample						
Sample No.	GW-122+60-1					
Sample Method	Paristalte					
Time	905					
No. Cont.	14					
Initials	LMK					
pH						
value	7.17	7.22	7.36			
time	8:45	905	915			
Conductivity (S/cm)						
value	29,220.7	30,757.4	29,481.2			
time µS/cm						
Temp. (Celsius)						
value	3.39	6.36	9.92			
time						
DO (mg/l)						
value	8.16	6.50	0.40			
time						
ORP (mV)						
value	58.4	51.6	39.5			
time						
TDS (ppt)						
value	~~19~~ 19	20	19			
time						
Turbidity (ntu)						
value			2375 AU - Very turbid			
time			915			
Ferrous Iron (mg/l)						
value			30.4 mg/L			
time			915			
Sulfide (mg/l)						
value			Out of range due to opacity of sample			
time						

COMMENTS: * Start Pumping @ 835

* Dissolved metals/solids field filtered 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kern
Date: 10-31-17

Well No. 124100-1

well depth (top PVC)	9.75'					
water level(top PVC)	6.63					
water height	3.12'					
time	10:33					
Casing/Volume						
type:	2"					
type: other	SS					
vol/ft	0.163 gal/ft					
tot. vol	0.51					
3 x vol	1.5 gallons					
Purge Volume						
gallons purged	0.5 gallons	1 gallon	1.5 gallon			
purge/bail/type	Peristaltic					
Water Sample						
Sample No.			GW-124100-1-103117			
Sample Method			Paristaltic			
Time			11:00			
No. Cont.			14			
Initials			JNK			
pH						
value	6.32	6.43	6.58			
time	10:48	10:58	11:08			
Conductivity (S/cm)						
value	29,766.7	29,508.8	29,847.1			
time						
Temp. (Celsius)						
value	13.25	13.35	13.42			
time						
DO (mg/l)						
value	0.32	0.21	0.14			
time						
ORP (mV)						
value	-63.9	-133.0	-144.4			
time						
TDS (ppt)						
value	19	19	19			
time						
Turbidity (ntu)						
value			23.6 NTU			
time			1115			
Ferrous Iron (mg/l)						
value			1.5 mg/L			
time			1115			
Sulfide (mg/l)						
value			0.33 mg/L			
time						

COMMENTS: - Begin LOW-FLOW PUMPING @ 10:38
- Dissolved ~~Total~~ metals & solids Field Filtered 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D BROWNING
Date: 31 OCTOBER 2017

Well No. 125+50-1

well depth (top PVC)	10.0	10	10	10		
water level(top PVC)	7.4	7.5	7.6	7.8		
water height	2.6	2.5	2.4	2.2		
time	9:25	9:45	9:55	10:05		
Casing/Volume						
type:	2"					
type: other	SS					
vol/ft	0.163					
tot. vol	0.4238					
3 x vol	1.2714					
Purge Volume						
gallons purged		~ 0.3	~ 0.75	~ 1.25		
purge/bail/type						
Water Sample						
Sample No.					GW 125+50-1	
Sample Method					PERISTALTIC	
Time					10:05 - 10:35	
No. Cont.					14	
Initials					DD	
pH						
value		7.98	7.86	7.76		
time		9:45	9:55	10:05		
Conductivity (S/cm)						
value		29983	29840	29726		
time		9:45	9:55	10:05		
Temp. (Celsius)						
value		11.96	12.29	12.58		
time		9:45	9:55	10:05		
DO (mg/l)						
value		7.28	7.58	7.62		
time		9:45	9:55	10:05		
ORP (mV)						
value		-90.8	-90.3	-80.3		
time		9:45	9:55	10:05		
TDS (ppt)						
value		19.57	18.41	18.33		
time		9.45	9:55	10:05		
Turbidity (ntu)						
value				6.53 NTU		
time				1100		
Ferrous Iron (mg/l)						
value				1.84 mg/L		
time				1100		
Sulfide (mg/l)						
value				0.02 mg/L		
time				1100		

COMMENTS: START PUMP @ 9:35; VERY SLOW HAD TO UNCLOG WELL: TUBINING

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-31-2017

Well No. 126+90-1

well depth (top PVC)	10.9 T.O.M.					
water level(top ~~PVC~~)	9.6 T.O.M.	Top of Monument				
water height	0.8'					
time	9:15					
Casing/Volume						
type:	2"					
type: other	SS					
vol/ft	0.163 gal/ft					
tot. vol						
3 x vol						
Purge Volume						
gallons purged	0.10 gallons	0.12 gallons				
purge/bail/type						
Water Sample						
Sample No.	GW-126+90-1-110217					
Sample Method	peristaltic					
Time	945					
No. Cont.	14					
initials	LNK					
pH						
value	6.26	6.39				
time	9:20	9:25				
Conductivity (S/cm)						
value	23,842.9	28,094.7				
time						
Temp. (Celsius)						
value	~~6.97~~ 9.96	10.16				
time						
DO (mg/l)						
value	~~73~~ 7.32	8.60				
time						
ORP (mV)						
value	30.0	12.8				
time						
TDS (ppt)						
value	17	15				
time						
Turbidity (ntu)						
value		3.85 NTU				
time		945				
Ferrous Iron (mg/l)						
value		0.40 mg/L				
time		945				
Sulfide (mg/l)						
value		0.02 mg/L				
time		945				

COMMENTS:
* No Casing Present. Open Hole inside Monument. Filled w/rust/metal
* Dry after 2 minutes ultra low-flow pumping

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D BROWNING
Date: 30 OCTOBER 2017

Well No. 129+30 -1

well depth (top PVC)	9.3	9.3				
water level(top PVC)	8.4	8.9				
water height	0.9	0.4				
time	10:25	10:35				
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	0.1467					
3 x vol	0.4401					
Purge Volume						
gallons purged		0.2				
purge/bail/type						
Water Sample						
Sample No.						
Sample Method						
Time						
No. Cont.						
Initials						
pH						
value	6.29	6.32				
time	10:25	10:35				
Conductivity (S/cm)						
value	33495	32114				
time	10:25	10:35				
Temp. (Celsius)						
value	14.9	16.06				
time	10:25	10:35				
DO (mg/l)						
value	3.37	2.04				
time	10:25	10:35				
ORP (mV)						
value	27.4	14.6				
time	10:25	10:35				
TDS (ppt)						
value	21.64	21.65				
time	10:25	10:35				
Turbidity (ntu)						
value		107.5NTU				
time		10:55				
Ferrous Iron (mg/l)						
value		40mg/L				
time		1055				
Sulfide (mg/l)						
value		0.47mg/L				
time		1055				

COMMENTS: START PUMP 10:25; HAD TO UNCLOG WELL TUBE @ START, IRON ON & IN TUBE RAN DRY @ 10:40, 10:45 GOT CONVENTIONAL/FE,S,T ALIQUOT INSUFFICIENT RECHARGE TO CONTINUE WATER COLLECTION @ 11:00. PULLING AIR. WILL LET WELL REST

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D BROWNING
Date: 129+65-1

Well No.

well depth (top PVC)	10.1	10.1	9.6			
water level(top PVC)	9.4		6.4			
water height	0.7		3.2			
time	09:00		9:20			
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	0.1141					
3 x vol	0.3423					
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.						
Sample Method						
Time						
No. Cont.						
Initials						
pH						
value		7.65				
time		9:10				
Conductivity (S/cm)						
value		5756.9				
time		9:10				
Temp. (Celsius)						
value		14.05				
time		9:10				
DO (mg/l)						
value		0.24				
time		9:10				
ORP (mV)						
value		-117.0				
time		9:10				
TDS (ppt)						
value		3.74				
time		9:10				
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: PUMP START 09:10 WATER COMING UP SILTY - WRONG WELL CHANGED TO RIGHT ONE @ 9:40 * MEASURED WELL DEPTH = 9.6' RAN DRY @ 0.1 Gallons of purge. water opaque rusty. TUBE CLOGGED ~~AND~~ AT START & THEN FIXED.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 131+00-1 27 OCTOBER 2012

Well No.

well depth (top PVC)	10.0	10 -	10	10		
water level(top PVC)	2.2	3.7	3.2	3.5		
water height	7.8	6.3	6.8	6.5		
time	12:55	13:05	13:15	13:25		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	1.2714					
3 x vol	3.8142					
Purge Volume						
gallons purged		1.0	1.75	2.5		
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.					GW131+00-1	
Sample Method					PERISTALTIC	
Time					13:25-13:55	
No. Cont.					14	
Initials					DB	
pH						
value		7.96	7.84	7.82		
time		13:05	13:15	13:25		
Conductivity (S/cm)						
value		3186.6	3704.5	3201.9		
time		13:05	13:15	13:25		
Temp. (Celsius)						
value		14.09	14.4	14.48		
time		13:05	13:15	13:25		
DO (mg/l)						
value		0.08	0.00	0.08		
time		13:05	13:15	13:25		
ORP (mV)						
value		-151.5	-137.8	-133.9		
time		13:05	13:15	13:25		
TDS (ppt)						
value		2.07	2.08	2.08		
time		13:15	13:15	13:25		
Turbidity (ntu)						
value				8.01 NTU		
time				1330		
Ferrous Iron (mg/l)						
value				0.75 mg/L		
time				1330		
Sulfide (mg/l)						
value				0.05 mg/L		
time				1330		

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 11-3-2017

Well No. 122+60-0

well depth (top PVC)	—					
water level(top PVC)	—					
water height	—					
time	9:50					
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	—					
purge/bail/type						
Water Sample						
Sample No.	GW-122+60-	0-110317				
Sample Method	Paristaltic					
Time	9:50					
No. Cont.	14					
Initials	LNK					
pH						
value	7.60					
time	9:45					
Conductivity (S/cm)						
value	36476					
time	9:45					
Temp. (Celsius)						
value	7.44					
time	9:45					
DO (mg/l)						
value	6.89mg/L					
time	945					
ORP (mV)						
value	46.0					
time	9:45					
TDS (ppt)						
value	23					
time	9:45					
Turbidity (ntu)						
value	5.18 NTU					
time	1000					
Ferrous Iron (mg/l)						
value	0.05					
time	1000					
Sulfide (mg/l)						
value	0.00					
time	10 00					

COMMENTS: Dissolved samples field filtered at 0.45um

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 31 OCTOBER 2017

Well No. 124+00-0

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type: -	2.5"					
type: other	SS					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	124+00-0					
Sample Method	PERISTALTIC					
Time	11:15-11:30					
No. Cont.	14					
Initials	DP					
pH						
value						
time						
Conductivity (S/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	3.19 NTU					
time	1145					
Ferrous Iron (mg/l)						
value	0.41 mg/L					
time	1145					
Sulfide (mg/l)						
value	0.02 mg/L					
time	1145					

COMMENTS: HAD TO PULL TUBING AND EXCISE SEDIMENT/IRON PRECIP BLOCKAGE IN TUBING

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 10-31-17

Well No. 125+50-O

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:	2" SS Scr					
type: other						
vol/ft	0.163					
tot. vol						
3 x vol						
Purge Volume						
gallons purged	0.25 gal					
purge/bail/type	Peristaltic					
Water Sample						
Sample No.	GW-125+50-O-103117					
Sample Method	Peristaltic					
Time	10:20					
No. Cont.	14					
Initials	LNK					
pH						
value	7.08					
time	11:45					
Conductivity (S/cm)						
value	26,150.9					
time						
Temp. (Celsius)						
value	13.76					
time						
DO (mg/l)						
value	5.37					
time						
ORP (mV)						
value	-36.4					
time						
TDS (ppt)						
value	17					
time						
Turbidity (ntu)						
value	253 NTU					
time	1100					
Ferrous Iron (mg/l)						
value	0.27 mg/L					
time	1600					
Sulfide (mg/l)						
value	~~0.04~~ 0.02 mg/L					
time	1100					

COMMENTS: *Dissolved metals/Solids Field Filtered 0.45 μm
- End of Tubing clogged.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 10-31-17

Well No. 126190-0

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:	2"					
type: other	Stainless Steel					
vol/ft	0.163					
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	GW-					
Sample Method	Peristaltic					
Time	9:45					
No. Cont.	14					
Initials	LNK					
pH						
value	7.08					
time	9:35					
Conductivity (S/cm)						
value µS/cm	19,382.0					
time	9:35					
Temp. (Celsius)						
value	11.04					
time	9:35					
DO (mg/l)						
value	7.75					
time						
ORP (mV)						
value	36.2					
time						
TDS (ppt)						
value	13					
time						
Turbidity (ntu)						
value	19.1 NTU					
time	1000					
Ferrous Iron (mg/l)						
value	2.58 mg/L					
time	1000					
Sulfide (mg/l)						
value	0.10 mg/L					
time	1000					

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A Kepner
Date: 10-30-17

Well No. 128+30-0

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1/2 Liter					
purge/bail/type						
Water Sample						
Sample No.	GW-128+30-0 -103017					
Sample Method	Peristaltic					
Time	1100					
No. Cont.	14					
Initials						
pH						
value	6.90					
time	10:20					
Conductivity (S/cm)						
value	26443.9					
time						
Temp. (Celsius)						
value	13.83					
time						
DO (mg/l)						
value	5.76					
time						
ORP (mV)						
value	633					
time						
TDS (ppt)						
value	17					
time						
Turbidity (ntu)						
value		3.82 NTU				
time		1100				
Ferrous Iron (mg/l)						
value		0.26 mg/L				
time		1100				
Sulfide (mg/l)						
value		0.02 mg/L				
time		1100				

COMMENTS: + Clear, could not purge
- Dissolved Metals/Solids Field Filtered 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 10-30-2017

Well No. 129+65-0

well depth (top PVC)	Unknown					
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1/2 Liter	1 Liter				
purge/bail/type						
Water Sample						
Sample No.	GW-129+65-0-103017					
Sample Method	Peristatic					
Time	940					
No. Cont	14					
Initials	LNK					
pH						
value	6.47	6.84				
time	9:25	9:35				
Conductivity (S/cm)						
value	16,372	19,159.5				
time						
Temp. (Celsius)						
value	13.86	14.26				
time						
DO (mg/l)						
value	9.21	8.08				
time						
ORP (mV)						
value	579	472				
time						
TDS (ppt)						
value	11	12				
time						
Turbidity (ntu)						
value		0.86 NTU				
time		940				
Ferrous Iron (mg/l)						
value		0.03 mg/L				
time		940				
Sulfide (mg/l)						
value		0.05 mg/L				
time		940				

COMMENTS:

Well Volumes
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/11/2017

Well No. IC2-2

well depth (top PVC)	29.2					
water level(top PVC)	7.60					
water height	21.6					
time	1440					
Casing/Volume						
type:	2"					
type: other	PVC					
vol/ft						
tot. vol						
3 x vol	11.8					
Purge Volume						
gallons purged	~ 1	~ 2	~ 3			
purge/bail/type						
Water Sample						
Sample No.	GW-IC2-2-101117-13.8-23.6-(20)					
Sample Method	Parastaltic					
Time	1500					
No. Cont.	11					
Initials	DJP					
pH						
value	6.72	6.61	6.56			
time	1455	1505	1515			
Conductivity (S/cm)						
value	20135.7	21117.7	21055.4			
time	1455	1505	1515			
Temp. (Celsius)						
value	13.90	13.75	13.77			
time	1455	1505	1515			
DO (mg/l)						
value	0.03	0.01	0.01			
time	1455	1506	1515			
ORP (mV)						
value	-107.5	-105.3	-106.8			
time	1455	1505	1515			
TDS (ppt)						
value	13	14	14			
time	1455	1505	1515			
Turbidity (ntu)						
value			17.9 NTU			
time			1530			
Ferrous Iron (mg/l)						
value			~~0.99~~ 9.9mg/L			
time			1530			
Sulfide (mg/l)						
value			0.04mg/L			
time			1530			

COMMENTS:

Light brown, effervescent

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/13/2017

Well No. 2B2-32

well depth (top PVC)	36.1					
water level(top PVC)	11.6					
water height	24.5					
time	0825					
Casing/Volume						
type:	4" PVC					
type: other	sch 40					
vol/ft						
tot. vol	~16.3 gal					
3 x vol	49.0 gal					
Purge Volume						
gallons purged	1.5	3.0	4.5			
purge/bail/type						
Water Sample						
Sample No.	GW-2B2-2-101317-30.8-35.8					
Sample Method	Parastaltic					
Time	0900					
No. Cont.	11					
Initials	DJP					
pH						
value	6.20	6.20	6.20			
time	0840	0850	0900			
Conductivity (S/cm)						
value	170900.2	170798.9	169951.8			
time	0840	0850				
Temp. (Celsius)						
value	14.16	14.26	14.23			
time	0840	0850	0900			
DO (mg/l)						
value	0.04	0.03	0.02			
time	0840	0850	0900			
ORP (mV)						
value	-61.9	-64.1	-65.6			
time	0840	0850	0900			
TDS (ppt)						
value	111	111	111			
time	0840	0850	0900			
Turbidity (ntu)						
value			1.67 NTU			
time			0930			
Ferrous Iron (mg/l)						
value			43.8 mg/L			
time			0930			
Sulfide (mg/l)						
value			0 mg/L			
time			0930			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D Pickering
Date: 10/11/17

Well No. 2C2-2

well depth (top PVC)	25.9					
water level(top PVC)	6.3					
water height	19.6					
time	13:15					
Casing/Volume						
type:	4"					
type: other	PVC					
vol/ft						
tot. vol	~13					
3 x vol	39.2					
Purge Volume						
gallons purged	~1	~2	~3	~4		
purge/bail/type	~~Parastaltic~~					
Water Sample						
Sample No.	GW-2C2-	2-101117-	20.6-25.	6-(20)		
Sample Method	Parastaltic					
Time	1330					
No. Cont.						
Initials	DJP					
pH						
value	7.93	7.64	5.64	6.11		
time	1325	1335	1350	1405		
Conductivity (S/cm)						
value	142.0	131.9	50161.3	61476.9		
time	1325	1335	1350	1405		
Temp. (Celsius)						
value	18.88	18.01	15.14	15.04		
time	1325	1335	1350	1405		
DO (mg/l)						
value	2.42	9.18	0.07	0.04		
time	1325	1335	1350	1405		
ORP (mV)						
value	4.9	-33.0	-100.4	-96.4		
time	1325	1335	1350	1405		
TDS (ppt)						
value	0	0	32	40		
time	1325	1335	1350	1405		
Turbidity (ntu)						
value				2.15 NTU		
time				1400		
Ferrous Iron (mg/l)						
value				~~0.00mg/L~~	8.0mg/L	
time				1400		
Sulfide (mg/l)						
value				~~0.03mg/L~~	0.08mg/L	
time				1400		

COMMENTS:

New tubing put into well initially not long enough: Thought was near bottom of well until air bubbles coming up after ~2 gal of purge. Added 10'-12' of tubing

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Luke Kerner
Date: 10/12/17

Well No. 2D3-2

well depth (top PVC)	31.8'					
water level(top PVC)	6.79					
water height	25.01					
time	840					
Casing/Volume						
type:	4" PVC					
type: other						
vol/ft						
tot. vol	16.325					
3 x vol	48.9					
Purge Volume						
gallons purged	2	3	4.5			
purge/bail/type	~~Peristaltic~~	Purge				
Water Sample						
Sample No.			GTW-2D3-2-101217-26.5-31.5			
Sample Method	Peristaltic					
Time	~~840~~					
No. Cont.	11					
Initials	LNK					
pH						
value	6.17	6.25	6.26			
time	8.50	9:00	910			
Conductivity (S/cm)						
value	81247	72,383	70,618			
time	850	900	910			
Temp. (Celsius)						
value	14.37	14.40	14.40			
time	9:50	900	910			
DO (mg/l)						
value	0.04	0.03	0.03			
time	850	900	910			
ORP (mV)						
value	-67.1	-78	-73.4			
time	850	900	910			
TDS (ppt)						
value	52	47	46			
time	850	900	910			
Turbidity (ntu)						
value			17.8 NTU			
time			0910			
Ferrous Iron (mg/l)						
value			6.5 mg/L			
time			0910			
Sulfide (mg/l)						
value			0.02 mg/L			
time			0910			

COMMENTS:

31.8

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 16 OCTOBER 2017

Well No. 3A2-2R

well depth (top PVC)	27.6	27.6	27.6			
water level(top PVC)	18.8	18.6	18.5			
water height	8.9	9	9.1			
time	9:30	10:15	10:25			
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	1.43					
3 x vol	4.3					
Purge Volume						
gallons purged	1	1.5				
purge/bail/type	PERISTALTIC	PERISTALTIC				
Water Sample						
Sample No.				3A2-2R		
Sample Method				PERISTALTIC		
Time				10:25-11:00		
No. Cont.				~~14~~ 15		
Initials				DB		
pH						
value	6.91	6.95	7.01			
time	10:10	10:15	10:25			
Conductivity (S/cm)						
value	4290.1	4313	3773			
time	10:10	10:15	10:25			
Temp. (Celsius)						
value	15.71	15.76	15.98			
time	10:10	10:15	10:25			
DO (mg/l)						
value	0.09	0.07	0.07			
time	10:10	10:15	10:25			
ORP (mV)						
value	-75.8	-93.7	-92.0			
time	10:10	10:15	10:25			
TDS (ppt)						
value	3	3	2			
time	10:10	10:15	10:25			
Turbidity (ntu)						
value			2.37NTU			
time			1030			
Ferrous Iron (mg/l)						
value			6.5 mg/L			
time			1030			
Sulfide (mg/l)						
value			0 mg/L			
time			1030			

COMMENTS: START PUMPING @ 9:55; TUBE 0.7' ABOVE WELL BOTTOM

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/16/2017

Well No. 3A6-2R

well depth (top PVC)	27.5'					
water level(top PVC)	17.5					
water height	10.0					
time	1130					
Casing/Volume						
type:	2" PVC					
type: other	Sch. 40					
vol/ft						
tot. vol	~1.7					
3 x vol	5.0					
Purge Volume						
gallons purged	~1.25	2.25	3.0			
purge/bail/type						
Water Sample						
Sample No.	GW-3A6-2R-101617					
Sample Method	Peristaltic					
Time	1200					
No. Cont.	15					
Initials	DJP	4				
pH						
value	6.38	6.38	6.39			
time	1150	1200	1210			
Conductivity (S/cm)						
value	94622.6	94883.1	95944.4			
time	1150	1200	1210			
Temp. (Celsius)						
value	14.67	14.72	14.72			
time	1150	1200	1210			
DO (mg/l)						
value	0.12	0.09	0.08			
time	1150	1200	1210			
ORP (mV)						
value	-12.7	-16.1	-18.3			
time	1150	1200	1210			
TDS (ppt)						
value	61	62	62			
time	1130	1200	1210			
Turbidity (ntu)						
value			8.28 NTU			
time			1230			
Ferrous Iron (mg/l)						
value			9.0 mg/L			
time			1230			
Sulfide (mg/l)						
value			0.03mg/L			
time			1230			

COMMENTS: Water Ht increased after pumping started (10.5')

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Luke Kerner
Date: 10/12/2017

Well No. 3C5-2

well depth (top PVC)						
water level(top PVC)	10.2					
water height						
time						
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653 gal/ft					
tot. vol						
3 x vol						
Purge Volume	1 gal					
gallons purged	~~5.5~~	2.5	5.0			
purge/bail/type	Peristaltic					
Water Sample						
Sample No.						
Sample Method	Peristaltic					
Time						
No. Cont.	11					
Initials	LNK					
pH						
value	6.31	6.21	6.01			
time						
Conductivity (S/cm)						
value	150169	155299	164598			
time						
Temp. (Celsius)						
value	13.02	13.80	13.78			
time						
DO (mg/l)						
value	0.05	0.03				
time						
ORP (mV)						
value	-105.9	-103.4	-81.5			
time						
TDS (ppt)						
value	98	100	107			
time						
Turbidity (ntu)						
value			15.3 NTU			
time			1100			
Ferrous Iron (mg/l)						
value			7.5 mg/L			
time			1100			
Sulfide (mg/l)						
value			0.07 mg/L			
time			1100			

COMMENTS:

Field Filtered w/ 0.45 micron filters for Dissolved

*Replaced Tubing w/ new 1/4" OD

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: David Browning
Date: 10-11-2017

Well No. 3C7-2R

well depth (top PVC)	29.6	29.6				
water level(top PVC)	10.9	12.35				
water height	18.7	17.25				
time	09:40	10:24				
Casing/Volume						
type:	2"					
type: other	Sch 40 PVC					
vol/ft	0.163 g/ft					
tot. vol						
3 x vol	9.3					
Purge Volume						
gallons purged	5					
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	GW-3C7-2R-	101117-24.3-	29.3			
Sample Method	Peristaltic					
Time	10:45					
No. Cont.	11					
Initials	DB					
pH						
value	6.49	6.52	6.53	6.54		
time	10:09	10:19	10:28	10:39		
Conductivity (S/cm)						
value	99577.1	97410	96598.3	95690.7		
time	10:09	10:19	10:28	10:39		
Temp. (Celsius)						
value	15.21	15.4	15.21	15.58		
time	10:09	10:19	10:28	10:40		
DO (mg/l)						
value	0.09	0.07	0.06	0.05		
time	10:09	10:19	10:28	10:40		
ORP (mV)						
value	-71.5	-67.5	-65.6	-75.9		
time	10:10	10:19	10:28			
TDS (ppt)						
value	64	64	63	62		
time	10:10	10:19	10:28	10:40		
Turbidity (ntu)	SAMPLE COLLECTED 10:34 - 10:35					
value	16.7 NTU					
time	10 30					
Ferrous Iron (mg/l)						
value				5.9 mg/L		
time				1130		
Sulfide (mg/l)						
value				0.0 mg/L		
time				1100		

COMMENTS:

10/11/2017 09:20 pH cal test 7.0 Buffer = 7.14 @ 9.37c

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/13/17

Well No. 3E1-2

well depth (top PVC)	24.7					
water level(top PVC)	9.1					
water height	15.6					
time	1320					
Casing/Volume						
type:	4" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	10.4					
3 x vol	31.2					
Purge Volume						
gallons purged	1.5	4.0	~6.0			
purge/bail/type						
Water Sample						
Sample No.	GW-3E1-2	-101317-	17.5-22.5			
Sample Method	Parastaltic					
Time	1330					
No. Cont.	11					
Initials	DJP					
pH						
value	6.52	6.51	6.56			
time	1330	1340	1350			
Conductivity (S/cm)						
value	20773.7	21534.2	21332.6			
time	1330	1340	1350			
Temp. (Celsius)						
value	13.27	13.63	13.59			
time	1330	1340	1350			
DO (mg/l)						
value	0.04	0.02	0.03			
time	1330	1340	1350			
ORP (mV)						
value	-36.7	-39.5	-41.2			
time	1330	1340	1350			
TDS (ppt)						
value	13	14	14			
time	1330	1340	1350			
Turbidity (ntu)						
value			11.2 NTU			
time			1400			
Ferrous Iron (mg/l)						
value			24.3mg/L			
time			1400			
Sulfide (mg/l)						
value			0.02mg/L			
time			1400			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/13/2017

Well No. 4B2-2

well depth (top PVC)	30.8					
water level(top PVC)	11.6					
water height	25.2					
time	1130					
Casing/Volume						
type:	4" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	16.8					
3 x vol	50.4					
Purge Volume						
gallons purged	1.5	~3.0	~4.5	~6.0		
purge/bail/type						
Water Sample						
Sample No.	GW-4B2-2-101317-22.5-27.5					
Sample Method	Parastaltic					
Time	1145					
No. Cont.	11					
Initials	DJP					
pH						
value	6.20	6.32	6.41	6.40		
time	1145	1155	1205	1215		
Conductivity (S/cm)						
value	86026.5	722342	66291.9	66081.6		
time	1145	1155	1205	1215		
Temp. (Celsius)						
value	14.44	14.31	14.22	14.18		
time	1145	1155	1205	1215		
DO (mg/l)						
value	0.04	0.03	0.02	0.02		
time	1145	1155	1205	1215		
ORP (mV)						
value	-41.3	-54.1	-59.8	-63.5		
time	1145	1155	1205	1215		
TDS (ppt)						
value	55	47	43	43		
time	1145	1155	1205	1215		
Turbidity (ntu)						
value				13.9 NTU		
time				1230		
Ferrous Iron (mg/l)						
value				27.6 mg/L		
time				1230		
Sulfide (mg/l)						
value				0.09 mg/L		
time				1230		

COMMENTS:

Original tubing in well was corroded and plugged. Replaced w/ new

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 13 OCTOBER 2017

Well No. 4B-3-2 4B3-2

well depth (top PVC)	29.4	29.4	29.4	29.4		
water level(top PVC)	16.9	13.0	14.1	14.9		
water height	12.5	16.4	15.3	14.5		
time	11:55	12:10	12:20	12:30		
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653 g/ft					
tot. vol	12.08					
3 x vol	36.24					
Purge Volume						
gallons purged		2	2.5	3.5		
purge/bail/type		2 PER	PERISTALTIC			
Water Sample						
Sample No.				4B3-2		
Sample Method				PERISTALTIC		
Time				12:35-12:55		
No. Cont.				11		
Initials				DB		
pH						
value		6.12	6.28	6.37		
time		12:10		12:30		
Conductivity (S/cm)						
value		46822	46968.4	47032		
time		12:10	12:20	12:30		
Temp. (Celsius)						
value		14.87	14.94	14.99		
time		12:10	12:20	12:30		
DO (mg/l)						
value		0.07	0.06	0.07		
time		12:10	12:20	12:30		
ORP (mV)						
value		-34.2	-38.9	-43.1		
time		12:10	12:20	12:30		
TDS (ppt)						
value		30	31	31		
time		12:10	12:20	12:30		
Turbidity (ntu)						
value				19.0 NTU		
time				1300		
Ferrous Iron (mg/l)						
value				20.8 mg/L		
time				1300		
Sulfide (mg/l)						
value				0.02 mg/L		
time				1300		

COMMENTS: END OF TUBE 1 FT ABOVE BOTTOM OF WELL.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 16 OCTOBER 2017

Well No. 4B4-2

well depth (top PVC)	32.4	32.4	32.4	32.4	32.4		
water level(top PVC)	13.5	13.8	13.5	13.5	13.2		
water height	18.9	18.6	18.9	18.9	~~18.9~~ 19.2		
time	13:00	13:10	1320	13:30	13:40		
Casing/Volume							
type:	2"						
type: other	SCH 40 PVC						
vol/ft	0.163						
tot. vol							
3 x vol							
Purge Volume							
gallons purged		0.7	1.5	2.0	2.5		
purge/bail/type		PERISTALTIC					
Water Sample							
Sample No.		~~6.69~~			4B4-2	4B4-2-01	DUP
Sample Method					PER	PER	
Time					13:40-14:30	13:40-14:30	
No. Cont.					15	15	
Initials					DB	DB	
pH							
value		6.69	6.83	6.88	6.91		
time		13:10	13:20	13:30			
Conductivity (S/cm)							
value		101190	101181.5	101188.9	101026		
time		13:10	13:20	13:30			
Temp. (Celsius)							
value		15.48	15.43	15.48	15:40		
time		13:10	13:20	13:30			
DO (mg/l)							
value		0.05	0.04	0.03	0.03		
time		13:10	13:20	13:30			
ORP (mV)							
value		-50.7	-67.8	-73.4	-76.7		
time		13:10	13:20	13:30			
TDS (ppt)							
value		66	66	66	66		
time		13:10	13:20	13:30			
Turbidity (ntu)							
value					9.32 NTU		
time					1430		
Ferrous Iron (mg/l)							
value					16.4 mg/L		
time					1430		
Sulfide (mg/l)							
value					0.03 mg/L		
time					1430		

COMMENTS: START PUMP 1 13:03

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/18/17

Well No. 4E1-2

well depth (top PVC)	24.0					
water level(top PVC)	9.8	13.7	15.1			
water height	14.2					
time	0952	1005	1015			
Casing/Volume						
type:	2" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	~2.3					
3 x vol	7.1					
Purge Volume						
gallons purged	~1.5	3.25				
purge/bail/type						
Water Sample						
Sample No.	GW-4E1-2-101817					
Sample Method	Peristaltic					
Time	1025					
No. Cont.	10					
Initials	DJP					
pH						
value	7.01	6.90	6.89			
time	1005	1015	1025			
Conductivity (S/cm)						
value	19438	22,300	22876			
time						
Temp. (Celsius)						
value	13.86	13.86	13.81			
time						
DO (mg/l)						
value	0.04	0.03	0.03			
time						
ORP (mV)						
value	-66.1	-52.2	-53.6			
time						
TDS (ppt)						
value	13	14	15			
time						
Turbidity (ntu)						
value			20.2 NTU			
time			1100			
Ferrous Iron (mg/l)						
value			3.9 mg/L			
time			1100			
Sulfide (mg/l)						
value			0.03 mg/L			
time			1100			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/18/17

Well No. 4F1-2

well depth (top PVC)	25.3					
water level(top PVC)	9.4	9.4	9.4	9.4		
water height	15.9					
time	1240	1255	1305	1315		
Casing/Volume						
type:	2" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	2.4					
3 x vol	7.45					
Purge Volume						
gallons purged	1.5	2.75	4.5			
purge/bail/type						
Water Sample						
Sample No.	GW-4F1-2-101817					
Sample Method	Peristaltic					
Time	1305					
No. Cont.	10					
Initials	DWP					
pH						
value	6.34	6.33	6.32			
time	1255	1305	1315			
Conductivity (S/cm)						
value	15803	15497	15493			
time						
Temp. (Celsius)						
value	14.3	14.26	14.31			
time						
DO (mg/l)						
value	0.05	0.03	0.03			
time						
ORP (mV)						
value	-36.1	-36.1	-37.8			
time						
TDS (ppt)						
value	10	10	10			
time	1255	1305				
Turbidity (ntu)						
value			6.44 NTU			
time			1330			
Ferrous Iron (mg/l)						
value			21.7 mg/L			
time			1330			
Sulfide (mg/l)						
value			0.09 mg/L			
time			1330			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerr
Date: 11-01-2017

Well No. 4G2-2.

well depth (top PVC)	21.5					
water level(top PVC)	7.77					
water height	13.73					
time	11:00					
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653 gal/ft					
tot. vol	8.97 gal					
3 x vol	26.89 gal					
Purge Volume						
gallons purged	1.75gal	3.25gal	4.75gal			
purge/bail/type	Paristaltic					
Water Sample						
Sample No.	GW-4G2-2-110117					
Sample Method	Paristaltic					
Time	11:50					
No. Cont.	10					
Initials	JNK					
pH						
value	6.74	6.68	6.55			
time	11:15	11:25	11:35			
Conductivity (S/cm)						
value µS/cm	2,166.6	2,163.9	2,806.9			
time						
Temp. (Celsius)						
value	12.14	12.21	12.21			
time						
DO (mg/l)						
value	0.08	0.04	0.03			
time						
ORP (mV)						
value	-102.4	-112.7	-106.1			
time						
TDS (ppt)						
value	1	1	2			
time						
Turbidity (ntu)						
value			4.16 NTU			
time			1150			
Ferrous Iron (mg/l)						
value			8.3 mg/L			
time			1150			
Sulfide (mg/l)						
value			0.05 mg/L			
time			1150			

COMMENTS: * Dissolved Metals/Solids Field Filtered 0.45 µm

Start Pumping @ 11:05

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: J Herne
Date: 11-01-2017

Well No. 4H4-2

well depth (top PVC)	21.9					
water level(top PVC)	7.71					
water.height	14.09					
time	1310					
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	9.20					
3 x vol	27.6					
Purge Volume						
gallons.purged						
purge/bail/type	Peristaltic					
Water Sample						
Sample No.	GW-4H4-2-110117					
Sample Method	Peristaltic					
Time	1350					
No. Cont.	10					
Initials	JNK					
pH						
value	6.60	6.50	6.50			
time	1322	1332	1342			
Conductivity (S/cm)						
value µS/cm	11,860.5	11,695.1	11,677.8			
time						
Temp. (Celsius)						
value	12.12	12.12	12.21			
time						
DO (mg/l)						
value	0.09	0.05	0.03			
time						
ORP (mV)						
value	-115.2	-122.9	-129.5			
time						
TDS (ppt)						
value	8	8	8			
time						
Turbidity (ntu)						
value			1.50 NTU			
time			1400			
Ferrous Iron (mg/l)						
value			0.09 mg/L			
time			1400			
Sulfide (mg/l)						
value			0.27 mg/L			
time			1400			

COMMENTS: - Begin Pumping @ 13:12

* Dissolved metals/solids Field Filtered 0.45

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 16 OCTOBER 2017

Well No. SB1-2

well depth (top PVC)	33.9	33.9	15:10 33.9	33.9		
water level(top PVC)	10.9	11.9	12.1	12.2		
water height	23.00	22	21.8	21.7		
time	14:50	15:00	15:10	15:20		
Casing/Volume						
type:	2"					
type: other	PVC SCH 40					
vol/ft	0.163					
tot. vol	3.749					
3 x vol	11.247					
Purge Volume						
gallons purged		1	1.75	2.5		
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.					SB1-2R	
Sample Method					PERISTALTIC	
Time					15:25-15:50	
No. Cont.					15	
Initials					DB	
pH						
value		8.34	7.86	7.69		
time		15:00	15:10	15:20		
Conductivity (S/cm)						
value		42554	42854	42297		
time		15:00	15:10	15:20		
Temp. (Celsius)						
value		15.34	15.12	15.08		
time		15:00	15:10	15:20		
DO (mg/l)						
value		0.15	0.05	0.04		
time		15:00	15:10	15:20		
ORP (mV)						
value		-55.8	-99.7	-109.2		
time		15:00	15:10	15:20		
TDS (ppt)						
value		28	28	27		
time		15:00	15:10	15:20		
Turbidity (ntu)						
value				30.3NTU		
time				1530		
Ferrous Iron (mg/l)						
value				16.7mg/L		
time				1530		
Sulfide (mg/l)						
value				0.03mg/L		
time				1530		

COMMENTS: START PUMP @ 14:50

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/17/2017

Well No. SC10-2

well depth (top PVC)	37.9					
water level(top PVC)	11.3	12.7	12.7			
water height	22.6					
time	1045	1108	1115			
Casing/Volume						
type:	4" PVC					
type: other	Sch 40					
vol/ft						
tot. vol	15					
3 x vol	45.2					
Purge Volume						
gallons purged	1.0	~2.75	~4.5	~6.5		
purge/bail/type						
Water Sample						
Sample No.	GW-SC10-2-101717					
Sample Method	Parestaltic					
Time	1115					
No. Cont.	~~4~~ (10)					
Initials	DJP					
pH						
value	7.26	7.3	7.34	7.35		
time	1055	1105	1115	1125		
Conductivity (S/cm)						
value	18380	18157.9	14774.6	~~14.6~~ 14873		
time	1055	1105	1115	1125		
Temp. (Celsius)						
value	14.97	14.74	14.68	14.68		
time	1055	1105	1115	1125		
DO (mg/l)						
value	0.0	0.00	0.00	0.0		
time	1055	1105	1115	1125		
ORP (mV)						
value	-171.6	-178.6	-187.1	-189.1		
time	1055	1105	1115	1125		
TDS (ppt)						
value	12	10	10.	10		
time	1055	1105	1115	1125		
Turbidity (ntu)						
value				opaque - No Reading		
time				1145		
Ferrous Iron (mg/l)						
value				29.6mg/L		
time				1145		
Sulfide (mg/l)						
value				2.5mg/L		
time				1145		

COMMENTS: GW is dark brownish red ~~[illegible]~~ Not really much odor but wind is blowing ~10-15 mph gusts

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 17 OCTOBER 2017

Well No. SC14-2

well depth (top PVC)	29~~19.04~~	27	29	29	29	
water level(top PVC)	11.1	12.2	13.4	14.3	15.1	
water height	17.9	16.8	15.6	14.7	13.9	
time	11:55	12:00	12:10	12:20	12:30	
Casing/Volume						
type:	4" P					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	11.688					
3 x vol	35.07					
Purge Volume						
gallons purged		0.5	1.75	2.75	3.5	
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.						SC14-2
Sample Method						PERISTALTIC
Time						12:35-13:10
No. Cont.						10
Initials						DB
pH						
value		10.37	9.83	9.44	9.13	
time		12:00	12:10	12:20	12:30	
Conductivity (S/cm)						
value		24719	24584	24635.6	24486.3	
time		12:00	12:10	12:20	12:30	
Temp. (Celsius)						
value		14.82	15.17	15.39	15.52	
time		12:00	12:10	12:20	12:30	
DO (mg/l)						
value		0.10	0.05	0.04	0.04	
time		12:00	12:10	12:20	12:30	
ORP (mV)						
value		3.5	4.2	-2.8	-2.7	
time		12:00	12:10	12:20	12:30	
TDS (ppt)						
value		16	16	16	16	
time		12:00	12:10	12:20	12:30	
Turbidity (ntu)						
value					2.19 NTU	
time					1235	
Ferrous Iron (mg/l)						
value					0.46 mg/L	
time					1235	
Sulfide (mg/l)						
value					0.05 mg/L	
time					1235	

COMMENTS: START PUMPING @ 11:55 INITIAL SLUG WAS DARK BROWN, BECAME LIGHT COLORED IN ~ 30 SEC OF PUMPING.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

9.7
24.3

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. Browning
Date: 10-17-17

Well No. 5C16-2R

well depth (top PVC)	24.3	24.3	24.3	24.3		
water level(top PVC)	11.9	12.1	12.2	12.3		
water height	12.4	12.2	12.1	12		
time	9:10	9:25	9:35	9:45		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol						
3 x vol						
Purge Volume						
gallons purged		0.5	1.5	2.5		
purge/bail/type		PERISTALTIC →	→	→		
Water Sample						
Sample No.					5C16-2R	
Sample Method					PERISTALTIC	
Time					9:50-10:15	
No. Cont.					11	
Initials					DB	
pH						
value		7.17	7.24	7.25		
time		9:25	9:35	9:45		
Conductivity (S/cm)						
value		221661	22027.9	21957.6		
time		9:25	9:35	9:45		
Temp. (Celsius)						
value		13.95	14.21	14.26		
time		9:25	9:35	9:45		
DO (mg/l)						
value		0.09	0.05	0.04		
time		9:25	9:35	9:45		
ORP (mV)						
value		-72.3	-109.3	-118.1		
time		9:25	9:35	9:45		
TDS (ppt)						
value		14	14	14		
time		9:25	9:35	9:45		
Turbidity (ntu)						
value				13.3 NTU		
time				1000		
Ferrous Iron (mg/l)						
value				53 mg/L		
time				1000		
Sulfide (mg/l)						
value				0.05mg/L		
time				1000		

COMMENTS: START PUMP 9:18, OILY SHEEN, DULL SILVER, SPREADING IN PURGE WATER

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-20-17

Well No. 5C 21-2

well depth (top PVC)	31.5					
water level(top PVC)	12.03					
water height	19.5					
time	14:14					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163 gal/ft					
tot. vol	5.1348					
3 x vol	15.4					
Purge Volume						
gallons purged	1.5 gal	3 gal				
purge/bail/type						
Water Sample						
Sample No.	GW-SC21-2-102017-(20)					
Sample Method	Paristaltic					
Time	1445					
No. Cont.	10					
Initials	LNK					
pH						
value	6.74	6.78	6.81		~~9.97~~ * DB	
time	1430	1440	1450		~~15:26~~ DD	
Conductivity (S/cm)						
value	19,714	18,735	18157.9			
time						
Temp. (Celsius)						
value	14.08	14.81	14.80			
time						
DO (mg/l)						
value	0.12	0.03	0.02			
time						
ORP (mV)						
value	-99.5	-132.0	-140.3			
time						
TDS (ppt)						
value	13	12	12			
time						
Turbidity (ntu)						
value				26.1 NTU		
time				15:45		
Ferrous Iron (mg/l)						
value				24.75 mg/L		
time				15:45		
Sulfide (mg/l)						
value				0.34 mg/l		
time				15:45		

COMMENTS:

* Field filtered dissolved metals w/ 0.45 μm, 25/1 DILUTION ON Fe

~~* SECOND SONDE~~

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Dan Pickering
Date: 10/17/2017

Well No. SDE-2

well depth (top PVC)	27.5					
water level(top PVC)	8.9	11.35	11.45	11.5		
water height	18.6					
time	1340	1350	1400	1410		
Casing/Volume						
type:	2" PVC					
type: other	sch 40					
vol/ft						
tot. vol	3.1					
3 x vol	9.3					
Purge Volume						
gallons purged	~1.8	~4.0	~5.5			
purge/bail/type						
Water Sample						
Sample No.	GW-SDE-2-101717					
Sample Method	Peristaltic					
Time	1410					
No. Cont.	10					
Initials	DJP					
pH						
value	6.66	6.68	6.70	6.71		
time	1350	1400	1410	1420		
Conductivity (S/cm)						
value	17313	17607	17975	18142		
time	1350	1400	1410	1420		
Temp. (Celsius)						
value	15.35	15.18	15.08	15.03		
time	1350	1400	1410	1420		
DO (mg/l)						
value	0.05	0.04	0.03	~0.03		
time	1350	1400	1410	1420		
ORP (mV)						
value	-49.7	-49.3	-53.5	-58.2		
time	1350	1400	1410	1420		
TDS (ppt)						
value	~~1750~~ 11	11	12	12		
time	1350	1400	1410	1420		
Turbidity (ntu)						
value				21.8NTU		
time				1430		
Ferrous Iron (mg/l)						
value				10.7 mg/L		
time				1430		
Sulfide (mg/l)						
value				0.02 mg/L		
time				1430		

COMMENTS:
Well missing cap for PVC well!

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DAVID BROWNING
Date: 18 OCTOBER 2017

Well No. 5E1-2

well depth (top PVC)	25.7	25.7	25.7	25.7	25.7	
water level(top PVC)	10.6	11.0	11.0	11.0	11.0	
water height	15.1	14.7	14.7	14.7	14.2	
time	12:25	12:30	12:40	12:50	13:00	
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	2.46					
3 x vol	7.38					
Purge Volume						
gallons purged		0.5	1.5	2.5	3.5	
purge/bail/type			12:1			
Water Sample						
Sample No.						GW-5E1-2
Sample Method						PERISTALTIC
Time						13:00-13:35
No. Cont.						10
Initials						DB
pH						
value		6.18	6.41	6.51	6.57	
time		12:35	12:40	12:50	13:00	
Conductivity (S/cm)						
value		17593.0	16791.0	16212.0	15994.0	
time		12:35	12:40	12:50	13:00	
Temp. (Celsius)						
value		14.44	14.80	14.77	14.84	
time		12:35	12:40	12:50	13:00	
DO (mg/l)						
value		~~1.33~~ 0.74	0.05	0.04	0.03	
time		12:35	12:40	12:50	13:00	
ORP (mV)						
value		27.8	-33.5	-56.0	-67.8	
time		12:35	12:40	12:50	13:00	
TDS (ppt)						
value		11	11	11	10	
time		12:35	12:40	12:50	13:00	
Turbidity (ntu)						
value					47.8 NTU	
time					1330	
Ferrous Iron (mg/l)						
value					Out of range	@ 20x dilution
time					1330	
Sulfide (mg/l)						
value					0.02 mg/L	
time					1330	

COMMENTS: START PUMPING 12:25

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. Browning
Date: 1-November 2017

Well No. SH2-2

well depth (top PVC)	33'	33	33	33		
water level(top PVC)	9	7.2	7.0	7.0		
water height	26.0	25.8	26	26		
time	11:40	11:50	12:00	12:10		
Casing/Volume						
type:	1 1/4"					
type: other	SCH 40 PVC					
vol/ft	0.04					
tot. vol	1.04					
3 x vol	3.12					
Purge Volume						
gallons purged	1 1/4"	0.5	1.25	2		
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.					GW SH2-2	
Sample Method					PERISTALTIC	
Time					12:10-12:30	
No. Cont.					10	
Initials					DB	
pH						
value		6.77	6.77	6.76		
time		11:50	12:00	12:10		
Conductivity (S/cm)						
value		14641	13860	13490		
time		11:50	12:00	12:10		
Temp. (Celsius)						
value		12.95	12.98	12.99		
time		11:50	12:00	12:10		
DO (mg/l)						
value		0.15	0.10	0.10		
time		11:50	12:00	12:10		
ORP (mV)						
value	-114.4 →	-11.4.4	-110.9	-108.0		
time		11:50	12:00	12:10		
TDS (ppt)						
value		9.54	9.00	9.76		
time		11:50	12:00	12:10		
Turbidity (ntu)						
value				5.78 NTU		
time				1230		
Ferrous Iron (mg/l)						
value				2.24 mg/L		
time				1230		
Sulfide (mg/l)						
value				0.04 mg/L		
time				1230		

COMMENTS: START PUMP 11:40

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 24 OCTOBER 2017

Well No. 6B19-2

well depth (top PVC)	24.5	24.5	24.5	24.5		
water level(top PVC)	8.2	8.2	12.2	13.1		
water height	16.3	16.3	12.3	11.4		
time	~~12:10~~ 12:15	12:40	12:50	13:00		
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	10.64					
3 x vol	31.92					
Purge Volume						
gallons purged		1.5	3			
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.					GW6B19-2	GW6B19-2 DUP
Sample Method					PERISTALTIC	→
Time					13:10-13:40	13:10-13:40
No. Cont.					10	10
Initials					DB	DB
pH						
value		7.54	7.37	7.54		
time		12:40	12:50			
Conductivity (S/cm)						
value		11303	11327	11303		
time		12:40	12:50			
Temp. (Celsius)						
value		14.76	14.85	15.03		
time		12:40	12:50			
DO (mg/l)						
value		0.07	0.08	0.09		
time		12:40	12:50			
ORP (mV)						
value		-162.9	-159.9	-157.2		
time		12:40	12:50			
TDS (ppt)						
value		7.35	7.36	7.34		
time		12:40	12:50			
Turbidity (ntu)						
value				6.52 NTU		
time				1345		
Ferrous Iron (mg/l)						
value				6.2 mg/L		
time				1345		
Sulfide (mg/l)						
value				0.07 mg/L		
time				1345		

COMMENTS: 12:25 START PUMP; HAD TO REPLACE TUBING; TUBING WAS CLOGGED

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 10-24-17

Well No. 6E3-2

well depth (top PVC)	26.0	26.0				
water level(top PVC)	8.52	25.7'				
water height	17.48	0.3'				
time	11:45	12:05				
Casing/Volume						
type:	1.5"					
type: other	SCH 80 PVC					
vol/ft	.064 gal/ft					
tot. vol	1.12 gallons					
3 x vol	3.36 gallons					
Purge Volume						
gallons purged	.75 gal	1.5 gal	2 gal			
purge/bail/type						
Water Sample	GW-6E3-2-103017					
Sample No.	~~GW-6E3-2-102417-20~~		~~GW-6E3-2-102417-21~~	~~(Duplicate)~~ LK		
Sample Method	Paristaltic		~~Paristaltic~~	} dk		
Time	~~1215~~ 1515		~~1220~~			
No. Cont.	10		~~10~~			
Initials	~~LNK~~	~~LNK~~	~~LNK~~			
pH						
value	7.25	6.66 ~~6.68~~ dk	6.19			
time	1155	1205	1215			
Conductivity (S/cm)						
value	21363.6	22,661.5	28972.6			
time µS/cm	//	//				
Temp. (Celsius)						
value	15.39	15.34	16.75			
time	//					
DO (mg/l)						
value	0.08	0.54	3.31			
time	//					
ORP (mV)						
value	-115.4	-85	-41.0			
time	//					
TDS (ppt)						
value	14	15	20			
time	//					
Turbidity (ntu)						
value			1446 AV			
time			1330			
Ferrous Iron (mg/l)						
value			~~[illegible] mg/L~~	Out of Range due to color		
time			1330			
Sulfide (mg/l)						
value			~~0.0[illegible] mg/L~~	Out of Range @ 20x dilution		
time			1330			

COMMENTS: ~~Da.~~ Well went dry after 2-gallons

Couldn't get sample

* Sample taken 10/30/2017

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 25 OCTOBER 2017

Well No. 6G3-2

well depth (top PVC)	28.7	28.7	28.7	28.7		
water level(top PVC)	7.6	8.6	8.8	8.2		
water height	21.1	20.1	19.9	20.5		
time	8:20	8:30	8:40	8:50		
Casing/Volume						
type:	1½"					
type: other	SCH 40 PVC					
vol/ft	0.04					
tot. vol	0.86					
3 x vol	2.58					
Purge Volume						
gallons purged		0.25	1.25	2.75		
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.					GW-6G3-2	
Sample Method					PERISTALTIC	
Time					08:50 - 9:20	
No. Cont.					11	
Initials					DB	
pH						
value		6.61	6.47	6.42		
time		8:30	8:40	8:50		
Conductivity (S/cm) uS/cm.						
value		50721	31194	28347		
time		8:30	8:40	8:50		
Temp. (Celsius)						
value		13.9	14.13	14.29		
time		8:30	8:40	8:50		
DO (mg/l)						
value		0.17	0.11	0.09		
time		8:30	8:40	8:50		
ORP (mV)						
value		-290.3	-311.3	-308.4		
time		8:30	8:40	8:50		
TDS (ppt)						
value		32.81	19.94	18.39		
time		8:30	8:40	8:50		
Turbidity (ntu)						
value				88.4 NTU		
time				0930		
Ferrous Iron (mg/l)						
value				0.27 mg/L		
time				0930		
Sulfide (mg/l)						
value				0.32 mg/L		
time				0930		

COMMENTS: START PUMP @ 8:20, STRONG SULFUR ODOR WHEN REMOVING CAP FROM WELL TUBE

* TOTAL ALKALINITY HERE

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 10-25-2017

Well No. 7E7-2

well depth (top PVC)	31.8'					
water level(top PVC)	~~4~~ 9.4'					
water height	22.4'					
time	1350					
Casing/Volume						
type:	4"					
type: other	SCH 40PVC					
vol/ft	0.653 gal/ft					
tot. vol	14.63 gal					
3 x vol	43.88gal					
Purge Volume						
gallons purged	1gallon	2.25 gallons	4 gallons			
purge/bail/type	Paristaltic →	→	→			
Water Sample						
Sample No.	GW-7E7-2					
Sample Method	Paristaltic					
Time	14:15					
No. Cont.	10					
Initials	JNK					
pH						
value	9.85	9.38	9.40			
time	1400	1410	1420			
Conductivity (S/cm)	↓	↓	↓			
value	6,283.1	1465.2	1928.9			
time						
Temp. (Celsius)						
value	13.86	13.85	13.88			
time						
DO (mg/l)						
value	0.08	2.07	2.01			
time						
ORP (mV)						
value	-136.8	-44.6	-55.1			
time						
TDS (ppt)						
value	4.4	1.1	1			
time						
Turbidity (ntu)						
value			1.13NTU			
time			1430			
Ferrous Iron (mg/l)						
value			0.07mg/L			
time			1430			
Sulfide (mg/l)						
value			Exceeds Range @ 40x dilution			
time			1430			

COMMENTS:
- Dissolved Metals Field Filtered w/ 0.45µm.
- Max Pumping Rate for 30 minutes

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 25 OCTOBER 2017

Well No. 6E9-2

well depth (top PVC)	32.1	32.1	32.1	32.1		
water level(top PVC)	10.7	13.9	14	17.3		
water height	21.4	18.2	18.1	14.8		
time	1100	11:10	11:20	11:30		
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	13.9742					
3 x vol	41.9226					
Purge Volume						
gallons purged	-	2	3.25	4.5		
purge/bail/type						
Water Sample						
Sample No.					GW 6E9-2	
Sample Method					PERISTALTIC	
Time					11:30-11:50	
No. Cont.					10	
Initials					DB	
pH						
value		7.64	7.66	7.69		
time		11:10	11:20	11:30		
Conductivity (S/cm)						
value		15079	15115	15143		
time		11:10	11:20	11:30		
Temp. (Celsius)						
value		14.27	14.41	14.68		
time		11:10	11:20	11:30		
DO (mg/l)						
value		0.02	0.07	0.02		
time		11:10	11:20	11:30		
ORP (mV)						
value		-242.0	-238.0	-235.4		
time		11:10	11:20	11:30		
TDS (ppt)						
value		9.83	9.83	9.84		
time		11:10	11:20	11:30		
Turbidity (ntu)						
value				0.09 NTU		
time				1200		
Ferrous Iron (mg/l)						
value				0 mg/L		
time				1200		
Sulfide (mg/l)						
value				0.55 mg/L		
time				1200		

COMMENTS: START PUMP 1100

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-23-2017

Well No. 6E12-2

well depth (top PVC)	28.7					
water level(top PVC)	14.2					
water height	14.5					
time	1345					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	2.36					
3 x vol	7.09					
Purge Volume						
gallons purged	1.25	2.5	4gal			
purge/bail/type						
Water Sample						
Sample No.	GW-6E12-2-102317					
Sample Method	Peristaltic					
Time	1400					
No. Cont.	10					
Initials	LNK					
pH						
value	7.02	7.06	7.03			
time	1355	1405	1415			
Conductivity (S/cm)						
value	38,575.0	38217.4	37959.2			
time						
Temp. (Celsius)						
value	14.84	14.58	14.68			
time						
DO (mg/l)						
value	0.02	0.01	0.00			
time						
ORP (mV)						
value	-43.4	-35.1	-43.5			
time						
TDS (ppt)						
value	25	26	25			
time						
Turbidity (ntu)						
value			2.97NTU			
time			1405			
Ferrous Iron (mg/l)						
value			7.7 mg/L			
time			1405			
Sulfide (mg/l)						
value			0.9mg/L			
time			1405			

COMMENTS: Dissolved Metals Field Filtered w/0.45µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerne
Date: 10/20/17

Well No. GF1-2

well depth (top PVC)	28.5					
water level(top PVC)	8.35					
water height	20.15					
time	10:08					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163 gal/ft					
tot. vol	3.28 gal					
3 x vol	9.84 gal					
Purge Volume						
gallons purged	2 gal	3.5	5			
purge/bail/type						
Water Sample						
Sample No.	GW-GF1-2-102017-(20)					
Sample Method	Peristaltic					
Time	10:40					
No. Cont.	10					
Initials	LK					
pH						
value	6.27	6.29	6.30			
time	10:20	10:30	10:40			
Conductivity (S/cm)						
value	24761	24673	24618			
time						
Temp. (Celsius)						
value	14.22	14.41	14.36			
time						
DO (mg/l)						
value	0.06	0.04	0.03			
time						
ORP (mV)						
value	-37.9	-63.9	-68.8			
time						
TDS (ppt)						
value	16	16	16			
time						
Turbidity (ntu)						
value				20.8 NTU		
time				11:30		
Ferrous Iron (mg/l)						
value				55.7 mg/L		
time				11:30		
Sulfide (mg/l)						
value				0.01 mg/L		
time				11:30		

COMMENTS:

~~ADD+~~ Fe had 1/10 dilution and followed 1/10 with 1/2.5

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 23 OCTOBER 2017

Well No. 7E4-2

well depth (top PVC)	25.2	25.2	25.2	25.2		
water level(top PVC)	7.3	14.6	14.3	6.8		
water height	17.9	10.6	10.9	18.4		
time	12:45	12:50	13:00	13:10		
Casing/Volume						
type:	1¼"					
type: other	SCH40 PVC					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged		0.5	1.0	1.75		
purge/bail/type						
Water Sample						
Sample No.					GW 7E4-2	
Sample Method					PER	
Time					13:15-13:35	
No. Cont.					10	
Initials					DB	
pH						
value		11.95/9.27	11.93	11.56		
time		12:50	13:00	13:10		
Conductivity (S/cm)						
value		15070	13292.0	12600.6		
time		12:50	13:00	13:10		
Temp. (Celsius)						
value		14.49	14.33	14.24		
time		12:50	13:00	13:10		
DO (mg/l)						
value		0.07	0.00	0.00		
time		12:50	13:00	13:10		
ORP (mV)						
value		-238.6	-270.7	-274.8		
time			13:00	13:10		
TDS (ppt)						
value		10	9	8		
time		12:50	13:00	13:10		
Turbidity (ntu)						
value				0.43NTU		
time				1330		
Ferrous Iron (mg/l)						
value				Out of Range due to opacity		
time				1330		
Sulfide (mg/l)						
value				Out of range @ 40x dilution		
time				1330		

COMMENTS: START PUMP @ 12:45 Strong sulfer smell

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D.Browning
Date: 24 october 2017

Well No. 7E6-2

well depth (top PVC)	27.8	27.8	27.8	27.8		
water level(top PVC)	6.4	6.5	6.5	6.5		
water height	21.4	21.3	21.3	21.3		
time	09:30	08:35	8:45	8:55		
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	13.9742					
3 x vol	41.9226					
Purge Volume						
gallons purged		1	2.5	4.		
purge/bail/type		PERISTALTIC				
Water Sample						
Sample No.		~~10:15~~			GW7E6-2	
Sample Method					PERISTALTIC	
Time					9:00-9:15	
No. Cont.					10	
Initials					DB	
pH						
value		10.6/7.88	10.6/7.4	10.54/		
time		8:35	8:45			
Conductivity (S/cm)						
value		8937.7	8816.6	8745.2		
time		8:35	8:45			
Temp. (Celsius)						
value		12.95	13.49	13.37		
time		8:35	8:45			
DO (mg/l)						
value		0.08	0.01	0.00		
time		8:35	8:45			
ORP (mV)						
value		-234.5	-249.4	-250.6		
time		8:35	8:45			
TDS (ppt)						
value		6	6	6		
time		8:35	8:45			
Turbidity (ntu)						
value				0.35 NTU		
time				915		
Ferrous Iron (mg/l)						
value				Out of range due to dark color		
time				915		
Sulfide (mg/l)						
value				22.8 mg/L		
time				9:15		

COMMENTS: START PUMP 08:30; pH SONDE/METER

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Herner
Date: 10-23-17

Well No. 7E9-2

well depth (top PVC)	27.5					
water level(top PVC)	8.82'					
water height	18.68					
time	11:20					
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	12.198					
3 x vol	36.6					
Purge Volume						
gallons purged	1.5 gall	≈ 3gal	4gal	≈ 5gallons		
purge/bail/type						
Water Sample						
Sample No.	GW-7E9-2-102317					
Sample Method	Peristaltic					
Time	12:00					
No. Cont.	10					
Initials	LNL					
pH						
value	~~7.60~~ 7.67	7.77	7.74	7.68		
time	11:35	11:45	11:55	12:00		
Conductivity (S/cm)	↓	↓	↓	↓		
value	5371	4273.3	4323.8	4814.7		
time						
Temp. (Celsius)						
value	14.45	14.21	14.17	14.36		
time						
DO (mg/l)						
value	0.55	2.96	3.32	3.35		
time						
ORP (mV)						
value	-189.8	-163.5	-138.2	-125.1		
time						
TDS (ppt)						
value	3	3	3	3		
time						
Turbidity (ntu)						
value				1.71 NTU		
time				1205		
Ferrous Iron (mg/l)						
value				0.05 mg/L		
time				1205		
Sulfide (mg/l)						
value				1.1 mg/L		
time				1205		

COMMENTS: Dissolved Metals Field filtered w/ 0.45μm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Lherne
Date: 10-25-17

Well No. 7E13-2R

well depth (top PVC)	29.4					
water level(top PVC)	8.80					
water height	20.6					
time	9:45					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163 gal/ft					
tot. vol	3.35 gal					
3 x vol	10.1 gal					
Purge Volume						
gallons purged	2 gallons	3 gal	4.5 gal			
purge/bail/type	Paristaltic					
Water Sample						
Sample No.	GW-7E13-2R-102517					
Sample Method	Paristaltic					
Time	10:15					
No. Cont.	10					
Initials	LNK					
pH						
value	9.64	9.55	9.54			
time	955	10:05	10:15			
Conductivity (S/cm)	↓	↓	↓			
value	3965.2	3975.4	3950.9			
time	955	10:05	10:15			
Temp. (Celsius)						
value	13.71	13.76	13.85			
time	955	10:05	10:15			
DO (mg/l)						
value	0.03	0.02	0.02			
time	9:55	10:05	10:15			
ORP (mV)						
value	-128.5	-130.6	-136.2			
time	9:55	10:05	10:15			
TDS (ppt)						
value	3	3	3			
time	9:55	10:05	10:15			
Turbidity (ntu)						
value			0.93 NTU			
time			1030			
Ferrous Iron (mg/l)						
value			0 mg/L			
time			1030			
Sulfide (mg/l)						
value			11.6 mg/L			
time			1030			

COMMENTS: - Dissolved Metals Field Filtered w/ 0.45 µm
- Brown Color, NO SHEEN

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 24 OCTOBER 2017

Well No. 7E16-2

well depth (top PVC)	19.38	19.38	19.38	19.38	19.38	
water level(top PVC)	3.5	3.6	3.6	3.7	3.7	
water height	15.88	15.78	15.78	15.68	15.68	
time	9:35	9:45	9:55	10:10	10:10	
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.65					
tot. vol	10.3696					
3 x vol	31.1089					
Purge Volume						
gallons purged		1	3.5	6	9	
purge/bail/type						
Water Sample						
Sample No.						GW-7E16-2
Sample Method						PERISTALTIC
Time						10:25-10:40
No. Cont.						10
Initials						DB
pH						
value		10.2/7.06	9.79	9.16	8.66	
time		9:45	9:55	10:10	10:20	
Conductivity (S/cm)						
value		~~10.72~~ 10668.1	4000.5	3028.3	2876.8	
time		9:45	9:55	10:10	10:20	
Temp. (Celsius)						
value		~~10668~~ 15.83	16.38	16.4	16.51	
time		9:45	9:55	10:10	10:20	
DO (mg/l)						
value		0.06	0.04	0.12	0.11	
time		9:45	9:55	10:10	10:20	
ORP (mV)						
value		-133.0	-112.8	-96.9	-91.4	
time		9:45	9:55	10:10	10:20	
TDS (ppt)						
value		7	3	2	2	
time		9:45	9:55	10:10	10:20	
Turbidity (ntu)						
value					3.33 NTU	
time					1030	
Ferrous Iron (mg/l)						
value					3.7 mg/L	
time					1030	
Sulfide (mg/l)						
value					0.02 mg/L	
time					1030	

COMMENTS: START PUMP 9:40; REPLACED TUBING, WELL OPEN TO ELEMENTS WITH NO CAP. WILL DO LONGER PURGE

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-23-17

Well No. 7FI-2

well depth (top PVC)	25.9					
water level(top PVC)	13.49					
water height	12.41					
time	10:10					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163 gal/ft					
tot. vol	2.02 gal					
3 x vol	6.06 gal					
Purge Volume						
gallons purged	1.5 gal	2.5 gal	4 gall			
purge/bail/type						
Water Sample						
Sample No.	GW-7FI-2-102317-(20)					
Sample Method	Paristaltic					
Time	10:45					
No. Cont.	10					
Initials	LNK					
pH						
value	~~7.40~~ 7.95	8.30	8.32			
time	10:25	10:35	10:45			
Conductivity (S/cm)						
value	~~4.0~~ 24,617.7	25,226.7	25,309			
time						
Temp. (Celsius)						
value	14.95	14.85	14.72			
time	10:25	10:35	10:45			
DO (mg/l)						
value	0.27	0.07	0.00			
time	10:25	10:35	10:45			
ORP (mV)						
value	~~0.45.0~~ -118.9	-149.8	-199.0			
time	10:25	10:35	10:45			
TDS (ppt)						
value	~~316.2~~ 15	16	16			
time	10:25	1035	10:45			
Turbidity (ntu)						
value			1.81 NTU			
time			1100			
Ferrous Iron (mg/l)						
value			0.21 mg/L			
time			1100			
Sulfide (mg/l)						
value			8.0 mg/L			
time			1100			

COMMENTS: Dissolved Metals Field Filtered w/ .45 µm field filter.
Amber colored water

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D.BROWNING
Date: 27 OCTOBER 2017

Well No. 7G1-2

well depth (top PVC)	26.2	26.2	26.2	26.2		
water level(top PVC)	12.6	12.7	12.7	12.7		
water height	13.6	13.5	13.5	13.5		
time	9:30	9:40	9:50	10:00		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	2.2168					
3 x vol	6.6504					
Purge Volume						
gallons purged		1	2.5	4		
purge/bail/type			PERISTALTIC			
Water Sample						
Sample No.					GW7G1-2	
Sample Method					PERISTALTIC	
Time					10:00 - 10:15	
No. Cont.					10	
Initials					DB	
pH						
value		6.39	6.41	6.42		
time		9:40	9:50	10:00		
Conductivity (S/cm)						
value		27707	28482	28446		
time		9:40	9:50	10:00		
Temp. (Celsius)						
value		12.77	12.76	12.89		
time		9:40	9:50	10:00		
DO (mg/l)						
value		~~12.77~~ 0.10	0.08	0.07		
time		9:40	9:50	10:00		
ORP (mV)						
value		-43.8	-43.5	-42.6		
time		9:40	9:50	10:00		
TDS (ppt)						
value		18.05	17.53	18.51		
time		9:40	9:50	~~9~~ 10:00		
Turbidity (ntu)						
value				9.23 NTU		
time				1005		
Ferrous Iron (mg/l)						
value				14.2 mg/L		
time				1005		
Sulfide (mg/l)						
value				0.02 mg/L ~~Out of Range due to turbidity~~		
time				1005		

COMMENTS: START PUMP 9:30

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-27-17

Well No. FI3-2

well depth (top PVC)	23.8'					
water level(top PVC)	4.9'					
water height	18.9'					
time	8:15					
Casing/Volume						
type:	1.5"					
type: other	~~.09~~ SCH 40 PVC					
vol/ft	.0918 gal/ft					
tot. vol	1.735 gal					
3 x vol	5.205					
Purge Volume						
gallons purged	1.25 gall	2.5	3.5			
purge/bail/type	Paristaltic					
Water Sample						
Sample No.	GW-FI3-2-102717					
Sample Method	Paristaltic					
Time	850					
No. Cont.	10					
Initials	LNV					
pH						
value	6.69	6.67	6.65			
time	8:25	8:35	8:45			
Conductivity (S/cm)						
value	2,260.9	2248.5	2,245.8			
time						
Temp. (Celsius)						
value	15.39	15.71	15.89			
time						
DO (mg/l)						
value	0.17	0.10	0.08			
time						
ORP (mV)						
value	-19.4	-28.1	-38.9			
time						
TDS (ppt)						
value	1	1	1			
time						
Turbidity (ntu)						
value			7.38 NTU			
time			900			
Ferrous Iron (mg/l)						
value			9.6 mg/L			
time			900			
Sulfide (mg/l)						
value			0.04 mg/L			
time			900			

COMMENTS: * Dissolved Metals Field Filtered 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 27 OCTOBER 2017

Well No. 8F2-2R

well depth (top PVC)	29.1	29.1	29.1	29.1		
water level(top PVC)	8.4	12.0	10.4	10.1		
water height	20.7	17.1	18.7	19		
time	11:45	11:55	12:05	12:15		
Casing/Volume						
type:	2" PVC					
type: other	sch 40 PVC					
vol/ft	0.163					
tot. vol	3.374					
3 x vol	10.1223					
Purge Volume						
gallons purged		1.25	2	2.75		
purge/bail/type						
Water Sample						
Sample No.					GW-8F2-2(R)	
Sample Method					PERISTALTIC	
Time					12:15 - 12:35	
No. Cont.					10	
Initials					DB	
pH						
value		10.81	10.85	10.86		
time		11:55	12:05	12:15		
Conductivity (S/cm)						
value		30664	33238	33001		
time		11:55	12:05	12:15		
Temp. (Celsius)						
value		13.99	14.43	14.35		
time		11:55	12:05	12:15		
DO (mg/l)						
value		0.01	0.60	0.01		
time		11:55	12:05	12:15		
ORP (mV)						
value		-421.1	-429.1	-432.8		
time		11:55	12:05	12:15		
TDS (ppt)						
value		20.09	20.18	21.44		
time		11:55	12:05	12:15		
Turbidity (ntu)						
value				Opaque - No reading		
time				1230		
Ferrous Iron (mg/l)						
value				0 mg/L		
time				1230		
Sulfide (mg/l)						
value				Out of range at 40x dilution		
time				1230		

COMMENTS: START PUMP 11:45

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Luke Kerner
Date: 10 ·27·17

Well No. 8G3-2

well depth (top PVC)	27.8					
water level(top PVC)	7.5					
water height	20.3					
time	~~11:19~~ 11:25					
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653 gal/ft					
tot. vol	13.26					
3 x vol	39.77					
Purge Volume						
gallons purged	1.5 gallons	3 gallons	4.5 gallons			
purge/bail/type						
Water Sample						
Sample No.	GW-8G3-2-102717					
Sample Method	Paristaltic					
Time						
No. Cont.	10					
Initials	LNK					
pH						
value	9.30	9.13	9.11			
time	11:35	11:45	11:55			
Conductivity (S/cm)						
value	28264.9	28,516.2	28428.4			
time						
Temp. (Celsius)						
value	13.59	13.24	13.26			
time						
DO (mg/l)						
value	0.80	0.13	0.06			
time						
ORP (mV)						
value	-189.1	-203.4	-219.7 -~~219.7~~			
time						
TDS (ppt)						
value	18	19	19			
time						
Turbidity (ntu)						
value			1.24 NTU			
time			1200			
Ferrous Iron (mg/l)						
value			0.0mg/L			
time			1200			
Sulfide (mg/l)						
value			0.4mg/L			
time			1200			

COMMENTS:

* Dissolved Metals/Solids / Alkalinity Field Filtered 0.45μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 24 OCTOBER 2017

Well No. 6D25-2

well depth (top PVC)	28.7'	28.7	28.7	28.7		
water level(top PVC)	7.5	9.4	9.9	10		
water height	21.2	19.3	18.8	18.7		
time	14:15	14:25	14:35	14:45		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	3.4556					
3 x vol	10.3668					
Purge Volume						
gallons purged		1.5	2.5	3.5		
purge/bail/type		~~14~~ PERISTALTIC				
Water Sample						
Sample No.					GW6D25-2	
Sample Method					PERISTALTIC	
Time					14:45-15:10	
No. Cont.					10	
Initials					DB	
pH						
value		9.6	9.63	9.66		
time		14:25	14:35	17:45		
Conductivity (S/cm)						
value		4767.6	4735.0	4934.1		
time		14:25	14:35	14:45		
Temp. (Celsius)						
value		15.24	15.12	15.03		
time		14:25	14:35	14:45		
DO (mg/l)						
value		0.06	0.04	0.04		
time		14:25	14:35	14:45		
ORP (mV)						
value		-168.7	-151.6	-154.6		
time		14:25	14:35	14:45		
TDS (ppt)						
value		3.09	3.1	3.22		
time		14:25	14135	14:45		
Turbidity (ntu)						
value				7.13 NTU		
time				1500		
Ferrous Iron (mg/l)						
value				0.7 mg/L		
time				1500		
Sulfide (mg/l)						
value				24.4 mg/L		
time				1500		

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: Jhema
Date: 10-31-17

Well No. 120+75-2

well depth (top PVC)	~~19.0'~~ 21.3'					
water level(top PVC)	5.6'					
water height	15.7					
time	12:40					
Casing/Volume						
type:	2"					
type: other	SS					
vol/ft	0.163 gal/ft					
tot. vol	2.55					
3 x vol	7.67					
Purge Volume						
gallons purged	1 gallon	1.75 gallons	2.25 gall ≈ 2.5			
purge/bail/type						
Water Sample						
Sample No.	GW-120+75-2-103117					
Sample Method						
Time						
No. Cont.						
Initials						
pH						
value	6.94	6.90	6.88			
time	12:50	1300	1310			
Conductivity (S/cm)						
value	32,299.3	32,825.9	33,082.7			
time						
Temp. (Celsius)						
value	15.05	15.03	15.12			
time						
DO (mg/l)						
value	0.10	0.06	0.05			
time						
ORP (mV)						
value	-136.5	-138.9	-145.6			
time						
TDS (ppt)						
value	21	21	22			
time						
Turbidity (ntu)						
value			5.19 NTU			
time			1350			
Ferrous Iron (mg/l)						
value			0.83 mg/L			
time			1350			
Sulfide (mg/l)						
value			0.1 mg/L			
time			1350			

COMMENTS: * Dissolved Metals/Solids Field Filtered 0.45μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D BROWN NG
Date: 30 OCTOBER 2017

Well No. 121+80-2

well depth (top PVC)	21.5	21.5	21.5	21.5		
water level(top PVC)	11.0	11.7	11.7	10.9		
water height	10.5	9.8	9.8	10.6		
time	15:00	15:35	15:45	15:55		
Casing/Volume						
type:	2"					
type: other	STEEL, STAINLESS					
vol/ft	0.1653					
tot. vol	1.7					
3 x vol	5.1					
Purge Volume						
gallons purged		0.5	1.0	1.5		
purge/bail/type						
Water Sample						
Sample No.					121+80-2	~~15:55-16:20~~
Sample Method						PERISTALTIC
Time						15:55-16:20
No. Cont.						14
Initials						DB
pH						
value		8.97	8.63	8.9		
time						
Conductivity (S/cm)						
value		14884	14764	14752		
time						
Temp. (Celsius)						
value		15.44	15.49	15.47		
time						
DO (mg/l)						
value		0.00	0.00	0.00		
time						
ORP (mV)						
value		-322.3	-132.6	-334		
time						
TDS (ppt)						
value		9.66	9.62	9.59		
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: START PUMP 15:30, HAD TO CLEAR TUBE, TAN GELATINOUS MATERIAL COATED LAST 10-12 FT OF WELL TUBE

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: F BROONING
Date: 30 OCTOBER 2017

Well No. 122+60 - 2

well depth (top PVC)	22.9	22.9	22.9	~~19~~22.9		
water level(top PVC)	7.7	11.7	15.4	20.9		
water height	15.2	11.2	7.5	2 -		
time	14:05	14:15	14:25	14:35		
Casing/Volume						
type:	2"					
type: other	SCH 40 PV					
vol/ft	0.163					
tot. vol	2.4770					
3 x vol	7.4328					
Purge Volume						
gallons purged		~~2~~ 1.5	~~3.5~~ 2	~~3.5~~ 2.5		
purge/bail/type						
Water Sample						
Sample No.					NON FILTERED	Filtered-Field
Sample Method					&	Collected
Time					As Species	on 11/02/2017
No. Cont.					Collected	@B120
Initials					On 10/30	
pH						
value		8.32	8.32	DRY		
time		14:15	14:25			
Conductivity (S/cm)						
value		30491	30506			
time		14:15	14:25			
Temp. (Celsius)						
value		15.17	15.3			
time		14:15	14:25			
DO (mg/l)						
value		0.73	0.70			
time		14:15	14:25			
ORP (mV)						
value		-137.2	-100.8			
time		14:15	14:25			
TDS (ppt)						
value		19.32	19.82			
time		14:15	14:25			
Turbidity (ntu)						
value			2.71 NTU			
time			1330			
Ferrous Iron (mg/l)						
value			0.12 mg/L			
time			1330			
Sulfide (mg/l)						
value			0.06 mg/L			
time			1330			

COMMENTS: START PUMP: 14:05 DRY
TURNED PUMP RATE DOWN @ 14:15 & Again at 14:25
REBOUNDED TO 19.3 BY 15:00; WATER LEVEL PRIOR TO COLLECTION ON 11/02/17 WAS 12.9'

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date: 10-30-2017

Well No. 124+00-2

well depth (top PVC)	19.5					
water level(top PVC)	2.99					
water height	16.51					
time	1355					
Casing/Volume						
type:	2"					
type: other	SS Casing					
vol/ft	0.163 gal/ft					
tot. vol	2.69 gallons					
3 x vol	8.07 gallons					
Purge Volume						
gallons purged	1 gallon	2 gallon	3 gallon			
purge/bail/type	Paristaltic					
Water Sample						
Sample No.	GW-124+00-2- 103017					
Sample Method	Paristaltic					
Time	1430					
No. Cont.	14					
Initials	LVK					
pH						
value	8.29	8.37	8.39			
time	1405	1415	1425			
Conductivity (S/cm)						
value	25,844.2	25,972	25,947.4			
time						
Temp. (Celsius)						
value	14.80	14.49	14.64			
time						
DO (mg/l)						
value	0.08	0.01	0.00			
time						
ORP (mV)						
value	-182.2	-211.[illegible]	-224.8			
time						
TDS (ppt)						
value	17	17	17			
time						
Turbidity (ntu)						
value			0.37 NTU			
time			1435			
Ferrous Iron (mg/l)						
value			0.4 mg/L			
time			1435			
Sulfide (mg/l)						
value			Out of range due to color			
time			1435			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D BROWNING
Date: 30 OCTOBER 2017

Well No. 125+50 -2

well depth (top PVC)	22.1	22.1	22.1	22.1		
water level(top PVC)	3.7	3.6	3.6	3.6		
water height	18.4	18.5	18.5	18.5		
time	12:55	13:05	13:15	13:25		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	2.9992					
3 x vol	8.9976					
Purge Volume						
gallons purged		0.5	1.5	2.5		
purge/bail/type						
Water Sample						
Sample No.					GW125+50-2	
Sample Method					PERISTALTIC	
Time					13:25-13:50	
No. Cont.					14	
Initials					DB	
pH						
value		7.20	7.19	7.19		
time						
Conductivity (S/cm)						
value		35734	35776	35717		
time						
Temp. (Celsius)						
value		15.41	15.48	15.50		
time						
DO (mg/l)						
value		0.09	0.07	0.06		
time						
ORP (mV)						
value		-178.4	-164.	-187.2		
time						
TDS (ppt)						
value		23.28	22.6	23.2		
time						
Turbidity (ntu)						
value				3.47 NTU		
time				1400		
Ferrous Iron (mg/l)						
value				2.7 mg/L		
time				1400		
Sulfide (mg/l)						
value				0.05 mg/L		
time				1400		

COMMENTS:

START PUMP 12:55

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 10-30-2017

Well No. 126+90-2

well depth (top PVC)	.25.1'					
water level(top PVC)	3.61'					
water height	21.49					
time	12:52					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163 gal/ft					
tot. vol	3.5					
3 x vol	10.5					
Purge Volume						
gallons purged	1 gallon	2 gallon	3 gallon			
purge/bail/type	Paristaltic →					
Water Sample						
Sample No.	GW-126+90-2-103017					
Sample Method	Paristaltic					
Time	1300					
No. Cont.	14					
Initials	LNK					
pH						
value	7.39	7.38	7.38			
time	1302	1312	1322			
Conductivity (S/cm)						
value µS/cm	29,231	29,243.7	29,263.7			
time						
Temp. (Celsius)						
value	15.33	15.39	15.41			
time						
DO (mg/l)						
value	0.11	0.07	0.07			
time						
ORP (mV)						
value	-156.2	-156.7	-156.6			
time						
TDS (ppt)						
value	19	19				
time						
Turbidity (ntu)						
value			0.75 NTU			
time			1310			
Ferrous Iron (mg/l)						
value			0.27 mg/L			
time			1310			
Sulfide (mg/l)						
value			0.23 mg/L			
time			1310			

COMMENTS:
* Dissolved Metals/Solids Field Filtered 0.45 µm.
* Start Pumping @ 12:52

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 128+30-2 30 OCTOBER 2017

Well No. 128+30-2

well depth (top PVC)	19.4	19.4	19.4	14.4		
water level(top PVC)	6.6	6.6	6.6	6.6		
water height	12.8	12.8	12.8	12.8		
time	11:20	11:30	11:40	11:50		
Casing/Volume						
type:	2" P					
type: other	PVC SCH 40					
vol/ft	0.163					
tot. vol	2.0864					
3 x vol	6.2592					
Purge Volume						
gallons purged		0.5	1.5			
purge/bail/type						
Water Sample						
Sample No.						
Sample Method						
Time						
No. Cont.						
Initials						
pH						
value		8.31	8.3	8.29		
time		11:30	11:40			
Conductivity (S/cm)						
value		17817	17885	17 030		
time		11:30	11:40			
Temp. (Celsius)						
value		14.66	14.71	14.57		
time		11:30	11:40			
DO (mg/l)						
value		0.08	0.04	0.04		
time		11:30	11:40			
ORP (mV)						
value		-100.0	-303.8	-309.4		
time		11:30	11:40			
TDS (ppt)						
value		11.61	11.62	11.58		
time		11:30	11:40			
Turbidity (ntu)						
value				0.87 NTU		
time				1205		
Ferrous Iron (mg/l)						
value				0.05 mg/L		
time				1205		
Sulfide (mg/l)						
value				6.9 mg/L		
time				1205		

COMMENTS: START PUMP @ 11:20

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerrn
Date: 10-30-17

Well No. 129+65-2

well depth (top PVC)	~~18.0'~~	21.1'				
water level(top PVC)		7.67				
water height		13.43				
time		~~11:15~~ 11:17				
Casing/Volume						
type:		2"				
type: other		SCH 40 PVC				
vol/ft		0.163				
tot. vol		2.19 gall				
3 x vol		6.57 gall				
Purge Volume						
gallons purged		~~Paris~~ 0.75	1.5	2.25 gall		
purge/bail/type		Paristaltic →				
Water Sample						
Sample No.		GW-129+65-2-103017				
Sample Method		Paristaltic				
Time		1150				
No. Cont.		14				
Initials		LNK				
pH						
value	Begin Pumping	7.25	7.23	7.12		
time	11:18	11:28	11:38	11:48		
Conductivity (S/cm)						
value µS/cm		22,020.4	21,791.6	22,541.0		
time		~~11:58~~ LK				
Temp. (Celsius)						
value		15.23	15.07	14.99		
time						
DO (mg/l)						
value		0.07	0.02	0.02		
time						
ORP (mV)						
value		-298.2	-309.4	-327.3		
time						
TDS (ppt)						
value		14	14	15		
time						
Turbidity (ntu)						
value				1.45 NTU		
time				1200		
Ferrous Iron (mg/l)						
value				0.05 mg/L		
time				1200		
Sulfide (mg/l)						
value				22 mg/L		
time				1200		

COMMENTS: * Dissolved Metals/Solids Field Filtered 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 10-27-17

Well No. ~~AW-A2-2~~ 131+00-2

well depth (top PVC)	22.8	23.6'				
water level(top PVC)		5.69'				
water height		17.91				
time		12:45				
Casing/Volume						
type:		2"				
type: other		SCH 40 PVC				
vol/ft		0.163				
tot. vol		2.92				
3 x vol		8.76				
Purge Volume						
gallons purged		1 gallon	2-gallon	3-gallon		
purge/bail/type						
Water Sample						
Sample No.		GW-131+00-2-102717				
Sample Method		Paristaltic				
Time		1300				
No. Cont.		~~10~~ 14				
Initials		JNL				
pH						
value		8.25	8.31	8.31		
time		1255	1305	1315		
Conductivity (S/cm)		↓	↓	↓		
value		15,775	17,864.3	12,806.2		
time						
Temp. (Celsius)						
value		14.27	~~-0.15~~ 14.49	14.67		
time						
DO (mg/l)						
value		0.16	~~-136.3~~ 0.16	0.23		
time						
ORP (mV)						
value		-151.5	-135.0	-119.2		
time						
TDS (ppt)						
value		10	8	8		
time						
Turbidity (ntu)						
value				15.1 NTV		
time				1330		
Ferrous Iron (mg/l)						
value				0.77 mg/L		
time				1330		
Sulfide (mg/l)						
value				0.8 mg/L		
time				1330		

COMMENTS: *Dissolved Metals Field Filtered 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: ~~D Browning~~ L.hmy
Date: 3 NOV 2017

Well No. K1-3

well depth (top PVC)	54.6					
water level(top PVC)	9.4					
water height						
time						
Casing/Volume						
type:	1.25"					
type: other	SCH80 PVC					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1.5	2.5	3.5			
purge/bail/type	Peristaltic					
Water Sample						
Sample No.	GW-K1-3-110317					
Sample Method	Peristaltic					
Time	1140					
No. Cont.	10					
Initials	LNK					
pH						
value	7.85	7.81	7.78			
time	1055	1105	1115			
Conductivity (S/cm)						
value	2,947.3	3,096.2	3,229.6			
time						
Temp. (Celsius)						
value	12.27	12.30	12.37			
time						
DO (mg/l)						
value	0.11	0.08	0.07			
time						
ORP (mV)						
value	-147.0	-142.9	-139.9			
time						
TDS (ppt)						
value	2	2	2			
time						
Turbidity (ntu)						
value			3.8 NTU			
time			1200			
Ferrous Iron (mg/l)						
value			0.89 mg/L			
time			1200			
Sulfide (mg/l)						
value			0.00 mg/L			
time			1200			

COMMENTS: *Begin Pumping @ 1045

*Dissolved Metals/Solids Field Filtered 0.45 µm

*Clogged Casing @ 20.1' and 8' (?)

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.652 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kern
Date: 11-02-2017

Well No. 3A1-3R

well depth (top PVC)	55.4					
water level(top PVC)	14.82					
water height	40.58					
time	10:07					
Casing/Volume						
type:	2"					
type: other	SCH40 PVC					
vol/ft	0.163 gal/ft					
tot. vol	6.615 gal					
3 x vol	19.84 gal					
Purge Volume						
gallons purged	1 gal	2 gal	3 gal			
purge/bail/type	Paristaltic →	→	→			
Water Sample						
Sample No.	GW-3A1-3R-110217					
Sample Method	Paristaltic					
Time	1040					
No. Cont.	14					
Initials	LNK					
pH						
value	7.80	7.79	7.77			
time	10:17 ↓	10:27 ↓	10:37 ↓			
Conductivity (S/cm)						
value µS/cm	3125	3122.9	3132.2			
time						
Temp. (Celsius)						
value	13.22	13.08	13.04			
time						
DO (mg/l)						
value	0.07	0.05	0.04			
time						
ORP (mV)						
value	-129.3	-120.4	-117.5			
time						
TDS (ppt)						
value	2	2	2			
time						
Turbidity (ntu)						
value			1.81 NTU			
time			1045			
Ferrous Iron (mg/l)						
value			0.53 mg/L			
time			1045			
Sulfide (mg/l)						
value			0.03 mg/L			
time			1045			

COMMENTS: * Begin Pumping @ 10:07
* Dissolved Metals/Solids field filtered 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 2 NOV 2017

Well No. ~~4B1-3~~ 4B1-3

well depth (top PVC)	54.2	54.2	54.2	54.2		
water level(top PVC)	12.4	12.7	12.8	12.8		
water height	41.8	41.5	41.4	41.4		
time	10:05	10:15	10:25	10:35		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol						
3 x vol						
Purge Volume						
gallons purged		1.75	3.25	4.25		
purge/bail/type						
Water Sample						
Sample No.					GW4B1-3-110217	
Sample Method					PERISTALTIC	
Time					10:35 - 10:50	
No. Cont.					10	
Initials					DB	
pH						
value		6.81	6.76	6.84		
time		10:15	10:25	10:35		
Conductivity (S/cm)						
value		18383	15183	13454		
time		10:15	10:25	10:35		
Temp. (Celsius)						
value		13.67	13.80	13.77		
time		10:15	10:25	10:35		
DO (mg/l)						
value		0.81	0.11	0.07		
time		10:15	10:25	10:35		
ORP (mV)						
value		-81.2	-94	-100.6		
time		10:15	10:25	10:35		
TDS (ppt)						
value		11.81	9.79	8.68		
time		10:15	10:25	10:35		
Turbidity (ntu)						
value				2.05 NTU		
time				1030		
Ferrous Iron (mg/l)						
value				4.1 mg/L		
time				1030		
Sulfide (mg/l)						
value				0.03 mg/L		
time				1030		

COMMENTS: START PUMP 10:05

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Kerner
Date:

Well No. 4B2-3

well depth (top PVC)	48.6					
water level(top PVC)	13.07					
water height	35.53					
time	9:03					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163 gal/ft					
tot. vol	5.79 gal					
3 x vol	17.37 gal					
Purge Volume						
gallons purged		2.25 gal	3.5 gal			
purge/bail/type	Paristaltic					
Water Sample						
Sample No.	GW-4B2-3-110217					
Sample Method	Paristaltic					
Time	0940					
No. Cont.	14					
Initials	LNK					
pH						
value	6.91	6.98	7.01			
time	9:15	9:25	9:35			
Conductivity (S/cm)						
value µS/cm	57,599.4	49,140	45,736.5			
time						
Temp. (Celsius)						
value	13.95	13.77	13.91			
time						
DO (mg/l)						
value	0.08	0.06	0.05			
time						
ORP (mV)						
value	-196.7	-200.7	-209.7			
time						
TDS (ppt)						
value	39	32	30			
time						
Turbidity (ntu)						
value			1.04 NTU			
time			945			
Ferrous Iron (mg/l)						
value			0.00 mg/L			
time			945			
Sulfide (mg/l)						
value			1 mg/L			
time			945			

COMMENTS: * Begin purging @ 9:04 am
* Dissolved metals/Solids Field Filtered 0.45 um

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 2 NOVEMBER 2017

Well No. 5BI-3R

well depth (top PVC)	47.4	47.4	47.4	47.4		
water level(top PVC)	12.6	13.4	13.8	13.9		
water height	34.8	34	33.6	33.5		
time	08:50	9:00	9:10	9:25		
Casing/Volume						
type:	2"	1.5	2.5			
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	5.6724					
3 x vol	17.0172					
Purge Volume						
gallons purged		1.5	2.5	4.5		
purge/bail/type						
Water Sample						
Sample No.					GWSBI-3R-110217	
Sample Method					PERISTALTIC	
Time					9:25-9:45	
No. Cont.					13	
Initials					DB	
pH						
value		7.39	7.43	7.44		
time		9:00	9:10	9:25		
Conductivity (S/cm)						
value		3113.8	3119.3	3112.7		
time		9:00	9:10	9:25		
Temp. (Celsius)						
value		13.58	13.54	13.39		
time		9:00	9:10	9:25		
DO (mg/l)						
value		0.10	0.07	0.05		
time		9:00	9:10	9:25		
ORP (mV)			92.6			
value		-93.5	-92.6	-56.1		
time		9:00	9:10	9:25		
TDS (ppt)						
value		2.03	2.03	2.03		
time		9:00	9:10	9:25		
Turbidity (ntu)						
value				1.97 NTU		
time				930		
Ferrous Iron (mg/l)						
value				0.32 mg/L		
time				930		
Sulfide (mg/l)						
value				0.02 mg/L		
time				930		

COMMENTS: PUMP START 8:50

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 11-01-17

Well No. 5D1-3

well depth (top PVC)	48.3					
water level(top PVC)	10.15					
water height	38.15					
time	1430					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163 gal/ft					
tot. vol	6.22 gallons					
3 x vol	18.66 gallons					
Purge Volume						
gallons purged	1.5 gal	2.5 gal	3.5 gal			
purge/bail/type	Paristaltic					
Water Sample						
Sample No.	GW-5D1-3-110117					
Sample Method	Paristaltic					
Time	1500					
No. Cont.	10					
Initials	LNK					
pH						
value	6.96	6.78	6.71			
time	1440	1950	1500			
Conductivity (S/cm) µS/cm						
value	24,433.5	24,849.3	24,944.8			
time						
Temp. (Celsius)						
value	15.45	14.76	14.64			
time						
DO (mg/l)						
value	0.77	0.24	0.10			
time						
ORP (mV)						
value	-100.9	-104.7	~~-109.73~~ -109.7			
time						
TDS (ppt)						
value	16	16	16			
time						
Turbidity (ntu)						
value			34.1 NTU			
time			1450			
Ferrous Iron (mg/l)						
value			6.0 mg/L			
time			1450			
Sulfide (mg/l)						
value			0.03 mg/L			
time			1450			

COMMENTS: - Begin Pumping @ 1430

+ Dissolved Metals/Solids FIELD FILTERED

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Herner
Date: 11-1-2017

Well No. 5G1-3

well depth (top PVC)	54'					
water level(top PVC)	10.0'					
water height	44'					
time	8:45					
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	7.172					
3 x vol	21.5					
Purge Volume						
gallons purged	1.5	2.75				
purge/bail/type						
Water Sample						
Sample No.	GW-5G1-3-~~107~~ 110117					
Sample Method	Peristaltic					
Time	9:20					
No. Cont.	10					
Initials	LNK					
pH						
value	6.66	6.71	6.73			
time	9:00	9:10	9:20			
Conductivity (S/cm)	↓	↓	↓			
value µS/cm	12,177	10,858	10,303.5			
time						
Temp. (Celsius)						
value	13.10	13.13	13.14			
time						
DO (mg/l)						
value	0.12	0.08	0.06			
time						
ORP (mV)						
value	-128.5	-139	-149.8			
time						
TDS (ppt)						
value	8	7	7			
time						
Turbidity (ntu)						
value			2.38 NTU			
time			930			
Ferrous Iron (mg/l)						
value			0.09 mg/L			
time			930			
Sulfide (mg/l)						
value			0.69 mg/L			
time			930			

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 1 NOVEMBER 2017

Well No. 6E7-3

well depth (top PVC)	57.5	57.5	57.5	57.5		
water level(top PVC)	12.9	15.1	15.5	18.1		
water height			42	39.4		
time	14:35	14:45	14:55	15:05		
Casing/Volume						
type:	4"					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol						
3 x vol						
Purge Volume						
gallons purged		1.5	3	4.5		
purge/bail/type						
Water Sample						
Sample No.					GW 6E7-3	
Sample Method					PERISTALTIC	
Time					15:10-15:30	
No. Cont.					10	
Initials					DB	
pH						
value		7.87	~~8~~ 7.64	7.65		
time		14:45	14:55	15:05		
Conductivity (S/cm)						
value		3872.4	3839.4	3826.7		
time		14:45	14:55	15:05		
Temp. (Celsius)						
value		14.69	14.60	14.90		
time		14:45	14:55	15:05		
DO. (mg/l)						
value		0.45	0.09	0.10		
time		14:45	14:55	15:05		
ORP (mV)						
value		-127.0	-134.5	-126.0		
time		14:45	14:55	15:05		
TDS (ppt)						
value		2.47	2.04	~~20~~ 2.49		
time		14:45	14:55	15:05		
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: START PUMP 14:35. NO TUBING IN WELL

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: J Kerner
Date: 110217

Well No. 6E8-3

well depth (top PVC)	59'					
water level(top PVC)	10.82					
water height						
time						
Casing/Volume						
type:	1.5"					
type: other	SCH 80 PVC					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1.25	2.5	3.75			
purge/bail/type	Peristaltic					
Water Sample						
Sample No.	GW-6E8-3-110217					
Sample Method	Peristaltic					
Time	130					
No. Cont.	10					
Initials	JNK					
pH						
value	7.96	7.93	7.92			
time	1253	1303	1313			
Conductivity (S/cm)						
value	2056.4	2045.7	2046			
time µS/cm						
Temp. (Celsius)						
value	12.67	12.78	12.87			
time						
DO (mg/l)						
value	0.15	0.12	0.11			
time						
ORP (mV)						
value	-90.5	-75.7	-72.9			
time						
TDS (ppt)						
value	1	1	1			
time						
Turbidity (ntu)						
value			1.33 NTU			
time			1320			
Ferrous Iron (mg/l)						
value			0.15 mg/L			
time			1320			
Sulfide (mg/l)						
value			0.01 mg/L			
time			1320			

COMMENTS:

*12:43 Start Pumping

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 1 NOVEMBER 2017

Well No. 6G2-3

well depth (top PVC)	~~56.1~~ 57.5	57.5				
water level(top PVC)	IND					
water height						
time	09:00	9:10	9:20	9:31		
Casing/Volume						
type:	1 1/4" PVC					
type: other	SCH 80 PVC					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged		0.75	1.75	2.75		
purge/bail/type						
Water Sample						
Sample No.					GW6G2-3	
Sample Method					PERISTALTIC	
Time					09:30-09:50	
No. Cont.					~~10~~ 13	MSD
Initials					DB	
pH						
value	7.75	→	7.08	7.09		
time						
Conductivity (S/cm)						
value	2644.5	→	2616.3	2581.1		
time						
Temp. (Celsius)						
value	13.63	→	13.94	13.94		
time						
DO (mg/l)						
value	0.10	→	0.02	0.0 0.02		
time						
ORP (mV)						
value	0.09	→	-102.3	-100.9		
time						
TDS (ppt)						
value	1.72	→	1.35	1.68		
time						
Turbidity (ntu)						
value				0.76 NTU		
time				940		
Ferrous Iron (mg/l)						
value				0.11 mg/L		
time				940		
Sulfide (mg/l)						
value				0.03 mg/L		
time				940		

COMMENTS: WELL HAS BEEN HIT BY VEHICLE & BENT FROM GROUND SURFACE RADIUS OF BEND TO ACUTE TO ALLOW DIPPER TO PASS FOR WATER LEVEL READING. START PUMP 09:00. PULLED TUBING AFTER SAMPLE COLLECTION & WATER LEVEL WAS ≈ 10 FT FROM WELL HEIGHT

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D BROWNING
Date: 2 NOV 2017

Well No. 7E5-3

well depth (top PVC)	59.5	59.5	59.5	59.5		
water level(top PVC)	11.6	11.9	11.8	11.0		
water height	47.9	47.6	47.7	48.5		
time	12:45	12:55	13:05	13:15		
Casing/Volume						
type:	1.5					
type: other	SCH 80 PVC					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged		1.5	3	5		
purge/bail/type						
Water Sample						
Sample No.					GW 7E5-3-110217	
Sample Method					PERISTALTIC	
Time					13:15-13:35	
No. Cont.					10	
Initials					DB	
pH						
value		7.97		7.82		
time		12:55		13:15		
Conductivity (S/cm)						
value		1138.5		1136.7 ~~1137.6~~		
time		12:55		13:15		
Temp. (Celsius)						
value		13.80		12.81		
time		12:55		13:15		
DO (mg/l)						
value		0.07		0.06		
time		12:55		13:35		
ORP (mV)						
value		-46.1		-57.4		
time		12:55		13:15		
TDS (ppt)						
value		0.74		0.06		
time		12:56		13:15		
Turbidity (ntu)						
value				0.72 NTU		
time				1330		
Ferrous Iron (mg/l)						
value				0.08 mg/L		
time				1330		
Sulfide (mg/l)						
value				0.02 mg/L		
time				1330		

COMMENTS: START PUMP 12:45

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 3 NOV 2017

Well No. 122+60-3

well depth (top PVC)	46.7	46.7	46.7	46.7		
water level(top PVC)	7.9	9.6	9.8	9.8		
water height	38.9	37.1	36.5	36.9		
time	9:35	9:45	9:55	10:05		
Casing/Volume						
type:	2"					
type: other	SS					
vol/ft	0.163					
tot. vol	6.3407					
3 x vol	19.0221					
Purge Volume						
gallons purged		0.75	1.75	2.75		
purge/bail/type						
Water Sample						
Sample No.					GW-122+60-3	
Sample Method					PERISTALTIC	
Time					10:05-10:25	
No. Cont.					14	
Initials					DB	
pH						
value		8.11	7.72	7.64		
time		9:45	9:55	10:05		
Conductivity (S/cm)						
value		5235.9	5153.0	5196.5		
time		9:45	9:55	10:05		
Temp. (Celsius)						
value		11.69	12.78	12.86		
time		9:45	9:55	10:05		
DO (mg/l)						
value		0.69	0.47	0.09		
time		9:45	9:55	10:05		
ORP (mV)						
value		-65.6	-88.8	-95.4		
time		~~3.35~~	9:55	10:05		
TDS (ppt)						
value		3.35	3.36	3.38		
time		9:45	9:55	10:05		
Turbidity (ntu)						
value				25 NTU		
time				1030		
Ferrous Iron (mg/l)						
value				0.33 mg/L		
time				1030		
Sulfide (mg/l)						
value				0.00		
time				mg/L		

COMMENTS: START PUMP 9:35

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 3 NOV 2017

Well No. 124+00-3

well depth (top PVC)	47.6	47.6	47.8	47.8		
water level(top PVC)	8.8	11.2	10.8	10.7		
water height	38.8	36.4	36.0	36.9		
time	10:45	10:55	11:05	1115		
Casing/Volume						
type:	2"					
type: other	SS					
vol/ft	0.163					
tot. vol	6.3244					
3 x vol	18.9732					
Purge Volume						
gallons purged		1.5	2	2.5		
purge/bail/type						
Water Sample						
Sample No.					GW 124+00-3	
Sample Method					PERISTALTIC	
Time					11:15-11:45	
No. Cont.					14	
Initials					DB	
pH						
value		7.51	7.47	7.47		
time		10:55	11:05	1115		
Conductivity (S/cm)						
value		1962.1	1983.0	1982.2		
time		10:55	11:05	11:15		
Temp. (Celsius)						
value		12.07	11.76	11.81		
time		10:55	11:05	11:15		
DO (mg/l)						
value		0.15	0.08	0.07		
time		10:55	11.05	11:15		
ORP (mV)						
value		-114.2	-104.0	-104.8		
time		10:55	11.05	11:15		
TDS (ppt)						
value		1.28	1.29	1.29		
time		10:55	11.05	11:15		
Turbidity (ntu)						
value				19.7 NTU		
time				1120		
Ferrous Iron (mg/l)						
value				3.3 mg/L		
time				1120		
Sulfide (mg/l)						
value				0.11 mg/L		
time				1120		

COMMENTS:

START PUMP 10:45

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D. BROWNING
Date: 3 NOV 2017

Well No. 125+50 -3

well depth (top PVC)	43.8	43.8	43.8	43.8		
water level(top PVC)	8.4	9.9	8.9	8.4		
water height	35.4	32.9	33.9	4335.4		
time	12:15	12:30	12:40	12:50		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	5.7702					
3 x vol	17.3106					
Purge Volume						
gallons purged		2.5	3.5	4.5		
purge/bail/type						
Water Sample						
Sample No.					GW 125+50-3	
Sample Method					PERISTALTIC	
Time					12:50-13:25	
No. Cont.					14	
Initials					DB	
pH						
value		6.98	7.05	7.08		
time		12:30	12:40	12:50		
Conductivity (S/cm)						
value		2616.4	2608.4	2642.8		
time		12:30	12:40	12:50		
Temp. (Celsius)						
value		12.21	12.03	11.75		
time		12:30	12:40	12:50		
DO (mg/l)						
value		~~1.7~~ 0.10	0.06	0.06		
time		12:30	12:40	12:50		
ORP (mV)						
value		-53.6	-52.7	-55.2		
time		12:30	12:40	12:50		
TDS (ppt)						
value		1.7	1.7	1.72		
time		12:30	12:40	12:50		
Turbidity (ntu)						
value				7.54 NTU		
time				1300		
Ferrous Iron (mg/l)						
value				1.16 mg/L		
time				13.00		
Sulfide (mg/l)						
value				0.06 mg/L		
time				1300		

COMMENTS: START PUMP 12:15, HAD TO PULL & CLEAR TUBE IN WELL. SILT @ BOTTOM OF WELL

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D.BROWNING
Date:

Well No. 126+90-3

well depth (top PVC)	43.7	43.7	43.7	43.7		
water level(top PVC)	5.9	6.5	6.1	6		
water height	37.8	37.2	37.6	37.7		
time	12:00	12:10	12:20	12:30		
Casing/Volume						
type:	2"					
type: other	SCH 40 PVC					
vol/ft	0.163					
tot. vol	6.1614					
3 x vol	18.48412					
Purge Volume						
gallons purged		2	4	6		
purge/bail/type						
Water Sample						
Sample No.					126+90 -3	DUP
Sample Method					PERISTALTIC	
Time					12:30-13:20 →	
No. Cont.					14	14
Initials					DB	DB
pH						
value		8.17	8.11	8.09		
time		12:10		12:30		
Conductivity (S/cm)						
value		1667.0	1661.5	1646.1		
time		12:10	12:20	12:30		
Temp. (Celsius)						
value		13.4	13.46	13.44		
time		12:10	12:20	12:30		
DO (mg/l)						
value		0.07	0.06	0.05		
time		12:10	12:20	12:30		
ORP (mV)						
value		-164.7	-154.6	+151.4		
time		12:10	12:20	12:30		
TDS (ppt)						
value		1.08	1.08	1.07		
time		12:10	12:20	12:30		
Turbidity (ntu)						
value				11.7 NTU		
time				1300		
Ferrous Iron (mg/l)						
value				0.23mg/L		
time				1300		
Sulfide (mg/l)						
value				0.11 mg/L		
time				1300		

COMMENTS:

AT INITIAL PUMP, WATER CAME UP SILTY. STOPPED AFTER ~2MIN. START PUMP 12:00

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 11-3-17

Well No. 128+30-3

well depth (top PVC)	43.1					
water level(top PVC)	8.32					
water height	34.78					
time	1212					
Casing/Volume						
type:	2"					
type: other	S.S.					
vol/ft	0.163					
tot. vol	5.67 gal					
3 x vol.	17.00					
Purge Volume						
gallons purged	1.5 gal	3 gal	4.5 gal			
purge/bail/type	Peristaltic					
Water Sample						
Sample No.	GW-128+30-3-110317					
Sample Method	Peristaltic					
Time	1245					
No. Cont.	14					
Initials	LNK					
pH						
value	7.87	7.88	7.90			
time	1225	1235	1245			
Conductivity (S/cm)						
value µS/cm	1,752.6	1,762.9	1753			
time						
Temp. (Celsius)						
value	10.00	9.99	10.03			
time						
DO (mg/l)						
value	0.09	0.08	0.07			
time						
ORP (mV)						
value	-111.1	-129.6	120.7			
time						
TDS (ppt)						
value	1	1	1			
time						
Turbidity (ntu)						
value			1/2 NTU			
time			1230			
Ferrous Iron (mg/l)						
value			0.55 mg/L			
time			1230			
Sulfide (mg/l)						
value			0.59 mg/L			
time			1230			

COMMENTS:

* 12:15 - Begin Pumping

✓ Dissolved metals/Solids/DOC Field Filtered 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 11-3-2017

Well No. 129+65-3

well depth (top PVC)	46.7'					
water level(top PVC)	7.40					
water height						
time						
Casing/Volume						
type:	2"					
type: other	SS					
vol/ft	0.163					
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1 gal	2.5 gal	4 gal			
purge/bail/type						
Water Sample						
Sample No.			GW-129+65-3-110317			
Sample Method			peristaltic			
Time	~~1326~~ 1340		1340			
No. Cont.			14			
Initials			LNK			
pH						
value	7.75	7.76	7.76			
time	1335	1345	1355			
Conductivity (S/cm)	↓	↓				
value	5,819.4	5823.0	5852.4			
time µS/cm	1335					
Temp. (Celsius)						
value	9.64	9.93	~~8~~ 9.84			
time						
DO (mg/l)						
value	0.13	0.09	0.08			
time						
ORP (mV)						
value	-126.2	-98.9	-94.5			
time						
TDS (ppt)						
value	4	4	4			
time						
Turbidity (ntu)						
value			5.82 NTU			
time			1400			
Ferrous Iron (mg/l)						
value			0.64 mg/L			
time			1400			
Sulfide (mg/l)						
value			0.02 mg/L			
time			1400			

COMMENTS: 1325 Start Pumping

Dissolved metals/Solids/DOCs Field Filtered 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D Browning
Date: 3 NOV 2017

Well No. 131+00-3

well depth (top PVC)	42.6	42.6				
water level(top PVC)	4.4	5.6	5.1	4.6		
water height	38.2	37	37.5	38.4		
time	1335	1345	1355	1405		
Casing/Volume						
type:	2" ss					
type: other						
vol/ft	0.163 gal/ft					
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	GW131+00-3-110317					
Sample Method	peristaltic					
Time	1400					
No. Cont.	14					
Initials	DB					
pH						
value	~~7.5~~	7.5	7.6	7.58		
time		1345	1355	1405		
Conductivity (S/cm)						
value		2750	2715	2695.5		
time						
Temp. (Celsius)						
value		10.03	10.67	10.83		
time						
DO (mg/l)						
value		0.67	0.13	0.08		
time						
ORP (mV)						
value		-103.6	-117.5	-118.5		
time						
TDS (ppt)						
value		1.78	1.77	1.74		
time						
Turbidity (ntu)						
value		3		3.91		
time				1430		
Ferrous Iron (mg/l)						
value				0.78		
time				1430		
Sulfide (mg/l)						
value				0.01		
time				1430		

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 11/15/17

Well No. 122+60-0

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-122+60-0-DS-111517					
Sample Method	peristaltic					
Time	1105					
No. Cont.	13					
Initials	LMK					
pH						
value	6.11					
time						
Conductivity (S/cm)						
value µS/cm	78,943					
time						
Temp. (Celsius)						
value	10.03					
time						
DO (mg/l)						
value *	12.90					
time						
ORP (mV)						
value	34.2					
time						
TDS (ppt)						
value	17.17					
time						
Turbidity (ntu)						
value	540					
time						
Ferrous Iron (mg/l)						
value	Out of Range ***					
time	1135					
Sulfide (mg/l)						
value	Out of Range due to turbidity					
time	1135					

COMMENTS: *Sampled from Jar, NOT Flow-Through

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L Horn
Date: 11-15-17

Well No. PV-124+00

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-124+00-0-DS-111517					
Sample Method	Peristaltic					
Time	12:00					
No. Cont.	13					
Initials	JNK					
pH						
value	6.18					
time						
Conductivity (S/cm)						
value	32,281					
time µS/cm						
Temp. (Celsius)						
value	10.43					
time						
DO (mg/l)						
value	7.01					
time *						
ORP (mV)						
value	35.6					
time						
TDS (ppt)						
value	29.07					
time						
Turbidity (ntu)						
value	11.32					
time						
Ferrous Iron (mg/l)						
value	0.61					
time	1230					
Sulfide (mg/l)						
value	0.09					
time	1230					

COMMENTS: *Sample from Jar. Not Flow-THRU

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerne
Date: 11-15-17

Well No. PW- 125+50-0-DS

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-125+50-0-DS-111517					
Sample Method	peristaltic					
Time	1320					
No. Cont.	13					
Initials	LNK					
pH						
value	6.79					
time						
Conductivity (S/cm)						
value μS/cm	33,391					
time						
Temp. (Celsius)						
value	11.04					
time						
DO (mg/l)						
value *	5.87					
time						
ORP (mV)						
value	25.6					
time						
TDS (ppt)						
value	29.59					
time						
Turbidity (ntu)						
value	10.13					
time						
Ferrous Iron (mg/l)						
value	0.24					
time						
Sulfide (mg/l)						
value	0.04					
time						

COMMENTS: * Sampled From Jar, NOT FLOW-THRU

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Herne
Date: 11-15-17

Well No. 126+90-0-DS

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-126+90-0-DS-111517					
Sample Method	Paristaltic					
Time	1345					
No. Cont.	13					
Initials						
pH						
value	6.78					
time						
Conductivity (S/cm)						
value	34,105					
time						
Temp. (Celsius)						
value	11.06					
time						
DO (mg/l)						
value *	5.75					
time						
ORP (mV)						
value	24.9					
time						
TDS (ppt)						
value	30.18					
time						
Turbidity (ntu)						
value	12.03					
time						
Ferrous Iron (mg/l)						
value	0.59					
time	1400					
Sulfide (mg/l)						
value	0.11					
time	1400					

COMMENTS: * Sampled in Jar. NOT FLOW-THRU

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: J. Kerner
Date: 11-15-17

Well No. PW-128+30-0-DS

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-128+30-0-DS-111517					
Sample Method	peristaltic					
Time	1410					
No. Cont.	13					
Initials	JNK					
pH						
value	6.84					
time						
Conductivity (S/cm)						
value	32,498					
time						
Temp. (Celsius)						
value	10.74					
time						
DO (mg/l)						
value	6.50					
time *						
ORP (mV)						
value	23.1					
time						
TDS (ppt)						
value	29.03					
time						
Turbidity (ntu)						
value	31.2					
time						
Ferrous Iron (mg/l)						
value	0.29					
time						
Sulfide (mg/l)						
value	0.10					
time						

COMMENTS:
* Sampled in Jar, NOT FLOW-THRU

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Horne
Date: 11-15-17

Well No. 120 + 75 - ST1

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-120+75-ST1-DS-111517					
Sample Method	peristaltic					
Time	10:05					
No. Cont.	13					
Initials	JNK					
pH	6.05					
value	~~7.32~~					
time	10:35					
Conductivity (S/cm)						
value	34522					
time µS/cm						
Temp. (Celsius)						
value	9.6					
time						
DO (mg/l)						
value *	7.40					
time						
ORP (mV)						
value	77.1					
time						
TDS (ppt)	31.59					
value	~~0.71~~					
time						
Turbidity (ntu)						
value	125					
time						
Ferrous Iron (mg/l)						
value	0.11 mg/L					
time	1030					
Sulfide (mg/l)						
value	0.01 mg/L					
time	1030					

COMMENTS: * USED YSI 556 MPS
* NOT FLOW THROUGH - Sampled from Jar

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Horne
Date: 11-15-17

Well No. PW25+00-STI-DS

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-125+00-STI-DS-111517					
Sample Method	peristaltic					
Time	1230					
No. Cont.	13					
Initials	LNK					
pH						
value	6.59					
time						
Conductivity (S/cm)						
value	35,630					
time µS/cm						
Temp. (Celsius)						
value	10.39					
time						
DO (mg/l)						
value	9.32					
time *						
ORP (mV)						
value	28.2					
time						
TDS (ppt)						
value	32.11					
time						
Turbidity (ntu)						
value	18.55					
time						
Ferrous Iron (mg/l)						
value	Out of Range					
time	1255					
Sulfide (mg/l)						
value	Out of Range due to turbidity					
time	1255					

COMMENTS: * Sampled FROM JAR. NOT FLOW-THRU

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: J Ihrer
Date:

Well No. 178+50-ST1-DS-111517

~~well depth (top PVC)~~						
~~water level(top PVC)~~						
~~water height~~						
~~time~~						
Casing/Volume						
~~type:~~						
~~type: other~~						
~~vol/ft~~						
~~tot. vol~~						
~~3 x vol~~						
Purge Volume						
~~gallons purged~~						
~~purge/bail/type~~						
Water Sample						
Sample No.	PW-178+50-ST1-DS-111517					
Sample Method	Peristaltic					
Time	1430					
No. Cont.	13					
Initials	JNK					
pH						
value	6.83					
time						
Conductivity (S/cm)						
value	36,135					
time μS/cm						
Temp. (Celsius)						
value	10.92					
time						
DO (mg/l)						
value	7.03					
time *						
ORP (mV)						
value	23.9					
time						
TDS (ppt)						
value	37.12					
time						
Turbidity (ntu)						
value	5.53					
time						
Ferrous Iron (mg/l)						
value	0.66					
time	1450					
Sulfide (mg/l)						
value	0.17					
time	1450					

COMMENTS: * Sampled from Jar, NOT FLOW-THRU

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 10/4/17
PORE WATER
~~Well No.~~ 119+25-ST1

well depth (top PVC)						
water level(top PVC)	~5' MLLW					
water height						
time						
Casing/Volume						
type:	1/2" STEEL PROBE 12" PENETRATION INTO SUBTIDAL ZONE					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1	2	3			
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	PW-119+25-ST1-100417					
Sample Method	PERISTALTIC					
Time	1130					
No. Cont.	15					
Initials	DGC					
pH						
value	7.26	7.15	7.12			
time						
Conductivity (S/cm)						
value	42,692	42,444	42,171			
time						
Temp. (Celsius)						
value	14.5	14.4	14.3			
time						
DO (mg/l)						
value	0.07	0.04	0.03			
time						
ORP (mV)						
value	-105.7	-112.3	-117.8			
time						
Ferrous Iron (mg/l)						
value			1.35			
time						
Turbidity (ntu)						
value			1.59			
time						

COMMENTS:

TDS (PPT)	28	28	27
SULFIDE (mg/l)			~~0.02~~ 0.00

ALL DISSOLVED SAMPLES FIELD FILTERED 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER / D. PICKERING
Date: 10/5/17

PORE WATER ~~**Well No.**~~ 120+75-ST1

well depth (top PVC)						
water level(top PVC)	-5' MLLW					
water height						
time						
Casing/Volume						
type:	SS PROBE W/ SURFACE SHIELD					
type: other	12" PENETRATION					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1	2	3			
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	PW-120+75-ST1-100517					
Sample Method	PERISTALTIC					
Time	0830					
No. Cont.	15					
Initials	DGC					
pH						
value	7.64	7.65	7.66			
time	0815	0824	0832			
Conductivity µ(S/cm)						
value	34262.9	34417.8	34465.1			
time	0815	0824	0832			
Temp. (Celsius)						
value	13.01	13.11	13.21			
time	0815	0824	0832			
DO (mg/l)						
value	0.06	0.03	0.02			
time	0815	0824	0832			
ORP (mV)						
value	-237.8	-253.9	-261.7			
time	0815	0824	0832			
Ferrous Iron (mg/l)						
value			0.0			
time						
Turbidity (ntu)						
value			0.80			
time						

COMMENTS:

TDS (PPT)	22	22	22
SULFIDE (mg/l)			~~>800 µg/L~~ >0.70 mg/L VERY DARK

ALL DISSOLVED SAMPLES FIELD FILTERED 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER / D PICKERING
Date: 10/5/17

PORE WATER
~~Well No.~~ 123+25-ST1

well depth (top PVC)						
water level(top PVC)	-.5' MLLW					
water height						
time						
Casing/Volume						
type:	SS PROBE W/SURFACE SHIELD					
type: other	12" PENETRATION					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1	1.5	2			
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	PW-123+25-ST1-100517					
Sample Method	PERISTALTIC					
Time	1015					
No. Cont.	15					
Initials	DGL					
pH						
value	7.63	7.60	7.61			
time	1008	1016	1030			
Conductivity (S/cm)						
value	39180.7	39128.3	38265			
time	1008	1016	1030			
Temp. (Celsius)						
value	13.03	13.19	13.2			
time	1008	1016				
DO (mg/l)						
value	2.50	2.76	2.65			
time	1008	1016	1030			
ORP (mV)						
value	-21.7	-16.6	-15.9			
time	1008	1016	1030			
Ferrous Iron (mg/l)						
value			0.20			
time						
Turbidity (ntu)						
value		2	22.1			
time						

COMMENTS:

TDS (PPT)	25	26	26
SULFIDE (mg/l)			0.10

~~DA~~ ALL DISSOLVED SAMPLES FIELD FILTERED 0.45µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER / D PICKERING
Date: 10/5/17

PORE WATER
~~Well No.~~ 125+00-ST1

well depth (top PVC)						
water level(top PVC)	-5'MLLW					
water height						
time						
Casing/Volume						
type:	SS PROBE W/ SURFACE SHIELD					
type: other	12'' PENETRATION					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1	2	3			
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	PW-125+00-ST1-100517					
Sample Method	PERISTALTIC					
Time	1300					
No. Cont.	15					
Initials	DGL					
pH						
value	7.51	7.45	7.43			
time	1210	1225	1230			
Conductivity (S/cm)						
value	37006.2	36953.3 ~~37006.2~~	36926.8			
time	1210	1225	1230			
Temp. (Celsius)						
value	15.25	15.33	15.28			
time	1210	1225	1230			
DO (mg/l)						
value	0.19	0.20	0.20			
time	1210	1225	1230			
ORP (mV)						
value	-9.9	-10.5	-9.7			
time	1210	1235	1230			
Ferrous Iron (mg/l)						
value			0.10			
time						
Turbidity (ntu)						
value			3.09			
time						

COMMENTS:

TDS(PPT)	24	24	24
SULFIDE (mg/l)			0.01

ALL DISSOLVED SAMPLES FIELD FILTERED 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/CK/AP
Date: 10/6/17

PORE WATER 126+80 STI
~~Well No.~~

well depth (top PVC)						
water level(top PVC)	~5' MLLW					
water height						
time						
Casing/Volume						
type:	SS PROBE W/SURFACE SHIELD					
type: other	12" PENETRATION					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1	2	3			
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	PW-126+80-STI-100617					
Sample Method	PERISTALTIC					
Time	0830					
No. Cont.	15					
Initials	DGL					
pH						
value	7.56	7.58	7.59			
time	0750	0800	0807			
Conductivity (S/cm)						
value	40416.4	40290.2	40299.0			
time	0750	0800	0807			
Temp. (Celsius)						
value	12.43	12.54	12.43			
time	0750	0800	0807			
DO (mg/l)						
value	4.18	4.13	4.18			
time	0750	0800				
ORP (mV)						
value	35.3	36.4	35.3			
time	0750	0800				
TDS (ppt)						
value	26	26	26			
time	0750	0800				
Turbidity (ntu)						
value			2.97			
time						
Ferrous Iron (mg/l)						
value			0.0			
time						
Sulfide (mg/l)						
value			0.0			
time						

COMMENTS:

ALL DISSOLVED SAMPLES FIELD FILTERED 0.45µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/LK/DP
Date: 10/6/17

Pore Water
~~Well~~ **No.** 128+50-ST1

well depth (top PVC)						
water level(top PVC)	-5' MLLW					
water height						
time						
Casing/Volume						
type:	SS Probe w/ Surface shield					
type: other	12" Penetration					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1	2	3			
purge/bail/type						
Water Sample						
Sample No.	PW-128+50-ST1-100617					
Sample Method	peristaltic					
Time	1000					
No. Cont.	11					
Initials	LK					
pH						
value	7.59	7.59	7.59			
time	0940	0950	1000			
Conductivity (S/cm)						
value	39423.5	39615.0	39279.0			
time	0940	0950	1000			
Temp. (Celsius)						
value	13.54	13.75	13.87			
time	0940	0950	1000			
DO (mg/l)						
value	4.15	4.14	4.13			
time	0940	0950	1000			
ORP (mV)						
value	3.6	10.7	15.3			
time	0940	0950	1000			
TDS (ppt)						
value	26	26	26			
time	0940	0950	1000			
Turbidity (ntu)						
value			3.97			
time						
Ferrous Iron (mg/l)						
value			0.11			
time						
Sulfide (mg/l)						
value			0.0			
time						

COMMENTS:

All Dissolved Samples Field Filtered 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/LK/DP
Date: 10/6/17

Pore Water
~~Well No.~~ 130+75-ST1

well depth (top PVC)						
water level(top PVC)	-5' MLLW					
water height						
time						
Casing/Volume						
type:	SS Probe	w/ Surface	Shield			
type: other	12" Penetration					
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1	2	3			
purge/bail/type						
Water Sample						
Sample No.	~~PVP~~ PV-130+75-ST1-100617					
Sample Method	Paristaltic					
Time	15					
No. Cont.	1130					
Initials	LK					
pH						
value	7.61	7.60	7.59			
time	1110	1120	1130			
Conductivity (S/cm)						
value	34586.7	34690.9	39617.7			
time	1110	1120	1130			
Temp. (Celsius)						
value	15,34	15.35	15.34			
time	1110	1120	1130			
DO (mg/l)						
value	3.38	3.35	3.34			
time	1110	1120	1130			
ORP (mV)						
value	42.6	30.6	27.8			
time	1110	1120	1130			
TDS (ppt)						
value	26	26	26			
time	1110	1120	1130			
Turbidity (ntu)						
value			0.04			
time						
Ferrous Iron (mg/l)						
value			0.16			
time						
Sulfide (mg/l)						
value			2.34			
time						

COMMENTS:

All Disolved Samples Field Filtered 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Kerner
Date: 11-15-17

Well No. 120 + 75 - SW

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-120+75-SW-111517					
Sample Method	peristaltic					
Time	1030					
No. Cont.	13					
Initials	LNK					
pH						
value	6.00					
time						
Conductivity (S/cm)						
value µS/cm	35,687					
time						
Temp. (Celsius)						
value	10.38					
time						
DO (mg/l)						
value *	6.98					
time						
ORP (mV)						
value	33.9					
time						
TDS (ppt)						
value	32.18					
time						
Turbidity (ntu)						
value	28.5					
time						
Ferrous Iron (mg/l)						
value	0.68 mg/l					
time	1050					
Sulfide (mg/l)						
value	0.09 mg/L					
time	1050					

COMMENTS: * Sampled from Jar, NOT FLOW-THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Herrer
Date: 11-15-17

Well No. PW-125+00-SW

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-125+00-SW-111517					
Sample Method	peristaltic					
Time	1300					
No. Cont.	13					
Initials	LNK					
pH						
value	6.78					
time						
Conductivity (S/cm)						
value	36,185					
time						
Temp. (Celsius)						
value	10.69					
time						
DO (mg/l)						
value	6.47					
time *						
ORP (mV)						
value	26.2					
time						
TDS (ppt)						
value	NOT Sampled					
time						
Turbidity (ntu)						
value	9.27					
time						
Ferrous Iron (mg/l)						
value	0.36					
time	1310					
Sulfide (mg/l)						
value	0.09					
time	1310					

COMMENTS: * Sampled From Jar, NOT Fl T
Flow-Thru

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: L. Herner
Date: 11-15-2017

Well No. 128+50-SW

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-128+50-SW-111517					
Sample Method	Paristaltic					
Time	1945					
No. Cont.	13					
Initials	INK					
pH						
value	6.91					
time						
Conductivity (S/cm)						
value	36,932					
time µS/cm						
Temp. (Celsius)						
value	11.04					
time						
DO (mg/l)						
value *	5.16					
time						
ORP (mV)						
value	23.7					
time						
TDS (ppt)						
value	32.74					
time						
Turbidity (ntu)						
value	7.20					
time						
Ferrous Iron (mg/l)						
value	0.16					
time						
Sulfide (mg/l)						
value	0.04					
time						

COMMENTS:

* Sampled From Jar - NOT FLOW-THRU

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D Cooper
Date: 10/4/17

Well No. EQUPMENT BLANK (SOIL/SEDIMENT SAMPLING)

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	EB-EB-2-100417					
Sample Method	POURED OVER SS HANDWARE					
Time	1545					
No. Cont.	4					
Initials						
pH						
value						
time						
Conductivity (S/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Turbidity (ntu)						
value						
time						

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

APPENDIX C
WATER QUALITY TABLES

FS DATA GAP INVESTIGATION 2017
FIELD MEASUREMENTS/SAMPLING
FORMER ARKEMA MANUFACTURING SITE
TACOMA, WASHINGTON

- 3Q 2017 Summary of Water Quality
    - TABLE 1A – Shallow Aquifer
    - TABLE 1B – Intermediate
    - TABLE 1C – Deep Aquifer
    - TABLE 1D – Angled Shoreline Wells
    - TABLE 1E – Pore Water & Surface Water
- 3Q 2017 Water levels
    - TABLE 2 – 11/28/2017 High Tide

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TABLE 1A
Summary of Water Quality
Shallow Wells
3rd Quarter 2017

Well Number	Water Level Top PVC	pH	Conductivity uS/cm	Temp Celsius	DO mg/L	ORP Mv	TDS ppt	Turbidity ntu	Ferrous Iron mg/L	Sulfide mg/L	Comments
1B4-1	6	6.93	860.4	15.33	2.59	5.4	1	4.01	0.72	0.04	
1C3-1	6.2	7.29	2162.7	16.98	0.02	-174.7	1	15.7	3.0	0.06	
1D1-1	7.9	9.24	4571.5	15.51	0.01	-67.9	3	7.2	0.38	0.27	
2A1-1	9.65	6.82	1830.2	15.56	0.05	-50	1	4.82	7.7	0.08	
2B1-1	9.7	6.22	17040	16.02	0.01	-144.4	11	1.12	14.8	0.3	
2C1-1R	6.85	7.17	3640.9	21.87	0.01	-154.5	2	3.88	7.4	0.63	
2D1-1	3.43	7.12	3253.4	18.36	0.07	-127.8	2	4.88	0.7	0.14	
3A3-1R	10.9	7.31	108.5	19.90	9.04	1.4	0	1.76	8.2	0.04	
3A7-1R	10.8	8.58	1242.9	18.82	0.01	-157	1	5.42	7.9	0.45	Had to change filter on dissolved samples, as flow was restricted by blocked filter to the point of back pressure
3C1-1	9.8	8.04	7183	16.20	0.01	-180.4	5	--	8.5	3.1	Turbidity: No reading due to opacity; very dark apparent color
3C2-1	6.4	9.81	10452.4	15.93	0.04	-166.8	7	2.16	1.0	3.1	
3C6-1R	7.4	6.52	10430.0	18.74	0.00	-142.6	7	0.1	1.18	1.5	
3D1-1	6.8	7.18	875.5	16.35	0.29	-115	1	39.8	9.5	0.04	
3E1-1	5.9	6.79	772.0	15.69	0.04	-75.9	1	8.28	1.7	0.1	
4B4-1	8.7	7.22	502.2	18.74	0.09	-82.0	0	0.54	4.5	0.04	
4B3-1	7.5	7.39	558.3	17.91	0.03	-105.1	0	46.1	3.3	0.17	
4C1-1	6.3	10.27	3605	16.78	0.02	-110.0	2	1.96	0	5.0	
4C2-1	6	10.56	1743.7	18.45	0.01	-75.5	1	1.45	0.8	4.9	
4D1-1	5.9	11.10	9184	16.02	0.00	-197.2	6	0.21	0	>14	Sulfide: Out of range at 20x dilution
4D2-1	7.75	8.86	2469	19.33	0.04	-168.8	2	2.16	0.2	0.62	
4F1-1	6.4	5.34	290.9	17.45	0.19	80.6	0	9.75	13.4	0.05	
4G1-1	5.31	7.20	833.9	13.45	0.05	-136.9	1	3.88	0.98	0.14	
4H3-1	2.8	11.59	19401.3	12.64	0.02	-444.8	13	--	0	>35	Turbidity: No reading due to opacity; very dark apparent color Sulfide: Out of range at 50x dilution
5B1-1R	8.3	9.94	2202.6	18.00	0.06	-104.1	1	1.6	0.07	4.3	
5C12-1	6.55	11.65	5805.6	18.25	0.04	-169.4	4	1.44	0	2.7	

TABLE 1A

Summary of Water Quality
Shallow Wells
3rd Quarter 2017

Well Number	Water Level Top PVC	pH	Conductivity uS/cm	Temp Celsius	DO mg/L	ORP Mv	TDS ppt	Turbidity ntu	Ferrous Iron mg/L	Sulfide mg/L	Comments
5C13-1	5.8	10.90	8126.6	18.7	0.01	-98.5	5	2.35	0.69	0.35	
5C16-1R	7.2	8.26	1676	16.58	0.06	-109.5	1	0.48	0.08	0.18	
5D2-1R	5.6	10.42	6207.1	17.90	0.02	-137.6	4	2.7	0.02	3.6	
5D5-1	6.2	6.67	12810	18.30	0.03	-139	8	72.4	>60	0.03	Ferrous Iron: Out of range at 20x dilution
5D7-1R	6.2	7.73	1025.0	17.67	0.14	-108.1	1	6.26	4.0	0.03	
5E1-1	7.7	7.00	470.7	17.32	0.09	-24.8	0	20.8	11.8	0.05	
5E2-1	5.6	7.82	2166.0	18.60	0.05	-85.3	1	2.29	3.1	0.32	
5E4-1	2.5	8.95	6462	17.85	0.00	-200	4	2.15	8.9	0.22	
5E8-1	7	7.72	496.2	17.63	0.07	-100.4	0	3.37	1.6	0.04	
5F1-1	5.8	6.74	18187	16.52	0.05	-71.9	12	7.49	6.5	0.13	
5G1-1	5	6.77	6104.9	16.52	0.11	-54.7	4	0.20	3.8	0.77	
5H1-1	6.3	6.50	945.13	14.04	0.22	-95.7	0.61	4.83	11.28	0.13	
5I2-1	3.9	11.49	11327	13.32	0.00	-386.9	12.56	--	0	41	Turbidity: No reading due to opacity; very dark apparent color
6D14-1	4.5	6.31	15289	15.24	0.08	-122.1	9.87	89.4	3.3	0.05	
6D25-1	6.8	8.85	2449.7	17.99	0.20	253.5	1.58	3.85	0	0.44	
6E1-1	5.74	7.09	1542.1	16.47	0.28	-16.1	1	2.24	0	0.02	
6E2-1	3.33	6.42	6522.2	14.38	0.22	-53.2	4	26.5	22.1	0.06	
6E5-1	2.98	6.98	3886.9	17.51	0.13	-136.1	3	9.33	24.1	0.03	
6E6-1	4.82	10.80	11888.0	15.71	0.00	-254.4	8	1.81	0	>28	Sulfide: Out of range at 40x dilution High pH - started off clear, brown at end
6F2-1	0.3	7.94	404.6	13.40	3.79	33.1	0	3.79	5.9	0.11	pH check at start was off by more than 1.0 - pH value was recorded, but final pH value was verified using another pH meter
6G1-1	0.2	9.87	500	15.48	2.90	21.7	0	86	2.4	0.45	
6H1-1	5.72	8.78	962.4	14.65	0.03	-193.7	1	19.2	0	0.92	
7E3-1	4.5	7.58	10869	15.62	0.07	-144.4	7.02	6.04	2.0	0.04	

TABLE 1A
Summary of Water Quality
Shallow Wells
3rd Quarter 2017

Well Number	Water Level Top PVC	pH	Conductivity uS/cm	Temp Celsius	DO mg/L	ORP Mv	TDS ppt	Turbidity ntu	Ferrous Iron mg/L	Sulfide mg/L	Comments
7E8-1	4.06	10.92	17727.6	14.45	0.05	-241.6	12	0.97	--	>28	Ferrous Iron: Colorimetric method not appropriate given natural opacity/color Sulfide: Out of range at 40x dilution
7E10-1	4.2	9.81	13390.5	17.10	0.00	-158.2	9	0	0	8.8	
7F2-1	4.4	7.52	1735.6	13.88	5.22	-84.9	1	3.57	0.12	0.04	
7F3-1	4.8	10.96	44815	12.67	0.67	-292.2	30	--	--	--	Turbidity: No reading due to opacity; very dark apparent color Ferrous Iron/Sulfide: Colorimetric method not appropriate given natural opacity/color
7F4-1	6.3	12.22	49374	17.09	0.00	-418.6	32	--	--	>28	Turbidity: No reading due to opacity; very dark apparent color. Ferrous Iron: Colorimetric method not appropriate given natural opacity/color Sulfide: Out of range at 40x dilution.
7G1-1	7.8	8.43	3277.5	15.12	0.06	-145.3	2.11	1.44	0.12	0.39	
7I1-1	4.4	6.85	1382.2	16.02	0.11	-93.5	0.90	2.4	3.6	0.02	
8F1-1R	4.7	10.33	12091	15.67	0.01	-342.9	7.86	0.36	0	>28	Sulfide: Out of range at 40x dilution
8G2-1	2.85	10.30	27508	15.55	0.03	-253.0	18	1.07	0	25.2	
8H1-1	7.24	6.59	20704.1	15.05	0.07	-77.8	13	>4000	11.26	--	Turbidity: Out of range Sulfide: Colorimetric method not appropriate given natural opacity/color
121+80-1	7.9	9.93	1207.8	13.71	0.21	-88.2	0.69	6.97	0.10	0.43	
122+60-1	6.8	7.36	29484.8	9.92	6.46	39.5	19	2375	30.4	--	Sulfide: Colorimetric method not appropriate given natural opacity/color

FS Data Gap Investigation
Arkema Manufacturing
Tacoma, Washington

TABLE 1A

Summary of Water Quality
Shallow Wells
3rd Quarter 2017

Well Number	Water Level Top PVC	pH	Conductivity uS/cm	Temp Celsius	DO mg/L	ORP Mv	TDS ppt	Turbidity ntu	Ferrous Iron mg/L	Sulfide mg/L	Comments
124+00-1	6.63	6.58	29847.1	13.42	0.14	-144.4	19	23.6	1.5	0.33	
125+50-1	7.4	7.76	29726	12.58	7.62	-80.3	18.33	6.53	1.84	0.02	
126+90-1	9.6	6.39	28094.7	10.16	8.60	12.8	15	3.85	0.40	0.02	Ran dry after 2 minutes with ultra low flow pumping
128+30-1	8.4	6.32	32114	16.06	2.04	14.6	21.25	107.5	40	0.47	Ran dry with insufficient recharge to continue water collection
129+65-1	9.4	--	--	--	--	--	--	--	--	--	Ran dry after .1 gallons
131+00-1	2.2	7.82	3201.9	14.48	0.08	-133.9	2.08	8.01	0.75	0.05	

--: Not measured, not recorded, and/or not applicable
DO: Dissolved Oxygen
ORP: Oxidation reduction potential
TDS: Total dissolved solids

TABLE 1B
Summary of Water Quality
Intermediate Wells
3rd Quarter 2017

Well Number	Water Level Top PVC	pH	Conductivity uS/cm	Temp Celsius	DO mg/L	ORP Mv	TDS ppt	Turbidity ntu	Ferrous Iron mg/L	Sulfide mg/L	Comments
1C2-2	7.6	6.56	21055.9	13.77	0.01	-106.8	14	17.9	9.9	0.04	
2B2-2	11.6	6.20	169951.8	14.23	0.02	-65.6	111	1.67	43.8	0	
2C2-2	6.3	6.11	61476.9	15.04	0.04	-96.4	40	2.15	8.0	0.08	
2D3-2	6.79	6.26	70618	14.40	0.03	-73.4	46	17.8	6.5	0.02	
3A2-2R	18.8	7.01	3773	15.98	0.07	-92.0	2	2.37	6.5	0	
3A6-2R	17.5	6.39	95944.4	14.72	0.08	-18.3	62	8.28	9.0	0.03	Water H+ increased after pumping started
3C5-2	10.2	6.01	164598	13.78	0.03	-81.5	107	15.3	7.5	0.07	
3C7-2R	10.9	6.54	95690.7	15.58	0.05	-75.9	62	16.7	5.9	0.0	
3E1-2	9.1	6.50	21332.8	13.59	0.03	-41.2	14	11.2	24.3	0.02	
4B2-2	11.6	6.40	66081.6	14.18	0.02	-63.5	43	13.9	27.6	0.09	
4B3-2	10.9	6.37	47032	14.99	0.07	-43.1	31	19.8	20.8	0.02	
4B4-2	13.5	6.91	101026	15.40	0.03	-76.7	66	9.32	16.4	0.03	
4E1-2	9.8	6.89	22876	13.81	0.03	-53.6	15	20.2	3.9	0.03	
4F1-2	9.4	6.32	15423	14.31	0.03	-39.8	10	6.44	21.7	0.09	
4G2-2	7.77	6.55	2806.9	12.21	0.03	-106.1	2	4.16	8.3	0.05	
4H4-2	7.71	6.50	11677.8	12.21	0.03	-124.5	8	1.50	0.09	0.27	
5B1-2R	10.9	7.69	42297	15.08	0.04	-109.2	27	30.3	16.7	0.03	
5C10-2	11.3	7.35	14875	14.68	0.00	-189.1	10	--	29.6	2.5	Turbidity: No reading due to opacity; very dark apparent color.
5C14-2	11.1	9.13	24486.3	15.52	0.04	-2.7	16	2.19	0.46	0.05	
5C16-2R	11.9	7.25	21957.6	14.26	0.04	-118.1	14	13.3	53	0.05	
5C21-2	12.03	6.81	18157.9	14.80	0.02	-140.3	12	26.1	24.75	0.34	
5D8-2	8.9	6.71	18142	15.03	-0.03	-58.2	12	21.8	10.7	0.02	
5E1-2	10.6	6.57	15994.0	14.84	0.03	-67.8	10	47.8	>60	0.02	Ferrous Iron: Out of range at 20x dilution
5H2-2	7	6.76	13490	12.99	0.10	-108.0	8.76	5.78	2.24	0.04	
6B19-2	8.2	7.54	11303	15.03	0.09	-157.2	7.34	6.52	6.2	0.07	
6E3-2	8.52	6.19	28972.6	16.75	3.31	-41.0	20	1446	--	>14	Ferrous Iron: Colorimetric method not appropriate given natural opacity/color Sulfide: Out of range at 20x dilution
6G3-2	7.6	6.42	28347	14.29	0.09	-308.4	18.39	88.4	0.27	0.32	
7E7-2	9.4	9.40	1928.9	13.88	2.01	-55.1	1	1.13	0.07	>28	Sulfide: Out of range at 40x dilution

TABLE 1B

Summary of Water Quality
Intermediate Wells
3rd Quarter 2017

Well Number	Water Level Top PVC	pH	Conductivity uS/cm	Temp Celsius	DO mg/L	ORP Mv	TDS ppt	Turbidity ntu	Ferrous Iron mg/L	Sulfide mg/L	Comments
6E9-2	10.7	7.69	15143	14.68	0.02	-235.4	9.84	0.09	0	0.55	
6E12-2	14.2	7.03	37959.2	14.68	0.00	-43.5	25	2.97	7.7	0.9	
6F1-2	8.35	6.30	24618	14.36	0.03	-68.8	16	20.8	55.7	0.01	
7E4-2	7.3	11.56	12600.6	14.24	0.00	-274.8	8	0.43	--	>28	Ferrous Iron: Colorimetric method not appropriate given natural opacity/color Sulfide: Out of range at 40x dilution - has a strong sulfur smell
7E6-2	6.4	10.54	8745.2	13.37	0.00	-250.6	6	0.35	--	22.8	Ferrous Iron: Colorimetric method not appropriate given natural opacity/color
7E9-2	8.82	7.68	4814.7	14.36	3.35	-125.1	3	1.71	0.05	1.1	
7E13-2R	8.8	9.54	3950.9	13.85	0.02	-136.2	3	0.93	0	11.6	
7E16-2	3.5	8.66	2876.8	16.51	0.11	-91.4	2	3.33	3.7	0.02	
7F1-2	13.49	8.32	25309	14.72	0.00	-199.0	16	1.81	0.21	8.0	
7G1-2	12.6	6.42	28446	12.89	0.07	-42.6	18.51	9.23	14.2	0.02	
7I3-2	4.9	6.65	2245.8	15.89	0.08	-38.9	1	7.38	9.6	0.04	
8F2-2R	8.4	10.86	33001	14.35	0.01	-432.8	21.44	--	0	>28	Turbidity: No reading due to opacity; very dark apparent color. Sulfide: Out of range at 40x dilution
8G3-2	7.5	9.11	28428.4	13.26	0.06	-214.7	19	1.24	0.0	0.4	
6D25-2	7.5	9.66	4934.1	15.03	0.04	-154.6	3.22	7.13	0.7	24.4	
120+75-2	5.6	6.88	33082.7	15.12	0.05	-145.6	22	5.19	0.83	0.1	
121+80-2	11	8.90	14752	15.47	0.00	-334	9.59	--	--	--	
122+60-2	7.7	8.32	30506	15.3	0.70	-100.8	19.82	2.71	0.12	0.06	
124+00-2	2.99	8.39	25947.4	14.64	0.00	-224.8	17	0.37	0.4	--	Sulfide: Colorimetric method not appropriate given natural opacity/color
125+50-2	3.7	7.19	35717	15.50	0.06	-187.2	23.2	3.47	2.7	0.05	
126+90-2	3.61	7.38	29263.7	15.41	0.07	-156.6	19	0.75	0.27	0.23	
128+30-2	6.6	8.29	17830	14.57	0.04	-309.4	11.58	0.87	0.05	6.9	
129+65-2	7.67	7.12	22541.0	14.99	0.02	-327.3	15	1.45	0.05	22	
131+00-2	5.69	8.31	12806.2	14.67	0.23	-119.2	8	15.1	0.77	0.8	

--: Not measured, not recorded, and/or not applicable

TABLE 1C
Summary of Water Quality
Deep Wells
3rd Quarter 2017

Well Number	Water Level Top PVC	pH	Conductivity uS/cm	Temp Celsius	DO mg/L	ORP Mv	TDS ppt	Turbidity ntu	Ferrous Iron mg/L	Sulfide mg/L	Comments
1C1-3	9.4	7.78	3224.6	12.37	0.07	-139.4	2	3.8	0.89	0.00	
3A1-3R	14.82	7.77	3132.2	13.04	0.04	-117.5	2	1.81	0.53	0.03	
4B1-3	12.4	6.84	13454	13.77	0.07	-100.6	8.68	2.05	4.1	0.03	
4B2-3	13.07	7.01	45736.5	13.91	0.05	-209.7	30	1.04	0.00	1	
5B1-3R	12.6	7.44	3112.7	13.39	0.05	-56.1	2.03	1.97	0.32	0.02	
5D1-3	10.15	6.71	24944.8	14.64	0.10	-109.7	16	34.1	6.0	0.03	
5G1-3	10	6.73	10303.5	13.14	0.06	-199.8	7	2.38	0.09	0.69	
6E7-3	12.9	7.65	3826.7	14.90	0.10	-126.8	2.49	--	--	--	
6E8-3	10.82	7.92	2046	12.87	0.11	-72.9	1	1.33	0.15	0.01	
6G2-3	--	7.89	2581.1	13.94	0.02	-100.9	1.68	0.26	0.11	0.03	
7E5-3	11.6	7.87	1136.7	12.81	0.06	-57.4	0.06	0.72	0.05	0.02	
122+60-3	7.9	7.64	5196.5	12.86	0.09	-95.4	3.38	25	0.33	0.00	
124+00-3	8.8	7.47	1982.2	11.81	0.07	-104.8	1.29	19.7	3.3	0.11	
125+50-3	8.4	7.08	2642.8	11.75	0.06	-55.2	1.72	7.54	1.16	0.06	
126+90-3	5.9	8.09	1646.1	13.44	0.05	-151.4	1.07	11.7	0.23	0.11	
128+30-3	8.32	7.90	1753	10.03	0.07	-120.7	1	16	0.55	0.59	
129+65-3	7.4	7.76	5852.4	9.84	0.08	-94.5	4	5.82	0.64	0.02	
131+00-3	4.4	7.58	2695.5	10.83	0.08	-118.5	1.74	3.91	0.78	0.01	

--: Not measured, not recorded, and/or not applicable
DO: Dissolved Oxygen
ORP: Oxidation reduction potential
TDS: Total dissolved solids

TABLE 1D
Summary of Water Quality
Angled Shoreline Wells
3rd Quarter 2017

Well Number	Water Level Top PVC	pH	Conductivity uS/cm	Temp Celsius	DO mg/L	ORP Mv	TDS ppt	Turbidity ntu	Ferrous Iron mg/L	Sulfide mg/L	Comments
122+60-0	--	7.60	36476	7.44	6.89	46.0	23	5.18	0.05	0.00	
124+00-0	--	--	--	--	--	--	--	3.19	0.41	0.02	
125+50-0	--	7.08	26150.9	13.76	5.37	-36.4	17	2.53	0.27	0.02	
126+90-0	--	7.08	19382.0	11.04	7.75	36.2	13	19.1	2.58	0.10	
128+30-0	--	6.90	26443.9	13.83	5.76	63.3	17	3.82	0.26	0.02	
129+65-0	--	6.84	19159.5	14.26	8.08	47.2	12	0.86	0.03	0.05	

--: Not measured, not recorded, and/or not applicable

DO: Dissolved Oxygen

ORP: Oxidation reduction potential

TDS: Total dissolved solids

FS Data Gap Investigation
Arkema Manufacturing
Tacoma, Washington

TABLE 1E
Summary of Water Quality
Pore Water / Surface Water
3rd Quarter 2017

Well Number	Water Level Top PVC	pH	Conductivity uS/cm	Temp Celsius	DO mg/L	ORP Mv	TDS ppt	Turbidity ntu	Ferrous Iron mg/L	Sulfide mg/L	Comments
122+60-0-DS	--	6.11	28943	10.03	12.90	34.2	17.17	540	>30	--	Ferrous Iron: Out of range at 10x dilution Sulfide: Colorimetric method not appropriate given natural opacity/color Parameters from jar, not flow through
124+00-0-DS	--	6.18	32289	10.43	7.01	35.6	24.07	11.32	0.61	0.09	Parameters from jar, not flow through
125+50-0-DS	--	6.71	33391	11.04	5.87	25.6	29.59	10.13	0.24	0.04	Parameters from jar, not flow through
126+90-0-DS	--	6.78	34105	11.06	5.75	24.9	30.18	12.03	0.59	0.11	Parameters from jar, not flow through
128+30-0-DS	--	6.84	32498	10.74	6.50	23.1	29.03	31.2	0.29	0.10	Parameters from jar, not flow through
119+25-ST1	--	7.12	42171	14.3	0.03	-117.8	27	1.59	1.35	0.00	
120+75-ST1	--	7.66	34465.1	13.21	0.02	-261.7	22	0.80	0.0	>0.70	Very dark / opaque, no dilution
123+25-ST1	--	7.61	38265	13.2	2.65	-15.9	26	22.1	0.20	0.10	
125+00-ST1	--	7.43	36926.8	15.28	0.20	-9.7	24	3.09	0.10	0.01	
126+80-ST1	--	7.59	40229.0	12.43	4.18	35.3	26	2.97	0.0	0.0	
128+50-ST1	--	7.59	39279.0	13.87	4.13	15.3	26	3.97	0.11	0.0	
130+75-ST1	--	7.59	39617.7	15.34	3.34	27.8	26	0.04	0.16	2.34	
120+75-ST1-DS	--	6.05	34522	9.6	7.40	27.1	31.59	125	0.11	0.01	Parameters from jar, not flow through
125+00-ST1-DS	--	6.59	35630	10.39	9.32	28.2	32.11	18.55	>30	--	Ferrous Iron: Out of range at 10x dilution Sulfide: Colorimetric method not appropriate given natural opacity/color Parameters from jar, not flow through
128+50-ST1-DS	--	6.83	36135	10.92	7.03	23.9	32.12	5.53	0.66	0.17	Parameters from jar, not flow through
120+75-SW	--	6.00	35687	10.38	6.98	33.9	32.18	28.5	0.68	0.09	Parameters from jar, not flow through
125+00-SW	--	6.78	36185	10.69	6.47	26.2	--	9.22	0.36	0.09	Parameters from jar, not flow through
128+50-SW	--	6.91	36932	11.04	5.16	23.7	32.74	7.20	0.16	0.04	Parameters from jar, not flow through

--: Not measured, not recorded, and/or not applicable
DO: Dissolved Oxygen
ORP: Oxidation reduction potential
TDS: Total dissolved solids

TABLE 2

Water Levels - High Tide
3rd Quarter 2017

11/28/2017 - Predicted High Tide (12.0' @ 12:24)

Well No.	Aquifer	Easting	Northing	MP	TOC Elev.	Time	Depth	Water Level	Comments
	Unit	feet	feet		feet		to Water	Elev. (ft)	
121+80-1	1	1175093	711295	Top of pvc	21.34	10:48	6.80	14.54	
122+60-1	1	1175174	711225	Top of pvc	14.79	10:50	2.30	12.49	
124+00-1	1	1175277	711128	Top of pvc	15.04	11:00	2.20	12.84	
125+50-1	1	1175383	711028	Top of pvc	14.30	11:10	1.60	12.70	
126+90-1	1	1175481	710933	Top of pvc	13.81	10:50	2.06	11.75	
128+30-1	1	1175594	710828	Top of pvc	14.67	11:05	2.1	12.57	
129+65-1	1	1175689	710738	Top of pvc	14.56	11:15	2.2	12.36	
131+00-1	1	1175752	710679	Top of pvc	13.35	11:26	1.04	12.31	
1B4-1	1	1174021	711507	Top of pvc	18.99	12:29	1.15	17.84	
1C3-1	1	1173951	711304	Top of pvc	-----	12:36	1.80	-	
1D1-1	1	1174129	711159	Top of pvc	18.54	12:40	3.75	14.79	
2A1-1	1	1174274	711781	Top of pvc	20.31	11:43	7.70	12.61	
2B1-1	1	1174314	711582	Top of pvc	15.69	12:46	6.90	8.79	
2C1-1	1	1174197	711250	Top of pvc	19.35	12:13	6.90	12.45	
2D1-1	1	1174314	711000	Top of pvc	20.85	12:50	0.00	20.85	Flush-Monument Area Flooded
3A3-1R	1	1174375	711801	Top of pvc	21.39	11:40	9.00	12.39	
3A7-1R	1	1174573	711679	Top of pvc	21.46	11:33	9.50	11.96	
3C1-1	1	1174480	711310	Top of pvc	15.82	12:21	3.97	11.85	
3C2-1	1	1174411	711204	Top of pvc	19.08	12:15	2.80	16.28	
3C6-1R	1	1174429	711450	Top of pvc	18.69	11:50	4.50	14.19	
3D1-1	1	1174538	710914	Top of pvc	18.88	12:10	2.50	16.38	
3E1-1	1	1174597	710938	Top of pvc	18.24	12:35	2.00	16.24	
4B3-1	1	1174597	711440	Top of pvc	19.93	11:59	3.20	16.73	
4B4-1	1	1174715	711563	Top of pvc	19.57	11:28	6.40	13.17	
4C1-1	1	1174829	711194	Top of pvc	18.66	11:48	2.60	16.06	
4C2-1	1	1174665	711255	Top of pvc	18.86	12:03	2.75	16.11	
4D1-1	1	1174840	711141	Top of pvc	18.52	11:50	1.90	16.62	
4D2-1	1	1174667	711084	Top of pvc	20.05	12:30	3.50	16.55	
4F1-1	1	1174667	710634	Top of pvc	18.73	12:40	2.00	16.73	
4G1-1	1	1174784	710311	Top of pvc	18.57	13:32	3.30	15.27	
4H3-1	1	1174766	710032	Top of pvc	16.35	13:35	2.50	13.85	
5B1-1R	1	1174873	711484	Top of pvc	19.58	11:23	5.80	13.78	
5C12-1	1	1174970	711255	Top of pvc	18.65	11:38	2.40	16.25	
5C13-1	1	1174949	711220	Top of pvc	18.51	11:45	2.30	16.21	
5C16-1	1	1174876	711348	Top of pvc	19.14	11:42	3.00	16.14	
5D2-1R	1	1175091	711173	Top of pvc	21.14	11:45	4.60	16.54	
5D5-1	1	1174989	710994	Top of pvc	19.28	11:57	2.80	16.48	
5D7-1R	1	1175129	710948	Top of pvc	19.96	12:05	3.00	16.96	
5E1-1	1	1174891	710856	Top of pvc	18.48	12:22	2.20	16.28	
5E2-1	1	1174957	710848	Top of pvc	18.74	12:15	2.50	16.24	
5E4-1	1	1175060	710853	Top of pvc	16.64	12:10	0.00	16.64	Flush Monument - Area flooded
5E8-1	1	1175052	710699	Top of pvc	20.37	12:10	3.50	16.87	
5F1-1	1	1174894	710658	Top of pvc	18.65	12:45	2.90	15.75	
5G1-1	1	1175028	710416	Top of pvc	19.03	13:25	3.08	15.95	
5H1-1	1	1175023	710134	Top of pvc	17.68	13:28	2.10	15.58	
5I2-1	1	1175099	709929	Top of pvc	16.47	13:40	1.30	15.17	
6D14-1	1	1175303	710953	Top of pvc	19.65	11:18	2.10	17.55	
6D25-1	1	1175216	711081	Top of pvc	21.89	11:30	5.80	16.09	
6E1-1	1	1175226	710911	Top of pvc	18.11	11:20	3.50	14.61	
6E2-1	1	1175370	710911	Top of pvc	18.43	12:06	1.00	17.43	

TABLE 2

Water Levels - High Tide

3rd Quarter 2017

11/28/2017 - Predicted High Tide (12.0' @ 12:24)

Well No.	Aquifer	Easting	Northing	MP	TOC Elev.	Time	Depth	Water Level	Comments
	Unit	feet	feet		feet		to Water	Elev. (ft)	
6E5-1	1	1175203	710696	Top of pvc	16.97	13:00	0.00	16.97	Flush Monument - Area flooded
6E6-1	1	1175324	710738	Top of pvc	20.24	12:45	2.23	18.01	
6F2-1	1	1175194	710559	Top of pvc	17.22	12:53	0.00	17.22	Flush Monument - Area flooded
6G1-1	1	1175180	710423		16.21	12:55	0.00	16.21	Flush Monument - Area flooded
6H1-1	1	1175305	710160	Top of pvc	20.02	13:20	3.79	16.23	
7E10-1	1	1175460	710787	Top of pvc	19.40	11:43	1.65	17.75	
7E3-1	1	1175522	710808	Top of pvc	19.98	11:53	2.12	17.86	
7E8-1	1	1175425	710830	Top of pvc	19.07	11:48	1.45	17.62	
7F2-1	1	1175597	710482	Top of pvc	19.18	12:25	0.00	19.18	Flush Monument - Area flooded
7F3-1	1	1175441	710591	Top of pvc	-----	12:41	2.14	-	
7F4-1	1	1175593	710639	Top of pvc	21.03	11:38	3.43	17.60	
7G1-1	1	1175477	710302	Top of pvc	21.30	13:09	2.95	18.35	
7I1-1	1	1175501	709904	Top of pvc	17.29	13:18	2.58	14.71	
8F1-1R	1	1175746	710655	Top of pvc	19.42	11:30	2.59	16.83	
8G2-1	1	1175745	710419	Top of pvc	17.84	12:26	1.51	16.33	
8H1-1	1	1175644	710141	Top of pvc	20.15	13:13	4.58	15.57	
120+75-2	2	1175027	711366	Top of pvc	14.62	10:45	3.30	11.32	
121+80-2	2	1175097	711290	Top of pvc	21.27	10:49	11.60	9.67	
122+60-2	2	1175168	711231	Top of pvc	15.03	10:51	6.90	8.13	
124+00-2	2	1175269	711136	Top of pvc	14.78	11:01	2.20	12.58	
125+50-2	2	1175376	711034	Top of pvc	14.57	11:11	1.70	12.87	
126+90-2	2	1175475	710938	Top of pvc	13.92	10:51	1.77	12.15	
128+30-2	2	1175586	710836	Top of pvc	14.44	11:06	1.83	12.61	
129+65-2	2	1175683	710745	Top of pvc	14.29	11:16	2.74	11.55	
131+00-2	2	1175747	710683	Top of pvc	13.36	11:27	0	13.36	
1C2-2	2	1173952	711299	Top of pvc	17.12	12:34	5.20	11.92	
2B2-2	2	1174333	711556	Top of pvc	19.17	12:45	10.00	9.17	
2C2-2	2	1174203	711262	Top of pvc	-----	12:24	0.00	-	Flush Monument - Area flooded
2D3-2	2	1174308	710995	Top of pvc	16.24	12:45	5.02	11.22	
3A2-2R	2	1174379	711797	Top of pvc	21.43	11:39	9.50	11.93	
3A6-2R	2	1174576	711677	Top of pvc	21.45	11:32	10.60	10.85	
3C5-2	2	1174412	711212	Top of pvc	18.82	12:17	8.15	10.67	
3C7-2R	2	1174432	711454	Top of pvc	18.58	12:52	9.50	9.08	
3E1-2	2	1174566	710901	Top of pvc	18.56	12:35	2.50	16.06	
4B2-2	2	1174615	711454	Top of pvc	18.99	11:57	9.00	9.99	
4B3-2	2	1174621	711267	Top of pvc	19.08	12:06	9.00	10.08	
4B4-2	2	1174718	711561	Top of pvc	19.50	11:29	9.90	9.60	
4E1-2	2	1174825	710924	Top of pvc	19.07	12:28	7.80	11.27	
4F1-2	2	1174871	710547	Top of pvc	18.48	12:42	7.90	10.58	
4G2-2	2	1174791	710305	Top of pvc	17.57	13:31	6.80	10.77	
4H4-2	2	1174779	710032	Top of pvc	16.62	13:36	6.30	10.32	
5B1-2R	2	1174877	711483	Top of pvc	19.90	11:24	9.10	10.80	
5C10-2	2	1174975	711259	Top of pvc	19.11	11:39	10.50	8.61	
5C14-2	2	1174933	711223	Top of pvc	19.04	11:46	10.00	9.04	
5C16-2R	2	1174872	711347	Top of pvc	19.05	11:43	9.50	9.55	
5C21-2	2	1175094	711177	Top of pvc	21.30	11:36	10.40	10.90	
5D8-2	2	1175012	711040	Top of pvc	18.11	12:00	6.90	11.21	
5E1-2	2	1175049	710698	Top of pvc	20.06	12:20	9.20	10.86	

TABLE 2
Water Levels - High Tide
3rd Quarter 2017

11/28/2017 - Predicted High Tide (12.0' @ 12:24)

Well No.	Aquifer	Easting	Northing	MP	TOC Elev.	Time	Depth	Water Level	Comments
	Unit	feet	feet		feet		to Water	Elev. (ft)	
5H2-2	2	1175019	710145	Top of pvc	16.41	13:29	6.15	10.26	
6B19-2	2	1175300	710954	Top of pvc	-----	11:19	6.40	-	
6E3-2	2	1175370	710915	Top of pvc	18.46	12:05	8.05	10.41	
6E9-2	2	1175225	710915	Top of pvc	18.24	11:25	9.50	8.74	
6F1-2	2	1175193	710586	Top of pvc	18.83	12:54	8.07	10.76	
6G3-2	2	1175175	710410	Top of pvc	-----	13:03	6.85	-	
7E13-2R	2	1175628	710720	Top of pvc	20.05	11:34	7.00	13.05	
7E16-2	2	1175437	710877	Top of pvc	19.38	11:52	1.15	18.23	
7E4-2	2	1175446	710839	Top of pvc	19.16	11:50	6.35	12.81	
7E6-2	2	1175481	710848	Top of pvc	17.26	11:45	6.65	10.61	
7E7-2	2	1175518	710812	Top of pvc	19.27	11:44	7.57	11.70	
7E9-2	2	1175464	710781	Top of pvc	19.65	12:35	6.64	13.01	
7F1-2	2	1175500	710639	Top of pvc	23.24	11:40	11.34	11.90	
7G1-2	2	1175478	710300	Top of pvc	21.45	13:10	11.45	10.00	
7I3-2	2	1175521	709904	Top of pvc	16.48	13:17	2.27	14.21	
8G3-2	2	1175743	710406	Top of pvc	17.95	12:27	8.71	9.24	
MW-A2	2								Well not installed
122+60-3	3	1175161	711238	Top of pvc	15.09	10:52	3.00	12.09	
124+00-3	3	1175263	711142	Top of pvc	14.80	11:02	2.20	12.60	
125+50-3	3	1175370	711040	Top of pvc	14.66	11:12	1.90	12.76	
126+90-3	3	1175470	710945	Top of pvc	13.79	10:52	1.65	12.14	
128+30-3	3	1175578	710844	Top of pvc	14.83	11:07	2.79	12.04	
129+65-3	3	1175677	710752	Top of pvc	14.57	11:17	2.49	12.08	
131+00-3	3	1175743	710687	Top of pvc	13.35	11:28	0.93	12.42	
1C1-3	3	1173944	711296	Top of pvc	18.19	12:35	8.10	10.09	
3A1-3R	3	1174384	711792	Top of pvc	21.27	11:38	9.65	11.62	
4B1-3	3	1174594	711429	Top of pvc	19.85	12:00	9.20	10.65	
4B2-3	3	1174721	711556	Top of pvc	19.49	11:28	8.30	11.19	
5B1-3R	3	1174880	711481	Top of pvc	19.49	11:25	7.70	11.79	
5D1-3	3	1175044	711045	Top of pvc	19.38	12:03	8.10	11.28	
5G1-3	3	1174938	710390	Top of pvc	18.59	13:26	8.27	10.32	
6D25-2	3	1175220	711079	Top of pvc	21.92	11:28	5.50	16.42	
6E12-2	3	1175328	710771	Top of pvc	23.37	12:18	12.39	10.98	
6E7-3	3	1175221	710913	Top of pvc	18.02	11:23	12.30	5.72	
6E8-3	3	1175370	710918	Top of pvc	18.66	12:07	6.71	11.95	
6G2-3	3	1175171	710409	Top of pvc	-----	13:02	7.94	-	
7E5-3	3	1175445	710837	Top of pvc	19.61	11:49	7.65	11.96	
8F2-2R	3	1175749	710653	Top of pvc	19.45	11:31	6.50	12.95	

APPENDIX D
IDW MANIFEST
QUALITY TABLES

FS DATA GAP INVESTIGATION 2017
FIELD MEASUREMENTS/SAMPLING
FORMER ARKEMA MANUFACTURING SITE
TACOMA, WASHINGTON

DALTON
OLMSTED
FUGLEVAND

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461236

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number: None Required

2. Page 1 of 2

3. Emergency Response Phone: 800-337-7455

4. Waste Tracking Number: 336867-040618

5. Generator's Name and Mailing Address:
Port of Tacoma-Arkema
One Sitcum Plaza
Tacoma WA 98421

Att: Scott Hooton
Scott Hooton

Generator's Phone: 253 383-9428

Generator's Site Address (if different than mailing address):
Port of Tacoma-Arkema
2901 Taylor Way
Tacoma WA 98421

6. Transporter 1 Company Name: DH Environmental Inc.
U.S. EPA ID Number: WAH000047217

7. Transporter 2 Company Name: Chemical Waste Management
U.S. EPA ID Number: ORD089452353

8. Designated Facility Name and Site Address:
CHEMICAL WASTE MANAGEMENT, INC
17629 CEDAR SPRINGS LANE
ARLINGTON OR 97812

Facility's Phone: 541 454-2643

U.S. EPA ID Number: ORD089452353

GENERATOR

9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.
1. Non-RCRA, non-DOT (IDW Soil OR336867)	4	DM	2000	P
2.				
3.				
4.				

13. Special Handling Instructions and Additional Information

1) OR336867 2-85, 1-55, 1-15

WMXU 980634

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: Luke Sherner
Signature:
Month 04 Day 06 Year 2018

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S.
Port of entry/exit:
Transporter Signature (for exports only):
Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Leonard J. Warnock
Signature: Leonard J Warnock
Month 04 Day 06 Year 18

Transporter 2 Printed/Typed Name: PETE LAUFAT
Signature:
Month 4 Day 6 Year 18

DESIGNATED FACILITY

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator)
U.S. EPA ID Number:
Facility's Phone:

17c. Signature of Alternate Facility (or Generator)
Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name: Dawn Dunlap
Signature:
Month 04 Day 13 Year 18

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DESIGNATED FACILITY TO GENERATOR

461236

CWMI

NON-HAZARDOUS WASTE MANIFEST
(Continuation Sheet)

19. Generator ID Number: NONE REQUIRED

20. Page 2 of 2

21. Waste Tracking Number 336867-040618

GENERATOR

22. Generator's Name: PORT OF TACOMA

23. Transporter 3 Company Name: UNION PACIFIC RAILROAD — U.S. EPA ID Number: NED001792910

24. Transporter 4 Company Name: COLUMBIA RIDGE LANDFILL — U.S. EPA ID Number: ORD987173457

25. Waste Shipping Name and Description	26. Containers		27. Total Quantity	28. Unit Wt./Vol.	
	No.	Type			

29. Special Handling Instructions and Additional Information

WMXN 980634

TRANSPORTER

30. Transporter_____ Acknowledgment of Receipt of Materials

Printed/Typed Name: Savimbi Tekle — Signature: — Month 4 Day 6 Year 18

31. Transporter 4 Acknowledgment of Receipt of Materials

Printed/Typed Name: Bonnie Shaw — Signature: B Shaw — Month 4 Day 9 Year 18

DESIGNATED FACILITY

32. Discrepancy

DESIGNATED FACILITY TO GENERATOR

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number: None Required

2. Page 1 of: 1

3. Emergency Response Phone: 800-337-7455

4. Waste Tracking Number: MT-040618-01

5. Generator's Name and Mailing Address
Port of Tacoma-Arkema DOF Arkema
One Sitcum Plaza
Tacoma WA 98421

405T [illegible]

Generator's Site Address (if different than mailing address)
Port of Tacoma-Arkema 4/6/18
2901 Taylor Way
Tacoma WA 98421

Generator's Phone: 253 383-9428 DHCC5 30

6. Transporter 1 Company Name: DH Environmental Inc

U.S. EPA ID Number: 2 WAH000047217

7. Transporter 2 Company Name:

U.S. EPA ID Number:

8. Designated Facility Name and Site Address
Petroleum Reclaiming Service Inc
3003 Taylor Way
Tacoma WA 98421

Facility's Phone:

U.S. EPA ID Number: WAD980511729

9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.
1. Non-RCRA, non-DOT (RCRA Empty Drums)	3	DM	100	P
2.				
3.				
4.				

13. Special Handling Instructions and Additional Information

1) 5181-b 2-5gal 1-15gal,

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name | Signature | Month Day Year

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:

Transporter Signature (for exports only): Date leaving U.S.:

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Leonard J. Weinock | Signature: Leonard J. W. | Month Day Year: 4 6 18 2

Transporter 2 Printed/Typed Name | Signature | Month Day Year

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Picked up 2 empty 5gal + 1 15g

Manifest Reference Number:

17b. Alternate Facility (or Generator) | U.S. EPA ID Number

Facility's Phone:

17c. Signature of Alternate Facility (or Generator) | Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name | Signature | Month Day Year

GENERATOR
INT'L
TRANSPORTER
DESIGNATED FACILITY

169-BLC-O 6 10498 (Rev. 9/09)

COPY

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number: None Required
2. Page 1 of 1
3. Emergency Response Phone: 800-337-7455
4. **Waste Tracking Number**: 126704-040618

GENERATOR

5. Generator's Name and Mailing Address
Port of Tacoma-Arkema DOF Arkema
One Sitcum Plaza
Tacoma WA 98421
Att: Scott Hooton
Generator's Phone: 253 383-9429 HCC5 30

Generator's Site Address (if different than mailing address)
Port of Tacoma-Arkema 4/6/18
2901 Taylor Way
Tacoma WA 98421

6. Transporter 1 Company Name: R Transport
U.S. EPA ID Number: WAH000024338

7. Transporter 2 Company Name:
U.S. EPA ID Number:

8. Designated Facility Name and Site Address
Greater Wenatchee Regional Landfill
191 Webb Road
Wenatchee WA 98807
Facility's Phone:
U.S. EPA ID Number:

9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.
1. Non-RCRA, non-DOT (IDW Water)	1	TK	600	G
2.				
3.				
4.				

13. Special Handling Instructions and Additional Information
1) 126704OR

14. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name | Signature | Month | Day | Year

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit: ____
Transporter Signature (for exports only): Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: Jason Edmonds | Signature | Month 4 | Day 6 | Year 18
Transporter 2 Printed/Typed Name: | Signature | Month | Day | Year

DESIGNATED FACILITY

17. Discrepancy
17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection
Picked up 2 empty [illegible] 1 15g
Manifest Reference Number:
17b. Alternate Facility (or Generator)
U.S. EPA ID Number:
Facility's Phone:
17c. Signature of Alternate Facility (or Generator) | Month | Day | Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a
Printed/Typed Name | Signature | Month | Day | Year

169-BLC-O 6 10498 (Rev. 9/09)

COPY

Appendix C

Description of Field Procedures
FS Data Gap Investigation
2018 Field Measurements/Sampling

Former Arkema Manufacturing Site
Tacoma, Washington

March 2019

Prepared by:

Dalton, Olmsted, & Fuglevand
1001 SW Klickitat Way, Suite 200B
Seattle, Washington 98134

Prepared for:

The Port of Tacoma and
Pioneer Technologies Corporation

DALTON OLMSTED FUGLEVAND

Table of Contents

APPENDICIES

1.0 GENERAL

This report summarizes the field measurements and samples that were collected in support of the Feasibility Study (FS) Data Gap Investigation between September 2018 and November 2018. Procedures used to accomplish the field measurements and sampling followed those described in the Washington State Department of Ecology (Ecology) approved FS Data Gap Investigation Work Plan (WP) prepared by Pioneer Technologies Corporation (Pioneer [Pioneer, 2017]). Field activities associated with Data Gaps #1A through #1C, #2A through #2C and #4A are described in this document. 2017 field activities associated with Data Gaps #1A through #1C, #2A through #2D, #3, #4A and #4B are documented separately (DOF 2019).

Samples of various media were collected including surface and subsurface soils, groundwater, pore water, marine water from the Hylebos Waterway, and intertidal / subtidal sediment from the Arkema shoreline. Collection of samples from various media used the same general procedures (e.g. geologic logging) that are described in the subsections below. Media-specific procedures are described in Sections 2 to 5 of this report.

1.1 Deviations from the WP

Fieldwork was completed in general accordance with the WP. There were only a few minor fieldwork deviations from the WP, and all of the deviations were either directed by, or approved by, Pioneer after consultation with Ecology and the Port of Tacoma. The 2018 fieldwork deviations were:

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- Installing and collecting five more nylon screen diffusion samplers (NSDSs) than 2017.
- Collecting two anoxic sediment samples for sequential extraction (during NSDS installation).
- Adding and eliminating several monitoring wells for the 2018 groundwater sampling round.
- Analyzing water samples for dissolved arsenic only.
- Revising Data Gap 4A soil boring locations to provide better coverage of the Penite Pit area.
- Collecting an anoxic First Aquitard soil sample from six soil borings for sequential extraction.

1.2 Sample Collection, Field Documentation, and Geologic Logging

Field measurements, sample collection and documentation of the field work were completed by or under the supervision of David Cooper, a licensed geologist with Dalton, Olmsted, and Fuglevand (DOF). Field data were recorded using field forms included in the WP.

Soil samples were described in the field using American Society for Testing and Materials (ASTM) D-2488 as a general guide. Samples were field screened for visual indications of contamination (color, staining etc.). Soil borings for Data Gap #4A were screened for arsenic by X-ray fluorescence (XRF) as described in a more detail in Section 4. Water samples were collected in accordance with the WP procedures; sample handling is described in more detail in Section 1.3.

Geologic logs were prepared based on the sample descriptions and field screening; these are included in Appendix A. Completed field forms are included in Appendix B.

1.3 Sample Handling

Sample labeling was completed as described in the approved WP. Filled sample containers were placed in chilled coolers for transport to the laboratory. Samples were delivered to the laboratory generally the same day or within 48 hours (soil and sediment samples) and 24 hours (water samples) of collection. Sample handling was documented using standard chain-of-custody (COC) procedures. The samples remained in the immediate possession of DOF personnel at all times, or securely stowed (i.e. locked vehicle) before delivery to the laboratory by the sample collection team, or under custody seal by Thunderdog Messengers. A COC record accompanied the samples at all times which included the site and sample identification, date of collection, analysis requested, and the name and signature of the sampling technician. Analytical Resources Inc. (ARI) of Tukwila, Washington and BAL of Bothell, Washington performed the laboratory analyses.

Samples for sequential extraction analyses and batch adsorption testing required anoxic preservation. Soil and sediment samples requiring anoxic preservation were immediately removed from the core and placed into laboratory prepared containers using the following procedure:

(1) Transferred the sample to an 8 oz. jar with little or no headspace, using decontaminated stainless steel spoons,
(2) Placed the sealed sample jar in a zip-loc Mylar bag,
(3) Added oxygen-absorbing packets to the Mylar bag,
(4) Purged the Mylar bag with nitrogen gas introduced by flexible hose from a portable cylinder
(5) Manually expressed the majority of gas from the Mylar bag,
(6) Sealed the Mylar bag,
(7) Loosened the threads of the inner jar lid to allow oxygen absorption packets to work,
(8) Placed the sealed Mylar bag in a re-sealable plastic bag,
(9) Manually expressed the majority of air from the plastic bag, and
(10) Stored and transported the sample in a cooler with dry ice.

Following preservation of the anoxic samples, additional sample volume was collected for conventional analyses.

1.4 Surveying

All 2018 sampling locations were verified in the field using GPS survey methods. Horizontal coordinates were determined by using a Trimble Geo XH Differential Global Positioning System (DGPS). Vertical elevations for monitoring well top of casings were determined by professional survey to the datum/tolerance specified below. Vertical elevations for upland borings, intertidal and subtidal samples were estimated based on existing mapping data or relative to predicted tides.

Survey reference datum used for this project are listed below:

- Horizontal coordinates – 0.1 feet tolerance
  North American Datum [NAD] 1983 (2007)
  Based on National Geodetic Survey (NGS) continuously operation reference stations (CORS)
  WA – State Plane Zone South 4602, U.S. Survey Feet
- Vertical elevation of well casings – 0.01 feet tolerance
  Datum: Mean Lower Low Water [MLLW] as defined by the National Ocean Service Commencement Bay, Bench Mark *"Tide 22 1933"* = 19.39 feet for time period 1960-1978 Epoch.

1.5 Decontamination Protocol

Downhole drilling equipment was steamed cleaned prior to use and between each boring to avoid cross contamination. Other non-disposable sampling equipment was decontaminated between each sample interval using soap (Liquinox) and a double rinse with tap water.

1.6 Investigation Derived Waste (IDW)

Decontamination water and residual soils from sample cores were placed in sealed DOT-approved barrels and appropriately marked for waste profile and disposal. Purge-water generated from sampling groundwater monitoring wells was placed in 350 gallon totes onsite, appropriately marked, and profiled for disposal. DH Environmental Inc. of Seattle, WA managed waste disposal. The wastes were profiled as Materials Not-Regulated by DOT (non-regulated IDW soil or water). The Port of Tacoma was listed as the generator.

The following volumes of IDW were generated during the 2018 field sampling effort.

- 300 gallons of purged groundwater
- 2-55 gallon drums of soil
- 1-55 gallon drum of decontamination water
- General disposal/recycling of three 350 gallon cube-type used totes

The waste was picked up by DH Environmental on November 14, 2018 and transported for disposal at Chem Waste Management, Arlington Oregon. Copies of the waste manifests are included as Appendix D.

2.0 DATA GAPS 1A, 1B, 1C - SHORELINE SAMPLING

Pore water and surface water samples were collected during September and November of 2018 and consisted of seven pore water push point samplers (PPSs), thirteen pore water locations using NSDSs, and three surface water samples using NSDSs.

2.1 PPS Sampling

Subtidal pore water samples were collected using PPSs on September 11-13, 2018. The PPS samples were generally taken during an outgoing/falling tide, or near low tide. Samples were collected from seven station locations specified in the WP:

Shoreline PPS Pore Water Sampling Locations

Station	Elevation (feet MLLW)[a]	Location
119+25-ST1	-5	Intermediate aquifer outcrop
120+75-ST1	-5	Intermediate aquifer outcrop
123+25-ST1	-5	Intermediate aquifer outcrop
125+00-ST1	-5	Subtidal cap
126+80-ST1	-5	Subtidal cap
128+50-ST1	-5	Intermediate aquifer outcrop
130+75-ST1	-5	Intermediate aquifer outcrop

Note: (a) Elevation based on diver depth gauge relative to tide at time of sampling

A PPS sampling device constructed by DOF was deployed by divers from Northwest Underwater Construction LLC. Each PPS consisted of a ½-inch diameter stainless steel probe with a retractable stainless steel screened tip, capable of penetrating 9-12 inches into the sediment/cap and shielded by a 24-inch diameter pan with a 3-inch lip to impede short-circuiting of surface water. The probe was connected to ¼-inch diameter polyethylene tubing which ran up to the shoreline and was connected to a peristaltic pump for sample collection.

PPS shield

PPS probe with Screen

Once the diver seated the sampler into the surface sediment/cap and retracted the probe to expose the screen, pore water was purged by pumping at a rate of 100-500 ml/min. Approximately two to three gallons were purged prior to sampling. Field measurements were made and recorded during the purging for pH, electrical conductivity, temperature, dissolved oxygen (DO), oxidation/reduction potential (ORP), and turbidity. Field measurements were monitored using:

- Flow-thru cell equipped with an YSI Pro Plus Multiparameter Handheld Probe that directly measured:
    - pH
    - DO (polarographic cell)
    - ORP (Ag Ag/Cl reference electrode, stabilized with 4M KCl)
    - Temperature
    - Conductivity
- Hannah HI98703 Turbidity Meter used to measure:
    - Turbidity

The field instruments (meters) were calibrated on a daily basis. Water quality measurements are summarized in Table 1 (see Appendix C). Field observations and measurements were documented on the Water Sampling Field Form (see Appendix B).

Samples were decanted directly into laboratory prepared containers. Samples slated for dissolved metals analyses were field filtered using a 0.45 micron filter prior to decanting into the laboratory prepared container. All samples were placed in coolers packed with wet ice to chill the samples below 4 degrees Celsius, during transport to the laboratory.

To assist in assessing the quality of data, field quality control samples (e.g. field duplicates, equipment rinsate blanks) were collected in accordance with the WP.

2.2 NSDS Sampling

Pore water and surface water sampling using NSDSs was conducted between September and November 2018. The samplers were deployed on September 10 and 11, 2018 and retrieved on November 17, 2018. Shoreline samples representative of Upper Aquifer pore water, Intermediate Aquifer pore water and Hylebos surface water were collected.

NSDS Locations

Station	Elevation (feet MLLW)[a]	Location
119+25-0	+3	Upper Aquifer outcrop
119+25-ST1-DS	-5	Intermediate Aquifer outcrop
120+75-SW	-5	Surface water
120+75-0	+3	Upper Aquifer outcrop
120+75-ST1-DS	-5	Intermediate Aquifer outcrop
122+60-0-DS	+3	Upper Aquifer outcrop
123+25-ST1-DS	-5	Intermediate Aquifer outcrop
124+00-0-DS	+3	Upper Aquifer outcrop
125+00-ST1-DS	-5	Subtidal Cap
125+00-SW	-5	Surface water
125+50-0-DS	+3	Upper Aquifer outcrop
126+80-ST1-DS	-5	Intermediate Aquifer outcrop
126+90-0-DS	+3	Upper Aquifer outcrop
128+30-0-DS	+3	Upper Aquifer outcrop
128+50-ST1-DS	-5	Intermediate Aquifer outcrop
128+50-SW	-5	Surface water

Note: (a) Elevation based on diver depth gauge and/or relative to tide at time of sampling.

NSDS Samplers were fabricated by DOF, consistent with established procedures (USGS 2002, 2005; Peijnenburg et al 2013; GSI 2016). Each NSDS consisted of (1) a clean polyethylene sample jar with a threaded rim, (2) deoxygenated, deionized water, (3) a 22 micron nylon screen mesh, and (4) a threaded jar ring, prepared prior to deployment. The NSDS jars and screen mesh were acid washed and certified for trace metals by BAL. The deionized water used to fill each container was also deoxygenated with nitrogen gas and supplied by BAL.

NSDSs deployed in shallow trench

To deploy each pore water NSDS, a shallow trench was excavated at the target location with a decontaminated non-metal hand trowel in order to minimize disturbed sediment. The NSDSs were placed in the small trench, targeting approximately 0 to 10 centimeters of embedment below the mudline. Eight-8 oz. NSDSs were necessary at each sample location to provide the required volume of water for field measurements and laboratory analyses. The multiple NSDSs were placed adjacent to each other (at the same elevation), with the mesh sides of the NSDSs facing the Site (upland). Each NSDS was equipped with dedicated heavy nylon fishing-line ties that were secured to a nearby metal stake for easier retrieval. The NSDSs were covered with native sediment and the stake marked with a yellow float to assist in retrieval.

NSDSs for surface water sampling were prepared prior to deployment in the same manner described above for pore water NSDSs. NSDSs for surface water sampling were deployed by securing eight-8 oz. NSDSs in a new heavy duty nylon mesh oyster bag. The oyster bag was secured to the shoreline with plastic anchor stakes and marked with a yellow float to assist in retrieval of NSDSs. Pore water and surface water NSDSs were installed and retrieved by divers from Northwest Underwater Construction LLC.

Surface Water NSDS in Oyster bags

The NSDSs were allowed to equilibrate for approximately five weeks prior to retrieval. Following retrieval at each sample location, the set of eight, 8-ounce NSDS jars were carried directly to the onsite mobile field office for sampling, maintaining an anoxic atmosphere through temporary storage in zip-loc plastic bags containing oxygen absorbent packets. The water samples were withdrawn from each of the NSDSs by plunging a decontaminated stainless steel dispensing needle through the nylon membrane which was connected to polyethylene tubing and using a peristaltic pump. Samples were decanted from the pump tubing into the appropriate laboratory prepared containers.

Field measurements were made during the sampling for pH, electrical conductivity, temperature, DO, ORP, and turbidity using the same instrumentation described in Section 2.1. Due to limited sample volume, the measurements were made directly in the open water, without using a flow-through cell. Samples slated for dissolved metals analyses were field filtered using a 0.45 micron filter prior to decanting into laboratory prepared containers. All samples were placed in coolers packed with wet ice for transport to the laboratory.

NSDS Water Sampling Apparatus

3.0 DATA GAPS 2A, 2B, 2C - GROUNDWATER SAMPLING

Groundwater samples were collected for geochemical data in order to help evaluate plume stability for this 2018 sampling event. Primary water samples were collected from:

- 35 Upper Aquifer monitoring wells, including eight OMMP wells.
- 6 Upper Aquifer angled shoreline monitoring wells.
- 21 Intermediate Aquifer monitoring wells, including eight OMMP wells.
- 2 Deep Aquifer monitoring wells.

Sampling was conducted between October 2, 2018 and November 11, 2018.

3.1 Groundwater Sample Collection

Prior to sampling, static water levels were measured at all locations except the angled shoreline wells. Groundwater samples were collected using peristaltic pumps. The majority of the wells already had ¼-inch polyethylene tubing installed in the screen section for use of the peristaltic pump. New dedicated tubing was installed in other wells as necessary. Samples obtained from the angled shoreline monitoring wells were collected during a falling tide or near low tide.

Low flow sampling techniques (0.5 liters/minute) were used to minimize sample turbidity. The wells were purged prior to sampling until pH, temperature and electrical conductivity generally stabilized to within 10%.

Field measurements were made during the groundwater purging for pH, electrical conductivity, temperature, DO, ORP and turbidity using the equipment described in Section 2.1. The field instruments (meters) were calibrated on a daily basis. Field observations and measurements were documented on the Water Sampling Field Form (see Appendix B). Water quality measurements are summarized in Table 1 (see Appendix C).

Groundwater samples were collected by pumping directly into labeled containers, with the appropriate preservatives, provided by ARI and BAL, as outlined in the WP. Samples for dissolved analytes were field filtered using disposable in-line 0.45 micron filters.

To assist in assessing the quality of data, field quality control samples (e.g. field duplicates, equipment rinsate blanks) were collected in accordance with the WP.

Purge water was collected in a mobile 250 gallon tank and routinely transferred to 350 gallon cube tanks for temporary storage onsite prior to disposal.

3.2 Water Level Measurement

Water levels were measured prior to purging using calibrated electric well probes (recorded accuracy to +/- 0.01 feet). Measurements were made as part of groundwater sampling to determine saturated depth and well volume. Measurements were made relative to the top of well casing mark or highest spot on an uneven casing, previously surveyed. The measurements were recorded on the Water Sampling Field Form (Appendix B).

4.0 DATA GAP 4A - SOIL BORINGS

Soil samples were collected for geochemical data in order to help evaluate plume stability during September 2018. A total of 25 upland soil borings were completed pursuant to Data Gap #4A.

Field procedures unique to this task and described in the following subsections include:

- Soil Sampling from Soil Borings
- XRF Field Screening
- Bulk sample collection for bench scale testing

4.1 Soil Borings

The soil borings were advanced using a Geoprobe 7822DT Track-mounted, direct-push drill rig, operated by a licensed driller from Cascade Drilling, Inc. of Woodinville, Washington. Soil samples were collected from soil borings on a continuous basis using a dual-tube or macro sampler equipped with an acrylic liner. The borings ranged in depth from 15 to 20 feet below ground surface.

Push-Probe Equipment

Soil samples were collected directly from within the acrylic core liner using decontaminated stainless steel spoons. Field screening included at least one soil sample for XRF field screening every 2.5 feet of depth at each sampling location.

Based on field screening results and lithologic observations for each soil boring, soil samples with the highest arsenic screening concentration were submitted for laboratory analyses. One sample from each of the following zones:

- 1 Upper Aquifer
- 1 First Aquitard

Representative soil samples were collected for analyses designated in the WP which included total arsenic, TCLP metals and pH. Select samples from the first aquitard were also collected for Sequential Extraction lab analysis.

Field Sampling Station Layout

4.2 Field Screening

Field screening of soil samples utilized the following equipment and procedures.

XRF Field Screening – A portable XRF unit (INNOV-X Alpha) was used to field screen for arsenic. This field screening method was used to provide a vertical profile of arsenic concentrations within the soils of the boring and assist in selecting samples for laboratory analysis. The instrument was calibrated and operated by a representative of Pioneer working with staff from DOF.

Soil collected from each sample interval was screened using the following the procedure:

(1) Samples were placed into an aluminum pie pan and dried to less than 20% moisture in a convection oven before being homogenized.
(2) Samples were sieved by passing sample through a decontaminated ¼-inch (6.35 mm) sieve to remove large rocks and debris and then placed onto a piece of parchment paper.
(3) Samples were homogenized by folding the parchment paper, lifting and folding alternating corners, one at a time, for a minimum of 20 corner lifts. Additionally, a mortar and pestle were used to homogenize soils which adhered together while drying.
(4) Following homogenization, the dried, sieved, homogenized samples were placed in clear plastic sandwich bags for XRF analysis.
(5) Each sample was analyzed by the XRF four times, once on each of the four quadrants of the plastic bag. The representative arsenic concentration of each sample was determined by calculating the 95% upper confidence limit on the mean for the four quadrants.
(6) Data collection procedures and QA/QC procedures were completed as described in the WP to address XRF QA/QC metrics including bias, precision, accuracy, detection limits, quantitation limits, representativeness, and comparability.

4.3 Bench Scale Testing

As part of Data Gap 4A drilling and soil sampling activities, four bulk soil samples were collected for ex-situ stabilization bench tests from the following boring intervals:

- PTC-102 7.5-8.5 feet bgs
- PTC-102 14.5-15 feet bgs
- PTC-103 7.5-8.5 feet bgs
- PTC-103 12.8-13.8 feet bgs

The methodology for collection of the samples to be used in the bench tests was as follows:

- All field screening and “normal” sample collection for the soil were completed before any bench test samples were collected.
- Based on the field screening results, two Upper Aquifer locations and two First Aquitard locations were selected from which to collect the bench test samples. In general, locations with the highest arsenic concentrations were targeted.

- DOF and Cascade returned to the selected locations to collect the bench test samples via additional borings.
- The sample volume for each bench test sample was approximately 5 gallons.
- Samples were collected in double Ziploc bags and placed in wet ice-filled coolers.
- Samples were shipped using standard chain of custody procedures to the following parties:
    - Three gallons to Ursus Remediation Testing & Technologies and,
    - Two gallons to Free Flow Technologies.

4.4 Boring Completion and Surveying

Following sampling, each boring was backfilled with bentonite chip or grout in accordance with Chapter 173-160 Washington Administrative Code (WAC). Boring locations were surveyed, establishing horizontal coordinates using a DGPS. Based on the sample descriptions and field screening, geologic logs were prepared and are included in Appendix A.

5.0 DATA GAP 1A, 1B - SEDIMENT SAMPLES FROM SHORELINE

Sediment samples were collected for geochemical data in order to help evaluate plume stability on November 17, 2018 from the following locations.

- One Intertidal (Upper Aquifer) Sediment Sample Location where NSDSs were also installed pursuant to Data Gap #1A at 125+50-0-SED.
- One Subtidal (Intermediate Aquifer) Sediment Sample Location where NSDSs were also installed pursuant to Data Gap #1B at 125+00-ST1-SED.

The intertidal sample was collected by DOF during a low tide. A representative surface grab sample of sediment (upper 10 centimeters [cm]) was collected by hand using a decontaminated stainless steel spoon and mixed in a stainless steel bowl. The sample was transferred to laboratory prepared containers for transport to ARI.

The Subtidal sample was collected during NSDS retrieval by divers from Northwest Underwater Construction LLC. A representative grab sample of the subtidal sediment (upper 0 to 10 cm) was collected by hand under water using a stainless steel spoon to scrape a sample directly into a glass jar which was immediately capped. Once on shore, standing water was decanted from the sampling device/container and the remaining sediment transferred to laboratory prepared containers for transport to the laboratory.

6.0 REFERENCES

DOF, 2019, Description of Field Procedures FS Data Gap Investigation 2017 Field Measurements/Sampling, Port of Tacoma, Washington; Prepared for the Port of Tacoma and Pioneer Technologies, January 2019

Pioneer, 2017, FS Data Gap Investigation Work Plan, Former Arkema Manufacturing Site, Port of Tacoma, Washington; Prepared for the Port of Tacoma, February 2017.

GSI Water Solutions, Inc. 2016. Draft Sampling and Analysis Plan. Parcel 15 (Portac) Investigation. Ecology Facility Site No. 1215 / Cleanup Site No. 3642. April.

Peijnenburg, Willie et al. 2013. Passive Sampling Methods for Contaminated Sediments: State of the Science for Metals. Integrated Environmental Assessment and Management Volume 9999, Number 9999, pp 1-18.

USGS. 2005. Field Tests of Nylon-Screen Diffusion Samplers and Pushpoint Samplers for Detection of Metals in Sediment Pore Water, Ashland and Clinton, Massachusetts, 2003.

USGS. 2002. Field Tests of Diffusion Samplers for Inorganic Constituents in Wells and at a Ground-Water Discharge Zone.

APPENDIX A
GEOLOGIC LOGS

FS DATA GAP INVESTIGATION 2018
FIELD MEASUREMENTS/SAMPLING
FORMER ARKEMA MANUFACTURING SITE
TACOMA, WASHINGTON

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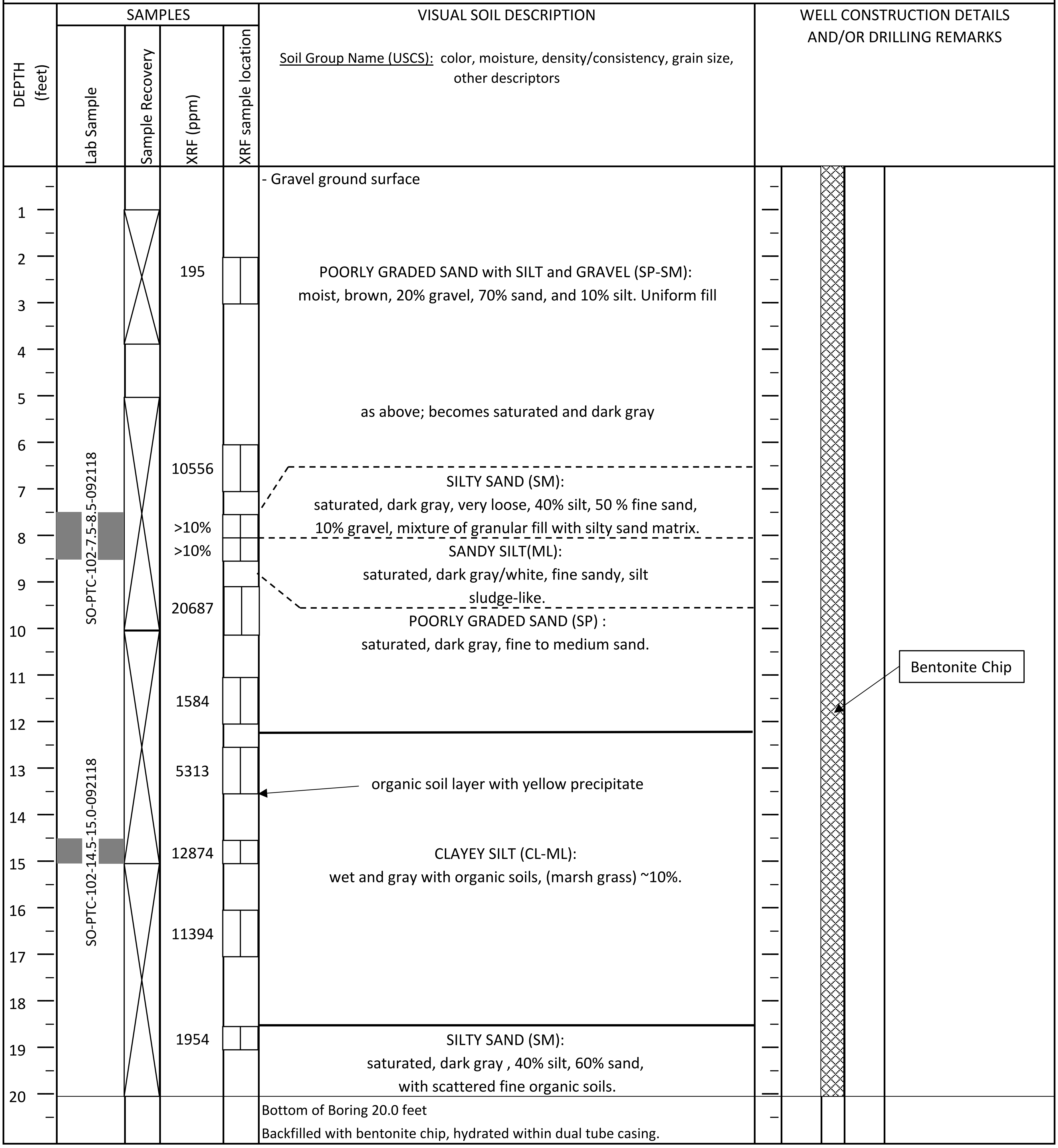
DALTON OLMSTED FUGLEVAND

LOG OF PTC-102

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710814.9N 1175230.3E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 17.7 (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 9/21/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



VISUAL SOIL DESCRIPTION

Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

POORLY GRADED SAND with SILT and GRAVEL (SP-SM): moist, brown, 20% gravel, 70% sand, and 10% silt. Uniform fill

as above; becomes saturated and dark gray

SILTY SAND (SM): saturated, dark gray, very loose, 40% silt, 50 % fine sand, 10% gravel, mixture of granular fill with silty sand matrix.

SANDY SILT(ML): saturated, dark gray/white, fine sandy, silt sludge-like.

POORLY GRADED SAND (SP) : saturated, dark gray, fine to medium sand.

organic soil layer with yellow precipitate

CLAYEY SILT (CL-ML): wet and gray with organic soils, (marsh grass) ~10%.

SILTY SAND (SM): saturated, dark gray , 40% silt, 60% sand, with scattered fine organic soils.

Bottom of Boring 20.0 feet

Backfilled with bentonite chip, hydrated within dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DALTON OLMSTED FUGLEVAND

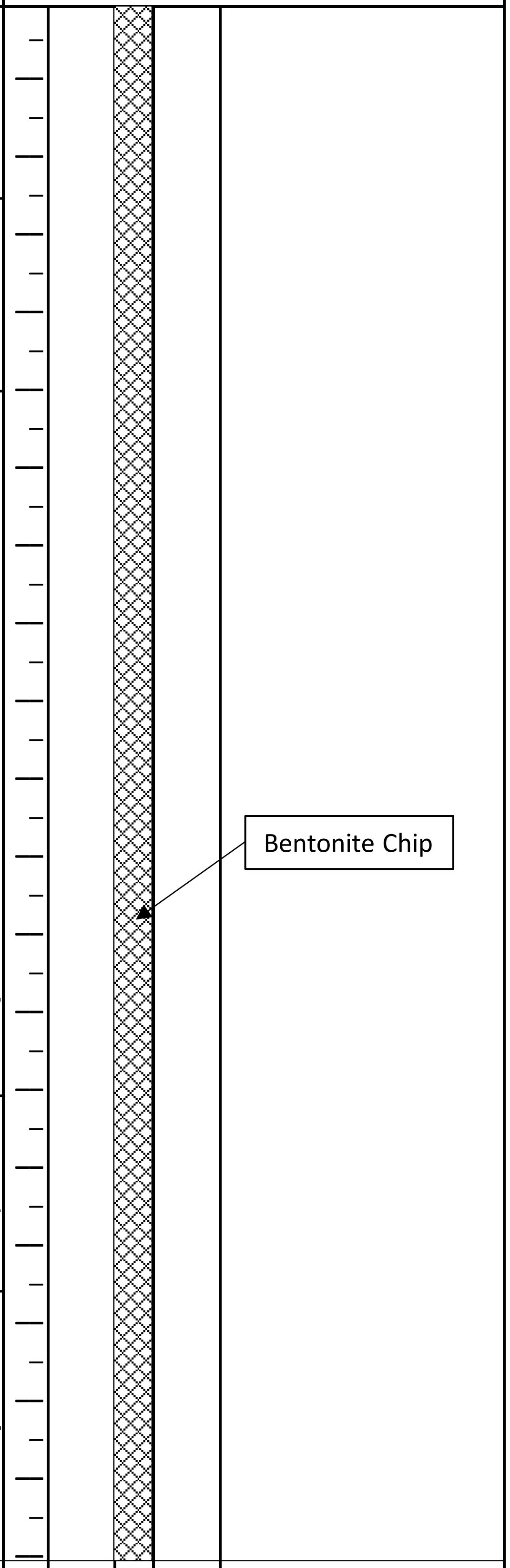
LOG OF PTC-103

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710861.7N 1175242.5E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 17.8 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 9/21/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		

DEPTH (feet)	Lab Sample	XRF (ppm)	VISUAL SOIL DESCRIPTION Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors
			- Gravel ground surface
2		2938	POORLY GRADED SAND with SILT and GRAVEL (SP-SM): moist, brown, 20% gravel, 70% sand, and 10% silt.
		753	POORLY GRADED SAND (SP): moist, dark brown, 95% fine to medium sand with trace gravel and silt clasts. Oxidized to dark red in places
		2097	POORLY GRADED SAND (SP): saturated, dark gray, fine to medium sand. Yellowish hue to fluid from 5-9', with yellow staining at 8.5' fine sand interbeds at: 7.0'-7.5', 8.6'-9.0'
8	SO-PTC-103-7.5-8.5-092118	5229	
10			⊽ uniform dark gray fine to medium sand
		304	
	SO-PTC-103-12.8-13.8-092118	9935	SILT (ML): wet, gray silt with trace organic soils.
			SILT (ML): wet, brown 80% silt with 20% organics (marsh grass) with yellow precipitate in root casts
		5504	SILT (ML): wet, gray 90% silt with 10% organics, (marsh grasses)
		1434	CLAYEY SILT (CL): wet, gray silt with 10% organic soils
			SILTY SAND (SM): saturated, gray, 60% fine sand, 40% silt.
20		215	Bottom of Boring 20.0 feet Backfilled with bentonite chip, hydrated within dual tube casing.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

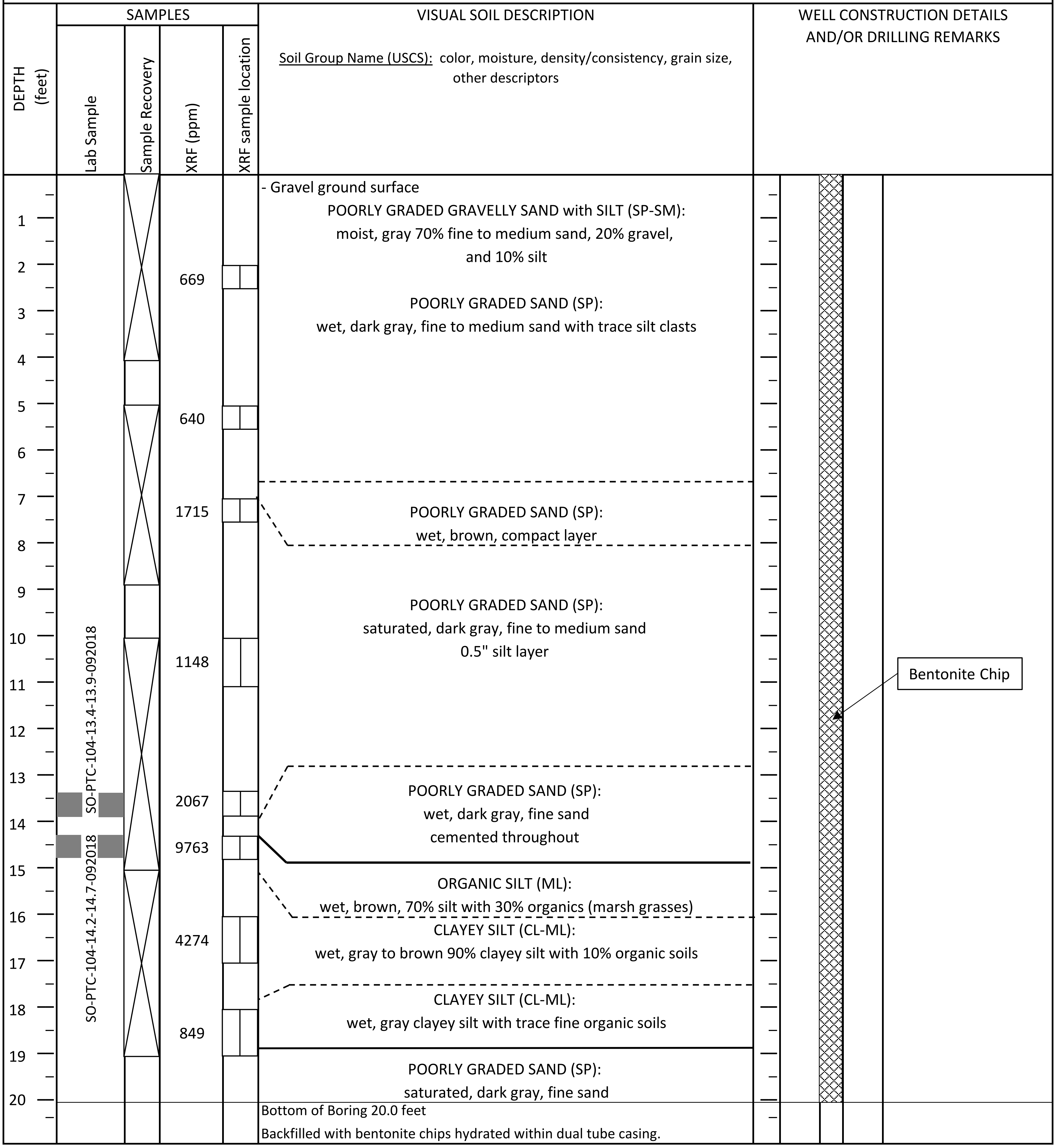


Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-104

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710900.3N 1175220.0E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 18.4 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 9/20/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



VISUAL SOIL DESCRIPTION

Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

POORLY GRADED GRAVELLY SAND with SILT (SP-SM): moist, gray 70% fine to medium sand, 20% gravel, and 10% silt

POORLY GRADED SAND (SP): wet, dark gray, fine to medium sand with trace silt clasts

POORLY GRADED SAND (SP): wet, brown, compact layer

POORLY GRADED SAND (SP): saturated, dark gray, fine to medium sand 0.5" silt layer

POORLY GRADED SAND (SP): wet, dark gray, fine sand cemented throughout

ORGANIC SILT (ML): wet, brown, 70% silt with 30% organics (marsh grasses)

CLAYEY SILT (CL-ML): wet, gray to brown 90% clayey silt with 10% organic soils

CLAYEY SILT (CL-ML): wet, gray clayey silt with trace fine organic soils

POORLY GRADED SAND (SP): saturated, dark gray, fine sand

Bottom of Boring 20.0 feet

Backfilled with bentonite chips hydrated within dual tube casing.

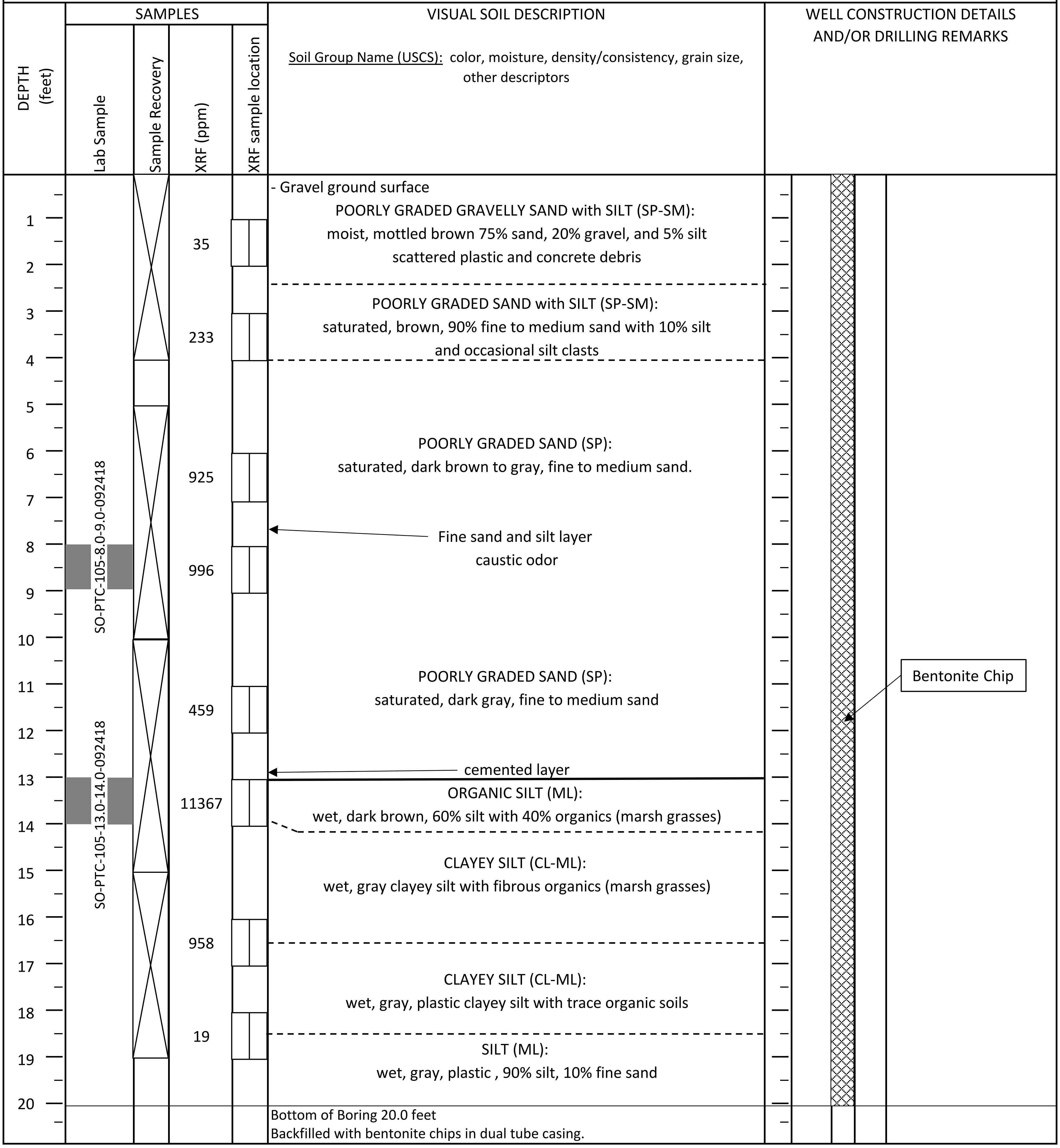
Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DOF DALTON OLMSTED FUGLEVAND

LOG OF PTC-105

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710926.9N 1175159.3E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 17.2 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 9/24/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



VISUAL SOIL DESCRIPTION

Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

POORLY GRADED GRAVELLY SAND with SILT (SP-SM):
moist, mottled brown 75% sand, 20% gravel, and 5% silt
scattered plastic and concrete debris

POORLY GRADED SAND with SILT (SP-SM):
saturated, brown, 90% fine to medium sand with 10% silt
and occasional silt clasts

POORLY GRADED SAND (SP):
saturated, dark brown to gray, fine to medium sand.

Fine sand and silt layer
caustic odor

POORLY GRADED SAND (SP):
saturated, dark gray, fine to medium sand

cemented layer

ORGANIC SILT (ML):
wet, dark brown, 60% silt with 40% organics (marsh grasses)

CLAYEY SILT (CL-ML):
wet, gray clayey silt with fibrous organics (marsh grasses)

CLAYEY SILT (CL-ML):
wet, gray, plastic clayey silt with trace organic soils

SILT (ML):
wet, gray, plastic , 90% silt, 10% fine sand

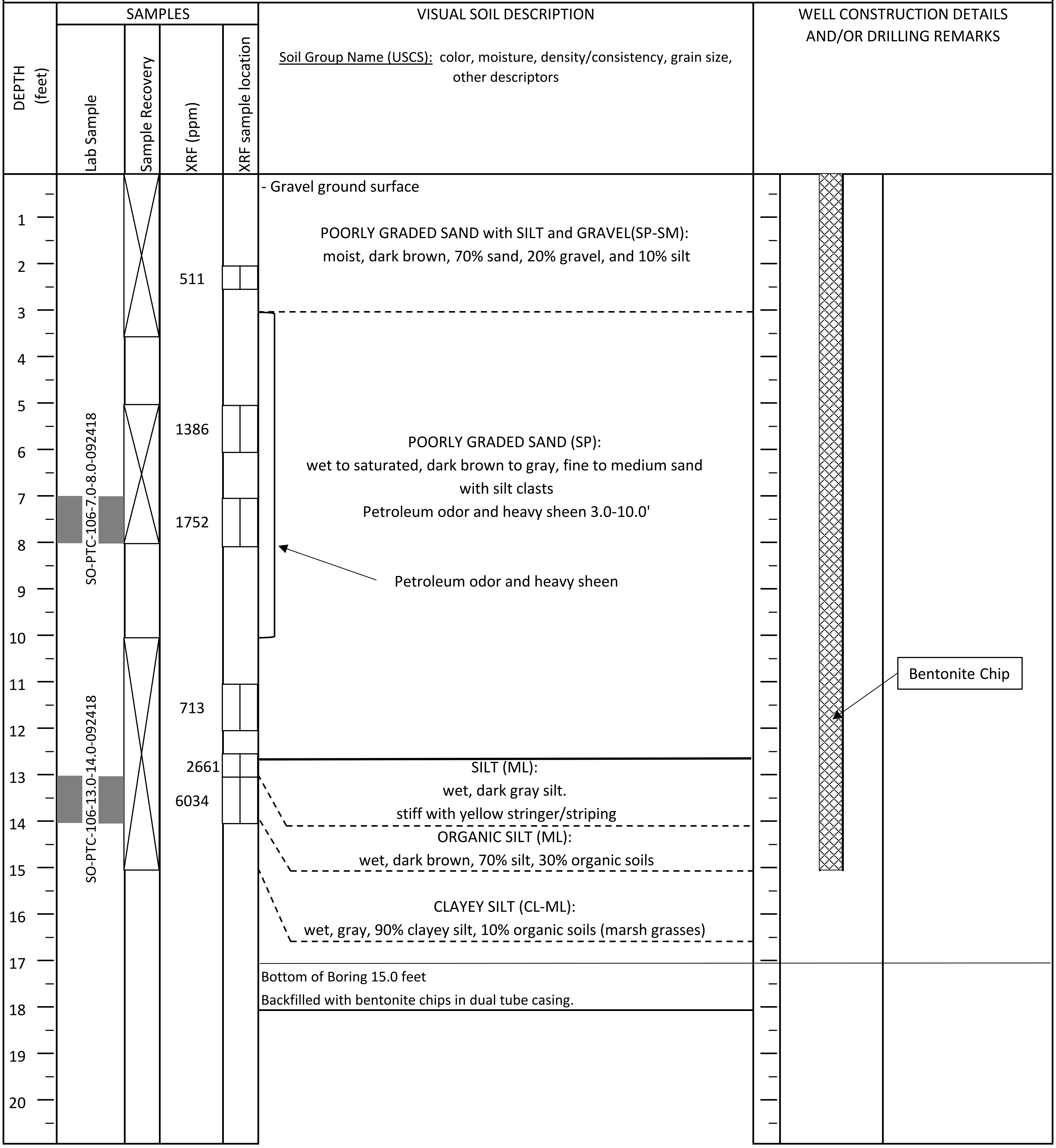
Bottom of Boring 20.0 feet
Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-106

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710906.2N 1175125.1E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 17.2 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 9/24/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



VISUAL SOIL DESCRIPTION

Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

POORLY GRADED SAND with SILT and GRAVEL(SP-SM): moist, dark brown, 70% sand, 20% gravel, and 10% silt

POORLY GRADED SAND (SP): wet to saturated, dark brown to gray, fine to medium sand with silt clasts

Petroleum odor and heavy sheen 3.0-10.0'

Petroleum odor and heavy sheen

SILT (ML): wet, dark gray silt. stiff with yellow stringer/striping

ORGANIC SILT (ML): wet, dark brown, 70% silt, 30% organic soils

CLAYEY SILT (CL-ML): wet, gray, 90% clayey silt, 10% organic soils (marsh grasses)

Bottom of Boring 15.0 feet

Backfilled with bentonite chips in dual tube casing.

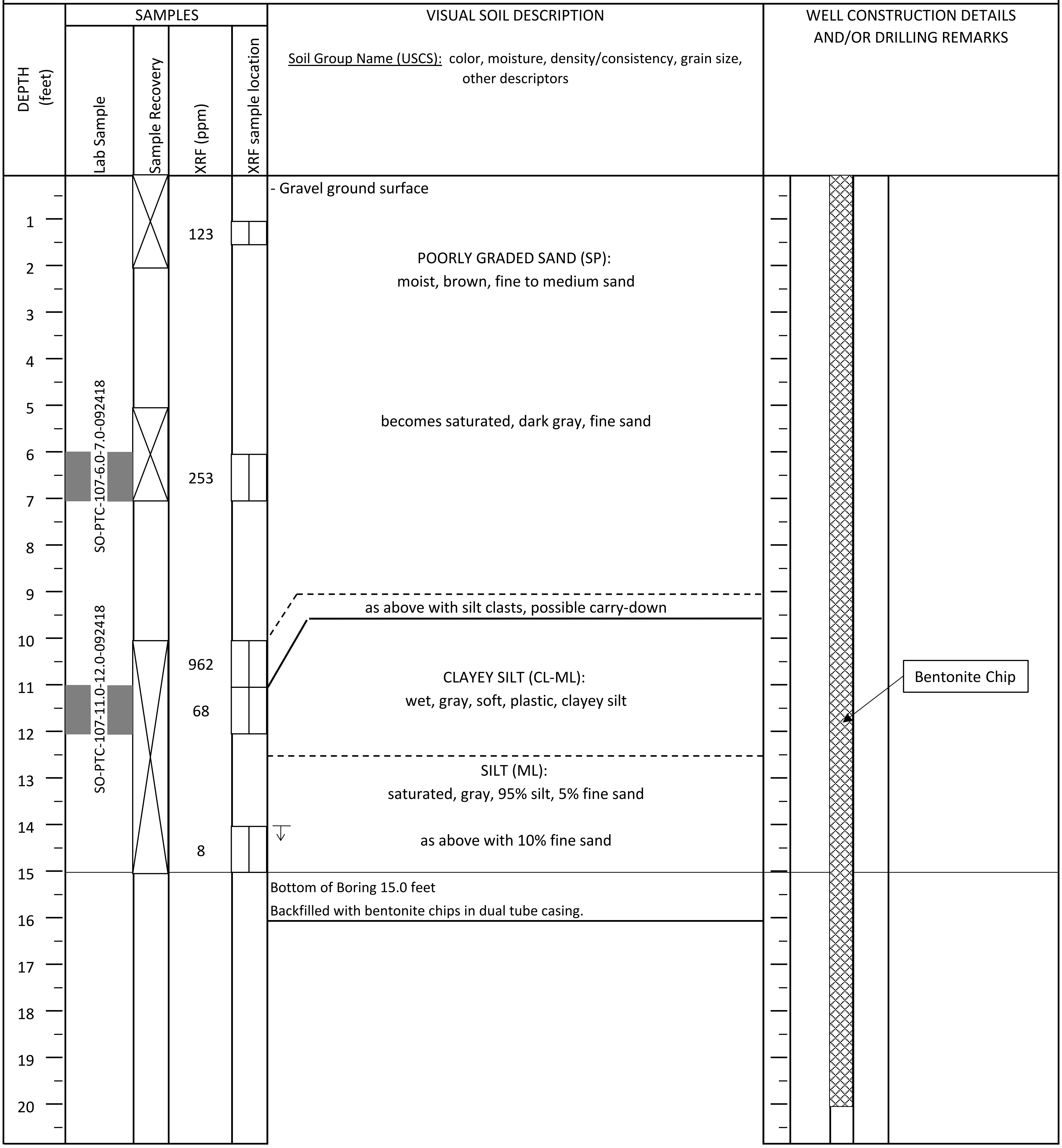
Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DALTON OLMSTED FUGLEVAND

LOG OF PTC-107

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710852.2N 1175096.3E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 17.1 feet (MLLW)
DRILLING CONTRACTOR: Cascade	DATE: 9/24/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper REG. NO.: 1600
NOTES:	



Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

POORLY GRADED SAND (SP):
moist, brown, fine to medium sand

becomes saturated, dark gray, fine sand

as above with silt clasts, possible carry-down

CLAYEY SILT (CL-ML):
wet, gray, soft, plastic, clayey silt

SILT (ML):
saturated, gray, 95% silt, 5% fine sand

as above with 10% fine sand

Bottom of Boring 15.0 feet
Backfilled with bentonite chips in dual tube casing.

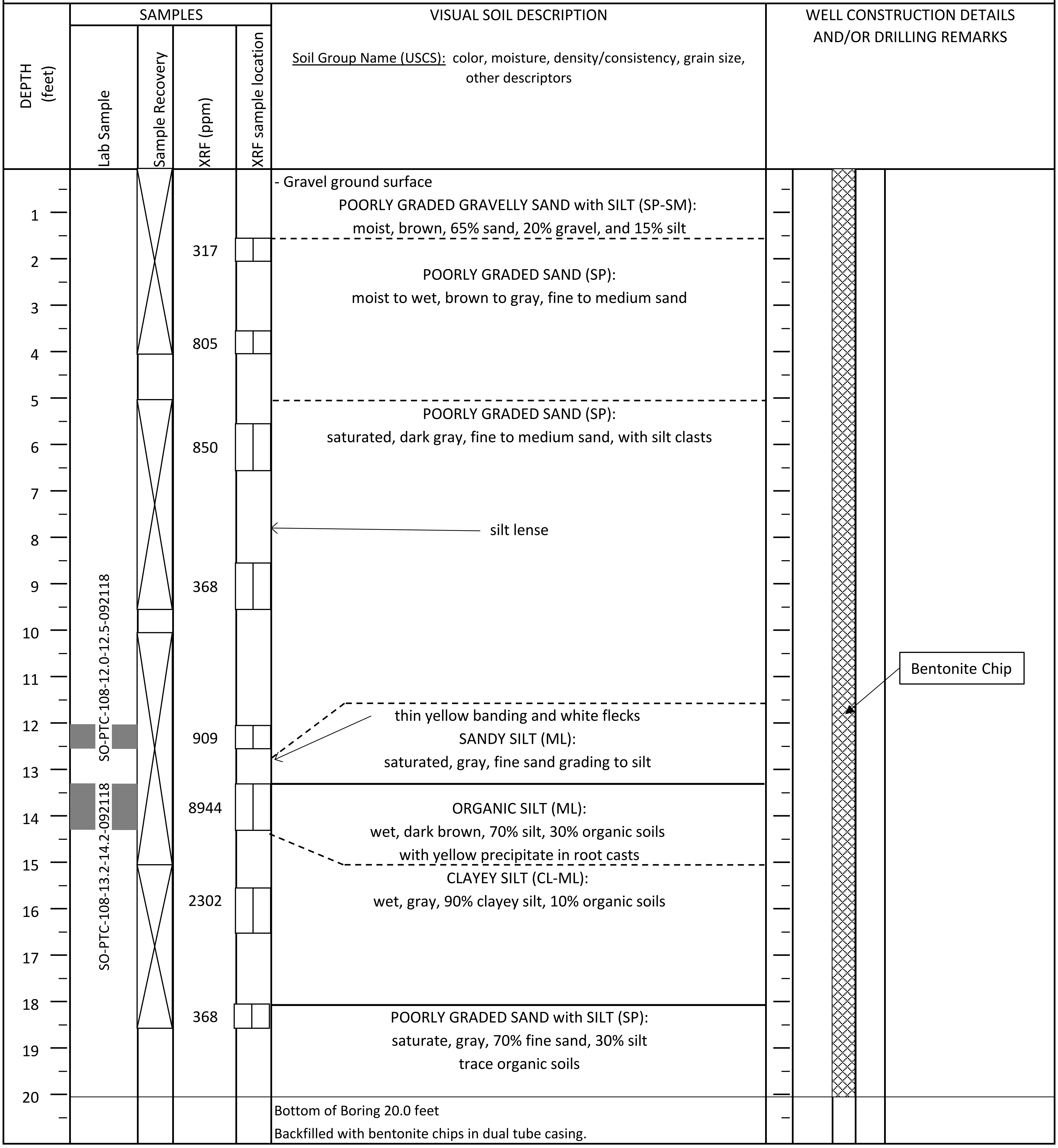
Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-108

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710834.0N 1175152.6E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 17.2 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 9/21/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600

NOTES:



VISUAL SOIL DESCRIPTION

Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

- Gravel ground surface

POORLY GRADED GRAVELLY SAND with SILT (SP-SM):
moist, brown, 65% sand, 20% gravel, and 15% silt

POORLY GRADED SAND (SP):
moist to wet, brown to gray, fine to medium sand

POORLY GRADED SAND (SP):
saturated, dark gray, fine to medium sand, with silt clasts

silt lense

thin yellow banding and white flecks

SANDY SILT (ML):
saturated, gray, fine sand grading to silt

ORGANIC SILT (ML):
wet, dark brown, 70% silt, 30% organic soils
with yellow precipitate in root casts

CLAYEY SILT (CL-ML):
wet, gray, 90% clayey silt, 10% organic soils

POORLY GRADED SAND with SILT (SP):
saturate, gray, 70% fine sand, 30% silt
trace organic soils

Bottom of Boring 20.0 feet

Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DALTON OLMSTED FUGLEVAND

LOG OF PTC-109

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710781.9N 1175183.7E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 17.6 feet (MLLW)
DRILLING CONTRACTOR: Cascade	DATE: 09/24/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper REG. NO.: 1600
NOTES:	

DEPTH (feet)	SAMPLES: Lab Sample	SAMPLES: Sample Recovery	SAMPLES: XRF (ppm)	SAMPLES: XRF sample location	VISUAL SOIL DESCRIPTION Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
1					- Gravel ground surface POORLY GRADED GRAVELLY SAND with SILT (SP-SM): moist, brown, 70% sand, 20% gravel, 10% silt	
2			275		POORLY GRADED SAND (SP): wet, brown to gray, fine to medium sand with silt clasts	
3						
4						
5	SO-PTC-109-5.0-6.0-092418		982		POORLY GRADED SAND (SP): saturated, dark gray, fine to medium sand	
6						
7					silt interbed	
8			114		SILTY SAND (SM): saturated, dark gray, 90% fine sand, 10% silt	
9						
10					POORLY GRADED SAND (SP): saturated, dark gray, fine to medium sand, with silt clasts	
11			840			Bentonite Chip
12					SILT (ML): wet, dark gray, stiff, silt	
13	SO-PTC-109-13.0-14.0-092418		8372		ORGANIC SILT (ML): wet, dark brown, 60% silt, 40% organic soils	
14					CLAYEY SILT (CL-ML): wet, gray, 95% clayey silt, 5% trace organic soils	
15						
16			1252			
17						
18			98			
19					SILTY SAND (SM): saturated, gray, 60% fine sand, 40% silt	
20					Bottom of Boring 20.0 feet Backfilled with bentonite chips in dual tube casing.	

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

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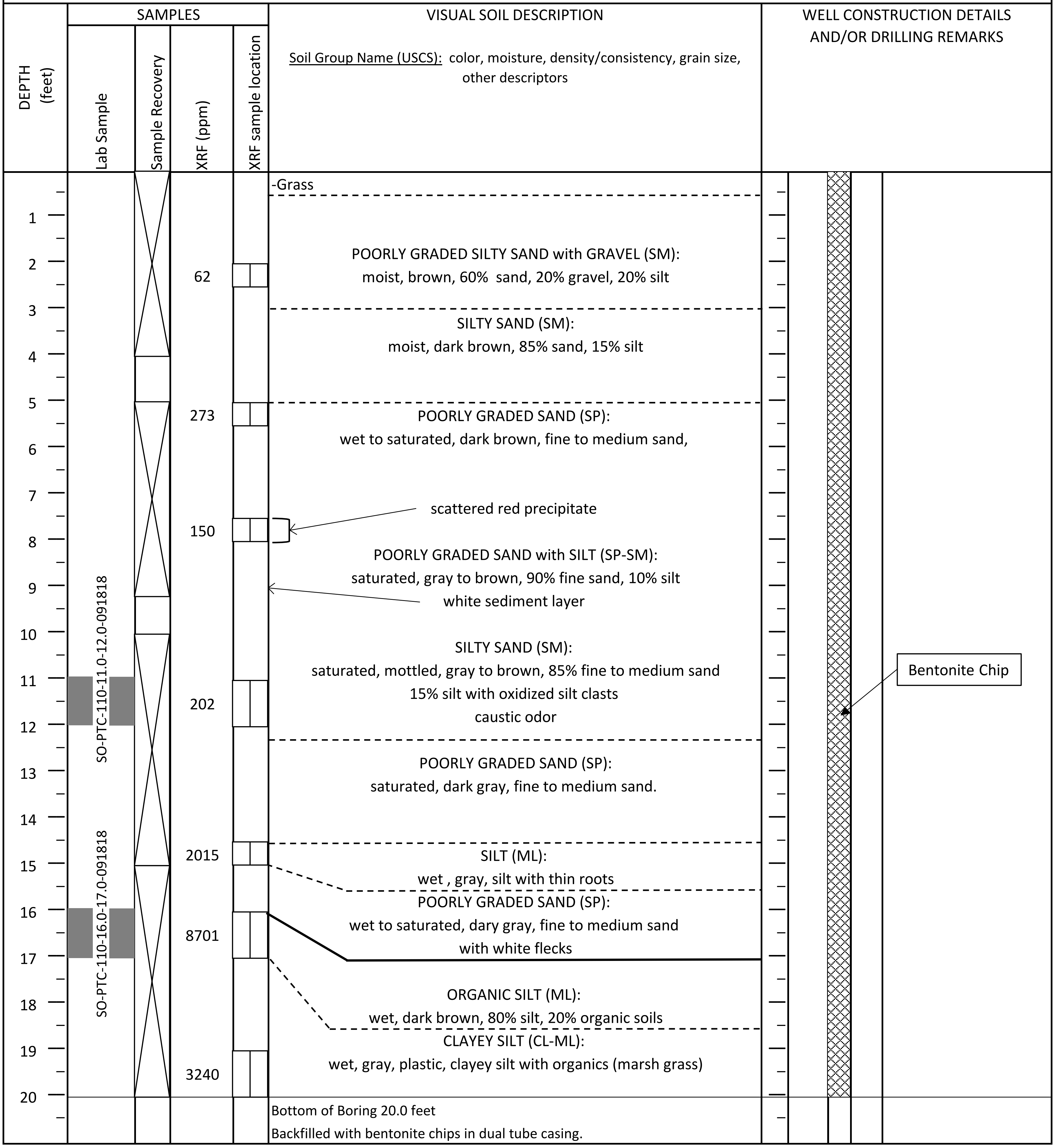
LOG OF PTC-110

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710765.5N 1175280.3E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 20.2 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 09/18/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



-Grass

POORLY GRADED SILTY SAND with GRAVEL (SM):
moist, brown, 60% sand, 20% gravel, 20% silt

SILTY SAND (SM):
moist, dark brown, 85% sand, 15% silt

POORLY GRADED SAND (SP):
wet to saturated, dark brown, fine to medium sand,

scattered red precipitate

POORLY GRADED SAND with SILT (SP-SM):
saturated, gray to brown, 90% fine sand, 10% silt
white sediment layer

SILTY SAND (SM):
saturated, mottled, gray to brown, 85% fine to medium sand
15% silt with oxidized silt clasts
caustic odor

POORLY GRADED SAND (SP):
saturated, dark gray, fine to medium sand.

SILT (ML):
wet , gray, silt with thin roots

POORLY GRADED SAND (SP):
wet to saturated, dary gray, fine to medium sand
with white flecks

ORGANIC SILT (ML):
wet, dark brown, 80% silt, 20% organic soils

CLAYEY SILT (CL-ML):
wet, gray, plastic, clayey silt with organics (marsh grass)

Bottom of Boring 20.0 feet

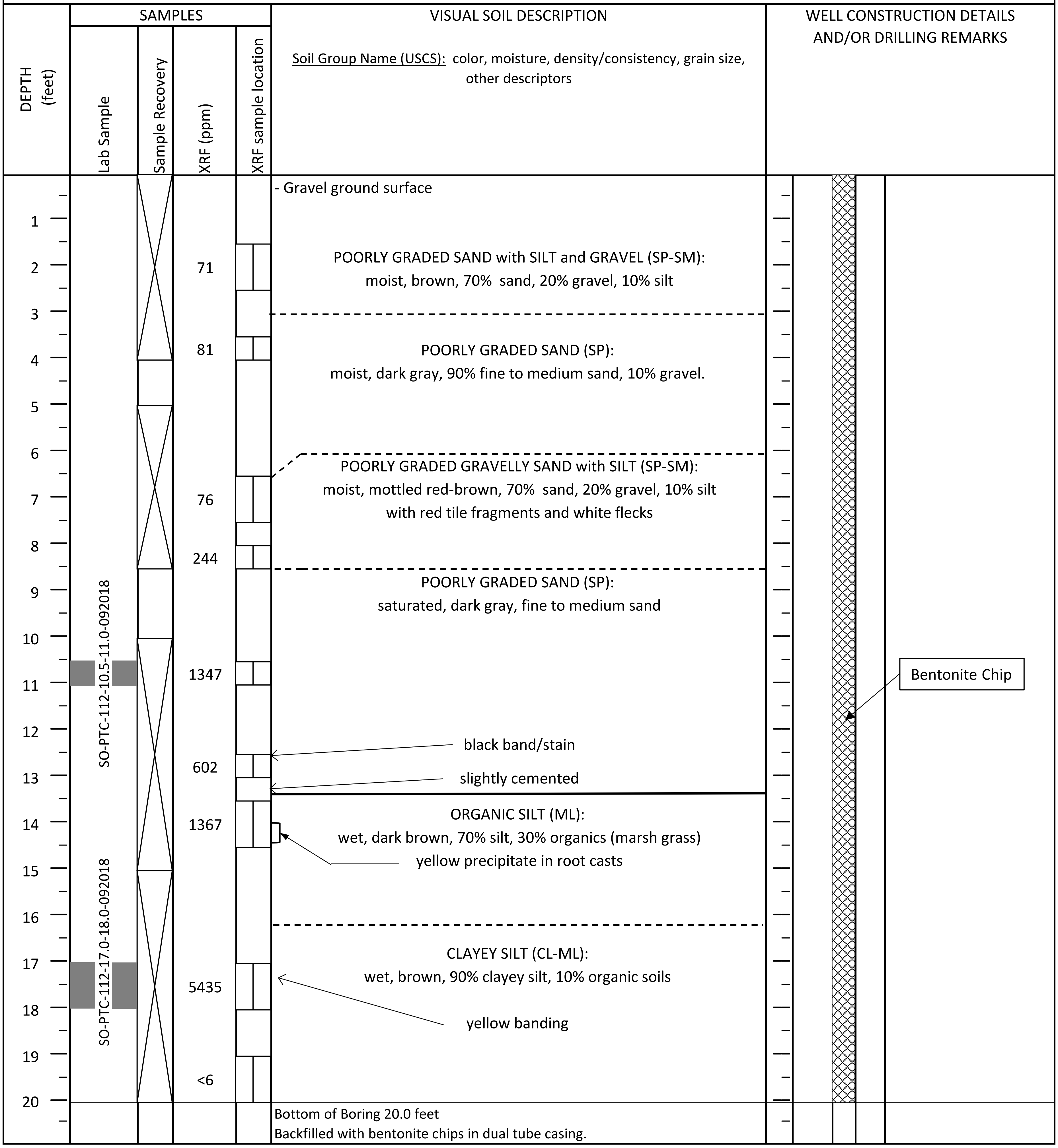
Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-112

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710969.6N 1175288.3E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 18.4 feet (MLLW)
DRILLING CONTRACTOR: Cascade	DATE: 09/20/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper REG. NO.: 1600
NOTES:	



VISUAL SOIL DESCRIPTION

Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

POORLY GRADED SAND with SILT and GRAVEL (SP-SM):
moist, brown, 70% sand, 20% gravel, 10% silt

POORLY GRADED SAND (SP):
moist, dark gray, 90% fine to medium sand, 10% gravel.

POORLY GRADED GRAVELLY SAND with SILT (SP-SM):
moist, mottled red-brown, 70% sand, 20% gravel, 10% silt
with red tile fragments and white flecks

POORLY GRADED SAND (SP):
saturated, dark gray, fine to medium sand

black band/stain

slightly cemented

ORGANIC SILT (ML):
wet, dark brown, 70% silt, 30% organics (marsh grass)
yellow precipitate in root casts

CLAYEY SILT (CL-ML):
wet, brown, 90% clayey silt, 10% organic soils

yellow banding

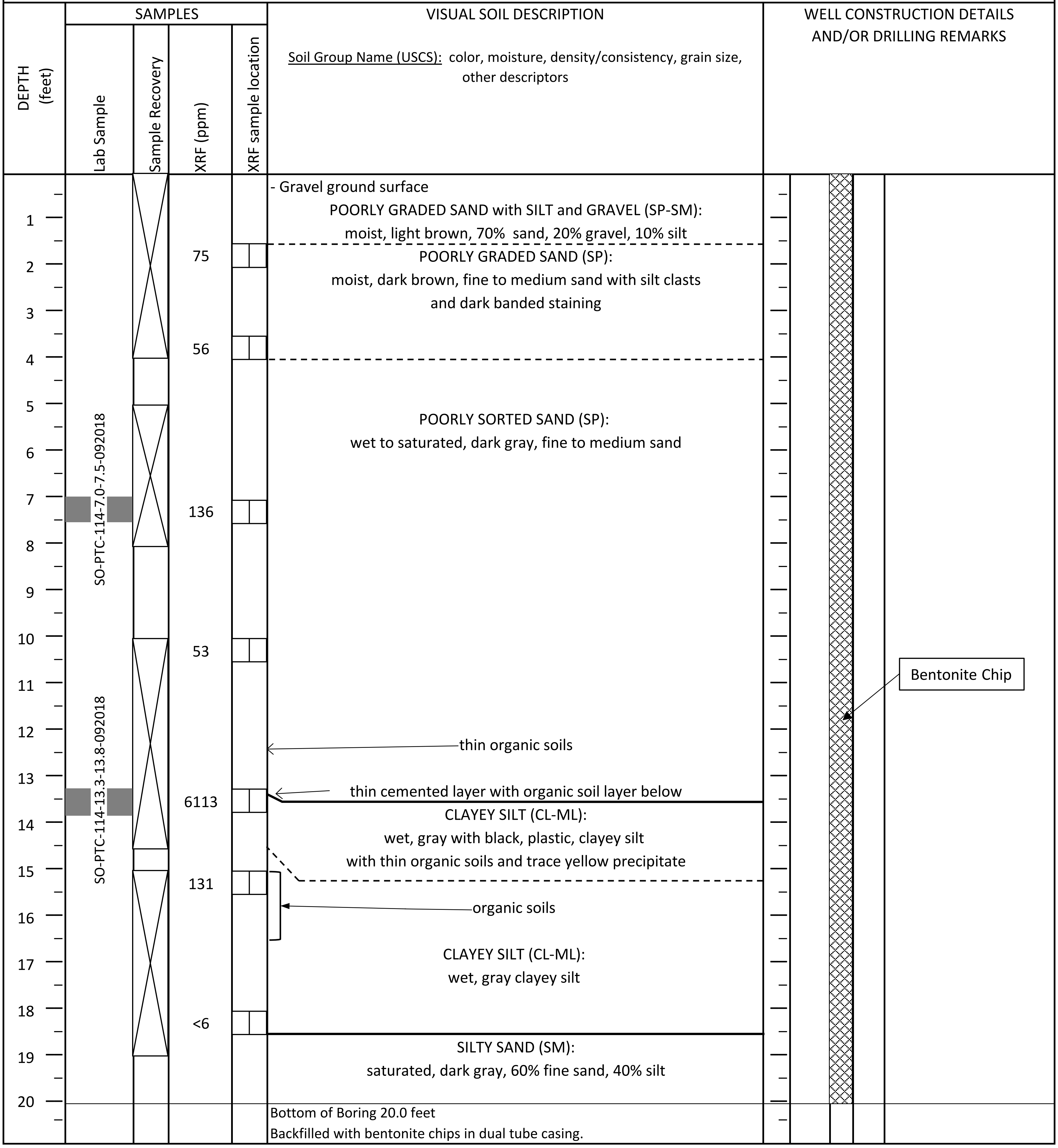
Bottom of Boring 20.0 feet
Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-114

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 711009.6N 1175179.1E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 18.0 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 09/20/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



<u>Soil Group Name (USCS):</u> color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

POORLY GRADED SAND with SILT and GRAVEL (SP-SM):
moist, light brown, 70% sand, 20% gravel, 10% silt

POORLY GRADED SAND (SP):
moist, dark brown, fine to medium sand with silt clasts
and dark banded staining

POORLY SORTED SAND (SP):
wet to saturated, dark gray, fine to medium sand

thin organic soils

thin cemented layer with organic soil layer below

CLAYEY SILT (CL-ML):
wet, gray with black, plastic, clayey silt
with thin organic soils and trace yellow precipitate

organic soils

CLAYEY SILT (CL-ML):
wet, gray clayey silt

SILTY SAND (SM):
saturated, dark gray, 60% fine sand, 40% silt

Bottom of Boring 20.0 feet
Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

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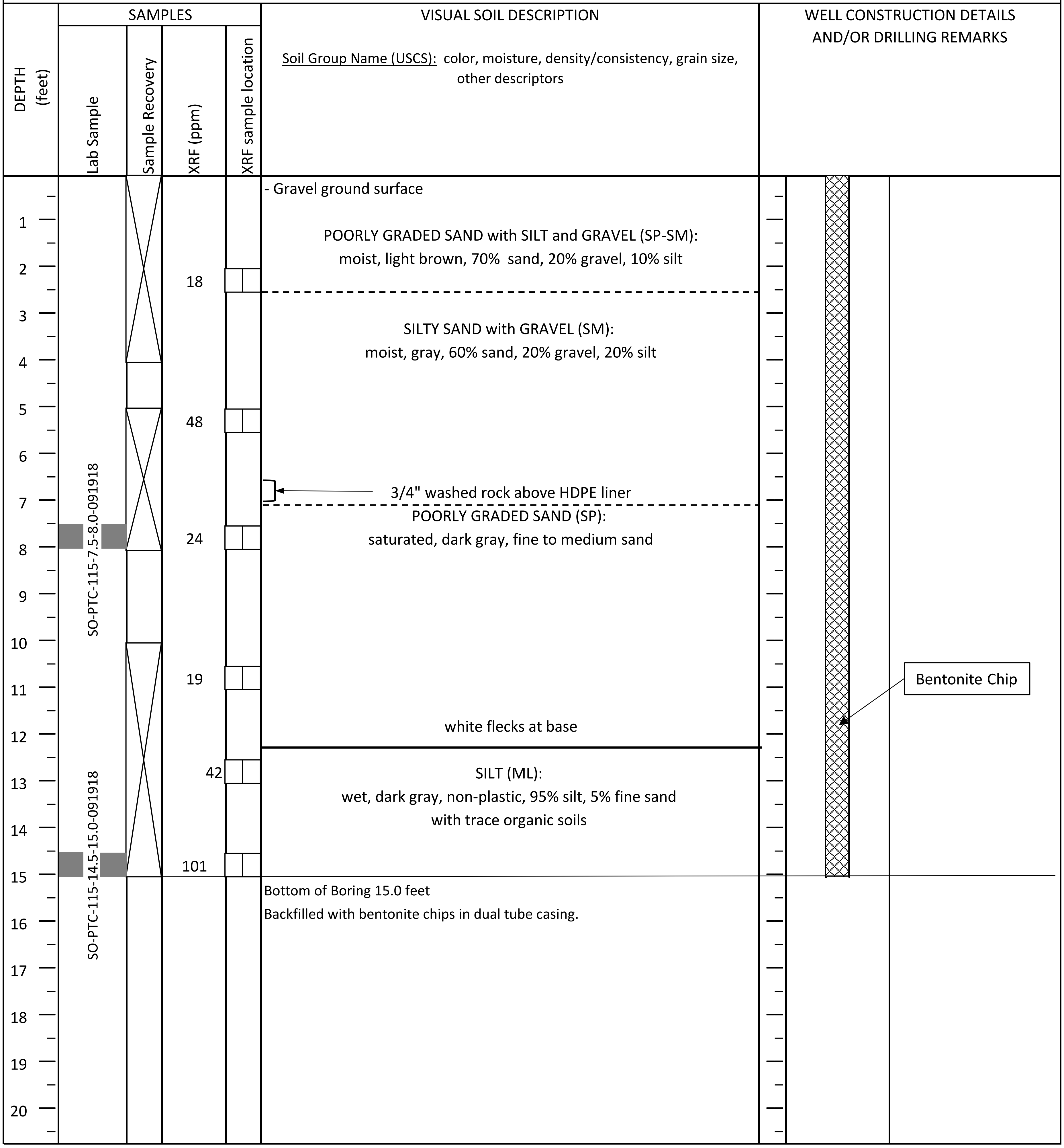
LOG OF PTC-115

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 711082.3 N 1175198.2E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 18.5 Feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 09/19/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 2" macro core with 5'x1.5" acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

POORLY GRADED SAND with SILT and GRAVEL (SP-SM): moist, light brown, 70% sand, 20% gravel, 10% silt

SILTY SAND with GRAVEL (SM): moist, gray, 60% sand, 20% gravel, 20% silt

3/4" washed rock above HDPE liner

POORLY GRADED SAND (SP): saturated, dark gray, fine to medium sand

white flecks at base

SILT (ML): wet, dark gray, non-plastic, 95% silt, 5% fine sand with trace organic soils

Bottom of Boring 15.0 feet

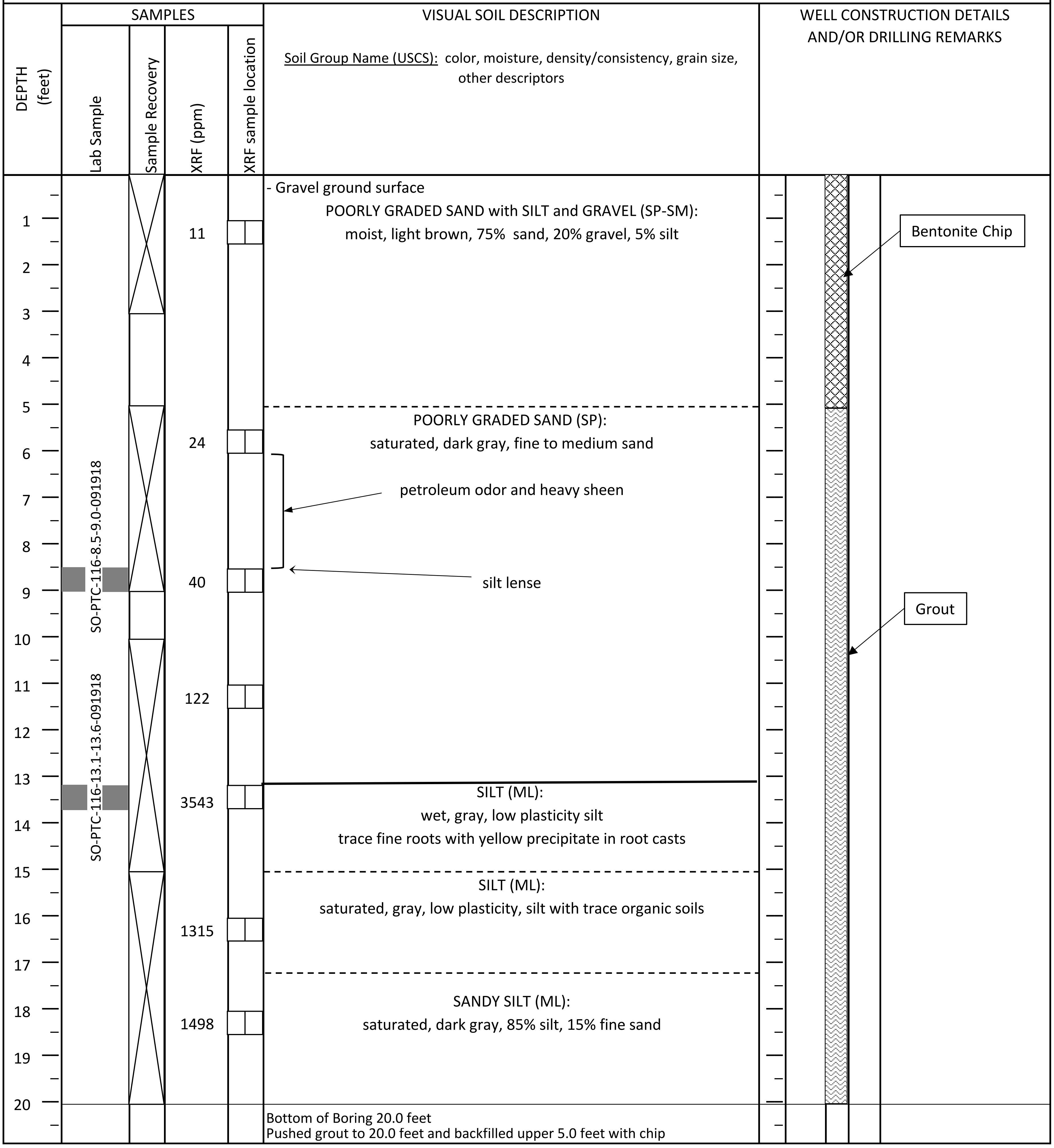
Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-116

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 711078.1N 1175286.8E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 19.0 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 09/19/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 2" macro core with 5'x1.5" acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



VISUAL SOIL DESCRIPTION

Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

POORLY GRADED SAND with SILT and GRAVEL (SP-SM):
moist, light brown, 75% sand, 20% gravel, 5% silt

POORLY GRADED SAND (SP):
saturated, dark gray, fine to medium sand

petroleum odor and heavy sheen

silt lense

SILT (ML):
wet, gray, low plasticity silt
trace fine roots with yellow precipitate in root casts

SILT (ML):
saturated, gray, low plasticity, silt with trace organic soils

SANDY SILT (ML):
saturated, dark gray, 85% silt, 15% fine sand

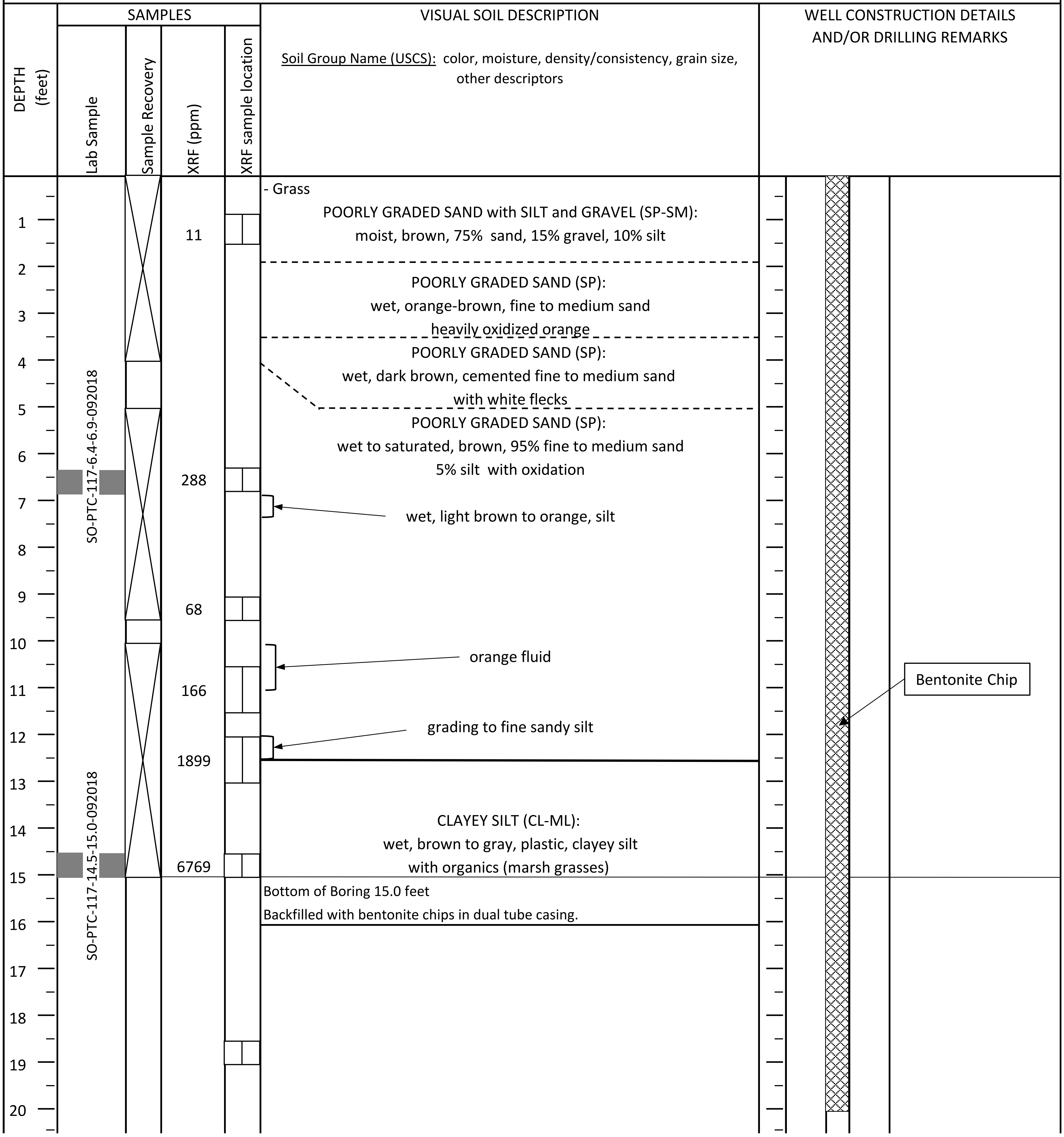
Bottom of Boring 20.0 feet
Pushed grout to 20.0 feet and backfilled upper 5.0 feet with chip

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-117

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710830.6N 1175360.8E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 18.0 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 09/20/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Grass

POORLY GRADED SAND with SILT and GRAVEL (SP-SM):
moist, brown, 75% sand, 15% gravel, 10% silt

POORLY GRADED SAND (SP):
wet, orange-brown, fine to medium sand
heavily oxidized orange

POORLY GRADED SAND (SP):
wet, dark brown, cemented fine to medium sand
with white flecks

POORLY GRADED SAND (SP):
wet to saturated, brown, 95% fine to medium sand
5% silt with oxidation

wet, light brown to orange, silt

orange fluid

grading to fine sandy silt

CLAYEY SILT (CL-ML):
wet, brown to gray, plastic, clayey silt
with organics (marsh grasses)

Bottom of Boring 15.0 feet
Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

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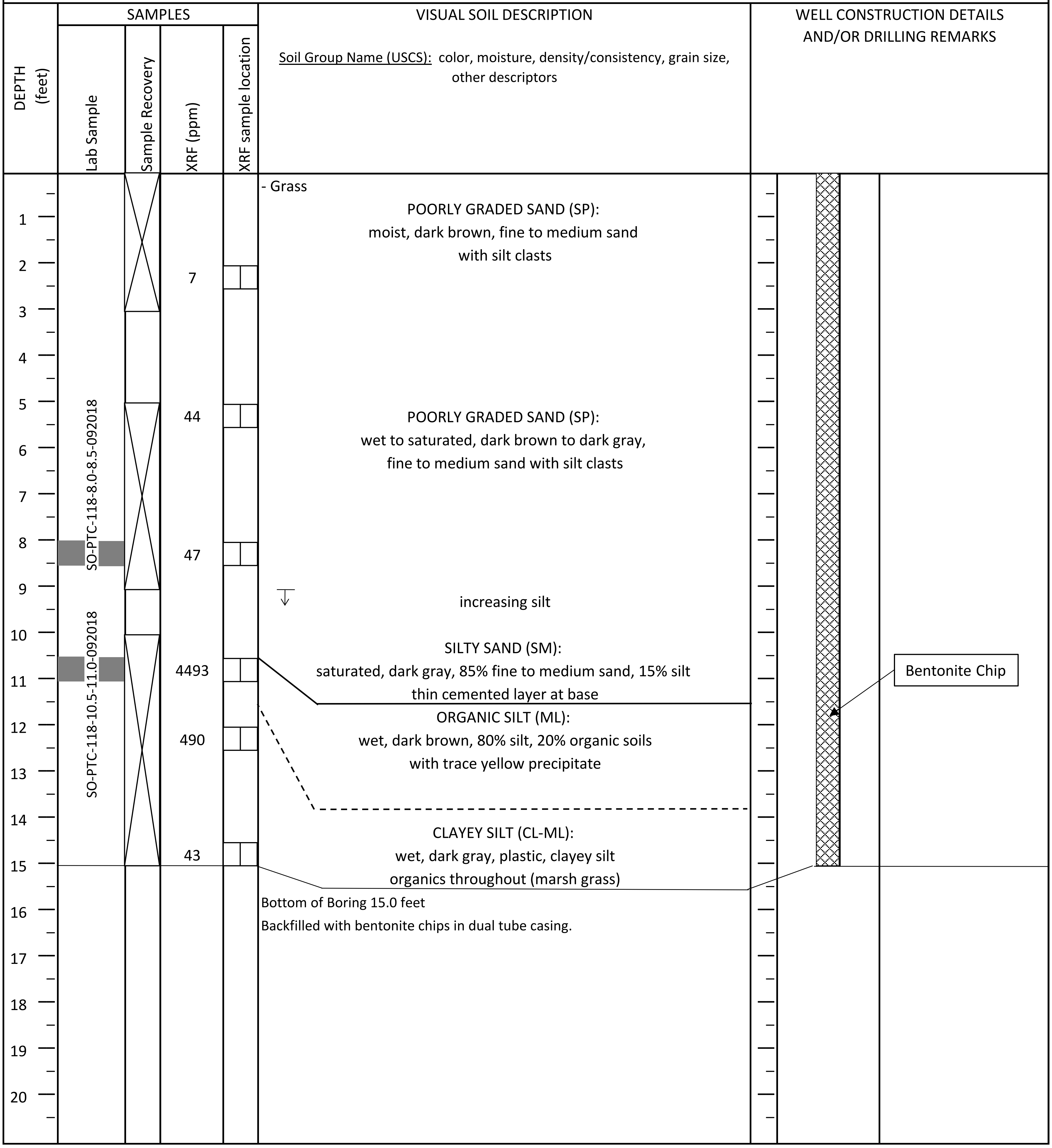
LOG OF PTC-118

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710850.1N 1175423.8E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 16.9 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 09/20/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



DEPTH (feet)	SAMPLES: Lab Sample	SAMPLES: XRF (ppm)	VISUAL SOIL DESCRIPTION: Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0			- Grass	
1			POORLY GRADED SAND (SP): moist, dark brown, fine to medium sand with silt clasts	
2		7		
5		44	POORLY GRADED SAND (SP): wet to saturated, dark brown to dark gray, fine to medium sand with silt clasts	
8	SO-PTC-118-8.0-8.5-092018	47		
9			∇ increasing silt	
10			SILTY SAND (SM): saturated, dark gray, 85% fine to medium sand, 15% silt thin cemented layer at base	
11	SO-PTC-118-10.5-11.0-092018	4493		Bentonite Chip
12		490	ORGANIC SILT (ML): wet, dark brown, 80% silt, 20% organic soils with trace yellow precipitate	
14			CLAYEY SILT (CL-ML): wet, dark gray, plastic, clayey silt organics throughout (marsh grass)	
15		43		
16			Bottom of Boring 15.0 feet Backfilled with bentonite chips in dual tube casing.	

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

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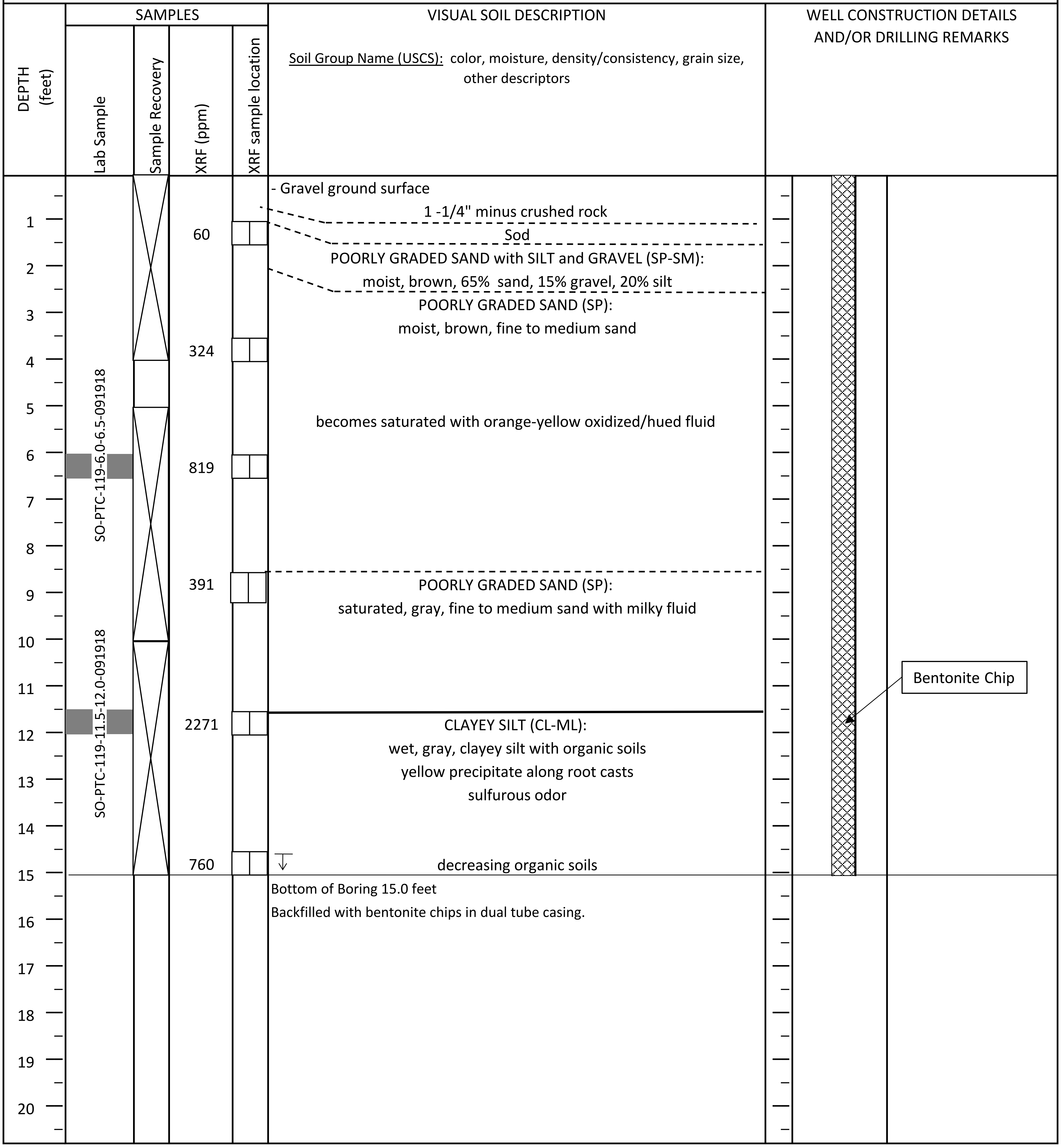
LOG OF PTC-119

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710942.1N 1175441.3E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 17.0 feet (MLLW)
DRILLING CONTRACTOR: Cascade	DATE: 09/19/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0 feet
DRILLING METHOD: Direct-Push	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper / REG. NO.: 1600
NOTES:	



VISUAL SOIL DESCRIPTION

Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

1 -1/4" minus crushed rock

Sod

POORLY GRADED SAND with SILT and GRAVEL (SP-SM):
moist, brown, 65% sand, 15% gravel, 20% silt

POORLY GRADED SAND (SP):
moist, brown, fine to medium sand

becomes saturated with orange-yellow oxidized/hued fluid

POORLY GRADED SAND (SP):
saturated, gray, fine to medium sand with milky fluid

CLAYEY SILT (CL-ML):
wet, gray, clayey silt with organic soils
yellow precipitate along root casts
sulfurous odor

decreasing organic soils

Bottom of Boring 15.0 feet
Backfilled with bentonite chips in dual tube casing.

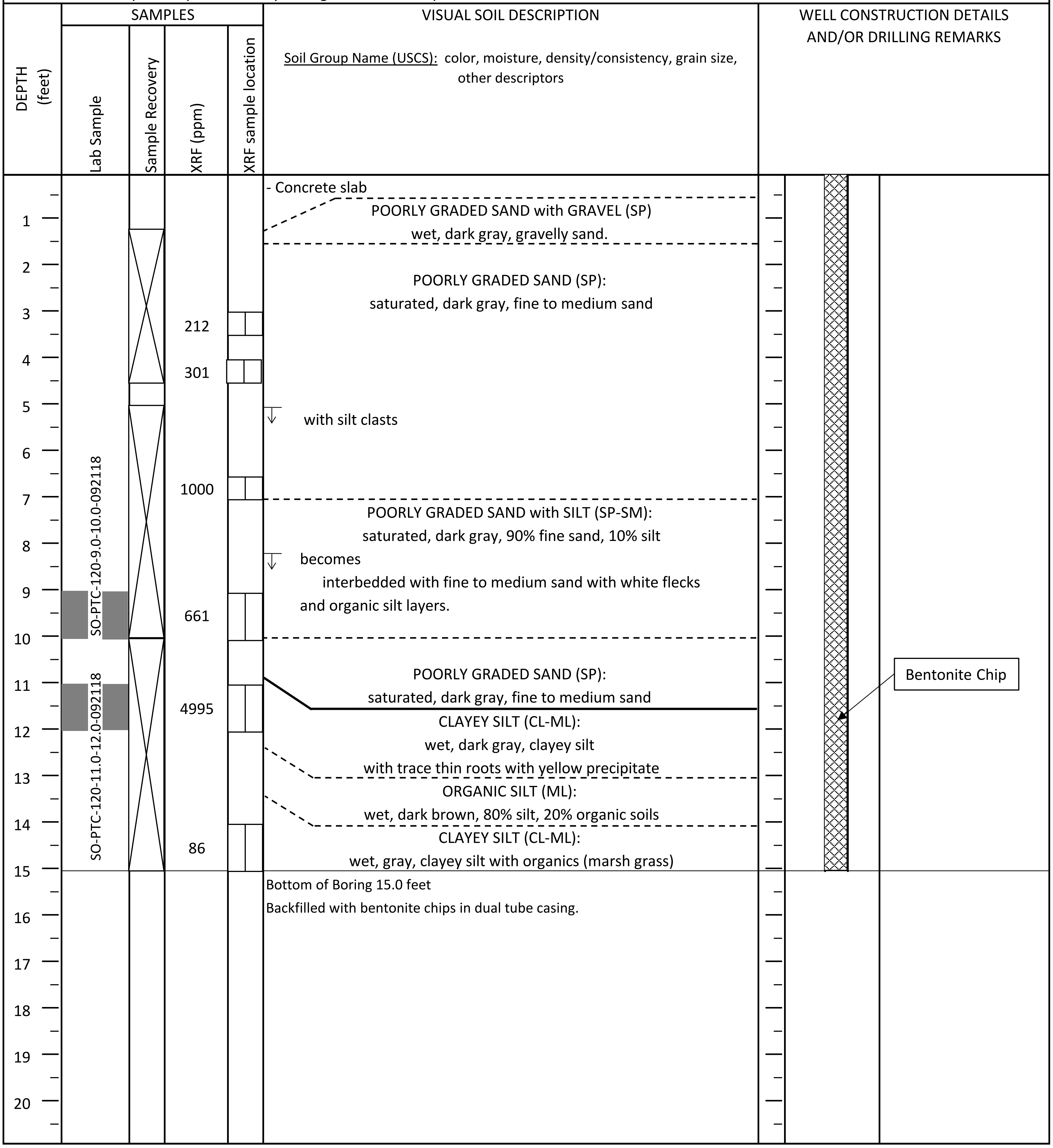
Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-120

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710771.0N 1175088.1E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 17.7 feet (MLLW)
DRILLING CONTRACTOR: Cascade	DATE: 09/21/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0 feet
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper — REG. NO.: 1600

NOTES: 3rd attempt after poor recovery during first two attempts



- Concrete slab

POORLY GRADED SAND with GRAVEL (SP)
wet, dark gray, gravelly sand.

POORLY GRADED SAND (SP):
saturated, dark gray, fine to medium sand

with silt clasts

POORLY GRADED SAND with SILT (SP-SM):
saturated, dark gray, 90% fine sand, 10% silt

becomes
interbedded with fine to medium sand with white flecks
and organic silt layers.

POORLY GRADED SAND (SP):
saturated, dark gray, fine to medium sand

CLAYEY SILT (CL-ML):
wet, dark gray, clayey silt
with trace thin roots with yellow precipitate

ORGANIC SILT (ML):
wet, dark brown, 80% silt, 20% organic soils

CLAYEY SILT (CL-ML):
wet, gray, clayey silt with organics (marsh grass)

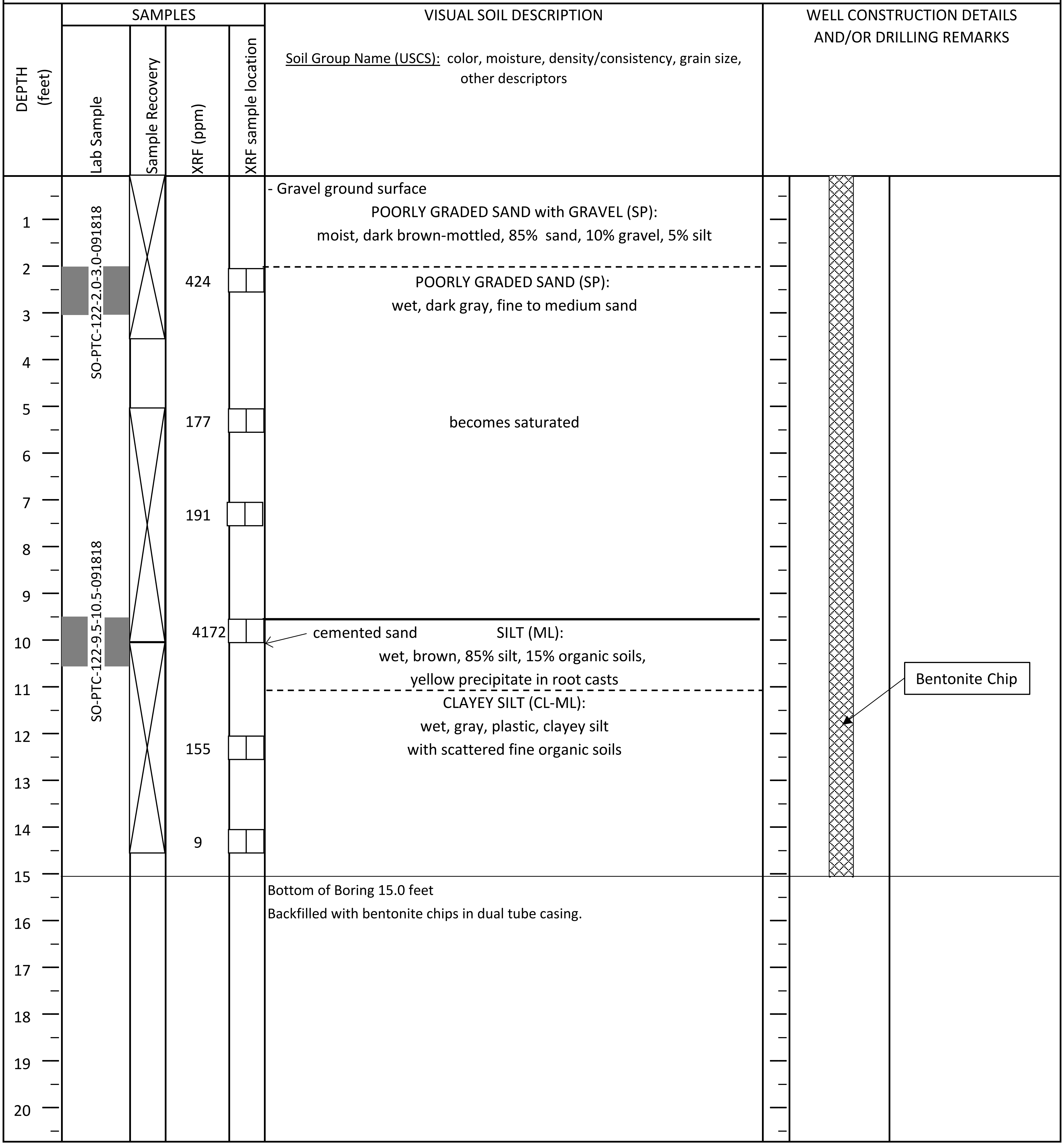
Bottom of Boring 15.0 feet
Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-122

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710984.9N 1175037.9E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 16.5 feet (MLLW)
DRILLING CONTRACTOR: Cascade	DATE: 09/18/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0 feet
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper
SAMPLING METHOD: 3" Dual Tube with 5'x2" dia.acrylic liner	RESPONSIBLE PROF.: D. Cooper — REG. NO.: 1600
NOTES:	



VISUAL SOIL DESCRIPTION

Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

- Gravel ground surface

POORLY GRADED SAND with GRAVEL (SP):
moist, dark brown-mottled, 85% sand, 10% gravel, 5% silt

POORLY GRADED SAND (SP):
wet, dark gray, fine to medium sand

becomes saturated

cemented sand

SILT (ML):
wet, brown, 85% silt, 15% organic soils,
yellow precipitate in root casts

CLAYEY SILT (CL-ML):
wet, gray, plastic, clayey silt
with scattered fine organic soils

Bottom of Boring 15.0 feet
Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

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LOG OF PTC-123

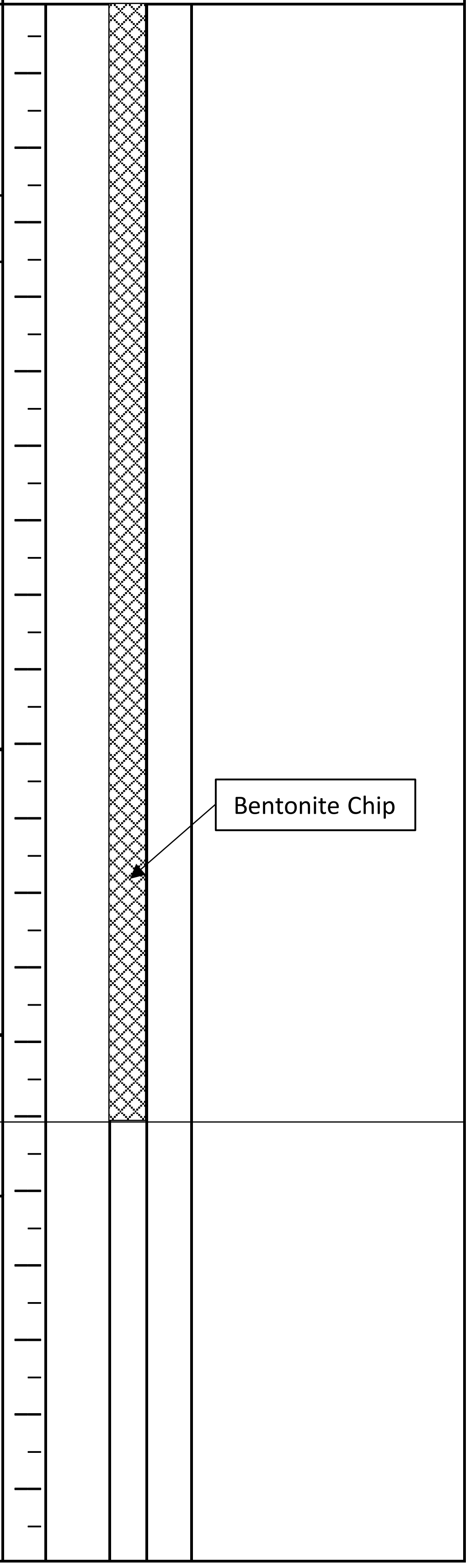
Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710939.9N 1175088.1E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 16.4 feet (MLLW)
DRILLING CONTRACTOR: Cascade	DATE: 09/17/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0 feet
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper
SAMPLING METHOD: 3" Dual Tube with 5'x2" dia.acrylic liner	RESPONSIBLE PROF.: D. Cooper / REG. NO.: 1600

NOTES:

DEPTH (feet)	SAMPLES: Lab Sample	SAMPLES: XRF (ppm)	VISUAL SOIL DESCRIPTION Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors
0			- Asphalt concrete
1			POORLY GRADED SAND (SP): moist, dark brown, fine to medium sand
2		957	geotextile fabric
3			black silty sand lense atop old concrete slab
3.5-4.0	SO-PTC-123-3.5-4.0-091718	827	POORLY GRADED SAND (SP): wet, dark gray, fine to medium sand
5			becomes saturated
7		558	
9			fine roots with yellow precipitate
9.5		448	
10			SILT (ML): wet, brown, stiff, 85% silt, 15% organic soils grass, roots with yellow precipitate in root casts
11.5		1337	
13.0-14.0	SO-PTC-123-13.0-14.0-091718	10167	
14		256	POORLY GRADED SAND (SP): saturated, dark gray, fine to medium sand, cemented at 14'
15			Bottom of Boring 15.0 feet Backfilled with bentonite chips in dual tube casing.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

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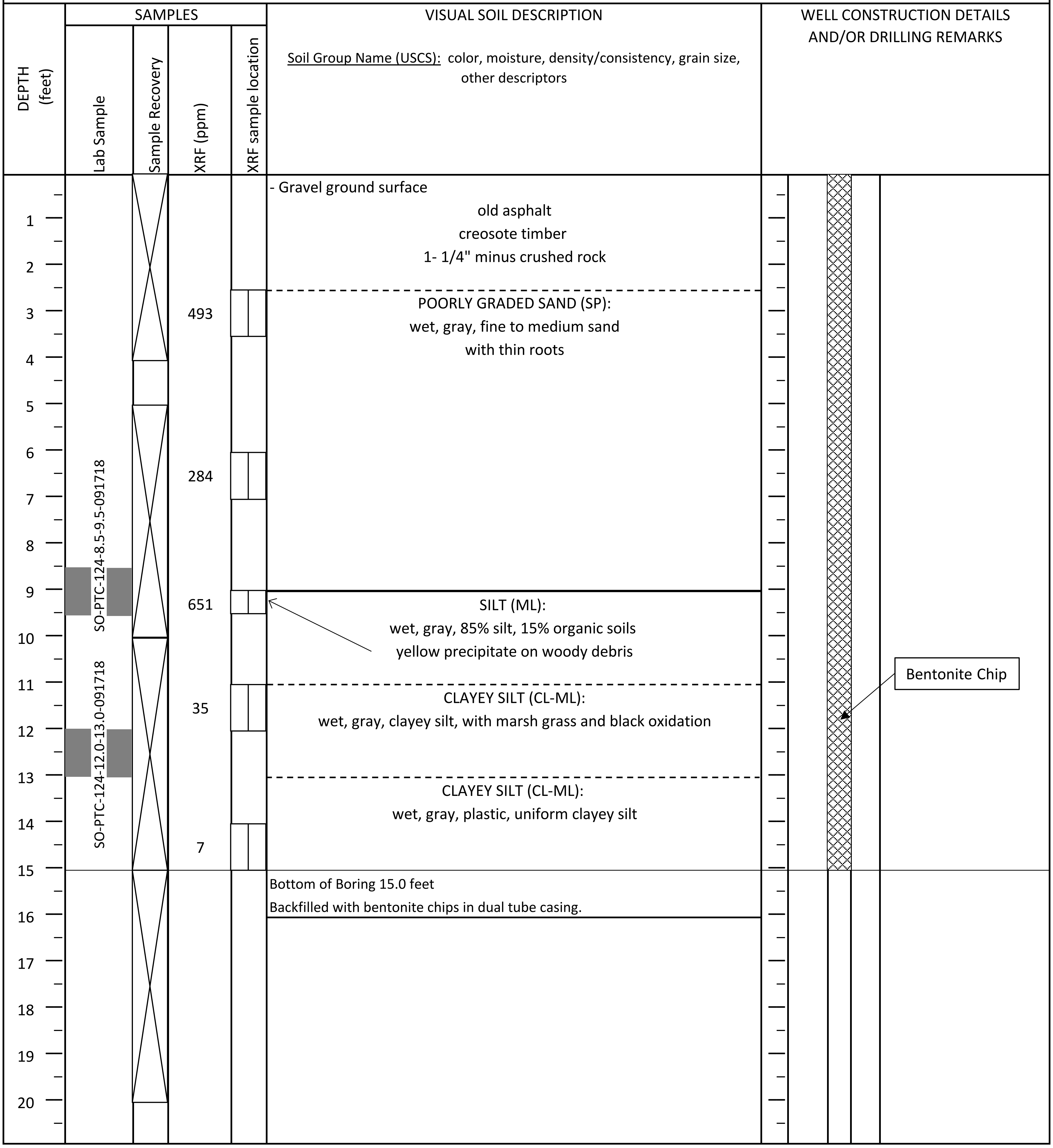
LOG OF PTC-124

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710847.494N 1175015.245E "NAD83"	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 16.6 feet (MLLW)	
DRILLING CONTRACTOR: Cascade	DATE: 09/17/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 3" Dual Tube with 5'x2" dia.acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES:		



- Gravel ground surface
old asphalt
creosote timber
1- 1/4" minus crushed rock

POORLY GRADED SAND (SP):
wet, gray, fine to medium sand
with thin roots

SILT (ML):
wet, gray, 85% silt, 15% organic soils
yellow precipitate on woody debris

CLAYEY SILT (CL-ML):
wet, gray, clayey silt, with marsh grass and black oxidation

CLAYEY SILT (CL-ML):
wet, gray, plastic, uniform clayey silt

Bottom of Boring 15.0 feet
Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-125

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710694.5N 1175028.8E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 16.7 feet (MLLW)
DRILLING CONTRACTOR: Cascade	DATE: 09/17/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0 feet
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper
SAMPLING METHOD: 3" Dual Tube with 5'x2" dia. acrylic liner	RESPONSIBLE PROF.: D. Cooper — REG. NO.: 1600

NOTES:

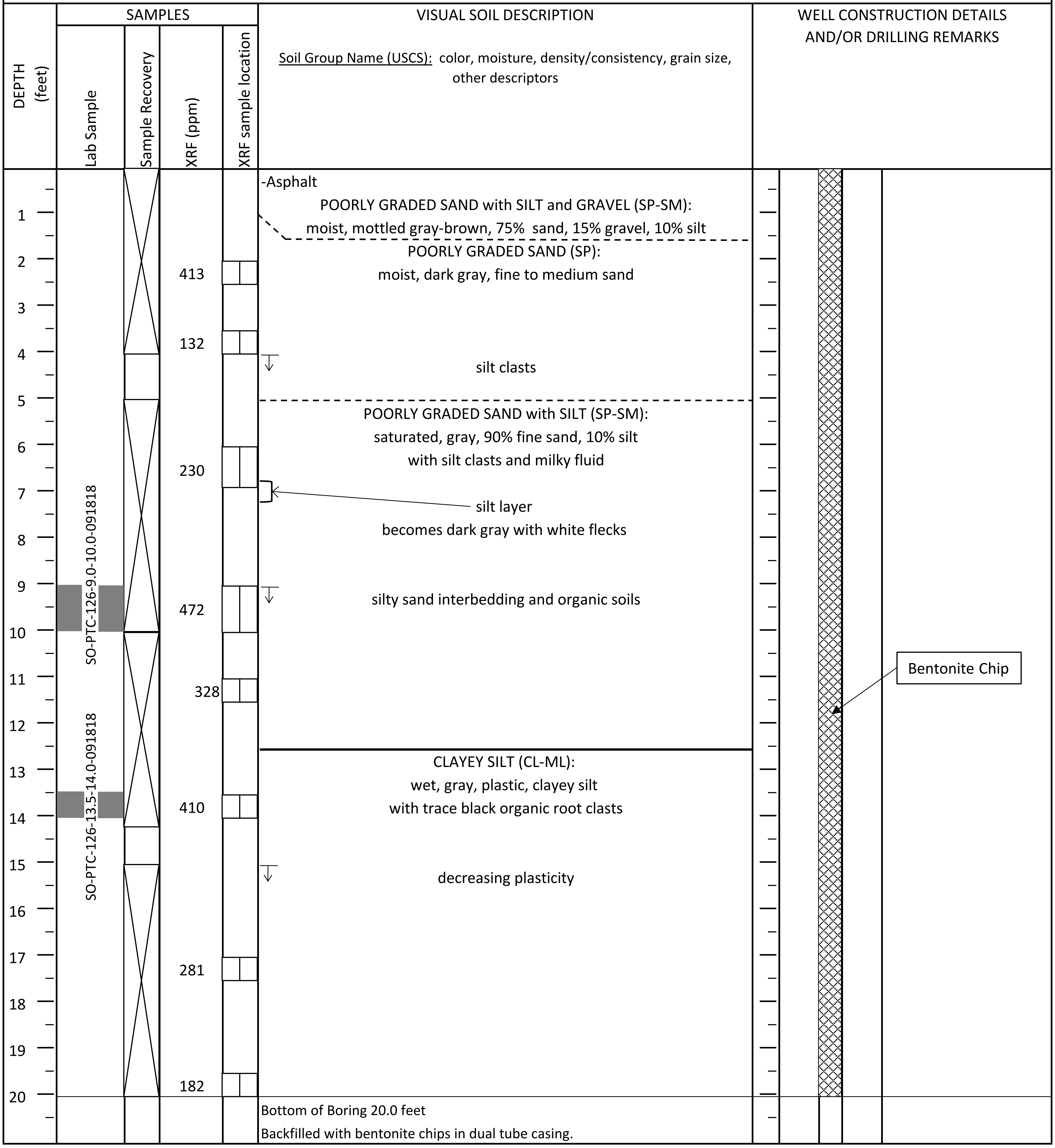
DEPTH (feet)	SAMPLES: Lab Sample	SAMPLES: Sample Recovery	SAMPLES: XRF (ppm)	SAMPLES: XRF sample location	VISUAL SOIL DESCRIPTION Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					- Gravel ground surface	
1	SO-PTC-125-1.0-2.0-091718		35	▭	POORLY GRADED SAND with SILT and GRAVEL (SP-SM): moist, mottledbrown, 75% sand, 15% gravel, 10% silt with roots and wood fragments	
2					POORLY GRADED SAND (SP): wet, gray, 95% fine to medium sand, 5% silt oxidation between 1' and 2'	
3						
4			11	▭		
5					▽ with silt clasts and becoming saturated	
6						
7			8	▭	▽ interbedding with SILTY SAND (SM): grading siltier with depth	
8						
9						
10					SILT (ML): wet, brown, soft, silt with organic soils heavy organic soils layer	
11			<7	▭	CLAYEY SILT (CL-ML): wet, gray, plastic, clayey silt marsh grasses	Bentonite Chip
12	SO-PTC-125-12.0-13.0-091718					
13					uniform clayey silt	
14			<8	▭		
15					Bottom of Boring 15.0 feet Backfilled with bentonite chips in dual tube casing.	
16						
17						
18						
19						
20						

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-126

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710694.7N 1175170.3E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 17.0 feet (MLLW)
DRILLING CONTRACTOR: Cascade	DATE: 09/18/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper REG. NO.: 1600
NOTES:	



VISUAL SOIL DESCRIPTION

Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors

-Asphalt

POORLY GRADED SAND with SILT and GRAVEL (SP-SM):
moist, mottled gray-brown, 75% sand, 15% gravel, 10% silt

POORLY GRADED SAND (SP):
moist, dark gray, fine to medium sand

silt clasts

POORLY GRADED SAND with SILT (SP-SM):
saturated, gray, 90% fine sand, 10% silt
with silt clasts and milky fluid

silt layer

becomes dark gray with white flecks

silty sand interbedding and organic soils

CLAYEY SILT (CL-ML):
wet, gray, plastic, clayey silt
with trace black organic root clasts

decreasing plasticity

Bottom of Boring 20.0 feet

Backfilled with bentonite chips in dual tube casing.

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

DALTON
OLMSTED
FUGLEVAND

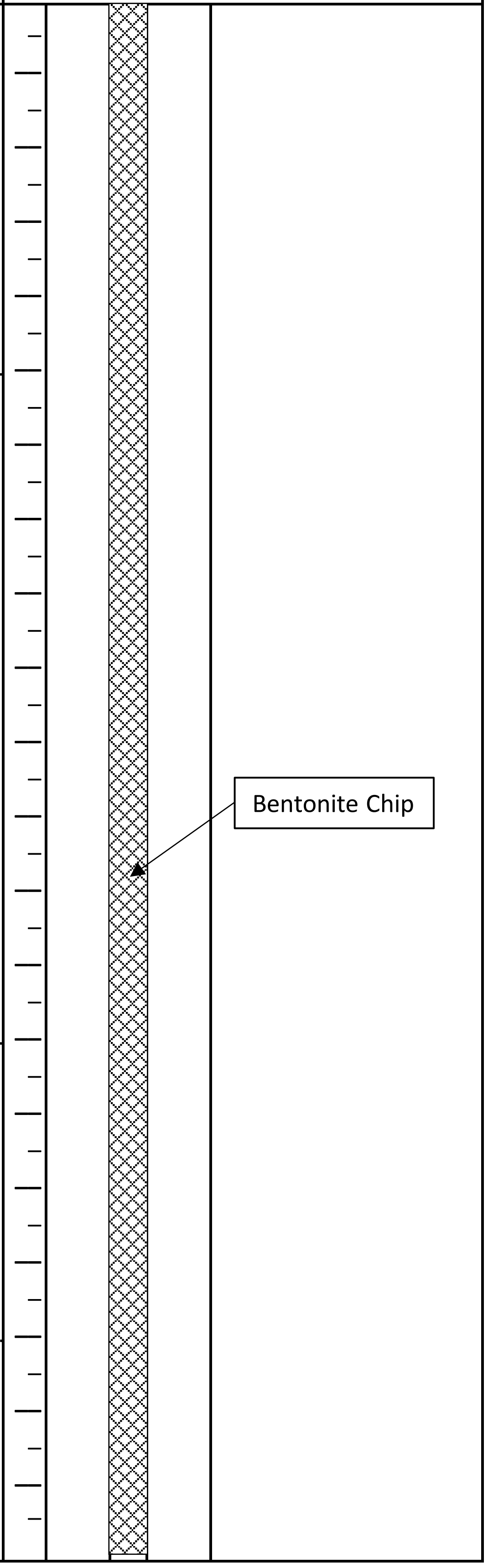
LOG OF PTC-127

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710739.0N 1175306.5E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 20.3 feet (MLLW)
DRILLING CONTRACTOR: Cascade	DATE: 09/18/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper REG. NO.: 1600
NOTES:	

DEPTH (feet)	SAMPLES Lab Sample	Sample Recovery	XRF (ppm)	XRF sample location	VISUAL SOIL DESCRIPTION Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors
0					- Gravel ground surface
1					POORLY GRADED SAND with SILT and GRAVEL(SP-SM): moist, brown, 70% sand, 15% gravel, 15% silt
2			78		
3					
4					
5			54		POORLY GRADED SAND with SILT (SP-SM): wet, brown, 90% fine to medium sand, 10% silt
6					
7	SO-PTC-127-7.0-7.5-091818		209		becomes saturated
8					
9					
10			186		▽ gray-brown mottling, silt clasts, milky fluid
11					
12			22		
13					
14					POORLY GRADED SAND (SP): saturated, dark gray, fine to medium sand
15			91		
16					
17	SO-PTC-127-17.0-17.5-091818		4008		SILT (ML): wet, dark brown, 85% silt, 15% organic soils
18					CLAYEY SILT (CL): wet, gray, clayey silt, organic soils and marsh grass
19					▽ becomes uniform, plastic
20			9		Bottom of Boring 21.0 feet Backfilled with bentonite chips in dual tube casing.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

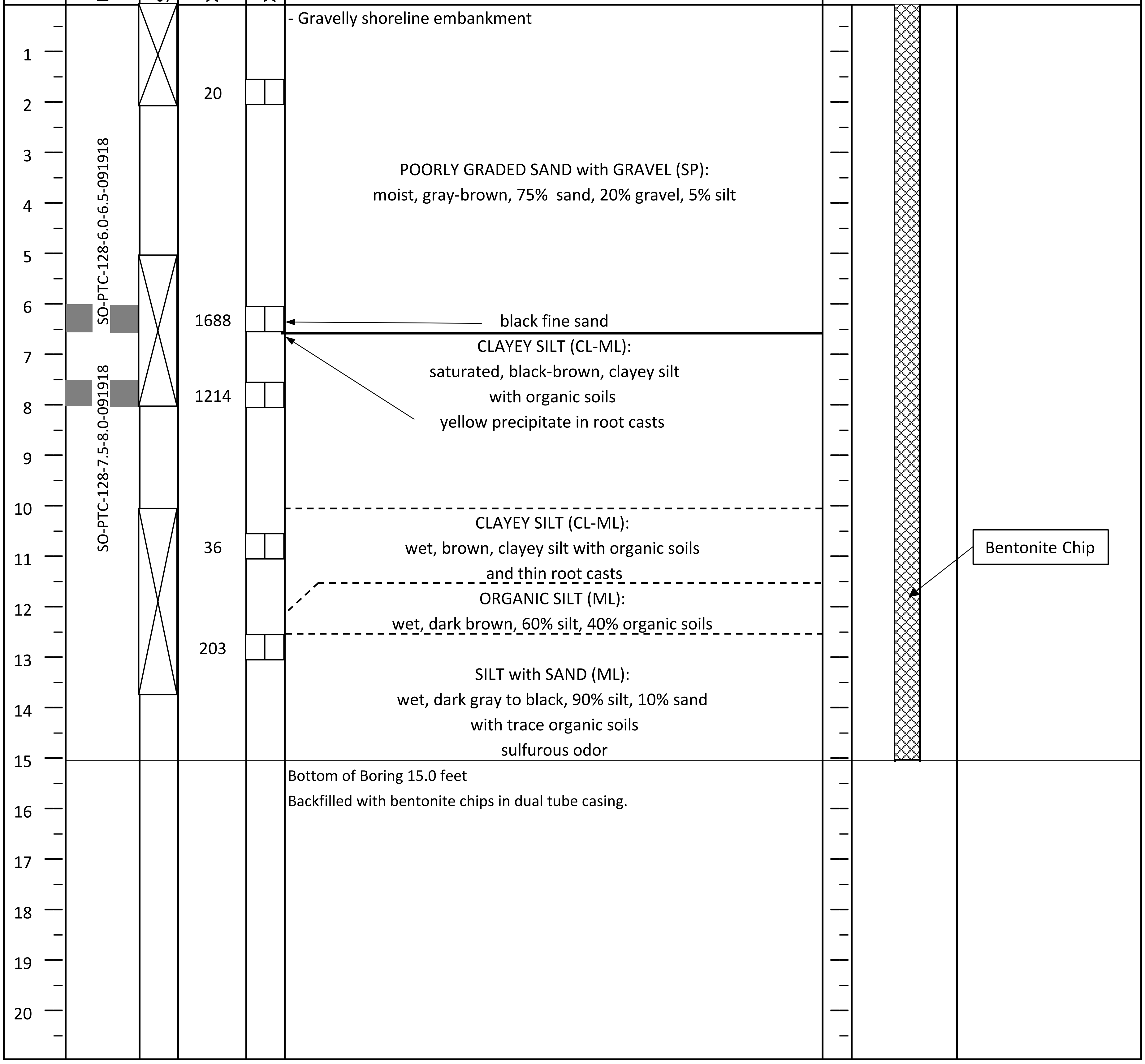
DALTON OLMSTED FUGLEVAND

LOG OF PTC-128

Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 711086.9N 1175301.6E (NAD83)	
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 15.2 feet	
DRILLING CONTRACTOR: Cascade	DATE: 09/19/2018	
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 15.0 feet	
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper	
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper	REG. NO.: 1600
NOTES: Hylebos Waterway-side of sheetpile wall		

DEPTH (feet)	SAMPLES: Lab Sample	SAMPLES: Sample Recovery	SAMPLES: XRF (ppm)	SAMPLES: XRF sample location	VISUAL SOIL DESCRIPTION Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0					- Gravelly shoreline embankment	
2			20			
3–4					POORLY GRADED SAND with GRAVEL (SP): moist, gray-brown, 75% sand, 20% gravel, 5% silt	
6	SO-PTC-128-6.0-6.5-091918		1688		black fine sand	
7					CLAYEY SILT (CL-ML): saturated, black-brown, clayey silt with organic soils yellow precipitate in root casts	
8	SO-PTC-128-7.5-8.0-091918		1214			
10–11			36		CLAYEY SILT (CL-ML): wet, brown, clayey silt with organic soils and thin root casts	Bentonite Chip
12					ORGANIC SILT (ML): wet, dark brown, 60% silt, 40% organic soils	
13–15			203		SILT with SAND (ML): wet, dark gray to black, 90% silt, 10% sand with trace organic soils sulfurous odor	
15					Bottom of Boring 15.0 feet Backfilled with bentonite chips in dual tube casing.	



Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

LOG OF PTC-130

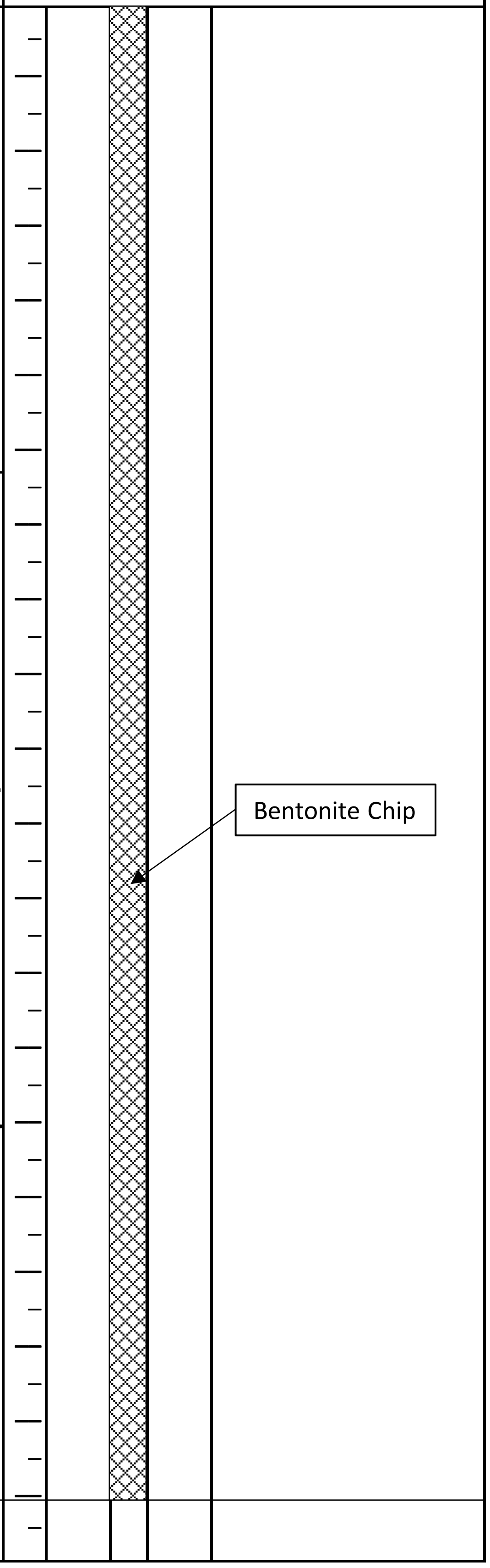
Sheet 1 of 1

PROJECT: Arkema FS Data Gap 2018	COORDINATES: 710951.9N 1175445.9E (NAD83)
LOCATION: 2901 Taylor Way Tacoma WA	SURFACE ELEVATION: 14.2 feet
DRILLING CONTRACTOR: Cascade	DATE: 09/19/2018
DRILLING EQUIPMENT: Geoprobe 7822 DT	TOTAL DEPTH OF BORING: 20.0 feet
DRILLING METHOD: Direct-Push	LOGGED BY: D. Cooper
SAMPLING METHOD: 4" Dual Tube with 5'x2"acrylic liner	RESPONSIBLE PROF.: D. Cooper — REG. NO.: 1600

NOTES: Hylebos Waterway-side of sheet pile wall

DEPTH (feet)	SAMPLES: Lab Sample	SAMPLES: XRF (ppm)	VISUAL SOIL DESCRIPTION Soil Group Name (USCS): color, moisture, density/consistency, grain size, other descriptors
0			- Gravelly shoreline embankment
1		13	
3			POORLY GRADED SAND with GRAVEL (SP): moist, brown, 80% sand, 20% gravel
6.5			POORLY GRADED SAND with SILT (SP-SM): wet to saturated, mottled brown, 85% fine to medium sand, 10% silt, 5% gravel with orange oxidation banding and silt clasts
7		99	
9.5–10	SO-PTC-130-9.5-10.0-091918	100	
10.5			ORGANIC SILT (ML): saturated, black, soft, organic silt
11–11.5	SO-PTC-130-11.0-11.5-091918	267	SILT (ML): moist, gray, non-plastic, silt
12–13			black, fine sand interbeds
13		101	
15			POORLY GRADED SAND (SP): saturated, dark gray, fine to medium sand
16		84	silt clast
18		230	cemented
20			Bottom of Boring 20.0 feet Backfilled with bentonite chips in dual tube casing.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

APPENDIX B
FIELD FORMS

FS DATA GAP INVESTIGATION 2018
FIELD MEASUREMENTS/SAMPLING
FORMER ARKEMA MANUFACTURING SITE
TACOMA, WASHINGTON

- Shallow Wells
- Intermediate Wells
- Deep Wells
- Angled Shoreline Wells
- Pore Water & Surface Water
- Duplicate and Equipment Blanks
- Shoreline Sediment Samples

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Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/5/18

Well No. 4C1-1

well depth (top PVC)	14.70					
water level(top PVC)	6.30					
water height	8.40					
time	1330					
Casing/Volume						
type:	4"-PVC					
type: other						
vol/ft	0.653					
tot. vol	5.49					
3 x vol						
Purge Volume	~500 mL/min					
gallons purged	0.50	1.00 gal	2.00 gal.			
purge/bail/type	PERI - LF.					
Water Sample						
Sample No.			GW-4C1-1-1005[illegible]18-(20)			
Sample Method			PERI - LF			
Time			1345			
No. Cont.			1-500 mL POLY			
Initials			AC.			
pH						
value YSI PRO +	10.74	10.80	10.81			
time						
Conductivity ~~(S/cm)~~						
value µS/cm	4548	4555	4548			
time						
Temp. (Celsius)						
value	16.9	17.2	17.3			
time						
DO (mg/l)						
value	0.03	0.00	0.00			
time						
ORP (mV)						
value	-56.9	-68.0	-76.0			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			7.05			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: • M. BROWN w/ EFFERVESCENCE & H_2S/METHANE ODOR.

– FIELD FILTERED TO 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/5/18

Well No. 4D1-1

well depth (top PVC)	14.90					
water level(top PVC)	5.80					
water height	9.10					
time	1350					
Casing/Volume						
type:	4" - PVC					
type: other						
vol/ft	0.653					
tot. vol	5.94					
3 x vol						
Purge Volume ~500 mL/min.						
gallons purged	0.50	2.0 gal	4.0 gal	4.5 gal.		
purge/bail/type	PERI - LF					
Water Sample						
Sample No.				GW-4D1-1-1005[illegible]18-(20)		
Sample Method				PERI - LF		
Time				1415		
No. Cont.				1-500 mL POLY		
Initials				AC.		
pH						
value YSI PRO +	11.41	11.46	11.47	11.47		
time						
Conductivity (~~S/cm~~)						
value µS/cm	13645	13300	12264	12134		
time						
Temp. (Celsius)						
value	15.1	15.1	15.5	15.6		
time						
DO (mg/l)						
value	0.00	0.03	0.00	0.00		
time						
ORP (mV)						
value	-275.0	-300.9	-312.7	-313.9.		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value				6.52		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: - DK BROWN, EFFERVESCENT w/ H_2S / METHANE ODOR.

- FIELD FILTERED TO 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: ~~5B1-1(R)~~ 10/11/18

Well No. 5B1-1(R)

well depth (top PVC)	12.30					
water level(top PVC)	8.05					
water height	4.25					
time	1250					
Casing/Volume						
type:	2" - PVC					
type: other						
vol/ft	0.163					
tot. vol	0.69					
3 x vol						
Purge Volume	~~~250 mL/min~~ AC ~500mL/min.					
gallons purged	0.250	1.5	2.0			
purge/bail/type	PERI - LF.					
Water Sample						
Sample No.			GW-5B1-1(R)-1011[illegible]18-(20)			
Sample Method			PERI - LF			
Time			1310			
No. Cont.			3 - (2) HDPE (1) FLPE.			
Initials			AC.			
pH						
value	10.16	10.10	10.05			
time YSI PRO +						
Conductivity (~~S/cm~~)						
value mS/cm	5800	2716	2709			
time						
Temp. (Celsius)						
value	17.2	17.6	17.7			
time						
DO (mg/l)						
value	0.98	0.38	0.28			
time						
ORP (mV)						
value	24.4	-11.2	-21.2			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			3.60			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: MED BROWN; BECOMES TAN.

* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/5/18

Well No. 5C#2-1

well depth (top PVC)	17.10					
water level(top PVC)	6.5					
water height	16.02					
time	1030					
Casing/Volume						
type:	4" - PVC					
type: other						
vol/ft	0.653					
tot. vol	10.46					
3 x vol						
Purge Volume	~500mL/Min.					
gallons purged	0.5 gal	2 gal	3 gal	4 gal.		
purge/bail/type						
Water Sample						
Sample No.	~~0.5~~ AC	~~2 gal~~ AC	~~3 gal~~ AC	~~5 gal~~ AC	GW-5C#2-1-1005[illegible]18-(20)	
Sample Method					PERI - LF	
Time					1100	
No. Cont.					1-500mL POLY	
Initials					AC	
pH						
value	12.08	11.77	11.67	11.59		
time						
Conductivity µS/cm)						
value	8895	7315	7018	6859		
time						
Temp. (Celsius)						
value	18.6	18.9	18.8	18.9		
time						
DO (mg/l)						
value	0.08	0.00	0.00	0.00		
time						
ORP (mV)						
value	-277.1	-293.6	-292.4	-280.0		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	~~[illegible]~~ AC	~~3~~ AC		3.21		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: - TAN COLOR/SLIGHT H_2S ODOR.
-

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

* FIELD FILTERED TO 0.45 µm.

Arkema MWSAMPL.XLS

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/5/18

Well No. ~~5C-13~~ AC 5C13-1

well depth (top PVC)	14.10					
water level(top PVC)	5.80					
water height	8.30					
time	0915					
Casing/Volume						
type:	4" - PVC					
type: other						
vol/ft	0.653					
tot. vol	5.42					
3 x vol						
Purge Volume	~500mL / min					
gallons purged	0.5 gal.	2 gal	3 gal	3.5 gal.		
purge/bail/type	PERI					
Water Sample						
Sample No.				GW-5C13-1-1005[illegible]18-(20)		
Sample Method				PERI - LF		
Time				1000		
No. Cont.				1-500mL POLY		
Initials				AC.		
pH						
value	10.44	10.69	10.75	10.30		
time						
Conductivity ~~(S/cm)~~						
value µS/cm	22000	18500	11860	8750		
time						
Temp. (Celsius)						
value	18.2	18.5	18.8	18.9		
time						
DO (mg/l)						
value	0.15	0.06	0.00	0.00		
time						
ORP (mV)						
value	-282.1	-294.6	-299.3	-291.8		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value				6.35		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: * MED. BROWN TO TAN ~2.5 gal purge.

- FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/5/18

Well No. 5C16-1R

well depth (top PVC)	12.40					
water level(top PVC)	7.15					
water height	4.25					
time	1205					
Casing/Volume						
type:	2" - PVC					
type: other						
vol/ft	0.163					
tot. vol	0.69 gal					
3 x vol						
Purge Volume	~530 mL/min					
gallons purged	0.25 gal	0.5 gal	1.0 gal			
purge/bail/type	PERI-LF					
Water Sample						
Sample No.				GW-5C16-1R-100518-(20)		
Sample Method				PERI-LF		
Time				1230		
No. Cont.				1 - 500 mL		
Initials				AC		
pH						
value	8.38	8.37	8.45			
time YSI PRO+						
Conductivity ~~(S/cm)~~						
value µS/cm	1760	1750	1860			
time						
Temp. (Celsius)						
value	17.3	17.5	17.5			
time						
DO (mg/l)						
value	0.00	0.02	0.00			
time						
ORP (mV)						
value	-180.0	-182.0	-188.9			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			0.68			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: –

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

- FIELD FILTERED TO 0.45 µm

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 05 2018

Well No. 5D2-1R

well depth (top PVC)	17.44					
water level(top PVC)	8.07					
water height	9.37					
time	915					
Casing/Volume						
type:	PVC					
type: other	2"					
vol/ft	0.163					
tot. vol	1.53					
3 x vol						
Purge Volume						
gallons purged	1	2	3	4	5	6
purge/bail/type	9:26	932				
Water Sample						
Sample No.						GW-5D2-1R-100518-(20)
Sample Method						
Time						
No. Cont.						
Initials						
pH	750 ml/min					
value	11.06	10.95	10.92	10.85	10.83	10.81
time	9:26	9:32	9:38	944	9:50	956
Conductivity (μS/cm)						
value	7617	6421	5665	5203	4961	4896
time						
Temp. (Celsius)						
value	17.7	17.8	17.8	17.9	17.9	18.0
time						
DO (mg/l)						
value	0.19	0.10	0.04	0.05	0.03	0.23
time						
ORP (mV)						
value	-198.2	-201.1	-206.5	-213.3	-219.2	-224.2
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	6.41	4.97	4.78	4.17	3.70	3.86
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PRO PLUS

COMMENTS:
LIGHT BROWN, EFFERVESCENT, SULFUR ODOR

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

FIELD DUP

Arkema MWSAMPL.XLS

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERNUTI
Date: 10|15|18

Well No. 5D5-1

well depth (top PVC)	17.50					
water level(top PVC)	5.90					
water height	11.60					
time	1300					
Casing/Volume						
type:	4"- PVC					
type: other						
vol/ft	0.653					
tot. vol	7.57					
3 x vol						
Purge Volume ~500 mL/min -						
gallons purged	1.0	2.5	3.5	5.0	6.0	7.50
purge/bail/type	PERI - LF					
Water Sample						
Sample No.						GW-5D5-1-101518-(20)
Sample Method						PERI - LF
Time						1330
No. Cont.						1- 500 mL POLY
Initials						A. CERNUTI
pH						
value YSI PRO +	6.50	6.70	6.89	6.97	7.00	7.01
time						
Conductivity (~~S/cm~~)						
value µS/cm	21893	17350	10896	9280	8518	8515
time						
Temp. (Celsius)						
value	18.0	18.6	18.7	18.7	18.7	18.7
time						
DO (mg/l)						
value	0.80	0.40	0.19	0.10	0.07	0.07
time						
ORP (mV)						
value	-39.1	-81.1	-101.3	-122.5	-146.8	152.7
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						7.56
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

*FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: E. BEAVER
Date: 10/5/18

Well No. 5D7-1R

well depth (top PVC)	12.94					
water level(top PVC)	6.82					
water height	6.12					
time	1040					
Casing/Volume						
type:	PVC					
type: other	2"					
vol/ft						
tot. vol	1.00					
3 x vol						
Purge Volume						
gallons purged	1	2	3	4	5	6
purge/bail/type						
Water Sample						
Sample No.						GW-5D7-1R-100518-(20)
Sample Method						
Time						1115
No. Cont.						
Initials						
pH		750ml/min				
value	7.56	7.53	7.52	7.51	7.60	7.49
time	1045	1051	1056	1101	1107	1113
Conductivity (µS/cm)						
value	1069	1075	1088	1090	1107	1108
time						
Temp. (Celsius)						
value	18.7	18.8	18.7	18.7	18.8	18.8
time						
DO (mg/l)			EB			
value	8.16	0.37	~~2.2~~ 0.20	0.14	0.14	0.08
time						
ORP (mV)						
value	-168.2	-152.9	-150.6	-151.3	-150.6	-152.5
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	7.72	5.88	7.12	4.60	6.28	5.27
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

PROPLUS YSI

COMMENTS: CLEAR

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/15/18

Well No. 5E1-1

well depth (top PVC)	12.15					
water level(top PVC)	4.95					
water height	7.20					
time	1220					
Casing/Volume						
type:	2" - PVC.					
type: other						
vol/ft	0.163					
tot. vol	1.18					
3 x vol						
Purge Volume ~500mL/min						
gallons purged	0.5	1.0	2.0			
purge/bail/type	PERI-LF					
Water Sample						
Sample No.			GW-5E1-1-101518-(20)			
Sample Method			PERI-LF			
Time			1235			
No. Cont.			1 - 500 mL POLY			
Initials			AC			
pH						
value	6.57	6.43	6.40			
time YSI PRO +						
Conductivity ~~(S/cm)~~						
value µS/cm	558.2	561.7	556.0			
time						
Temp. (Celsius)						
value	18.3	18.4	18.4			
time						
DO (mg/l)						
value	0.48	0.35	0.32			
time						
ORP (mV)						
value	-59.0	-52.1	-51.3.			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			4.90			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/15/18

Well No. 5E2-1

well depth (top PVC)	11.40					
water level(top PVC)	5.15					
water height	6.25					
time	1120					
Casing/Volume						
type:	2" -PVC					
type: other						
vol/ft	0.163					
tot. vol	1.01					
3 x vol						
Purge Volume	0.500 mL/min					
gallons purged	0.50	2.00	2.50			
purge/bail/type	PERI - LF					
Water Sample						
Sample No.			GW-5E2-1-101518-(20)			
Sample Method			PERI - LF			
Time			1145			
No. Cont.			1 - 500 mL POLY			
Initials			A. CERRUTI			
pH						
value YSI PRO +	7.21	7.20	7.21			
time						
Conductivity (S/cm)						
value µS/cm	2175	2180	2190			
time						
Temp. (Celsius)						
value	19.4	19.5	19.5			
time						
DO (mg/l)						
value	0.12	0.12	0.11			
time						
ORP (mV)						
value	-94.7	-95.2	-96.2			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			7.62			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: *BROWN WATER w/ EFFERVESCENCE & H_2S ODOR

*FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/15/18

Well No. 5E2-1 DUPLICATE

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	GW-5E2-1-101518-(21)					
Sample Method	PERI-LF					
Time	1150					
No. Cont.	1-500 mL POLY					
Initials	A. CERRUTI					
pH						
value						
time						
Conductivity (S/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

*FIELD FILTERED TO 0.45 μm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 05 2018

Well No. 5E4-1

well depth (top PVC)	11.10					
water level(top PVC)	3.23					
water height	8.73					
time						
Casing/Volume						
type:	PVC					
type: other	2"					
vol/ft	0.163					
tot. vol	1.37					
3 x vol						
Purge Volume						
gallons purged	1	2	3	4	5	
purge/bail/type						
Water Sample			300 ml/min			
Sample No.						
Sample Method					GW-5E4-1-100518-(2)	
Time					1230	
No. Cont.						
Initials						
pH		700 ml/min				
value	8.86	8.84	8.87	8.84	8.83	
time	1153	1158	1222	1225	1237	
Conductivity (S/cm)						
value	5006	6012	6056	6345	6523	
time						
Temp. (Celsius)						
value	18.2	18.2	18.1	18.1	18.2	
time						
DO (mg/l)						
value	0.08	0.04	0.15	0.04	0.04	
time						
ORP (mV)						
value	-131.4	-115.0	-191.3	-204.4	-210.4	
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	10.0	2.35	2.23	2.09	1.74	
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

MED BROWN

SLIGHT SULFUR ODOR

SLIGHTLY EFFERVESCENT

FIELD FILTERED

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A CERRUTI
Date: 10/15/18

Well No. ~~6.6~~ AC 5E8-1

well depth (top PVC)	13.2					
water level(top PVC)	6.65					
water height	6.55					
time	1045					
Casing/Volume						
type:	2" - PVC					
type: other						
vol/ft	0.163					
tot. vol	1.07					
3 x vol						
Purge Volume ~500mL/min.						
gallons purged	1.00	2.00	2.50			
purge/bail/type	PERI-LF.					
Water Sample						
Sample No.				GW-SE8-1-101518-(20)		
Sample Method				PERI-LF		
Time				1110		
No. Cont.				1-500mL POLY		
Initials				A. CERRUTI		
pH						
value YSI PRO+	7.78	7.57	7.50			
time						
Conductivity (~~S/cm~~)						
value µS/cm	539.2	538.0	534.6			
time						
Temp. (Celsius)						
value	18.9	18.8	18.8			
time						
DO (mg/l)						
value	1.16	0.50	0.45			
time						
ORP (mV)						
value	-73.3	-79.3	-86.2			
time						
TDS (ppt)						
value			~~6~~ AC			
time						
Turbidity (ntu)						
value			6.30			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

*FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/4/18

Well No. 6D14-1

well depth (top PVC)	12.90					
water level(top PVC)	6.30					
water height	6.60					
time	1250					
Casing/Volume						
type:	2" - PVC					
type: other						
vol/ft	0.163					
tot. vol	1.07 gal.					
3 x vol						
Purge Volume	250 ML/L					
gallons purged	0.250 gal	0.50 gal	1.00 gal			
purge/bail/type						
Water Sample						
Sample No.	~~0.~~ AC		GW-6D14-1-100418-(20)			
Sample Method			PERI - LF			
Time			1315			
No. Cont.			1 - 500mL			
Initials			AC			
pH						
value YSI-PRO+	6.16	6.03	6.01			
time						
Conductivity (µS/cm)						
value	19500	19154	18140			
time						
Temp. (Celsius)						
value	16.3	16.3	16.2			
time						
DO (mg/l)						
value	0.18	0.22	0.10			
time						
ORP (mV)						
value	-147.7	-133.5	-132.6			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			3.49			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: * SLIGHT EFFERVESCENCE & H_2S ODOR
* SOME FLOCULATION OBSERVED ON TAPE/TUBING.
* FIELD FILTERED to 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/4/18

Well No. 6D25-1

well depth (top PVC)	16.20					
water level(top PVC)	8.80					
water height	7.40					
time	1430					
Casing/Volume						
type:	2"-PVC					
type: other						
vol/ft	0.163					
tot. vol	1.20					
3 x vol						
Purge Volume						
gallons purged	1 gal	2 gal.	3 gal.			
purge/bail/type						
Water Sample						
Sample No.			GW-6D25-1-1004[illegible]18			
Sample Method			PERI - LF			
Time			1500			
No. Cont.			1-500mL	POLY		
Initials			AC			
pH						
value	8.75	8.72	8.70			
time						
Conductivity (μS/cm)						
value	2199	2157	2136			
time						
Temp. (Celsius)						
value	18.6	18.6	18.6			
time						
DO (mg/l)						
value	0.02	0.04	0.07			
time						
ORP (mV)						
value	-213.9	-217.1	-216.7			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			7.00			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: * 6D25-1 (N)

* SLIGHT TAN COLOR

* FIELD FILTERED TO 0.45 μm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/4/18

Well No. 6E1-1

well depth (top PVC)	15.00					
water level(top PVC)	7.80					
water height	7.20					
time	1330					
Casing/Volume						
type:	4" PVC					
type: other						
vol/ft	0.653					
tot. vol	4,70					
3 x vol						
Purge Volume						
gallons purged	0,50 gal	2 gal	3 gal	4 gal		
purge/bail/type						
Water Sample						
Sample No.				GW-6E1-1-1004[illegible]18-(20)		
Sample Method				PER-LF		
Time				1400		
No. Cont.				1 - 500 mL	POLY	
Initials				AC		
pH						
value YSI PRO+	6,94	6,89	6,88	6,88		
time						
Conductivity (μS/cm)						
value	842	910	1031	1057		
time						
Temp. (Celsius)						
value	17.4	17.4	17.4	17.4		
time						
DO (mg/l)						
value	1.4	0.19	0.12	0.08		
time						
ORP (mV)						
value	-131.0	-118.2	-113.9	-112.3		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value				1,12		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: –

*FIELD FILTERED to 0.45 μm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/16/18

Well No. 6E2-1

well depth (top PVC)	14.70					
water level(top PVC)	5.10					
water height	9.60					
time	0845					
Casing/Volume						
type:	2" - SS					
type: other	MAYBE 1.5"					
vol/ft	0.163					
tot. vol	1.5					
3 x vol						
Purge Volume ~ 500mL/min						
gallons purged	0.5 gal	1.5	2.5	3.0	3.5	
purge/bail/type	PERI - LF					
Water Sample						
Sample No.					GW-6E2-1-101618-(ZC)	
Sample Method					PERI - LF	
Time					0930	
No. Cont.					1- 500mL POLY	
Initials					A. CERRUTI	
pH						
value YSI PRO+	6.50	6.55	6.66	6.67	6.68	
time						
Conductivity (S/cm)						
value µS/cm	20500	7665	6250~~0~~ AC	5950	5946	
time						
Temp. (Celsius)						
value	15.2	15.7	15.7	15.7	15.7	
time						
DO (mg/l)						
value	1.24	0.54	0.27	0.25	0.20	
time						
ORP (mV)						
value	82.6	36.3	-6.9	-12.0	-26.2	
time						
TDS (ppt)						
value					22.2	
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 05 2018

Well No. GES-1

well depth (top PVC)	9.93					
water level(top PVC)	3.31					
water height	6.62					
time	1340					
Casing/Volume						
type:	PVC					
type: other	2"					
vol/ft	0.163					
tot. vol	1.08					
3 x vol						
Purge Volume						
gallons purged	1	2	2.5	3.25		
purge/bail/type						
Water Sample						
Sample No.						
Sample Method				GW-GES-1-100518-[illegible]		
Time				1420		
No. Cont.						
Initials						
pH	500 mL/MIN					
value	7.09	7.05	7.10	7.08		
time	1344	1350	1418	1425		
Conductivity (S/cm)						
value	4173	5228	3795	[illegible]		
time						
Temp. (Celsius)						
value	20.2	19.8	19.9	19.9		
time						
DO (mg/l)						
value	0.56	2.27	0.62	1.54		
time						
ORP (mV)						
value	-111.6	-97.7	-102.6	-101.5		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	12.6	—	5.1	6.1		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PRO PLUS

COMMENTS: POOR RECOVERY, DRY @ 2 gal | DRY @ 3.25 AGAIN

SHEEN

SULFUR ODOR

SAMPLE FIELD FILTERED

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/4/18

Well No. 6E6-1

well depth (top PVC)	13.20					
water level(top PVC)	~~7.80~~ AC	6.80				
water height	~~5.40~~ AC	6.40				
time	1150					
Casing/Volume						
type:	2" - PVC					
type: other						
vol/ft	0.163					
tot. vol	~~0.88 gal~~ AC	1.04 gal.				
3 x vol						
Purge Volume	250 mL/min					
gallons purged	0.250	0.50.	1.00			
purge/bail/type						
Water Sample						
Sample No.		GW-6E6-1-1004[illegible]18-(20)				
Sample Method		PERI-LF				
Time		1215				
No. Cont.		1 - 500mL POLY				
Initials		AC				
pH						
value	10.99	10.86	10.86			
time YSI-PRO+						
Conductivity (µS/cm)						
value	16000	14250	14217			
time						
Temp. (Celsius)						
value	16.2	16.4	16.3			
time						
DO (mg/l)						
value	0.00	0.00	0.00			
time						
ORP (mV)						
value	-351.3	-343.6	-348.5			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			4.18			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: * DK BROWN COLOR TO MED BROWN ~1gal.
* SLIGHT EFFERVESCENCE
* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/4/18

Well No. 7E3-1

well depth (top PVC)	12.50					
water level(top PVC)	6.45					
water height						
time	0950					
Casing/Volume						
type:	4" - PVC					
type: other						
vol/ft	~~0.163~~ 0.653					
tot. vol	3.95 gal					
3 x vol						
Purge Volume	500 mL/min					
gallons purged	0.5	1.5 gal	2.5	3.5 gal	4.5 gal	5.5 gal
purge/bail/type						
Water Sample						
Sample No.						GW-7E3-1-1004[illegible]18 - (20)
Sample Method						PERI - LF
Time						1030
No. Cont.						1 - 500mL POLY
Initials						AC
pH						
value YSI PRO+	7.43	7.67	7.87	7.92	7.90	7.89
time						
Conductivity (μS/cm)						
value	27200	149000	7218	6920	5953	5961
time						
Temp. (Celsius)						
value	14.9	16.0	16.2	16.3	16.4	16.40
time						
DO (mg/l)						
value	0.61	0.08	0.35	0.90	~~1.2~~ AC 1.20	1.18
time						
ORP (mV)						
value	-184.7	-175.0	-177.7	-156.6.	-146.0	-144.6
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			2.75			1.50
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: - SLIGHT EFFERVESCENCE.
- NO DRAWDOWN.
* FIELD FILTERED to 0.45 μm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERUTTI
Date: 10/3/18

Well No. 7E8-1

well depth (top PVC)	13.30					
water level(top PVC)	5.80					
water height	7.50					
time	1250					
Casing/Volume						
type:	4" - PVC					
type: other						
vol/ft	0.653					
tot. vol	4.89					
3 x vol						
Purge Volume	250 mL/min					
gallons purged	0.5	1 gal	2 gal.	3 gal	4 gal	
purge/bail/type	PERI					
Water Sample						
Sample No.					GW-7E8-~~10~~1003[redacted]18-(20)	
Sample Method					PERI - CF	
Time					1330	
No. Cont.					1 = 500 mL	POLY
Initials					AC.	
pH						
value	11.11	11.26	11.23	11.13	11.07	
time YSI - PRO+						
Conductivity (S/cm) µ						
value	50250	38200	30800	26800	23890	
time						
Temp. (Celsius)						
value	14.9	15.0	15.4	15.5	15.6	
time						
DO (mg/l)						
value	0.13	0.00	0.00	0.00	0.00	
time						
ORP (mV)						
value	-372.9	-404.4	-419.1	-429.6	-432.6	
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value					8.71	
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: - DK. BROWN COLOR. LIGHTENED TO M. BROWN ~ 3 gal.
- H_2S ODOR.

* FIELD FILTERED TO 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 03 2018

Well No. 7E10-1

YSI ProPlus

well depth (top PVC)	11.44					
water level(top PVC)	5.92					
water height	5.52					
time	1045					
Casing/Volume						
type:	PVC					
type: other						
vol/ft	0.653					
tot. vol	3.6					
3 x vol						
Purge Volume						
gallons purged	1	2	3	4	5	6
purge/bail/type						
Water Sample	.75L/min					
Sample No.						GW-7E10-1-100318-(20)
Sample Method						PERISTALTIC
Time						1115
No. Cont.						1 500ml
Initials						EB
pH						
value	10.21	10.34	10.20	10.13	10.06	10.05
time	1051	1056	1100	1104	1110	1116
Conductivity (μS/cm)						
value	22150	19255	16174	14267	11989	11400
time						
Temp. (Celsius)						
value	16.7	16.7	16.6	16.7	16.6	16.6
time						
DO (mg/l)						
value	~~95.66~~	~~96.57~~	~~97.71~~	~~98.76~~	~~100.12~~	~~100.35~~
time	0.30	0.25	0.21	0.15	0.15	0.15
ORP (mV)						
value	-329.0	-330.5	-326.1	-320.5	-325.7	-328.5
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	1.18	3.46	0.52	3.15	0.70	1.26
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

DARK BROWN, SLIGHT SHEEN, SLIGHT SEWAGE ODOR

FIELD FILTERED SAMPLE 0.45μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/3/13

Well No. ~~7F2-1~~ AC 7F2-1

well depth (top PVC)	9.70					
water level(top PVC)	6.17					
water height	3.53					
time	0915					
Casing/Volume						
type:	4" - METAL					
type: other						
vol/ft	0.653					
tot. vol	2.305 gal.					
3 x vol						
Purge Volume	250 mL/min					
gallons purged	0.25	0.50	1.0	1.5	2.0	
purge/bail/type	PERI-LF					
Water Sample	500mL/min.					
Sample No.						GW-7F2-1-1003[redacted]18-(2c)
Sample Method						PERI-LF
Time						1000
No. Cont.						1-500mL POLY
Initials						AC
pH						
value	7.05	7.67	7.07	7.06	7.06	
time YSI-PRO+						
Conductivity (µS/cm)						
value	11858	12702	12796	12560	11000	
time						
Temp. (Celsius)						
value	16.6	16.7	16.7	16.8	16.8	
time						
DO (mg/l)						
value	0.27	0.05	0.19	0.27	0.35	
time						
ORP (mV)						
value	-32.0	-71.3	-82.1	-91.0	-97.5	
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value		4.88		3.67	4.13	
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:
- H_2S ODOR
- SLIGHT EFF.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

* FIELD FILTERED TO 0.45 µm.

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/3/18

Well No. 7F3-1

well depth (top PVC)	~~7.~~ 16.55					
water level(top PVC)	4.75					
water height	11.8					
time	1010					
Casing/Volume						
type:	2" - PVC					
type: other						
vol/ft	0.163					
tot. vol	1.92					
3 x vol						
Purge Volume	250mL/min			100mL/min		
gallons purged	0:25	0.50	1.00	1.50		
purge/bail/type	PERI					
Water Sample						
Sample No.				GW-7F3-1-1003[illegible]18-(20)		
Sample Method				PERI - LF		
Time				1045		
No. Cont.				1 - 500mL POLY		
Initials				AC		
pH						
value	11.45	11.13	10.54			
time YSI PRO+						
Conductivity (µS/cm)						
value	37605	16938	13768			
time						
Temp. (Celsius)						
value	14.0	13.6	13.8			
time						
DO (mg/l)						
value	0.03	0.00	0.23			
time						
ORP (mV)						
value	-273.1	-318.01	-254.3			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	23.7			20.2		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: - DK. REDDISH/BROWN COLOR CHANGED TO TAN ~ 0.75 gal PURGED;
- H_2S ODOR.
- WATER LEVEL BELOW TUBING; RATE SLOWED TO ALLOW RECHARGE. FILTER STRUGGLING W/ BACKPRESSURE.
- BACK TO DK. BROWN FOR SAMPLE.
- RATE DOWN TO 100mL/min FOR SAMPLE
* FIELD FILTERED TO 0.45 µm/

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/5/18

Well No. 7F4-1

well depth (top PVC)	16.80					
water level(top PVC)	7.90					
water height	8.90					
time	0820					
Casing/Volume						
type:	2" - PVC					
type: other						
vol/ft	0.163					
tot. vol	1.45 gal					
3 x vol						
Purge Volume	~500mL/min					
gallons purged	0.5 gal.	1.0	1.5	2.0		
purge/bail/type						
Water Sample						
Sample No.			GW-7F4-1-1005[illegible]18-(20)			
Sample Method			PERI - LF			
Time			0900			
No. Cont.			1-500 mL			
Initials			AC.			
pH						
value	11.82	12.02	12.06	12.06		
time YSI PRO+						
Conductivity (µS/cm)						
value	65000	67020	60000	54050		
time						
Temp. (Celsius)						
value	14.9	15.8	16.0	16.4		
time						
DO (mg/l)						
value	0.12	0.02	0.01	0.00		
time						
ORP (mV)						
value	-306.0	-366.0	-369.5	-369.5		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value				1.64		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: * 7F4-1 (N)
* DARK BROWN/BLACK WATER
* RAINBOW SHEEN AND BIOWASTE ODOR
* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/15/18

Well No. 8F1-1R

well depth (top PVC)	16.2					
water level(top PVC)	6.45					
water height	9.75					
time	0930					
Casing/Volume						
type:	2" - PVC					
type: other						
vol/ft	0.163					
tot. vol	1.59					
3 x vol						
Purge Volume	~500 ml/min					
gallons purged	0.5	1.5	2.5			
purge/bail/type	PERI-LF					
Water Sample						
Sample No.				GW-8F1-1R-101518-(20)		
Sample Method				PERI-LF		
Time				1000		
No. Cont.				1 - 500ml POLY		
Initials				A CERRUTI		
pH						
value	10.89	10.90	10.92			
time YSI PRO +						
Conductivity (~~S/cm~~)						
value µS/cm	13065	12800	12600			
time						
Temp. (Celsius)						
value	15.5	15.5	15.7			
time						
DO (mg/l)						
value	0.54	0.58	0.69			
time						
ORP (mV)						
value	0.6	-96.2	-145.8			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			4.21			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: BROWN w/ EFFERVESCENCE & H_2S ODOR.

*FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: AC/EB
Date: 10/2/18

Well No. 8G2-1

well depth (top PVC)	14.87					
water level(top PVC)	5.64					
water height	9.23					
time	1432					
Casing/Volume						
type:	4" - PVC					
type: other						
vol/ft	0.653					
tot. vol	6.03 gal.					
3 x vol						
Purge Volume						
gallons purged	1 gal	2 gal	3 gal	4 gal.	5 gal.	
purge/bail/type						
Water Sample						
Sample No.					GW-8G-2-1002[illegible]18-(20)	
Sample Method					~~1500~~ PERI	
Time					1500	
No. Cont.					1 - 500mL POLY.	
Initials					AC/EB	
pH						
value YSI PRO +	10.90	11.27	11.36	11.40	11.38	
time						
Conductivity (μS/cm)						
value	~~594.1~~	~~594.5~~	29255	29355	29935	
time	29102	29096				
Temp. (Celsius)						
value	15.6	16.1	16.5	16.8	16.9	
time						
DO (mg/l)						
value	~~51.16~~	~~50.87~~	~~50.45~~	~~50.13~~	~~50.00~~	
time	0.22	0.21	0.15	0.15	0.11	
ORP (mV)						
value	-415.9	-352.5	-349.1	-334.0	-328.5	
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	4.13	3.36	3.67		3.20	
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: - DK. BROWN COLOR
- SULFURIC ODOR

SAMPLE FIELD FILTERED 0.45μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 11 2018

Well No. 121+80-1

well depth (top PVC)	13.46					
water level(top PVC)	9.27					
water height	4.19					
time	1125					
Casing/Volume						
type:	SS					
type: other	2"					
vol/ft	0.163					
tot. vol	0.68					
3 x vol						
Purge Volume						
gallons purged	0.5					
purge/bail/type						
Water Sample	300 mL/min					
Sample No.						
Sample Method				GW-121+80	1-101118-(20)	
Time						
No. Cont.						
Initials						
pH						
value	11.15					
time	11:30					
Conductivity (S/cm)						
value mS/cm	6.138					
time						
Temp. (Celsius)						
value	17.5					
time						
DO (mg/l)						
value	0.25					
time						
ORP (mV)						
value	-189.6					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	—					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS: POOR RECOVERY, DRY AFTER 0.5 gal

VERY SLOW RECOVERY

WAIT AND SAMPLE

FIELD FILTERED

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D Cooper
Date: 10/10/18

Well No. 122+60-1

well depth (top PVC)	10.6					
water level(top PVC)	8.40					
water height	2.2					
time	1345					
Casing/Volume						
type:	2"					
type: other	SS					
vol/ft						
tot. vol						
3 x vol	1.1					
Purge Volume						
gallons purged	0.5	1	1.5			
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.				GW-122+60-1-101018-120		
Sample Method	PERISTALTIC			PERISTALTIC		
Time				1350		
No. Cont.				3		
Initials				DC		
pH						
value	7.77	7.56	7.56			
time						
Conductivity (μS/cm)						
value	30,200	30,160	30,234			
time						
Temp. (Celsius)						
value	16.3	16.3	16.3			
time						
DO (mg/l)						
value	5.47	5.59	5.44			
time						
ORP (mV)						
value	+37.9	+38.3	+37.1			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			16.8			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: ORANGE BIOFLUFF FIELD FILTERED 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A.CERRUTI
Date: 10/10/18

Well No. ~~124+00-0~~ AC 124+00-1

well depth (top PVC)	9.70					
water level(top PVC)	6.40					
water height	3.30					
time	1340					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft	0.163					
tot. vol	0.54 gal					
3 x vol						
Purge Volume ~500 ml/min.						
gallons purged	0.250	0.50	0.65			
purge/bail/type	PERI - LF.					
Water Sample						
Sample No.			GW-124+00-1-1010[illegible]18-(20) AC			
Sample Method			PERI - LF			
Time			~~1400~~ 1340 AC.			
No. Cont.			3 - (2) HDPE	(1) FLPE		
Initials			AC.			
pH						
value	8.05	8.25	8.42.			
time YSI PRO+						
Conductivity ~~(S/cm)~~						
value μS/cm	38700	38000	37297			
time						
Temp. (Celsius)						
value	17.4	16.2	15.9			
time						
DO (mg/l)						
value	2.45	2.30	1.80			
time						
ORP (mV)						
value	104.8	98.3	95.6			
time						
TDS (ppt)						
value			46.0			
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45 μm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/10/18

Well No. 125+50-1

well depth (top PVC)	10.00					
water level(top PVC)	6.95					
water height	3.05					
time	1140					
Casing/Volume						
type:	2" SS					
type: other						
vol/ft	0.163					
tot. vol	0.50					
3 x vol						
Purge Volume	~250 mL/min.					
gallons purged	0.25 gal.	0.50	1.00			
purge/bail/type	PERI-LF					
Water Sample						
Sample No.				GW-125+50-1-1010[illegible]18-(20)		
Sample Method				PERI-LF		
Time				1200		
No. Cont.				3 - (2) HDPE	(1) FLPE	
Initials				AC		
pH						
value YSI PRO+	8.32	8.45	8.33			
time						
Conductivity (S/cm)						
value μS/cm	38230	38180	38238			
time						
Temp. (Celsius)						
value	15.1	15.1	14.9			
time						
DO (mg/l)						
value	6.86	7.46	~~8~~ AC 7.76			
time						
ORP (mV)						
value	104.9	104.4	105.0			
time						
TDS (ppt)						
value			AC			
time						
Turbidity (ntu)						
value			36.1			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45 μm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10|10|18

Well No. 126+90-1

well depth (top PVC)	9.10					
water level(top PVC)	6.60					
water height	2.50					
time	1040					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft	0.163					
tot. vol	0.40					
3 x vol						
Purge Volume ~250 mL.						
gallons purged	0.25 gal	0.50				
purge/bail/type	PERI - LF					
Water Sample						
Sample No.			GW-126+90-1	-1010[illegible]18-(20)		
Sample Method			PERI - LF			
Time			1045			
No. Cont.			3 - (2) HDPE	(1) FLPE		
Initials			AC			
pH						
value YSI PRO +	7.99	8.04				
time						
Conductivity (~~S/cm~~)						
value µS/cm	40600	40955				
time						
Temp. (Celsius)						
value	15.3	14.7				
time						
DO (mg/l)						
value	5.90	6.26				
time						
ORP (mV)						
value	108.1	108.3				
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value		40.0				
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 08 2018

NO SAMPLE.
COLLECTED 10/8

Well No. 126+90-1

well depth (top PVC)	9.3					
water level(top PVC)	8.9					
water height	0.4					
time	1330					
Casing/Volume						
type:	SS					
type: other	2"					
vol/ft	0.163					
tot. vol	0.07					
3 x vol						
Purge Volume						
gallons purged	0.05					
purge/bail/type						
Water Sample						
Sample No.					GW-126+90-1-100918 (20)	
Sample Method					PERISTALTIC	
Time					~~1000~~ 0930	
No. Cont.					3	
Initials					DGL	
pH	EB					
value	~~15.2~~ 8.02					
time	1330					
Conductivity (S/cm)						
value	27420					
time						
Temp. (Celsius)						
value	15.2					
time						
DO (mg/l)						
value	4.26					
time						
ORP (mV)						
value	29.3					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	—					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS:

STAINLESS STEEL CASING HAS ROTTED OUT - MISSING UPPER 1'
RUST CHIPS INSIDE WELL
PUMPED ~ 200mL
NO SAMPLE COLLECTED ON 10/8 SEE 10/10 FIELD SHEET.
NO ~~PARAMETERS~~ 215 COLLE TURBIDITY

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/08/18

Well No. 128+30-1

well depth (top PVC)	9.70					
water level(top PVC)	7.30					
water height	2.40					
time	1215					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft	0.163					
tot. vol	0.39					
3 x vol						
Purge Volume	250 mL/min.					
gallons purged	.250 gal.	0.50				
purge/bail/type	PERI - LF.					
Water Sample						
Sample No.		GW-128+30-1-1008[illegible]18-(20)				
Sample Method		PERI - LF.				
Time		1230				
No. Cont.		3 - (2) HDPE	(1) FLPE			
Initials						
pH						
value	6.87	6.59				
time YSI PRO +						
Conductivity (~~S/cm~~)						
value µS/cm	37930	37838				
time						
Temp. (Celsius)						
value	14.9	15.2				
time						
DO (mg/l)						
value	2.07.	2.60				
time						
ORP (mV)						
value	47.5	46.9				
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value		309				
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: * RUST COLORED TO CLEAR w/ occassional rusty Flocc ~~emitt~~ AC.
* WELL DRY DURING SAMPLING; ALLOWED TO RECHARGE, THEN CONTINUED COLLECTING SAMPLE.
* THREE FILTERS REQ'D.
— FIELD FILTERED TO 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/8/18

Well No. 129+65-1

well depth (top PVC)	10.00					
water level(top PVC)	7.80					
water height	2.20					
time	0945					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft	0.163					
tot. vol	0.359.					
3 x vol						
Purge Volume	~250 mL/min.					
gallons purged	0.250	0.50				
purge/bail/type	PERI-LF					
Water Sample						
Sample No.		GW-129+65-1-100818-(20)				
Sample Method		PER - LF				
Time		0940				
No. Cont.		3 - (2) HDPE	(1) FLPE.			
Initials		AC				
pH						
value	7.34	7.19				
time YSI-PRO +						
Conductivity ~~(S/cm)~~						
value MS/cm	28636	33217				
time						
Temp. (Celsius)						
value	14.3	14.5				
time						
DO (mg/l)						
value	6.83	7.16				
time						
ORP (mV)						
value	115.9	113.9				
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value		169				
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: * RUST COLOR cleared up ~0.250 gal.
* HIGH TURBIDITY & DO.

FIELD FILTERED TO 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB/DC
Date: OCT 08 2018

Well No. 131+00-1

well depth (top PVC)	9.97					
water level(top PVC)	5.59					
water height	4.38					
time	950					
Casing/Volume						
type:	PVC					
type: other	2"					
vol/ft	0.163					
tot. vol	0.71					
3 x vol						
Purge Volume						
gallons purged	0.4					
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	Ø					
Sample Method	PERISTALTIC				GW-131+00-1-100818-(ZC)	
Time					930	
No. Cont.					3	
Initials					EB	
pH						
value	7.41					
time						
Conductivity ~~(S/cm)~~						
value MS/cm	34090					
time						
Temp. (Celsius)						
value	14.9					
time						
DO (mg/l)						
value	5.73*					
time						
ORP (mV)						
value	+88.7					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	—					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS: VERY ORANGE, VERY TURBID, POOR RECOVERY/RECHARGE

BEGIN. SAMPLING AFTER WENT DRY, VERY CLEAR WATER

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

*BUBBLES DURING PUMPING

FIELD FILTERED SAMPLE

Arkema MWSAMPL.XLS

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/11/18

Well No. 5B1-2R

well depth (top PVC)	36.4					
water level(top PVC)	13.4					
water height	23.0					
time	1330					
Casing/Volume						
type:	2" - PVC					
type: other						
vol/ft	0.163					
tot. vol	3.75					
3 x vol						
Purge Volume ~500mL/min.						
gallons purged	1.25	2.00	2.50			
purge/bail/type	PERI - LF					
Water Sample						
Sample No.			GW-SB1-2R-1011[illegible]18-(20)			
Sample Method			PERI - LF			
Time			1345			
No. Cont.			3 - (2) HDPE	(1) FLPE		
Initials			A.C.			
pH						
value YSI PRO+	7.05	7.01	7.01			
time						
Conductivity (~~S/cm~~)						
value µS/cm	42300	42370	42316			
time						
Temp. (Celsius)						
value	14.2	14.2	14.2			
time						
DO (mg/l)						
value	0.39	0.38	0.38			
time						
ORP (mV)						
value	-83.2	-92.2	-92.6			
time						
TDS (ppt)						
value	-					
time						
Turbidity (ntu)						
value			30.4			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

* FIELD FILTERED TO 0.45 µm

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/5/18

Well No. 5C16-2R

well depth (top PVC)	28.30					
water level(top PVC)	13.15					
water height	14.15					
time	1130					
Casing/Volume						
type:	2" PVC					
type: other						
vol/ft	0.163					
tot. vol	2.31 gal.					
3 x vol						
Purge Volume	~500mL/min					
gallons purged	0.5 gal	1.0gal.	2.0 gal.	2.5gal		
purge/bail/type	PERI - LF					
Water Sample						
Sample No.	~~A~~ AC			GW-5C16-2R-1005[illegible]18-(20)		
Sample Method				PERI-LF		
Time				1200		
No. Cont.				1-500ml POLY		
Initials				AC.		
pH						
value YSI PRO+	7.38	7.16	7.18	7.14.		
time						
Conductivity ~~(S/cm)~~						
value µS/cm	21580	21512	21500	21515		
time						
Temp. (Celsius)						
value	14.0	14.0	14.0	14.0		
time						
DO (mg/l)						
value	0.68	0.15	0.15	0.17		
time						
ORP (mV)						
value	-143.0	-133.9	-133.8	-132.8		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value				1.42		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:
- SLIGHT TAN COLOR
- H_2S ODOR
- FIELD FILTERED TO 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: ~~5C21-2~~ 10/4/18

Well No. 5C21-2

well depth (top PVC)	31.40					
water level(top PVC)	12.20					
water height	19.20					
time	1540					
Casing/Volume						
type:	2" - PVC					
type: other						
vol/ft	0.163					
tot. vol	3.13 gal					
3 x vol						
Purge Volume	~500 mL/min.					
gallons purged	0.5	1.0 gal	3.0 gal	4.0 gal		
purge/bail/type	PERI					
Water Sample						
Sample No.				GW-5C21-2-1004[redacted]18-(20)		
Sample Method				PERI - LF		
Time				1610		
No. Cont.				1 - 500mL		
Initials				AC.		
pH						
value	7.21	6.49	6.48	6.50		
time						
Conductivity (µS/cm)						
value	20000	23500	22350	22000		
time						
Temp. (Celsius)						
value	15.3	15.1	15.0	15.0		
time						
DO (mg/l)						
value	0.07	0.03	0.00	0.00		
time						
ORP (mV)						
value	-105.0	-131.6	-143.1	-147.4		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value				2.74		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: * 5C21-2(K)
* TAN COLOR & EFFERVESCENCE
* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/4/18

Well No. 6D25-2

well depth (top PVC)	31.70					
water level(top PVC)	9.10					
water height	22.60					
time	1505					
Casing/Volume						
type:	2" – PVC					
type: other						
vol/ft	0.163					
tot. vol	3.68					
3 x vol						
Purge Volume	~500 mL/min					
gallons purged	1 gal	2 gal	3 gal			
purge/bail/type	PERI					
Water Sample						
Sample No.			GW-6D25-2-1004[illegible]18-(ze)			
Sample Method			PERI - LF			
Time			1530			
No. Cont.			1- 500mL	POLY		
Initials			AC.			
pH						
value	9.57	9.58	9.52			
time YSI-PRO +						
Conductivity (μS/cm)						
value	4871	4628	4785			
time						
Temp. (Celsius)						
value	15.2	15.1	15.1			
time						
DO (mg/l)						
value	0.00	0.00	0.00			
time						
ORP (mV)						
value	-218.8	-217.0	-221.1			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			12.3			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: * 6D25-2 (N)
* TAN COLOR W/ EFFERVESCENCE
* FIELD FILTERED TO 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB DC
Date: OCT 04 2018 / 10/9/18

REVISIT

Well No. 6E3-2

RESAMPLED 10/9/18 DC

well depth (top PVC)	25.79		25.8			
water level(top PVC)	8.31		18.1			
water height	17.48					
time	945					
Casing/Volume						
type:	PVC 2"					
type: other						
vol/ft	0.163					
tot. vol	2.849					
3 x vol						
Purge Volume			10/9/18			
gallons purged	1	1.5	SAMPLED IMMEDIATELY			
purge/bail/type			PERISTALTIC			
Water Sample						
Sample No.				GW-6E3-2-100918-(20)		
Sample Method				PERISTALTIC		
Time				1330		
No. Cont.				3		
Initials				DG		
pH		750 mL/min				
value	6.93	6.96	6.96			
time	957	10:02				
Conductivity (S/cm) µ						
value	17102	17577	37,194			
time						
Temp. (Celsius)						
value	13.7	14.5	13.8			
time						
DO (mg/l)						
value	~~102.78~~	~~63.22~~	1.01			
time						
ORP (mV)						
value	-199.8	-100.9	-47.0			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	57.5	93.3	151.0			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

PRO PLUS YSI

COMMENTS:
PUMPING DRY @ 1.5g. VERY POOR RECOVERY
GREEN ALGAE
UNABLE TO COLLECT SAMPLE
REDO @ LATER TIME

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/4/18

Well No. 6E9-2

well depth (top PVC)	32.60					
water level(top PVC)	11.45					
water height	21.15					
time	1050					
Casing/Volume						
type:	4" - PVC					
type: other						
vol/ft	0.653					
tot. vol	13.81					
3 x vol						
Purge Volume	~1 L/min					
gallons purged	0.5 gal	2 gal	5 gal	7 gal		
purge/bail/type						
Water Sample						
Sample No.				GW-6E9-2-1004[illegible]18-(20)		
Sample Method				PERI - LF		
Time				1115		
No. Cont.				1 - 500ml POLY		
Initials				AC		
pH						
value YSI-PRO+	7.65	7.65	7.66	7.66		
time						
Conductivity (µS/cm)						
value	13465	14699	14714	14709		
time						
Temp. (Celsius)						
value	14.2	14.8	14.9	15.0		
time						
DO (mg/l)						
value	0.32	0.00	0.00	0.00		
time						
ORP (mV)						
value	-91.0	-188.7	-210.2	-211.3		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value				8.35		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:
- TUBING INTAKE @ 24.0'
- DK. BROWN COLOR; SLIGHT H_2S ODOR & EFFERVESCENCE.

* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/3/18

Well No. 6E12-2

well depth (top PVC)	32.00					
water level(top PVC)	14.00					
water height	18.00					
time	1400					
Casing/Volume						
type:	2" PVC					
type: other						
vol/ft	0.164					
tot. vol	2.95					
3 x vol						
Purge Volume	250 mL/min					
gallons purged	0.5	1.5 gal	2.5 gal	3.0 gal		
purge/bail/type	PERI - LF					
Water Sample						
Sample No.				GW-6E12-2-1003[illegible]18-(20)		
Sample Method				PERI - LF		
Time				1430		
No. Cont.				1 — 500mL POLY		
Initials				AC.		
pH						
value	6.81	6.82	6.68	6.66		
time YSI-PRO+						
Conductivity (μS/cm)						
value	48888	47031	48260	47963		
time						
Temp. (Celsius)						
value	13.9	14.0	14.0	13.9		
time						
DO (mg/l)						
value	0.29	0.00	0.00	0.00		
time						
ORP (mV)						
value	-222.9	-209.8	-201.0	-193.4		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value				7.04		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: - LIGHT YELLOW HUE.
- METHANE LIKE ~~SMELL~~ ODOR.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

~~FF 0.5 μ~~ * FIELD FILTERED TO 0.45 μm.

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 16 2018

Well No. 7E4-2

YSI PROPLUS

well depth (top PVC)	25.62					
water level(top PVC)	7.28					
water height	18.34					
time	852					
Casing/Volume						
type:	PVC					
type: other	2"					
vol/ft	0.163					
tot. vol	2.99					
3 x vol						
Purge Volume						
gallons purged	1	2	3	3.5		
purge/bail/type						
Water Sample						
Sample No.					GW-7E4-2-101618-(20)	
Sample Method					Pump	
Time					930	
No. Cont.					1-500mL	
Initials					EB	
pH	500 mL/min					
value	9.47	9.72	9.93	9.98		
time	901	907	915	919		
Conductivity (µS/cm)						
value	11843	11390	10890	10715		
time						
Temp. (Celsius)						
value	13.3	13.2	13.2	13.1		
time						
DO (mg/l)						
value	0.06	0.07	0.06	0.05		
time						
ORP (mV)						
value	-264.4	-268.7	-289.4	-294.7		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value				4.60		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: TUBE CLOGGED, FLOATING ORGANIC MATERIAL @ FIRST
BROWN ~~SLIGHT~~ EB SULFUR ODOR
EFFERVESCENT

FIELD FILTERED

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date:
OCT 03 2018

Well No. 7E6-2

well depth (top PVC)	27.52					
water level(top PVC)	6.83					
water height	20.69					
time	1324					
Casing/Volume						
type:	PVC 4"					
type: other						
vol/ft	0.653					
tot. vol	13.51					
3 x vol						
Purge Volume						
gallons purged	2	4	6	7		
purge/bail/type						
Water Sample						
Sample No.				GW-7E6-1-100318-(20)		
Sample Method				PERISTALTIC		
Time				1400		
No. Cont.				1 - 500ml		
Initials				E		
pH	756 mL/min					
value	10.20	10.00	9.98	9.79		
time	1334	1344	1356	1403		
Conductivity (µS/cm)						
value	8260	7872	7842	7858		
time						
Temp. (Celsius)						
value	13.7	13.6	13.6	13.7		
time						
DO (mg/l)						
value	~~108.73~~	~~109.01~~	~~108.97~~	~~108.78~~		
time			0.17	0.12		
ORP (mV)						
value	-341.0	-350.1	-362.4	-365.5		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	0.97	1.22	0.92	0.80		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

PROPLUS YSI

COMMENTS:

BROWN - NOT TURBID

SULFUR ODOR, SLIGHT

FIELD FILTERED SAMPLE 0.45µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: 10/15/18

Well No. 7E6-2 PARAMETER REDO

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1	2				
purge/bail/type						
Water Sample						
Sample No.						
Sample Method						
Time						
No. Cont.						
Initials						
pH						
value	9.98	10.30				
time	1145	1156				
Conductivity (μS/cm)		750 mL/min				
value	7078	7053				
time						
Temp. (Celsius)						
value	14.0	13.9				
time						
DO (mg/l)						
value	0.17	0.12				
time						
ORP (mV)						
value	-254.1	-290.4				
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	2.08	2.07				
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS:

* FIELD FILTERED TO 0.45 μm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 03 2018

Well No. 7E7-Z

well depth (top PVC)	31.76					
water level(top PVC)	9.71					
water height	22.05					
time	1153					
Casing/Volume						
type:	4" Ø					
type: other	SCH 40 PVC					
vol/ft	0.653					
tot. vol	14.4					
3 x vol						
Purge Volume						
gallons purged	2	4	6.5	7.5		
purge/bail/type						
Water Sample						
Sample No.				GW-7E7-Z-100318-(20)		
Sample Method				PERISTALTIC		
Time				1240		
No. Cont.				1 500ml		
Initials				EB		
pH	750mL/min					
value YSI PRO +	9.30	9.57	9.51	9.54		
time	1205	1215	1231	1236		
Conductivity (µS/cm)						
value	1165	1660	1599	1742		
time						
Temp. (Celsius)						
value	13.6	13.8	14.1	14.0		
time						
DO (mg/l)						
value	~~72.36~~	~~81.01~~	~~83.95~~	~~86.16~~		
time	1.5	1.1	0.28	0.13		
ORP (mV)						
value	-204.3	-216.5	-213.4	-216.1		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	1.77	1.68	1.68	1.61		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

MOSTLY CLEAR, SLIGHT BROWN COLOR, SLIGHT SULFUR ODOR

FIELD FILTERED 0.45µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: 10/15/18

Well No. 7E7-2 PARAMETER REDO

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1	2	3			
purge/bail/type						
Water Sample	750 mL/min					
Sample No.						
Sample Method						
Time						
No. Cont.						
Initials						
pH						
value	9.87	9.77	9.76			
time	1210	1216	1222			
Conductivity (µS/cm)						
value	10863	8841	8692			
time						
Temp. (Celsius)						
value	13.7	13.7	13.7			
time						
DO (mg/l)						
value	1.1	0.28	0.13			
time						
ORP (mV)						
value	-248.3	-250.4	-253.0			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	283	306	303			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: ~~7E9-2~~ 10/3/18

Well No. 7E9-2

well depth (top PVC)	27.4					
water level(top PVC)	900					
water height	18.40					
time	1125					
Casing/Volume						
type:	4" - PVC					
type: other						
vol/ft	0.653					
tot. vol	12.02					
3 x vol						
Purge Volume	1 L/min					500mL/min
gallons purged	1 gal.	2 gal	3gal	4 gal	9 gal	10gal
purge/bail/type						
Water Sample						
Sample No.						GW-7E9-2-1003[illegible]18-(20)
Sample Method						~~1200~~ PERI - LF
Time						1200
No. Cont.						1 - 500mL
Initials						AC
pH						
value YSI PRO +	7.24	7.20	7.29	7.35	7.41	7.38
time						
Conductivity (µS/cm)						
value	32336	31942	20865	16255	7820	8620
time						
Temp. (Celsius)						
value	13.4	13.4	13.6	13.6	13.7	13.8
time						
DO (mg/l)						
value	0.26	0.07	0.00	0.00	2.06	2.36
time						
ORP (mV)						
value	-200.0	-210.1	-205.7	-200.2	-161.8	-169.0
time						
TDS (ppt)						
value	~~2~~ AC					
time						
Turbidity (ntu)						
value	23.7				0.82	0.91
time HANNA						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: - SLIGHT YELLOW HUE & EFFERVESCENCE BECOMES TAN
- AT 5 gal purged water becomes clear, YELLOW HUE

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

* FIELD FILTERED to 0.45 µm.

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 04 2018

Well No. 7E16-2

well depth (top PVC)	12.46					
water level(top PVC)	5.31					
water height	7.15					
time	1530					
Casing/Volume						
type:	PVC					
type: other	4"					
vol/ft	0.653					
tot. vol	4.67					
3 x vol						
Purge Volume						
gallons purged	1	2	3	4	5	6
purge/bail/type						
Water Sample						
Sample No.					GW-7E16-2-100418-(20)	
Sample Method					PERISTALTIC	
Time					1615	
No. Cont.					1-500ml	
Initials					EB	
pH	750 mL/M					
value	6.84	6.97	7.04	7.13	7.14	7.20
time	1533	1538	1543	1549	1604	1610
Conductivity (S/cm)						
value	14254	11200	6736	4240	3966	3053
time						
Temp. (Celsius)						
value	16.8	17.1	17.4	17.6	17.4	17.5
time						
DO (mg/l)						
value	0.15	0.21	0.22	0.28	0.33	0.27
time						
ORP (mV)						
value	-130	-139.9	-145.2	-132.9	-125.7	-126.0
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	25.1	5.62	3.79	3.58	3.60	2.10
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

PROPLUS YSI

COMMENTS: CLOGGED TUBE, BLACK @ FIRST THEN CLEAR (MOSTLY) NO ODOR

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

FIELD FILTERED SAMPLE

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/11/18

Well No. 120+75-2

well depth (top PVC)	21.40					
water level(top PVC)	9.40					
water height	12.00					
time	1415					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft	0.163					
tot. vol	1.96					
3 x vol						
Purge Volume	~500 mL/min					
gallons purged	0.25	0.50				
purge/bail/type	PERI-LF					
Water Sample						
Sample No.			GW-120+75-2	-1011[illegible]18-(20)		
Sample Method			PERI-LF.			
Time			1430			
No. Cont.			3 - (2) HDPE	(1) FLPE.		
Initials			AC.			
pH						
value	7.46	7.33	7.30			
time YSI PRO +						
Conductivity (~~S/cm~~)						
value µS/cm	37390	37033	37464			
time						
Temp. (Celsius)						
value	15.1	14.5	14.4			
time						
DO (mg/l)						
value	1.09	0.26	0.22			
time						
ORP (mV)						
value	38.4	0.5	-13.0			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			0.23			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: GREY COLOR w/ H_2S ODOR.

* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 11 2018

Well No. 121+80-2

ProPlus YSI

well depth (top PVC)	24.38					
water level(top PVC)	10.83					
water height	13.55					
time	1157					
Casing/Volume						
type:	SS					
type: other	2"					
vol/ft	0.163					
tot. vol	2.21					
3 x vol						
Purge Volume						
gallons purged	1	1.75				
purge/bail/type						
Water Sample						
Sample No.				GW-121+80-2-101118-(20)		
Sample Method				1400		
Time						
No. Cont.						
Initials						
pH	500 ml/min					
value	9.58	9.59				
time	1228	1235				
Conductivity (µS/cm)						
value	11376	11455				
time						
Temp. (Celsius)						
value	14.9	15.2				
time						
DO (mg/l)						
value	0.57	0.08				
time						
ORP (mV)						
value	-207.8	-210.5				
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	42.7	~				
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: REPLACE TUBING -> COVERED IN LIGHT BROWN COAGULATE, DARK BLACK @ BOTTOM, FIELD PHOTOS TAKEN

DARK BROWN

POOR RECOVERY - DRY AFTER 1.75 gal

WAIT AND SAMPLE

FIELD FILTERED

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/11/18

Well No. 122+60-2

well depth (top PVC)	23.00					
water level(top PVC)	7.45					
water height	15.55					
time	1125					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft	0.163					
tot. vol	2.53					
3 x vol						
Purge Volume ~500mL/min.						
gallons purged	0.50·	1.0 gal	1.5 gal			
purge/bail/type	PERI - LF					
Water Sample						
Sample No.			GW-122+60-2-1010[illegible]18-(20)			
Sample Method			PERI - LF			
Time			1200			
No. Cont.			3 - (2) HDPE	(1) FLPE		
Initials			AC.			
pH						
value	7.95	7.99	8.10			
time YSI PRO +						
Conductivity (S/cm)						
value µS/cm	29811	29778	29764			
time						
Temp. (Celsius)						
value	15.1	15.0	15.1			
time						
DO (mg/l)						
value	0.47	0.35	0.27			
time						
ORP (mV)						
value	80.0	54.5	45.2			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			5.00			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/10/18

Well No. 124+00-2

well depth (top PVC)	21.80					
water level(top PVC)	9.85					
water height	12.95					
time	1405					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft	0.163					
tot. vol	2.11					
3 x vol						
Purge Volume	~500 mL/min					
gallons purged	0.5 gal	2.5 gal	3.5 gal	4.0 gal		
purge/bail/type	PERI - LF					
Water Sample						
Sample No.				GW-124+00-2~~#~~10	10[illegible]18-(20)	
Sample Method				PERI - LF		
Time				~~1415~~ 1405 A.C.		
No. Cont.				3 - (2) HDPE	(1) FLPE	
Initials				A. CERRUTI		
pH						
value	8.67	8.85	8.86	8.85		
time YSI PRO +						
Conductivity (~~S/cm~~)						
value	31946	31652	31649	31580		
time µS/cm						
Temp. (Celsius)						
value	14.8	14.4	14.4	14.2		
time						
DO (mg/l)						
value	0.50	0.24	0.25	0.24		
time						
ORP (mV)						
value	49.2	3.9	-3.2	-11.9		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value				10.1		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: - DARK BROWN TO TAN COLOR. H_2S ODOR

* FIELD FILTERED TO 0.45 µS/cm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/10/2018

Well No. 125+50-2

well depth (top PVC)	22.0					
water level(top PVC)	10.8					
water height	12.2					
time	1145					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft	0.163					
tot. vol	1.99					
3 x vol						
Purge Volume ~500ml/min						
gallons purged	0.5 gal.	1.5 gal	3.0 gal			
purge/bail/type	PERI - LF					
Water Sample						
Sample No.				GW-125+50-2-1010[illegible]18-(20)		
Sample Method				PERI - LF		
Time				1210		
No. Cont.				3 - (2) HDPE	(1) FLPE	
Initials				AC		
pH						
value YSI PRO+	7.47	7.47	7.49			
time						
Conductivity (S/cm)						
value µS/cm	29327	29415	29440			
time						
Temp. (Celsius)						
value	15.8	15.8	15.8			
time						
DO (mg/l)						
value	0.14	0.15	0.14			
time						
ORP (mV)						
value	-22.7	-32.5	-64.2			
time						
TDS (ppt)						
value			~~4~~ AC			
time						
Turbidity (ntu)						
value			4.57			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

* FIELD FILTERED TO 0.45 µm.

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 08 2018

Well No. 126+90-2

YSI PROPLUS

well depth (top PVC)	24.66					
water level(top PVC)	7.63					
water height	17.03					
time	1355					
Casing/Volume						
type:	SS					
type: other	2''					
vol/ft	0.163					
tot. vol	2.78					
3 x vol						
Purge Volume						
gallons purged	1	2	3	4		
purge/bail/type						
Water Sample						
Sample No.					GW-126+90-2-	100818-⑳
Sample Method					1420	
Time						
No. Cont.						
Initials						
pH			700 ml/min			
value	7.88	7.90	7.91	7.92		
time	1408	1413	1418	1424		
Conductivity ~~(S/cm)~~						
value µS/cm	28685	28775	28882	28957		
time						
Temp. (Celsius)						
value	14.5	14.5	14.6	14.6		
time						
DO (mg/l)						
value	0.30	0.14	0.13	0.13		
time						
ORP (mV)						
value	-28.0	-49.6	-65.6	-75.7		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	0	0	0	0		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/8/18

Well No. 128+30-2

well depth (top PVC)	19.40					
water level(top PVC)	7.90					
water height	11.50					
time	1345					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft	0.163					
tot. vol	1.87					
3 x vol						
Purge Volume ~500 mL/min.						
gallons purged	0.50	1.00 gal	2.00 gal			
purge/bail/type	PERI - LF					
Water Sample						
Sample No.			GW-128+30-2-1005[illegible]18-(20)			
Sample Method			~~1400~~ PER-LF			
Time			1400			
No. Cont.			3 - (2) HDPE (1) FLPE.			
Initials			AC			
pH						
value YSI PRO +	8.36	8.53	8.54			
time						
Conductivity ~~(S/cm)~~						
value μS/cm	17486	18070	18140			
time						
Temp. (Celsius)						
value	13.8	13.9	13.9			
time						
DO (mg/l)						
value	0.32	0.04	0.03			
time						
ORP (mV)						
value	-127.0	-229.9	-235.8			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			1.80.			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: * H_2S ODOR; MED. BROWN TO CLEAR.
* FINAL ~~WL 7.10~~ WL = 7.10'.
- FIELD FILTERED TO 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/8/18

Well No. 129+65-2

well depth (top PVC)	21.00					
water level(top PVC)	8.50					
water height	12.50					
time						
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft	0.163					
tot. vol	2.075					
3 x vol						
Purge Volume	~250 mL/min					
gallons purged	0.50 gal.	1.00 gal	1.50 gal.			
purge/bail/type	PERI-LF					
Water Sample						
Sample No.			GW-129+65-2-1008[illegible]18 - (2c)			
Sample Method			PERI - LF			
Time			~~1000~~ 1015			
No. Cont.			3 -- (2) HDPE (1) FLPE.			
Initials			AC.			
pH						
value YSI PRO +	7.07	7.24	7.05			
time						
Conductivity (S~~/cm~~)						
value mS/cm	29200	27600	26500			
time						
Temp. (Celsius)						
value	14.6	14.7	14.7			
time						
DO (mg/l)						
value	0.15	0.00	0.00			
time						
ORP (mV)						
value	-179.6	-205.0	-210.0			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			13.9.			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: VERY STRONG H_2S ODOR.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5 — FIELD FILTERED TO 0.45 µm
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB
Date: OCT 08 2018

Well No. 131+00-2

well depth (top PVC)	23.52					
water level(top PVC)	5.49					
water height	18.03					
time	1010					
Casing/Volume						
type:	PVC					
type: other	2"					
vol/ft	0.163					
tot. vol	2.94					
3 x vol						
Purge Volume						
gallons purged	0.5	1.25	2	3		
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.						
Sample Method	PERISTALTIC				GW-131+00-2-100818-(20)	
Time					12:00	
No. Cont.					3	
Initials					EB	
pH			500 ML/MIN			
value	8.72	8.64	8.08	8.85		
time	1115	1121	1127	1134		
Conductivity (S/cm)						
value	15864	13461	13235	13315		
time						
Temp. (Celsius)						
value	13.9	14.1	14.3	14.3		
time						
DO (mg/l)						
value	0.22	0.20	0.68	0.67		
time						
ORP (mV)						
value	-251.7	-242.1	-221.1	-198.7		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	111	129	285	—		
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PRO PLUS

COMMENTS: REPLACE TUBE VERY TURBID, ORANGE COLOR

WELL DRY @ 3 GALLONS POOR RECOVERY FIELD FILTERED

SULFUR SMELL

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: AC/EB
Date: 10/12/18

Well No. 5D1-3

well depth (top PVC)	~~10.0~~ 50.96					
water level(top PVC)	10.09					
water height	40.87					
time	11:35					
Casing/Volume						
type:	2" – PVC					
type: other						
vol/ft	0.163					
tot. vol	6.66					
3 x vol						
Purge Volume 1L/min						
gallons purged	0.500 gal.	2.00	3.00			
purge/bail/type	PERI-LF					
Water Sample						
Sample No.			GW-5D1-3-101218-(20)			
Sample Method			PERI – LF			
Time			1150			
No. Cont.			1 POLY 500mL			
Initials			AC/EB			
pH						
value	7.20	7.14	7.12			
time YSI PRO+						
Conductivity ~~(S/cm)~~						
value µS/cm	29699	29583	29480			
time						
Temp. (Celsius)						
value	14.8	14.8	14.8			
time						
DO (mg/l)						
value	0.40	0.50	0.30			
time						
ORP (mV)						
value	39.6	4.1	-16.9			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value		15.8	8.27			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: – NO DRAWDOWN
– SLIGHTLY ODOROUS (H_2S)
* FIELD FILTERED TO 0.45µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: EB/PC
Date: OCT 15 2018

Well No. 6E7-3

well depth (top PVC)	57.50					
water level(top PVC)	12.18					
water height	45.32					
time	1315					
Casing/Volume						
type:	4" PVC					
type: other						
vol/ft	0.653					
tot. vol	29.6					
3 x vol						
Purge Volume						
gallons purged	~~29.6~~ 213	4	8	16	18	20
purge/bail/type	2					
Water Sample	0.5 gal/min					
Sample No.						
Sample Method						GW-6E7-3-101518-(20)
Time						1400
No. Cont.						1-500mL
Initials						EB
pH						
value	7.98	7.87	7.93	8.18	8.18	8.19
time	1320	1324	1331	1342	1349	1353
Conductivity (µS/cm)						
value	4299	3904	3233	2970	3043	3074
time						
Temp. (Celsius)						
value	13.8	13.8	13.8	13.8	14.3	14.2
time						
DO (mg/l)						
value	0.56	0.18	0.11	0.10	0.12	0.12
time						
ORP (mV)						
value	-120.6	-126.1	-140.9	-160.0	-161.7	-162.8
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						14.5
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PRO PLUS

COMMENTS:
VERY SLOW RECOVERY
SS MEGA-TYPHOON PRO PUMP USED
WELL DRAWN DOWN TO 45 FT
CLEAR H_2O

FIELD FILTERED

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COLPEN
Date: 10/10/18

Well No. 122+60-0

well depth (top PVC)	- ANGLED	SHORELINE	WELL			
water level(top PVC)	- SLACK TIDE	- LOW TIDE	+3' MLLW			
water height						
time						
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	1	2				
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.				GW-122+60-0-101018-(20)		
Sample Method				PERISTALTIC		
Time				1245		
No. Cont.				3		
Initials				DC		
pH						
value	8.03	8.03				
time YSI PRO +						
Conductivity (μS/cm)						
value	27047	27375				
time						
Temp. (Celsius)						
value	14.7	14.9				
time						
DO (mg/l)						
value	5.35	5.32				
time						
ORP (mV)						
value	+6.3	+6.1				
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value		4.42				
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: FIELD FILTERED 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A CERRUTI
Date: 10/10/18

Well No. 124+00-0

well depth (top PVC)	ANGLED SHORELINE WELL					
water level(top PVC)	- SLACK TIDE - LOW TIDE +3' MLLW					
water height						
time						
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume ~500 ml/min.						
gallons purged	0.25	0.50	1.0			
purge/bail/type	PERI - LF					
Water Sample						
Sample No.			GW-124+00-0-1010[illegible]18-(20)			
Sample Method			PERI - LF			
Time			AC: ~~1245~~ 1300			
No. Cont.			3 - (2) HDPE	(1) FLPE		
Initials			AC			
pH						
value YSI PRO +	8.47	8.46	8.46			
time						
Conductivity (S/cm)						
value µS/cm	38000	38360	38590			
time						
Temp. (Celsius)						
value	13.7	13.8	13.8			
time						
DO (mg/l)						
value	5.82	5.41	5.33			
time						
ORP (mV)						
value	106.9	107.0	107.1			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			3.36			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A CERRUTI
Date: 10/11/18

*** HIGH TIDE**

Well No. 124+00-0

well depth (top PVC)	ANGLED SHORELINE					
water level(top PVC)	+9' HIGH TIDE MLLW.					
water height						
time	0915					
Casing/Volume ~500mL/min.						
type:	2" - SS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged	0.5	1.0	1.25.			
purge/bail/type	PERI – LF					
Water Sample						
Sample No.			GW-124+00-0-	1011[illegible]18-(20)		
Sample Method			PERI-LF.			
Time			0930			
No. Cont.			3 -(2) HDPE	(1) FLPE		
Initials			AC			
pH						
value YSI PRO+	8.23	8.22	8,22			
time						
Conductivity (S/cm)						
value µS/cm.	32327	32344	32356			
time						
Temp. (Celsius)						
value	12.9	17.9	12.9			
time						
DO (mg/l)						
value	4.53	4.52	4.55			
time						
ORP (mV)						
value	161.0	161.3	161.3			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			4.86			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45 µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/10/18

Well No. 125+50-0

well depth (top PVC)	- ANGLED SHORELINE WELL					
water level(top PVC)	- OUTGOING TIDE / NEAR LT. +5' MLLW					
water height						
time	0940					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume ~500 mL/min						
gallons purged	1 gal.	2.5 gal.				
purge/bail/type	PERI-LF					
Water Sample						
Sample No.			GW-125+50-0-1010[illegible]18-(20)			
Sample Method			PERI-LF			
Time			1015			
No. Cont.			3 - (2) HDPE	(1) FLPE		
Initials			AC			
pH						
value YSI PRO+	7.47	7.60				
time						
Conductivity (S/cm)						
value mS/cm	29700	30457				
time						
Temp. (Celsius)						
value	13.4	13.6				
time						
DO (mg/l)						
value	6.00	6.06				
time						
ORP (mV)						
value	101.5	85.0				
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value		2.13				
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45 ~~µS/cm~~ AC µm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/11/18

*** HIGH TIDE.**

Well No. 125+50-0

well depth (top PVC)	ANGLED SHORELINE					
water level(top PVC)	+ 10' HIGH TIDE MLLW.					
water height						
time	0900					
Casing/Volume						
type:	2" - PVC					
type: other	~~AN~~ AC					
vol/ft						
tot. vol						
3 x vol						
Purge Volume ~500mL/min						
gallons purged	0.25	0.50	~~0915~~ AC 1.0			
purge/bail/type			PERI-LF			
Water Sample						
Sample No.			GW-125+50-0-	1011[illegible]18 -(2d)		
Sample Method			PERI-LF			
Time			0915			
No. Cont.			3 - (2) HDPE	(1) FLPE		
Initials			AC			
pH						
value YSI PRO +	6.96	7.09	7.16			
time						
Conductivity (S/cm)						
value uS/cm	36934	37940	38521			
time						
Temp. (Celsius)						
value	12.5	12.6	12.7			
time						
DO (mg/l)						
value	6.36	6.09	6.26			
time						
ORP (mV)						
value	130.8	130.7	129.1			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			4.36			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

*FIELD FILTERED TO 0.45 um.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/10/18

Well No. 126+90-0

well depth (top PVC)	ANGELED SHORELINE WELL				
water level(top PVC)	~~SLACK TIDE~~ AC	OUTGOING TIDE / + 6' MLLW			
water height					
time	0930				
Casing/Volume					
type:	2" - SS				
type: other					
vol/ft					
tot. vol					
3 x vol					
Purge Volume ~500mL/min.					
gallons purged	1 gal.	2.0 gal			
purge/bail/type	PERI - LF.				
Water Sample					
Sample No.			GW-126+90-0-1010[illegible]18-(20)		
Sample Method			PERI-LF		
Time			1000		
No. Cont.			3 - (2) HDPE (1) FLPE		
Initials			AC		
pH					
value YSI PRO+	7.60	7.71			
time					
Conductivity ~~(S/cm)~~					
value μS/cm	36240	36721			
time					
Temp. (Celsius)					
value	13.3	13.4			
time					
DO (mg/l)					
value	5.96	5.90			
time					
ORP (mV)					
value	153.4	142.2			
time					
TDS (ppt)					
value					
time					
Turbidity (ntu)					
value		0.00			
time					
Ferrous Iron (mg/l)					
value					
time					
Sulfide (mg/l)					
value					
time					

COMMENTS:

- FIELD FILTERED TO 0.45 μm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A CERRUT
Date: 10/11/18

* HIGH TIDE

Well No. 126+90-0

well depth (top PVC)	ANGLED SHORELINE					
water level(top PVC)	+10' HIGH	TIDE MLLW				
water height						
time	0345					
Casing/Volume						
type:	2" - SS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume ~500mL/min -						
gallons purged	0.5	1.0	1.5			
purge/bail/type	PERI - LF					
Water Sample						
Sample No.			GW-126+90-0 -	1011[illegible]18-(20)		
Sample Method			PERI - LF			
Time			0700			
No. Cont.			3 - (2) HDPE	(1) FLPE		
Initials			AC			
pH						
value YSI PRO +	7.66	7.71	7.74.			
time						
Conductivity (S/cm)						
value mS/cm	28003	28122	28189			
time						
Temp. (Celsius)						
value	13.0	13.1	13.0			
time						
DO (mg/l)						
value	5.84	5.84.	5.89			
time						
ORP (mV)						
value	173.6	172.9	172.4			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			5.26			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

*FIELD FILTERED TO 0.45 μm.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 10/9/18

Well No. 128+30-0

well depth (top PVC)	— ANGLED SHORELINE WELL					
water level(top PVC)	— DRY AT LOW TIDE < 3' MLLW					
water height	— SAMPLED DURING OUTGOING TIDE NEAR LOW					
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume	300ml/min					
gallons purged	1	2	3			
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.					GW-128+30-0-100918-(20)	
Sample Method					PERISTALTIC	
Time					1000	
No. Cont.					3	
Initials					DC	
pH						
value	6.84	~~7.33~~	6.81			
time YSI PRO +		6.77				
Conductivity (mS/cm)						
value	38684	39178	39278			
time						
Temp. (Celsius)						
value	13.6	13.6	13.6			
time						
DO (mg/l)						
value	8.53	6.87	6.71			
time						
ORP (mV)						
value	+62.3	+62.4	+63.1			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value HANNA			4.16			
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

DRY AT LOW TIDE
SAMPLED ON OUTGOING TIDE +3' MLLW

FIELD FILTERED
0.45µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 10/9/18

Well No. 129+65-0

well depth (top PVC)	- ANGLED SHORELINE WELL					
water level(top PVC)	- DRY AT LOW TIDE < 3' MLLW					
water height	- SAMPLED DURING OUTGOING TIDE NEAR LOW					
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume	500 ml/min					
gallons purged	1	2	3			
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.						
Sample Method					GW-129+65-0-100918-(20)	
Time					1030	
No. Cont.					3	
Initials					DGC	
pH						
value YSI PRO +	7.52	7.50	7.48			
time						
Conductivity (µS/cm)						
value	29296	29248	29216			
time						
Temp. (Celsius)						
value	13.7	13.6	13.6			
time						
DO (mg/l)						
value	5.71	5.74	5.78			
time						
ORP (mV)						
value	+76.5	+78.2	+78.8			
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value			13.4			
time HANNA						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: FIELD FILTERED 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS ~~Well~~ **No.** SW-120+75-SW

well depth (top PVC)	SURFACE WATER NSDS SAMPLE					
water level(top PVC)	INSTALLED	8/4/18				
water height	+3 MLLW					
time						
Casing/Volume						
type:	8 x 8 OZ SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	SW-120+75-SW-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1400					
No. Cont.	3					
Initials	~~DC~~/EB					
pH						
value	7.71					
time						
Conductivity (~~S/cm~~)						
value µS/cm	44427					
time						
Temp. (Celsius)						
value	14.2*					
time						
DO (mg/l)						
value	3.83*					
time						
ORP (mV)						
value	+98.4					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	5.95					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

SAMPLE FIELD FILTERED

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS ~~**Well No.**~~ SW-125+00-SW

well depth (top PVC)	SURFACE WATER NSDS SAMPLE					
water level(top PVC)	INSTALLED	8/12/18				
water height	~5 MLLW					
time						
Casing/Volume						
type:	8 x 8 oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	SW-125+00-SW-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1200					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.71					
time						
Conductivity (uS/cm)						
value	44309					
time						
Temp. (Celsius)						
value	14.5 *					
time						
DO (mg/l)						
value	1.08 *					
time						
ORP (mV)						
value	+91.0					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	15.4					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS
Well No. SW-128+50-SW

well depth (top PVC)	SURFACE WATER NSDS		SAMPLE			
water level(top PVC)	INSTALLED	8/13/18				
water height	+3 MLLW					
time						
Casing/Volume						
type:	8 x 8oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	SW-128+50-SW-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1315					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.68					
time						
Conductivity (S/cm)						
value	39737					
time						
Temp. (Celsius)						
value	16.8*					
time						
DO (mg/l)						
value	2.44*					
time						
ORP (mV)						
value	+81.2					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	3.81					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS: * STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: AC/EB
Date: 10/17/18

NSDS
~~Well No.~~ PW-119+25-0

well depth (top PVC)	INTERTIDAL NSDS SAMPLE					
water level(top PVC)	INSTALLED 8/10/18					
water height	+3 MLLW					
time						
Casing/Volume						
type:	8x 8OZ SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-119+25-0-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	0930					
No. Cont.	3					
Initials	AC/EB					
pH						
value	6.51					
time						
Conductivity (µS/cm)						
value	41897					
time						
Temp. (Celsius)						
value	11.7					
time						
DO (mg/l)						
value	3.68*					
time						
ORP (mV)						
value	+181.2					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	74.9					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS:
* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

~~Well~~ NSDS No. PW-120+75-0

well depth (top PVC)	INTERTIDAL	NSDS SAMPLE				
water level(top PVC)	INSTALLED	8/10/18				
water height	+3 MLLW					
time						
Casing/Volume						
type:	8 x 8oz	SAMPLERS				
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-120+75-0-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1015					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.31					
time						
Conductivity ~~(uS/cm)~~						
value mS/cm	37666					
time						
Temp. (Celsius)						
value	12.4*					
time						
DO (mg/l)						
value	4.81*					
time						
ORP (mV)						
value	+97.8					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	7.25					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS: * STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

SAMPLE FIELD FILTERED

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

Well ~~No~~. NSDS PW-122+60-0

well depth (top PVC)	INTERTIDAL	NSDS SAMPLE				
water level(top PVC)	INSTALLED	8/10/18				
water height	+3 MLLW					
time						
Casing/Volume						
type:	8x 8oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-122+60-0-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1100					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.45					
time						
Conductivity (uS/cm)						
value	40384					
time						
Temp. (Celsius)						
value	14.1*					
time						
DO (mg/l)						
value	0.35 *					
time						
ORP (mV)						
value	+92.1					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	21.9					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PRO PLUS

COMMENTS: * STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS
~~Well~~ No. PW-124+00-0

well depth (top PVC)	INTERTIDAL	NSDS SAMPLE				
water level(top PVC)	INSTALLED	10/10/18				
water height	+3 MLLW					
time						
Casing/Volume						
type:	8 x 8oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-124+00-0-DS-101718-(2c)					
Sample Method	PERISTALTIC					
Time	1130					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.72					
time						
Conductivity (uS/cm)						
value	41567					
time						
Temp. (Celsius)						
value	14.4					
time						
DO (mg/l)						
value	5.18*					
time						
ORP (mV)						
value	+81.0					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	9.01					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PRO PLUS

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/ER
Date: 10/17/18

NSDS
~~Well No.~~ PW-125+50-0

well depth (top PVC)	INTERTIDAL	NSDS SAMPLE				
water level(top PVC)	INSTALLED	8/10/18				
water height	+3 MLLW					
time						
Casing/Volume						
type:	8 x 8 oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample	PW					
Sample No.	~~PU~~-125+50-0-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1145					
No. Cont.	3					
Initials	DC/ER					
pH						
value	7.78					
time						
Conductivity (uS/cm)						
value	45272					
time						
Temp. (Celsius)						
value	15.7*					
time						
DO (mg/l)						
value	3.72*					
time						
ORP (mV)						
value	+87.0					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	4.87					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS
~~Well~~ No. PW-126+90-0

well depth (top PVC)	INTERTIDAL	NSDS SAMPLE				
water level(top PVC)	INSTALLED	8/10/18				
water height	+3 MLLW					
time						
Casing/Volume						
type:	8 x 8oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-126+90-0-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1238					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.71					
time						
Conductivity (uS/cm)						
value	42545					
time						
Temp. (Celsius)						
value	15.9*					
time						
DO (mg/l)						
value	4.74*					
time						
ORP (mV)						
value	+87.7					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	5.07					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI
PRO
PLUS

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

SAMPLE FIELD FILTERED

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS ~~**Well**~~ **No.** PW-128+30-0

well depth (top PVC)	INTERTIDAL	NSDS SAMPLE				
water level(top PVC)	INSTALLED	8/12/18				
water height	+3 MLLW					
time						
Casing/Volume						
type:	8x8OZ SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-128+30-0-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1245					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.64					
time						
Conductivity (uS/cm)						
value	41687					
time						
Temp. (Celsius)						
value	14.8*					
time						
DO (mg/l)						
value	3.84*					
time						
ORP (mV)						
value	+91.5					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	15.9					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PRO
x

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS
~~Well~~ No. PW-119+25-ST1

well depth (top PVC)	SUBTIDAL NSDS SAMPLE					
water level(top PVC)	INSTALLED	8/11/18				
water height	-5 MLLW					
time						
Casing/Volume						
type:	8x 8oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-119+25-ST1-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1000					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.35					
time						
Conductivity (µS/cm)						
value	43779					
time						
Temp. (Celsius)						
value	12.7*					
time						
DO (mg/l)						
value	0.68 *					
time						
ORP (mV)						
value	+100.5					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	26.7					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI
PRO
PLUS

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

~~Well No.~~ NSDS PW-120+75-ST1

well depth (top PVC)	SUBTIDAL					
water level(top PVC)	INSTALLED 8/11/18					
water height	-5 MLLW					
time						
Casing/Volume						
type:	8x8oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-120+75-ST1-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1045					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.38					
time						
Conductivity (~~uS/cm~~) mS/cm						
value	42447					
time						
Temp. (Celsius)						
value	13.2*					
time						
DO (mg/l)						
value	0.67*					
time						
ORP (mV)						
value	+94.5					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	23.4					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PRO PLUS

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

~~Well No.~~ NSDS PW-123 +25-ST1

well depth (top PVC)	SUBTIDAL NSDS SAMPLE					
water level(top PVC)	INSTALLED	8/12/18				
water height	-5 MLLW					
time	1115					
Casing/Volume						
type:	8x 8oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample	PW-123+					
Sample No.	PW-[illegible]+25-ST1-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1115					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.62					
time YSI PRO+						
Conductivity (uS/cm)						
value	44209					
time						
Temp. (Celsius)						
value	15.2 *					
time						
DO (mg/l)						
value	0.77 *					
time						
ORP (mV)						
value	+87.0					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	13.1					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* STATIC SAMPLE NOT FLOW THROUGH

DUPLICATE TAKEN

SAMPLE FIELD FILTERED

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS ~~Well~~ No. PW-125+00-ST1

well depth (top PVC)	SUBTIDAL NSDS SAMPLE					
water level(top PVC)	INSTALLED	8/12/18				
water height	-5 MLLW					
time						
Casing/Volume						
type:	8 x 8oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-125+00-ST1-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1215					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.71					
time						
Conductivity (uS/cm)						
value	41779					
time						
Temp. (Celsius)						
value	15.0*					
time						
DO (mg/l)						
value	4.55*					
time						
ORP (mV)						
value	+90.0					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	6.6					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PROPLUS

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS
~~Well No.~~ PW-126+80-ST1

well depth (top PVC)	SUBTIDAL NSDS SAMPLE					
water level(top PVC)	INSTALLED 8/12/18					
water height	-5 MLLW					
time						
Casing/Volume						
type:	8 x 8oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-126+80-ST1-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1300					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.65					
time						
Conductivity (S/cm)						
value µS/cm	44011					
time						
Temp. (Celsius)						
value	14.9*					
time						
DO (mg/l)						
value	1.51*					
time						
ORP (mV)						
value	+90.7					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	13.3					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI PRO PLUS

COMMENTS:

* STATIC SAMPLE, NOT ~~FIELD FILTERED~~ EB FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS ~~Well~~ No. PW-128+50-ST1

well depth (top PVC)	SUBTIDAL NSOS SAMPLE					
water level(top PVC)	INSTALLED	8/13/18				
water height	-5 MLLW					
time						
Casing/Volume						
type:	8 x 8oz SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-128+50-ST1-DS-101718-(20)					
Sample Method	PERISTALTIC					
Time	1330					
No. Cont.	3					
Initials	DC/EB					
pH						
value	7.63					
time						
Conductivity (S/cm)						
value	43277					
time						
Temp. (Celsius)						
value	16.0					
time						
DO (mg/l)						
value	0.86					
time						
ORP (mV)						
value	+89.8					
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	19.9					
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

YSI ProPlus

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 9/11/18

APS
~~Well~~ No. 119 + 25 ST1

well depth (top PVC)						
water level(top PVC)	-5 MLLW					
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume	200-500 ml/min					
~~gallons~~ purged LITERS	1	2	3	4	5	6
purge/bail/type	PERISTALTIC	W/SS	PUSH POINT	- 12"	PENETRATION	
Water Sample						
Sample No.	PW-119+25-ST1-091118-(20)					
Sample Method	PERISTALTIC					
Time	1130					
No. Cont.	3					
Initials	DC					
pH						
value YSI 556	7.04	7.16	7.30	7.29	7.31	7.30
time						
Conductivity (uS/cm)						
value	46,786	47,073	47,004	47,084	47,310	47,244
time						
Temp. (Celsius) *						
value	17.6	17.4	17.5	17.8	17.5	17.6
time						
DO (mg/l)						
value	2.65	2.65	2.68	2.52	2.48	2.65
time						
ORP (mV)						
value	+15.3	+11.7	+7.9	-1.5	-7.0	-5.4
time						
TDS (ppt)						
value	-	-	-	-	-	-
time						
Turbidity (ntu)						
value GEOTECH	~~157~~	~~117~~	24.2	10.9	10.7	10.9
time	40.2	21.7				
Ferrous Iron (mg/l)						
value DR 900						0.88
time						
Sulfide (mg/l)						
value DR 900						0.00
time						

COMMENTS:

FIELD FILTERED 0.45 µm
LOW TIDE TO .5' @ 1242
* POLY HOSE EXPOSED TO SUN

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D Cooper
Date: 9/11/18

APS
~~Well~~ No. 120+75 ST1

well depth (top PVC)						
water level(top PVC)						
water height	~5' MLLW					
time	AT SAME	STATION	/ STAKE AS	2017		
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume	200-500 ml/min					
gallons purged	2	3	4	5	6	
purge/bail/type	PERISTALTIC	W/ SS	PUSH POINT	~12"	PENETRATION	
Water Sample						
Sample No.	PW-120+75-ST1-09	1118-(20)				
Sample Method	PERISTALTIC					
Time	1245					
No. Cont.	3					
Initials	DC					
pH						
value	7.28	7.36	7.35	7.35	7.36	
time YSI 556						
Conductivity (uS/cm)						
value	46,753	46,648	46,592	46,564	46,596	
time YSI 556						
Temp. (Celsius)						
value	15.7	15.6	15.7	16.1	16.2	
time						
DO (mg/l)						
value	0.34	0.16	0.12	0.18	0.16	
time						
ORP (mV)						
value	-48.4	-64.6	-67.0	-75.3	-79.3	
time						
TDS (ppt)						
value	—	—	—	—	—	
time						
Turbidity (ntu)						
value	15.3	15.4	7.69	8.26	4.21	
time GEOTECH						
Ferrous Iron (mg/l)						
value					3.78	
time DR 900						
Sulfide (mg/l)						
value					0.00	
time DR 900						

COMMENTS:

FIELD FILTERED 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 9/12/18

PPS
Well No. 123+25 ST1

well depth (top PVC)						
water level(top PVC)						
water height	~5' MLLW					
time	EXISTING STAKE	FROM 2017				
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
~~gallons~~ purged LITERS	2	~~4~~3	4	5	6	
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	PW-123+25-ST1-091218-(20)					
Sample Method	PERISTALTIC w/ SS PUSH POINT - 12" PENETRATION					
Time	1000					
No. Cont.	3					
Initials	DC					
pH						
value	7.59	7.63	7.63	7.64	7.65	
time YSI 556						
Conductivity (uS/cm)						
value	46442	46247	46236	46254	46330	
time						
Temp. (Celsius)						
value	15.3	15.2	15.3	15.6	15.5	
time						
DO (mg/l)						
value	0.77	0.37	0.34	0.29	0.29	
time						
ORP (mV)						
value	+20.1	+19.4	+17.6	+17.3	+16.7	
time						
TDS (ppt)						
value	—	—	—	—	—	
time						
Turbidity (ntu)						
value GEO	8.34	5.31	6.68	7.10	5.34	
time						
Ferrous Iron (mg/l)						
value DR 900					0.03	DR 900
time						
Sulfide (mg/l)						
value DR 900					0.00	DR 900
time						

COMMENTS:
YSI 556 MPS   FIELD FILTERED 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 9/12/18

PPS ~~Well~~ **No.** 125+00 STI

well depth (top PVC)						
water level(top PVC)						
water height	-5' MLLW					
time	EXISTING GRADE FROM 2017					
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume	200 ml/min					
~~gallons~~ purged LITERS	2	3	4	~~5~~ 6	~~6~~ 8	
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	PW-125+00-STI-091218-(20)					
Sample Method	PERISTALTIC - W/ SS PUSH POINT - 12" PENETRATION					
Time	1200					
No. Cont.	3					
Initials	DC					
pH						
value YSI 556	7.65	7.63	7.62	7.59	7.55	
time						
Conductivity (uS/cm)						
value	45,198	45,061	45,011	44765	44875	
time						
Temp. (Celsius)						
value	16.1	15.9	16.0	16.1	16.1	
time						
DO (mg/l)						
value	1.72	1.37	1.27	1.30	1.03	
time						
ORP (mV)						
value	+41.7	+41.0	+39.9	+37.7	+35.0	
time						
TDS (ppt)						
value	—	—	—	—	—	
time						
Turbidity (ntu)						
value	36.3	20.4	21.9	33.4	14.5	
time GEO						
Ferrous Iron (mg/l)						
value	X				0.10	
time DR 900						
Sulfide (mg/l)						
value					0.00	
time DR 900						

COMMENTS:
YSI 556 MPS FIELD FILTERED 0.45 μm

STI SEDIMENT SAMPLE SD-125.00-STI-SED-091218-0-0.33 @1230
2-8OZ. POLY

INTERTIDAL SED SAMPLE SD-125+50-0-SED-091218-0-0.33 @ 1300
2-8OZ POLY

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A COOPER
Date: 9/12/18

~~Well~~ PPS No. 126 + 80 ST1

well depth (top PVC)						
water level(top PVC)						
water height	~5' MLLW					
time	EXISTING SPACE/LOCATION FROM 2017					
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
~~gallons~~ purged LITERS	2	3	4	6	8	
purge/bail/type						
Water Sample						
Sample No.	PW-126+80-ST1-091218-(20)					
Sample Method	PNEUMATIC w/ SS PUSH POINT - 12" PENETRATION					
Time	1400					
No. Cont.	3					
Initials	AC					
pH						
value	7.36	7.38	7.39	7.39	7.39	
time YSI 556						
Conductivity (uS/cm)						
value	47306	47316	47113	47226	47329	
time						
Temp. (Celsius)						
value	16.4	16.3	16.8	16.9	16.8	
time						
DO (mg/l)						
value	3.57	3.39	3.00	2.86	2.77	
time						
ORP (mV)						
value	+40.8	+41.1	+39.9	+39.4	+39.5	
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value	40.1	36.5	18.8	23.3	22.4	
time GEO						
Ferrous Iron (mg/l)						
value					0.27	
time DR 900						
Sulfide (mg/l)						
value					0.05	
time DR 900						

COMMENTS:
YSI 556 MPS FIELD FILTERED 0.45 µm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 9/13/18

PPS
~~Well~~ No. 128+50 STI

well depth (top PVC)						
water level(top PVC)						
water height	-5' MLLW					
time	FOUND ORIGINAL STAKE/LOCATION FROM 2017					
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
~~gallons~~ purged LITERS	2	3	4	5	6	
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	PW-128+50-STI-091318-(20)					
Sample Method	PERISTALTIC ~ W/SS PUSH POINT ~ 12" PENETRATION					
Time	1215					
No. Cont.	3					
Initials	DC					
pH						
value YSI 556	7.61	7.63	7.64	7.65	7.66	
time						
Conductivity (uS/cm)						
value	46947	46923	47035	47039	47029	
time						
Temp. (Celsius)						
value	16.2	16.3	16.2	16.2	16.1	
time						
DO (mg/l)						
value	0.49	0.26	0.19	0.17	0.12	
time						
ORP (mV)						
value	-190.5	-209.5	-221.0	-228.2	-239.8	
time						
TDS (ppt)						
value	-	-	-	-		
time						
Turbidity (ntu)						
value GEOTECH	11.2	8.91	7.14	6.74	6.30	
time						
Ferrous Iron (mg/l)						
value DR 900					0.07	
time						
Sulfide (mg/l)						
value DR 900					5.00	(10X DILUTION)
time						

COMMENTS:

DUPLICATE PW-128+50+STI-091318-(21) @1220
FIELD FILTERED 0.45 μm
* SULFUROUS ODOR

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 9/13/18

PPS
Well No. PW-130+75 ST1

well depth (top PVC)						
water level(top PVC)						
water height	-5' BELOW					
time	AND OLD INTAKE - SET NEW ONE @ -5' BELOW W/ POLY TUBE					
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume	VERY LOW FLOW/YIELD 100 ML/MIN					
~~gallons~~ purged LITER	2	3	4	5		
purge/bail/type	PERISTALTIC					
Water Sample						
Sample No.	PW-130+75-ST1-091318-(20)					
Sample Method	PERISTALTIC - W/ SS PUSH POINT - 12" PENETRATION					
Time	1415					
No. Cont.	3					
Initials	DC					
pH						
value YSI 556	7.52	7.46	7.42	7.41		
time						
Conductivity (uS/cm)						
value	47549	47664	47623	47610		
time						
Temp. (Celsius)	* TUBING EXPOSED TO SUN					
value	* 18.8	19.2	19.9	19.9		
time						
DO (mg/l)						
value	1.82	0.90	0.88	0.86		
time						
ORP (mV)						
value	-121.6	-124.8	-106.6	-110.8		
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value GEOTECH	40.0	32.6	23.3	22.1		
time						
Ferrous Iron (mg/l)						
value DR900				2.00		
time						
Sulfide (mg/l)						
value DR900				0.02		
time						

COMMENTS: FIELD FILTERED 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: A. CERRUTI
Date: 10/11/18

Well No. 5B1-1(R) [DUPLICATE]

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	GW-5B1-1(R)-	1011[illegible]18-(21)				
Sample Method	PERI-LF					
Time	1315					
No. Cont.	3-(2) HDPE	(1) FLPE				
Initials	AC.					
pH						
value						
time						
Conductivity (S/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* FIELD FILTERED TO 0.45 μm

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/5/18

Well No. DUPLICATE OF SD2-1R

well depth (top PVC)	ARI SUPPLIED DIW RUN THROUGH PERISTALTIC TUBING					
water level(top PVC)	AND FILTER 0.45μm					
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	GW-SD2-1R-100518-(21)					
Sample Method	PERISTALTIC					
Time	0950					
No. Cont.	1 - 500ml					
Initials	EB					
pH						
value						
time						
Conductivity (S/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 9/13/18

~~Well~~ PPS No. PW 128+50-ST1 DUPLICATE

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-128+50-ST1-091318-(21)					
Sample Method	PERISTALTIC					
Time	1220					
No. Cont.	3					
Initials	DGC					
pH						
value						
time						
Conductivity (uS/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

NSDS PW ~~Well No.~~ 123+25-ST1

well depth (top PVC)	SUBTIDAL	DUPLICATE	NSDS SAMPLE			
water level(top PVC)	INSTALLED	8/12/18				
water height	-5 MLLW					
time	1120					
Casing/Volume						
type:	8×8OZ SAMPLERS					
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	PW-123+25-ST1-DS-101718-(21)					
Sample Method	PERISTALTIC					
Time	1120					
No. Cont.	3					
Initials	DC/EB					
pH						
value						
time						
Conductivity (uS/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value	*					
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

* STATIC SAMPLE, NOT FLOW THROUGH

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

SAMPLE FIELD FILTERED

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: AC/EB
Date: 10/12/18

Well No. ~~GW-EB-EB-101218-(20)~~ EQUIPMENT BLANK

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	GW-EB-EB-	101218-(20)				
Sample Method	PERI-LF					
Time	0930					
No. Cont.	3 - (2) HDPE	(1) FLPE				
Initials	AC/EB					
pH						
value						
time						
Conductivity (S/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS: FLPE BOTTLE DIW FROM FLPE BOTTLE.
THEN HDPE BOTTLES DIW FROM HDPE BOTTLE.

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: B Cooper
Date: 10/5/18

Well No. EQUIPMENT BLANK

well depth (top PVC)	ARI SUPPLIED DIW RUN THROUGH PERISTALTIC TUBING					
water level(top PVC)	AND FIELD FILTERED 0.45 µm					
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	EB-EB-100518 (20)					
Sample Method	PERISTALTIC					
Time	1000					
No. Cont.	1 250 ml					
Initials	BC					
pH						
value						
time						
Conductivity (S/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 9/13/18

Well No. FIELD BLANK FROM PPS

well depth (top PVC)						
water level(top PVC)	SAMPLED OF DI RUN THRU PERISTALTIC TUBING/FILTER					
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	FB-PPS-07-091318-(20)					
Sample Method	PERISTALTIC					
Time	1515					
No. Cont.						
Initials						
pH						
value						
time						
Conductivity (uS/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: DC/EB
Date: 10/17/18

~~Well No.~~ NSDS EQUIPMENT BLANK

well depth (top PVC)	USING DE-GASSED DIW PROVIDED BY BAL					
water level(top PVC)	IN CONTACT WITH NSDS SAMPLE JAR / SCREEN					
water height	RUN THROUGH PERISTALTIC TUBING AND SS PROBE TIP					
time	FILTERED 0.45 µm					
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
Water Sample						
Sample No.	EB-EB-101718-(20)					
Sample Method	PERISTALTIC					
Time	1430					
No. Cont.	2-HDPE 1-FLPE					
Initials	DC/EB					
pH						
value						
time						
Conductivity (uS/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Dalton, Olmsted Fuglevand, Inc.

Water Sampling Record

Former Arkema Manufacturing
Tacoma, WA

Sampled by: D COOPER
Date: 9/12/18

125+50 - O INTERTIDAL
PPS ~~Well~~ No. SHORELINE SEDIMENT SAMPLE @ 125+00 - STI SUBTIDAL

well depth (top PVC)						
water level(top PVC)						
water height						
time						
Casing/Volume						
type:						
type: other						
vol/ft						
tot. vol						
3 x vol						
Purge Volume						
gallons purged						
purge/bail/type						
~~Water~~ Sample						
O Sample No.	SD-125+50-O-SED-091218-0-0.33 @ 1300					
STI Sample ~~Method~~	SD-125+00-STI-SED-091218-0-0.33 @ 1230					
Time						
No. Cont.	2-8OZ JARS EACH - ANOXIC PRESERVATION					
Initials						
pH						
value						
time						
Conductivity (uS/cm)						
value						
time						
Temp. (Celsius)						
value						
time						
DO (mg/l)						
value						
time						
ORP (mV)						
value						
time						
TDS (ppt)						
value						
time						
Turbidity (ntu)						
value						
time						
Ferrous Iron (mg/l)						
value						
time						
Sulfide (mg/l)						
value						
time						

COMMENTS:
BOTH SAMPLES - BROWN, GRAVELLY, SAND
20% 80%

Well Volumes:
2" = 0.163 gal/ft x 3 = 0.5
4" = 0.653 gal/ft x 3 = 2.0

Arkema MWSAMPL.XLS

APPENDIX C
WATER QUALITY TABLES

FS DATA GAP INVESTIGATION 2018
FIELD MEASUREMENTS/SAMPLING
FORMER ARKEMA MANUFACTURING SITE
TACOMA, WASHINGTON

- TABLE 1 - 3Q 2018 Summary of Water Quality

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TABLE 1
Summary of Water Quality
3rd Quarter 2018

Type	SiteID	Field pH	Field Conductivity (uS/cm)	Field Temperature (Celsius)	Dissolved Oxygen (mg/L)	Field ORP (mV)	Field Turbidity (NTU)	Comments
Shallow Aquifer Wells	4C1-1	10.81	4548	17.3	0.00	-76.0	7.05	medium brown color with effervescence and sulfurous odor
	4D1-1	11.47	12134	15.6	0.00	-313.9	6.52	dark brown color with effervescence and sulfurous odor
	5B1-1R	10.05	2709	17.7	0.28	-21.2	3.6	medium brown to tan color
	5C12-1	11.59	6859	18.9	0.00	-280.0	3.21	tan color with slight sulfurous odor
	5C13-1	10.30	8750	18.9	0.00	-291.8	6.35	tan color
	5C16-1R	8.45	1860	17.5	0.00	-188.9	0.68	
	5D2-1R	10.81	4896	18.0	0.23	-224.2	3.86	light brown color with effervescence and sulfurous odor
	5D5-1	7.01	8515	18.7	0.07	152.7	7.56	
	5D7-1R	7.49	1108	18.8	0.08	-152.5	5.23	
	5E1-1	6.40	556	18.4	0.32	-51.3	4.9	
	5E2-1	7.21	2190	19.5	0.11	-96.2	7.62	brown color with effervescence and sulfurous odor
	5E4-1	8.83	6523	18.2	0.04	-218.4	1.74	medium brown with slight sulfur odor and effervescence
	5E8-1	7.50	535	18.8	0.45	-86.2	6.3	
	6D14-1	6.01	18140	16.2	0.10	-132.6	3.49	slight effervescence and sulfurous odor. Some floculation observed on tape/tubing.
	6D25-1	8.70	2136	18.6	0.07	-216.7	7	slight tan color
	6E1-1	6.88	1057	17.4	0.08	-112.3	1.12	
	6E2-1	6.68	5946	15.7	0.20	-26.2	22.2	
	6E5-1	7.08	4433	19.9	1.31	-101.5	6.1	sheen and sulfurous odor observed. poor recovery, well pumped dry prior to collecting sample
	6E6-1	10.86	14217	16.3	0.00	-348.5	4.18	medium brown color with slight effervescence
	7E3-1	7.89	5961	16.4	1.18	-144.6	1.5	slight effervescence
	7E8-1	11.07	23890	15.6	0.00	-432.6	8.71	medium brown color with sulfurous odor
	7E10-1	10.05	11400	16.6	0.15	-328.5	1.26	dark brown, slight sheen, and sewage odor observed
	7F2-1	7.06	11000	16.8	0.35	-97.5	4.13	sulfurous odor with slight effervescence
	7F3-1	10.54	13768	13.8	0.23	-254.3	20.2	tan color with sulfurous odor
	7F4-1	12.06	54050	16.4	0.00	-369.5	1.64	dark brown to black water with rainbow sheen and biowaste odor
	8F1-1R	10.92	12600	15.7	0.69	-145.8	4.21	brown color with effervescence and sulfurous odor
	8G2-1	11.38	29435	16.9	0.11	-328.5	3.2	dark brown color and sulfurous odor
	121+80-1	11.15	6138	17.5	0.25	-189.6	--	poor recovery,well pumped dry prior to collecting sample.
	122+60-1	7.56	30234	16.3	5.44	37.1	16.8	orange flocculent
	124+00-1	8.42	37297	15.9	1.80	95.6	46	
	125+50-1	8.33	38238	14.9	7.76	105.0	36.1	
	126+90-1	8.04	40955	14.7	6.26	108.3	40	
	128+30-1	6.59	37838	15.2	2.60	46.9	309	orange flocculent. Well pumped dry during sample collection.
	129+65-1	7.19	33217	14.5	7.16	113.9	169	
	131+00-1	7.41	34090	14.9	5.73	88.7	--	air bubbles in flow cell, very orange and turbid with poor recovery. Well pumped dry prior to sample collection, water clear during sampling.

TABLE 1

Summary of Water Quality
3rd Quarter 2018

Type	SiteID	Field pH	Field Conductivity (uS/cm)	Field Temperature (Celsius)	Dissolved Oxygen (mg/L)	Field ORP (mV)	Field Turbidity (NTU)	Comments
Intermediate Aquifer Wells	5B1-2R	7.01	42316	14.2	0.38	-92.6	30.4	
	5C16-2R	7.14	21515	14.0	0.17	-132.8	1.42	slight tan color with sulfurous odor
	5C21-2	6.50	22000	15.0	0.00	-147.4	2.74	tan color with effervescence
	6D25-2	9.52	4785	15.1	0.00	-221.1	12.3	tan color with effervescence
	6E3-2	6.96	32194	13.8	1.01	-47.0	151	pumped dry (10/4) prior to sampling (10/9). Green algae observed
	7E7-2	9.54	1742	14.0	0.13	-216.1	1.61	slight brown color with slight sulfur odor
	6E9-2	7.66	14709	15.0	0.00	-211.3	8.35	dark brown color with slight sulfurous odor and effervescence
	6E12-2	6.66	47963	13.9	0.00	-193.4	7.04	light yellow color with methane odor
	7E4-2	9.98	10715	13.1	0.05	-294.7	4.6	brown with sulfur odor and effervescence. Floating organic material observed
	7E6-2	10.30	7858	13.7	0.12	-365.5	2.07	brown color, sulfurous odor
	7E9-2	7.38	8620	13.8	2.36	-164.0	0.91	slight yellow color and effervescence.
	7E16-2	7.20	3053	17.5	0.27	-126.0	2.1	
	120+75-2	7.30	37464	14.4	0.22	-13.0	6.23	grey color with sulfurous odor
	121+80-2	9.59	11455	15.2	0.08	-210.5	42.7	dark brown, poor recovery. Well pumped dry prior to collecting sample
	122+60-2	8.10	29764	15.1	0.27	45.2	5	
	124+00-2	8.85	31580	14.2	0.24	-11.9	10.1	brown color with sulfurous odor
	125+50-2	7.49	29440	15.8	0.14	-64.2	4.57	
	126+90-2	7.92	28957	14.6	0.13	-75.7	0	
	128+30-2	8.54	18140	13.9.	0.03	-235.8	1.8	sulfurous odor
	129+65-2	7.05	26500	14.7	0.00	-210.0	13.9	very strong sulfurous odor
	131+00-2	8.85	13315	14.3	0.67	-198.7	285	orange color with sulfur smell. Well pumped dry during sample collection.
Deep Aquifer Wells	5D1-3	7.12	29480	14.8	0.30	-16.9	8.27	slight sulfurous odor
	6E7-3	8.19	3074	14.2	0.12	-162.8	14.5	SS Mega Typhoon Pro Pump used. Draw down to 45 ft.
Angled Shoreline Wells	122+60-0	8.03	27375	14.9	5.32	6.1	4.42	Sampled during slack tide near low tide : + 3' MLLW
	124+00-0	8.46	38590	13.8	5.33	107.1	3.36	Sampled during slack tide near low tide : +3' MLLW
	124+00-0	8.22	32356	12.9	4.55	161.3	9.86	High tide : +9' MLLW
	125+50-0	7.60	30457	13.6	6.06	85.0	2.13	Sampled during outgoing tide near low tide: +5' MLLW
	125+50-0	7.16	38521	12.7	6.26	129.1	4.36	High tide : +10' MLLW
	126+90-0	7.71	36721	13.4	5.90	142.2	0	Sampled during outgoing tide near low tide : +6' MLLW
	126+90-0	7.74	28189	13.0	5.89	172.4	5.26	High tide : +10' MLLW
	128+30-0	6.81	39278	13.6	6.71	63.1	4.16	Dry at tide lower than +3' MLLW. Sampled during outgoing tide near low of: +3' MLLW
	129+65-0	7.48	29216	13.6	5.78	78.8	13.4	Dry at tide lower than +3' MLLW. Sampled during outgoing tide near low of: +3' MLLW
Pore Water Nylon Screen Diffusion Samples	119+25-0-DS	6.51	41897	11.7	3.68	181.2	74.9	Static sample, not flow through
	122+60-0-DS	7.45	40384	14.1	0.35	92.1	21.9	Static sample, not flow through
	124+00-0-DS	7.72	41567	14.4	5.18	81.0	9.01	Static sample, not flow through
	125+50-0-DS	7.78	45272	15.7	3.72	87.0	4.87	Static sample, not flow through
	126+90-0-DS	7.71	42545	15.9	4.74	87.7	5.07	Static sample, not flow through
	120+75-0-DS	7.31	37666	12.4	4.81	97.8	7.25	Static sample, not flow through
	128+30-0-DS	7.64	41687	14.8	3.84	91.5	15.9	Static sample, not flow through
	119+25-ST1-DS	7.35	43779	12.7	0.68	100.5	26.7	Static sample, not flow through
	120+75-ST1-DS	7.38	42447	13.2	0.67	94.5	23.40	Static sample, not flow through
	123+25-ST1-DS	7.62	44209	15.2	0.77	87.0	13.1	Static sample, not flow through
	125+00-ST1-DS	7.71	41779	15.0	4.55	90.0	6.6	Static sample, not flow through
	126+80-ST1-DS	7.65	44011	14.9	1.51	90.7	13.3	Static sample, not flow through
	128+50-ST1-DS	7.63	43277	16.0	0.86	89.8	19.9	Static sample, not flow through

TABLE 1
Summary of Water Quality
3rd Quarter 2018

Type	SiteID	Field pH	Field Conductivity (uS/cm)	Field Temperature (Celsius)	Dissolved Oxygen (mg/L)	Field ORP (mV)	Field Turbidity (NTU)	Comments
Pore Water Probe Samples	119+25-ST1	7.30	47244	17.6	2.65	-5.4	10.9	Low tide : 0.5' MLLW. Poly tube exposed to sun
	120+75-ST1	7.36	46596	16.2	0.16	-79.3	4.21	
	123+25-ST1	7.65	46330	15.5	0.29	16.7	5.34	
	125+00-ST1	7.55	44875	16.1	1.03	35.0	14.5	
	126+80-ST1	7.39	47329	16.8	2.77	39.5	22.4	
	128+50-ST1	7.66	47029	16.1	0.12	-239.8	6.3	sulfurous odor
	130+75-ST1	7.41	47610	19.9	0.86	-110.8	22.1	
Surface water Nylon Screen Diffusion Samples	120+75-SW	7.71	44427	14.2	3.83	98.4	5.95	Static sample, not flow through
	125+00-SW	7.71	44309	14.5	1.08	91.0	15.4	Static sample, not flow through
	128+50-SW	7.68	39737	16.8	2.44	81.2	3.81	Static sample, not flow through

--: Not measured, not recorded, and/or not applicable

DO: Dissolved Oxygen

ORP: Oxidation reduction potential

APPENDIX D

IDW MANIFEST

QUALITY TABLES

FS DATA GAP INVESTIGATION 2018
FIELD MEASUREMENTS/SAMPLING
FORMER ARKEMA MANUFACTURING SITE
TACOMA, WASHINGTON

DOF DALTON OLMSTED FUGLEVAND

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4066220

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number: N/A

2. Page 1 of 1

3. Emergency Response Phone: (800) 337-7455

4. Manifest Tracking Number 017543478 **JJK**

5. Generator's Name and Mailing Address
Port of Tacoma
One Sitcum Plaza
Tacoma, WA 98421
Generator's Phone: (253) 383-5341

Generator's Site Address (if different than mailing address)
2901 Taylor Way
Tacoma, WA 98421

6. Transporter 1 Company Name: DH Environmental, Inc.
U.S. EPA ID Number: WAH000047217

7. Transporter 2 Company Name: Chemical Waste Management of the Northwest
U.S. EPA ID Number: ORD089452353

8. Designated Facility Name and Site Address
Chemical Waste Management of the Northwest
17629 Cedar Springs Lane
Arlington, OR 97812
Facility's Phone: (541) 454-2643
U.S. EPA ID Number: ORD089452353

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
	1. Material Not Regulated by DOT (non-Regulated IDW water)	1	TP	300	G	X004
	2. Material Not Regulated by DOT (non-Regulated IDW water)	2	DM	500	P	X004
	3. Material Not Regulated by DOT (non-Regulated IDW soil)	1	DM	700	P	X004
	4.					

14. Special Handling Instructions and Additional Information

1, 2. OR339910 - STAB01, non-reg IDW water

3. OR336867 - 1F01/STAB01, non-reg IDW soil

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name: on behalf of Port of Tacoma Leonard J. Warnack
Signature: Leonard J Warnack
Month 11 Day 14 Year 18

16. International Shipments ☐ Import to U.S. ☐ Export from U.S.
Port of entry/exit:
Transporter signature (for exports only):
Date leaving U.S.:

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Leonard J. Warnack
Signature: Leonard J Warnack
Month 11 Day 14 Year 18

Transporter 2 Printed/Typed Name: KELE LAUFFT
Signature:
Month 11 Day 16 Year 18

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

18b. Alternate Facility (or Generator)
U.S. EPA ID Number:
Facility's Phone:

18c. Signature of Alternate Facility (or Generator)
Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1. H100	2. H100	3. H132	4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a

Printed/Typed Name: Dawn Dunlap
Signature: Dawn Dunlap
Month 11 Day 26 Year 18

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO GENERATOR

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number: N/A

2. Page 1 of 1

3. Emergency Response Phone: (800) 337-7455

4. Waste Tracking Number: PCT-111418-02

GENERATOR

5. Generator's Name and Mailing Address:
Port of Tacoma
One Sitcum Plaza
Tacoma, WA 98421

Generator's Phone:

Generator's Site Address (if different than mailing address):
Arkema Site
2901 Taylor Way
Tacoma, WA 98421

6. Transporter 1 Company Name: DH Environmental Inc.
U.S. EPA ID Number: WAH 000 047217

7. Transporter 2 Company Name:
U.S. EPA ID Number:

8. Designated Facility Name and Site Address:
PKS Group Inc.
3003 Taylor Way
Tacoma WA 98421

Facility's Phone:

U.S. EPA ID Number:

	9. Waste Shipping Name and Description	10. Containers		11. Total Quantity	12. Unit Wt./Vol.
		No.	Type		
1.	Material Not Regulated By DOT - Trash IBC Totes	3	TP	150	P
2.					
3.					
4.					

13. Special Handling Instructions and Additional Information:
empty containers

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: On behalf of Port of Tacoma Leonard J. Warnick
Signature: Leonard J. Warnick
Month 11 Day 14 Year 18

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S.
Port of entry/exit:
Transporter Signature (for exports only):
Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Leonard J. Warnick
Signature: Leonard J. Warnick
Month 11 Day 14 Year 18

Transporter 2 Printed/Typed Name:
Signature:
Month Day Year

DESIGNATED FACILITY

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator)
U.S. EPA ID Number:
Facility's Phone:

17c. Signature of Alternate Facility (or Generator)
Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name: KEN LISOSKI
Signature:
Month 11 Day 15 Year 18

82973

PRS Group, Inc.

ENTRY LOG FOR NON-HAZARDOUS ITEMS

3003 Taylor Way
Tacoma, WA 98421
Phone: (253)383-4175 Fax: (253)383-4531
prs@prsplant.net

Date: 11/15/2018	**Carrier:** DH ENVIRO.	**Vehicle #:** 7
Drivers Signature:	**Plant Employee:** KENNY	**Time:** 9:12 AM

% Water: 0%	**% Oil / Fuel:** 0%	**pH:** N/A
% Solids: 100%	**% Other:** 0%	**Tank # / Area:** YARD

Flash >140: X
Other Flash:
Chlor Test NA: X
Chlor <1000:

Generator	Profile #	Work Order, BOL, Manifest	Used Oil	"A" & "C" Category Waste	Used Oil Filters	Off Spec Fuel	Oil / Water Mix	Oily Solids / Sludge	PCS	Absorbent	Empty Drums	Other
PORT OF TACOMA	6648-B	POT-111418-02									3TOTES	IC

Notes:

* The information contained in this entry log describes your waste as specified in the specific waste profile approved in to the PRS facility.
Please verify the information for accuracy prior to signing.

Appendix D

Electronically
Transmitted
Document

Tinnea & Associates
Investigating the Infrastructure

November 27, 2017

Paul Fuglevand
DALTON OLMSTED FUGLEVAND
1001 SW Klickitat Way
Suite 200B
Seattle, Washington 98134

SUBJECT: PORT OF TACOMA ARKEMA SHEET PILING CONDITION SURVEY

Dear Paul,

Figure 1: Typical condition of exposed sheet piling

On September 28, 2017, Tinnea & Associates staff performed a condition survey of the sheet pile wall installed as an expedited response action at the Port of Tacoma's Former Arkema Manufacturing site. The sheet pile wall was installed in 1990 with a nominal thickness of 0.315 inches. The condition assessment consisted of visual observations and ultrasonic thickness (UT) readings of exposed sections of the sheet pile wall at two test pits, exposed the day of testing. The purpose of this testing was to assess the condition of the sheet piling, make predictions about its continued functional life, and develop a plan for future testing.

Two test pits were exposed for testing. Pits were up to 3.5' in depth with one pit extending from approximately station 124+70 to 125+50 and the other extending from approximately 127+65 to 127+85. The condition of the piling was good with superficial rust staining and scattered minor pitting (<0.05") visible on the surface (see Figure 1). At approximately station 124+75, a 1.1" thick steel plate was welded to the sheet piling (see Figure 2). Records indicate that a hole in the sheet piling was found and repaired in 2004.

Figure 3: Typical condition of exposed sheet piling

UT spot readings were taken at several test locations in each pit – a spot reading is the average of three readings within a 1.5" diameter area on the structure. The purpose of the spot reading method is to minimize the effect of spurious readings which can occur when obtaining UT readings on dirty, corroded, or otherwise roughened surfaces. Spot readings show full thickness at all locations. Nominal thickness of the sheet piling was 0.315" with the average UT reading measuring 0.314" and the thinnest spot reading at 0.311". Thickness readings were also obtained on the 1.1" plate with both spot readings showing full section of the plate remaining. Visually, the plate was in similar condition to the sheet piling with only superficial rust staining visible. Connections between piling have varying thicknesses throughout, making UT readings meaningless, and as such, no readings were taken at these locations. Visually, the connections are in similar condition to the rest of the sheet piling. Often with sheet pile connections, initial corrosion product will quickly fill any gaps at the connections, acting as a physical barrier, retarding further corrosion at the joints.

One limitation of the testing performed was that only the top 3.5' of the piling could be tested due to the depths of the test pits which were limited due to the presence of ground water. In most soils, as depth increases, dissolved oxygen in the soil tends to decrease. This leads to reduced corrosion rates as depth increases barring a dramatic shift in soil composition. At this site, the presence of aquifers and fully-saturated soils at depth is expected to further reduce available oxygen content. Given that all test locations show full section remaining and that soil corrosivity is unlikely to dramatically increase at increasing depth where dissolved oxygen levels are reduced, the UT results are most likely representative of the entire sheet pile wall.

The UT data and visual inspection results indicate that the sheet piling wall is in excellent condition with negligible corrosion section loss since its installation in 1990. Given that the sheet piling has been in service since 1990 without significant section loss of the steel, it is reasonable to project that the sheet piling will remain in good condition for many years. Using average corrosion penetration rates from the National Institute of Standards and Technology at 4.2 mils/year/surface for soils between 500 and 3,000 ohm-cm, the sheet piling would be expected to last another 38 years before any full-section penetrations (this assumes that worst-case pitting will occur at exactly the same point on both sides of the piling which is extremely unlikely).[1] Using a linear projection of the observed corrosion loss, a full-section pit would not be expected for over 100 years.

NIST corrosion penetration rates were provided in addition to the linear projection of measured corrosion loss due to the lack of known history about the structure’s previous protection. It is possible that a cathodic protection system was installed previously on the sheet piling which would have protected the structure from corrosion until the cathodic protection anodes were consumed. This would significantly reduce the corrosion damage to the sheet piling observed and invalidated any projections based on measured thickness loss. Regardless of the projection used, a functional life of multiple decades is expected for the sheet piling.

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[1] Schwerdtfeger, W.J., *Soil Resistivity as Related to Underground Corrosion and Cathodic Protection,* Journal of Research at the National Bureau of Standards, Vol. 69C, No. 1, January-March 1965.

If the sheet piling is to remain as a critical long-term asset, Tinnea & Associates recommends periodic inspection, monitoring, and/or hydraulic testing of the sheet piling to confirm the condition of the wall. Attached please find data sheets for the inspection. Tinnea & Associates appreciates this opportunity to be of service to Dalton Olmsted Fuglevand. If you have any questions, please call me at (206) 328-7872 or email me at rtinnea@tinnea.net.

Sincerely,
TINNEA & ASSOCIATES, LLC

Ryan Tinnea
Project Engineer
NACE CP Specialist #9748
RJT/mjl
encl: thickness data

Port of Tacoma
Arkema Site UT Readings

Thickness Data

Site	Chainage	Designation	Thickness (nominal thickness: 0.315") 1	2	3	Avg.	Remarks
Pit 1	124+75	Plate N End	1.104 in	1.096 in	1.101 in	**1.100 in**	
		Plate S End	1.102 in	1.104 in	1.099 in	**1.102 in**	
	124+80	Top of Pile	0.315 in	0.315 in	0.314 in	**0.315 in**	
		18" Below Top	0.314 in	0.313 in	0.312 in	**0.313 in**	
		36" Below Top	0.312 in	0.313 in	0.314 in	**0.313 in**	
	125+00	Top of Pile	0.315 in	0.313 in	0.312 in	**0.313 in**	
		18" Below Top	0.319 in	0.313 in	0.312 in	**0.315 in**	
		36" Below Top	0.312 in	0.313 in	0.315 in	**0.313 in**	
	125+03	Top of Pile	0.314 in	0.315 in	0.316 in	**0.315 in**	
		18" Below Top	0.315 in	0.314 in	0.312 in	**0.314 in**	
		36" Below Top	0.315 in	0.314 in	0.314 in	**0.314 in**	
	125+05	Top of Pile	0.314 in	0.315 in	0.312 in	**0.314 in**	
		18" Below Top	0.319 in	0.317 in	0.315 in	**0.317 in**	
		36" Below Top	0.315 in	0.312 in	0.315 in	**0.314 in**	
	125+08	Top of Pile	0.316 in	0.315 in	0.315 in	**0.315 in**	
		18" Below Top	0.317 in	0.315 in	0.316 in	**0.316 in**	
		36" Below Top	0.315 in	0.315 in	0.316 in	**0.315 in**	
Pit 2	127+65	Top of Pile	0.315 in	0.319 in	0.320 in	**0.318 in**	
		18" Below Top	0.310 in	0.312 in	0.312 in	**0.311 in**	
		36" Below Top	0.315 in	0.313 in	0.316 in	**0.315 in**	
	127+68	Top of Pile	0.315 in	0.311 in	0.315 in	**0.314 in**	
		18" Below Top	0.316 in	0.313 in	0.315 in	**0.315 in**	
		36" Below Top	0.313 in	0.312 in	0.314 in	**0.313 in**	
	127+72	Top of Pile	0.315 in	0.313 in	0.316 in	**0.315 in**	
		18" Below Top	0.314 in	0.311 in	0.312 in	**0.312 in**	
		36" Below Top	0.314 in	0.314 in	0.314 in	**0.314 in**	
	127+78	Top of Pile	0.315 in	0.316 in	0.314 in	**0.315 in**	
		18" Below Top	0.313 in	0.316 in	0.314 in	**0.314 in**	
		36" Below Top	0.312 in	0.320 in	0.314 in	**0.315 in**	
	127+82	Top of Pile	0.313 in	0.317 in	0.313 in	**0.314 in**	
		18" Below Top	0.314 in	0.315 in	0.311 in	**0.313 in**	
		36" Below Top	0.312 in	0.315 in	0.313 in	**0.313 in**	
	127+85	Top of Pile	0.315 in	0.311 in	0.312 in	**0.313 in**	
		18" Below Top	0.315 in	0.314 in	0.317 in	**0.315 in**	
		36" Below Top	0.313 in	0.313 in	0.313 in	**0.313 in**	