Reichhold/SSA Containers Facility

Supplemental Focused Remedial Investigation/ Supplemental Focused Feasibility Study

Prepared for

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LIMITATIONS

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Table of Contents

List of Tables

List of Figures

List of Appendices

List of Abbreviations and Acronyms

Acronym/ Abbreviation	**Definition**
AO	Agreed Order
ARAR	Applicable or Relevant and Appropriate Requirement
ARI	Analytical Resources, Inc.
bgs	Below ground surface
bogs	Below original ground surface
CAMU	Corrective Action Management Unit
CAP	Cleanup Action Plan
CAWP	Cleanup Action Work Plan
CCWP	CAMU Closure Work Plan
CD	Consent Decree
CMCP	Compliance Monitoring and Contingency Plan

Acronym/ Abbreviation	Definition
COC	Contaminants of concern
CUL	Cleanup level
DCA	Disproportionate Cost Analysis
DU	Decision Unit
DWM	Dangerous Waste Management
Ecology	Washington State Department of Ecology
ERM	ERM-West, Inc.
FFS	Focused feasibility study
FRI	Focused remedial investigation
GETS	Groundwater Extraction and Treatment System
µg/L	Micrograms per liter
MIS	Multi-Increment Sampling
MTCA	Model Toxics Control Act
NTU	Nephelometric turbidity unit
PCP	Pentachlorophenol
pg/g	Picograms per gram
pg/L	Picograms per liter
PMI	Port Maritime and Industrial
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
Reichhold	Reichhold, Inc.
SAP	Sampling and Analysis Plan
SFFS	Supplemental Focused Feasibility Study
SFRI	Supplemental Focused Remedial Investigation
Site	Reichhold/SSA Containers Facility
SSA	SSA Tacoma, Inc.
TCCWP	Treatment Cell Closure Work Plan
TCDD	Tetrachlorodibenzo-p-dioxin
TEF	Toxicity equivalency factor
TEQ	Toxic equivalent
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
WAC	Washington Administrative Code

1.0 Introduction

This document presents the Supplemental Focused Remedial Investigation/Supplemental Focused Feasibility Study (SFRI/SFFS) for the Reichhold/SSA Containers Facility (the Site), a former chemical manufacturing plant located at 3320 Lincoln Avenue East in Tacoma, Washington (Figure 1.1). SSA Tacoma, Inc. (SSA), as the current owner of the facility and performing party, has accepted the environmental responsibilities of the previous owner and previous performing party, Reichhold, Inc. (Reichhold). These responsibilities are specified in Agreed Orders (AOs) Nos. 1577 (Ecology 2006) and 1578 (Ecology 2008a)—agreements initially between the Washington State Department of Ecology (Ecology) and Reichhold that are now between Ecology and SSA.

1.1 PURPOSE OF REPORT

This report focuses on the recent identification of dioxins/furans at the Site at concentrations greater than the applicable criteria, presents cleanup levels (CULs) and provides a summary of the nature and extent of the dioxins/furans, evaluates cleanup action alternatives, and identifies the proposed cleanup action alternative for cleanup of soil at the Site. The proposed cleanup action alternative for final cleanup action that is put forward in this document will be subject to public review and comment, and Ecology approval. As described in Sections 3.3 and 3.4, the other contaminants of concern (COCs) at the Site have been addressed through previous investigations, remedial activities, and on-going monitoring.

This SFRI/SFFS has been prepared in accordance with the First Amendment to Consent Decree (CD) No. 08-2-15781-0 (Ecology 2015) and provides the basis for Ecology and SSA to select a proposed cleanup action alternative. The proposed cleanup action alternative will then be used to develop a CD and CAP Amendment defining the supplemental cleanup action to be performed.

1.2 DOCUMENT ORGANIZATION

The SFRI/SFFS is organized as follows:

- **Section 2.0 – Site Description:** Provides information on the location, ownership, and current land use of the Site. Presents site geology and hydrogeology, natural resources, and historical and cultural resources.
- **Section 3.0 – Background and Regulatory History:** Presents the historic property ownership and use, current regulatory framework, and prior dioxins/furans environmental investigations.
- **Section 4.0 – Cleanup Standards:** Presents release mechanisms, exposure pathway and receptors, and site CULs.
- **Section 5.0 – Supplemental Focused Remedial Investigation Activities:** Presents a summary of the supplemental focused remedial investigation activities conducted and the results of this investigation.

- **Section 6.0 – Cleanup Action Objectives and ARARs:** Presents the cleanup action objectives for the Site and identifies the site-specific Applicable or Relevant and Appropriate Requirements (ARARs).
- **Section 7.0 – Identification and Screening of Remedial Technologies:** Identifies and briefly describes the most commonly implemented remedial technologies for remediation of dioxins/furans in soil and the application and limitations of each technology. Describes the preliminary technology screening preformed to eliminate technologies that do not meet site cleanup action objectives or are not technically feasible.
- **Section 8.0 – Cleanup Action Alternatives Evaluation and Disproportionate Cost Analysis:** Evaluates alternatives comparatively with the Model Toxics Control Act (MTCA) requirements for a cleanup action per Washington Administrative Code (WAC) 173-340-360.
- **Section 9.0 – Proposed Cleanup Action Alternative:** Presents the proposed cleanup action alternative for soil at the Site and provides a summary of the cleanup action alternative as a whole.
- **Section 10.0 – References:** Presents the reference information for materials cited in the document.

2.0 Site Description

This section provides a description of the physical characteristics of the subject property. The regulatory history and environmental conditions of the subject property are described in Section 3.0.

2.1 LOCATION

The property, owned by SSA, comprises approximately 52 acres in the Commencement Bay industrial area of Tacoma, Washington, between the Hylebos and Blair Waterways. The property is located on relatively flat terrain with generally less than 5 feet of topographic relief. This area was constructed in the early 1950s by filling the then-existing salt marsh with dredge spoils from adjacent waterways (CH2M HILL 2006). The property is currently zoned for industrial use. The Site's current zoning classification is Port Maritime and Industrial (PMI).

2.2 SITE AND VICINITY GENERAL CHARACTERISTICS

The subject property is located between the Hylebos and Blair Waterways on relatively flat terrain with generally less than 5 feet of topographic relief. This area was constructed in the early 1950s by filling the then-existing salt marsh with dredge spoils from adjacent waterways (CH2M HILL 2006). The subject property is currently zoned for industrial use.

2.2.1 Current Property Use

Currently SSA does not conduct any industrial activities on the Site. Portions of the property are subleased on a month-to-month basis for industrial use. The current tenants and approximate acreage leased under license agreement from SSA include the following:

- Totem Ocean Trailer Express has access to 7 acres for parking of empty trailers.
- Calhoun Tank has access to 1,000 square feet of office, 4,800 square feet of shop, and 3 acres of graveled yard space for inspection and repair of Washington State Department of Transportation-rated propane and other tank trailers.
- Spirit Transport Systems parks up to 20 commercial trailers overnight.
- Lynden Transport has access to 2 acres for the storage of commercial trailers.
- Shippers Transport Express (an SSA Marine, Inc. company) parks up to five employee cars (daytime) and up to five commercial tractors (nighttime).

2.2.2 Current Use of Adjacent Properties

The adjacent properties are currently zoned by the City of Tacoma as PMI. The use of these properties is consistent with the zoning in this area.

Because the environmental conditions of the subject property have been extensively reviewed, the limits of contamination on the property have been carefully identified and the cleanup actions performed at the property have been carefully cataloged. There is little to no concern that adjacent properties will affect the condition of the subject property.

2.2.3 Historical and Cultural Resources

A review of records maintained by the National Register of Historic Places and Washington State Department of Archaeology and Historic Preservation (DAHP) available on the Washington Information System for Architectural and Archaeological Records Data did not identify historical or cultural resources on the subject property (DAHP 2013).

2.3 PHYSICAL SETTING

2.3.1 Geology

The Site is located in the Tacoma Tideflats, an area of unconsolidated sediment from the Puyallup River Valley, which extends from Commencement Bay to the south flank of Mount Rainier, more than 45 miles to the east. Sediment deposited at the mouth of the Puyallup River built a large estuarine delta into Commencement Bay. The delta consisted of a tidal flat that merged landward with complex tidal marshes and sinuous tidal channels that in turn merged with the Puyallup River Valley floor.

2.3.2 Hydrogeology

The Site is underlain by three near-surface aquifers and two near-surface aquitards, or confining layers. The three aquifers, which are brackish and non-potable, are referred to as the Shallow, Intermediate, and Deep Aquifers. The two aquitards are referred to as the upper and lower aquitards. The Tacoma Tideflats are a regional groundwater discharge area. Groundwater flows from recharge areas at higher elevations toward discharge areas along Commencement Bay and its adjacent waterways, such as the Blair Waterway. Because of this, the vertical groundwater gradient direction is typically upward from the Deep Aquifer to the Intermediate Aquifer.

The Shallow Aquifer consists of fine to medium sand and silty sand that is primarily dredge spoils from the Hylebos and Blair Waterways deposited as fill in the 1950s. The Shallow Aquifer is unconfined and ranges in saturated thickness from 0 to 10 feet above the upper aquitard with significant seasonal variability. Groundwater flow direction in the Shallow Aquifer at the Site is generally radial from the interior of the Property toward the previously existing Shallow Interceptor Drain and drainage ditches at the perimeter of the property. The Shallow Aquifer is not tidally influenced and does not experience reversals in groundwater flow direction.

The upper aquitard is the uppermost native formation, considered to represent the former ground surface of the salt marsh that existed prior to filling. The unit ranges from 1 to 20 feet thick and consists primarily of silt, organic silt, and clayey silt, with zones of peat.

The Intermediate Aquifer consists primarily of fine to medium sand and silty sand, with zones of interbedded sand, silty sand, and silt. The Intermediate Aquifer is confined and ranges in thickness from 4 to approximately 31.5 feet. Groundwater elevation data indicate that groundwater in the Intermediate Aquifer generally flows from east to west across the eastern portion of the property, toward the Blair Waterway and Commencement Bay. The Intermediate Aquifer is tidally-influenced and experiences short-term, transient reversals in the groundwater flow direction in areas near the Blair Waterway, which is the closest marine waterway to the Site. However, the net groundwater flow direction is toward the Blair Waterway and the transient reversals in the groundwater flow direction do not prevent groundwater discharge to the waterway.

The lower aquitard separates the Intermediate and Deep Aquifers at the property. This unit consists of silt, organic silt, and clayey silt, with occasional very fine sandy silt interbedded with peat and zones of organic material. The lower aquitard ranges in thickness from approximately 5.5 to 18 feet.

The Deep Aquifer consists primarily of alternating fine to medium sand and silty sand, with occasional silt interbeds. The total thickness of the Deep Aquifer is not known; regional studies indicate that the sand might reach a thickness of 80 feet or more in the vicinity of the facility (Walters and Kimmel 1968). Groundwater flow in the Deep Aquifer occurs under confined conditions, with the potentiometric surface approximately 20 to 30 feet above the top of the unit. Groundwater flow in the Deep Aquifer is generally to the southwest toward the Blair Waterway. The Deep Aquifer is tidally-influenced like the Intermediate Aquifer and also experiences transient, localized reversals in the groundwater flow direction in areas near the Blair Waterway. The net groundwater flow direction in the Deep Aquifer is toward the Blair Waterway.

Underlying the three uppermost aquifers is up to 400 feet of generally fine-grained marine sediments. These fine-grained sediments provide a low-permeability base that separates the three uppermost aquifers beneath the Site from the underlying deep regional aquifer, a glacially derived unit of alternating layers of fine- and coarse-grained materials (Walters and Kimmel 1968).

2.3.3 Surface Water

The surface water features in the immediate vicinity of the Site are the Blair Waterway, the Lincoln Avenue Ditch, the North Ditch, and the South Ditch (Figure 2.1). The Site is located approximately 800 feet northeast of the Blair Waterway, which was excavated from the sediment of the Puyallup River Delta at the head of Commencement Bay. The North Ditch is a man-made industrial drainage ditch that runs along the northern SSA property boundary and carries stormwater runoff from SSA and other adjacent properties to the Lincoln Avenue Ditch, which runs along the northwestern property boundary. The Lincoln Avenue Ditch, which receives runoff from several industrial and urban properties northeast of the facility, enters a concrete culvert adjacent to the facility that conveys runoff to the Blair Waterway. The South Ditch is located along a portion of the southern property boundary and also enters a corrugated metal culvert conveying runoff northwest to the Lincoln Avenue Ditch and the Blair Waterway. The North and South Ditches flow only when precipitation runoff or high groundwater levels cause inflow into them, and typically either go dry or cease to flow and become stagnant during dry summer conditions.

In 2007, a portion of the Blair Waterway was widened by the Port of Tacoma in the vicinity of the Site. This new cutback decreased the distance from the property to the Blair Waterway by approximately 200 feet.

2.3.4 Floodplain Zoning and Wetlands

SSA was notified in January 2009 that the U.S. Army Corps of Engineers (USACE) had completed a jurisdictional determination confirming the presence of wetlands adjacent to the property. The USACE issued an approved jurisdictional determination valid for a period of 5 years due to a portion of Wetland Area "B" being located along the eastern boundary of the subject property. Jurisdictional Wetland Areas "I," "H," and "G" are also located adjacent to the SSA parcel on Trust Property (AMEC 2008). In addition, two areas of the property are located within Zone A 100-year floodplain (FEMA 2012).

3.0 Background and Regulatory History

3.1 PROPERTY OWNERSHIP HISTORY

Reichhold formerly owned the subject property and used it for chemical manufacturing. On July 27, 2006, SSA Containers, Inc., a subsidiary of SSA Marine, Inc., purchased the property from Reichhold and became the owner and operator of the facility. SSA Containers, Inc., as the new owner of the facility assumed the responsibilities of AO Nos. 1577 and 1578 and transferred the Dangerous Waste Management (DWM) Permit into their name, and assumed responsibility going forward for addressing environmental conditions. On December 30, 2008, the property was transferred to SSA Tacoma, Inc., another entity owned by SSA Marine, Inc., and it in turn became the responsible performing party under the AO Nos. 1577 and 1578 and the DWM permit.

3.2 HISTORICAL PROPERTY USE

From 1956 to 1990, Reichhold produced chemical and chemical-related products, including pentachlorophenol (PCP), urea-formaldehyde resins, calcium chloride solution, treated fiber products, and a formaldehyde catalyst. Reichhold worked extensively with Ecology and the USEPA Region 10 beginning in 1986 to investigate, begin remediation, and permit the property for further cleanup action. Reichhold completed Resource Conservation and Recovery Act (RCRA) corrective actions, including a “facility assessment” and a “facility investigation” prior to ownership transfer to SSA.

3.3 REGULATORY HISTORY

Reichhold, and then SSA, worked extensively with the USEPA Region 10 and Ecology since 1986 to investigate and remediate the Site.

On June 30, 1986, Reichhold entered into a Consent Agreement and Order (No. 1086-04-33-3008; referred to as the 1986 Order) with USEPA Region 10 and Ecology to undertake an investigation to characterize site soils and hydrogeology and to research and identify areas at the facility that would correspond to RCRA-regulated units, solid waste management units, and Areas of Concern. In July 1987, USEPA performed a RCRA Facility Assessment to identify areas that could potentially require corrective actions. In 1988, USEPA issued a RCRA storage and corrective action permit, effective December 4, 1988 (referred to as the 1988 RCRA Permit). The 1988 RCRA Permit replaced the 1986 Order.

Under the 1986 Order and the 1988 RCRA Permit, Reichhold conducted numerous investigations between 1986 and 2006, including a RCRA Facility Investigation (CH2M HILL 1987). After the basic site characterization work was completed in the late 1980s, Reichhold conducted several corrective actions at the property, addressing the primary source areas of contamination. Reichhold also installed several interim measures including extraction, containment, and treatment systems for groundwater in the Shallow and Intermediate Aquifers.

On October 20, 2000, Reichhold submitted an application for the designation of a Corrective Action Management Unit (CAMU) at the property (State of Washington 2006a). Ecology determined that the application was substantially complete. Reichhold updated the application document in November 2001 and March 2004.

Effective July 30, 2004, under Ecology's authorization to satisfy the RCRA corrective action requirements through Washington's MTCA, Ecology issued Reichhold a DWM Permit for Corrective Action (No. WAD009252891; referred to as the DWM Permit). The DWM Permit established AO Nos. 1577 and 1578. AO No. 1577 included requirements for a focused remedial investigation (FRI) and focused feasibility study (FFS), the preparation of a draft CAP, and the continued operation of interim measures/cleanup actions, while corrective actions elements were completed at the property. AO No. 1578 described the continued use of the CAMU at the property and provided requirements for construction and operation of the on-site soil treatment cells to allow soil to be biologically treated on-site and for the treated soil to be placed within an approved laydown area within the CAMU. The DWM Permit and associated AOs replaced the 1988 RCRA Permit.

In April 2006, Reichhold completed an Ecology-approved FRI report for the facility (CH2M HILL 2006). The FRI completed activities that had been identified in the Ecology-approved FRI Work Plan for the facility (CH2M HILL 2005).

In July 2006, SSA Containers, Inc. purchased the property. To facilitate transfer of the DWM Permit, SSA Containers, Inc., as the new owner of the property and performing party, agreed to assume certain environmental responsibilities of the previous owner and performing party, Reichhold. AO Nos. 1577 and 1578 were amended to be between Ecology and SSA Containers, Inc. (State of Washington 2006a and 2006b).

SSA Containers, Inc. subsequently prepared a FFS defining final cleanup actions for the property, which was approved by Ecology (Floyd|Snider 2008a). The FFS updated the site-specific surface water criteria, soil CULs, groundwater remediation levels, soil treatment levels, and the list of COCs at the property based on current site conditions and an updated review of applicable laws and regulations. The FFS identified the remediation technologies for the treatment of soils exceeding the calculated soil CULs, evaluated the phased shutdown of off-site extraction wells, and evaluated the options for achieving hydraulic control of contaminated groundwater.

The Ecology-approved CAP defined a comprehensive site-wide remedy that is protective of both human health and the environment (Ecology 2008b). The final cleanup action alternative for in situ soil included the site-specific soil CULs and necessary cleanup actions for the four remaining areas of concern. The remedy also included a groundwater cleanup action designed to prevent COCs from reaching nearby surface water bodies and on-going biological treatment of soil within the soil treatment cells.

The CAP included a Compliance Monitoring and Contingency Plan (CMCP; Floyd|Snider 2008b), which identified the process for conducting compliance monitoring of the groundwater to ensure that monitored natural attenuation was occurring and that groundwater CULs were being met at the off-site conditional point of compliance.

When the property was transferred from SSA Containers, Inc. to SSA, CD No. 08-2-15781-0 (Ecology 2008c), was executed on December 30, 2008, to replace AO No. 1577. The CD required SSA to undertake the cleanup actions included in the final CAP and identified the selected cleanup actions for the facility and an implementation schedule.

In 2009, SSA completed a Work Plan describing the in situ soil cleanup actions to take place at the property in accordance with the FFS (Floyd|Snider 2008a) and the CAP (Ecology 2008b). The in situ soil cleanup action activities were conducted at the property in accordance with the Work Plan following its approval by Ecology, and a *Remedial Actions Construction Completion Report* describing the in situ soil cleanup action activities was submitted to, and approved by, Ecology following the completion of the cleanup action activities (Floyd|Snider 2009).

In accordance with the CAP, three additional work plans were submitted to Ecology in 2010 to: detail the procedures required to meet all CAMU closure requirements; shut down the groundwater extraction and treatment system; and decommission and close the treatment cells present at the property. All work related to these three work plans has been completed and approved by Ecology.

Annual Remedial Action Reports are prepared and submitted to Ecology that describe any cleanup actions that have occurred on the property, and provide an updated schedule for the remaining environmental obligations.

On-going groundwater monitoring and reporting under the CMCP and renewal of the DWM Permit had been the only remaining environmental obligation occurring at the facility until the recent identification of dioxins/furans at levels of concern.

3.4 DIOXINS/FURANS

As previously described, all other COCs at the Site have been addressed in accordance with the CAP and dioxins/furans are the only COC, and thus are the focus of this SFRI/SFFS. This section summarizes the known activities and previous investigations related to dioxins/furans at the Site.

3.4.1 Dioxin/Furan Association with Historical Site Use

Dioxins/furans are an impurity created during the manufacturing process of PCP. None of the other chemicals produced on-site have an association with dioxins/furans. Technical grade PCP, which was the type of PCP historically manufactured at the Site, is approximately 86 percent pure with the remaining percentage typically containing impurities such as lesser chlorinated phenols, dioxins (particularly tetra-, hexa-, and octochlorodibenzo-p-dioxin) and hexachlorobenzene as manufacturing byproducts (Extoxnet 1996).

A dioxin/furan congener evaluation, described in the SFRI Work Plan, was conducted utilizing the available dioxin/furan data to confirm that the dioxins/furans present at the Site are associated with the historical PCP production.

Primary PCP manufacturing activities were limited to the central area of the Site around the former PCP Plant. Based on historical documentation, PCP manufacturing occurred aboveground on concrete flooring, and PCP manufacturing materials and waste were not stored at depth. PCP manufacturing waste materials were removed off-site for disposal at a RCRA hazardous waste disposal facility, and anything solid that came into contact with PCP in any form required off-site disposal (CH2M Hill 1987).

The majority of soils excavated for corrective action were placed in on-site treatment cells, and treated with a proprietary amendment-enhanced biodegradation process that successfully decomposed the PCP and other organic COCs, but did not decompose some other compounds such as polychlorinated biphenyls and dioxins/furans. Upon treatment of each soil horizon, the soil was analyzed to ensure that it met the treatment levels for the site COCs. If so, it was approved by Ecology for removal from the treatment cells, and placed as fill in the approved Treated Soil Laydown Area of the property. Because dioxins/furans were not a COC, the treated soil was not tested for dioxins/furans; therefore, the treated soil placed in the laydown area might contain dioxins/furans.

3.4.2 Prior Dioxin/Furan Investigations

Prior to the FRI, FFS, and CAP submittals in 2008, various dioxin/furan investigations were performed at the Site, eventually leading to the determination that dioxin/furan was not a Site COC. At the request of Ecology, a memo summarizing the known information regarding dioxins/furans at the Site was prepared and submitted to Ecology (Floyd|Snider 2008c). This memorandum, included as Appendix A, includes a description of the findings of the soil and groundwater dioxin sampling events conducted at the facility in the 1980s and 1990s, as identified below.

- **1984.** As part of the USEPA National Dioxin Study, 39 soil samples were collected at the Site.
- **1984 or 1985.** An unauthorized event by Greenpeace collected three soil samples.
- **1986.** International Technology Corporation collected and analyzed six soil samples and prepared a report summarizing the analytical results.
- **1986–1987.** CH2M HILL collected and analyzed 45 soil samples for a Dioxin/Furan Study.
- **1989–1990.** Groundwater sampling from Shallow and Intermediate Aquifer wells.
- **1998.** Groundwater sampling event for dioxins/furans as part of a USEPA Comprehensive Monitoring Evaluation audit.

This memorandum provided a summary of these investigations and provided documentation regarding the finding that dioxins/furans were not a COC for the Site.

3.4.3 2014 ERM-West, Inc. Investigation

In April 2014, on behalf of the potential site purchaser, soil and groundwater samples were collected by ERM-West, Inc. (ERM). Samples were submitted to Test America and analyzed for dioxins/furans per the methods described in an ERM Scope of Work (ERM 2014). The ERM soil samples indicated dioxin/furan concentrations in several locations with exceedances of the MTCA Method C Industrial Criterion for dioxins/furans of 1,680 picograms per gram (pg/g). Until recently, this value was 1,500 pg/g, but was updated in May 2014 by Ecology to 1,680 pg/g based on updated toxicity values, as reflected in Ecology's Cleanup Levels and Risk Calculation tables (Ecology 2014).

In order to verify contaminant concentrations and to assist in filling data gaps to delineate the extent of contamination, Floyd|Snider, on behalf of SSA, requested that all remaining soil volume be transferred from Test America to Analytical Resources, Inc. (ARI) for dioxin/furan analysis. On June 6, 2014, all remaining soil volume was transferred to ARI under standard chain-of-custody procedure. In order to establish a more complete data set and verify sample results, samples analyzed under ERM's direction that contained dioxin/furan criteria exceedances were reanalyzed. In addition, at the direction of Floyd|Snider, select soil samples with remaining volume that were not originally analyzed at Test America for dioxins/furans were analyzed for dioxins/furans at ARI.

3.4.3.1 Soil

The sampling data identified the presence of dioxins/furans at concentrations exceeding the MTCA Method C Industrial Criterion in soil at seven locations: SB-11/EMW-5, SB-12, SB-17, SB-19, SB-20/EMW-9, SB-21/EMW-10, and SS-1. The locations with exceedances are primarily in the vicinity of the former PCP Plant, a primary area of concern for dioxins/furans. Sample SS-1 is located within the area where treated soil was placed. The exceedances are primarily within the top 3 feet of soil, with the exception of two locations (SB-20/EMW-9 and SB-21/EMW-10), which were composited soil samples from 2 to 6 feet below ground surface (bgs). Summed dioxin/furan toxic equivalent (TEQs) ranged between 2,010 and 130,000 pg/g.

Soil analytical results from this investigation are shown in Figure 3.1 and in Table 3.1

3.4.3.2 Groundwater

Groundwater was analyzed for dioxins/furans in three wells installed in April 2014 by ERM. 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) was not detected in any groundwater samples collected from wells EMW-7, EMW-9, or EMW-19; however, the reporting limits were greater than the surface water criteria of 5.1×10^{-9} micrograms per liter (µg/L) or 0.0051 picograms per liter (pg/L). Dioxins/furans were not analyzed for at other wells installed by ERM.

Groundwater analytical results from this investigation are shown in Table 3.2 and well locations are shown on Figure 2.1.

3.4.4 Conceptual Site Model

Based on an understanding of site history, the correlation of dioxins/furans with PCP, and evaluation of existing data, two primary areas were identified to be of concern for dioxins/furans due to their association with PCP as shown on Figure 3.1: (1) Area A, which is the core area of the Site where primary historical activities associated with PCP production and storage took place, including areas of previous corrective actions for PCP, and (2) Area B, which is the area where treated soil was placed and several corrective actions occurred. The remaining areas of the Site are outside the areas of primary historical industrial activities associated with PCP production and treated soil laydown, and are not expected to contain dioxin/furan contamination at levels of concern.

3.4.4.1 Area A

Area A is located within the CAMU and encompasses the primary area of the Site with historical industrial activities associated with PCP production. The former PCP Plant, which manufactured PCP, and all primary activities associated with the manufacturing of PCP were located in Area A. This area also includes corrective action areas associated with PCP. Area A contained the majority of the dioxin/furan exceedances identified during the ERM due diligence sampling.

3.4.4.2 Area B

Area B is located within the CAMU and is the location of the former soil treatment cells. Area B includes the area where treated soil from the treatment cells was placed upon verification that site COCs determined at the time were less than CULs. All treated soil that was removed and placed within the laydown area was done with Ecology approval and no treated soil was placed outside of Area B. Corrective actions associated with PCP were also conducted in this area. This area contained the highest exceedance of dioxins/furans identified during the ERM due diligence sampling.

Based on this, in order to further delineate the nature and extent of dioxins/furans in soil at concentrations greater than the MTCA Method C Industrial Criteria and evaluate the potential concern regarding dioxins/furans in groundwater, SSA submitted the SFRI Work Plan to Ecology in July 2014. The SFRI Work Plan was approved by Ecology in September 2014 and the investigation was conducted that month. Section 4.0 presents a discussion of the cleanup standards and Section 5.0 presents the results of the investigation.

It should be noted that one sample from location SB-17 from the 2014 ERM investigation outside of Areas A and B exceeded the MTCA Method C Industrial Criteria. This location was determined to not be of concern due to the relatively low concentration and it being the only location outside of Areas A and B with an exceedance of the MTCA Method C Industrial Criteria. Pursuant to MTCA guidance and based on the statistical analysis of the set of discrete sample results, sampling in the area outside of Areas A and B meets all three tests for compliance with dioxins/furans, as defined in MTCA WAC 173-340-740 (7)(d) and (e) and summarized below:

- The upper one-sided 95 percent upper confidence limit on the true mean soil concentration shall be less than the soil CUL.
- No single sample concentration shall be greater than two times the soil CUL.
- Less than 10 percent of the sample concentrations shall exceed the soil CUL.

The TEQ concentration at SB-17 at 0.4 to 2 feet bgs was 2,250 pg/g and the TEQ concentration at that location from 2 to 4 feet bgs was 63.2 pg/g. Additionally, a nearby sample, SB-18/EMW-8, had a TEQ concentration at the same depth of 44.2 pg/g. Based on the statistical analysis and the results of the nearby samples, this location does not require further action.

4.0 Cleanup Standards

This section presents the cleanup standards for dioxins/furans at the Site including surface water criteria, groundwater source area target concentrations, and soil CULs. The development of these cleanup standards is consistent with the logic presented in previous documents including the CAP. In accordance with MTCA regulation (WAC 173-340-700) the cleanup objectives used at the facility are the most protective of human health and the environment and remain protective of the surface water in the nearby ditches and the Blair Waterway. It should be noted that although there are no sediments on-site, the cleanup standards developed for surface water are protective of exposure pathways for sediments. Cleanup standards include concentrations that protect human health and the environment for each constituent by media, the points of compliance where these concentrations must be met, and any additional regulatory requirements that apply to a cleanup action (WAC 173-340-200).

4.1 CURRENT AND FUTURE POTENTIAL EXPOSURE PATHWAYS AND RECEPTORS

In order to determine the appropriate cleanup standards for the Site, it is necessary to determine the potential exposure pathways and receptors. Based on the current and planned future conditions at the Site and the conceptual site model presented in Section 3.0, the potential current and potential exposure pathways were identified for each media and are described below.

Surface Water: Surface water is present at the Site in perimeter ditches that convey groundwater and stormwater to the Blair Waterway. These ditches only intermittently contain water during the rainy periods of the year and during storm events. Surface water is not a contaminated medium at the Site; however, in order to establish groundwater concentrations that are protective of surface water, it is necessary to define concentrations in surface water that are protective of human health and aquatic species, and then establish groundwater CULs that are protective of these calculated surface water concentrations. Human receptors for surface water include incidental ingestion by maintenance workers and recreational swimmers (although the Blair Waterway is an industrial/commercial shipping channel and restricted from recreational swimming) and fish consumption for recreational and subsistence anglers. The selection of appropriate surface water quality standards is described in Section 4.2.1.

Groundwater: The following potential pathways were identified for groundwater. These pathways are considered for identification of applicable soil and groundwater CULs at the Site:

- **Protection of human health via drinking water.** As described in the CAP, the site groundwater is non-potable and unfit for human consumption (WAC 173-340-720(2)(d)); therefore, this is not an active pathway.
- **Protection of surface water.** Groundwater in the Shallow Aquifer beneath the Site has the potential to migrate through groundwater flow to the surface water in the drainage ditches at the perimeter of the property. This is an active pathway at the Site.

- **Protection of indoor air from vapor intrusion from shallow contaminated groundwater.** Volatile contaminants in shallow groundwater have the potential to volatilize and rise through the soil column and discharge into ambient air. Dioxins/furans are characterized by extremely low vapor pressures, indicating a strong affinity for soil. Chemicals with high boiling points and low vapor pressures are not considered volatile and are not likely to move from soil and shallow groundwater source areas into the pores in the unsaturated vadose zone. Therefore, dioxins/furans are not considered volatile chemicals and the soil vapor intrusion pathway is not an active pathway at the Site for these chemicals.

The selection of appropriate groundwater quality standards is described in Section 4.2.2.

Soil: The following potential pathways were identified for soil. These pathways are considered for identification of applicable soil CULs at the Site:

- **Protection of human health via direct contact with contaminated soil.** This pathway would include incidental ingestion occurring during soil disturbing activities such as utility work, landscaping, trenching, excavation, or regrading. This is an active pathway at the Site.
- **Protection of groundwater resources from contaminants leaching from soil.** Contamination to the ground surface or to the subsurface can result in leaching of contaminants entrained in soil to the groundwater table. This is an active pathway at the Site.
- **Protection of ecological receptors.** Site conditions and the planned action of a physical barrier appear to satisfy the requirements of WAC 173-340-7491(1)(b) and qualify for a terrestrial ecological evaluation (TEE) exclusion based on an incomplete exposure pathway. WAC 173-340-7491(1)(b) provides for an exclusion based on the existence of a physical barrier “that will prevent plants or wildlife from being exposed to the soil contamination.”

  As stated in the Concise Explanatory Statement for the Amendments to the MTCA Cleanup Regulation Chapter 173-340 WAC (Pub # 01-09-043, 2001), GQ 14.2.1 states that, “an elaboration of this functional standard as applied to wildlife appears in WAC 173-340-7491(1)(c)(iii): ’barriers that would prevent wildlife from feeding on plants, earthworms, insects or other food in or on the soil.’ The criterion provides three examples of physical barriers that are likely to meet the functional standard: buildings, paved roads, and pavement (e.g., a concrete sidewalk). These examples are not intended to preclude other possibilities that may meet the standard on a case-by-case basis.” For the Site, a compacted crushed rock surface meets the barrier criteria, however, its effectiveness would depend on thickness, size distribution, and degree of compaction.

  As described in Section 3.4, dioxins/furans were discovered on-site in 2014 and the extent of the dioxins/furans was further delineated through additional investigations in 2015 as described in detail in Section 5.0. These investigations identified two areas with soil containing dioxins/furans at concentrations of concern, Area A and Area B.

Area A contains isolated areas of dioxin/furan contamination. In order to remove the ecological exposure in Area A, the contaminated soil will be removed from this area as a component of the cleanup action. This requirement will be included as part of any cleanup action evaluated in this document and will be implemented per the schedule described in Section 9.0.

Area B is a larger area that contains dioxin/furan-contaminated soil. In order to remove ecological exposure from this area, a physical barrier consisting of a geotextile and a compacted crushed rock cap that prevents wildlife from being exposed to the soil contamination will be placed in areas where dioxin/furan soil contamination at concentrations greater than the CUL will remain. This requirement will be included as part of any cleanup action evaluated in this document where contaminated soil in this area is not fully removed. Placement of the physical barrier will be implemented according to the schedule described in Section 9.0. Details of the barrier are described in Section 7.2.1. Additionally, in accordance with WAC 173-340-7491(b) and 173-340-440, an institutional control will be implemented that will require maintaining this barrier as part of future land use.

- **Protection of indoor air from vapor intrusion from contaminated soil.** Volatile contaminants in soil have the potential to volatilize and rise through the soil column and discharge into ambient air. As mentioned previously, dioxins/furans are not considered volatile chemicals; therefore, this is not an active pathway at the Site for these chemicals.
- **Protection of surface water from soil erosion.** Surface soil has the potential to reach surface water via direct runoff downslope. The majority of the area that contains dioxins at concentrations of concern is largely unpaved, and presumably the majority of stormwater infiltrates through the ground surface; however, ponding does occur in some areas of the Site and water has the potential to runoff to surface water features. This is an active pathway at the Site.

The selection of appropriate soil quality standards is described in Section 4.2.3.

4.2 CLEANUP STANDARDS

Cleanup standards include concentrations that protect human health by media, the point of compliance where these concentrations must be met, and any additional regulatory requirements that apply to a cleanup action (WAC 173-340-200). The rationale for cleanup standards is consistent with the process used in the development of the cleanup standards presented in the CAP.

4.2.1 Surface Water

As discussed in Section 4.1, surface water is present at the Site only in perimeter ditches that convey groundwater and stormwater to the Blair Waterway. These ditches only intermittently contain water during the rainy periods of the year and during storm events. Surface water is not a contaminated medium at the Site; however, in order to establish groundwater concentrations that are protective of surface water, it is necessary to define concentrations in surface water that are protective of human health and aquatic species, and then establish groundwater concentrations that are protective of these calculated surface water concentrations. Surface water criteria are shown in Table 4.1.

Because the development of appropriate groundwater cleanup standards is intrinsically linked to the selection of surface water quality standards, surface water quality standards are discussed in further detail in Section 4.2.2.

4.2.2 Groundwater

4.2.2.1 Groundwater Point of Compliance

The location and rationale for the determination of the groundwater conditional point of compliance described here is consistent with the process used in the development of the cleanup standards presented in the CAP. Groundwater must be protective of surface water and must meet surface water standards at the point where groundwater enters the surface water. For the Site, Shallow Aquifer groundwater enters surface water at the perimeter ditches and Intermediate Aquifer groundwater enters surface water at the Blair Waterway. The CULs for this facility are equivalent to surface water standards and must be met at the points of compliance. With no on-site exposure to groundwater, the off-property conditional point of compliance for the Shallow Aquifer is at the perimeter ditches and the off-property conditional point of compliance for the Intermediate Aquifer is at the Blair Waterway.

The off-property conditional point of compliance for the Intermediate Aquifer at the Blair Waterway is consistent with WAC 173-340-720(8)(d)(ii) for properties near, but not abutting, surface water. A deed restriction will be placed on the property in perpetuity prohibiting the use of groundwater at the facility. Additionally, SSA and the owners of the property between the SSA property and the Blair Waterway, the Puyallup Tribe of Indians, have agreed in writing to the use of the off-property conditional point of compliance.

In order to ensure that the cleanup standards are met at the conditional point of compliance, source area target concentrations have been established at the shallow aquifer monitoring wells, approximately 40 feet in proximity to the North and South Ditches, in the 2008 FFS (Floyd|Snider 2008a) for other Site COCs. Because all the soil containing dioxins/furans at levels of concern are within the perimeter of compliance monitoring wells, the 40-foot distance from the wells to the surface water features is still appropriate. In order to develop a source area target concentration to be compared to at the shallow aquifer monitoring wells, this methodology was conducted for dioxins/furans.

Source area target concentrations were developed through attenuation and degradation modeling that represent the maximum allowable concentrations that, based on modeling and empirical evidence, will naturally attenuate between the compliance monitoring wells and the conditional point of compliance so as to meet the CULs as described in WAC 173-340-720(8)(e). These source area target concentrations provide the same function as remediation levels, as described in WAC 173-340-355, and constitute the values to be met for the compliance monitoring well network at the property boundary.

4.2.2.2 Groundwater Source Area Target Concentration

The rationale for and the development process for groundwater source area target concentrations presented here is consistent with the process used in the development of the cleanup standards presented in the 2008 FFS (Floyd|Snider 2008a) and CAP (Ecology 2008b). Because groundwater at the Site is non-potable, the risk of exposure to constituents in groundwater is limited to discharge into surface water within the perimeter ditches and the Blair Waterway. Therefore, as the groundwater enters the surface water, it must meet relevant surface water criteria.

In 2008 values were developed at the Site using the Ecology-approved BIOSCREEN model. The surface water criteria were back-calculated for the identified constituents of concern to determine maximum concentrations in groundwater at the Site’s boundary that would naturally attenuate to meet the surface water criteria as the groundwater enters the respective water bodies.

Similar to 2008, for this SFRI/SFFS the BIOSCREEN model was used to identify the maximum dioxin/furan concentration in groundwater that is protective of surface water. Source area target concentrations were developed using the following steps:

1. **Determine the potential exposure pathways and receptors (WAC 173-340-708).** Because the groundwater in the area is non-potable, the highest beneficial use of groundwater at the Site is protection of surface water.

   Ecological receptors for surface water include aquatic and avian species. An ecological exposure evaluation was not required based on the ecological risk exclusion provision in WAC 173-340-7491. The Site meets the requirements of this provision based on the corrective actions completed to date and the requirements of the cleanup actions developed in this document. No terrestrial ecological exposure to groundwater or surface water exists at the Site.

   Human receptors for surface water include incidental ingestion of maintenance workers and recreational swimmers (although the Blair Waterway is an industrial/commercial shipping channel and restricted from recreational swimming) and fish consumption for recreational and subsistence anglers.

2. **Determine relevant surface water criteria protective of potential human and ecological receptors.** In accordance with MTCA Surface Water Cleanup Standards (WAC 173-340-730), the surface water criteria selected must be at least as stringent as concentrations established under applicable state and federal laws and protective of human and ecological receptors. The most stringent dioxin/furan surface water criterion for the protection of human health via consumption of organisms is 0.0051 pg/L for 2,3,7,8-TCDD; Federal Clean Water Act Section 304).
3. **Calculate the source area target concentrations that would meet the selected surface water criteria.** Once the surface water criterion was determined, the transport and attenuation of dioxins/furans from the Site to surface water was calculated using the BIOSCREEN model. Due to the high tendency of dioxins/furans to adsorb to soils and attenuate at a rapid rate, the BIOSCREEN model was used to determine that even for 2,3,7,8-TCDD concentrations in a perimeter monitoring well of $1x10^{54}$ milligrams per liter (mg/L), the groundwater concentration at the conditional point of compliance would still be less than the surface water criterion of 0.0051 pg/L. All the results for 2,3,7,8-TCDD at the Site were non-detects at values of 1 to 2 pg/L and are not of concern. Appendix B presents the results of the numerical modeling process.

Based on the results of the modeling, a source area target concentration was impractical to calculate. Dioxin/furan concentrations are predicted to attenuate rapidly as the groundwater moves through soil, and are not likely to reach surface water at concentrations greater than the surface water quality criterion.

In order to provide an additional level of analysis, the maximum 2,3,7,8-TCDD groundwater concentration throughout the Site was calculated based on actual soil analytical data, 0.0033 milligrams per kilogram at location SS-1. Using the MTCA three-phase equilibrium equation, this soil concentration is in equilibrium with groundwater at a concentration of 1.7×10^{-7} mg/L, or 170 pg/L. The BIOSCREEN model results show that this concentration attenuates to 0.0018 pg/L, less than the surface water criterion of 0.0051 pg/L, within 10 feet.

Therefore, this modeling evaluation demonstrates that groundwater at the Site is protective of surface water and that soil at the Site containing dioxins/furans may remain on-site at a distance of greater than 10 feet from surface water features without posing a risk to adjacent surface waters.

It should be noted that because a source area target concentration was impractical to calculate, the proposed groundwater monitoring will be based on evaluation of the concentrations to ensure that there is not a significant increase in concentrations that poses a concern. This approach will be described in the CMCP that will be part of the CAP Amendment.

4.2.3 Soil

Consistent with development of the cleanup standards presented in the CAP, CULs for soil must be protective of both direct human contact and the surface water in the Blair Waterway via a leaching to groundwater pathway. The soil concentrations are selected to be the more conservative of the MTCA requirements for a maintenance worker's exposure to soil for ingestion (MTCA Method C values) and the leaching to groundwater risk-based concentrations (Ecology's three-phase model calculations).

4.2.3.1 Soil Point of Compliance

The location and rationale for the determination of the soil point of compliance described here is consistent with the process used in the development of the cleanup standards presented in the CAP. The point of compliance for soil, based on the soil direct contact exposure pathway, is the MTCA standard point of compliance for soil direct contact throughout the Site, from the ground surface to a depth of 15 feet bgs (WAC 173-340-740 (6)(d); Ecology 2007). However, WAC 173-340-740(6)(f) defines how the point of compliance can be met for cleanup actions selected under MTCA that involve containment of hazardous substances. For this Site, the selected cleanup action involves consolidation and containment of hazardous substances, which achieves the requirements of permanence, protection of human health and ecological receptors, and the application of institutional controls, which prohibit or control activities that could interfere with the long-term integrity of the containment system.

The point of compliance for soil based on the leaching to groundwater pathway is throughout the Site from the ground surface to the depth to the Upper Aquitard, approximately 7 to 10 feet bgs.

4.2.3.2 Soil Cleanup Levels

The rationale and development process for the soil CULs source area is consistent with the process used in the development of the cleanup standards presented in the CAP. Because the Site meets the criteria of an industrial site (WAC 173-340-745) and will continue to do so, the MTCA Method C Industrial Criterion (1,680 pg/g) for dioxin/furan has been identified as the appropriate CUL in order to be protective of industrial use and worker direct contact exposure. In order to protect groundwater, the BIOSCREEN modeling demonstrated that soil on-site containing dioxins/furans may remain on-site at distances greater than 10 feet from the surface water features without posing a risk to adjacent surface waters. Based on this, it was determined that 1,680 pg/g is the appropriate CUL for the Site.

5.0 Supplemental Focused Remedial Investigation Activities

In order to further delineate the nature and extent of dioxins/furans in soil at concentrations greater than the CULs and evaluate the potential concern regarding dioxins/furans in groundwater, SSA submitted a SFRI Work Plan to Ecology in July 2014. The SFRI Work Plan was approved by Ecology in September 2014 and the investigation was conducted later that month. This section describes the activities conducted and the results of this investigation.

5.1 SOIL

5.1.1 Characterization Areas

As described in Section 3.4.4, the SFRI Work Plan developed an investigation focused on two primary areas of concern: (1) Area A, which is the core area of the Site where primary historical activities associated with PCP production and storage took place, including areas of previous corrective actions for PCP, and (2) Area B, which is the area where treated soil was placed and several corrective actions occurred. The remaining areas of the Site were not characterized because they are outside the areas of primary historical industrial activities associated with PCP production and treated soil laydown, and are not expected to contain dioxin/furan contamination at levels of concern.

The SFRI Work Plan identified the methodology used to collect and analyze samples and identified how the results would be used to characterize the nature and extent of contamination in these areas. The SFRI Work Plan included a description of both the discrete samples that would be collected and analyzed and the samples that would be collected and analyzed as part of the multi-increment sampling (MIS) methodology. A summary of the sampling approach is included in Section 5.1.2.

5.1.2 Sampling Approach

Within each of the areas, samples were collected for distinctive reasons, which are discussed below.

5.1.2.1 Area A – Known Locations with Dioxin/Furan Contamination

To verify the vertical depth of dioxin/furan impacts identified during ERM due diligence sampling, four soil borings were advanced within the vicinity of ERM soil borings SB-12, SB-19, SB-20/EMW-9, and SB-21/EMW-10. These were locations where existing data indicated the presence of dioxins/furans at greater than two times the CUL within the upper 3 feet of soil. It was assumed that these locations would require remediation; however, data did not exist to define the depth of contamination at all of these locations. Discrete soil samples (EX-31 through EX-34) were collected at 4, 6, and 8 feet bgs. These data were used to determine the vertical extent for remedial excavation activities that will occur as part of the site cleanup action.

The sample locations and results are shown on Figure 5.1.

5.1.2.2 Area A – Multi-Increment Sampling for Remaining Area

MIS was conducted in order to characterize and obtain a representative view of mean dioxin/furan concentrations throughout Area A. The MIS approach and analysis method is discussed further in Section 5.1.4.1. Areas of known contamination (20-by-20-foot areas surrounding ERM samples SB-11/EMW-6, SB-12, SB-19, SB-20/EMW-9, and SB-21/EMW-10) were excluded from the MIS analysis, as these locations had been previously determined to contain dioxins/furans at concentrations greater than the CUL and will be evaluated in the SFFS. In the remaining portion of Area A, 30 direct-push soil borings were advanced at random locations using a random point generator tool in ArcGIS. The borings in Area A were split into two separate Decision Units (DUs). The upper DU in Area A is called DU A1 and extends from ground surface down to 4 feet bgs. This DU interval was selected based on the determination made through evaluation of the existing data that dioxins/furans are primarily present within the upper 3 feet within Area A. The lower DU is called DU A2 and extends from 4 to 8 feet bgs, or down to the aquitard, whichever was encountered first. This DU was selected to characterize the deeper soil interval within Area A in order to confirm that it is in compliance with CULs for dioxins/furans.

The sample locations and results are shown on Figure 5.1.

5.1.2.3 Area B – Treated Soil Horizon Characterization

In order to identify the quality of the treated soil that was placed within Area B, composite samples of the treated soil were collected at locations within Area B where treated soil was present. As mentioned previously, the majority of soil excavated during corrective actions at the Site was placed in the on-site soil treatment cells for biological treatment. Upon treatment of each 2-foot-thick soil horizon, soil that met CULs for the Site COCs was removed from the cells and placed in approved laydown areas. The limits of Area B were defined based on an understanding of the area in which treated soil was handled following removal from the treatment cells. These areas and the locations of the former treatment cells are shown on Figure 5.2. Following completion of the soil treatment within the treatment cells, the cells were decommissioned in accordance with the *Treatment Cell Closure Work Plan* (Floyd|Snider 2012a) and documented in the *Treatment Cells Closure Report* (Floyd|Snider 2012b).

To decommission the treatment cells, the drainage sand layer within the treatment cells was sampled to ensure that it met the treatment levels and was then removed and placed within Area B. Following that, the treatment cell infrastructure and leachate collection system was deconstructed, decontaminated, and disposed of appropriately. Next, the soil beneath the treatment cells was sampled to ensure that it met the treatment levels. The treated soil within Area B was subsequently re-graded following final decommissioning of the treatment cells and preparation for site development. All treated soil was retained within Area B.

Treated soil is present on what is being termed the "original ground surface." The thickness of the treated soil horizon within Area B varies, but is as thick as 14 feet. Due to the correlation of dioxins/furans with PCP, and the fact that dioxins/furans are relatively immobile in the environment, it was anticipated that, within Area B, dioxin/furan contamination that exceeds CULs was most likely present within the treated soil.

Soil logging during boring advancement allowed for observation and delineation of the stratigraphy and the treated soil/original soil interface. In general, treated soil consists mainly of fine- to coarse-grained sand with angular clasts of limestone/dolomite approximately 1 to 2 inches in diameter and visible remnants of the biological amendment Daramend® that degraded the PCP. Treated soil was identified at 16 of the 30 locations, primarily within the northern half of Area B.

In the southern portion of the treated soil in Area B, within the footprint of the former treatment cells, the treated soil was placed over a thin layer of sandy gravel fill that overlies an impermeable liner material consisting of a hard, fine-grained silt/clay layer. In this area, the thin layer of sandy gravel fill was included in the treated soil horizon due to the thinness of this layer and potential comingling of treated soil during placement, and the original ground surface was defined as soil below the thin fill layer. In the northern portion of Area B, the sandy gravel fill and liner material are absent, and the treated soil directly overlies original soil. In this area, the original ground surface was defined as the soil below the treated soil layer.

At each of the boring locations with treated soil, a composite soil sample was collected over the total thickness of the treated soil horizon, if present. In areas where treated soil is present, its thickness ranges from 1 to 14 feet thick. Twelve samples were selected from the treated soil horizon for analysis of dioxins/furans based on the identified thickness of the treated soil horizon, to be representative of the zone of treated soil defined within Area B. The remaining samples were archived for potential future dioxin/furan analysis. Table 5.3 identifies whether or not treated soil is present at each of the sample locations, and, if treated soil is present, identifies the thickness of treated soil at each sample location.

The sample locations and results are shown on Figure 5.3.

5.1.2.4 Area B – Multi-Increment Sampling for Underlying Original Soil

MIS was conducted in order to characterize and obtain a representative view of dioxin/furan concentrations below the original ground surface throughout Area B. The MIS approach and analysis method is discussed further in Section 5.1.4.1. As mentioned previously, treated soil was placed on what is being termed the “original ground surface.” Depths were identified of each sample for both bgs and below original ground surface (bogs). The definition of original ground surface is described in Section 5.1.2.3.

The soil that is original, or below the treated soil within Area B, was split into two separate DUs. The upper DU in Area B is called DU B1 and extends from the original ground surface down to 2 feet bogs. The lower DU is called DU B2 and extends from 2 to 6 feet bogs, or the aquitard, whichever is encountered first. The upper DU interval, DU B1, was selected to capture any shallow dioxin/furan contamination that may be present associated with remediation activities within the treatment cells and laydown soil. The lower DU interval was selected to characterize dioxin impacts if the upper original soil interval exceeds the CULs.

The sample locations and results are shown on Figure 5.1.

5.1.3 Field Methods

Soil samples were collected from random soil boring locations in Areas A and B using a direct-push rig (e.g., Geoprobe^{TM}). Thirty-four soil borings were installed in Area A and 30 soil borings were installed in Area B. All borings were monitored and recorded by a field technician. Soil samples were described and classified according to the United Soil Classification System and photographed. Soil intervals were collected continuously using a 5-foot-long sampler and continuously logged. A schematic of a typical Geoprobe sampler is included in Appendix C.

To collect clean, continuous soil cores, two sets of rods are used. The first set of rods is driven into the ground and acts as an outer casing, which eliminates the chance for cross-contamination. The second, smaller set of rods are placed within the outer casing. The smaller rods hold a clean, expendable sample liner in place and both are driven downward with the outer casing in 5-foot intervals. The smaller rods are retracted and recovered with the 5-foot interval of soil contained within the liner. Sample interval collection started at the ground surface and the maximum depth varied with each area. This boring methodology allowed for observation and delineation of the stratigraphy beneath the Site and the treated soil fill/original surface interface within Area B.

Soil samples were screened to identify intervals potentially contaminated with volatile constituents using a photoionization detector for the purpose of health and safety. Depending on the area, discrete or composite soil samples were collected for analyses and archival purposes within the sample interval of interest.

For MIS, at each of the 30 boring locations, soil sub-samples were collected from random discrete depths within each DU. The depth within each DU was chosen prior to the sampling using a random number generator in Microsoft Excel. Samples were then collected from a discrete 0.5-foot section within each interval. Soil was placed into laboratory-supplied sample containers, with the lid tightly sealed, labeled, and placed in a cooler on ice. For MIS sampling, a 4-ounce jar was sufficient to provide enough material for the laboratory to take an aliquot of soil to use in the MIS compositing, as well as provide enough volume for potential discrete dioxin/furan analysis.

5.1.4 Analytical Methods

5.1.4.1 Multi-Increment Sub-Sampling Analysis

In order to prepare the MIS sample, the laboratory composited sub-samples from each area DU to form a homogenous mixture that represented the average concentration of each area DU. Under standard MIS analysis protocols, the sub-samples collected were air-dried to facilitate the sieving of any remaining material that was unacceptably large (i.e., greater than 2 millimeters).

A stainless steel #10 (2-millimeter) sieve was used to separate the oversized material, and stainless steel spoons were used to gently break up any fine particle agglomerations able to pass through the sieve.

Under standard laboratory protocols, a small amount (approximately 10 grams) of the aggregate material less than 2 millimeters in size was then separated from the composite material by incremental sub-sampling. The composite was spread across a tray and then leveled such that the material was no more than 0.5 inches thick and was approximately uniform in thickness across the tray. The material was then divided into 30 equal grid volumes. The laboratory analyst then removed an equal amount of material (by weight) out of each grid, equal to 0.3 gram ±0.05°grams prior to drying. The material removed from each grid was collected from a random point (or points) within the grid boundaries. The spatula used to remove material had a flat bottom and was scraped along the bottom of the tray to ensure that all particle sizes were equally represented in the sample, as fines tend to settle.

If too much material was removed from a particular grid, the material was returned to the grid, the volume within the grid was mixed, and a new quantity of material was removed. Once the material removed from a particular grid volume was equal to 0.3 gram, within the acceptable margin of error, the material was placed in an aliquot jar for dioxin/furan analysis, as described in Section 5.1.4.2.

After each aliquot was prepared in this manner and prior to the preparation of the subsequent aliquot for analysis, the grids were leveled to obscure the area where the previous sample volume was collected to ensure the randomness of material retrieved to compose the aliquots.

5.1.4.2 Specific Dioxin/Furan Data Analyses and Considerations

Because dioxins/furans can be difficult to identify at low concentrations and the potential exists for compound interference, which could cause the reporting of artificially elevated values, USEPA Method 8290 was employed in the analysis of the dioxin/furan congeners.

Dioxins/furans are generally present in the environment as a complex mixture of chemical congeners that differ in terms of the number and location of chlorine atoms. The most toxic and best-studied of the dioxin/furan congeners is 2,3,7,8-TCDD. Because of the need to evaluate the risks associated with the mixture of congeners, the toxicity equivalency factor (TEF) methodology is used. A TEF value is assigned to each congener relative to the toxicity of TCDD. The total TEQ of a mixture is the sum of the products of the concentration of each congener in a sample and the congener’s corresponding TEF value. The TEF values used to calculate the TEQs are those resulting from the World Health Organization re-evaluation of TEFs for dioxins, performed in 2005 (Van den Berg et al. 2006).

5.1.4.3 Quality Assurance/Quality Control

Surrogates were required (organics only) for every sample, including matrix spike samples, blanks, laboratory control samples, and standard reference materials. Matrix spike /matrix spike duplicates were required for every 20 samples received.

All samples were diluted and re-analyzed if target compounds were detected at levels that exceeded their established calibration ranges. Any cleanups performed were conducted prior to the dilutions. Re-analysis was performed if a surrogate, internal standard, or spike recovery was outside of the data quality objective parameters.

5.1.5 Results

The analytical results of the dioxin/furan sampling within Area A are shown on Figure 5.1 and in Table 5.1. The analytical results of the dioxin/furan sampling within Area B are shown on Figure 5.1 and in Table 5.2

5.1.5.1 Area A

The ground surface of Area A consists of road base fill material, asphalt, and/or concrete. Based on 34 soil borings advanced in Area A, the subsurface typically consists of 0.5 to 4 feet of sandy, gravelly, crushed gravel or road base fill that overlies dredge spoils. The dredge spoils consist of brown to dark brown, fine to medium sand and gray silty sand. The dredge material is up to at least 8 feet thick and is occasionally interbedded with brown to olive-gray silt with low to medium plasticity. Native soils were encountered beneath the dredge spoils at depths of at least 6 feet bgs. The uppermost native material consists of black to olive-gray, organic-rich silt with occasional woody debris and peat. Underlying the organic-rich silt is olive-gray silt to dark brown, silty sand and sand (field boring logs are included in Appendix D). Lithology encountered during this investigation is consistent with previous investigations.

Analytical results from the soil boring advanced in areas of known contamination (EX-31 through EX-34) confirm the presence of dioxins/furans greater than the CUL and indicate a vertical extent of contamination between 4 and 6 feet in those areas.

Soil analytical results from DU A1 indicate that dioxins/furans were present at a TEQ concentration of 5,710 pg/g, which exceeds the CUL of 1,680 pg/g. Therefore, the lower decision unit, DU A2, was analyzed using MIS. The dioxin/furan TEQ concentration for DU A2 was detected at 331 pg/g, which is less than the CUL. Based on this, it was determined that the lower DU, the horizon from 4 to 8 feet bgs, met the CUL and did not require further analysis.

Due to the exceedance in the upper decision unit, DU A1, 21 of the 30 discrete samples that comprised DU A1 were selected for dioxin/furan analysis to investigate vertical and lateral extent of contamination. Not all discrete samples from DU A1 were selected for analysis due to close proximity to other samples.

Dioxin/furan concentrations for discrete samples within DU A1 exceeded the CUL within the areas of known exceedances, such as adjacent to ERM boring SB-21/EMW-10. In addition, dioxin/furan TEQ concentrations exceeded the CUL in soil boring A-10, which was an area not previously known to contain elevated dioxin/furan concentrations.

The discrete samples analyzed within DU A1 showed that there were only three exceedances of the CUL, which were limited to borings that were either adjacent to or within the areas of known contamination. There was only one boring, A-10, that had not been identified as being in an area of contamination. Based on these data and the data from previous investigation activities, there are six areas within Area A with dioxin/furan concentrations that exceed the CUL. Five of the areas are estimated to be approximately 20-by-20 feet, and the sixth area is approximately 30-by-30 feet. Within these six areas, dioxins/furans were detected at concentrations ranging from 2,010 pg/g to 91,900 pg/g.

5.1.5.2 Area B

Based on 30 soil borings advanced during the September 2014 field activities, the subsurface lithology consists of treated soil, imported fill material, dredge spoils, and native silts and sands associated with the estuarine delta into Commencement Bay (field boring logs are included in Appendix D). A large portion of the surface within the northeastern half of Area B contains treated soil (Figure 5.3). The remaining portion of Area B contains pit run and road base fill material at the surface.

The treated soil consists of light brown to gray, fine- to coarse-grained sand with angular clasts of limestone and dolomite up to 2 inches in diameter and remnants of Daramend®. The treated soil is up to approximately 14.5 feet thick in some areas. Within the footprint of the former treatment cells, the treated soil overlies a thin layer of sandy gravel fill and an impermeable liner material that was encountered in a few of the soil borings. The liner consists of a dark gray to black, hard silt/clay up to approximately 12 inches thick and marks the vertical boundary between the treated soil and original ground surface. The original ground surface lithology consists of dark brown to olive-gray, silty, fine-grained sand to olive-gray, sandy silt and black organic silt with woody and peat debris.

In portions of Area B where the treated soil is absent, the subsurface lithology consists of light brown, gravelly, fine- to medium-grained sand and crushed recycled concrete or road base fill that postdates the treatment cell activities. Beneath the recycled concrete and road base fill material is light to dark brown, fine- to medium-grained sandy fill material that pre-dates the treatment cell activities. This fill material is up to 7 feet thick in some areas. Underlying the fill material is native material consisting of dark brown to olive-gray, silty, fine-grained sand to olive-gray, sandy silt and black, organic silt with woody and peat debris.

In portions of Area B where treated soil was present, a composite sample was collected at each sample location over the total thickness of the treated soil. Composite samples were created by collecting approximately equivalent amounts of soil from the entire length of the boring where treated soil was present, irrespective of depth below ground surface. The composite sample volume was homogenized in a stainless steel dish using a stainless steel spoon prior to sample collection for laboratory analysis. The composite sample represents soil conditions in the treated soil area, and was collected in addition to the samples that were collected to represent DU B1 and DU B2.

In the treated soil area, samples collected to represent DU B1 and DU B2 were collected in the intervals from 0 to 2 feet and from 2 to 6 feet bogs, respectively. In the remainder of Area B, where treated soil was not present, the original ground surface and current ground surface are the same, and this distinction is not meaningful. Depths in units of feet bgs and in feet bogs are presented for all analyzed samples in Table 5.2. The thickness of treated soil at each sample location is shown on Table 5.3. A discussion of the samples selected for analysis throughout Area B, as well as the results of this analysis, is presented in the text that follows.

In total, 16 out of the 30 sample locations contained treated soil. Of those samples, 12 were submitted for dioxin/furan analysis. Four samples (B17, B-22, B-23, and B-27) were not submitted for analysis due to proximity to other sample locations. All 12 of the treated soil samples submitted for analysis had TEQ concentrations greater than the CUL, ranging from 6,170 pg/g to 175,000 pg/g.

Concurrent with analysis of the treated soil samples, dioxin/furan MIS analysis was run on DU B1 (the 0 to 2 feet bogs composite sample, as described in Section 5.1.2.4). From among the 30 samples that were collected and composited to obtain the analyzed sample volume for DU B1, 18 of the samples were collected in areas where treated soil was present. The remaining 12 samples were collected in the south and southwestern portions of Area B, where treated soil is not present. Analytical results from MIS sample DU B1 indicated that dioxins/furans were present at a TEQ concentration of 61,600 pg/g, which exceeds the CUL. It was assumed that the majority of the soil that exceeds the CUL is located within areas of treated soil. To confirm this assumption and identify clean areas of the Site that do not require further action, the 12 discrete samples that did not contain treated soil at the surface were submitted for analysis. Of the 12 discrete samples that were analyzed, 11 resulted in concentrations less than the CUL. Therefore, it was determined that no further action was needed in the portion of Area B that contained these 11 samples. Two additional discrete soil samples, B-29 and B-30 within DU B1, were also analyzed to delineate lateral extent of contamination within Area B.

Concurrent with the discrete analysis of the samples from DU B1, the lower MIS decision unit DU B2 (the 2 to 6 feet bogs composite sample, as described in Section 5.1.2.4) was analyzed for dioxins/furans. MIS analytical results from DU B2 indicated that dioxins/furans were present at a TEQ concentration of 7,390 pg/g, which exceeds the CUL. Due to this exceedance, the 18 discrete soil samples that comprised DU B2 beneath and near the treated soil were analyzed in order to delineate the vertical extent of contamination beneath the treated soil area. Of the 18 soil samples analyzed, 16 contained TEQ concentrations less than the CUL. Soil samples B-14 and B-18 contained elevated TEQ concentrations, 12,000 pg/g and 247,000 pg/g, respectively, that are likely driving the concentration for the DU B2 MIS sample, which exceeds the CUL. All analytical results for soil samples within Area B are presented in Table 5.2 and Figure 5.3.

Based on the results of this sampling and the previous ERM sampling, it was determined that the treated soil and the 2-foot horizon below the treated soil are contaminated at concentrations greater than the CUL. Below 2 feet bogs, contaminated soil greater than the CUL is only present in soil borings B-14 and B-18. In addition, soil borings B-14 and B-29 are located in areas where treated soil is not present and both contain dioxin/furan TEQ concentrations that exceed the CUL. Based on soil borings, topography, and soil analytical data, approximately 56,000 cubic yards of contaminated soil is present within Area B within the footprint of the contaminated soil area, shown in Figure 5.3 as hatched lines. The excavation volume was determined using computer-aided design (CAD) software and was based on the vertical delineation of contamination extent based on thickness of the contaminated soil identified. The surface area utilized in this calculation was the footprint of the contaminated soil area. Approximately 33,000 cubic yards of the contaminated soil is stockpiled treated soil from previous remedial activities.

5.2 GROUNDWATER

5.2.1 Field Methods

In September 2014, Environmental Partners Incorporated collected groundwater samples from six of the seven existing SSA shallow aquifer monitoring wells shown on Figure 2.1. A sample was not collected from MW-108(S), as it was dry during the sampling event. Monitoring wells were purged and sampled using low-flow sampling to achieve the lowest turbidity practicable with a peristaltic pump (or equivalent) and disposable polyethylene tubing.

To minimize turbidity, monitoring wells were purged prior to sampling at a flow rate of 0.1 liters per minute (L/min), if achievable, and up to a maximum of 0.25 L/min. Prior to and during sampling, depth to water was measured using a water level indicator. During purging, field parameters (i.e., temperature, pH, conductivity, and turbidity) were recorded using a multi-parameter groundwater meter. Once the field measurements for turbidity and conductivity were approximately stable (within 10 percent) for three consecutive readings, a field-filtered sample was then collected with an in-line 0.2 micron (micrometer [µm]) polycarbonate membrane filter. All field measurements were recorded on a groundwater sample collection form. The labeled groundwater samples were immediately placed in a cooler packed with ice and transported to ARI for dioxin/furan analysis.

5.2.2 Analytical Methods

Because dioxins/furans can be difficult to identify at low concentrations and the potential exists for compound interference, which could cause the reporting of artificially elevated values, USEPA Method 8290 was employed in the analysis of the dioxin/furan congeners.

5.2.3 Results

2,3,7,8-TCDD was not detected in any groundwater samples.

5.3 DATA VALIDATION

EcoChem performed a full validation (USEPA Stage 4) on the dioxins/furans data for soil and groundwater. They concluded that the laboratory followed the specified analytical method, and the overall accuracy and precision were acceptable. Some results were qualified based on compound recovery, compound identification, and laboratory duplicates. It was also noted that detection limits were elevated based on ion ratio outliers and method blank contamination. EcoChem stated that all data, as qualified, are acceptable for use. The full data validation report is included in Appendix E.

5.4 REMEDIAL INVESTIGATION CONCLUSION

Within Area A, there are six areas with dioxin/furan TEQ concentrations that exceed the cleanup standards. Five of the areas are approximately 20-by-20 feet, and the sixth area is approximately 30-by-30 feet. The vertical extent of contamination in these areas ranged between 2 and 6 feet. Based on these depths and with an additional contingency added for a larger lateral extent of contamination than is currently known, the expected removal area is between 450 and 1,100 cubic yards. A pre-excavation extent investigation will be conducted prior to construction to determine the specific volume of soil to be removed. The six areas with dioxin/furan TEQ exceedances will be incorporated into the cleanup action alternatives for the Site and are shown on Figure 5.1. No further action is required for the remainder of Area A.

Within Area B, most of the soil in areas that did not contain treated soil was determined to be in compliance with the cleanup standards. Areas with treated soil at the surface have dioxin/furan TEQ concentrations greater than the CUL down to 2 feet bogs. Below 2 feet bogs, contaminated soil concentrations greater than the CUL is only present in two borings, B-14 and B-18. The concentrations in these two soil borings are driving the DU B2 MIS TEQ concentration greater than the CUL and the rest of DU B2 is in compliance with the cleanup standards. Based on soil borings, topography, and soil analytical data, approximately 56,000 cubic yards of contaminated soil at concentrations greater than CULs is present within Area B. This area is shown on Figure 5.3.

Groundwater at the Site is determined to be in compliance for 2,3,7,8-TCDD. None of the shallow aquifer wells that were sampled contained 2,3,7,8-TCDD.

6.0 Cleanup Action Objectives and ARARs

The SFRI/SFFS has been developed in accordance with MTCA WAC 173-340-350(8). Cleanup action alternatives for the Site are developed and evaluated, and then a Proposed Cleanup Action Alternative is proposed to Ecology for consideration. The tasks, discussed in the following sections, include the following:

- Evaluate cleanup action alternatives.
- Evaluate ARARs (i.e., identify applicable local, state, and federal laws).
- Compile, evaluate, and screen potentially applicable remedial technologies.
- Aggregate and evaluate proposed cleanup action alternatives that meet the requirements outlined by MTCA.
- Compare cleanup action alternatives to the MTCA requirements for a cleanup action per WAC 173-340-350(8).
- Complete a Disproportionate Cost Analysis (DCA) procedure consistent with WAC 173-340-360(3)(e) to identify the alternative that is permanent to the maximum extent practicable.
- Propose the Proposed Cleanup Action Alternative for the Site to Ecology for consideration in development of the CAP Amendment.

6.1 CLEANUP ACTION CRITERIA

Cleanup action objectives are determined to specifically identify objectives that should be accomplished in order to ensure compliance with ARARs. The following objectives are defined for the Site:

- Protect human and ecological receptors from exposure to dioxin/furan contamination that exceeds applicable CULs.
- Remove unacceptable human health and ecological risk resulting from direct contact with contaminated soil.
- During implementation of cleanup actions, ensure that migration of dioxins/furans does not occur.
- During implementation of cleanup actions, protect human receptors from exposure to noxious vapors and odors released from contaminated soil that may cause health impacts.

Each cleanup action alternative proposed will be evaluated for its ability to accomplish the objectives listed above.

6.2 APPLICABLE LOCAL, STATE, AND FEDERAL LAWS

The selected cleanup alternative must comply with MTCA cleanup regulations (WAC 173-340) and with applicable local, state, and federal laws. Together, these regulations and laws are identified as ARARs. Under WAC 173-340-350 and 173-340-710, the term "applicable requirements" refers to regulatory cleanup standards, standards of control, and other environmental requirements, criteria, or limitations established under state or federal law that specifically address a cleanup action, location, COC, or other circumstance at the Site. The "relevant and appropriate" requirements are regulatory requirements or guidance that do not apply to the Site under law, but have been determined to be appropriate for use by Ecology. ARARs are often categorized as location-specific, action-specific, or chemical-specific as described below. Federal, state, and local regulations and ordinances that apply directly to the project are listed in detail in Table 6.1.

The soil addressed in this SFRI/SFFS is considered to be a listed F021 hazardous waste by the 1988 RCRA permit that was active prior to the DWM Permit, and is subject to RCRA Land Disposal Regulations and any associated public comment requirements. As discussed in Section 3.3, a CAMU has already been designated at the Site; however, at the time of designation, dioxins/furans were not included as a COC. Any cleanup action alternative that leaves dioxin/furan-contaminated soil with concentrations greater than the CUL on-site will need to include the designation of a new CAMU to permanently manage the dioxin/furan-contaminated soil. By facilitating a final cleanup under MTCA, a CAMU helps to satisfy the corrective action requirements under WAC 173-303-646. The new CAMU is part of a final cleanup action, and is subject to requirements of WAC 173-303-64660. This SFRI/SFFS considers these requirements in screening soil remedial technologies, so that only alternatives that include management of this waste in accordance with the ARARs and CAMU restrictions (WAC 173-303-64650 and WAC 173-303-64660) are evaluated.

6.2.1 Location-Specific ARARs

Location-specific ARARs are those requirements that restrict the allowable concentration of hazardous substances or the performance of activities, including cleanup actions, solely because they occur in specific locations.

6.2.2 Action-Specific ARARs

Action-specific ARARs are requirements that define acceptable management practices and are often specific to certain kinds of activities that occur or technologies that are used during the implementation of cleanup actions. Activities could include excavation, grading or capping of soil, or disposal of excavated soil. Any construction activities or excavations will require compliance with stormwater regulations.

6.2.3 Chemical-Specific ARARs

The remediation of contaminated media must meet the CULs developed under MTCA. These potential CULs are considered chemical-specific ARARs. Chemical-specific ARARs consist of those requirements that regulate the acceptable amount or concentration of a chemical that may be found in or released to the environment.

7.0 Identification and Screening of Remedial Technologies

This section identifies and briefly describes the most commonly implemented remedial technologies for remediation of dioxins/furans with concentrations greater than CULs, and the application and limitations of each technology.

7.1 POTENTIALLY APPLICABLE TECHNOLOGIES

The following technologies are commonly used to address dioxin/furan contamination at concentrations greater than the CUL.

7.1.1 Institutional Controls

Institutional controls are physical, legal, and administrative measures that are implemented to minimize or prevent human exposure to contamination by restricting access to the Site. Institutional controls often involve deed restrictions or covenants, site advisories, use restrictions, designation of a CAMU, or consent decrees, and would be implemented at the Site to limit or prohibit activities that may interfere with the integrity of any cleanup action or result in exposures to hazardous substances at the Site. Institutional controls are typically implemented in addition to other technologies when those technologies leave contaminants on-site at concentrations greater than CULs. Institutional controls may include documents such as a Cap Inspection and Maintenance Plan that would describe how contamination that remains on-site would be addressed if disturbed in the future.

The benefits of institutional controls are the low cost to implement, and the fact that they are protective of direct contact through controls and the technology has proven success when combined with other technologies. Limitations include the lack of reduction or removal of chemical concentrations and the impacts to future site operations.

Institutional controls are applicable to the Site, but would likely be combined with other technologies to achieve cleanup action objectives.

7.1.2 Surface Capping

Surface capping is an example of a containment remedy that places a cap over contaminated soil to control surface water infiltration, erosion, and wind migration of soil. Surface capping provides a physical barrier, preventing human health and ecological exposures via direct contact and ingestion (i.e., by burrowing animals). Surface caps can be constructed as: a hard cap such as asphalt, concrete, or gravel designed to meet permeability requirements and prevent human health and ecological exposures; a clean fill cap, of variable thickness to prevent human health and ecological exposures; or an engineered cap designed to achieve permeability requirements, prevent human health and ecological exposures, and control water runoff. A surface cap may include an indicator layer to identify where the contamination remains. This may be a simple material such as plastic or something more substantial such as geotextile or GeoGrid, which may provide additional structural stability.

The benefits of surface capping are that a cap would contain contaminated soil below the ground surface and provide a barrier from direct contact pathways, and that the technology has proven success. Limitations are that chemicals remain in place and are not reduced or destroyed, and that surface capping requires maintenance to maintain the integrity of the cap will be conducted for as long as contamination at concentrations greater than the CUL is present at the Site. Institutional controls are required for capped areas. Surface capping would leave dioxin/furan-contaminated soil with concentrations greater than the CUL on-site and would need to include the designation of a new CAMU to permanently manage the dioxin/furan-contaminated soil. Per WAC 173-303-64660(1)(g), "the CAMU will, to the extent practicable, minimize the land area of the facility upon which wastes will remain in place after closure of the CAMU;" therefore, the area of a surface cap would have to be minimized and be consistent with the ARARs and CAMU restrictions, WAC 173-303-64650 and WAC 173-303-64660.

The surface capping technology is applicable to the Site and would achieve cleanup action objectives when combined with other technologies; therefore, it is retained as a remedial technology.

7.1.3 Solidification and Stabilization

Solidification or stabilization of soil that contains dioxins/furans at concentrations greater than the CUL physically and chemically immobilizes the contaminants within the soil matrix, thereby reducing or eliminating contaminant mobility. With solidification, the contaminants are either enclosed or bound within the soil matrix via a binding reagent, typically a cement or grout mixture. Stabilization involves adding and mixing a chemical compound with the contaminated soil to make the contaminant immobile through a chemical reaction that forms a new compound that is less toxic than the parent contaminant or through adsorption processes. Vitrification is a type of solidification and stabilization that uses an electric current to melt soil, thereby immobilizing or destroying subsurface contaminants.

The benefit of solidification and stabilization is that the technology reduces the mobility of contaminants in soil and reduces their potential to leach or migrate to groundwater. Limitations include the need for long-term groundwater compliance testing to ensure immobilization, the fact that chemicals are not removed (just immobilized).

Solidification and stabilization has been successfully used on sites with heavy metals and other types of inorganic contamination. This technology is still being developed for use with high levels of semivolatile organic contaminants and may be applicable for dioxins/furans. However, after solidification and stabilization, the material that remains on-site sometimes becomes very brittle. This material, although efficient at keeping contaminants in place, is very difficult to dig through for activities such as utility trenching and foundation work, and other such activities. Further, disturbing treated soil during future development may diminish the long-term effectiveness of the remedy in ways that are difficult to predict or monitor. These properties may interfere with or restrict proposed site development and future use plans for commercial or industrial redevelopment of the Site.

The solidification/stabilization technology is applicable to the Site and would achieve cleanup action objectives when combined with other technologies; therefore, it is retained as a remedial technology.

7.1.4 Excavation and Disposal

Excavation of soil contamination using standard construction equipment is a common method to achieve cleanup action objectives. For off-site disposal, excavated contaminated soil is transported either by truck or rail to an appropriate licensed disposal facility. The contaminated soil at the Site is a F021-listed waste and disposal options are limited. Contaminated soil excavated and disposed of off-site during the 2009 cleanup actions required macroencapsulation prior to placement in the landfill. Following soil removal, excavated areas may be subjected to confirmation soil sampling prior to backfill, compaction, and site restoration or could be excavated to pre-determined limits.

The benefits of excavation and disposal are that it results in immediate removal of chemicals from the Site and reduces mass in a short time frame, and that the technology has proven success at similar sites. Limitations include the high cost of disposal of contaminated soil, the possible need for shoring to maintain sidewall stability, and the potential need for dewatering, or drawdown of the groundwater table if excavation is to occur below the groundwater table.

Excavation and disposal is applicable to the Site and would achieve cleanup action objectives; therefore, it is retained as a remedial technology.

7.2 DESCRIPTION OF CLEANUP ACTION ALTERNATIVES

The retained technologies described in Section 7.1 have been aggregated into the following cleanup action alternatives for the Site. The alternatives are discussed below and are presented in order from least invasive to most aggressive, a sequence that reflects an increasing level of effort, protectiveness, and cost.

7.2.1 Alternative 1 – Consolidation, Capping, and Institutional Controls

Alternative 1 consists of a combination of institutional controls, surface capping, and excavation and consolidation of surface soil. Deeper soil excavation is required in the six areas identified in Area A.

In Area A, the six areas with concentrations greater than cleanup standards (between 450 and 1,100 cubic yards[1]) would be excavated and transported to Area B. Each of these areas would then be backfilled with clean material and compacted. Sampling to verify that these areas were excavated to extents sufficient to ensure that remaining soil contamination concentrations are less than CULs would be conducted. Laboratory analysis of dioxins/furans takes approximately

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[1] The actual volume of soil removed from the dioxin-impacted locations in Area A would be dependent on verification sampling of the excavations. Though 500 cubic yards has been used as a basis for cost estimates, the volume of impacted soil may be greater than 500 cubic yards.

3 weeks for each sample. In order to expedite the excavation and eliminate the duration that the excavation remains open, an Area A pre-excavation extent investigation would be conducted prior to construction. The investigation would be conducted under an Ecology-approved Area A Pre-Excavation Extent Investigation SAP/QAPP. The results of these samples would be presented to Ecology in an Area A Cleanup Action Work Plan (CAWP), which would identify the horizontal and vertical extents of the excavations.

In Area B, a 317,000-square-foot area would be regraded in order to provide a suitable surface for both the temporary use of the area (parking for cars/trucks) and for future development. Once regraded, the area would be capped with a surface that would prevent direct contact for humans and also prevent terrestrial ecological exposure. The cap design would not need to be impervious and could allow for infiltration of stormwater. Due to the potential of future development, the construction of the final cap has several possibilities. The cap proposed in this SFRI/SFFS is a geotextile or GeoGrid indicator layer that would be placed below a minimum 12-inch-thick cap of compacted crushed rock surfacing. This cap design would allow for infiltration of stormwater and would prevent any stormwater that does not infiltrate from contacting any contaminated soil. This cap would be protective of ecological exposure and prevent animals from burrowing and contacting the contaminated soil, as described in Integral Consulting’s memorandum “Puget Sound Burrowing Animals Analysis” provided in Appendix F.

Future development of the Site may include placement of asphalt or concrete pavements, buildings and stormwater controls in Area B. These surfaces would prevent direct contact for humans and also prevent terrestrial ecological exposure. If these alternative surfaces are proposed to be installed in lieu of the crushed rock cap described above, plans would be presented to Ecology for their approval.

Institutional controls would be required in the capped area where soil contamination greater than CULs would remain on-site. Institutional controls would include the designation of a new CAMU for the permanent management of dioxin/furan-contaminated soil on-site and a deed restriction in the form of a restrictive covenant that would require maintenance and monitoring of the cap surface and through compliance with a Cap Inspection and Maintenance Plan. The Cap Inspection and Maintenance Plan would specify soil management procedures for future excavation work within the capped areas and identify health and safety requirements for subsurface work.

Post-construction groundwater confirmation monitoring of the Shallow Aquifer wells downgradient of the capped area is an additional component of this alternative.

7.2.2 Alternative 2 – Full Removal by Excavation and Disposal

Alternative 2 is full removal that excavates all soil at the Site with exceedances of the CUL. Between 450 and 1,100 cubic yards[2] of soil from Area A and 56,000 cubic yards of soil from Area B would be removed from the Site for off-site disposal as F021-listed waste at an approved hazardous waste landfill. Because this contaminated soil is a F021-listed waste, disposal options are limited. Contaminated soil excavated and disposed of off-site during the 2009 cleanup actions required macroencapsulation prior to placement in the landfill. Disposal of excavated soil in this alternative would likely have similar disposal requirements.

Sampling to verify that these areas were excavated to extents sufficient to ensure that remaining soil contamination concentrations are less than CULs would be conducted. Laboratory analysis of dioxins/furans takes approximately 3 weeks for each sample. In order to expedite the excavation and eliminate the duration that the excavation remains open, a pre-excavation extent investigation would be conducted prior to construction. The investigation would be conducted under an Ecology-approved Pre-Excavation Extent Investigation SAP/QAPP. The results of these samples would be presented to Ecology in a CAWP, which would identify the horizontal and vertical extents of the excavations. The excavated areas would then be backfilled to create a suitable surface for current temporary and future use.

Post-construction groundwater confirmation monitoring of the Shallow Aquifer wells is an additional component of this alternative.

7.2.3 Alternative 3 – Consolidation, Solidification, and Institutional Controls

Alternative 3 consists of a combination of excavation and consolidation of surface soil, solidification, and institutional controls.

In Area A, the six areas with concentrations greater than cleanup standards (between 450 and 1,100 cubic yards[3]) would be excavated and transported to Area B. Each of these areas would then be backfilled with clean material and compacted. Sampling to verify that these areas were excavated to extents sufficient to ensure that remaining soil contamination concentrations are less than CULs would be conducted. Laboratory analysis of dioxins/furans takes approximately 3 weeks for each sample. In order to expedite the excavation and eliminate the duration that the excavation remains open, an Area A pre-excavation extent investigation would be conducted prior to construction. The investigation would be conducted under an Ecology-approved Area A Pre-Excavation Extent Investigation SAP/QAPP. The results of these samples would be presented

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[2] The actual volume of soil removed from the dioxin-impacted locations in Area A would be dependent on verification sampling of the excavations. Though 500 cubic yards has been used as a basis for cost estimates, the volume of impacted soil may be greater than 500 cubic yards.

[3] The actual volume of soil removed from the dioxin-impacted locations in Area A would be dependent on verification sampling of the excavations. Though 500 cubic yards has been used as a basis for cost estimates, the volume of impacted soil may be greater than 500 cubic yards.

to Ecology in an Area A CAWP, which would identify the horizontal and vertical extents of the excavations.

In Area B, the consolidated contaminated soils would be regraded within a 317,000-square-foot portion of Area B. Following regrading, the contaminated soil would undergo solidification/stabilization. Approximately 57,000 cubic yards of contaminated soil plus an appropriate volume of a binding reagent (5 to 30 percent of the contaminated soil volume) would be mixed with the soil. Mixing could be performed using ex-situ techniques in which the contaminated soil is excavated, mixed with cement/reagent in a temporary plant, and placed back into the excavation. Alternatively, mixing could be performed using in situ techniques in which cement/reagent is mixed into the contaminated soil using large-diameter augers. Following mixing, the soil-cement mixture will be a solid block. During final mixing operations, the surface would be graded in order to provide a suitable surface for both the temporary use of the area (parking for cars/trucks) and for future development. The new surface would be sloped to allow for sheet flow, which would then flow into a swale designed to treat and convey stormwater. Institutional controls would be required for the solidified area, where soil contamination greater than CULs would remain on-site. Institutional controls would include the designation of a new CAMU for the permanent management of dioxin/furan-contaminated soil on-site and a deed restriction in the form of a restrictive covenant that would require maintenance and monitoring of the new surface. A maintenance and monitoring plan would specify procedures for inspection and maintenance of the surface, as well as procedures for potential future excavation and management of excavated material, and identify health and safety requirements for work within the stabilized material.

Post-construction groundwater confirmation monitoring of the Shallow Aquifer wells downgradient of the capped area is an additional component of this alternative.

8.0 Cleanup Action Alternatives Evaluation and Disproportionate Cost Analysis

In this section, the alternatives developed for the Site are evaluated against the MTCA requirements for a cleanup remedy per WAC 173-340-360. The MTCA requirements are introduced in the first section below, followed by the alternatives evaluation that compares each alternative based on its ability to comply with the MTCA requirements.

8.1 MINIMUM REQUIREMENTS FOR CLEANUP ACTIONS

This section provides a summary of the requirements that each cleanup action alternative must meet in accordance with MTCA. If more than one cleanup action component is used, the overall cleanup action shall meet these requirements.

8.1.1 Model Toxics Control Act Threshold Requirements

Protect Human Health and the Environment. Protection of human health and the environment shall be achieved through implementation of the selected cleanup action.

Comply with Cleanup Standards. Cleanup standards, as defined by MTCA, consist of CULs for hazardous substances present at a site, the location, or point of compliance, where the CULs must be met, and any regulatory requirements that may apply to the site due to the type of action being implemented and/or the location of the site. It should be noted that, as described in Section 4.2.3.1, the soil point of compliance for direct contact is from the ground surface to 15 feet bgs–not met by Alternatives 1 and 3, which include containment of hazardous substances. However, in accordance with WAC 173-340-740(6)(f), these cleanup actions "comply with cleanup standards, provided:

(i) The selected remedy is permanent to the maximum extent practicable using the procedures in WAC 173-340-360;

(ii) The cleanup action is protective of human health.

(iii) The cleanup action is demonstrated to be protective of terrestrial ecological receptors under WAC 173-340-7490 through 173-340-7494;

(iv) Institutional controls are put in place under WAC 173-340-440 that prohibit or limit activities that could interfere with the long-term integrity of the containment system;

(v) Compliance monitoring under WAC 173-340-410 and periodic reviews under WAC 173-340-430 are designed to ensure the long-term integrity of the containment system; and

(vi) The types, levels and amount of hazardous substances remaining on-site and the measures that will be used to prevent migration and contact with those substances are specified in the draft cleanup action plan."

Alternatives 1 and 3 meet each of the requirements of the above as described in this document and, therefore, meet the cleanup standards defined for the Site.

Alternative 2 meets the soil point of compliance for direct contact and all other cleanup standards defined for the Site.

Comply with Applicable State and Federal Laws. WAC 173-340-710 states that cleanup standards shall comply with legally applicable ARARs. ARARs applicable to this Site are detailed in Section 6.2 and consist of chemical-specific ARARs applicable to the contamination types present at the Site, location-specific ARARs that apply to the physical location of the Site, and action-specific ARARs that apply to the construction components of the remedy.

Provide for Compliance Monitoring. MTCA requires that all selected cleanup alternatives provide for compliance monitoring as described in WAC 173-340-410. Compliance monitoring consists of protection monitoring, performance monitoring, and confirmation monitoring. Protection monitoring is performed during remedial implementation to monitor short-term risks and confirm protection of human health and the environment during construction activities. Performance monitoring will assess short-term remedy effectiveness and confirm compliance with the site CULs immediately during remedial implementation. Confirmation monitoring will evaluate long-term effectiveness of the cleanup action following attainment of the cleanup standards.

8.1.2 Other Model Toxics Control Act Requirements

Cleanup alternatives that meet the Threshold Requirements must also fulfill Other MTCA Requirements described in WAC 173-340-360(2)(b):

- **Use Permanent Solutions to the Maximum Extent Practicable.** The use of permanent solutions to the maximum extent practicable for a cleanup action is analyzed according to the DCA procedure described in WAC 173-340-360(3). Preference is given to alternatives that implement permanent solutions, defined in MTCA as actions that can meet cleanup standards “without further action being required at the site being cleaned up or any other site involved with the cleanup action, other than the approved disposal of any residue from the treatment of hazardous substances” (WAC 173-340-200).

  The DCA process is conducted to identify the alternative that uses permanent solutions to the maximum extent practicable.

- **Provide for a Reasonable Restoration Time Frame.** Restoration time frame is defined in MTCA as “the period of time needed to achieve the required CULs at the points of compliance established for the site.” Preference is given to alternatives that provide for a reasonable restoration time frame. For alternatives that rely on natural attenuation and degradation over time to meet cleanup standards, a restoration time frame of 10 years or less is typically accepted as “reasonable.”

- **Consideration of Public Concerns.** Public involvement must be initiated according to the requirements set forth in WAC 173-340-600. Public concerns are taken into account at each step in the formal process under MTCA.

8.1.3 Model Toxics Control Act Selection Criteria and Disproportionate Cost Analysis

The MTCA DCA is used to evaluate whether a cleanup action uses permanent solutions to the maximum extent practicable as determined by the level of attainment of evaluation criteria defined in WAC 173-340-360(3)(f). The environmental benefits of each alternative are scored using six evaluation criteria. Additionally, the cost of each alternative is estimated. For each alternative, a "Cost per Unit Benefit Ratio" is calculated by dividing the total cost for the alternative (in millions) by the total benefit score for that alternative. A lower "cost per unit benefit ratio" value indicates the most benefit for the associated cost. The alternative with the lowest "cost per unit benefit ratio" provides the highest level of environmental benefit and permanence per dollar spent.

As stated in MTCA, the cost of an individual alternative is determined disproportionate "if the incremental costs of the alternative over that of a lower cost alternative exceed the incremental degree of benefits achieved by the alternative over that of the other lower cost alternative" (WAC 173-340-360(3)(e)(i)).

Evaluation of disproportionate cost allows comparison of each alternative to the most permanent alternative presented, as determined by attainment of MTCA criteria. This analysis can be qualitative or quantitative. If multiple alternatives possess equivalent benefits, the lower-cost alternative will be selected. The seven DCA criteria defined in MTCA (WAC 173-340-360(f)) are as follows:

- **Protectiveness.** Overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, the time required to reduce these risks, and the overall improvement in environmental quality.
- **Permanence.** The degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances.
- **Effectiveness over the Long-Term.** Long-term effectiveness consists of the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at levels greater than CULs, and the effectiveness of controls in place to control risk while contaminants remain on-site.
- **Management of Short-Term Risks.** Short-term risks comprise the risk to human health and the environment associated with the alternative during construction and implementation and the effectiveness of measures taken to control those risks.
- **Technical and Administrative Implementability.** The ability of the alternative to be implemented is based on whether the alternative is technically possible, meets

administrative and regulatory requirements, and if all necessary services, supplies, and facilities are readily available.

- **Consideration of Public Concerns.** Consideration is taken on whether the community has concerns regarding the alternative and, if so, to what extent the alternative addresses those concerns.
- **Cost.** The cost to implement the alternative consists of construction, net present value of any long-term costs, and agency oversight costs that are recoverable.

As part of the DCA conducted for this report, each alternative was ranked and assigned a numerical score for each DCA criterion on a scale of 1 to 10, where a score of 10 represents the highest benefit and a score of 1 represents the lowest benefit. Each numerical score was then multiplied by a weighting value and the scores were summed to determine the total alternative benefit score. Floyd|Snider has implemented a similar approach on the Ecology-approved Lora Lake and Lora Lake Apartments RI/FS; this approach has also been successfully implemented at several other Ecology sites, including a Voluntary Cleanup Program (VCP) site in Puyallup, Terminal 30 in Seattle, and the Everett Shipyard in Everett. This approach is also consistent with the methodology and weighting values presented in Ecology's sediment cleanup manual (SCUM II).

Weighting values for the DCA criteria used in this report are consistent with the weighting values recently adopted at other remediation sites with the approval of Ecology. The weighting values used in this report are as follows:

- Overall protectiveness: 30%
- Permanence: 20%
- Effectiveness over the long-term: 20%
- Management of short-term risks: 10%
- Implementability: 10%
- Consideration of public concerns: 10%

8.2 EVALUATION AND DISPROPORTIONATE COST ANALYSIS

Table 8.1 presents the DCA criteria evaluation completed for the Site. A DCA is required under MTCA for cleanup actions that use remediation levels. The table evaluates the three proposed cleanup action alternatives for the Site for each of the evaluation criteria. A relative score is assigned to each of the evaluation criteria for each proposed cleanup action alternative. A summary of the cleanup action alternative evaluation is provided in Table 8.2.

Alternatives 1 and 3 are not as protective, permanent, or effective over the long-term as Alternative 2. Alternative 2 is 20 times the cost of Alternative 1, and 5 times the cost of Alternative 1, making it disproportionate in cost based on the total benefit scores and the cost per unit benefit ratios presented in Table 8.2. Alternative 1 received a slightly higher Total Benefit

Score than Alternative 3. Alternative 3 is 4 times the cost of Alternative 1. The cost per unit benefit ratio is more favorable for Alternative 1 than for any other alternative.

Alternative 1 would be less protective and permanent than Alternative 2 because no contaminant mass would be removed and instead the areas would be capped. Alternative 1 scored higher for both short-term risk management and implementability than Alternatives 2 and 3 because it would require less material handling and heavy equipment. Unlike Alternative 2, Alternatives 1 and 3 pose less risk to the general public because no contaminated soil will be taken off-site.

Because Alternative 2 is a full removal alternative, it received the highest total benefit score, as it is the most protective, permanent, and effective over the long-term. Alternative 2 received a low score for short-term risk management because of the volume of contaminated soil that would be handled and due to the number of trucks that would be required to haul the contaminated soil off-site, and the resultant risk associated with excavation and transportation. Although Alternative 2 has a high benefit score, the high cost associated with the alternative resulted in a high cost per unit benefit ratio. As a result, Alternative 2 provides the least benefit for the associated cost and is disproportionately costly to the benefit received. For these reasons, Alternative 2 should not be selected as the Proposed Cleanup Action Alternative. Refer to Tables 8.1 and 8.2 for additional details.

Alternative 1 and Alternative 3 have very similar benefit scores. Alternative 1 provides protectiveness, permanence, and long-term effectiveness based on the assumption that the surface capping materials are maintained in perpetuity in accordance with institutional controls. The capping provided by Alternative 1 isolates the contamination from direct contact by human and animal receptors. Under existing conditions, groundwater is currently in compliance with cleanup standards, and the contamination is not mobilized by leaching—the cleanup action does not need to be designed to prevent infiltration. The capping provided by Alternative 1 is a proven technology, compatible with industrial development, and easily monitored and repaired. Alternative 1 receives high scores for implementability and short-term risk management, as it is implemented using standard construction equipment with the least amount of disturbance of the contaminated media.

Alternative 3 provides protectiveness, permanence, and long-term effectiveness based on the assumption that the solidified mass of contaminated soil/cement mixture remains undisturbed and maintained in perpetuity in accordance with institutional controls. The solidification provided by Alternative 3 isolates the contamination from direct contact by human and animal receptors, with additional permanence when compared to Alternative 1. The solidification does not provide additional protection to groundwater, as groundwater is currently in compliance with cleanup standards, and the contamination is not mobilized by leaching. Solidification of dioxin-contaminated soil with the methods described in Alternative 3 is a relatively unproven technology for dioxins/furans, requiring specialty equipment and significant handling of the contaminated material. Risks associated with the alternative include the long-term potential for the exposed surface to degrade, with associated mobilization of contaminants. Additionally, when the stabilized mass must be disturbed by future industrial development activities (such as utility trenching), the excavated material is difficult to manage and would likely require off-site disposal. For these reasons, Alternative 3 receives lower scores for implementability and short-term risk management than Alternative 1. Alternative 3 is 4 times more costly than Alternative 1. It is also less preferable than Alternative 1 when considered on a cost per unit benefit ratio basis. For these reasons, Alternative 3 should not be selected as the Proposed Cleanup Action Alternative. Refer to Tables 8.1 and 8.2 for additional details.

8.3 CONCLUSIONS

Based on the evaluation presented in Section 8.2 and in Tables 8.1 and 8.2, Alternative 1 is selected as the Proposed Cleanup Action Alternative for recommendation to Ecology. Section 9.0 describes the Proposed Cleanup Action Alternative in greater detail.

9.0 Proposed Cleanup Action Alternative

9.1 DESCRIPTION OF THE PROPOSED CLEANUP ACTION ALTERNATIVE

The Proposed Cleanup Action Alternative (Figure 9.1) recommended for the remediation of soil at the Site is Alternative 1. Alternative 1 provides the greatest degree of benefit for the associated cost when comparing the alternative with Alternative 2, as discussed in Section 8.0. The components of this Proposed Cleanup Action Alternative are presented below. The Proposed Cleanup Action Alternative for soil is a comprehensive remedy for the Site that is in compliance with all the applicable remedy selection requirements under MTCA.

The Proposed Cleanup Action Alternative would remediate soil at the Site using the following technologies:

- Preparation and implementation of an Ecology-approved Area A Pre-Excavation Extent Investigation SAP/QAPP. The results of the samples collected during this investigation would be presented to Ecology in an Area A CAWP, which would identify the horizontal and vertical extents of the Area A excavations.
- Excavation of the contaminated soil in the six hot-spot locations in Area A and consolidation of that soil in the portion of Area B to be capped. The excavated areas in Area A would then be backfilled with clean soil and compacted.
- Regrading of a 317,000-square-foot portion of Area B to a relatively flat area that is suitable for both temporary use of the area (parking for cars/trucks) and future development. Once regraded, the area would be capped with a surface that would prevent direct contact for humans and also prevent terrestrial ecological exposure. The cap design would not need to be impervious and could allow for infiltration of stormwater. Due to the potential of future development, the construction of the final cap has several possibilities. The cap proposed in this SFRI/SFFS is a geotextile or GeoGrid indicator layer placed below a minimum 12-inch-thick cap of compacted crushed rock surfacing. This cap design would allow for infiltration of stormwater and would prevent any stormwater that does not infiltrate from contacting any contaminated soil.

  Future development of the Site may include placement of asphalt or concrete pavements, buildings, and stormwater controls in the capped area of Area B. Both asphalt or concrete pavements and building slab surfaces would prevent direct contact for humans and also prevent terrestrial ecological exposure. If these alternative surfaces are proposed to be installed in lieu of the crushed rock cap described above, plans would be presented to Ecology for their approval.
- Institutional controls would be implemented in the form of the designation of a new CAMU for the permanent management of dioxin/furan-contaminated soil, a deed restriction in the form of a restrictive covenant that would require maintenance and monitoring of the cap surface through compliance with a Cap Inspection and

Maintenance Plan. The Cap Inspection and Maintenance Plan would specify soil management procedures for future excavation work within the capped areas and identify health and safety requirements for subsurface work, as discussed further in Section 9.2.

- Compliance monitoring would include protection monitoring, performance monitoring, and confirmation monitoring as described in Section 9.1.1.

Together, consolidation, capping, and institutional controls manage the exposure pathways to dioxin/furan contamination at the Site. The Proposed Cleanup Action Alternative supports current operations and is compatible with anticipated future development at the Site.

9.1.1 Compliance Monitoring Requirements

Compliance monitoring requirements associated with remedy implementation consist of protection monitoring during construction activities, performance monitoring to ensure remedy construction in accordance with the project plans and design, and confirmation monitoring following remedy completion to confirm the long-term effectiveness of the remedy.

9.1.1.1 Protection Monitoring

Protection monitoring would be conducted during both remedy construction and operation and maintenance activities to confirm the protection of human health and the environment. Protection monitoring requirements would be described in Health and Safety Plans addressing worker activities during remedy construction, and in the Cap Inspection and Maintenance Plan regarding future operations and maintenance associated with constructed remedy. Any activities conducted at the Site following remedy implementation that have the potential to disturb capped areas would require adherence to the Cap Inspection and Maintenance Plan.

9.1.1.2 Performance Monitoring

Performance monitoring activities would be conducted during remedy construction. Performance monitoring would consist of the following:

- Implementation of an Ecology-approved Area A Pre-Excavation Extent Investigation SAP/QAPP. The results of the samples collected during this investigation would be presented to Ecology in an Area A CAWP, which would identify the horizontal and vertical extents of the Area A excavations.
- Quality control monitoring for construction activities.
- Monitoring during cap placement to confirm the constructed caps meet design requirements.

9.1.1.3 Confirmation Monitoring

Confirmation monitoring activities would be conducted following completion of the remedy. Confirmation monitoring would consist of the following:

- Following remedy completion, semi-annual groundwater monitoring would be conducted for 3 years to verify that 2,3,7,8-TCDD groundwater concentrations continue to be in compliance with cleanup standards. Compliance monitoring of groundwater would be conducted in the shallow aquifer perimeter wells directly downgradient of the capped area. The CMCP would be included as an attachment to the CAP Amendment.
- Long-term maintenance would be conducted to ensure stability and effectiveness of the constructed cap. Maintenance would include regular observation for any problems or damage to the cap. Long-term maintenance in capped areas will be conducted for as long as contamination at concentrations greater than the CUL is present at the Site. This is detailed in the Cap Inspection and Maintenance Plan, which is an appendix to the CAP Amendment.

9.2 OWNERSHIP, ACCESS, AND INSTITUTIONAL CONTROLS

Site ownership is described in detail in Section 3.0. Reichhold formerly owned the subject property and used it for chemical manufacturing. The Site is currently owned by SSA, an entity owned by SSA Marine, Inc.

Implementation of institutional controls and implementation of the Cap Inspection and Maintenance Plan to manage contaminated soil remaining beneath capped areas would be conducted by the property owner.

The Proposed Cleanup Action Alternative includes institutional controls to manage contamination left on-site. Institutional controls at the Site would include the following:

- Designation of a new CAMU for the permanent management of dioxin/furan-contaminated soil. A CAMU application will be included in the CAP Amendment and will be prepared in accordance with the CAMU regulations as identified in WAC 173-303-64650 and WAC 173-303-64660. If approved, the CAMU will remain in perpetuity and will be subject to the 5-year reviews.
- A deed restriction in the form of a restrictive covenant limiting the Site to industrial or other use that is consistent with Site CULs, prohibiting groundwater withdrawal for beneficial uses, and including a map showing the nature and extent of residual contamination at concentrations greater than CULs. This is consistent with the existing deed restriction already in place on the Site. The restrictive covenant will meet the requirements of WAC 173-340-440(8), (9), and (10), Chapter 64.70 RCW (Uniform Environmental Covenants Act), and the Toxics Cleanup Program’s Procedure 440A (Establishing Environmental Covenants under MTCA).

- Implementation of an Ecology-approved Cap Inspection and Maintenance Plan specifying soil management procedures for future excavation and health and safety requirements for subsurface work. These procedures would be applicable to any future site redevelopment or maintenance that involves removal or disturbance of subsurface material within the capped areas. The Cap Inspection and Maintenance Plan would include specific requirements to protect the direct contact and erosion pathways if subsurface soil is excavated and relocated or exposed. The Cap Inspection and Maintenance Plan would be prepared for Ecology approval and would include specifications for the following:
    - Health and safety requirements for working in and during handling of site soils.
    - Best Management Practices for soil stockpiling, dust control and erosion control. Requirements for off-site disposal and associated recordkeeping.
    - Requirements for Ecology notification and reporting.

9.3 COMPLIANCE WITH THE MODEL TOXICS CONTROL ACT AND SITE CLEANUP ACTION OBJECTIVES

The Proposed Cleanup Action Alternative meets the minimum requirements for selection of a cleanup action under MTCA WAC 173-340-360(2)(a) because it is protective of human health and the environment, complies with cleanup standards, complies with applicable state and federal laws, and provides for compliance monitoring. These requirements are met in the following ways:

- **Protect Human Health and the Environment.** The Proposed Cleanup Action Alternative would be protective of human health and the environment through excavation, capping, and institutional controls. The direct contact and surface soil to surface water pathways would be addressed through capping and through institutional controls requiring maintenance in perpetuity. The Cap Inspection and Maintenance Plan would include requirements to protect these pathways if subsurface soil is excavated and relocated to another area. Risks would be immediately reduced as a result of capping. Groundwater monitoring would be conducted to ensure that dioxin/furan concentrations continue to be protective of human health and the environment.
- **Comply with Cleanup Standards.** The Proposed Cleanup Action Alternative complies with all MTCA cleanup standards through containment and isolation of dioxins/furans that remain on-site at levels greater than the CUL.
- **Comply with Applicable State and Federal Laws.** The Proposed Cleanup Action Alternative complies with all applicable state and federal laws outlined in Section 6.2 and in Table 6.1 through excavation, capping, and institutional controls. Chemical-specific ARARs are met through compliance with applicable CUL criteria. Location-specific ARARs are met through compliance with all applicable state, federal, and local regulations in place for the physical location of the Site. Applicable action-specific ARARs would be met through implementation of construction activities in compliance

with all applicable construction-related requirements such as health and safety restrictions, site use, and other local permits.

- **Provide for Compliance Monitoring.** The Proposed Cleanup Action Alternative meets the requirements for compliance monitoring by conducting protection monitoring during implementation, performance monitoring following completion of capping, and confirmation monitoring for groundwater compliance following remedy implementation.

The evaluation of the alternatives was presented in Section 8.0, and the Proposed Cleanup Action Alternative was determined to be the remedy that gave the lowest cost per unit benefit ratio while also meeting MTCA requirements in the DCA. A detailed discussion of the DCA is presented in Section 8.0 and in Tables 8.1 and 8.2. Section 8.0 also describes how the Proposed Cleanup Action Alternative meets the Other MTCA Requirements for selection of a cleanup action, including using permanent solutions to the maximum extent practicable, providing for a reasonable restoration time frame, and considering public concerns. The Proposed Cleanup Action Alternative is not the most aggressive cleanup action; however, Alternative 2 (full removal) is considered disproportionate because of its much higher cost compared to its benefit score.

The Proposed Cleanup Action Alternative would comply with all cleanup action objectives by: (1) protecting human receptors from exposure to dioxin/furan contamination that exceeds the CUL by capping and removing the direct contact exposure pathway, and (2) ensuring that migration of dioxins/furans does not occur.

9.4 SUMMARY OF THE ESTIMATED REMEDY COSTS

Estimated costs for the recommended Proposed Cleanup Action Alternative are presented in Appendix G. The costs associated with remedy implementation consist of capital construction costs, long-term monitoring costs following remedy completion, and agency oversight that would include periodic reviews of the constructed remedy.

The estimated costs for remedy construction of the Proposed Cleanup Action Alternative are as follows:

- Agency oversight, engineering design, planning, pre-excavation sampling, and permitting costs associated with remedy implementation are estimated to be approximately $330K.
- Construction capital costs that include excavation, regrading, and capping, are estimated to be approximately $1. 25M.
- Long-term monitoring costs are estimated to be approximately $70K.
- The total project cost for the Proposed Cleanup Action Alternative, which includes a $4,80K contingency cost, is estimated to be $2.1M.

9.5 IMPLEMENTATION SCHEDULE

In order to conduct the cleanup action, the following implementation steps would be conducted. Estimated completion dates are provided for discussion and planning purposes:

Implementation Step	**Estimated Completion Date**
Submit Draft Area A Pre-Excavation Extent Investigation SAP/QAPP to Ecology for Approval	December 2015
Receive Ecology Approval of Draft Area A Pre-Excavation Extent Investigation SAP/QAPP	January 2016
Conduct Area A Pre-Excavation Extent Investigation	February 2016
Prepare Construction Documents and Contractor Bid Period, Selection, and Contracting	March to April 2016
Execute Second Amendment to the Consent Decree and CAP Amendment	April 2016
Submit Draft Area A CAWP to Ecology for Approval	May 2016
Construct Remedy (Start with Area B)	May to July 2016
Receive Ecology Approval of Draft Area A CAWP	June 2016
Complete Construction	July 2016
Prepare Cleanup Action Completion Report and Initiate Compliance Groundwater Monitoring	August 2016
Receive Ecology Approval of Cleanup Action Completion Report	September 2016
Complete Compliance Groundwater Monitoring	January 2019

10.0 References

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Reichold/SSA
Containers Facility

Supplemental Focused Remedial Investigation/ Supplemental Focused Feasibility Study

Tables

Table 3.1
Summary of 2014 ERM Dioxin/Furan Analytical Soil Results

Location		SB-3/EMW-1		SB-8		SB-9/EMW-4		SB-10		SB-11/EMW-5		SB-12		SB-13	
Sample ID		SB-3-0-2	SB-3-2-6	SB-8-0-2	SB-8-2-6	SB-9-0.3-2	SB-9-2-6	SB-10-0.2-2	SB-10-2-6	SB-11-0.3-2	SB-11-2-6	SB-12-0-2	SB-12-2-3	SB-13-0-2	SB-13-2-6
Sample Date		03/10/2014	03/10/2014	03/13/2014	03/13/2014	03/13/2014	03/13/2014	03/13/2014	03/13/2014	03/12/2014	03/12/2014	03/12/2014	03/12/2014	03/12/2014	03/12/2014
Sample Depth (bgs)		0–2 ft	2–6 ft	0–2 ft	2–6 ft	0.3–2 ft	2–6 ft	0.2–2 ft	2–6 ft	0.3–2 ft	2–6 ft	0–2 ft	2–3 ft	0–2 ft	2–6 ft
Laboratory		ARI	ARI	ARI	ARI	ARI	ARI	ARI	ARI	ARI	ARI	ARI	ARI	ARI	ARI
Analyte	**Units**														
2,3,7,8-TCDD	pg/g	0.62 U	7.11 U	1.82	0.11 U	18.8 U	1.29	1.67	0.127 U	42.2 U	0.881 U	90.5	170	19.8 U	0.696 U
1,2,3,7,8-PeCDD	pg/g	115	67.9	20.3	0.445 U	111	9.94	17.5	0.227 U	790	16.6	1,230	2,560	163	4.04
1,2,3,4,7,8-HxCDD	pg/g	214	103	31.7	0.734 J	157	19.4	27.6	0.333 J	1,130	29.5	1,680	3,570	262	6.07
1,2,3,6,7,8-HxCDD	pg/g	1,910	654	117	2.51	684	51.4	110	1.17	6,270	153	8,490	24,800	1,020	22
1,2,3,7,8,9-HxCDD	pg/g	406	252	67.9	1.48	359	30.4	55	0.738 U	2,900	74.9	3,950	8,480	531	12.3
1,2,3,4,6,7,8-HpCDD	pg/g	48,800	14,400	1,660	36.7	11,300	961	2,240	14.4	71,300	1,950	116,000	270,000	27,100	504
OCDD	pg/g	823,000 J	296,000 J	15,600 J	372	435,000 J	25,700 J	25,000 J	113	396,000	13,100 J	905,000	1,460,000	313,000 J	6,080 J
2,3,7,8-TCDF	pg/g	51.1	48.7	2.06	0.117 U	11 U	1.08	1.43 U	0.196 UJ	60.6 J	1.3 U	88.5	341	9.7 J	0.899 J
1,2,3,7,8-PeCDF	pg/g	172	45	5.13 J	0.153 U	26.6 J	2.22	6.11	0.0626 U	174	3.81	210	713	30.9 J	1.06
2,3,4,7,8-PeCDF	pg/g	210	55.2	5.62	0.129 J	28.2 J	3.06	7.88	0.0568 U	138	3.26	236	721	34.6 U	1.44
1,2,3,4,7,8-HxCDF	pg/g	1,180	265	20.8	0.516 J	111	13.6	57.5	0.121 U	422	14.1	753	1,880	286	7.78
1,2,3,6,7,8-HxCDF	pg/g	306	99.9	14.8	0.342 J	67.8 J	7.07	25.4	0.105 J	433	15.1	694	1,540	116	3.19
2,3,4,6,7,8-HxCDF	pg/g	448	158	20.3	0.473 U	105	9.75	38.1	0.0568 U	669	18.1	973	2,540	199	5.1
1,2,3,7,8,9-HxCDF	pg/g	494	101	9.03	0.214 J	50 U	5.1	12.5	0.0607 U	215	5.94	286	904	76.7	2.15
1,2,3,4,6,7,8-HpCDF	pg/g	6,970	1,830	196	4.58	1,150	133	732	1.56	4,210	144	7,760	20,100	6,870	146
1,2,3,4,7,8,9-HpCDF	pg/g	562	131	14.7	0.349 J	87.2 J	10.8	65.1	0.092 U	235	10.8	487	989	534	10.9
OCDF	pg/g	13,300	2,270	296	8.45	2,750	305	2,770	3.34	4,190	231	9,640	12,300	42,900	653
Dioxins/Furans (MTCA TEQ-HalfND)[1,2]	pg/g	1,500 J	511 J	75.8 J	1.46 J	538 J	44.8 J	93.1 J	0.601 J	2,950 J	74.3 J	4,610	10,700	881 J	19.4 J

Notes:

▨ Exceeds MTCA Method C Industrial Criterion of 1,680 pg/g.

1 Calculated using detected dioxin/furan concentrations plus one-half the method detection limit for dioxins/furans that were not detected.

2 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxins/furans TEQ (Van den Berg et al. 2006).

Abbreviations:

ARI	Analytical Resources, Inc.	OCDD	Octachlorodibenzo-p-dioxin
bgs	Below ground surface	OCDF	Octachlorodibenzofuran
ft	Feet	PeCDD	Pentachlorodibenzo-p-dioxin
HpCDD	Heptachlorodibenzo-p-dioxin	PeCDF	Pentachlorodibenzofuran
HpCDF	Heptachlorodibenzofuran	pg/g	Picograms per gram
HxCDD	Hexachlorodibenzo-p-dioxin	TEQ	Toxic equivalent
HxCDF	Hexachlorodibenzofuran	TCDD	Tetrachlorodibenzo-p-dioxin
MTCA	Model Toxics Control Act	TCDF	Tetrachlorodibenzofuran
ND	Non-detect		

Qualifiers:

J	The analyte was detected, the given concentration is considered an estimate.
JB	The analyte was detected, the given concentration is considered an estimate due to potential blank contamination.
JQ	The analyte was detected between the method detection limit and reporting limit, and is considered an estimate.
U	The analyte was not detected at the given reporting limit.
UJ	The analyte was not detected, the given reporting limit is considered an estimate.

Table 3.1
Summary of 2014 ERM Dioxin/Furan Analytical Soil Results

Location		SB-14/EMW-6		SB-15/EMW-7		SB-16		SB-17		SB-18/EMW-8			SB-19	
Sample ID		SB-14-1-2	SB-14-2-6	SB-15-1.3-2	SB-15-2-4.5	SB-16-0.3-2	SB-16-2-6	SB-17-0.4-2	SB-17-2-4	SB-18-0.4-2	SB-18-2-6	SB-18-6-9	SB-19-0-2	SB-19-2-4
Sample Date		03/13/2014	03/13/2014	03/11/2014	03/11/2014	03/13/2014	03/13/2014	03/14/2014	03/14/2014	03/12/2014	03/12/2014	03/12/2014	03/13/2014	03/13/2014
Sample Depth (ft bgs)		1–2 ft	2–6 ft	1.3–2 ft	2–4.5 ft	0.3–2 ft	2–6 ft	0.4–2 ft	2–4 ft	0.4–2 ft	2–6 ft	6–9 ft	0–2 ft	2–4 ft
Laboratory		ARI	ARI	ARI	ARI	Test America	Test America	ARI	ARI	Test America	Test America	Test America	ARI	ARI
Analyte	**Units**													
2,3,7,8-TCDD	pg/g	0.227 U	0.0694 U	16.3	6.76	8 U	0.66 U	0.412 U	0.274 U	21 U	29 U	29 U	29.5 U	1.28
1,2,3,7,8-PeCDD	pg/g	2.07	0.254 U	49.8	22.1	220 JQ	1.5 U	36.5 J	1.74	36 U	38 U	47 U	226	6.79
1,2,3,4,7,8-HxCDD	pg/g	3.93	0.359 U	24.3	12.3	390 JQ	2.4 JQ	80.4 J	3.54	24 U	28 U	30 U	443	20.9
1,2,3,6,7,8-HxCDD	pg/g	12.1	0.786 J	73.1	36.3	1,400	7.4	2370	80.5	22 U	110 JQ	94 JQ	2,630	58.7
1,2,3,7,8,9-HxCDD	pg/g	7.08	0.578 U	72.9	35.7	690 JQ	4.2 JQ	242	10.6	20 U	24 U	25 U	841	28.7
1,2,3,4,6,7,8-HpCDD	pg/g	203	16.3	1540	833	39,000 J	180 JB	86,200	2150	340 JQ	1,900 JQ	2,300 JQ	140,000	3,030
OCDD	pg/g	1,730	179	17,600 J	10,600 J	580,000 JB	3,900 JB	1,400,000 J	33,400 J	5,000 JB	40,000 JB	36,000 JB	1,640,000 J	46,300 J
2,3,7,8-TCDF	pg/g	0.535 U	0.0912 U	0.704 J	0.348 U	280 JQ	1.4	60.8 J	2.41	14 U	15 U	19 U	10.3 U	0.472 U
1,2,3,7,8-PeCDF	pg/g	1.27 J	0.111 U	1.85	0.968 J	150 JQ	1.7 U	257	8.29	21 U	25 U	25 U	50.3 U	1.2
2,3,4,7,8-PeCDF	pg/g	4.27	0.145 J	2.96	1.51	150 JQ	1.8 U	288	9.93	21 U	25 U	25 U	54.7 U	0.993 U
1,2,3,4,7,8-HxCDF	pg/g	20	0.825 U	20.5	10.8	730 JQ	3.8 JQ	2,220	64.4	16 U	77 JQ	18 U	1,240	23
1,2,3,6,7,8-HxCDF	pg/g	4.53	0.307 U	8.78	4.69	240 JQ	1.5 JQ	493	16.2	14 U	14 U	16 U	366	11.3
2,3,4,6,7,8-HxCDF	pg/g	5.81	0.679 J	15.2	8.95	140 JQ	0.94 U	662	22.3	15 U	15 U	16 U	875	25.6
1,2,3,7,8,9-HxCDF	pg/g	3.54	0.24 J	7.37	4.5	22 JQ	1.2 U	811	25.8	15 U	15 U	16 U	251	6.05
1,2,3,4,6,7,8-HpCDF	pg/g	52.9	3.51	413	215	3,600	27 JB	13,100	362	28 U	280 JQ	330 JQ	52,500	1,280
1,2,3,4,7,8,9-HpCDF	pg/g	6.7	0.585 U	26.9	14.7	200 JQ	2.3 U	964	28.6	32 U	38 U	36 U	3,990	83
OCDF	pg/g	96.4	8.43	1,740	949	4,900	63 JB	18,700	412	260 JQ	630 JQ	750 JQ	430,000 J	7,430
Dioxins/Furans (MTCA TEQ-HalfND)[1,2]	pg/g	12.4 J	0.743 J	115 J	54.8 J	1,270 J	6.82 J	2,250 J	63.2 J	44.2 J	96.1 J	96 J	3,500 J	85.8 J

Notes:

▨ Exceeds MTCA Method C Industrial Criterion of 1,680 pg/g.

1 Calculated using detected dioxin/furan concentrations plus one-half the method detection limit for dioxins/furans that were not detected.

2 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxins/furans TEQ (Van den Berg et al. 2006).

Abbreviations:

ARI	Analytical Resources, Inc.	OCDD	Octachlorodibenzo-p-dioxin
bgs	Below ground surface	OCDF	Octachlorodibenzofuran
ft	Feet	PeCDD	Pentachlorodibenzo-p-dioxin
HpCDD	Heptachlorodibenzo-p-dioxin	PeCDF	Pentachlorodibenzofuran
HpCDF	Heptachlorodibenzofuran	pg/g	Picograms per gram
HxCDD	Hexachlorodibenzo-p-dioxin	TEQ	Toxic equivalent
HxCDF	Hexachlorodibenzofuran	TCDD	Tetrachlorodibenzo-p-dioxin
MTCA	Model Toxics Control Act	TCDF	Tetrachlorodibenzofuran
ND	Non-detect		

Qualifiers:

J	The analyte was detected, the given concentration is considered an estimate.
JB	The analyte was detected, the given concentration is considered an estimate due to potential blank contamination.
JQ	The analyte was detected between the method detection limit and reporting limit, and is considered an estimate.
U	The analyte was not detected at the given reporting limit.
UJ	The analyte was not detected, the given reporting limit is considered an estimate.

Table 3.1
Summary of 2014 ERM Dioxin/Furan Analytical Soil Results

Location		SB-20/EMW-9					SB-20/EMW-9		SB-21/EMW-10				SS-1
Sample ID		SB-20-0.7-2		SB-20-1.5	SB-20-2-6		SB-20-3.5	SB-20-6-8	SB-21-0.3-2		SB-21-2-6		SS-1-0-0.5
Sample Date		03/11/2014		03/11/2014	03/11/2014		03/11/2014	03/11/2014	03/12/2014		03/12/2014		03/14/2014
Sample Depth (ft bgs)		0.7–2 ft		1.5–1.5 ft	2–6 ft		3.5–3.5 ft	6–8 ft	0.3–2 ft		2–6 ft		0–0.5 ft
Laboratory		ARI	Test America	ARI	ARI	Test America	ARI	Test America	ARI	Test America	ARI	Test America	Test America
Analyte	Units												
2,3,7,8-TCDD	pg/g	22.2 U	480 U	1.95 U	3.33 U	800 U	210 U	26 U	36.1 J	63 JQ	3.76 U	3900 U	3,300 JQ
1,2,3,7,8-PeCDD	pg/g	89.3 J	710 U	14.8	829 J	1,200 U	2,060 J	35 U	370	350 J	926 J	5,100 U	6,200
1,2,3,4,7,8-HxCDD	pg/g	125	500 U	23	1,350 J	1,000 U	3,060	34 U	591	590 J	2,830 J	4,000 U	18,000
1,2,3,6,7,8-HxCDD	pg/g	810	5,400 JQ	65.9	8,380	14,000 J	18,900	510 JQ	2,910	3,100 J	52,900	88,000 J	120,000 JQ
1,2,3,7,8,9-HxCDD	pg/g	272	2,800 J	46.1	2,290 J	6,300 J	6,970	210 JQ	1,220	1,600 J	4,780	12,000 J	57,000 JQ
1,2,3,4,6,7,8-HpCDD	pg/g	32,300	190,000 J	1510	301,000	470,000 J	715,000	28,000	53,500	69,000	3,620,000 J	5,500,000	5,100,000 JB
OCDD	pg/g	958,000 J	4,500,000	24,400 J	10,900,000	13,000,000	24,600,000 J	460,000	793,000 J	810,000 JB	65,700,000 J	91,000,000 JB	88,000,000 JB
2,3,7,8-TCDF	pg/g	64 U	6200 J	1.5	995 J	8700 J	2,710 J	150 JQ	48.6 J	120 JQ	272 U	2100 U	4,900 JQ
1,2,3,7,8-PeCDF	pg/g	70.5 J	440 U	2.74	724 J	790 U	1,690 J	26 U	144 J	150 J	2,470 J	3,200 U	10,000
2,3,4,7,8-PeCDF	pg/g	96.6 J	440 U	2.91	1,300 J	790 U	2,750 J	26 U	182	210 J	2,390 J	3,200 U	11,000
1,2,3,4,7,8-HxCDF	pg/g	527	5,100 J	19.4	5,150	9,000 JQ	11,800	430 JQ	897	1,000 J	61,100	110,000 J	87,000 JQ
1,2,3,6,7,8-HxCDF	pg/g	137	860 JQ	8.64	1,480 J	1,500 JQ	3,110 J	67 JQ	342	350 J	9,640 J	13,000 JQ	17,000 JQ
2,3,4,6,7,8-HxCDF	pg/g	204	330 U	13.8	2,150 J	700 U	5,020	83 JQ	532	30 J	17,400	3,400 U	14,000
1,2,3,7,8,9-HxCDF	pg/g	206	330 U	6.51	1,980 J	700 U	4,340	20 U	330	210 J	15,600	3,300 U	4,400
1,2,3,4,6,7,8-HpCDF	pg/g	4750	27,000 J	249	43,900	60,000 J	103,000	2,400 JQ	7,440	9,000 J	1,410,000 J	1,800,000 J	600,000 J
1,2,3,4,7,8,9-HpCDF	pg/g	365	750 U	17.2	3,430	5,100 J	7,630	47 U	543	700 J	126,000 J	180,000 J	56,000 JQ
OCDF	pg/g	10,700	77,000 J	911	106,000	160,000 J	221,000	4,800 JQ	22,000	33,000	8,310,000 J	12,000,000	1,600,000 J
Dioxins/Furans (MTCA TEQ-HalfND)[1,2]	pg/g	1,030 J	▨ 6,310 J	60.6 J	▨ 10,400 J	▨ 14,500 J	▨ 24,300 J	626 J	▨ 2,010 J	▨ 2,200 J	▨ 91,900 J	▨ 134,000 J	▨ 130,000 J

Notes:

▨ Exceeds MTCA Method C Industrial Criterion of 1,680 pg/g.

1 Calculated using detected dioxin/furan concentrations plus one-half the method detection limit for dioxins/furans that were not detected.

2 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxins/furans TEQ (Van den Berg et al. 2006).

Abbreviations:

ARI	Analytical Resources, Inc.	OCDD	Octachlorodibenzo-p-dioxin
bgs	Below ground surface	OCDF	Octachlorodibenzofuran
ft	Feet	PeCDD	Pentachlorodibenzo-p-dioxin
HpCDD	Heptachlorodibenzo-p-dioxin	PeCDF	Pentachlorodibenzofuran
HpCDF	Heptachlorodibenzofuran	pg/g	Picograms per gram
HxCDD	Hexachlorodibenzo-p-dioxin	TEQ	Toxic equivalent
HxCDF	Hexachlorodibenzofuran	TCDD	Tetrachlorodibenzo-p-dioxin
MTCA	Model Toxics Control Act	TCDF	Tetrachlorodibenzofuran
ND	Non-detect		

Qualifiers:

J	The analyte was detected, the given concentration is considered an estimate.
JB	The analyte was detected, the given concentration is considered an estimate due to potential blank contamination.
JQ	The analyte was detected between the method detection limit and reporting limit, and is considered an estimate.
U	The analyte was not detected at the given reporting limit.
UJ	The analyte was not detected, the given reporting limit is considered an estimate.

Table 3.2
Summary of 2014 Dioxin/Furan Analytical Groundwater Results

	Well ID	EMW-7	EMW-9	EMW-10		MW-103(S)	MW-104(S)	MW-105(S)	MW-106(S)	MW-107(S)	MW-109(S)
	Sample ID	EMW-7-031814-NP	EMW-9-031814-NP	EMW-10-031914-NP	Dup031914-NP-02	SSA-GW-103S-09/14	SSA-GW-104S-09/14	SSA-GW-105S-09/14	SSA-GW-106S-09/14	SSA-GW-107S-09/14	SSA-GW-109S-09/14
	Sample Date	3/18/2014	3/18/2014	3/19/2014	3/19/2014	9/4/2014	9/4/2014	9/4/2014	9/4/2014	9/5/2014	9/5/2014
	Company	ERM	ERM	ERM	ERM	EPI	EPI	EPI	EPI	EPI	EPI
Analyte	Units										
2,3,7,8-TCDD	pg/L	210 U	93 U	270 U	170 U	2.18 U	1.64 U	1.54 U	0.36 U	1.2 U	1.36 U
1,2,3,7,8-PeCDD	pg/L	310 U	120 U	410 U	270 U	1.38 J	1.06 U	0.5 U	0.62 U	0.7 U	0.92 U
1,2,3,4,7,8-HxCDD	pg/L	170 U	130 U	360 U	200 U	0.78 U	0.72 U	0.6 U	0.62 U	0.7 U	1.54 U
1,2,3,6,7,8-HxCDD	pg/L	150 U	110 U	330 U	670 U	0.98 U	3.52 U	0.64 U	1.56 U	1.28 U	9.3 J
1,2,3,7,8,9-HxCDD	pg/L	140 U	110 U	300 U	530 JQ	1.52 U	0.98 U	0.64 U	0.66 U	0.96 U	4.78 U
1,2,3,4,6,7,8-HpCDD	pg/L	240 U	190 U	42,000 JQ	3,600 JQ	12.8	80.7	3.06 U	36.1	25	341 U
OCDD	pg/L	270 U	200 U	800,000	36,000 JQ	60.7 U	987	20.5 U	433	513	7,950 U
2,3,7,8-TCDF	pg/L	140 U	52 U	180 U	98 U	1.18 U	0.64 U	0.46 U	0.62 U	0.46 U	1.36 J
1,2,3,7,8-PeCDF	pg/L	190 U	79 U	300 U	170 U	1.68 U	1.56 U	0.68 U	1.32 U	1.24 U	1.98 J
2,3,4,7,8-PeCDF	pg/L	190 U	79 U	300 U	170 U	1.18 U	1.08 U	0.7 U	1 U	0.76 U	1.54 J
1,2,3,4,7,8-HxCDF	pg/L	93 U	54 U	720 JQ	880 U	1.5 U	2.24 U	0.64 U	1.51 J	1 J	5.28 U
1,2,3,6,7,8-HxCDF	pg/L	83 U	48 U	230 U	120 U	1.64 U	1.98 U	0.78 U	1.73 U	1.48 U	1.14 U
2,3,4,6,7,8-HxCDF	pg/L	86 U	50 U	240 U	280 U	1.66 J	0.76 U	0.52 U	0.98 U	1.32 U	4.79 J
1,2,3,7,8,9-HxCDF	pg/L	87 U	51 U	240 U	380 U	2.06 U	2.32 U	0.74 U	1.17 J	1.14 U	3.36 U
1,2,3,4,6,7,8-HpCDF	pg/L	170 U	130 U	15,000 JQ	1,900 JQ	2.42 J	18.7	1.14 J	8.14 J	4.44 U	46.7 U
1,2,3,4,7,8,9-HpCDF	pg/L	190 U	140 U	530 U	260 U	0.94 U	1.88 U	0.6 U	0.82 U	0.66 U	2 U
OCDF	pg/L	190 U	140 U	100,000 JQ	7,800 JQ	3.8 J	49.1	1.7 U	17.8 U	6.93 J	86.5 U

Abbreviations:

ft	Feet
HpCDD	Heptachlorodibenzo-p-dioxi
HpCDF	Heptachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin
HxCDF	Hexachlorodibenzofuran
MTCA	Model Toxics Control Act
ND	Non-detect
OCDD	Octachlorodibenzo-p-dioxin
OCDF	Octachlorodibenzofuran
PeCDD	Pentachlorodibenzo-p-dioxin
PeCDF	Pentachlorodibenzofuran
pg/L	Picograms per gram
TCDD	Tetrachlorodibenzo-p-dioxin
TCDF	Tetrachlorodibenzofuran

Qualifiers:

J	The analyte was detected, the given concentration is considered an estimate.
U	The analyte was not detected at the given reporting limit.
JQ	The analyte was detected between the method detection limit and reporting limit, and is considered an estimate.

Table 4.1
Dioxin/Furan Surface Water Criteria

		Protection of Aquatic Organisms						Human Health Through Fish Consumption					
		Federal Standards				Washington State		Federal Standards		Washington State Standards			
		National Toxics Rule[1] 40 CFR 131 (µg/L)		National Recommended Water Quality Criteria [1] CWA §304(a) (µg/L)		Water Quality Standard[1,2] WAC 173-201A (µg/L)		National Toxics Rule[3] 40 CFR 131 Organism Only (µg/L)	National Recommended Water Quality Criteria [3] CWA §304(a) Organism Only (µg/L)	MTCA Method B Surface Water Values from CLARC Database (µg/L)		Current Tribal Water Quality Standards Puyallup 1994 Criteria—Marine	Surface Water Criteria
CAS Number	**Constituent**	**Value**	**Risk Type**	**Value**	**Risk Type**	**Value**	**Risk Type**	**Value**	**Value**	**Carcinogen**	**Non-Carcinogen**	**µg/L**	**µg/L**
Semivolatile Organic Compounds													
1746-01-6	2,3,7,8-TCDD [4]	NA		NA		NA		1.4E-08	5.1E-09	9.97E-09	3.63E-07	1.4E-08	5.1E-09

Notes:

1 Criteria Chronic Concentration Marine Ecological criteria used.
2 A 4-day average concentration not to be exceeded more than once every 3 years on the average for pentachlorophenol.
3 Criteria for consumption of organisms only was used.
4 Criteria for dioxin toxicity equivalent (dioxin mixtures) were also considered if/when available, and the lower criterion selected; however, most regulations are promulgated for 2,3,7,8-TCDD.

Abbreviations:

µg/L	Micrograms per liter
CFR	Code of Federal Regulations
CLARC	Cleanup levels and risk calculations
CWA	Clean Water Act
NA	Not applicable
TCDD	Tetrachlorodibenzo-p-dioxin
WAC	Washington Administrative Code

Table 5.1
Summary of 2014 Area A Dioxin/Furan Analytical Soil Results

Location		EX-31	EX-32	EX-33	EX-33 Duplicate	EX-34		Area A MIS		A-1	A-2	A-4	A-5	A-6	A-7	A-8
Depth (ft bgs)		3.5–4	4–4.5	4–4.5	4–4.5	4–4.5	6–6.5	0–4	4–8	2.5–3	3–3.5	1.5–2	1–1.5	3–3.5	3–3.5	2–2.5
Sample Date		9/8/2014	9/8/2014	9/9/2014	9/9/2014	9/8/2014	9/8/2014	9/9/2014	9/8/2014	9/9/2014	9/9/2014	9/8/2014	9/9/2014	9/9/2014	9/9/2014	9/9/2014
Horizon[1]		NA	NA	NA	NA	NA	NA	DUA1	DUA2	DUA1	DUA1	DUA1	DUA1	DUA1	DUA1	DUA1
Analyte	**Units**															
2,3,7,8-TCDD	pg/g	0.646 J	12.7	121 J	5.21 U	72.6 U	1.47 U	32 U	11.1 U	3.28 U	0.851 U	0.816 U	2.04 U	2.49 U	0.784 U	2.33 U
1,2,3,7,8-PeCDD	pg/g	6.89	45.3	1,060 UJ	1,100 J	563 J	3.39 J	284	10.9 UJ	10.4 J	1.84 J	2.84 U	7.73 J	2.41 J	2.74 U	2.54 U
1,2,3,4,7,8-HxCDD	pg/g	13.1 U	73.7	1,890	2,020 J	1,430	5.88 J	498	143 UJ	10.5 J	2.79 U	5.06 J	10.4	2.86 J	3.92 J	2.85 J
1,2,3,6,7,8-HxCDD	pg/g	43.2	38	13,200	14,800 J	37,700	32.2	4,400	688 U	34.8	9.15 J	15.5 U	42.7	4.54 U	12.5 U	13
1,2,3,7,8,9-HxCDD	pg/g	13.6	9.29	3,800	3,680	2,710	10.1 J	973	322 J	19.1	4.45 J	11.1	22.8	4.54 U	8.23 J	5.32 U
1,2,3,4,6,7,8-HpCDD	pg/g	540	505	568,000 J	663,000 J	2,280,000	1320	205,000	13,300	550	155	364	762	90	250	616
OCDD	pg/g	4,660 J	2520	17,000,000 J	21,000,000 J	39,200,000 J	16,800	3,520,000 J	132,000 J	9,630	2,040	8,730	9,870	1,630	2,760	6,870
2,3,7,8-TCDF	pg/g	0.162 U	0.516 J	2,560 J	2,040 J	2,530	0.449 U	53.6 U	8.51 U	2.51 J	0.681 U	0.776 U	0.745 U	0.68 U	1.57 U	0.635 U
1,2,3,7,8-PeCDF	pg/g	0.664 J	4.32	1,330 J	1,420 UJ	1,660	1.76 U	219	8.51 U	3.4 J	2.34 U	1.73 J	2.29 U	2.14 U	2.19 UJ	0.847 U
2,3,4,7,8-PeCDF	pg/g	0.442 J	0.206 J	2,380 J	2,140 UJ	1,470	0.755 U	277	8.32 UJ	5.47 U	2.59 J	1.84 J	2.1 U	1.22 U	1.11 U	2.31 U
1,2,3,4,7,8-HxCDF	pg/g	17	1.89 U	9,660 J	10,600 J	38,800	28.2	3,830	242	18.1	6.68 U	8.08 J	10.2	2.47 U	7.01 J	7.15 U
1,2,3,6,7,8-HxCDF	pg/g	3.29	1.06	3,110 J	3,340 U	8,160	6.08 J	749	8.91 UJ	6.02 J	2.19 J	2.8 U	4.59 J	2.52 U	2.87 J	2.09 U
2,3,4,6,7,8-HxCDF	pg/g	3.03 U	1.92 U	4,010 UJ	4,090 J	12,900	13.1	1,260	140	3.78 U	3.3 J	4.86 J	6.88 J	2.62 U	4.58 J	2.09 U
1,2,3,7,8,9-HxCDF	pg/g	5.81 U	2.99 U	3,670 J	4,100 J	11,500	8.59 J	1,150	11.9 UJ	7.16 U	3.36 U	3.69 J	4.08 J	3.59 U	4.31 J	3.55 U
1,2,3,4,6,7,8-HpCDF	pg/g	80.4	54.7	95,000 J	107,000 J	1,110,000	563	72,100	2,540	84.1	25.6	51.6	107	15.4	75	66.2
1,2,3,4,7,8,9-HpCDF	pg/g	8.19	4.8	6,690 UJ	8,370 J	78,800	61.1	6,740	270	6.92 J	1.87 U	3.55 U	9.39 J	3.86 U	10.1 J	7.79 U
OCDF	pg/g	310	345	159,000	246,000	4,990,000 J	3370	381,000	15,000	166	94.9	188	360	85.2	343	336
Dioxins/Furans (MTCA TEQ-HalfND)[2,3]	pg/g	25.4 J	77.6 J	▨ 18,000 J	▨ 20,400 J	▨ 60,600 J	40.2 J	▨ 5,710 J	331 J	32 J	8.12 J	13.5 J	31.2 J	6.79 J	10 J	14.4 J

Notes:

▨ Exceeds MTCA Method C Industrial Criterion of 1,680 pg/g.

1 The depths of DUA1 and DUA2 are 0–4 ft bgs and 4–8 ft bgs, respectively.

2 Calculated using detected dioxin/furan concentrations plus one-half the method detection limit for dioxins/furans that were not detected.

3 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxins/furans TEQ (Van den Berg et al. 2006).

Abbreviations:

bgs	Below ground surface	OCDD	Octachlorodibenzo-p-dioxin
ft	Feet	OCDF	Octachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	PeCDD	Pentachlorodibenzo-p-dioxin
HpCDF	Heptachlorodibenzofuran	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	pg/g	Picograms per gram
HxCDF	Hexachlorodibenzofuran	TEQ	Toxic equivalent
MTCA	Model Toxics Control Act	TCDD	Tetrachlorodibenzo-p-dioxin
ND	Non-detect	TCDF	Tetrachlorodibenzofuran
NA	Not applicable		

Qualifiers:

J	The analyte was detected, the given concentration is considered an estimate.
U	The analyte was not detected at the given reporting limit.
UJ	The analyte was not detected, the given reporting limit is considered an estimate.

Table 5.1
Summary of 2014 Area A Dioxin/Furan Analytical Soil Results

Location		A-10	A-11	A-12	A-14	A-17	A-18	A-20	A-22	A-23	A-24	A-26	A-27	A-28	A-29
Depth (ft bgs)		1.5–2	2–2.5	2–2.5	2.5–3	1.5–2	3.5–4	3–3.5	3.5–4	2.5–3	2.5–3	1.5–2	2.5–3	3–3.5	2.5–3
Sample Date		9/9/2014	9/9/2014	9/8/2014	9/9/2014	9/8/2014	9/9/2014	9/8/2014	9/8/2014	9/8/2014	9/9/2014	9/8/2014	9/8/2014	9/8/2014	9/8/2014
Horizon[1]		DUA1	DUA1	DUA1	DUA1	DUA1	DUA1	DUA1	DUA1	DUA1	DUA1	DUA1	DUA1	DUA1	DUA1
Analyte	Units														
2,3,7,8-TCDD	pg/g	148	22.7 U	0.989 U	0.81 U	42.7 U	4.57 U	50.9 U	1.03 U	13.8 U	0.968 U	0.948 U	24.5 U	0.64 U	0.727 U
1,2,3,7,8-PeCDD	pg/g	1,760	106	1.81 J	1.05 U	258	26	475	9.24 J	35.8 U	4.39 U	1.05 U	139	0.6 U	3.94 J
1,2,3,4,7,8-HxCDD	pg/g	2,710	161	0.989 U	1.07 U	460	41.1	1,770	15.5	123	9.44 U	1.22 U	219	0.98 U	4.12 J
1,2,3,6,7,8-HxCDD	pg/g	14,800	822	1.62 U	25.9	2,060	269	53,300	65	1,350	16.7	14.3 U	1,000	0.82 U	18.9
1,2,3,7,8,9-HxCDD	pg/g	5,720	355	1.94 U	5.26 U	886	97.5	3,190	30.5	230	12.7 U	3.98 J	468	0.8 U	10.2
1,2,3,4,6,7,8-HpCDD	pg/g	221,000	17,500	23.7	200	47,600	6,000	3,180,000	1,620	89,500	271	902	20,000	15.9	488
OCDD	pg/g	1,480,000 J	309,000	412	4,980	615,000 J	111,000 J	51,400,000 J	23,700	1,600,000 J	2,600	18,800 J	255,000 J	228	6,840
2,3,7,8-TCDF	pg/g	418 U	59 U	0.842 U	4.98 J	47.6 J	42.4	211	1.89 J	9.8 J	1.74 U	0.557 U	18 U	0.6 U	0.545 U
1,2,3,7,8-PeCDF	pg/g	1,200	65 U	1.14 U	4.14 J	99.6 U	20.2	2,130	3.96 U	44.6 U	3.2 U	1.11 U	49.6 J	0.98 U	1.29 U
2,3,4,7,8-PeCDF	pg/g	2,190	87.1 U	1.07 U	10.2 J	86.1 J	26.8 UJ	1,940	4.04 U	41.2 U	2.88 J	1.11 U	60.8 U	0.98 U	1.13 U
1,2,3,4,7,8-HxCDF	pg/g	12,700	316	0.695 U	21.5	637	97.3	57,000	23	1,190	4.88 J	5.92 U	338	0.86 U	7.56 U
1,2,3,6,7,8-HxCDF	pg/g	3,110	110	1.12 U	5.1 U	234	30.4	8,530	8.67 U	221 U	3.05 U	1.42 U	127 U	0.42 U	2.75 U
2,3,4,6,7,8-HxCDF	pg/g	5,000	175	0.737 U	11.5 J	377 U	53.3	16,300	17.7	449	2.77 U	1.48 U	201	0.54 J	4.53 J
1,2,3,7,8,9-HxCDF	pg/g	3,740	145	1.49 J	9.5 J	261	41.1	16,700	7.75 U	348	3.83 U	1.81 U	117	0.92 U	3.6 J
1,2,3,4,6,7,8-HpCDF	pg/g	69,300	2,490	6.72 U	137	10,500	897	1,360,000	251	31,400	24.5	281	2,950	3.08 U	116
1,2,3,4,7,8,9-HpCDF	pg/g	8,400	236	1.47 U	9.05 U	826	70.5	119,000	22.7	2,920	3.59 J	26.1	238	0.6 U	4.53 U
OCDF	pg/g	147,000	7,100	38.4	115	55,200	3,120	12,200,000	1,030	196,000	67.2	3,790 J	9,650	13.7 J	808
Dioxins/Furans (MTCA TEQ-HalfND)[2,3]	pg/g	10,900 J	640	3.44 J	17 J	1,570 J	204 J	82,500 J	53 J	2,190 J	11.2 J	21.8 J	715 J	1.36 J	17.5 J

Notes:

▨ Exceeds MTCA Method C Industrial Criterion of 1,680 pg/g.

1 The depths of DUA1 and DUA2 are 0–4 ft bgs and 4–8 ft bgs, respectively.

2 Calculated using detected dioxin/furan concentrations plus one-half the method detection limit for dioxins/furans that were not detected.

3 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxins/furans TEQ (Van den Berg et al. 2006).

Abbreviations:

bgs	Below ground surface	OCDD	Octachlorodibenzo-p-dioxin
ft	Feet	OCDF	Octachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	PeCDD	Pentachlorodibenzo-p-dioxin
HpCDF	Heptachlorodibenzofuran	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	pg/g	Picograms per gram
HxCDF	Hexachlorodibenzofuran	TEQ	Toxic equivalent
MTCA	Model Toxics Control Act	TCDD	Tetrachlorodibenzo-p-dioxin
ND	Non-detect	TCDF	Tetrachlorodibenzofuran
NA	Not applicable		

Qualifiers:

J	The analyte was detected, the given concentration is considered an estimate.
U	The analyte was not detected at the given reporting limit.
UJ	The analyte was not detected, the given reporting limit is considered an estimate.

Table 5.2
Summary of 2014 Area B Dioxin/Furan Analytical Soil Results

Location		Area B MIS		B-1	B-2	B-3	B-4	B-5	B-6	B-7		B-8	B-9	
Depth (bgs)		NA	NA	4.5–5	1.5–2	1.5–2	0–0.5	1.5–2	1.5–2	0–5	7–7.5	1.5–2	0–6.5	9.5–10
Depth (ft bogs)		0–2	2–6	1–1.5	1.5–2	1.5–2	0–0.5	1.5–2	1.5–2	NA	2–2.5	1.5–2	NA	3–3.5
Sample Date		9/12/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014	9/12/2014	9/12/2014	9/10/2014	9/12/2014	9/12/2014
Horizon[1]		DUB1	DUB2	DUB1	DUB1	DUB1	DUB1	DUB1	DUB1	Treated Soil	DUB2	DUB1	Treated Soil	DUB2
Analyte	**Units**													
2,3,7,8-TCDD	pg/g	181 U	14.7 U	0.444 U	1.14 U	3.31 U	5.6 U	4.77 J	0.409 U	68.4 U	0.447 U	0.837 U	339 U	0.368 U
1,2,3,7,8-PeCDD	pg/g	1,840	792 J	1.13 U	1.1 J	14.9	65.9 J	28.1 J	57.5 J	720	0.5 U	5.92 U	4,720	0.474 U
1,2,3,4,7,8-HxCDD	pg/g	5,310	1,220 UJ	2.36 J	2.76 U	24.6	137	45.9 U	105 J	1,340	0.553 U	9.61 J	12,100	0.5 U
1,2,3,6,7,8-HxCDD	pg/g	61,500	7,810 J	12.9	19.8	679	1,220	504	917	16,700	0.579 U	73.3	83,400	0.526 U
1,2,3,7,8,9-HxCDD	pg/g	10,700	2,250	4.78 J	7.96 U	69.9	319	116 U	245	3,120	0.579 U	21.5	22,600	0.526 U
1,2,3,4,6,7,8-HpCDD	pg/g	2,300,000	251,000 J	535	659	12,500	43,000	16,000	26,800	499,000	70.8 J	2,260	3,180,000	50.5 U
OCDD	pg/g	37,700,000 J	4,480,000 J	17,700	14,500	203,000 J	762,000 J	464,000 J	604,000 J	8,510,000 J	1,150	55,000 J	78,200,000 J	635
2,3,7,8-TCDF	pg/g	1,160 U	731 UJ	2.98 J	2.7 J	46.5	27.2 U	99.4 U	66.4 J	563 U	0.342 U	5.39 J	1,970	0.342 U
1,2,3,7,8-PeCDF	pg/g	5,620	702 J	1.87 J	2.18 U	68.3	96.9 U	40.3 J	55.1 J	1,010	0.395 U	6.27 U	6,290	0.447 U
2,3,4,7,8-PeCDF	pg/g	6,400	783 U	2.58 J	1.06 U	104	131	46.9 U	74.9 U	1,390 U	0.395 U	6.86 U	7,540	0.421 U
1,2,3,4,7,8-HxCDF	pg/g	61,900	5,320 J	7.03 J	8.9 J	564	1,010	209	376	7,680	0.289 U	45.4	66,900	0.395 U
1,2,3,6,7,8-HxCDF	pg/g	13,300	1,220 J	2.11 U	2.48 U	146	235	52.8 U	122	1,940	2.89 U	11.8	15,900	2.11 U
2,3,4,6,7,8-HxCDF	pg/g	17,100	1,800 J	2.38 J	3.24 U	206	301	72.5 J	155	2,930	0.289 U	17	20,200	0.421 U
1,2,3,7,8,9-HxCDF	pg/g	22,500	2,240 J	2.52 J	4.6 J	239	378	74.1 J	131	2,920	11.8 J	18.3	25,500	9.74 U
1,2,3,4,6,7,8-HpCDF	pg/g	341,000	37,600 J	41.9	60.4	2,190	6,420	1,220	2,390	49,800	13.7 J	303	452,000 J	11.8 J
1,2,3,4,7,8,9-HpCDF	pg/g	29,200	3,210 J	2.86 J	4.94 J	201	551 U	65.1 J	166	2,910	0.421 U	26.4	39,500	0.421 U
OCDF	pg/g	525,000	88,500 J	81.7	110	1,580	10,500 J	1,650 J	4,260	62,900	36.1 J	661	867,000 J	31.1 J
Dioxins/Furans (MTCA TEQ-HalfND)[2,3]	pg/g	61,600 J	7,390 J	16.3 J	17.9 J	458 J	1,200 J	455 J	758 J	13000 J	3.2 J	67.3 J	92,800 J	1.79 J

Notes:

▨ Exceeds MTCA Method C Industrial Criterion of 1,680 pg/g.

1 The depths of DUB1 and DUB2 are 0–2 ft bogs and 2–6 ft bogs, respectively.

2 Calculated using detected dioxin/furan concentrations plus one-half the method detection limit for dioxins/furans that were not detected.

3 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxins/furans TEQ (Van den Berg et al. 2006).

Abbreviations:

bgs	Below ground surface	OCDD	Octachlorodibenzo-p-dioxin
bogs	Below original ground surface	OCDF	Octachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	PeCDD	Pentachlorodibenzo-p-dioxin
HpCDF	Heptachlorodibenzofuran	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	pg/g	Picograms per gram
HxCDF	Hexachlorodibenzofuran	TEQ	Toxic equivalent
MTCA	Model Toxics Control Act	TCDD	Tetrachlorodibenzo-p-dioxin
ND	Non-detect	TCDF	Tetrachlorodibenzofuran
ft	Feet	NA	Not applicable

Qualifiers:

J	The analyte was detected, the given concentration is considered an estimate.
U	The analyte was not detected at the given reporting limit.
UJ	The analyte was not detected, the given reporting limit is considered an estimate.

Table 5.2
Summary of 2014 Area B Dioxin/Furan Analytical Soil Results

	Location	B-10		B-11		B-12	B-13	B-14		B-15	B-16	B-18	
	Depth (bgs)	0–5	8–8.5	0–4	6–6.5	1.5–2	1–1.5	0–0.5	2–2.5	1.5–2	1.5–2	0–1	3–3.5
	Depth (bogs)	NA	3–3.5	NA	2–2.5	1.5–2	1–1.5	0–0.5	2–2.5	1.5–2	1.5–2	NA	2–2.5
	Sample Date	9/12/2014	9/12/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014	9/10/2014
	Horizon[1]	Treated Soil	DUB2	Treated Soil	DUB2	DUB1	DUB1	DUB1	DUB2	DUB1	DUB1	Treated Soil	DUB2
Analyte	**Units**												
2,3,7,8-TCDD	pg/g	145 J	0.345 U	3.37 U	16 U	4.19 U	4.57 U	24.5 J	129 U	8.77 U	7.4 U	152 J	1,220
1,2,3,7,8-PeCDD	pg/g	1,610	0.322 U	1,150 U	0.568 U	22.9	59 J	309	1,190 U	105	68.3 J	2,210	15,800
1,2,3,4,7,8-HxCDD	pg/g	3,880	3.22 U	3,100	0.617 U	43.6	90.8 J	730	1,960	256	93.6 U	4,980	39,200
1,2,3,6,7,8-HxCDD	pg/g	28,000	15.4 J	30,000	33.6 J	276	623	7,170	24,200	928	487	38,000	248,000 J
1,2,3,7,8,9-HxCDD	pg/g	7,760	11 U	6,160	19.7 J	90.2	217	1,420	5,440	339	215	9,620	56,400
1,2,3,4,6,7,8-HpCDD	pg/g	926,000	321	1,120,000	3,700	9,280	15,500	247,000	398,000	14,600	11,900	1,210,000	9,170,000
OCDD	pg/g	16,400,000 J	11,000	41,200,000 J	96,900	214,000 J	364,000 J	5,560,000 J	3,430,000	158,000	215,000	24,600,000 J	123,000,000 J
2,3,7,8-TCDF	pg/g	895	0.276 U	660 J	0.395 U	9.45 J	332	173	543 J	36.2 J	42.1 J	1,500	3,890
1,2,3,7,8-PeCDF	pg/g	2,110	0.391 U	2310 J	0.593 U	19.7	58.6 U	543	1,140	45.7 J	30.1 U	2,560	20,200
2,3,4,7,8-PeCDF	pg/g	2,350	0.368 U	2760	0.568 U	22.1	93.8 J	724	2,460	63.1 J	55.7 J	3,230	21,700
1,2,3,4,7,8-HxCDF	pg/g	20,300	8.05 J	23,400	26 J	174	273	5,720	8,980	220	218	25,400	218,000 J
1,2,3,6,7,8-HxCDF	pg/g	4,910	5.52 U	5,190 U	0.667 U	43.9	78.4 J	1,320	2,070	77.9 J	69.8 J	6,030	50,600 J
2,3,4,6,7,8-HxCDF	pg/g	6,710	5.29 U	6,820	0.691 U	63.9	110 U	1,740	3,440	131	105	8,320	64,000 J
1,2,3,7,8,9-HxCDF	pg/g	7,920	11.5 J	9,160	23 U	67.4	92.6 J	2,120	3,100	78 J	84.6 J	9,130	87,600
1,2,3,4,6,7,8-HpCDF	pg/g	139,000	46.4 J	141,000	357	1,250	1,960 J	35,500	52,400	1,550	1,560	173,000	1,530,000
1,2,3,4,7,8,9-HpCDF	pg/g	12,700 U	6.67 U	11,500	24.4 U	108	144	3,080	3,650	89.1 J	112	14,300	133,000
OCDF	pg/g	271,000	126 J	264,000	1,590	2,860	4,670 J	117,000	91,000	2,380	3,060	384,000	4,430,000
Dioxins/Furans (MTCA TEQ-HalfND)[2,3]	pg/g	26,300 J	12.2 J	35,700 J	87.8 J	280 J	553 J	7,170 J	12,000 J	547 J	417 J	35,200 J	247,000 J

Notes:

▨ Exceeds MTCA Method C Industrial Criterion of 1,680 pg/g.

1 The depths of DUB1 and DUB2 are 0–2 ft bogs and 2–6 ft bogs, respectively.

2 Calculated using detected dioxin/furan concentrations plus one-half the method detection limit for dioxins/furans that were not detected.

3 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxins/furans TEQ (Van den Berg et al. 2006).

Abbreviations:

bgs	Below ground surface	OCDD	Octachlorodibenzo-p-dioxin
bogs	Below original ground surface	OCDF	Octachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	PeCDD	Pentachlorodibenzo-p-dioxin
HpCDF	Heptachlorodibenzofuran	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	pg/g	Picograms per gram
HxCDF	Hexachlorodibenzofuran	TEQ	Toxic equivalent
MTCA	Model Toxics Control Act	TCDD	Tetrachlorodibenzo-p-dioxin
ND	Non-detect	TCDF	Tetrachlorodibenzofuran
ft	Feet	NA	Not applicable

Qualifiers:

J	The analyte was detected, the given concentration is considered an estimate.
U	The analyte was not detected at the given reporting limit.
UJ	The analyte was not detected, the given reporting limit is considered an estimate.

Table 5.2
Summary of 2014 Area B Dioxin/Furan Analytical Soil Results

Location		B-19		B-20		B-21		B-22	B-23	B-24		B-25	
Depth (bgs)		0–5	9–9.5	0–2.5	5.5–6	0–2.5	6–6.5	17.5–18	9–9.5	0–5	10–10.5	0–4	6.5–7
Depth (bogs)		NA	4–4.5	NA	3–3.5	NA	3.5–4	4–4.5	4–4.5	NA	5–5.5	NA	2.5–3
Sample Date		9/12/2014	9/12/2014	9/10/2014	9/10/2014	9/12/2014	9/12/2014	9/12/2014	9/12/2014	9/12/2014	9/12/2014	9/12/2014	9/12/2014
Horizon[1]		Treated Soil	DUB2	Treated Soil	DUB2	Treated Soil	DUB2	DUB2	DUB2	Treated Soil	DUB2	Treated Soil	DUB2
Analyte	**Units**												
2,3,7,8-TCDD	pg/g	51.9 U	18.6 U	35.9 U	13.7 U	621	0.395 U	0.486 U	14.8 U	467 J	0.41 U	5.32 U	0.32 U
1,2,3,7,8-PeCDD	pg/g	522	57.7 U	384	4.88 U	8,330	0.349 U	0.405 U	0.447 U	5,510	0.41 U	3,240	0.4 U
1,2,3,4,7,8-HxCDD	pg/g	989	43.7 J	731	10.5 J	20,800	0.488 U	0.73 U	0.588 U	14,700	0.564 U	8,160	0.36 U
1,2,3,6,7,8-HxCDD	pg/g	9,170	523	6,870	57.6 J	177,000	0.488 U	9.46 U	9.18 J	153,000	21.3 J	55,000	5.2 U
1,2,3,7,8,9-HxCDD	pg/g	2,530	136	1,450	19.8 U	32,700	0.512 U	0.784 U	7.76 U	26,900	8.72 J	14,500	8 J
1,2,3,4,6,7,8-HpCDD	pg/g	180,000	10,600	210,000	2,890	6,110,000	586	572	385	5,780,000 J	634	2,090,000	196
OCDD	pg/g	3,070,000 J	83,200	4,460,000 J	69,400	117,000,000 J	12,700	11,300	5,180	93,600,000 J	12,200	47,500,000 J	3,640
2,3,7,8-TCDF	pg/g	413	24.4 U	248 J	0.366 U	3,400 U	0.349 U	0.405 U	0.353 U	3,680	0.385 U	1,190 J	0.3 U
1,2,3,7,8-PeCDF	pg/g	698	0.598 U	509	8.29 U	14,200	0.395 U	0.514 U	0.494 U	14,400	0.462 U	3,900	0.42 U
2,3,4,7,8-PeCDF	pg/g	1,050	80 J	648	0.439 U	16,800	4.88 U	0.514 U	0.494 U	15,700	0.462 U	4,850	0.4 U
1,2,3,4,7,8-HxCDF	pg/g	4,430	352	4,650 J	49.5 J	147,000	0.349 U	11.4 U	12.2 U	139,000 J	16.9 J	40,100	5.2 U
1,2,3,6,7,8-HxCDF	pg/g	1,360	18.4 U	1,180 J	11.7 U	34,200	0.349 U	0.378 U	4.24 U	30,900	5.64 U	8,810	3.8 U
2,3,4,6,7,8-HxCDF	pg/g	1,960	0.368 U	1,520	11.7 U	45,500	0.349 U	4.32 U	0.4 U	40,800	10 J	13,100	0.46 U
1,2,3,7,8,9-HxCDF	pg/g	1,900 U	26 U	1,910	24.6 U	54,900	7.44 U	7.84 U	12.7 U	56,800	12.6 U	16,400	8.4 U
1,2,3,4,6,7,8-HpCDF	pg/g	23,100	87.4 J	29,200	343	1,070,000	68.6 J	68.4 J	54.6 U	823,000 J	86.4 J	298,000	31.2 J
1,2,3,4,7,8,9-HpCDF	pg/g	2,140	9.43 U	2,300	28.8 U	90,400	0.419 U	0.486 U	0.706 U	68,000	0.564 U	24,800	0.36 U
OCDF	pg/g	36,200 J	107 J	57,000 J	1070	5,050,000	219 J	176 J	72 J	982,000 J	193 J	650,000 J	81 J
Dioxins/Furans (MTCA TEQ-HalfND)[2,3]	pg/g	6,170 J	303 J	6,260 J	78.3 J	175,000 J	12 J	12.1 J	16.2 J	153,000 J	18.1 J	59,100 J	5.8 J

Notes:

▨ Exceeds MTCA Method C Industrial Criterion of 1,680 pg/g.

1 The depths of DUB1 and DUB2 are 0–2 ft bogs and 2–6 ft bogs, respectively.

2 Calculated using detected dioxin/furan concentrations plus one-half the method detection limit for dioxins/furans that were not detected.

3 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxins/furans TEQ (Van den Berg et al. 2006).

Abbreviations:

bgs	Below ground surface	OCDD	Octachlorodibenzo-p-dioxin
bogs	Below original ground surface	OCDF	Octachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	PeCDD	Pentachlorodibenzo-p-dioxin
HpCDF	Heptachlorodibenzofuran	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	pg/g	Picograms per gram
HxCDF	Hexachlorodibenzofuran	TEQ	Toxic equivalent
MTCA	Model Toxics Control Act	TCDD	Tetrachlorodibenzo-p-dioxin
ND	Non-detect	TCDF	Tetrachlorodibenzofuran
ft	Feet	NA	Not applicable

Qualifiers:

J	The analyte was detected, the given concentration is considered an estimate.
U	The analyte was not detected at the given reporting limit.
UJ	The analyte was not detected, the given reporting limit is considered an estimate.

Table 5.2
Summary of 2014 Area B Dioxin/Furan Analytical Soil Results

Location		B-26		B-27	B-28		B-29		B-30	
Depth (bgs)		0–14.5	18.5–19	15–15.5	0–7.5	10–10.5	1–1.5	2.5–3	1 -1.5	3–3.5
Depth (bogs)		NA	4–4.5	2.5–3	NA	2.5–3	1–1.5	2.5–3	1 -1.5	3–3.5
Sample Date		9/12/2014	9/12/2014	9/12/2014	9/12/2014	9/12/2014	9/12/2014	9/12/2014	9/12/2014	9/12/2014
Horizon[1]		Treated Soil	DUB2	DUB2	Treated Soil	DUB2	DUB1	DUB2	DUB1	DUB2
Analyte	**Units**									
2,3,7,8-TCDD	pg/g	639 U	16.8 U	19.8 U	538 U	0.444 U	483 J	0.396 U	14.9 U	0.425 U
1,2,3,7,8-PeCDD	pg/g	7,700	0.35 U	16 J	6,130	0.469 U	4,890	0.354 U	0.367 U	0.5 U
1,2,3,4,7,8-HxCDD	pg/g	21,800	0.5 U	22.5 J	13,100	0.519 U	11,000	0.521 U	0.694 U	0.45 U
1,2,3,6,7,8-HxCDD	pg/g	139,000	0.5 U	103 J	133,000	0.543 U	72,000	29.4 J	33.9 U	6.5 U
1,2,3,7,8,9-HxCDD	pg/g	41,500	0.5 U	32.6 J	23,100	0.543 U	16,900	7.5 U	21.4 U	7.75 U
1,2,3,4,6,7,8-HpCDD	pg/g	4,740,000	104 J	3,750	3,700,000	49.9 J	2,680,000	1,150	2,300	66.5 U
OCDD	pg/g	65,800,000 J	1,780	72,600	89,900,000 J	705	42,900,000 J	22,600	63,100	1,020
2,3,7,8-TCDF	pg/g	2,210 J	0.4 U	0.395 U	2,480 U	0.346 U	1,420	3.96 U	0.408 U	0.325 U
1,2,3,7,8-PeCDF	pg/g	10,800	0.45 U	18.8 J	8,990	0.519 U	6,190	5.83 U	7.35 U	0.475 U
2,3,4,7,8-PeCDF	pg/g	13,800	0.425 U	13.8 J	30,800	0.519 U	6,710	0.479 U	0.469 U	0.45 U
1,2,3,4,7,8-HxCDF	pg/g	104,000	4 J	85.7 J	135,000	0.37 U	59,700	28.3 J	20.3 J	0.3 U
1,2,3,6,7,8-HxCDF	pg/g	25,100 U	0.275 U	25.7 J	23,100	0.37 U	13,700	8.54 U	0.347 U	0.3 U
2,3,4,6,7,8-HxCDF	pg/g	32,700	0.275 U	15.6 U	33,500	0.37 U	18,300	10.8 U	6.24 J	4.5 U
1,2,3,7,8,9-HxCDF	pg/g	44,500	8.75 U	44.2 J	39,100	0.494 U	22,900	17.9 J	14.8 J	9.5 U
1,2,3,4,6,7,8-HpCDF	pg/g	650,000	16 U	510	543,000	12.3 U	381,000	199	192	17.5 J
1,2,3,4,7,8,9-HpCDF	pg/g	54,900	0.65 U	50.6 J	38,300	0.568 U	30,800	21.9 U	16.6 J	6 U
OCDF	pg/g	1,030,000	40.8 J	1,040	835,000	36.5 U	1,570,000 J	648	740	45.5 J
Dioxins/Furans (MTCA TEQ-HalfND)[2,3]	pg/g	128,000 J	11.3 J	128 J	126,000 J	1.5 J	73,400 J	30.2 J	59 J	2.88 J

Notes:

▨ Exceeds MTCA Method C Industrial Criterion of 1,680 pg/g.

1 The depths of DUB1 and DUB2 are 0–2 ft bogs and 2–6 ft bogs, respectively.

2 Calculated using detected dioxin/furan concentrations plus one-half the method detection limit for dioxins/furans that were not detected.

3 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxins/furans TEQ (Van den Berg et al. 2006).

Abbreviations:

bgs	Below ground surface	OCDD	Octachlorodibenzo-p-dioxin
bogs	Below original ground surface	OCDF	Octachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	PeCDD	Pentachlorodibenzo-p-dioxin
HpCDF	Heptachlorodibenzofuran	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	pg/g	Picograms per gram
HxCDF	Hexachlorodibenzofuran	TEQ	Toxic equivalent
MTCA	Model Toxics Control Act	TCDD	Tetrachlorodibenzo-p-dioxin
ND	Non-detect	TCDF	Tetrachlorodibenzofuran
ft	Feet	NA	Not applicable

Qualifiers:

J	The analyte was detected, the given concentration is considered an estimate.
U	The analyte was not detected at the given reporting limit.
UJ	The analyte was not detected, the given reporting limit is considered an estimate.

Table 5.3
Vertical Extent of Treated Soil in Area B

Location	Treated Soil Present	Thickness of Treated Soil (feet)
B-1	No	--
B-2	No	--
B-3	No	--
B-4	No	--
B-5	No	--
B-6	No	--
B-7	Yes	5
B-8	No	--
B-9	Yes	6.5
B-10	Yes	5
B-11	Yes	4
B-12	No	--
B-13	No	--
B-14	No	--
B-15	No	--
B-16	No	--
B-17	Yes	1
B-18	Yes	1
B-19	Yes	5
B-20	Yes	2.5
B-21	Yes	2.5
B-22	Yes	13.5
B-23	Yes	5
B-24	Yes	5
B-25	Yes	4
B-26	Yes	14.5
B-27	Yes	12.5
B-28	Yes	7.5
B-29	No	--
B-30	No	--

Note:
-- Not applicable

Table 6.1
Applicable or Relevant and Appropriate Requirements

Standard, Requirement, or Limitation	Description	Applicability
Constituent-Specific Applicable or Relevant and Appropriate Requirements		
General Requirements		
CERCLA and National Oil and Hazardous Substances Pollution Contingency Plan (42 USC 9601 et seq and 40 CFR 300)	Establishes federal administrative processes and standards to identify, investigate, and clean up facilities where hazardous substances are located.	USEPA CERCLA requirements: although the site is located within the USEPA Commencement Bay Nearshore/Tideflats Superfund site, it has been "deferred" to the RCRA/HWMA corrective action process for cleanup. However, because CERCLA remains applicable, the cleanup must be sufficiently protective in order to not require any further action under CERCLA.
RCRA (40 CFR 239 through 282)	RCRA, an amendment to the Solid Waste Disposal Act, was enacted in 1976 to address the huge volumes of municipal and industrial solid waste generated nationwide. RCRA has been amended and revised since; however, the goals remain: • to protect human health and the environment from the potential hazards of waste disposal, • to conserve energy and natural resources, • to reduce the amount of waste generated, and • to ensure that wastes are managed in an environmentally sound manner. CERCLA is a related statute that deals with cleaning up inactive and abandoned hazardous waste sites. RCRA, on the other hand, deals with active industrial sites and materials that are destined for disposal or recycling.	This is a RCRA Facility, delegated to Washington State for implementation of final corrective actions.
Surface Water Requirements		
MTCA (WAC 173-340)	Establishes Washington State administrative processes and standards to identify, investigate, and clean up facilities where hazardous substances are located.	Facility is regulated under MTCA and must meet MTCA cleanup requirements.
Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A)	The Surface Water Standards establish water quality standards for surface waters of Washington State. Water quality standards require that toxic substances shall not be introduced beyond the mixing zone above levels that have the potential to adversely affect characteristic water users, cause acute or chronic toxicity to the most sensitive biota, or adversely affect public health.	Applicable at the Blair Waterway and ditches that discharge into the Blair Waterway.
CWA (33 USC 1251 et seq.)	Section 401 of the CWA requires the establishment of guidelines and standards to control the direct or indirect discharge of pollutants to the waters of the United States. Section 402 establishes the NPDES, which provides for the issuance of permits to regulate discharges to navigable waters.	Section 401 is applicable. Requirements under Section 402 are discussed under Action-Specific ARARs for NPDES issues related to construction.
National Recommended Water Quality Standards (40 CFR 131)	These water quality standards define the water quality goals of the water body by designating the use or uses to be made of the water and by setting criteria necessary to protect the uses. States adopt water quality standards to protect public health or welfare, enhance the quality of water, and serve the purposes of the CWA.	Applicable at the Blair Waterway and ditches that discharge into the Blair Waterway.

Table 6.1
Applicable or Relevant and Appropriate Requirements

Standard, Requirement, or Limitation	Description	Applicability
Constituent-Specific Applicable or Relevant and Appropriate Requirements (cont.)		
Groundwater Requirements		
Washington Water Pollution Control Law (RCW 90.48; WAC 173-220)	Washington State has been delegated authority to issue NPDES permits. CWA Section 301, 302, and 303 require states to adopt water quality standards. The Washington Water Pollution Control Law and regulations address this requirement.	Substantive requirements are applicable for NPDES requirements and stormwater management under Action-specific ARARs. MTCA cleanup actions are exempt from the procedural requirements of this law, but must comply with the substantive requirements.
MTCA (WAC 173-340)	Establishes Washington State administrative processes and standards to identify, investigate, and clean up facilities where hazardous substances are located.	Facility is a RCRA Facility delegated to Washington State for implementation of final corrective actions. That work is regulated under MTCA and must meet MTCA standards. Cleanup levels must consider beneficial use of groundwater, which is impact to surface water.
Drinking Water Standards—State Maximum Contaminant Levels (WAC 246-290-310)	Establishes standards for contaminant levels in drinking water for water system purveyors.	No drinking water supplies are impacted by the Facility, therefore, these standards are not applicable.
Water Quality Standards for Groundwaters of the State of Washington (WAC 173-200)	Implements the Water Pollution Control Act and the Water Resources Act of 1971 (RCW 90.54).	Not applicable at sites operating under consent decree with USEPA or Ecology.
Soil Requirements		
MTCA (WAC 173-340)	Establishes Washington State administrative processes and standards to identify, investigate, and clean up facilities where hazardous substances are located.	Facility is a RCRA Facility delegated to Washington State for implementation of final corrective actions. Facility is regulated under MTCA and must meet MTCA standards. The standards include requirements for alternative selection, cleanup standards, monitored natural attenuation, and restoration time frame.
Location-Specific Applicable or Relevant and Appropriate Requirements		
Shoreline, Wetlands, and Other Critical Areas		
Washington Shoreline Management Act (RCW 90.58; WAC 173-14) Tacoma Municipal Code Chapter 13.10—Shoreline Management	The Washington Shoreline Management Act, authorized under the federal Coastal Zone management Act, establishes requirements for substantial development occurring within the waters of Washington State or within 200 feet of a shoreline.	Not applicable, the Facility is more than 200 feet from the shoreline.
Tacoma Municipal Code Chapter 13.11—Critical Areas Preservation	Critical areas include critical aquifer recharge areas, fish and wildlife habitat conservation areas, flood hazard areas, geologically hazardous areas, stream corridors, wetlands, and any buffer zones. The criteria and standards provided in this chapter are intended to secure the public health, safety, and welfare by: • protecting members of the public and public resources form damage or injury due to slope failures, erosion, landslides, and seismic or volcanic hazards, • maintaining a healthy functioning ecosystem, • preventing impacts to streams, fish and wildlife habitats, and water quality, • providing open space and aesthetic value, • providing migratory pathways for fish and birds, and • giving special consideration to conservation efforts.	Substantive requirements may be applicable based on specific actions and locations. MTCA cleanup actions are exempt from the procedural requirements of this law, but must comply with the substantive requirements.

Table 6.1
Applicable or Relevant and Appropriate Requirements

Standard, Requirement, or Limitation	Description	Applicability
Location-Specific Applicable or Relevant and Appropriate Requirements (cont.)		
Shoreline, Wetlands, and Other Critical Areas (cont.)		
Executive Order 11990, Protection of Wetlands (40 CFR 6, Appendix A)	Executive Order 11990 Section 7 requires measures to minimize the destruction, loss, or degradation of wetlands. Requires no net loss of remaining wetlands.	Only applicable if alternatives impact wetlands.
Flood Plain Management (40 CFR 6, Appendix A: 10 CFR 1022	In 100-year flood plains, actions must be taken to reduce the risk of flood loss, minimize the impact of floods on human safety, and restore and preserve the natural beneficial values of flood plains.	Substantive requirements may be applicable based on specific actions and locations. MTCA cleanup actions are exempt from the procedural requirements of this law, but must comply with the substantive requirements.
Washington Floodplain Management Plan RCW 68.16; WAC 173-158)	An advisory standard pertaining to wetlands management that suggests local governments, with technical assistance from Ecology, institute a program that can identify and map critical wetland areas located within base floodplains.	
Tribal and Cultural Protections		
Native American Graves Protection and Repatriation Act (25 USC 3001 through 3113; 43 CFR Part 10) and Washington's Indian Graves and Records Law (RCW 27.44)	These statutes prohibit the destruction or removal of Native American cultural items and require written notification of inadvertent discovery to the appropriate agencies and Native American tribe. These programs are applicable to the cleanup action if cultural items are found. The activities must cease in the area of the discovery, a reasonable effort must be made to protect the items discovered, and notice must be provided.	Because of the Facility's industrial history, Native American protections are likely not an issue; however, the National Historic Preservation Act is applicable.
Archaeological Resources Protection Act (16 USC 470aa et seq.; 43 CFR part 7)	This program sets forth requirements that are triggered when archaeological resources are discovered. These requirements only apply if archaeological items are discovered during implementation of the selected remedy.	Because of the Facility's industrial history, Native American protections are likely not an issue; however, the Archeological Resources Protection Action and National Historic Preservation Act are applicable.
National Historic Preservation Act (16 USC 470 et seq.; 36 CFR parts 60, 63, and 800)	This program sets forth a national policy of historic preservation and provides a process that must be followed to ensure that impacts of actions on archaeological, historic, and other cultural resources are protected.	
Action-Specific Applicable or Relevant and Appropriate Requirements		
Evaluate Environmental Impacts		
SEPA (RCW 43.21C; WAC 197-11)	Establishes the state's policy for protection and preservation of the natural environment.	Applicable, implemented during design and permitting phase. Coordination with federal agencies may be necessary to ensure the SEPA process will to meet NEPA requirements. SEPA and MTCA are integrated processes per WAC 197-11-250 through 197-11-268
Disposal of Excavated Material		
RCRA (42 USC 6921-6949a; 40 CFR Part 268, Subtitles C and D)	Establishes requirements for the identification, handling, and disposal of hazardous and non-hazardous waste.	Facility is a RCRA Facility delegated to Washington State for implementation of final corrective actions. Facility is regulated under MTCA and must meet MTCA standards.
Dangerous Waste Regulations (RCW 70.105; WAC 173-303)	Establishes regulations that are the state equivalent of RCRA requirements for determining whether a solid waste is a state dangerous waste. This regulation also provides requirements for the management of dangerous wastes.	Only applicable if waste is generated from selected alternative.

Table 6.1
Applicable or Relevant and Appropriate Requirements

Standard, Requirement, or Limitation	**Description**	**Applicability**
Action-Specific Applicable or Relevant and Appropriate Requirements (cont.)		
Disposal of Excavated Material (cont.)		
Solid Waste Disposal Act (42 USC Sec. 325103259, 6901-6991; 40 CFR 257, 258) Federal Land Disposal Requirements (40 CFR part 268)	Protects health and the environment and promotes conservation of valuable material and energy resources.	
Minimum Functional Standards for Solid Waste Handling (WAC 173-304)	Sets minimum functional standards for the proper handling of all solid waste materials originating form residences, commercial, agricultural, and industrial operations and other sources.	
Solid Waste Handling Standards (WAC 173-350)	Regulates upland beneficial reuse of sediments.	Only applicable if sediments are reused in uplands areas, on- or off-site.
Wastewater/Stormwater Discharge		
Washington Water Pollution Control Law (RCW 90.48; WAC 173-216, WAC 173-220)	Washington State has been delegated authority to issue NPDES permits. CWA Sections 301, 302, and 303 require states to adopt water quality standards and implement an NPDES permitting process. The Washington Water Pollution Control Law and regulations address this requirement.	State version of CWA NPDES. Substantive requirements are applicable. MTCA cleanup actions are exempt from the procedural requirements of this law, but must comply with the substantive requirements. Any construction or regrading activity will require compliance with NPDES.
NPDES (CWA Part 402)	Regulates discharges to off-site activities for pretreatment standards.	Any discharges from the Facility to a POTW or other water body (Blair Waterway) will be required to comply with pretreatment standards and permitted through the public utility.
National Pretreatment Standards (40 CFR 403)		
Tacoma Wastewater Treatment Requirements (Tacoma City Ordinance Chapter 12.08) and Shoreline Management (Chapter 13.10.130 for discharges to surface water in Port Industrial Area)	Provides requirements for discharge to the POTW.	Applicable through NPDES permit.
Worker Safety		
Health and Safety for HAZWOPER (WAC 296-62; and Health and Safety 29 CAR 1901.120)	The Health and Safety for HAZWOPER regulates health and safety operations for hazardous waste sites. The health and safety regulations describe federal requirements for health and safety training for workers at hazardous waste sites.	Any cleanup work will require compliance with OSHA and WISHA.
OSHA (29 USC 653, 655, 657; Occupational Safety and Health Standards and 29 CFR 1910)	Employee health and safety regulations for construction activities and general construction standards as well as regulations for fire protection, materials handling, hazardous materials, personal protective equipment, and general environmental controls. Hazardous waste site work requires employees to be trained prior to participation in site activities, medical monitoring, monitoring to protect employees from excessive exposure to hazardous substances and decontamination of personnel and equipment.	Any cleanup work will require compliance with OSHA and WISHA.
WISHA (RCW 49.17) Washington Industrial Safety and Health Regulations (WAC 296-62; WAC 296-155)	Adopts the OSHA standards that govern the conditions of employment in all work places. The regulations encourage efforts to reduce safety and health hazards in the work place and set standards for safe work practices for dangerous areas such as trenches, excavations, and hazardous waste sites.	Any cleanup work will require compliance with OSHA and WISHA.

Table 6.1
Applicable or Relevant and Appropriate Requirements

Standard, Requirement, or Limitation	**Description**	**Applicability**
Action-Specific Applicable or Relevant and Appropriate Requirements (cont.)		
Air Quality Controls		
Federal, State, and Local Air Quality Protection Programs State Implementation of ambient air quality standards NWAPA ambient and emission standards Regional Standards for fugitive dust emissions, and toxic air pollutants.	Regulations promulgated under the federal Clean Air Act (42 USC 7401) and the Washington State Clean Air Act (RCW 70.94) governs the release of airborne contaminants from point and non-point sources. Local air pollution control authorities such as the PSCAA have also set forth regulations for implementing these air quality requirements. These requirements may be applicable to the Facility for the purposes of dust control should the selected cleanup action alternatives require excavation activities. Both PSCAA (under Regulation III) and WAC 173-460 establish ambient source impact levels for arsenic.	The selected alternative will require compliance with air quality regulations and best management practices for dust control.
Miscellaneous		
Noise Control Act of 1974 (RCW 70.107; WAC 173-60)	Establishes maximum noise levels.	The selective alternative will need to comply with local and state noise pollution requirements. Construction and other activities will need to be limited to normal working hours.
Grading Activities under Tacoma Municipal Code (Chapters 13.11 and 13.12)	Establishes restrictions of upland grading activities.	Substantive compliance required to minimize stormwater and other related impacts. MTCA cleanup actions are exempt from the procedural requirements of this law, but must comply with the substantive requirements.

Abbreviations:

ARAR	Applicable or relevant and appropriate requirement	MTCA	Model Toxics Control Act	RCRA	Resource Conservation and Recovery Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	NEPA	National Environmental Policy Act	RCW	Revised Code of Washington
CFR	Code of Federal Regulations	NPDES	National Pollutant Discharge Elimination System	SEPA	State Environmental Policy Act
CWA	Clean Water Act	NWAPA	Northwest Air Pollution Authority	USC	U.S. Code
Ecology	Washington State Department of Ecology	OSHA	Occupational Safety and Health Act	USEPA	U.S. Environmental Protection Agency
HAZWOPER	Hazardous Waste Operations and Emergency Response	POTW	Publicly-Owned Treatment Works	WAC	Washington Administrative Code
HWMA	Hazardous Waste Management Act	PSCAA	Puget Sound Clean Air Authority	WISHA	Washington Industrial Safety and Health Act

Table 8.1
Alternatives Disproportionate Cost Analysis

Disproportionate Cost Analysis Criteria[1]	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative Benefit Scoring**[2]
Alternative Description	Alternative 1 consists of soil excavation in six areas identified in Area A, consolidation of this soil to Area B, followed by regrading and capping of Area B. Soil would be excavated in the six areas to depths between 3 and 6 feet. The volume of soil to be excavated from Area A is between 450 and 1,100 cubic yards and will be established following a Pre-Excavation Extent Investigation. In this alternative, a 317,000 square-foot portion of Area B will be regraded in order to provide a suitable surface for both the temporary use of the area (parking for cars/trucks) and for future development. Once regraded, the area would be capped with a minimum 12-inch-thick cap consisting of a geotextile fabric or GeoGrid and crushed rock surfacing. The cap design would allow for infiltration of stormwater and would prevent any stormwater that does not infiltrate from contacting any contaminated soil. . Institutional controls would be required in the capped area where contaminated soil greater than cleanup levels would remain on site. Institutional controls would include required maintenance and monitoring of the cap surface. Post-construction groundwater confirmation monitoring of the shallow aquifer wells downgradient of the capped area is an additional component of this alternative.	Alternative 2 consists of full removal that excavates all soil at the Site with exceedances of the MTCA Method C cleanup level (1,680 pg/g). Between 450 and 1,100 cubic yards of soil from Area A and approximately 56,000 cubic yards of soil from Area B would be removed from the Site for off-site disposal. The excavated areas would then be backfilled to create a suitable surface for current temporary and future use. Post-construction groundwater confirmation monitoring of the shallow aquifer wells is an additional component of this alternative.	Alternative 3 consists of soil excavation in six areas identified in Area A, consolidation of this soil to Area B, followed by regrading and solidification/stabilization of soil in Area B. Soil would be excavated in the six areas to depths between 3 and 6 feet. The volume of soil to be excavated from Area A is between 450 and 1,100 cubic yards and will be established following a Pre-Excavation Extent Investigation. After an initial grading of the soil within a 317,000 square-foot portion of the Area B capped area, the contaminated soil would undergo solidification/stabilization. Approximately 57,000 cubic yards of contaminated soil plus an appropriate volume of a binding reagent (5 to 30 percent of the contaminated soil volume) would be mixed with the soil. Following mixing, the surface will be regraded in order to provide a suitable surface for both the temporary use of the area (parking for cars/trucks) and for future development. The new surface would be sloped to allow for sheet flow, which would then flow into a swale designed to treat and convey stormwater. Institutional controls would be required in the solidified area where contaminated soil greater than cleanup levels would remain on-site. Institutional controls would include required monitoring of the new surface. Post-construction groundwater confirmation monitoring of the shallow aquifer wells downgradient of and adjacent to the soil solidification/stabilization area is an additional component of this alternative.	
Consideration of Public Concerns • Whether the community has concerns • Degree to which the alternative addresses those concerns	Public concerns will be reviewed following the public comment period and addressed in the final cleanup action alternative selection and design.	Public concerns will be reviewed following the public comment period and addressed in the final cleanup action alternative selection and design.	Public concerns will be reviewed following the public comment period and addressed in the final cleanup action alternative selection and design.	Pending public comment.

Table 8.1
Alternatives Disproportionate Cost Analysis

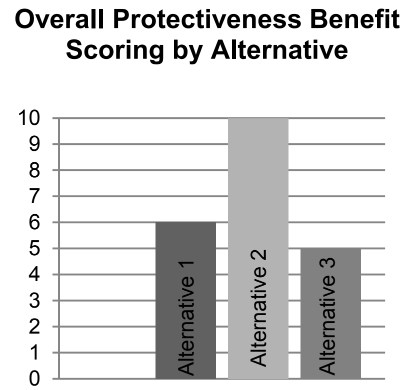
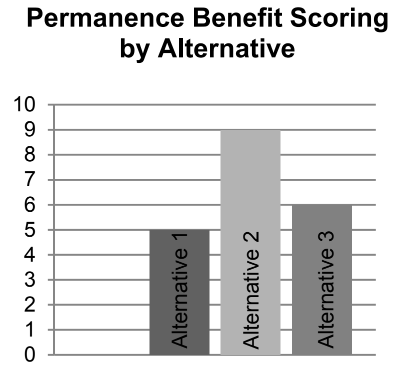
Disproportionate Cost Analysis Criteria[1]	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative Benefit Scoring[2]**
Overall Protectiveness - Degree to which existing risks are reduced - Time required to reduce risks and attain cleanup standards - On- and off-site risks resulting from alternative implementation - Improvement in overall environmental quality	- Risks would be reduced through contaminant mass removal in Area A, and capping with a crushed rock surfacing cap in Area B. The capped surface would be expected to have a long life and retain its integrity with required maintenance. The cap isolates the contamination from direct contact exposure by human and animal receptors. - Capping design, which incorporates infiltration and a stormwater conveyance system, would reduce the risk of contaminant conveyance to surface water features. The time frame to reduce risk for the direct contact exposure and erosion pathways in soil would be immediate, following remedy implementation; however, contamination remaining on-site would be greater than cleanup levels, requiring cap maintenance, monitoring, and institutional controls in perpetuity. - No on- or off-site risks result from implementation of this alternative. - Groundwater is currently in compliance; the existing contamination does not pose a risk for leaching to groundwater. There is an improvement in overall environmental quality resulting from implementation of this alternative through excavation, capping, monitoring, and implementation of institutional controls.	- Risks would be reduced through contaminant mass removal and relocation of all contaminants to a licensed landfill facility. Excavation and landfill disposal is considered a permanent remedy under MTCA. - The time frame to reduce risk for the direct contact exposure and erosion pathways in soil would be immediate, following remedy implementation. - No on- or off-site risks result from implementation of this alternative. - Groundwater is currently in compliance; the existing contamination does not pose a risk for leaching to groundwater. - There is a substantial improvement in overall environmental quality resulting from implementation of this alternative through excavation. This is a full removal alternative and would provide the greatest improvement in environmental quality.	- Risks would be reduced through contaminant mass removal in Area A, and by solidification/stabilization of contaminated soil in Area B. The solidified/stabilized soil mass would be expected to have a long life and retain its integrity as long as it remains in place undisturbed. Risk would be reduced by providing a protective remedy for direct contact exposure. Weathering and site redevelopment may cause the integrity of the surface to degrade over time, allowing for the mobilization of contaminants. - The solidified/stabilized soil surface will be sloped to a stormwater conveyance system to reduce the risk of contaminant conveyance to surface water features via stormwater. - The time frame to reduce risk for the direct contact exposure and erosion pathways in soil would be immediate, following remedy implementation; however, contamination remaining on-site would be greater than cleanup levels, requiring monitoring and institutional controls in perpetuity. - No on- or off-site risks result from implementation of this alternative. - Groundwater is currently in compliance; the existing contamination does not pose a risk for leaching to groundwater. - There is an improvement in overall environmental quality resulting from implementation of this alternative through excavation, solidification/stabilization, monitoring, and implementation of institutional controls. Uncertainties, including possible changes to groundwater flow at the Site and weathering of the solidified/stabilized surface over time, reduce the overall environmental benefit relative to Alternative 1.	
Permanence - Degree of reduction of contaminant toxicity, mobility, and volume - Adequacy of destruction of hazardous substances - Reduction or elimination of substance release, and source of release - Degree of irreversibility of waste treatment processes - Volume and characteristics of generated treatment residuals	This alternative provides no reduction in contaminant toxicity or volume. The surface cap would eliminate the potential for contaminant mobility through erosion. The existing dioxin contamination is not mobilized by leaching to groundwater, and groundwater is currently in compliance with cleanup standards. The cleanup action does not need to be designed to prevent infiltration. All contamination at the Site would remain beneath a capped surface, isolating the contamination from direct contact by human and animal receptors. Primary release mechanisms of dioxins/furans on-site have already been removed. There are no waste treatment processes or residuals associated with this alternative.	This alternative provides a high degree of reduction in on-site contaminant toxicity, mobility, and volume as all contamination would be excavated and disposed of off-site. Hazardous substances would be relocated to a permitted hazardous waste landfill for permanent management and isolation. Hazardous substances would not be treated or destroyed. Primary release mechanisms of dioxins/furans on-site have already been removed. There are no waste treatment processes or residuals associated with this alternative.	This alternative provides no reduction in contaminant toxicity. The addition of reagents (e.g., cement, additives) solidifies the contaminants and increases the volume of contaminants present at the Site. The solidification would eliminate the potential for contaminant mobility through erosion, assuming maintenance of the solidified surface. There is a risk that the surface of the solidified mass could degrade and release contaminants over the long-term. The existing dioxin contamination is not mobilized by leaching to groundwater, and groundwater is currently in compliance with cleanup standards. The cleanup action does not need to be designed to prevent infiltration. All contamination at the Site would remain within the solidified mass, isolating the contamination from direct contact by human and animal receptors. Primary release mechanisms of dioxins/furans on-site have already been removed. Stabilization is not considered a treatment technology, as contaminant toxicity is not reduced. Stabilization is irreversible. Residuals associated with the stabilization process include contaminated process water, which requires off-site disposal.	

Table 8.1
Alternatives Disproportionate Cost Analysis

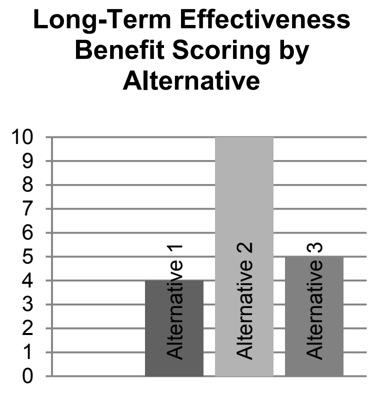
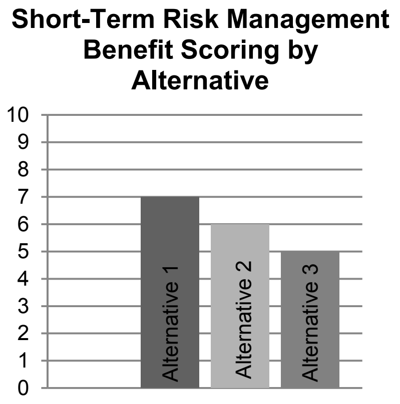
Disproportionate Cost Analysis Criteria[1]	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative Benefit Scoring**[2]
Effectiveness over the Long-Term - Degree of certainty of alternative success - Reliability while contaminants remain on-site greater than cleanup levels - Magnitude of residual risk - Effectiveness of controls implemented to manage residual risk	- Excavation and capping are proven common technologies that would effectively manage exposure pathways—assuming that caps are maintained and monitored in perpetuity, in accordance with institutional controls. - This alternative is reliable as long as the cap is properly maintained and institutional controls are followed. The alternative is fully compatible with industrial development and long-term site use. - Confirmational groundwater monitoring would confirm Site groundwater remains in compliance with cleanup standards. - Residual risk is moderate, as dioxin/furan contamination would remain on-site. - Risks are controlled through the enforcement of institutional controls and a Cap Inspection and Maintenance Plan, which are considered to be effective at managing risk.	- Excavation with landfill disposal is a common technology that would permanently remove contamination from the Site. - Excavation with landfill disposal is a reliable technology with measurable success for similar excavation and disposal projects. - Confirmational groundwater monitoring would confirm that groundwater at the Site remains in compliance with cleanup standards. - The magnitude of residual risk associated with this alternative is low, as all site contamination would be removed and managed at the hazardous waste landfill. - Residual risks associated with this alternative would be relocated to the hazardous waste landfill location.	- Soil solidification/stabilization is a proven technology that would effectively limit exposure pathways—assuming solidified/stabilized soil is monitored and maintained in perpetuity, in accordance with institutional controls. - This alternative is reliable as long as the solidified/stabilized soil is undisturbed and institutional controls are followed. Soil properties at the Site are well known and the contamination is reasonably homogenous, allowing for uniform application of the treatment technology. - Weathering of the stabilized soil surface over the long-term may pose a risk of contaminant release. When the stabilized mass must be disturbed by future industrial development activities (such as utility trenching), the excavated material is difficult to manage and would likely require off-site disposal. - Confirmational groundwater monitoring would confirm that groundwater at the Site remains in compliance with cleanup standards. - Residual risk is moderate, as dioxin/furan contamination would remain on-site. - Risks are controlled through the enforcement of institutional controls and a Cap Inspection and Maintenance Plan, which are considered to be effective at managing risk.	
Short-Term Risk Management - Risk to human health and the environment associated with alternative construction - The effectiveness of controls in place to manage short-term risks	With Alternative 1, contaminated soil is handled during excavation and regrading. - There is moderate short-term risk to human health and the environment during implementation. Excavation and regrading requires some handling of contaminated materials. - There is also a low risk for public exposure with this alternative as contaminated soil is not being removed from the Site. - Site activities would require appropriate PPE, BMPs, and appropriate training requirements for management of risk. These controls are highly effective and anticipated to adequately manage short-term risk.	Alternative 2 is a full removal alternative consisting of excavation and off-site disposal of a large volume of contaminated soil. - This alternative has a moderate short-term risk associated with workers' direct-contact during excavation and handling, and disposal of contaminated soil. - There is also a low, but increased, risk compared to Alternatives 1 and 3, for public exposure with this alternative as the contaminated soil would be removed and transported over public roadways, from the Site for disposal; however, the excavated soil would be managed by licensed professionals. - Site activities would require appropriate PPE, BMPs, and training requirements for management of risk. These controls are highly effective and anticipated to adequately manage short-term risk.	With Alternative 3, contaminated soil is handled during excavation, mixing, and regrading. - There is moderate short-term risk to human health and the environment during implementation. Excavation, mixing, and regrading requires significant handling of contaminated materials, and generates contaminated process water requiring off-site disposal. - There is also a low risk for public exposure with this alternative as contaminated soil would not be removed from the Site. - Site activities would require appropriate PPE, BMPs, and training requirements for management of risk. These controls are highly effective and anticipated to adequately manage short-term risk.	

Table 8.1
Alternatives Disproportionate Cost Analysis

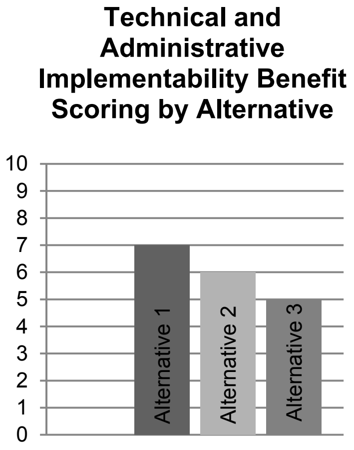
Disproportionate Cost Analysis Criteria[1]	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative Benefit Scoring[2]**
Technical and Administrative Implementability *Ability of alternative to be implemented considering:* • Technical possibility • Availability of off-site facilities, services, and materials • Administrative and regulatory requirements • Schedule, size, and complexity of construction • Monitoring requirements • Site access for construction, operations, and monitoring • Integration with existing site operations or other current and potential future cleanup action	• This alternative is technically possible to implement and involves common technologies. • All necessary off-site facilities, materials, and services are available within the region. • This alternative complies with all applicable administrative and regulatory requirements. • This alternative is moderate in scale. This alternative would be managed and constructed by specialty professionals familiar with the type of work, and this alternative can easily be implemented in a single construction season. • Monitoring requirements include soil cap monitoring in perpetuity and groundwater monitoring following implementation. • Site access would not be impeded for the implementation and construction of this alternative. • Future site access would be required for groundwater monitoring, soil cap monitoring, and maintenance. • This alternative is consistent with current conditions, but implementation can be integrated with both existing and proposed future site uses. • This alternative is fully compatible with industrial site development.	• This alternative is technically possible to implement and involves common technologies. • All necessary off-site facilities, materials, and services are available within the region. • This alternative complies with all applicable administrative and regulatory requirements. • This alternative is anticipated to achieve compliance with regulatory requirements in a short time frame. This alternative is very large in scale. This alternative would be managed and constructed by specialty professionals familiar with the type of work. • Monitoring requirements include groundwater monitoring. • Site access would not be impeded for the implementation and construction of this alternative. • Future site access would be required for groundwater monitoring. • This alternative is consistent with current conditions, but implementation can be integrated with both existing and proposed future site uses. • This alternative is fully compatible with industrial site development.	• This alternative is technically possible to implement. It involves specialty equipment, and is not commonly used for remediation of dioxins/furans. Solidification/stabilization is generally considered a "potentially effective" remediation technology for dioxins/furans. Limited performance data exists for sites with dioxin/furan concentrations present. • All necessary off-site facilities, materials, and services are available within the region. • This alternative complies with all applicable administrative and regulatory requirements. • This alternative is large in scale. Its complexity depends on whether an in situ or ex situ solidification/stabilization remedy is implemented. This alternative would be managed and constructed by specialty professionals familiar with the type of work, and this alternative could be implemented in a single year. • Monitoring requirements include monitoring of the new surface in perpetuity and groundwater monitoring following implementation. Solidification/stabilization alters groundwater flow patterns; for example, this alternative would likely require more extensive groundwater monitoring than would be required under Alternative 1. • Construction of the remedy is expected to have a longer duration than Alternative 1. Successful implementation will entail the use of specialized equipment. Reagents used for solidification/stabilization (e.g., cement, binders, and additives) must be transported to the Site, staged, and stored prior to their use in the implementation of the alternative. Solidification/stabilization increases soil volume; this consideration must be incorporated into the site grading plan and could affect future development at the Site. • Future site access would be required for groundwater monitoring and monitoring of the new surface. • This alternative is consistent with current conditions. Its implementation may limit proposed future site uses. When the stabilized mass must be disturbed by future industrial development activities (such as utility trenching), the excavated material is difficult to manage and would likely require off-site disposal.	

Table 8.1
Alternatives Disproportionate Cost Analysis

Disproportionate Cost Analysis Criteria[1]	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative Benefit Scoring**[2]
Cost[3] • Cost of construction • Long-term monitoring, operations, and maintenance costs • Agency oversight costs	• Construction Cost: $1.25 Million • Total Alternative Cost (including design and contingency): $2.0 Million • Long-term monitoring, operations, and maintenance costs would be moderate with Alternative 1. Annual monitoring and periodic maintenance of the cap would be required in perpetuity. • Agency oversight costs would be moderate with Alternative 1 and would include costs associated with oversight activities during construction and during annual groundwater and cap monitoring. Although construction oversight would likely consist of only one season, oversight of annual monitoring would be conducted in perpetuity.	• Construction Cost: $29.6 Million • Total Alternative Cost (including design and contingency): $41.6 Million • Long-term monitoring, operations, and maintenance costs would be low with Alternative 2. • Agency oversight costs would be moderate with Alternative 2 and would include oversight activities during construction and during groundwater monitoring. Costs for agency oversight during construction are expected to be higher with Alternative 2 than the other alternatives.	• Construction Cost: $5.8 Million • Total Alternative Cost (including design and contingency): $8.2 Million • Long-term monitoring, operations, and maintenance costs would be moderate with Alternative 3. Annual monitoring and periodic maintenance of the solidified/stabilized soil would be required in perpetuity. • Agency oversight costs would be moderate with Alternative 3 and would include costs associated with oversight activities during construction and during annual groundwater and monitoring of the new surface. Although construction oversight would likely consist of only 1 year, oversight of annual monitoring would be conducted in perpetuity. • This alternative carries some degree of uncertainty associated with prediction of long-term behavior of the remedy; additional agency oversight costs may be incurred to address mounding, weathering, or other problems that may develop over time.	

Notes:

1 Each alternative is scored relative to the seven Disproportionate Cost Analysis criteria defined in WAC 173-340-360(3)(f), which are provided in the left hand column of this table. The bullets underneath each criterion describe specific factors that are considered when evaluating the alternative's ability to satisfy this criterion.

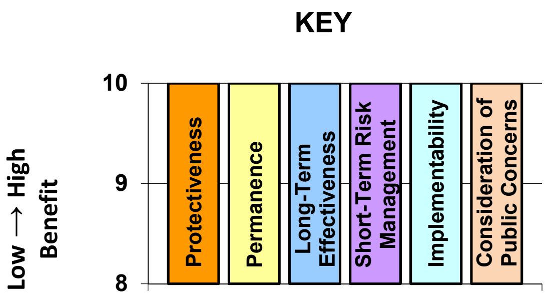
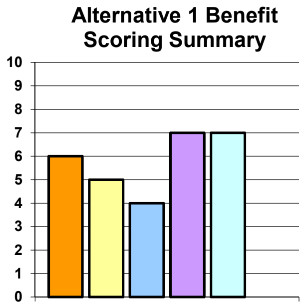
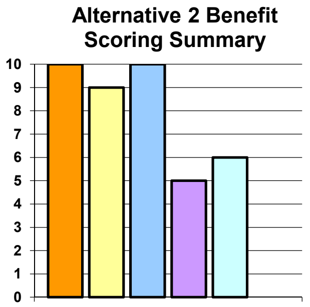
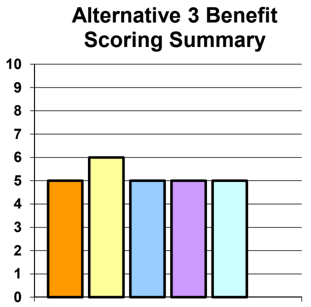
2 Based on the analysis provided in this table for each alternative, each alternative is assigned a benefit score for each criterion, with a maximum value of 10. A higher benefit score indicates that the alternative provides a higher level of relative benefit. Therefore, the benefit of Overall Protectiveness will earn a higher score if the alternative provides a greater protectiveness to human health and the environment, including considerations of time required to reduce risk, the degree of risk reduction, and the overall improvement in environmental quality. Similarly, a higher Permanence score indicates the alternative more permanently reduces the toxicity, mobility, or volume of hazardous substances. Table 8.2 identifies the Total Benefit Score assigned to each alternative after consideration of each of the individual scores assigned to each alternative in each category.

3 Specific cost estimate information is provided in Appendix E.

Abbreviations:

BMP	Best Management Practice.
MTCA	Model Toxics Control Act.
PPE	Personal Protective Equipment.
Site	Reichhold/SSA Containers.
WAC	Washington Administrative Code

Table 8.2
Disproportionate Cost Analysis Summary

Alternative	**Alternative 1**	**Alternative 2**	**Alternative 3**
Alternative Description	Alternative 1 consists of soil excavation in six areas identified in Area A, consolidation of this soil to Area B, followed by regrading and capping of Area B. The volume of soil to be excavated from Area A is between 450 and 1,100 cubic yards and will be established following a Pre-Excavation Extent Investigation. In this alternative, a 317,000-square-foot portion of Area B will be regraded in order to provide a suitable surface for both the temporary use of the area (parking for cars/trucks) and for future development. Once regraded, the area would be capped with a minimum 12-inch-thick cap consisting of a geotextile fabric or GeoGrid and crushed rock surfacing. The cap design would allow for infiltration of stormwater and would prevent any stormwater that does not infiltrate from contacting any contaminated soil. Institutional controls would be required in areas where contaminated soil with concentrations greater than cleanup levels would remain on-site. Institutional controls would likely include required maintenance and monitoring of the cap surface. Long-term groundwater monitoring of the shallow aquifer wells is also included in this alternative.	Alternative 2 consists of full removal that excavates all soil at the Site with exceedances of the MTCA Method C cleanup level (1,680 pg/g). Between 450 and 1,100 cubic yards of soil from Area A and approximately 56,000 cubic yards of soil from Area B would be removed from the Site for off-site disposal. The excavated areas would then be backfilled to create a suitable surface for current, temporary, and future use. Long-term groundwater monitoring of the shallow aquifer wells is also included in this alternative.	Alternative 3 consists of soil excavation in six areas identified in Area A, consolidation of this soil to Area B, followed by regrading and solidification/stabilization of soil in Area B. Soil would be excavated in the six areas to depths between 3 and 6 feet. The volume of soil to be excavated from Area A is between 450 and 1,100 cubic yards and will be established following a Pre-Excavation Extent Investigation. After an initial grading of the soil within a 317,000 square-foot portion of the Area B capped area, the contaminated soil would undergo solidification/stabilization. Approximately 57,000 cubic yards of contaminated soil plus an appropriate volume of a binding reagent (5 to 30 percent of the contaminated soil volume) would be mixed with the soil. Following mixing, the surface will be regraded in order to provide a suitable surface for both the temporary use of the area (parking for cars/trucks) and for future development. The new surface would be sloped to allow for sheet flow, which would then flow into a swale designed to treat and convey stormwater. Institutional controls would be required in areas where contaminated soil greater than cleanup levels would remain on-site. Institutional controls would include required monitoring of the new surface. Post-construction groundwater confirmation monitoring of the shallow aquifer wells downgradient of and adjacent to the soil solidification/stabilization area is an additional component of this alternative.
	Alternative 1 Benefit Scoring Summary Note: Public comment pending.	Alternative 2 Benefit Scoring Summary Note: Public comment pending.	Alternative 3 Benefit Scoring Summary Note: Public comment pending.
Compliance with MTCA Threshold Requirements	Yes	Yes	Yes
Restoration Time Frame (to achieve remediation goals)	Following Construction	Following Construction	Following Construction
Benefit Scoring[1]			
Overall Protectiveness (30%)	6	10	5
Permanence (20%)	5	9	6
Long-Term Effectiveness (20%)	4	10	5
Short-Term Risk Management (10%)	7	5	5
Implementability (10%)	7	6	5
Consideration of Public Concerns (10%)[2]	Pending Public Comment	Pending Public Comment	Pending Public Comment
Total Benefit Score (weighted)[3]	**5.0**	**7.9**	**4.7**
Estimated Alternative Cost[4]	$2.1 Million	$41.7 Million	$8.2 Million
Cost per Unit Benefit Ratio[5]	**0.4**	**5.3**	**1.7**

Notes:

1 Higher scores equate to a higher level of relative benefit. Detailed information justifying the scores given to each alternative in each category is presented in Table 8.1.

2 Public comment has not been received on the RI/FS. The benefit scoring for public concerns are estimated based on prior public concerns on similar projects.

3 The Total Benefit Score was calculated by multiplying the score each alternative received in each benefit category by its weighted percent, then summing the weighted scores. For example, for Alternative 2, the Overall Protectiveness score of 10 was multiplied by 0.3 for a weighted Overall Protectiveness score of 3; this process was repeated for each of the individual benefits to achieve weighted values of 1.8, 2, 0.5, and 0.6 in each of the remaining categories. These weighted values were summed to achieve a Total Benefit Score of 7.9.

4 Specific cost estimate information is provided in Appendix E.

5 Cost per Unit Benefit Ratio calculated by dividing the total alternative cost (in millions) by the alternative Total Benefit Score. Lower value indicates the most benefit for the associated cost.

Abbreviations:

MTCA	Model Toxics Control Act.
RI/FS	Remedial Investigation/Feasibility Study
Site	Reichhold/SSA Containers Facility

Reichold/SSA
Containers Facility

Supplemental Focused Remedial Investigation/ Supplemental Focused Feasibility Study

Figures

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Supplemental Focused Remedial Investigation/
Supplemental Focused Feasibility Study
Reichhold/SSA Containers Facility
Tacoma, Washington

Figure 1.1
Vicinity Map

I:\GIS\Projects\SSA-RHOLD\MXD\Phase 6200\Dioxin FRI-FFS\Figure 1.1 Vicinity Map.mxd
November 2015

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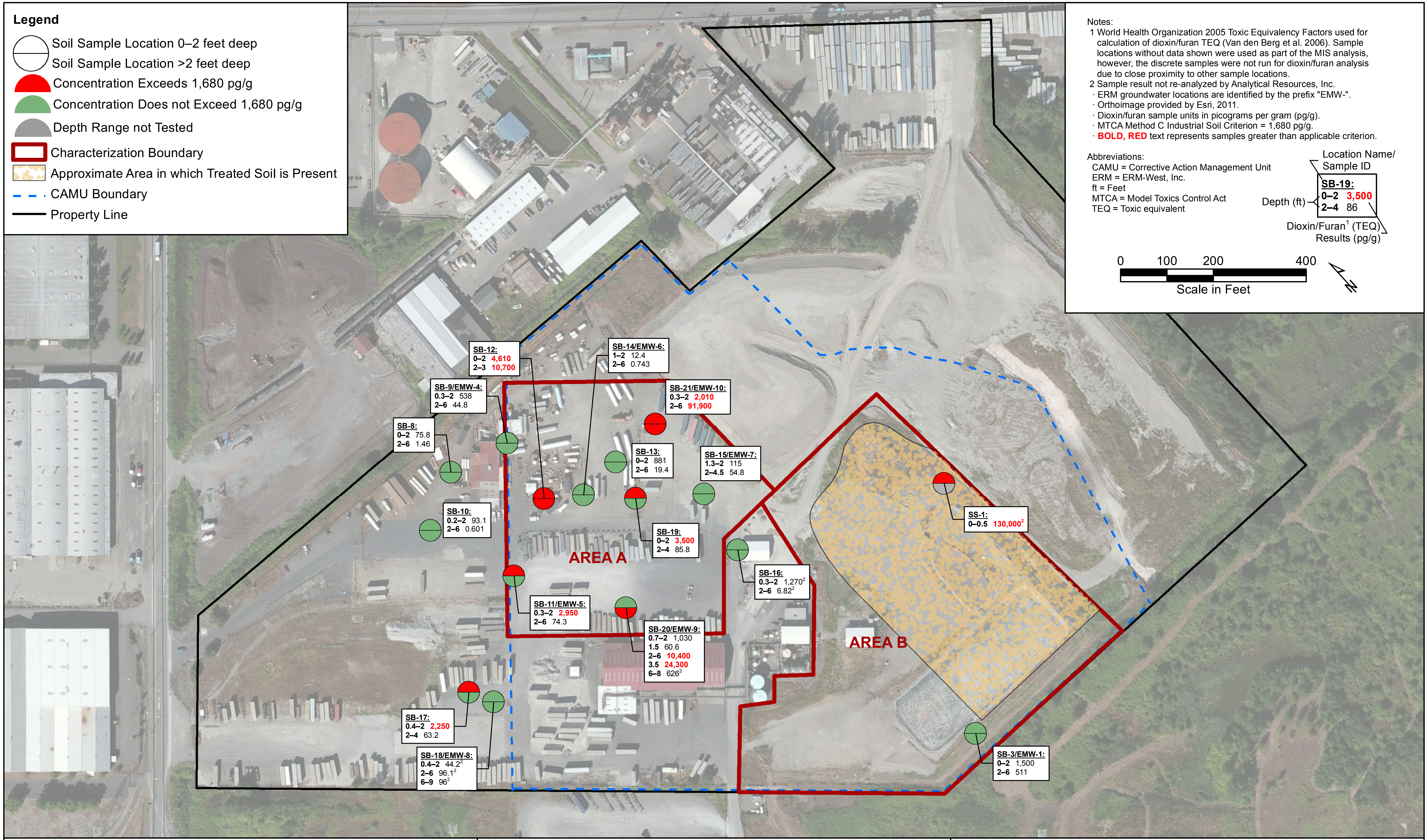
**Supplemental Focused Remedial Investigation/
Supplemental Focused Feasibility Study
Reichhold/SSA Containers Facility
Tacoma, Washington**

Figure 2.1
Monitoring Well Sample Locations
and Surface Water Features

I:\GIS\Projects\SSA-RHOLD\MXD\Phase 6200\Dioxin FRI-FFS\Figure 2.1 Monitoring Well Sample Locations and Surface Water Features.mxd
November 2015



Notes:
1 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxin/furan TEQ (Van den Berg et al. 2006). Sample locations without data shown were used as part of the MIS analysis, however, the discrete samples were not run for dioxin/furan analysis due to close proximity to other sample locations.
2 Sample result not re-analyzed by Analytical Resources, Inc.
· ERM groundwater locations are identified by the prefix "EMW-".
· Orthoimage provided by Esri, 2011.
· Dioxin/furan sample units in picograms per gram (pg/g).
· MTCA Method C Industrial Soil Criterion = 1,680 pg/g.
· **BOLD, RED** text represents samples greater than applicable criterion.

Abbreviations:
CAMU = Corrective Action Management Unit
ERM = ERM-West, Inc.
ft = Feet
MTCA = Model Toxics Control Act
TEQ = Toxic equivalent

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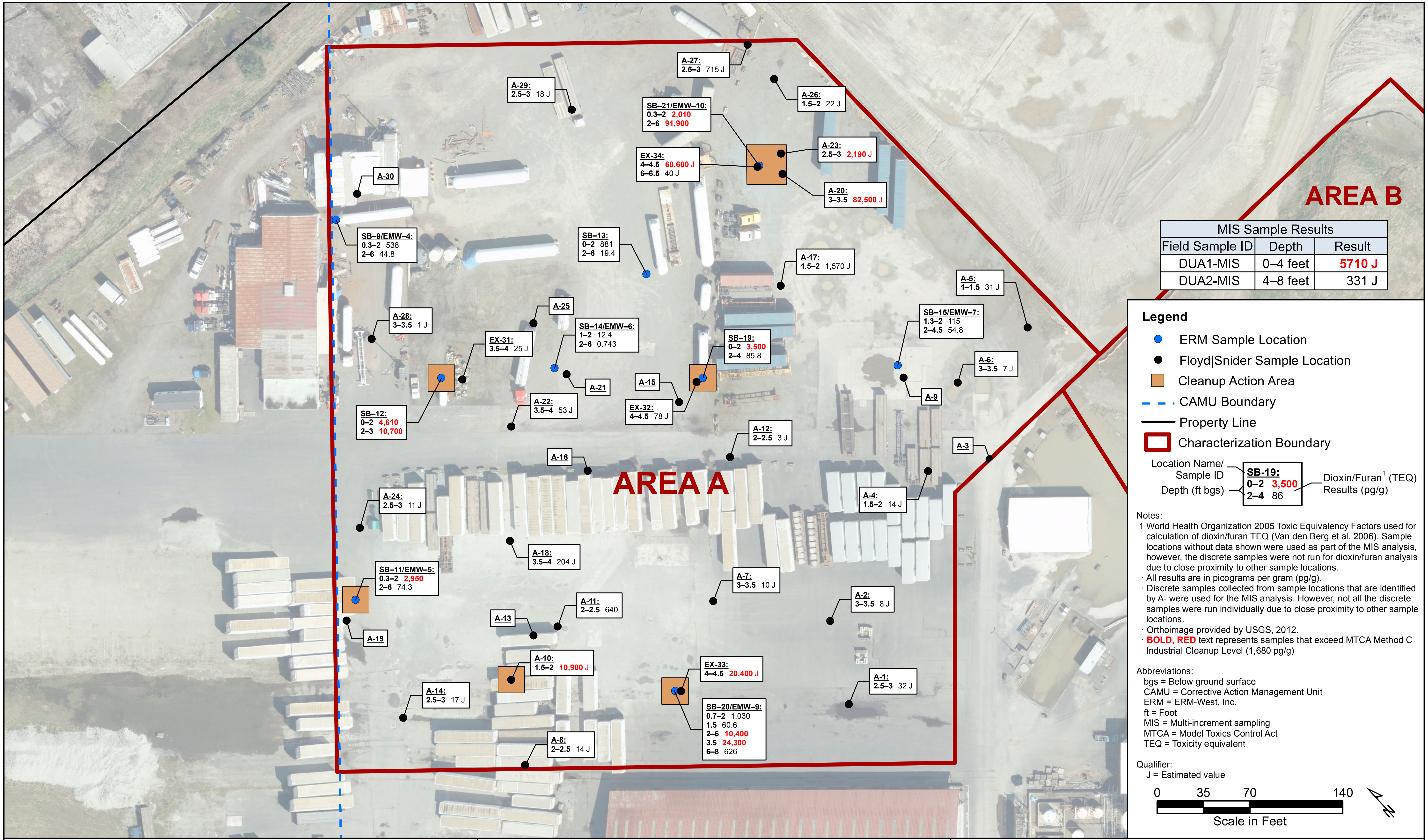
Figure 3.1
2014 ERM Dioxin/Furan Analytical Soil Results

I:\GIS\Projects\SSA-RHOLD\MXD\Phase 6200\Dioxin FRI-FFS\Figure 3.1 Sample Locations and Corrective Actions.mxd
November 2015



MIS Sample Results		
Field Sample ID	Depth	Result
DUA1-MIS	0–4 feet	**5710 J**
DUA2-MIS	4–8 feet	331 J

Legend

- ● ERM Sample Location
- ● Floyd|Snider Sample Location
- 🟧 Cleanup Action Area
- CAMU Boundary
- Property Line
- Characterization Boundary

Location Name/ Sample ID — **SB-19:**
Depth (ft bgs) — **0–2** **3,500** / **2–4** 86
Dioxin/Furan[1] (TEQ) Results (pg/g)

Notes:

1 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxin/furan TEQ (Van den Berg et al. 2006). Sample locations without data shown were used as part of the MIS analysis, however, the discrete samples were not run for dioxin/furan analysis due to close proximity to other sample locations.

- All results are in picograms per gram (pg/g).
- Discrete samples collected from sample locations that are identified by A- were used for the MIS analysis. However, not all the discrete samples were run individually due to close proximity to other sample locations.
- Orthoimage provided by USGS, 2012.
- **BOLD, RED** text represents samples that exceed MTCA Method C Industrial Cleanup Level (1,680 pg/g)

Abbreviations:

bgs = Below ground surface
CAMU = Corrective Action Management Unit
ERM = ERM-West, Inc.
ft = Foot
MIS = Multi-increment sampling
MTCA = Model Toxics Control Act
TEQ = Toxicity equivalent

Qualifier:

J = Estimated value

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Figure 5.1
Area A Dioxin/Furan TEQ Sample Results

I:\GIS\Projects\SSA-RHOLD\MXD\Phase 6200\Dioxin FRI-FFS\Figure 5.1 Area A Dioxin Furan TEQ Sample Results.mxd
January 2016

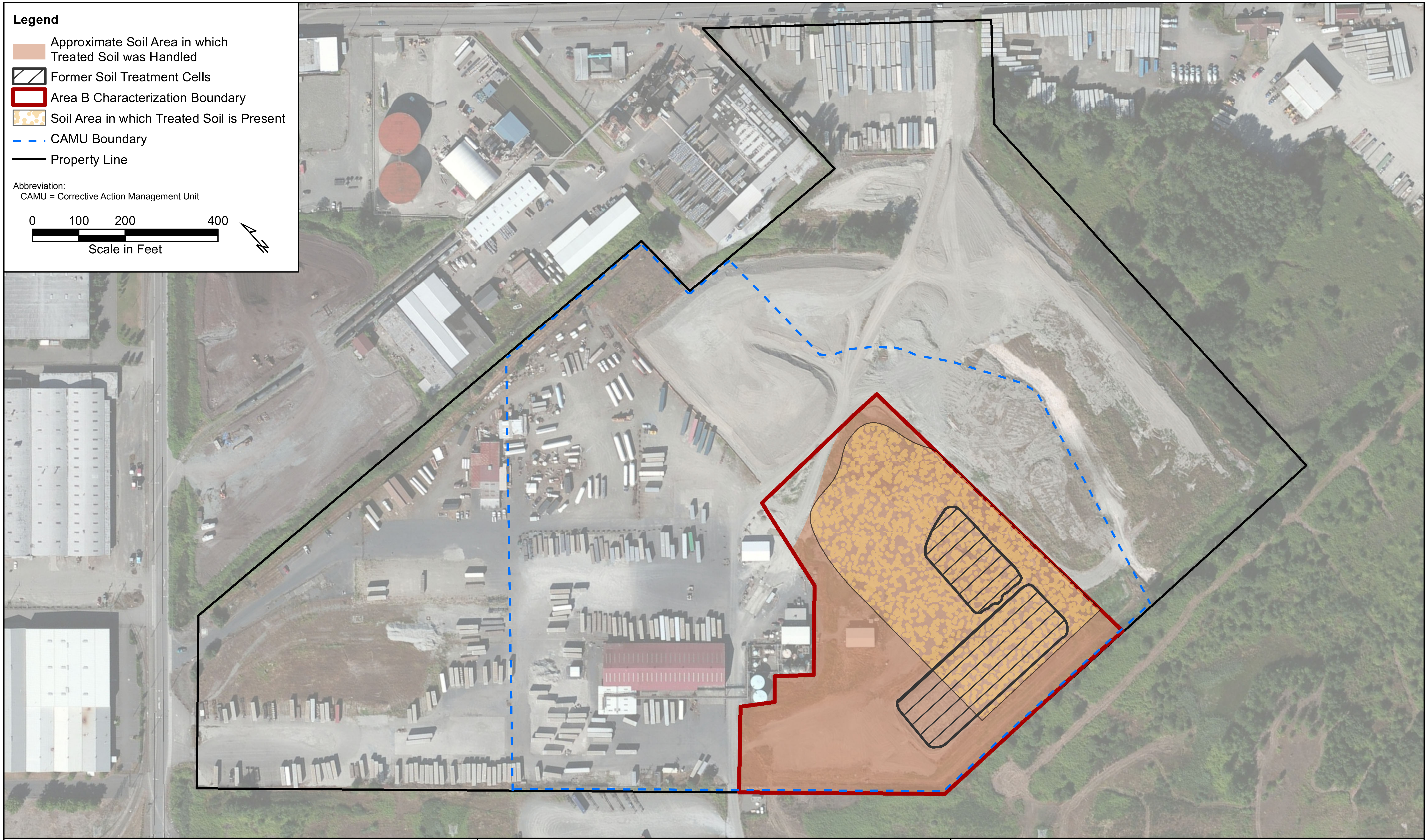

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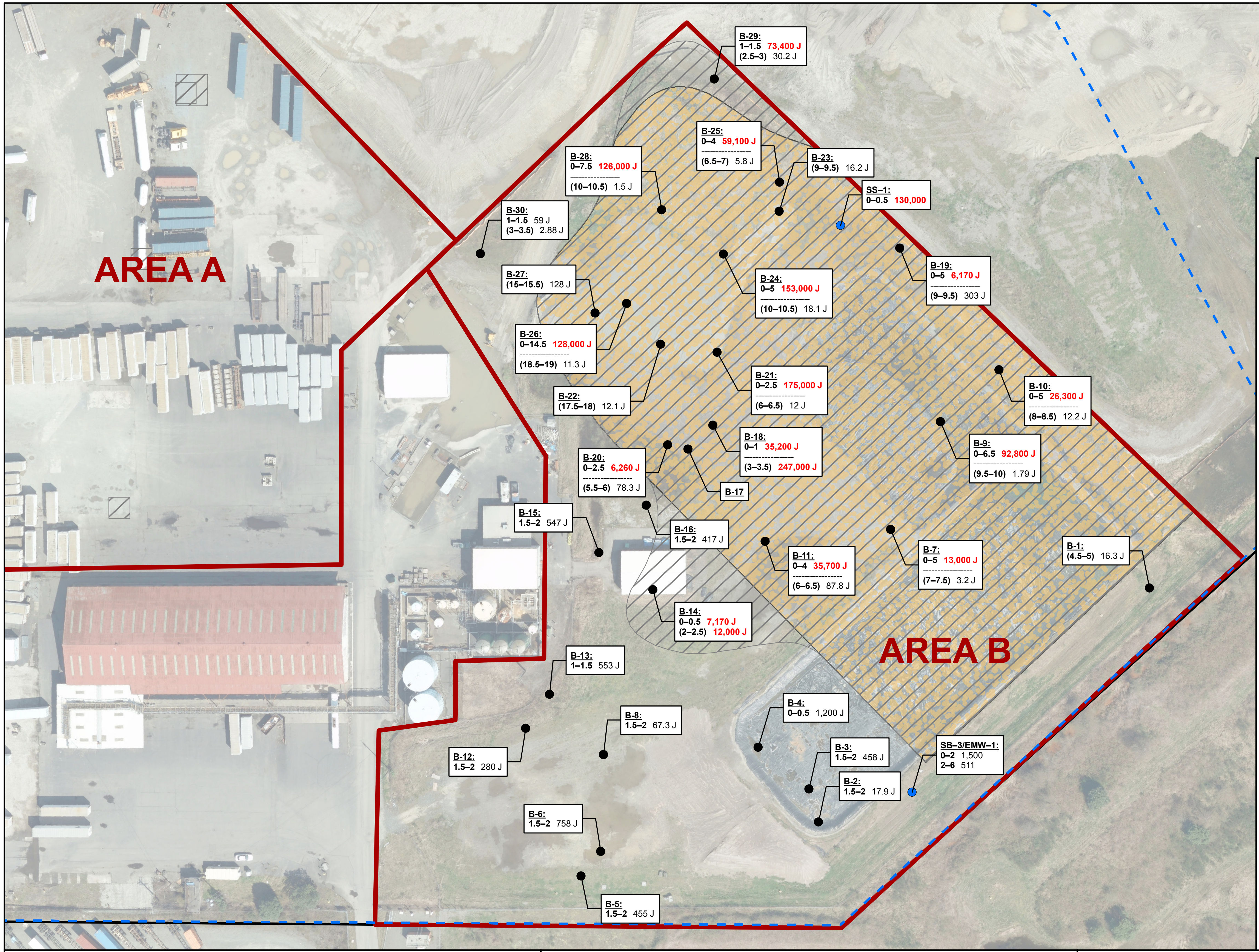
Figure 5.2
Treated Soil Laydown Area

I:\GIS\Projects\SSA-RHOLD\MXD\Phase 6200\Dioxin FRI-FFS\Figure 5.2 Treated Soil Laydown Area.mxd
January 2016



MIS Sample Results

Field Sample ID	Depth	Result
DU B1	0–2 feet bogs	**61600 J**
DU B2	2–6 feet bogs	**7390 J**

Legend

● ERM Sample Location

● Floyd|Snider Sample Location

- - - CAMU Boundary

— Property Line

▭ Characterization Boundary

▨ Approximate Soil Area in which Treated Soil is Present

▨ Area with Dioxin/Furan TEQ Concentrations Greater than CUL

Location Name/ Sample ID

B-10:
0–5 26,300 J

(8–8.5) 12.2 J

Dioxin/Furan[1] (TEQ) Results (pg/g)

All depths are in ft. bgs. Depths shown in "( )" are in DU B2, 2-6 ft. bogs.[2]

Results above dashed line are sampled from within treated soil.[3]

Notes:

1 World Health Organization 2005 Toxic Equivalency Factors used for calculation of dioxin/furan TEQ (Van den Berg et al. 2006). Sample locations without data shown were used as part of the MIS analysis, however, the discrete samples were not run for dioxin/furan analysis due to close proximity to other sample locations.

2. Refer to Table 5.2 for sample-specific conversions between depth bgs and depth bogs.

3. If no dashed line, either no treated soil was present or a discrete sample was not analyzed due to proximity of adjacent samples.

- All results are in picograms per gram (pg/g).
- Discrete samples collected from sample locations that are identified by B- were used for the MIS analysis. However, not all the discrete samples were run individually due to close proximity to other sample locations.
- Orthoimage provided by USGS, 2012.
- **BOLD, RED** text represents samples that exceed MTCA Method C Industrial Cleanup Level (1,680 pg/g).

Abbreviations:

bgs = Below ground surface
bogs = Below original ground surface (below treated soil if present)
CAMU = Corrective Action Management Unit
CUL = Cleanup level
ERM = ERM-West, Inc.
ft = Feet
MIS = Multi-increment sampling
MTCA = Model Toxics Control Act
TEQ = Toxicity equivalent

Qualifier:
J = Estimated value

0 50 100 200
Scale in Feet

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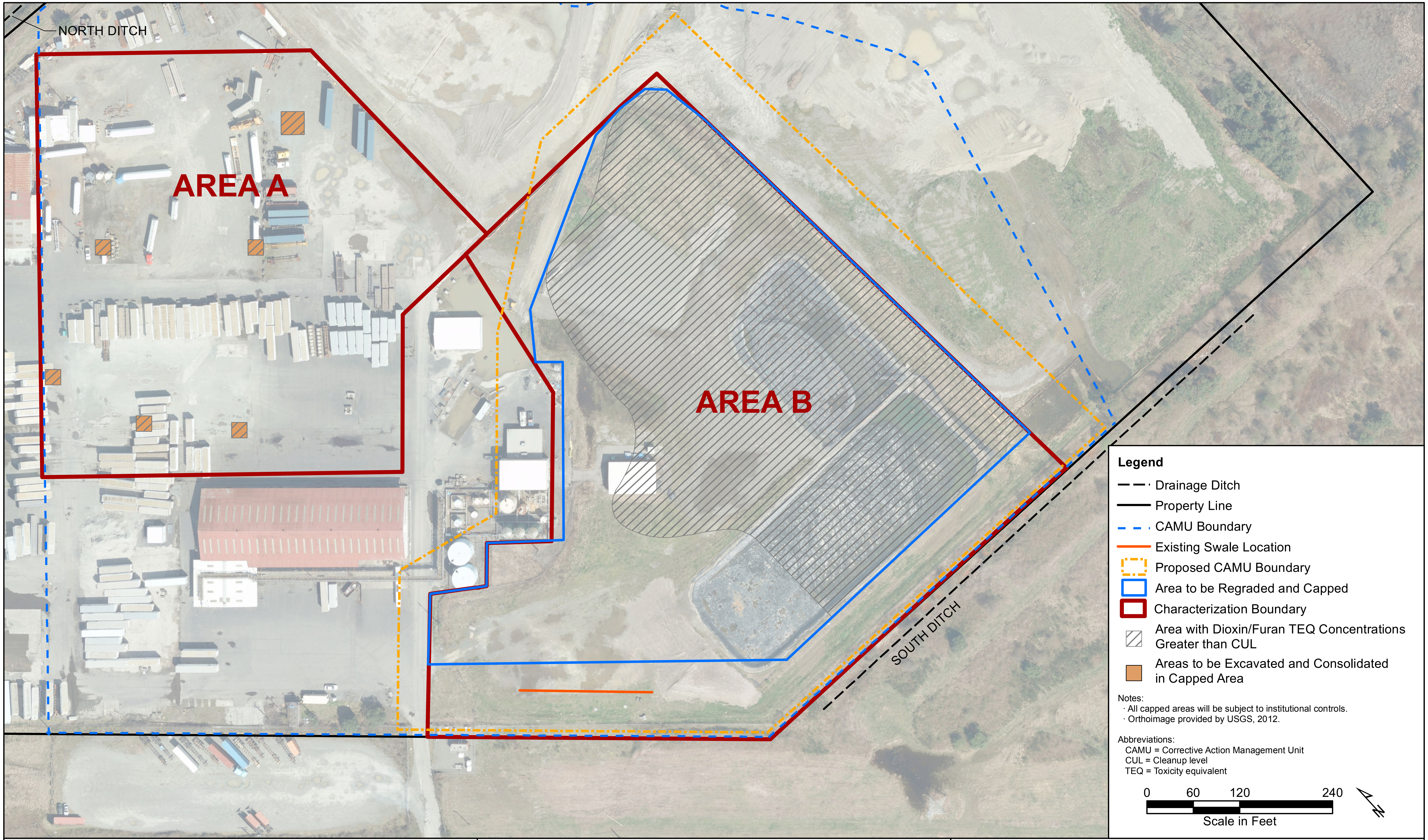
Figure 5.3
Area B Dioxin/Furan TEQ Sample Results

I:\GIS\Projects\SSA-RHOLD\MXD\Phase 6200\Dioxin FRI-FFS\Figure 5.3 Area B Dioxin Furan TEQ Sample Results.mxd
January 2016



Notes:
- All capped areas will be subject to institutional controls.
- Orthoimage provided by USGS, 2012.

Abbreviations:
CAMU = Corrective Action Management Unit
CUL = Cleanup level
TEQ = Toxicity equivalent

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Figure 9.1
Proposed Cleanup Action Alternative

I:\GIS\Projects\SSA-RHOLD\MXD\Phase 6200\Dioxin FRI-FFS\Figure 9.1 Proposed Cleanup Action Alternative.mxd
January 2016

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Appendix A

2008 Memorandum: Evaluation of Potential for Future Soil Dioxin Concerns at the Reichhold/SSA Containers Facility

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Memorandum

To: Stan Leja, Washington State Department of Ecology
Copies: Al Jeroue, SSA Containers, Inc.
From: Jill Thomas, Stephen Bentsen
Date: March 19, 2008
Project No: SSA-RHOLD.3050
Re: **Evaluation of Potential for Future Soil Dioxin Concerns at the Reichhold/SSA Containers Facility**

This memo has been prepared in response to a request from the Washington State Department of Ecology (Ecology) to provide documentation regarding the fact that dioxins are not defined as constituents of concern (COCs) at the Reichhold/SSA Containers Facility (the Facility). This memo provides a full summary of research on the issue conducted by Floyd|Snider.

Since 1986, Reichhold, Inc. (Reichhold) has performed extensive characterization and remediation activities under the Resource Conservation and Recovery Act (RCRA) Corrective Action Program. Significant soil and groundwater corrective actions were implemented by Reichhold at the Facility between 1989 and 2002. These corrective actions included excavation of source material from all primary areas of concern throughout the Facility—with both off-site disposal and on-site bioremediation of excavated soil. Additionally, significant interim corrective actions for groundwater cleanup were implemented during this time period including groundwater containment within both the Shallow and Intermediate Aquifers, and groundwater extraction and treatment.

These actions were implemented with the support of the U.S. Environmental Protection Agency (USEPA) Region 10 and Ecology under a RCRA Storage and Corrective Action Permit administered by USEPA and valid for 10 years. In 1997 USEPA and Ecology determined that Ecology would assume the role of lead agency for the RCRA permit renewal and for oversight of ongoing interim actions.

In 1998, Reichhold submitted to Ecology a permit renewal application to permit specific units and to continue the corrective action program to ensure that interim corrective actions met the cleanup standards of the expired permit. In 2002, Reichhold and the agencies concluded that Reichhold did not need the storage portion of the permit to support corrective actions and that a dangerous waste permit solely for corrective action would suffice. The corrective action permit was issued in 2004 and incorporates by reference Model Toxics Control Act (MTCA) Agreed Orders for corrective action. This Agreed Order is the legal mechanism for completing the Final Remedial Investigation and Feasibility Study at the Facility. The Agreed Order meets the requirements of federal corrective action, Washington State's Dangerous Waste Management Act (Revised Code of Washington [RCW] 70.105D.050(1)) and its Dangerous Waste Regulations (Washington Administrative Code [WAC] 173-303) and MTCA (WAC 173-340).

The Facility has met both RCRA Corrective Action Environmental Indicators: Current Human Exposures Under Control (CA725) and Migration of Contaminated Groundwater Under Control (CA750).

The corrective actions implemented between 1989 and 2002 have accomplished the significant majority of cleanup work required at the Facility. Therefore, the majority of site remediation was already completed when USEPA delegated authority for final corrective actions to Ecology in 2004.

The Ecology Agreed Orders for final corrective action issued in 2004 required Reichhold to conduct a Focused Remedial Investigation (FRI) at the Facility to augment the investigations completed to date, and to determine the extent of remaining contamination concerns. The FRI was approved by Ecology in July 2006. The FRI and subsequent Focused Feasibility Study (FFS) required by the Agreed Orders are focused on addressing residual contamination and environmental monitoring. The FRI and FFS identified the applicable surface water criteria, groundwater protective concentrations, and soil cleanup levels. They also evaluated the analytical data and identified the COCs for the Facility.

Throughout this regulatory history, dioxins have never been defined as COCs, and therefore were not addressed in the FRI/FFS process. Site data and regulatory history (summarized in this memo) support this approach.

All soils targeted for off-site disposal will be appropriately characterized per the requirements of the disposal facility. Although dioxins have not been defined as COCs for the Facility, dioxin analysis may be required to ensure proper disposal.

EXECUTIVE SUMMARY

Based on available dioxin data for the Facility, there appears to be little potential for future issues regarding levels of dioxins in the soil or groundwater at the Facility.

During the regulatory history at the Facility, investigation for dioxins was conducted, and dioxins were ruled out as COCs. Only 5 of the 92 soil samples collected at the Facility for dioxin analyses had detectable levels of 2,3,7,8-tetrachlorinated dibenzo-*p*-dioxin (TCDD) or 2,3,7,8-tetrachlorinated dibenzofuran (TCDF). Three of those five were collected in areas that have since been excavated and/or treated; the other two samples were collected from the Wastewater Pond area and had total toxic equivalencies (TEQs) of 160 and 290 parts per trillion (ppt), considerably less than both the previous and newly adopted revised MTCA Method C Industrial Cleanup Levels (CULs) that are applicable to this Facility. Groundwater samples from the 1980s and 1990s were primarily non-detects. The only two well samples with any measurable level of dioxins had total TEQs less than 0.1 ppt.

BACKGROUND

Previous corrective actions at the Facility did not address dioxins in soil and dioxins were not formally defined as COCs in the FRI and FFS processes. However, several investigations concerning dioxins have been implemented at the Facility, which are discussed further below. Additionally, in a 2002 letter from Ecology that identified the treatment levels for COCs in the soil treatment cells, it was stated that "Dioxin and furan compounds, although present in soil in many areas of the site, have not been included since treatment options for these chemicals do not exist" (Ecology 2002).

Dioxin Background

Dioxins are primarily of interest in soils, as they are lipophilic and hydrophobic. As a result of these particular characteristics, they preferentially associate with particulate matter and organic matter in sediments and soil rather than existing freely in water. Once associated with particulate matter, there is little migration into groundwater.

The term "dioxins" actually refers to a complex mixture of chlorinated dibenzo-*p*-dioxins (CDDs) and chlorinated dibenzofurans (CDFs). Both CDDs and CDFs are composed of two benzene rings, CDDs have two oxygen atoms connecting the benzene rings and CDFs have one oxygen atom connecting the benzene rings. CDDs and CDFs can have one to eight chlorine atoms substituted on the benzene rings. The number of chlorine atoms determines the homologue group with the first letter abbreviated to indicate the number of chlorine atoms (e.g., four chlorine atoms are tetrachlorinated dibenzo-*p*-dioxin (TCDD) or tetrachlorinated dibenzofuran (TCDF). Within each homologue group the spatial arrangement of the chlorine atoms (e.g., which carbon atoms have chlorine atoms) defines specific congeners (e.g., 2,3,7,8-TCDD). There are 75 possible CDD congeners and 135 possible CDF congeners (Shields et al. 2006).

The relative toxicity of individual CDD/CDF congeners varies a great deal, with differences ranging up to three orders of magnitude, which makes evaluating dioxin mixtures difficult. One method of evaluating a complex mixture is the toxicity equivalency methodology, which uses toxicity equivalency factors (TEFs) to estimate the potency of each congener in a mixture relative to the index chemical, which for dioxins is 2,3,7,8-TCDD, considered the most toxic congener. Each measured concentration for a congener or homologue group is multiplied by the TEF for that congener or homologue. These values are then summed to produce the total TEQ, which represents the approximate toxicity of the mixture. The TEQ can then be compared to criteria. TEFs are unitless, so TEQs carry the units of the original measurements.

REICHHOLD/SSA CONTAINERS FACILITY DIOXIN INFORMATION

Reichhold manufactured pentachlorophenol (PCP) at the Facility using a stepwise chlorination method, combining phenol and elemental chlorine with heat and aluminum chloride catalyst (CH2M HILL 1998), the method commonly used by manufacturers in the United States (ASTDR 2001). A by-product of this method is low levels of dioxins as impurities in the PCP.

There were several soil and groundwater dioxin sampling events at the Facility in the 1980s and 1990s, as identified below.

- **1984**. As part of the USEPA National Dioxin Study, 39 soil samples were collected at the Facility.
- **1984 or 1985**. An unauthorized event by Greenpeace collected three soil samples.
- **1986.** International Technology Corporation (ITC) collected and analyzed six soil samples and prepared a report summarizing the analytical results (ITC 1986).
- **1986-1987**. CH2M HILL collected and analyzed 45 soil samples for a Dioxin Furan Study.
- **1989-1990**. Groundwater sampling from Shallow and Intermediate Aquifer wells.
- **1998**. Groundwater sampling event for dioxin as part of a USEPA Comprehensive Monitoring Evaluation (CME) audit.

The nature of these investigations and the results are described in the following paragraphs. All samples, except for one, show dioxin levels less than the recently revised MTCA Method C CULs. The one sample from the 1986 ITC Dioxin Report that exceeds the CUL has numerous uncertainties and does not provide realistic results. This sample is discussed in further detail below.

1984 USEPA National Dioxin Study

In the 1980s the USEPA conducted the National Dioxin Study, a 2-year investigation to establish the extent of dioxin contamination nationwide. As part of this study, Radian Corporation collected 39 soil and sediment samples from the Facility in December 1984. The Facility was classified as a Tier 6 facility, which is defined as a facility where chemical processes could inadvertently form 2,3,7,8-TCDD. Sample locations included Wastewater Ponds 1 through 4, the Lincoln Avenue Drain, the Main Disposal Area and the Resin Tank Farm (refer to enclosed Figure 2-1 from the study). Analysis for 2,3,7,8-TCDD showed detects in only two samples, both sediment from wastewater ponds. The 2,3,7,8-TCDD result for a sediment sample taken at the influent pipe at Treatment Pond #1 at Sample Location 1 was 260 ppt (0.26 ppb) and for another sample taken at the influent pipe at Treatment Pond #3, Sample Location 14, was 160 ppt (0.16 ppb; USEPA 1986). As these results were less than the then current National Centers for Disease Control threshold level of concern for this chemical in residential soil of 1 ppb 2,3,7,8-TCDD, the USEPA concluded that these results did not constitute an environmental concern.

In 1990, soils from Treatment Pond #1, which contained Sample Location #1, were excavated and the pond was filled and closed. Verification samples showed soil remaining in place with concentrations less than the MTCA Method B CULs. Sample Location #1 was likely removed during this excavation. Analytical results from Treatment Pond #3 showed that no contaminants at concentrations greater than regulatory levels were present and the ponds were subsequently filled in and covered (Leja 2002).

1984 or 1985 Greenpeace Sampling

Members of the Greenpeace organization trespassed on Facility property and collected soil samples in the Disposal Area and the Lincoln Avenue Drain. Northwest Environmental Services analyzed the Greenpeace samples for 2,3,7,8-TCDD and found no detectable amounts (CH2M HILL 1986).

1986 ITC Dioxin Report

As summarized in an August 1986 report entitled Final Dioxin and Dibenzofuran Report for Reichhold Chemical, Tacoma, Washington, ITC received six soil composite samples in July 1986 for analysis of 2,3,7,8-TCDD/TCDF and total dioxin and total dibenzofuran homolog analysis. The sampling locations are unknown for these samples and data are available only for Samples #1 through #5. There is no explanation for the absence of data from the sixth sample. The results for all five samples were non-detects for 2,3,7,8-TCDD and 2,3,7,8-TCDF. Only one sample showed detectable levels of TCDD or TCDF homologs, Sample #1, with 2,000 ppt (2.0 ppb) and 1,800 ppt (1.8 ppb), respectively. The results for this sample showed detectable levels for all homologs but HxCDF, with the highest measured homolog OCDD at 23,500 ppt (23.5 ppb). The results for two of the samples, #2 and #3, were non-detect for all but four of the homologs (HpCDD, OCDD, HpCDF and OCDF) with OCDD detected at the highest concentrations in both samples at 2,200 ppt (2.2 ppb) and 18,700 ppt (18.7 ppb), respectively. The results for Samples #4 and #5 were non-detects for all homologs but OCDD at 360 ppt (0.36 ppb) and 810 ppt (0.81 ppb), respectively. The results for Samples #1 through #5 are presented in Table 1.

1986-1988 Dioxin and Furan Soil Sampling

In 1988, CH2M HILL issued a report entitled Dioxin and Furan Soil Sampling Results. This study examined 38 archived soil samples that were collected in September and October 1986, as part of the 1986 Preclosure Investigation and 7 soil samples collected in 1987 to assess the leachability of any dioxins in the soil at the Facility using Toxicity Characteristic Leaching Procedure (TCLP) extraction. Of the 45 samples analyzed, only 3 had detectable amounts of CDDs and CDFs in the tetra-, penta-, or hexa-homolog classes in the TCLP leachate. Sample locations are shown in the enclosed Figure 1 from CH2M HILL's report and are described below.

1. PCP-5, a composite sample of soils collected 6 to 7.5 feet below ground surface (bgs) from the former Pentachlorophenol Plant Area.
2. SDA-7, a composite sample of soils collected 4.5 to 6 feet bgs from the Construction Debris Area.
3. SDA-23, a composite sample of soils collected 3 to 4.5 feet bgs, also from the Construction Debris Area.

In response to a request from Ecology and USEPA that any samples with detectable levels of CDDs or CDFs in the TCLP extract be analyzed for total soil CDDs and CDFs, these three samples, along with a sample from a relatively clean area for background/quality assurance

(SDA-16), were analyzed for total CDDs and CDFs in the soil. Only one of these samples, SDA-7, the deeper sample (4.5 to 6 feet bgs) from the Construction Debris Area, had results with detectable 2,3,7,8-TCDD at 5,000 ppt (5 ppb). The results for this same sample, SDA-7, showed the highest levels of other congeners, with 31,500,000 ppt (31,500 ppb) of HpCDDs. The TEQs ranged from a low at PCP-5 of 354,700 ppt (355 ppb) to a high at SDA-7 of 58,425,900 ppt (58,426 ppb). It should be noted that quality assurance checks indicated poor precision for all of the samples, particularly for samples near the detection limit.

In 1996, soil from three areas of the former Pentachlorophenol Plant (where Sample PCP-5 was collected) was excavated. In 2002 the soil from the Construction Debris Area, where Samples SDA-7 and SDA-23 were collected, was excavated. Based on information provided by site personnel, the excavation was up to 18-feet deep in areas and was filled with clean soil after the excavation was complete. Confirmation sampling was done for polychlorinated biphenyls and PCP, but not for dioxins. Results for SDA-16, the only sample in this event collected from an area not known to be subsequently excavated, are presented in Table 1.

1989-1990 Groundwater Sampling

Examination of the historical database for the Facility shows that groundwater samples were collected in January 1989 from seven wells in the Shallow Aquifer: MW-004(S), MW-010(S), MW-012(S), MW-033(S), MW-051(S), MW-054(S), and MW-057(S). In addition, groundwater was collected from a well in the Intermediate Aquifer in July 1990. These groundwater samples were analyzed for 2,3,7,8-TCDD, total TCDDs, PeCDDs, HxCDDs, TCDFs, PeCDFs and HxCDFs. All sample results were less than detection limits, which ranged from 0.042 µg/L to 0.84 µg/L, for all analytes.

1998 Groundwater Sampling for USEPA CME Audit

Groundwater samples were also collected during the 1998 USEPA CME audit from two wells in the Intermediate Aquifer, MW-30(I) and MW-45(I), and one well from the Shallow Aquifer, MW-14(S). The samples were analyzed for 17 dioxin and furan congeners (Landau 1999). There were no detects for Well MW-45(I). The total TEQ for Well MW-30I was 0.000645 ppt, and for Well MW-14(S) was 0.66 ppt. The MW-14(S) sample was turbid, which could have impacted the results, so the well was resampled and subsequently showed a TEQ of 0.06 ppt. All these groundwater results, showing little if any dioxin in the groundwater, are consistent with the known dioxin chemical characteristics of high lipophilicity and low water solubility that result in dioxin compounds preferentially adsorbing to sediment particles.

WASHINGTON STATE RULE CHANGES FOR MODEL TOXICS CONTROL ACT

On November 12, 2007 Ecology adopted proposed revisions to MTCA for determining action levels for dioxin in soil (Ecology 2007). The adopted revision:

- requires that CULs for dioxin and furan mixtures be based on a cancer risk of one-in-a-million (10^{-6}),

- uses the 2005 TEFs for dioxins recommended by World Health Organization (WHO; Van den Berg et al. 2006),
- modifies the Gastrointestinal Absorption Fraction used to establish soil CULs for dioxin mixtures from 1.0 to 0.6, and
- requires cleanup proponents to consider the physical-chemical properties of individual dioxin congeners when evaluating cross-media impacts.

These changes result in an increase in the CULs (i.e., less stringent) for dioxins in industrial soil based on human health risk, going from the previous 875 ppt to 1,460 ppt TEQ as shown in Table 2.

CONCLUSIONS

Only 5 of the 92 soil samples collected at the Facility had results with detectable levels of 2,3,7,8-TCDD or 2,3,7,8-TCDF. Four of those five were collected in areas that have since been excavated and/or treated. The other sample was collected from the Wastewater Pond Area and its result showed a total TEQ of 160 ppt, significantly less than either the previous MTCA Method C criteria of 875 ppt or the new level of 1,460 ppt TEQ. A few undocumented samples collected from unknown locations and depths showed measurable levels of some of the homolog groups (primarily hepta- and octachlorinated CDDs and CDFs). Conservative total TEQs for these samples ranged from less than 1 to 4,800 ppt. The highest of these and the only TEQ greater than either previous or current MTCA Method C criteria, is an unrealistic and overly conservative TEQ value driven by using 2,3,7,8-TCDD and 2,3,7,8-TCDF TEFs with homolog data where the actual 2,3,7,8-TCDD and 2,3,7,8-TCDF analysis showed non-detects. Therefore, the soil data do not indicate a potential for future issues with dioxins at this Facility.

The groundwater data (which were largely non-detects for dioxins in groundwater) indicates that dioxin transport from soil to groundwater is not of concern.

These soil and groundwater data defend the determination that dioxins are not COCs at the Facility.

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Tables

Table 1
Reichhold/SSA Facility Dioxin Soil Data[1] (ppb)

		National Dioxin Study (1984)	CH2M HILL[2] (1986-1987)	ITC (1986)				
Constituent	**WHO 2005 TEFs**	**Wastewater Pond #3 Sediment Sample #14**	**SDA-16 (6-7.5 feet) Composite**	**Soil #1 Composite**	**Soil #2 Composite**	**Soil #3 Composite**	**Soil #4 Composite**	**Soil #5 Composite**
TetraCDDs				2.00	ND(0.018)	ND(0.035)	ND(0.052)	ND(0.030)
2,3,7,8-TCDD	1	0.16	ND (1.6)	ND(0.093)	ND(0.0031)	ND(0.086)	ND(0.14)	ND(0.080)
Other TCDDs			ND (0.4)					
PentaCDDs				2.10	ND(0.0035)	ND(0.12)	ND(0.091)	ND(0.33)
1,2,3,7,8-PeCDD	1		ND (8.4)					
Other PeCDDs			ND (1.6)					
HexaCDDs				2.10	ND(0.0083)	ND(0.17)	ND(0.48)	ND(0.71)
1,2,3,4,7,8-HxCDD	0.1		ND (13.2)					
1,2,3,6,7,8-HxCDD	0.1		ND (12.3)					
1,2,3,7,8,9-HxCDD	0.1		ND (11.4)					
Other HxCDDs			ND (1.7)					
HeptaCDDs				5.20	0.23	1.9	ND(0.046)	ND(0.042)
1,2,3,4,6,7,8-HpCDD	0.01		18.1					
Other HpCDDs			11.1					
OctaCDDs	0.0003			23.50	2.2	18.7	0.36	0.81
TetraCDFs				1.80	ND(0.0060)	ND(0.016)	ND(0.29)	ND(0.020)
2,3,7,8-TCDF	0.1		ND (1.9)	ND(0.18)	ND(0.0060)	ND(0.074)	ND(0.046)	ND(0.096)
Other TCDFs			1.9					
PentaCDFs				0.75	ND(0.0031)	ND(0.021)	ND(0.34)	ND(0.079)
1,2,3,7,8-PeCDF	0.03		ND (3.4)					

Table 1
Reichhold/SSA Facility Dioxin Soil Data[1] (ppb)

		National Dioxin Study (1984)	CH2M HILL[2] (1986-1987)	ITC (1986)				
Constituent	**WHO 2005 TEFs**	**Wastewater Pond #3 Sediment Sample #14**	**SDA-16 (6-7.5 feet) Composite**	**Soil #1 Composite**	**Soil #2 Composite**	**Soil #3 Composite**	**Soil #4 Composite**	**Soil #5 Composite**
2,3,4,7,8-PeCDF	0.3		ND (4.3)					
Other PeCDFs			ND (0.59)					
HexaCDFs				ND(0.11)	ND(0.0050)	ND(0.045)	ND(0.27)	ND(0.34)
1,2,3,4,7,8-HxCDF	0.1		ND (10)					
1,2,3,6,7,8-HxCDF	0.1		ND (9.7)					
1,2,3,7,8,9-HxCDF	0.1		ND (12.3)					
2,3,4,6,7,8-HxCDF	0.1		ND (11.7)					
Other HxCDFs			ND (4.4)					
HeptaCDFs				2.20	0.1	0.87	ND(0.035)	ND(0.033)
1,2,3,4,6,7,8-HpCDF	0.01		ND (1.5)					
1,2,3,4,7,8,9-HpCDF	0.01		ND (1.2)					
Other HpCDFs			3.1					
OctaCDFs	0.0003			2.10	0.097	1.2	ND(0.040)	ND(0.046)
Total TEQ[3]		0.16	0.5	4.8	0.0040	0.033	0.0001	0.0002

Notes:

1	Data are from samples collected in areas not excavated or treated.
2	CH2M HILL 1988.
3	Calculated by using WHO 2005 TEFs. For homolog analysis the most conservative TEF value from that homolog group is used for the calculation
ND	Non-detect with detection limit given in parenthesis.
TEF	Toxic equivalency factors
WHO	World Health Organization

Table 2
Comparison of Soil Cleanup Levels for Dioxins[1]

	Former Regulatory Baseline (ppt)	Revised Rule (ppt)
MTCA C—Industrial (Human Health) [2]		
2,3,7,8 TCDD	875	1460
Dioxin Mixtures (TEQ)	875	1460
Ecological Screening		
Dioxins	2-5	2-5
Chlorinated Dibenzofurans	2-3	2-3

Notes:

1 Ecology 2007

2 Assumes direct contact via soil ingestion is the controlling exposure pathway and a gastrointestinal absorption fraction of 0.6.

Figures

Figure taken from:
CH2M HILL. 1986.
Dioxin and Furan Sampling Plan.

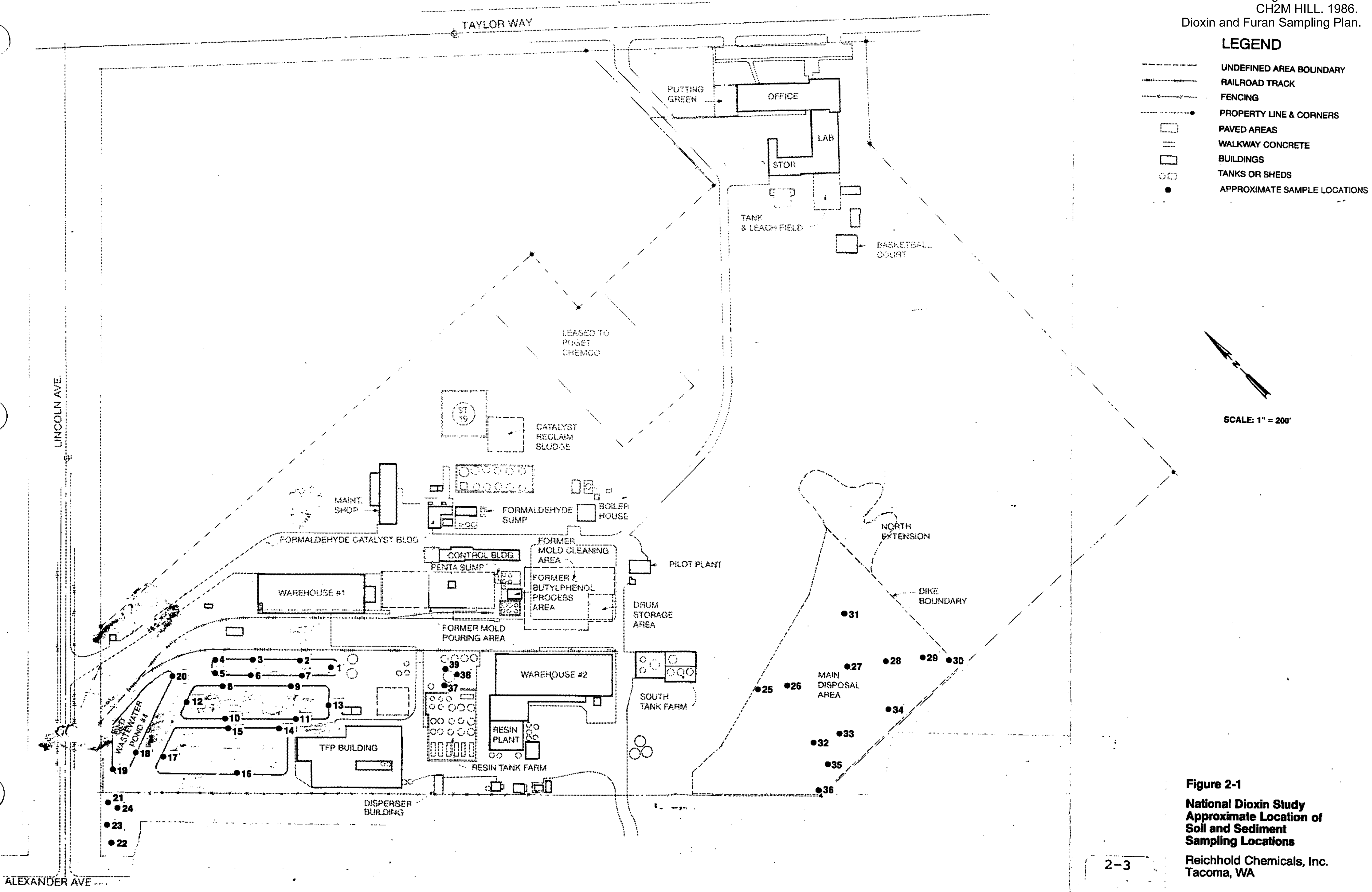
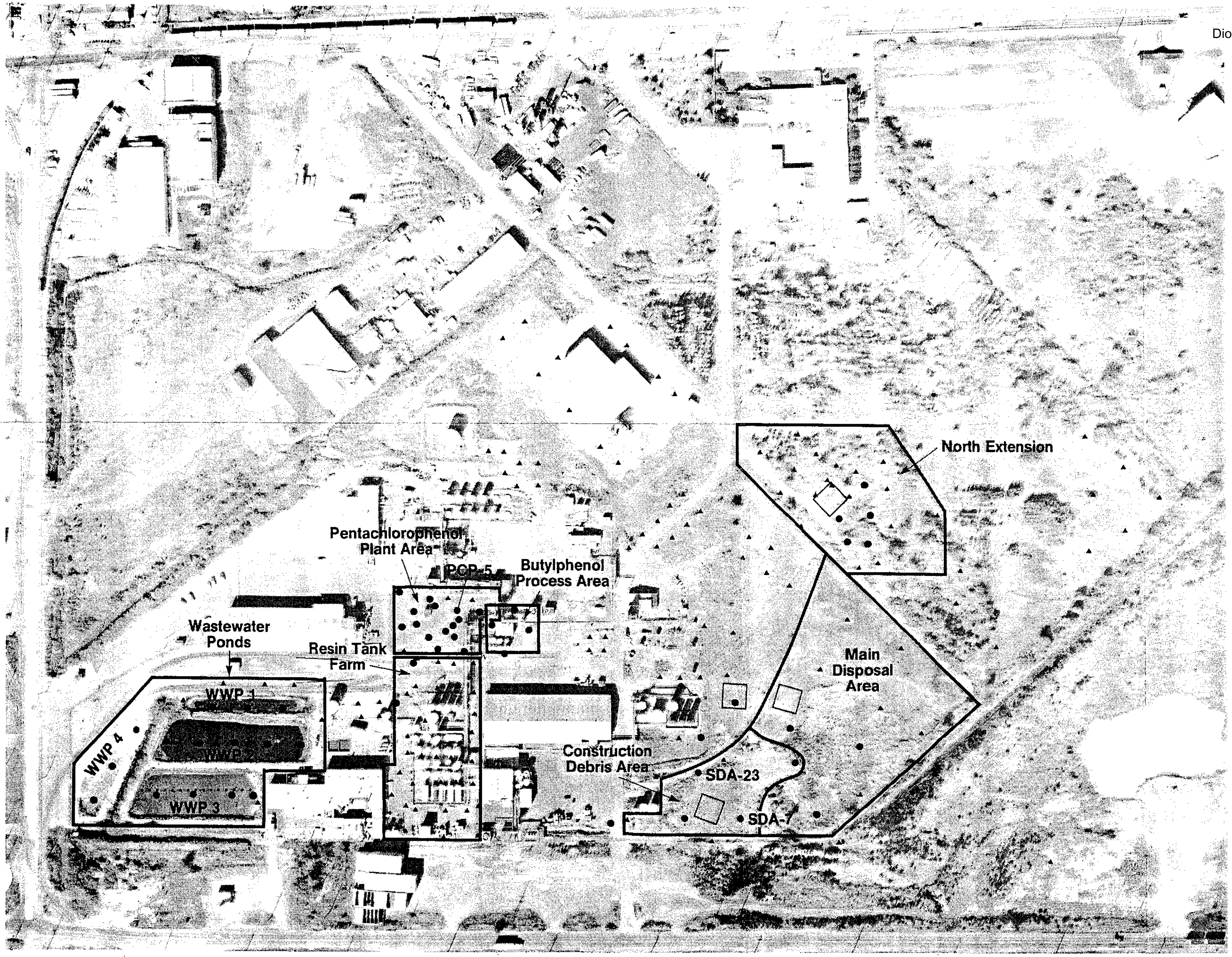


Figure 2-1

National Dioxin Study Approximate Location of Soil and Sediment Sampling Locations

Reichhold Chemicals, Inc.
Tacoma, WA

Figure taken from:
CH2M HILL. 1988.
Dioxin and Furan Soil Sampling Results.



KEY

- ● Sample locations from pre-closure investigation used to prepare CDDs/CDFs for composite samples
- ▲ Sample locations not used for CDDs/CDFs
- □ Sample grid subarea
- ... Supplemental sample locations for CDDs/CDFs

Note: See Figures B-6 and B-7 for sample grid subarea detail

Figure 1

Soil/Sediment Sampling Locations for CDDs/CDFs

Reichhold Chemicals, Inc.
Tacoma, Washington

Reichold/SSA
Containers Facility

Supplemental Focused Remedial Investigation/ Supplemental Focused Feasibility Study

Appendix B
BIOSCREEN Modeling

Table of Contents

List of Tables

List of Attachments

List of Abbreviations/Acronyms

Abbreviation/ Acronym	Definition
FFS	Focused Feasibility Study
K_{OC}	Organic carbon partitioning coefficient
mg/L	Milligrams per liter
MTCA	Model Toxics Control Act
pg/g	Picograms per gram
pg/L	Picograms per liter

Abbreviation/ Acronym	Definition
Site	Reichhold/SSA Containers Site
TCDD	Tetrachlorodibenzo-p-dioxin
TEQ	Toxic equivalent
USEPA	U.S. Environmental Protection Agency

1.0 Introduction

This appendix presents the results of the numerical modeling process used to accomplish two goals: (1) to establish a groundwater concentration (source area target concentration) protective of surface water to be used during groundwater monitoring, and (2) to establish that dioxin/furan concentrations present in soil at the Reichhold/SSA Containers Site (Site) are protective of surface water at the point of compliance for the Reichhold/SSA Containers facility. Two models were used to complete this analysis. The first model is the Model Toxics Control Act (MTCA) three-phase equilibrium partitioning model, which enables calculation of equilibrium groundwater concentrations from a soil concentration. Once this groundwater concentration was obtained, it was entered into the U.S. Environmental Protection Agency (USEPA)-derived BIOSCREEN model, which evaluates attenuation and degradation processes of contamination in groundwater between a designated point and the groundwater discharge point to the adjacent surface water (USEPA 1996). The BIOSCREEN model is designed to use actual on-site concentrations to determine an attenuated concentration at a specified distance.

This model was previously used at the facility in 2008 in the focused feasibility study (FFS) to determine contaminant concentrations that are protective of surface water in the perimeter ditches and the Blair Waterway for other site constituents of concern (Floyd|Snider 2008).The 2008 modeling effort included analysis of attenuation in both the Shallow and Intermediate Aquifer. This work includes only analysis of attenuation in the Shallow Aquifer, as soil source material containing dioxins is only present within the surface soil (i.e., less than 6 feet below original ground surface), on-site within the Shallow Aquifer.

Because groundwater at the Site is non-potable, the risk of exposure to constituents in groundwater is limited to discharge into surface water within the perimeter ditches and the Blair Waterway. Therefore, the groundwater must meet the relevant surface water criteria at the point at which groundwater discharges to surface water (the point of compliance) as described in Washington Administrative Code 173-340-720(8)(e). For this facility, this is where the Shallow Aquifer enters surface water at the perimeter ditches. In the 2008 FFS (Floyd|Snider 2008), source area target concentrations were established at the shallow aquifer monitoring wells, approximately 40-feet in proximity to the North and South Ditches, to be protective at the point-of-compliance. Groundwater concentrations were modeled from a distance of 0 feet (i.e., within the source zone) to a maximum downgradient distance of 40 feet, consistent with the 2008 FFS.

Other site-specific aquifer parameters utilized by the BIOSCREEN model are the same as those developed for the Shallow Aquifer for use in the BIOSCREEN modeling completed in 2008. Table B.1 summarizes these parameters, their source, and the technical rationale behind their selection.

Surface water quality criteria have been developed for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), rather than for dioxin/furan toxic equivalent (TEQ) concentrations, consistent with the surface water criteria; thus, modeling of 2,3,7,8-TCDD will result in a groundwater concentration that can be directly compared to existing regulatory criteria to determine compliance. The most stringent dioxin/furan surface water criterion for the protection of human health via consumption of organisms is 0.0051 picograms per liter (pg/L; Federal Clean Water Act Section 304).

The BIOSCREEN model was run for 2,3,7,8-TCDD using a series of potential concentrations to ensure that any 2,3,7,8-TCDD present on-site at concentrations greater than the maximum detected concentration will attenuate to a level that will meet surface water criteria at the off-property point of compliance, as recommended in the model guidance (USEPA 1996).

2.0 BIOSCREEN-AT Model Input Parameters

The following sections discuss in detail the input parameters that were selected based on detected dioxin concentrations at the Site. The model runs were conducted with a simulation time of 100 years, analogous to BIOSCREEN modeling completed as part of the 2008 FFS. Many input parameters in Table B.1 originate from the 2008 FFS (e.g., hydraulic conductivity, fraction of organic carbon, etc.). Most of these parameters, including hydraulic conductivity and hydraulic gradient, are site-specific parameters that were developed for the Shallow Aquifer. These parameters will not be described in additional detail in this appendix. For more information on the technical rational behind selection of each of these parameters, refer to the 2008 FFS (Floyd|Snider 2008).

2.1 GROUNDWATER SOURCE CONCENTRATIONS

In order to run the BIOSCREEN model, it is first necessary to determine appropriate groundwater concentrations to input into the model. For the current analysis, model runs were completed to determine the maximum source area target concentration that would meet the surface water criteria. Additionally, the maximum concentration of groundwater on-site based on the actual soil analytical data was modeled.

2.1.1 Theoretical Maximum Groundwater Concentration (Source Area Target Concentration)

The first scenario modeled was completed in order to determine the maximum dioxin/furan TEQ source concentration in groundwater that would be protective of human health at the point of compliance. In order to identify this concentration, the BIOSCREEN model was run several times to identify a groundwater source concentration that will attenuate to a concentration less than 0.0051 pg/L after travelling a downgradient distance of up to 40 feet. The BIOSCREEN model was run as described in Section 3.0.

Once the theoretical groundwater source concentration had been determined, the associated soil concentration would be determined using the MTCA three-phase equilibrium partitioning equation for saturated zone soil. As indicated in Table B.2, default MTCA parameters were utilized for the dilution factor and air-filled soil porosity; site-specific parameters were utilized for water-filled soil porosity and dry bulk soil density. Additionally, the congener-specific soil-to-water partitioning coefficient (organic carbon partitioning coefficient [K_{oc}] value) described in Section 2.2 was utilized in the equation. As described in Section 3.0, it was impractical to determine a source area target concentration due to the rapid attenuation within 16 feet of the source even at a soil 2,3,7,8-TCDD concentration of 2×10^{64} picograms per gram (pg/g), which is in equilibrium with groundwater at a concentration of 1.0×10^{54} milligrams per liter (mg/L; 1.9×10^{63} pg/L). Because 2×10^{64} pg/g far exceeds the soil concentrations on-site, the groundwater concentration of 1.0×10^{54} mg/L was the maximum concentration modeled.

2.1.2 Maximum Site Groundwater Concentration

Because a source area target concentration was impractical to calculate, a groundwater source concentration present at the Site was determined from actual 2,3,7,8-TCDD site soil concentrations using the MTCA three-phase equilibrium partitioning equation.

For the second model run, 2,3,7,8-TCDD concentrations in groundwater were determined using equilibrium partitioning with detected soil concentrations from soil sample SS-1-0-0.5, which has the greatest concentration of 2,3,7,8-TCDD at the Site, 3300 pg/g. This soil concentration is in equilibrium with groundwater at a concentration of 1.7×10^{-7} mg/L, or 170 pg/L. This groundwater concentration was input into the BIOSCREEN model as described in Section 3.0.

2.2 DIOXIN/FURAN PARTITIONING COEFFICIENT

The K_{oc} represents the ratio of the mass (in milligrams) of chemical adsorbed in the soil per unit mass (in kilograms) of organic carbon in the soil. The K_{oc} is used as a chemical-specific measure of the tendency for an organic compound to be adsorbed by soil. Dioxin congener 2,3,7,8-TCDD is the most toxic and well-studied dioxin congener (USEPA 2003); it is also the only dioxin congener with multiple peer-reviewed and published K_{oc} values. For this analysis, modeling was performed using a $\log_{10}(K_{oc})$ value for 2,3,7,8-TCDD that has been approved for use by USEPA and Washington State Department of Ecology in various documents (e.g., Anchor QEA 2015). This value was converted to its K_{oc} equivalent and rounded to two significant digits for use in the model.

Partitioning is dependent on a variety of factors, including aquifer properties, in addition to chemical structure. The dioxin congener 2,3,7,8-TCDD consists of four chlorine atoms, while all of the other dioxin and furan congeners consist of five, six, seven, or eight chlorine atoms; this makes it the most mobile congener. Dioxin/furan migration and transport calculations are very sensitive to the K_{oc} value used because the additional chlorine atoms significantly reduce the liberation of dioxin congeners into the dissolved phase. Therefore, the use of the lower chlorinated K_{oc} value for 2,3,7,8-TCDD is conservative and substantially overestimates the amount of dioxin that would exist in the dissolved phase.

2.3 SOLUBLE MASS CONCENTRATION

Consistent with the most simplistic and most conservative scenario for determination of soluble mass quantities in the BIOSCREEN model, infinite soluble mass was assumed. Thus, as groundwater passes through the contaminated soil, it will never reduce the amount of mass available to partition into groundwater, and groundwater concentrations in the source zone will not decrease. This assumption is consistent with the 2008 FFS (Floyd|Snider 2008).

3.0 Model Results and Conclusion

Attachment B.1 presents BIOSCREEN printouts of the model results performed using the input parameters as discussed above and summarized in Table B.1. Tabular results for these two scenarios, including the congener-specific input parameter entered into the model, are presented in Table B.3. It should be noted that the BIOSCREEN results shown in the printout attachments are in the model default concentration units of mg/L and require conversion to pg/L.

As mentioned in Section 2.1.1, the results of the initial model run show that greatest theoretical groundwater 2,3,7,8-TCDD concentration modeled attenuates to concentrations less than the surface water criterion of 0.0051 pg/L at distances of less than 16 feet downgradient (Table B.3). This theoretical groundwater concentration is in equilibrium with a soil 2,3,7,8-TCDD concentration of 2×10^{64} pg/g, which is far greater than anything on-site. Because this soil concentration is not relevant to the Site and the attenuation distance is only 16 feet, less than half of the 40-foot distance available from the monitoring wells to the nearby ditches, it is impractical to calculate a source area target concentration.

The second BIOSCREEN model run results show that the maximum groundwater 2,3,7,8-TCDD concentration in equilibrium with the maximum soil detection at the Site (1.7×10^{-7} mg/L based on equilibrium with soil sample SS-1-0-0.5) attenuates to 0.0018 pg/L within 8 feet and to 0 pg/L within 16 feet. This is less than the surface water criterion of 0.0051 pg/L in less than half of the 40-foot distance available from the monitoring wells to the nearby ditches, even when the model is run for a time period of 100 years (Table B.3).

Dioxins/furans are predicted to attenuate rapidly as the groundwater moves through soil, and are not likely to reach surface water at concentrations greater than the surface water quality criterion. Therefore, this modeling evaluation demonstrates that current concentrations of soil at the Site containing dioxins/furans may remain on-site at a distance of greater than 10 feet from surface water features without posing a risk to adjacent surface waters. Therefore, the proposed groundwater monitoring will be based on evaluation of the concentrations to ensure that there is not a significant increase in concentrations that poses a concern. This approach will be described in the Compliance Monitoring and Contingency Plan that will be part of the Cleanup Action Plan amendment.

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4.0 References

Anchor QEA. 2015. "Appendix E: Contaminant Mobility Modeling." *Whatcom Waterway Final Engineering Design Report*. February.

Floyd|Snider. 2008. *Reichhold/SSA Containers Facility Focused Feasibility Study Public Review Draft*. October.

U.S. Environmental Protection Agency (USEPA). 1996. *BIOSCREEN Natural Attenuation Decision Support System User's Manual, Version 1.3*. EPA/600/R-96/087. Office of Research and Development. Washington, D.C. August.

____. 2003. *Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds National Academy Sciences (NAS) Review Draft, Part I: Estimating Exposure to Dioxin-Like Compounds, Volume 3: Site-Specific Assessment Procedures*. Office of Research and Development. Washington, District of Columbia.

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Tables

Table B.1
Bioscreen Model Inputs

Input	Symbol	Value	Unit	Notes
Seepage Velocity	V_s	25.9	ft/yr	Calculated from parameters K, i, n.
Hydraulic Conductivity	K	0.0005	cm/sec	Site-specific. From 2008 FFS Appendix for the Shallow Aquifer. The FRI indicates that this value is based on "site measurements, described in the Order and in the 1998 permit renewal application" (CH2M HILL 2006, Table A3-1)[1]. Additional model runs were performed using a K value of 0.005 cm/sec; results of these runs were numerically equivalent to the results of runs performed with a K of 0.0005 cm/sec.
Hydraulic Gradient	i	0.01	ft/ft	Site-specific. From 2008 FFS Appendix for the Shallow Aquifer.
Porosity	n	0.2	--	Site-specific. From 2008 FFS Appendix for the Shallow Aquifer.
Longitudinal Dispersivity	alpha x	3.3	ft	Calculated in Bioscreen based on estimated plume length.
Transverse Dispersivity	alpha y	0.3	ft	Calculated in Bioscreen based on estimated plume length.
Vertical Dispersivity	alpha z	0	ft	Calculated in Bioscreen based on estimated plume length.
Estimated Plume Length	Lp	40	ft	Site-specific. From 2008 FFS Appendix for the Shallow Aquifer.
Retardation Factor	R	calculated	--	Calculated from parameters rho, K_{oc}, and f_{oc}.
Soil Bulk Density	rho	1.6	kg/L	Site-specific. From 2008 FFS Appendix for the Shallow Aquifer.
Partition Coefficient	K_{oc}	varies	L/kg	Parameter varies for different analytes consistent with literature values in Table B.3.
Fraction Organic Carbon	f_{oc}	0.004	--	Site-specific. From 2008 FFS Appendix for the Shallow Aquifer.
Modeled Area Length		40	ft	Length selected to provide highest resolution concentration results based on scale of capped area to South Ditch.
Modeled Area Width		250	ft	Width consistent with 2008 FFS.
Simulation Time		50	yr	Time selected to provide sufficient time for plume equilibration, confirmed using model runs.
Source Thickness in Sat.Zone		7	ft	Depth selected to be consistent with 2008 FFS Appendix for Shallow Aquifer; represents depth of dioxin material placement in capped area.
Source Width		100	ft	Width selected to be consistent with 2008 FFS Appendix for Shallow Aquifer; represents width of dioxin material placement in capped area.
Source Concentration		varies	mg/L	Concentration varied for different constituents, calculated using MTCA three-phase model (Cw; units changed from µg/L to mg/L) and inputs described in Table B.3.
Soluble Mass		varies	kg	Calculated based on source area dimension inputs and representative concentration selected for modeling.

Note:

1 CH2M Hill. 2006. *Final Focused Remedial Investigation* . Prepared for Reichhold, Inc. Tacoma Facility, Tacoma, Washington. April.

-- Not appliacable.

Abbreviations:

cm/sec	Centimeters per second
CW	Groundwater concentration in H_2O
FFS	Focused Feasibility Study
FRI	Focused Remedial Investigation
ft	Feet
ft/ft	Feet per foot
kg	Kilograms
L	Liter
µg	Micrograms
mg	Milligrams
MTCA	Model Toxics Control Act
yr	Years

Table B.2
MTCA Three-Phase Model Inputs

Input	Symbol	Value	Unit	Notes
Unit Conversion Factor	UCF	0.001	mg/µg	
Dilution Factor	DF	1	--	Default for Equation 747-1 for saturated soil.
Distribution Coefficient	K_d	varies	L/kg	Calculated using congener-specific K_{oc}'s described in Table B.1 and f_{oc} = 0.004
Water-Filled Soil Porosity	Θ_w	0.2	mL water/mL soil	Site-specific. From 2008 FFS Appendix for the Shallow Aquifer.
Air-Fillled Soil Porosity	Θ_a	0	mL air/mL soil	A value of 0 is used for saturated zone soil per MTCA.
Henry's Law Constant	H_{cc}	--	--	This term cancels in the three-phase model because the air-filled soil porosity is 0.
Dry Bulk Soil Density	ρ_b	1.6	kg/L	Site-specific. From 2008 FFS Appendix for the Shallow Aquifer.

Note:

--	Not applicable.

Abbreviations:

FFS	Focused Feasibility Study
f_{oc}	Fraction Organic Carbon
kg	Kilograms
K_{oc}	Partition Coefficient
L	Liter
µg	Micrograms
mg	Milligrams
mL	Milliliters
MTCA	Model Toxics Control Act

Table B.3
Modeled 1 Results: Equilibrium Groundwater Partitioning with Maximum Detected Soil TEQ Concentration and Sensitivity Analysis

				K_{oc}[1]	Calculated Water Concentration (MTCA Three-Phase)	Soluble Mass	Groundwater Concentration after 100 years (pg/L)					
Parameter	**Units**	**TEF**	**Modelled Soil Concentration**	**L/kg to Two Significant Figures**	**mg/L**	**kg**	**In Source Area**	**4 ft Downgradient**	**8 ft Downgradient**	**16 ft Downgradient**	**24 ft Downgradient**	**40 ft Downgradient**
2,3,7,8-TCDD	pg/g	1	2.00E+64	4,800,000	1.00E+54	Infinite	1.0E+63	2.3E+61	1.1E+58	0.0E+00	0.0E+00	0.0E+00
2,3,7,8-TCDD	pg/g	1	3,300	4,800,000	1.70E-07	Infinite	1.7E+02	4.0E+00	1.8E-03	0.0E+00	0.0E+00	0.0E+00

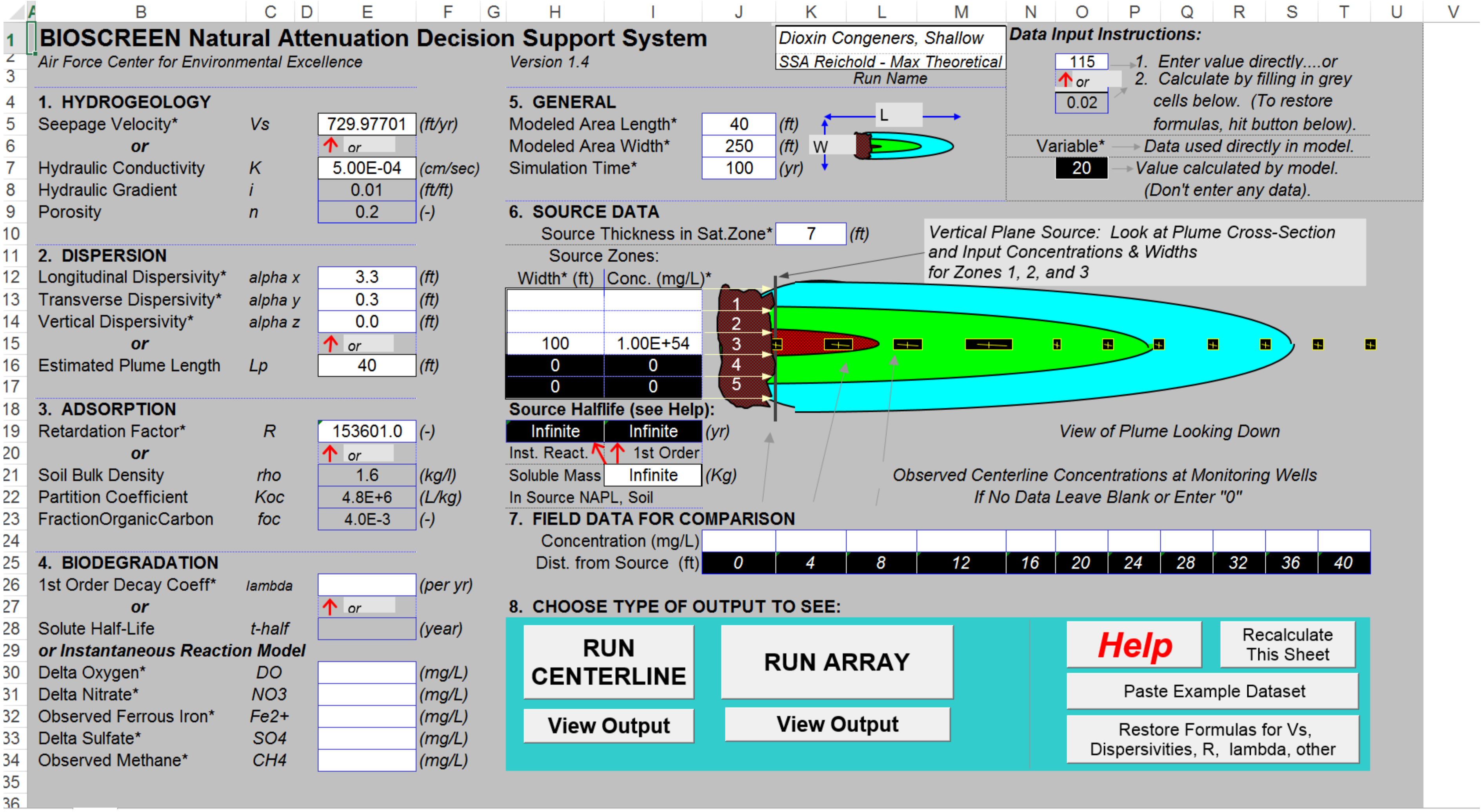
Note:

1 Log10(K_{oc}) value converted to K_{oc} and rounded to two significant figures. Log10(K_{oc}) value from Appendix E: Contaminant Mobility Modeling. *Whatcom Waterway Final Engineering Design Report*. February 2015.

Abbreviations:

ft	Feet
g	Gram
kg	Kilogram
K_{oc}	Partition coefficient
L	Liters
pg	Picograms
mg	Milligrams
MTCA	Model Toxics Control Act
TCDD	Tetrachlorodibenzo-p-dioxin
TEF	Toxic equivalency factor
TEQ	Toxic equivalent

Attachment B.1
BIOSCREEN Model Screenshots



BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence

Version 1.4

Dioxin Congeners, Shallow
SSA Reichold - Max Theoretical
Run Name

Data Input Instructions:

115 → *1. Enter value directly....or*
or *2. Calculate by filling in grey*
0.02 *cells below. (To restore formulas, hit button below).*

Variable* → *Data used directly in model.*
20 → *Value calculated by model.*
(Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	*Vs*	729.97701	*(ft/yr)*
or		or	
Hydraulic Conductivity	*K*	5.00E-04	*(cm/sec)*
Hydraulic Gradient	*i*	0.01	*(ft/ft)*
Porosity	*n*	0.2	*(-)*

2. DISPERSION

Longitudinal Dispersivity*	*alpha x*	3.3	*(ft)*
Transverse Dispersivity*	*alpha y*	0.3	*(ft)*
Vertical Dispersivity*	*alpha z*	0.0	*(ft)*
or		or	
Estimated Plume Length	*Lp*	40	*(ft)*

3. ADSORPTION

Retardation Factor*	*R*	153601.0	*(-)*
or		or	
Soil Bulk Density	*rho*	1.6	*(kg/l)*
Partition Coefficient	*Koc*	4.8E+6	*(L/kg)*
FractionOrganicCarbon	*foc*	4.0E-3	*(-)*

4. BIODEGRADATION

1st Order Decay Coeff*	*lambda*		*(per yr)*
or		or	
Solute Half-Life	*t-half*		*(year)*
or Instantaneous Reaction Model			
Delta Oxygen*	*DO*		*(mg/L)*
Delta Nitrate*	*NO3*		*(mg/L)*
Observed Ferrous Iron*	*Fe2+*		*(mg/L)*
Delta Sulfate*	*SO4*		*(mg/L)*
Observed Methane*	*CH4*		*(mg/L)*

5. GENERAL

Modeled Area Length*	40	*(ft)*
Modeled Area Width*	250	*(ft)*
Simulation Time*	100	*(yr)*

6. SOURCE DATA

Source Thickness in Sat.Zone* 7 *(ft)*

Source Zones:

Width* (ft)	Conc. (mg/L)*	Zone
		1
		2
100	1.00E+54	3
0	0	4
0	0	5

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3

View of Plume Looking Down

Source Halflife (see Help):

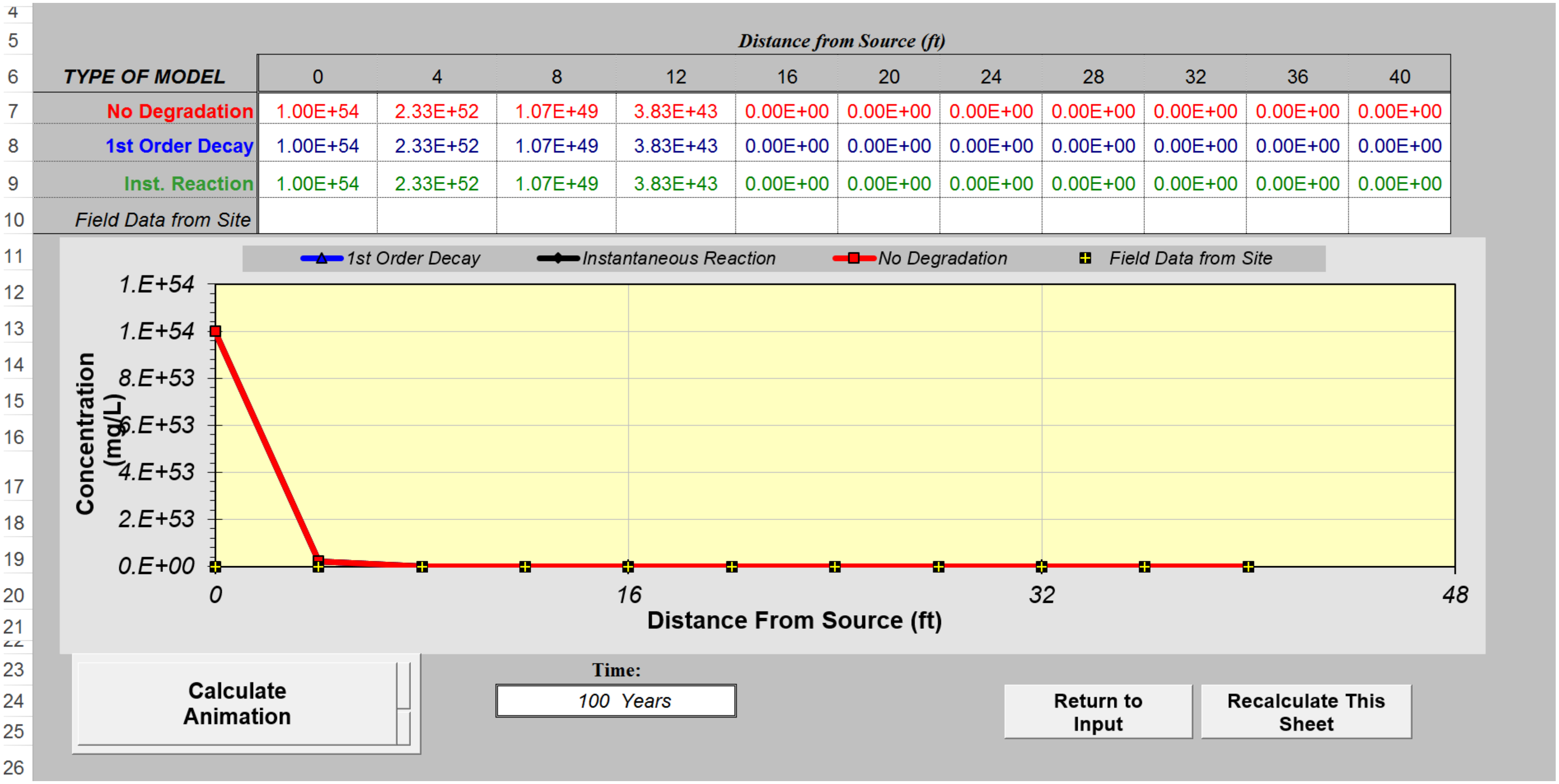
Infinite | Infinite *(yr)*
Inst. React. | 1st Order
Soluble Mass Infinite *(Kg)*
In Source NAPL, Soil

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

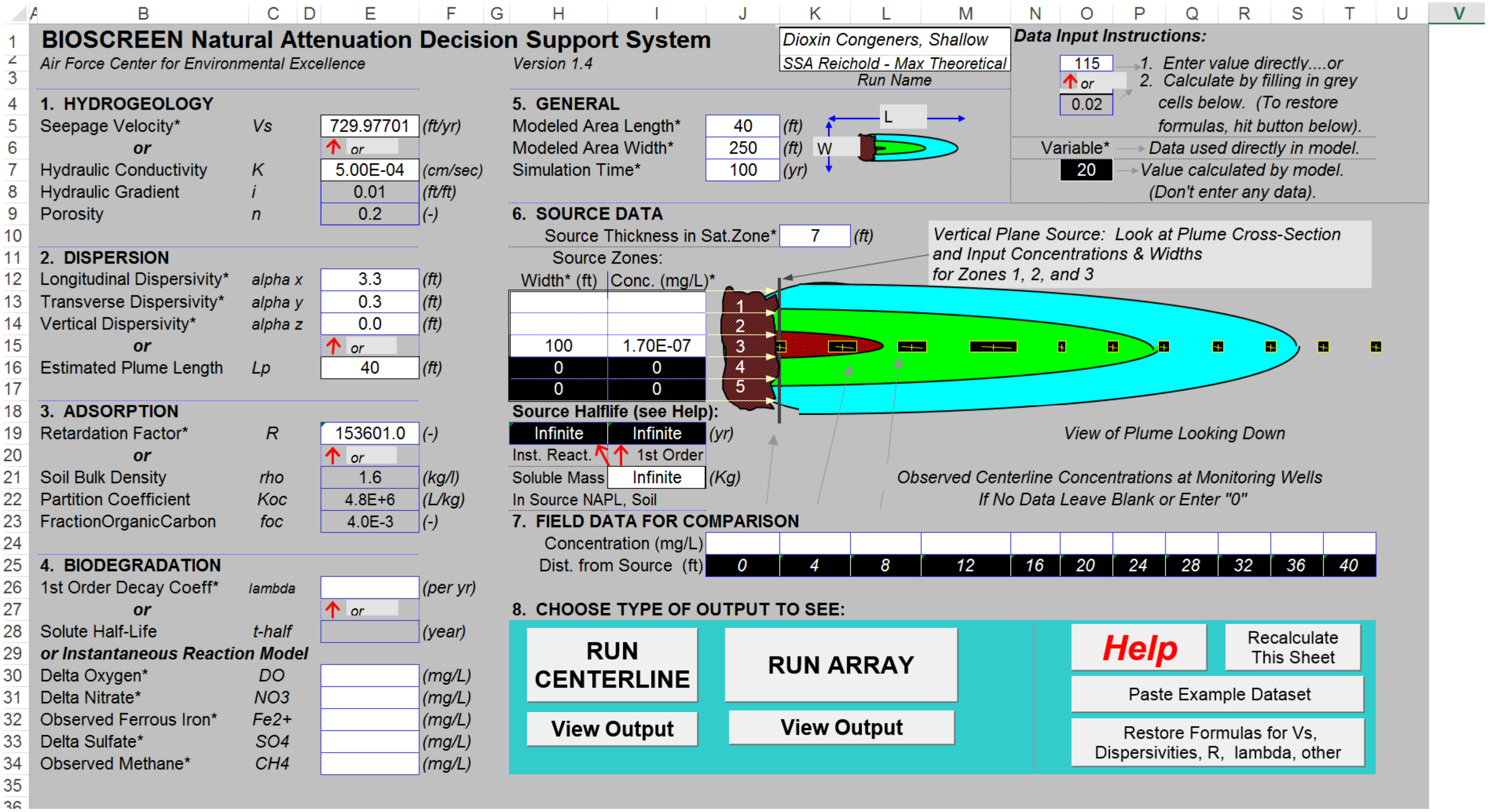
Concentration (mg/L)											
Dist. from Source (ft)	0	4	8	12	16	20	24	28	32	36	40

8. CHOOSE TYPE OF OUTPUT TO SEE:



	Distance from Source (ft)										
TYPE OF MODEL	0	4	8	12	16	20	24	28	32	36	40
No Degradation	1.00E+54	2.33E+52	1.07E+49	3.83E+43	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1st Order Decay	1.00E+54	2.33E+52	1.07E+49	3.83E+43	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inst. Reaction	1.00E+54	2.33E+52	1.07E+49	3.83E+43	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Field Data from Site											

Time: 100 Years



BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence *Version 1.4*

Dioxin Congeners, Shallow
SSA Reichold - Max Theoretical
Run Name

Data Input Instructions:

115 → *1. Enter value directly....or*
or *2. Calculate by filling in grey*
0.02 *cells below. (To restore formulas, hit button below).*

Variable* → *Data used directly in model.*
20 → *Value calculated by model. (Don't enter any data).*

1. HYDROGEOLOGY

Seepage Velocity*	*Vs*	729.97701	*(ft/yr)*
or		or	
Hydraulic Conductivity	*K*	5.00E-04	*(cm/sec)*
Hydraulic Gradient	*i*	0.01	*(ft/ft)*
Porosity	*n*	0.2	*(-)*

2. DISPERSION

Longitudinal Dispersivity*	*alpha x*	3.3	*(ft)*
Transverse Dispersivity*	*alpha y*	0.3	*(ft)*
Vertical Dispersivity*	*alpha z*	0.0	*(ft)*
or		or	
Estimated Plume Length	*Lp*	40	*(ft)*

3. ADSORPTION

Retardation Factor*	*R*	153601.0	*(-)*
or		or	
Soil Bulk Density	*rho*	1.6	*(kg/l)*
Partition Coefficient	*Koc*	4.8E+6	*(L/kg)*
FractionOrganicCarbon	*foc*	4.0E-3	*(-)*

4. BIODEGRADATION

1st Order Decay Coeff*	*lambda*		*(per yr)*
or		or	
Solute Half-Life	*t-half*		*(year)*
or Instantaneous Reaction Model			
Delta Oxygen*	*DO*		*(mg/L)*
Delta Nitrate*	*NO3*		*(mg/L)*
Observed Ferrous Iron*	*Fe2+*		*(mg/L)*
Delta Sulfate*	*SO4*		*(mg/L)*
Observed Methane*	*CH4*		*(mg/L)*

5. GENERAL

Modeled Area Length*	40	*(ft)*
Modeled Area Width*	250	*(ft)*
Simulation Time*	100	*(yr)*

6. SOURCE DATA

Source Thickness in Sat.Zone* 7 *(ft)*

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones:

Zone	Width* (ft)	Conc. (mg/L)*
1		
2		
3	100	1.70E-07
4	0	0
5	0	0

Source Halflife (see Help):

Inst. React.	1st Order	
Infinite	Infinite	*(yr)*

Soluble Mass Infinite *(Kg)*
In Source NAPL, Soil

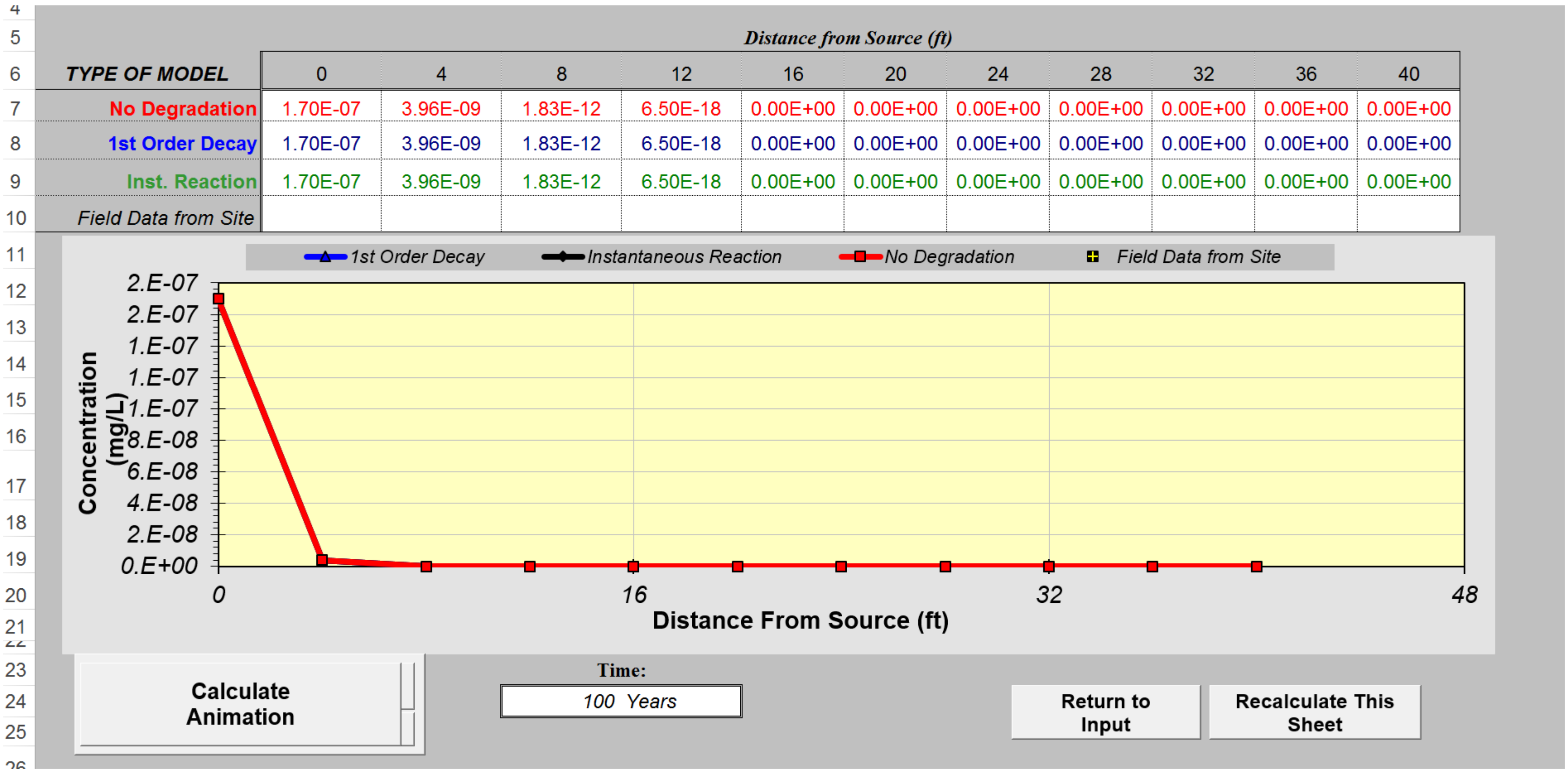
View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)											
Dist. from Source (ft)	*0*	*4*	*8*	*12*	*16*	*20*	*24*	*28*	*32*	*36*	*40*

8. CHOOSE TYPE OF OUTPUT TO SEE:



Distance from Source (ft)

TYPE OF MODEL	0	4	8	12	16	20	24	28	32	36	40
No Degradation	1.70E-07	3.96E-09	1.83E-12	6.50E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1st Order Decay	1.70E-07	3.96E-09	1.83E-12	6.50E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inst. Reaction	1.70E-07	3.96E-09	1.83E-12	6.50E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Field Data from Site											

Time: *100 Years*

Reichold/SSA
Containers Facility

Supplemental Focused Remedial Investigation/ Supplemental Focused Feasibility Study

Appendix C
Geoprobe MC5 Sampling Schematic

MC^5 Soil Sampling System

The Industry Work Horse in Soil Sampling..!

- ***Discrete Soil Sampling***
- ***Continuous Soil Sampling***
- ***Unmatched Durability***

Coupled with Light-Weight Center Rods, soil sampling got faster and easier! Times have changed since the first Macro-Core® tooling was developed in 1994. Machines are larger, hammers are more powerful, and field operators push tool strings deeper into the subsurface. The formula to meet these demands began with designing a larger MC Sample Tube (increased the OD from 2.125 in. to 2.25 in.) which led to beefing up the thread design. These improvements to the already robust Macro-Core® sampler make a great product perform even better in the field.

Macro-Core® Liner Cutter
Manufactured under Patent #6029355

> *"The success of testing and using this new MC system has given us an increase in confidence, in production, and in profit."*
> *Scott Vojta, Geotek Alaska*

MC^5 Soil Sampling System

TOOL STRING DIAGRAM

2.25 in. GH60
Drive Cap (threadless)
31530

MC5 Drive Head
(2.25 in. bored)
28646

MC5 Drive Cap
23639

1.25 in.
Light-Weight Center Rod
27600, 60 in.
21900, 48 in.
43012, 36 in.
32318, 1 m.

MC5 Plug (threaded)
23641

MC5 Liners
10074, 60 in. PVC
AT737K, 48 in. PVC - Light-weight
AT927K, 48 in. PVC - Heavy Duty
AT921K, 36 in. PVC
AT926K, 24 in. PVC
AT928K, 1 m. PVC

MC5 Sample Tubes
22992, 60 in.
22923, 48 in
24238, 36 in.
24237, 24 in.
24239, 1 m.

MC5 Liner Spacer Ring
AT8533K, 500 qty
AT8532K, 66 qty

MC5 Liner Core Catcher
AT8534K, 100 qty
AT8531K, 28 qty

MC5 Closed Piston Point
28113, standard
26865, undersized

MC5 Cutting Shoe
23978, 1.5 in. ID ext shank
32035, 1.35 in. ID ext shank
26078, 1.25 in. ID ext shank

22922, 1.5 in. ID std shank
29552, 1.35 in. ID std shank

Reichold/SSA
Containers Facility

Supplemental Focused Remedial Investigation/ Supplemental Focused Feasibility Study

Appendix D
2014 Supplemental Focused Remedial Investigation Boring Logs

DUA1/A2

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Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 4.5'

Boring ID: A-1

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	ASPH	3" of Asphalt
0				1	SP	Brown, dense, fine to med SAND; no odor; moist
0				2		
	2.5-3.0	DUA1-SB1-2.5-3.0				
0				3		Brown, dense coarse SAND with shells from 3.0 to 3.5 feet, bgs
				4		Dark Brown, dense, fine to med SAND; No odor, Wet
0				▼		
	5.0-5.5	DUA2-SB1-5.0-5.5		5	ML	Olive gray, stiff SILT; no odor, moist
0				6	SP	Dark brown, m. dense, fine to med SAND; no odor; saturated.
0				7	ML	Olive gray, stiff SILT with moderate plasticity; no odor; wet
0				8	OL	-Black organic-rich SILT.
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUA1/A2-

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Boring ID: A-2

Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5'

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	Asp	Asphalt Top 3".
					Fill	Crushed Gravel Road Base
0				1	SM	Brown, dense silty SAND; no odor; moist
0				2	ML	Brown olive, stiff SILT
					SM	Brown, dense, silty SAND; no odor; moist
0	3.0-3.5	DUA1-SB2-3.0-3.5 @0945		3	SP	Brown to dark brown, dense, fine to med SAND; no odor; moist.
0				4		
0				5	SM	Brown, dense silty fine to med. SAND; wet
0	5.5-6.0	DUA2-SB2-5.5-6.0 @0950		▼	ML	Olive gray SILT lenses with mod-plasticity
0				6	SM	Brown to gray, m-dense, silty fine to Med. SAND; no odor wet
				7	ML	Olive gray, stiff SILT lense with moderate plasticity
				8	SM	Brown to gray, m.dense, silty, fine SAND; no odor, moist
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUA1/A2

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Boring ID: A-3

Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: COT
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8"
Groundwater ATD (ft bgs): 5.25'

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	FILL	Brown, sandy crushed GRAVEL FILL (Road Base)
0				1		
0				2	SP	Brown, dense, fine to med SAND; no odor; moist
	3-3.5	DUA1-SB3-3.0-3.5 @1530		3		
0				4	SM	Dark Brown, dense, silty, fine SAND; no odor;
	4.5-5.0	DUA2-SB3-4.5-5.0 @ 1535		5	ML	Dark Gray, hard ~~silty SA~~ sandy SILT; SAA, SILT no sand
0	~~[illegible]~~			6	OL	Dark Gray to black, stiff, Organic SILT; no odor; moist
0				7	ML	Olive gray, hard SILT; no odor; moist.
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUA1/A2

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Boring ID: A-4

Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 10'
Groundwater ATD (ft bgs): 5.5

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA
Project: RHCD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	ASPHALT	3" of Asphalt
0	1.5-2.0 1510	DUA1-SB4-1.5-2.0 @ 1510		1	FILL	Brown, dense, sandy crushed gravel, ROAD BASE FILL
0 0				2	SP	Dark Brown, dense, fine to med SAND; no odor, Moist
0				3		
0				4		SAA. Dark brown to gray SAND; No odor, Moist
	4.5-5 1515	DUA2-SB4-4.5-5.0 @ 1515		5		
0				▼	SM	Dark Gray, silty fine SAND; no odor, wet
0				6	ML	Dark olive gray, hard SILT; wet
				7	OL	Black, stiff Organic SILT
				8	ML	Dark Olive Gray, stiff sandy SILT; No odor; wet
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

OU A1/A2.

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Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5

Boring ID: A-5

Client: SSA
Project: RHOCD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	FILL	Brown, dense, sandy Crushed Gravel: Road base FILL
0	1.0-1.5 @ 0810	OUA1-SBS-1.0-1.5		1	SP	Brown to Dark Brown, dense, Fine to med SAND; no odor; Moist
0				2		
0				3		
0				4	SM	Dark Brown silty SAND; no odor; moist
0	5-5.5 @ 0815	OUA2-SBS-5.0-5.5		5	SP	Dark Brown, dense, Fine to med SAND; no odor; wet
0				6	ML	Olive gray, stiff SILT; no odor; wet
0				7	OL	Black organic SILT
					ML	Olive gray, stiff SILT; no odor; moist
0				8	SM	Dark brown, dense, Fine to med SAND; no odor; moist
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

OU A1/A2

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Boring ID: A-6

Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: G. Cisneros
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.25

Client: SSA
Project: RHOLD
Task: 62000
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0				0	FILL	Brown, dense, sandy crushed GRAVEL Road Base FILL
0				1		Brown, ~~m dense~~, fine to med SAND; no odor; moist
				2		
0	3.0 - 3.5	OUA1-SB6-3.0-3.5		3	GP	
0	4.5 - 5.0			4		SAA, dark brown; no odor; moist
0		OUA2-SB6-4.5-5.0		5	ML	Olive gray, hard SILT; no odor; wet
0				6	OL	- Black organic SILT
0				7	ML	- Olive gray, hard sandy SILT; no odor; moist
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DU A1/A2

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Boring ID: A-7

Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.75'

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0				0	AS	6" Asphalt
0				1	FILL	Brown, dense, sandy crushed GRAVEL Road base Fill
0				2	SP	Brown to dark brown, dense, Fine to med SAND; no odor; moist
0	3.0-3.5	DuA1-SB7-3.0-3.5 @ 1015		3		
0	4.5-5.0	DuA2-SB7-4.5-5.0 @ 1020		4		SAA; no odor; moist
0				5 ▼		
0				6	SM	-Olive gray, m. dense, silty SAND; chlorine odor; wet
					ML	-Olive gray, stiff SILT with moderate plasticity; chlorine odor; wet
0				7	OL	-Black organic-rich SILT; no odor; moist
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DM A1|A2

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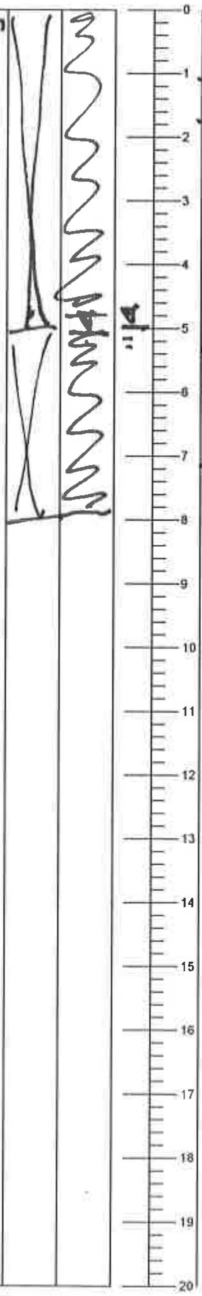
Boring ID: A-8

Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5'

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:



PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	AS	Asphalt up to 2" thick
0					Fill	Brown, m.dense, sandy crushed Gravel Fill; no odor;
					ML	Brown, stiff, sandy SILT w/ low plasticity
0	2.0-2.5 1140	DMA1-SB8-2.0-2.5 @ 1140			SP	Dark Brown to Gray, m.dense, fine to med SAND no odor; moist
1.2						
0						-SAA; no sheen, no odor; wet
0	5.5-6 1145	DMA2-SB-5.5-6.0 @ 1145			SM	Olive gray, m.dense, Silty fine SAND; no odor; wet
					ML	Olive gray, stiff SILT; no odor; moist
0					OL	Black organic SILT

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUA1/A2-

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Drill Date: 9/9/14
Logged By: G.Cisneros
Drilled By: CDI
Drill Type: ~~Cont.~~ GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5

Boring ID: A-9

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
ø				0	Concrete	Concrete 14" thick
ø	2-2.5	DU A1-SB9-2.0-2.5 @ 0915		1 2	SP	Brown to dark brown, dense, Fine to med SAND; no odor; Moist
ø				3		
ø				4		
ø				5	SM	Dark Brown to Dark Gray, dense, silty fine SAND; no odor, wet.
ø	5.5-6.0	DUA2-SB9-5.5-6.0 @0920		6	ML	Olive gray, stiff SILT; no odor; wet
				7	OL	Black organic SILT; moist
				8	SM	Dark Brown to black, m.dense, ~~fine~~ silty, fine SAND; no odor; moist

Notes:
FT BGS = feet below ground surface
ppm = parts per million

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USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUA1/A2

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Drill Date: 9/9/14
Logged By: G.Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5

Boring ID: A-10

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	ASPH	3" of Asphalt
0				1	FILL	Brown, dense, sandy crushed GRAVEL FILL. slight odor; moist
17.0	■ 1.5-2.0	DUA1-SB10-1.5-2.0 @1445		2		
1.0				3		Crushed rock from 2.[illegible] to 3.25'. No fine material
				4		
9.1				5 ▼	SP	Dark Gray, dense, fine to medium SAND; slight odor; wet
25.0	■ 6.0-6.5	DUA2-SB10-6.0-6.5 @1450		6	SM	Gray, dense, silty fine SAND; strong odor; wet
3.1				7	ML	Olive gray, firm SILT w/ low to moderate plasticity slight odor, moist
1.2				8	OL	Black organic SILT; slight odor; moist
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
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ppm = parts per million

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USCS = Unified Soil Classification System
▼ = denotes groundwater table

DuA1/A2

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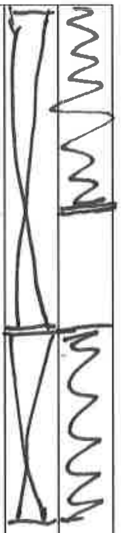
Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 4.5'

Boring ID: A-11

Client: SSA
Project: ZHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:



PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		Crushed GRAVEL FILL
0				1		
0	2-2.5	DuA1-SB11-2-2.5 @1405		2	FILL	Gray to brown, m.dense, sandy GRAVEL w/ large concrete & bricks; no odor; moist
0				3		
0				4 ▼	SP	Dark brown to dark gray, m.dense, Fine to med SAND; slight odor; wet.
0	5.0-5.5	DuA2-SB11-5-5.5 @1410		5	SM	-Olive gray, m.dense, silty SAND; no odor; wet
0				6	ML	Olive gray, firm SILT w/ moderate plasticity; no odor; wet.
0				7	OL	- Black organic SILT with abundant woody debris.
				8	ML	-Olive gray, Firm SILT; moist
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUA1/A2

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Drill Date: 9/8/14
Logged By: G.Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5'

Boring ID: A-12

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	ASPH	3" of Asphalt
0				1	FILL	Brown, dense, sandy crushed Gravell, Roadbase FILL
0	2.0-2.5	DUA1-SB-12-2-2.5 @ 1445		2		Brown, dense, fine to medium SAND; slight solvent odor; Moist
0				3	SP	
0	4.0-4.5	DUA2-SB12-4-4.5 @ 1450		4		SAA, Dark Brown to dark Gray SAND; No odor; moist
0				5		
				▼		Dark Gray med dense, fine to med SAND; no odor; Wet
0				6		
0				7		SAA; SATURATED
0				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DU A1|A2

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Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.0'

Boring ID: A-13

Client: SSA
Project: PHOD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0	0.5-1.0			0		~~Brown~~
0		DUA1-SB13 0.5-1.0 @1415		1	FILL	Brown, m.dense, sandy, crushed GRAVEL Road base FILL
0				2	GW	
0				3	SP	Brown, m.dense, Finetomed SAND; no odor, moist
0				4		
0	5.5-6.0	DUA2-SB13-5.5-6.0 @1420		5 ▼	SM	Olive gray, m.dense, silty fine SAND; no odor; wet
0				6	ML	Olivegray, stiff SILT with ~~medium~~ moderate plasticity; no odor; wet
0				7	OL|PT ML	Black, stiff organic-rich SILT with Peat. olive gray, stiff SILT with moderate plasticity; no odor; moist
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUA1/A2-A-14

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Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 4.75

Boring ID: A-14

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	ASPH	2" of Asphalt
0				1	FILL	Brown, dense, sandy crushed GRAVEL Road Base Fill
0				2	SP	Brown to Dark brown, dense, fine to med SAND; no odor; moist
0	2.5-3.0	DUA1SB14-2.5-3.0 @ 1200		3		
0				4		
0	4.5-5.0	DUA2-SB14-4.5-5.0 @ 1205		5	SM	- Olive gray, m. dense, silty fine SAND; no odor; wet
					ML	Dark olive gray, stiff SILT with moderate plasticity; no odor, wet
0				6	SM	- silty SAND lens @ 6.5-6.75'
0				7	ML	- Olive gray, stiff SILT; no odor, moist
				8	OL/PT	- Black organic SILT w/ peat at bottom.
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DU-A1/A2-A-15

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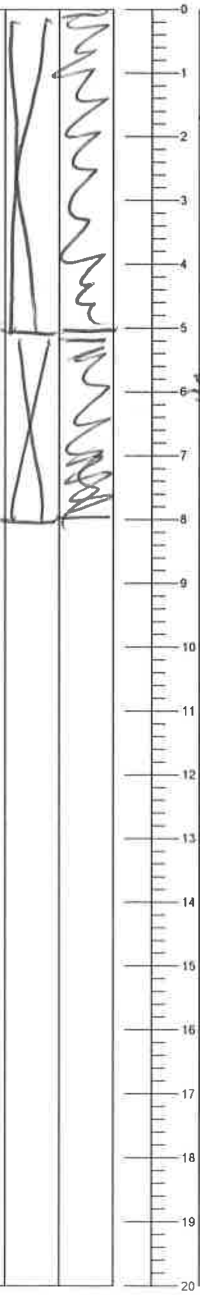
Boring ID: A-15

Drill Date: 9/8/14
Logged By: G.Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 6'

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA
Project: RHOCD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0.1					Fill	Crushed Gravel; Road base Fill
0.1	2.0-2.5 1050	DU-A1-SB15-2-2.5				Brown to Dark brown, dense, fine to med SAND; No odor; Moist
0.1	4.5-5.0 1055	DU-A2-SB15-4.5-5.0			SP	SAA
0.1						Dark brown to black, dense, fine to med SAND w/shells; No odor; wet
0.1						SAA; no odor wet

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DU-A1/A2-A-16

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Drill Date: 9/8/19
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5'

Boring ID: A-16

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0.1	0-0.5 @ 1125	DU-A1-SB16 0-0.5 @1125		0	FILL	.25' Asphalt Above 0.75' feet of crushed ROCK
0.1				1–2	SP	Brown, dense, Fine to med SAND; No odor; Moist,
0.1				3		
0.1				4		
0.1				4.25	SM	Dark Gray, dense, silty Fine SAND; No odor; Moist
0.1	6-6.5 @ 1130	DU-A2-SB16-6-6.5 @1130		5.5	ML	Gray, soft, sandy SILT; No odor; wet
0.1				7	OL	Black, organic SILT
				7.75	ML	Dark Gray, hard coarse SILT.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUA1/A2 - A-17

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Boring ID: A-17

Drill Date: 9/8/11
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5'

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	FILL	5/8 minus Road Base FILL. Brown, m.dense, sandy GRAVEL
0	1.5-2.0 1430	DUA1-SB17-1.5-2.0 @1430		1	GP	
6				2	SP	Brown, dense, fine to med SAND; no odor; moist
				3		
6	4.0-4.5 1438	DUA2-SB17-4-4.5 @ 1438		4		Dark Brown to Dark gray, dense, fine to med SAND; No odor
6				5 ▼	SM	Dark gray, dense, silty fine sand; No odor; Wet
6				6	ML	Dark olive gray, hard silt; no odor; wet
6				7	OL	Black, stiff, organic SILT w/abundant organic debris
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUA1/A2-A-18

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Boring ID: A-18

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5'

Client: SSA
Project: 2HOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		
0				1	FILL	Brown to gray, m. dense, silty, sandy GRAVEL; FILL slight chlorine odor; moist
0				2	GW	
0				3		Gray silty, sandy GRAVELLY FILL; slight chlorine odor; moist
0.1	3.5-4.0	DUA1-SB18-3.5-4.0 @ 1340		4		
~~0~~ 2.6	4.5-5.0	DUA2-SB-18-4.5-5.0 @ 1345		5 ▼	SP	Dark brown, m. dense, fine to med SAND; slight odor; moist to wet
1.7				6		S.A.A.; strong odor
5.2				7	ML SP	Olive gray, stiff SILT with moderate plasticity & lenses of gravelly SAND with strong odor; saturated.
5.7				8	ML	
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

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USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUA1/A2-A-19

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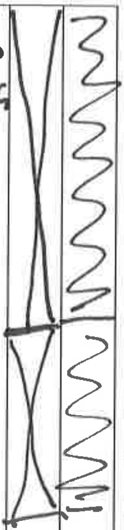
Boring ID: A-19

Drill Date: 9/9/14
Logged By: G.Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 4.5

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:



PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	ASPH	Asphalt Top 3"
0	0.5-1.0	DUA1-SB19-0.5-1.0 @1255				
4				1	SP	Brown, m. dense, fine to med SAND; no odor; moist
0				2		
0				3		
0				4	ML	Silt lens
				▼ 4.5	SP	Dark Brown to Gray, m. dense, fine to med SAND; no odor; wet to saturated
0	5-5.5	DUA2-SB19-5-5.5 @1300		5		
0				6		
0				7	ML	Olive gray, firm SILT with low plasticity; no odor; wet.
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

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USCS = Unified Soil Classification System
▼ = denotes groundwater table

Du-A1/A2

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Boring ID: A -20

Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 6'

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	FILL	Brown, sandy GRAVEL; Road base FILL
0				1		
0				2		
0	3-3.5	Du-A1-SB20-3-3.5 @1350		3	SP	Dark brown to black, dense, fine to med SAND w/Black Sand lense from 4.5 to 5.25 feet; No Odor; Moist.
0				4		
0				5		SAA; Dark brown SAND
0	6-6.5	Du-A2-SB20-6-6.5 @1355		6 ▼	SM	Dark gray, dense, silty Fine sand; ~~no~~ chlorine odor; wet
				7	ML	Dark olive gray, stiff to hard SILT; ~~no~~ chlorine odor; wet
				8	OL	Black, stiff, organic SILT.
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

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USCS = Unified Soil Classification System
▼ = denotes groundwater table

DU-A1/A2

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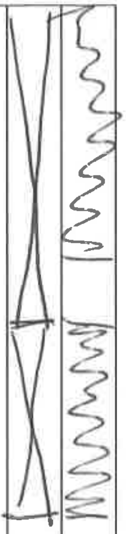
Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Core
Boring Diameter: 2
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5'

Boring ID: A-21

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA
Project: RMOD
Task: 6200
Address: Tacoma

Remarks:



PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	FILL	Gray, crushed GRAVEL Road Base FILL
0.1	0.5 1.0 1000			1		DU-A1-SB-21-0.5-1.0 collected @ 1000
0.1				2	SP	Brown to dark brown, dense, fine to med SAND with some shells; No odor; moist
0.1				3		
				4		SAA, Dark brown SAND w/ 5% silt; No odor wet Collected DU-A2-SB21-5.0-5.5
0.1	5-5.5 1005			5 ▼		Dark Gray, m. dense, Fine SAND, No odor, wet to Saturated
				6		
0.1				7	SM	Dark Gray to Black, dense, silty, fine SAND with woody debris, No odor; Saturated
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

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USCS = Unified Soil Classification System
▼ = denotes groundwater table

Du-A1/A2

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Boring ID: A-22

Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5'

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	FILL	~~Asp~~ Crushed Road Base FILL. 6" Thick
0.1				1		Brown, dense, fine to med SAND, no odor; Moist
0.1				2		
				3	SP	Dark brown to black, fine to med SAND w/ shells; No odor; moist
0.1	3.5 4.0	Du-A1-SB22-3.5-4.0 1015		4		
				5	▼	SAA; SATURATED
0.1				6		
0.1				7	SP	SAA; saturated
0.1	7.5 8.0	Du-A2-SB22-7.5-8.0 1020		8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

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▼ = denotes groundwater table

Page 1 of 1

DU-A1/A2-A-23

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Boring ID: A-23

Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 6'

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0			0–5	0	Fill	Road Base FILL, sandy crushed GRAVEL
0	2.5-3.0 1345	DU-A1-SB23-2.5-3 @ 1345		2.5	SP	Dark Brown to dark gray, dense, fine to med SAND, no odor, moist
0						
0			5–8	5		
0	5.5-6 1340	DU-A2-SB23-5.5-6 @ 1340		6	SM	Dark gray, dense, silty SAND; No odor, wet
				6.5	ML	Dark Olive gray, hard SILT; no odor; wet
0				8	OL	Dark Gray to black, Firm organic SILT; no odor, moist

Depth scale: 0–20

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

OUA1/A2-A-24

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Drill Date: 9/9/14
Logged By: G.Cisneros
Drilled By: CDI 21i
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5'

Boring ID: A-24
SB24

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	ASPH	2" Asphalt @ Top
0				1	FILL	Brown, m.dense, sandy crushed GRAVEL FILL
0	2.5-3.0 @1315	OUA1-SB24-2.5-3.0		2	SP	Brown to dark brown, m.dense, fine to med SAND, no odor; moist
0.1				3		(<5% red grains of unknown materials)
0.2				4		SAA. Dark brown SAND; slight chlorine odor; wet
0	5.0-5.5 @1320	OUA2-SB24-5.0-5.5		5 ▼		
				6	SM	-silty SAND; no odor; saturated
0					ML	-Olive gray, firm SILT with low plasticity; no odor, wet
0				7		
				8	OL/PT	Black organic SILT with peat
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

Page 1 of 1

Du-A1/A2

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Drill Date: 4/8/14
Logged By: G Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5'

Boring ID: A-25

Client: SSA
Project: RHOCA
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
		Du-A1-SB25-3-3.5		0	FILL	Crushed rock, Road base FILL
0.1				1		
0.1				2	SP	Brown, dense, Fine to med SAND, No odor; Moist
	3-3.5 1030			3		
0.1				4	SM	Dark brown, dense, silty SAND, No odor, wet
0.1	5.5-6.0	Du-A2-SB25-5.5-6		5 ▼	SP	Dark brown to black, dense, ~~med~~ Fine to med SAND, no odor; wet
				6	ML	Olive gray, hard SILT w/ thin lenses of sand, No odor; wet
0.1	1035			7		
				8	SM	Dark brown, dense, silty fine sand; no odor; wet
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DU-A1/A2

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Boring ID: A-26

Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: COI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 6.5'

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA RHLD
Project: RHLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		Dense, gravelly, sandy FILL.
Ø				1	F	
Ø	1.5-2.0 1320	DU-A1-SB26-1.5-2.0 @ 1320		2	L L	
Ø				3		
Ø				4	SP	Brown dense fine to med SAND; No odor; MOIST
				5		
Ø				6		Dark brown to dark gray, dense, fine to med SAND No odor; Wet
Ø				▼ 6.5		
Ø	7.5-8.0 1325	DUA1-SB26-7.5-8.0 @1325		7		
				8	SM/ML	Dark Olive gray, dense silty SAND/sandy SILT; no odor; wet.
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DU-A1/A2-A-27

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Boring ID: A-27

Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 6.5'

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		Rock & Crushed Gravel - Roadbase FILL Sandy, crushed gravel.
0				1	FILL	
0				2		
6	2.5-3.0 1305	DU-A1-SB27-2.5-3.0 @1305		3		Brown, m. dense, fine to med SAND; no odor; Moist
0				4		
0	4.5-5 1310	DU-A2-SB27-4.5-5.0 @1310		5	SP	Dark Brown to Dark Gray; M. dense, fine to med. SAND; Moist
0				6		
				▼		
0				7		SAA; Fine SAND; wet.
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5

Boring ID: ~~Du A1~~ A-28
A-28

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		Crushed road base FILL 6"
0.1				1	GW	sandy, gravelly FILL
						- - - - - - - - -
0.1	A1 SB-28 3-3.5			2	SP	Brown to dark brown, dense, fine to med SAND w/shells. No odor, moist
0.1	(0913)	3-3.5		3		Darker brown SAND
				4		
0.1	SB-28 5-5.5	5-5.5		5 ▼	SM	Dark Brown, dense, fine SAND with 15 to 30% silt. No odor Wet to SAT.
	(0920)			6		
0.1				7	ML	Gray, stiff SILT, No odor.
				8	OL	Black, organic SILT.
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DU-A1/A2

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Boring ID: A-29

Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 6.25'

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		Gravel Rock Fill. Road Base
0.1				1	FILL	Sandy crushed gravel
0.1				2		
0.1	2.5-3.0	DU-A1-SB29 2.5-3.0 1230		3		Dark brown, dense, fine to medium SAND; no odor; Moist
0.1				4		
0.1	5.5-6.0	DU-A2-SB29 5.5-6.0 1235		5	SP	SAA.
0.1				6 ▼		
0.1				7	SM	Dark brown, dense, silty fine SAND w/20% silt, No Odor; Wet
				8	ML	Dark Brown to Dark Gray, Stiff SILT; no odor; Wet
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

A-30

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Drill Date: 9/8/14
Logged By: G.C
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 6.5'

Boring ID: DU A1-A-30 & DU A2-A-30

Client: SSARHOLD
Project:
Task: 6200
Address: 3320 Lincoln Ave Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	FILL	Crushed gravel road base FILL Top 6".
0.1	☐ 1.5 2.0	DUA1 SB30- 1.5-2.0 0857		1 2	SP	Brown to Dark Brown, dense, Fine to med SAnd with 20% gravel and 5% silt. No odor; Moist
0.1				3 4		SAA; pinkish tint to Brown; no odor; moist
0.1	☐ 5.5 6.0	DUA2 SB30- 5.5-6.0 0901		5 6 ▼ 7 8	SP	Light Brown to dark brown, dense, fine to med SAND with 30% gravel & 5% silt; no odor; moist to wet @ 6.5
				9 10 11 12 13 14 15 16 17 18 19 20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

EX-31

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Drill Date: 9/8/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2
Boring Depth (ft bgs): 8
Groundwater ATD (ft bgs):

Boring ID:

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	FILL	Crushed Gravel/Road base FILL
0.1				1		-Red brick@1.75'
0.1				2		Brown to Dark brown, dense, Fine to med SAND, No Odor; moist
0.1	☐	SB-31 3.5-4.0 0930		3		
				4		
				5	SP	SAA w/ <10% SILT
0.1	☐ 0935	SB-31 6-6.5		6	▼ SM	Dark Gray, dense, silty fine SAND, No odor, Wet
					ML	Dark Gray, hard SILT; No odor; saturated
0.1				7		
	☐ 0940	SB-31 7.5-0		8		
				9		
				10		
				11		Adjacent to B-12
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

EX-32

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Drill Date: 9/8
Logged By: G.C
Drilled By: COI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5'

Boring ID:

Client: SSA
Project: RHOLD
Task: 6206
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	FILL	Crushed Gravel FILL 0-1' bgs
0.1				1		Brown, dense, fine to med SAND; no odor Moist
0.1				2	SP	
0.1				3		SAA; No odor, Moist
0.1	4-4.5 1110	SB32-4-4.5		4	ML	Olive gray, hard SILT w/ woody debris, No odor
0.1				5 ▼	SP	Dark Gray to black, dense, fine to med SAND w/shells; no odor; Wet
0.1	6-6.5 1115	SB32-6-6.5		6		
0.1				7	ML	Olive gray, stiff to hard SILT with organic debris
0.1	7.5-8.0 1120	SB-32-7.5-8.0		8		
				9		
				10		Duplicate collected @ SB32-6-6.5 D @ 1117
				11		
				12		
				13		Adjacent to B19 (April 2014)
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

EX-33

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Drill Date: 9/9/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5'

Boring ID:

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0 0				0	FILL	Brown, dense, sandy crushed GRAVEL FILL.
7.5	SB-33-4.0-4.5 @ 1050			4	SP	Brown to dark brown, dense, fine to med SAND; Moderate odor; moist
1.2 7.0	SB33-6.0-6.5 @ 1055			5	ML	Olive gray, stiff SILT with moderate plasticity; moderate odor; wet
				7	OL	Black organic-rich SILT
1.7	SB33-7.5-8.0 @ 1100			8	SM	Dark gray to black, dense, silty, fine to medium SAND; strong odor; wet.

Dup collected @ SB33-4.0-4.5

Adjacent to EMW-9

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

EX-34

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Drill Date: 9/8/14
Logged By: G Cisneros
Drilled By: CDT
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 6'

Boring ID:

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area A

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0				0 – 2	FILL	Brown, dense, sandy crushed gravel FILL; Roadbase
0				2 – 5		Brown to dark brown, dense, fine to med SAND; No Odor, moist
0	4-4.5 @1405	SB34-4.0-4.5				
0	6-6.5 @1410	SB-34-6.0-6.5		5 – 7.5	SP	Gray to dark Gray, dense, fine to medium SAND; ~~with~~ chlorine odor; wet
0	7.5-8.0 @1415	SB34-7.5-8.0		7.5 – 8		SAA; chlorine odor; wet.

Adjacent to EMW-10

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2-B1

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Drill Date: 9/10/14	**Boring ID:** B1
Logged By: G. Cisneros	
Drilled By: CDI	
Drill Type: GP	Client: SSA RHOLD
Sample Method: Cont.	Project: RHOLD
Boring Diameter: 2"	Task: 6200
Boring Depth (ft bgs): 8'	Address: Tacoma
Groundwater ATD (ft bgs): 5.5'	

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		Top Soil & Grass
Ø				1	SP FILL	Light Brown to yellowish brown, gravelly, fine to med SAND; no odor; Dry
Ø				2		Non treated surface backfill - Post Treated soil PitRun.
Ø				3	SM	Brown, silty SAND
Ø	@1120 4.5-5.0	ogs DUB1-SB1 4.5-5.0		4	SP	Brown, m.dense, fine to med SAND; no odor; no sheen; moist
Ø				5	ML	Brown, stiff SILT
					SP	Brown, m.dense, fine to med SAND w/10% gravel; No odor; moist
Ø	@5.5-6.5 @1125	DUB1-SB1 5.5-6.0		6	ML	Brown, stiff SILT
Ø				7	SP	Light brown to gray, m.dense gravelly med to coarse SAND with 20% gravel; no odor, wet
				8		
				9		
				10		
				11		
				12		
				13		Original ground surface ~3.5'
				14		According to AL:
				15		FILL is NOT TREATED SOIL but
				16		Filled after Treated soil cells with
				17		clean soil. Therefore top 3.5'
				18		is not included in Treated or in the
				19		decision unit.
				20		

SB1- 4.5-5.0
SB1 5.5-6.0

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 4'

Boring ID: B-2

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0				0	FILL	5/8 minus crushed rock FILL
0	1.5-2.0 @ 1020	DUB1-SB2-1.5-2.0		1		Brown to dark brown, m. dense, Fine to med SAND no odor; moist
0				x 2	SP	
0	2.5-3.0 @ 1025	DUB2-SB2-2.5-3.0		x 3	SM	-silty SAND; wet
0				▼ 4	ML	Olive gray, stiff SILT; no odor; wet
0				5		-Brown, firm SILT w/ abundant woody debris from 5-5.75'; no odor; moist
0				6		
0				7	SM	-Silty SAND
				8	ML	-olive gray, firm silt; no odor; moist
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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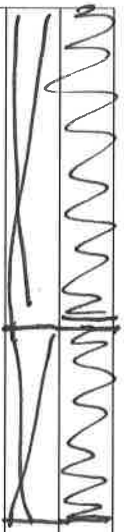
Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 4.75'

Boring ID: B-3

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:



PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
Ø				0		5/8 minus Roadbase FILL
Ø	1.5-2.0 1040	DUB-SB3 1.5-2.0		1 2	SP	Brown to dark brown, dense, fine to med SAND; no odor; moist
Ø						
Ø	3.5-4.0 P 1045	DUB-SB3 3.5-4.0		3		SAA; no odor; wet
				4	SM	Silty SAND lens
Ø				5	SP	Dark brown, dense, fine SAND; no odor; wet
Ø				6	ML	Olive gray, stiff SILT with moderate plasticity and some organics; no odor; wet
Ø				7		
Ø					SM	-Silty SAND lens
				8	ML	-Olive gray SILT with low plasticity, no odor, moist
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Drill Date: 9/10/14
Logged By: G Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 4.5

Boring ID: B4

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				X 0		2" of 5/8 minus
0	0.0-0.5 @ 1050	DUB1-SB4 0-0.5		1	SP	Brown to dark brown, m.dense, fine to med SAND no odor; moist
0						
0	2.0-2.5 @ 1055	DUB2-SB4 2-2.5		X 2		
0				3	ML	~~Silty SAND~~ sandy SILT lens 3.5-4.0'
				4	SP	Dark gray to dark brown, m.dense fine to med SAND; no odor wet
0				▼	SM	silty sand lense, wet
0				5	ML	olive gray, firm, SILT with high plasticity; no odor; wet
0				6		
0				7	OL	Black organic SILT; moist
					SM	SM- silty SAND 7.25' to 7.75'
				8	SP	sp@7.75'. Black, dense, med SAND, no odor; wet.

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

Page 1 of 1

OU B1/B2

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Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 4.5

Boring ID: B-5

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		Grass and topsoil
0						
0	1.5-2.0	OUB1-SB5-1.5-2.0		1	SP	Brown to darkbrown, m.dense, fine to medium SAND; no odor; moist
0	2.0-2.5	OUB2-SB5-2.0-2.5		2		
0				3		SAA; no odor, wet
0				4	ML	Olive gray, stiff SILT; no odor; wet
				.14		
				5	OL	Black, organic-rich SILT; no odor; moist
0				6	ML	Gray to dark gray, stiff SILT; no odor; moist
0				7		
0					SM	- silty SAND lens
				8	SP	- Black, m.dense, fine to coarse SAND with <5% red grains; no odor; Moist
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2-B-6

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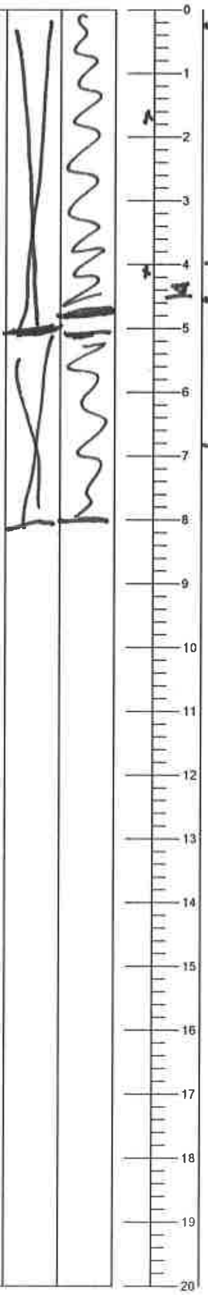
Boring ID: B6

Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: Cont.
Sample Method: GP
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 4.5

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:



PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
			Topsoil	Topsoil and grass
0				Brown to dark brown, m. dense, fine to med SAND; no odor; moist
0	1.5-2.0 @ 1005	DUB1-SB6-1.5-2.0		
0			SP	
				SAA; Dark brown SAND; no odor; wet
0				
	4.0-4.5 @ 1010	DUB2-SB6-4.0-4.5	SM	Dark brown silty SAND; wet
0			ML	Olive gray, stiff SILT with low plasticity; no odor; wet
0				
0				
0			SM	Olive gray to Black; m. dense, silty very fine SAND; no odor; wet.

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Boring ID: B7

Drill Date: 9/12/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs):
Groundwater ATD (ft bgs): 6.75'

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
	0-5.0			0		Light brown, m.dense, silty, gravelly, fine to coarse SAND (FILL); no odor; dry
0		B1-SB7-0-5 @1455		1	FILL SW	
0				2	Treated Soil	Dark Brown, m. dense, silty, fine to med SAND; slight chlorine odor; moist
				3		
0				4		
0		DUB1-SB7-6-6.5 @1445		5	ML	Dark black SILT liner
0	6-6.5			6	SP	Dark gray to black, m.dense, fine to med SAND w/5% fine red grains; no odor; wet
	7-7.5	DUB2-SB7-7-7.5 @ 1450		7	SM	Dark gray to black silty SAND; wet
0				8	ML	olive gray, stiff SILT w/high plasticity; no odor; moist
0				9		
				10		
				11		Original Ground Surface @ 5'
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): ~~[illegible]~~ 5.5'
Groundwater ATD (ft bgs): N/A

Boring ID: B8

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	5/8 minus FILL	Crushed 5/8 minus road base FILL
0	1.5-2.0	DUB1-SB8-1.5-2.0 0850		1	~~[illegible]~~	
0	2.5-3.0	DUB1-SB8-2.5-3.0 0855		2		~~Quarry Spalls~~
				3	GW	Brown, dense, SANDY crushed gravel & concrete FILL
0				4	FILL	
				5		
				6		
				7		
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2-

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Drill Date: 9/12/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 10'
Groundwater ATD (ft bgs): 7.25

Boring ID: B-9

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0	0-6.5	B1-SB9-0-6.5		0	FILL	PIT RUN FILL 0-1.5' Light brown to brown, m. dense, silty, gravelly, fine to coarse SAND; slight chlorine odor; dry
0				2	Treated soil	
0				4	SW	SAA; Dark Brown, silty SAND; slight chlorine odor; moist
0				5.5	GP	Light Brown, dense, sandy GRAVEL; no odor; moist
				6.5	ML	contact Black SILT Liner @ 6.5 to 7'
0	7.5-8.0	DUB1-SB9-7.5-8.0		7 ▼	SP	Black to dark Brown, m. dense, fine to med. SAND with <5% fine red grains; no odor; wet
0				9		
0	9.5-10.0	DUB2-SB9-9.5-10.0		9.5	SM	Dark brown to black, m. dense, silty fine SAND; no odor; moist
				9.75	ML	Olive gray silt @ 9.75

Original ground contact @ 6.5'

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Drill Date: 9/12/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 15'
Groundwater ATD (ft bgs): 9'

Boring ID: B-10

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		
ø	0-5	B1-SB10-0-5		1	Soil	Light Brown to brown, m dense, silty, gravelly, fine to coarse SAND with daramend remnants; slight chlorine odor; dry to moist
				2	Treated Fill	FILL / Treated Soil ←2'
ø				3		
				4	SW	SAA, moist slight chlorine odor
6		DUB1-SB10-6-6.5		5	ML	orange reddish Oxidize SILT Layer ~3" thick
	6-6.5			6	SP	Dark gray to black, m. dense, fine to med SAND with fine red grains; NO ODOR; moist
ø				7		
	8-8.5	DUB2-SB10-8-8.5		8		
ø				9 ▼		
				10		SAA; [illegible] no odor; wet
				11		
				12	ML	Olive gray, stiff SILT w/ high plasticity; no odor; wet
				13	OL	Black organic SILT
				14	ML	Olive gray, [illegible] hard SILT with some organics; no odor; moist
				15		
				16		
				17		Original GS @ 5.0'
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DuB1/B2

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Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5'

Boring ID: B-11

Client: SSA RHOLD
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0	B1-SB11 0-4 @1625			0	~~GR~~ SW	Light brown, fine to coarse SAND w/crushed gravel
0				1	Treated Soil	Light Brown to gray, med sand with tiny angular gravel (Treated Soil) and limestone clasts.
0				2		
0				3	SW	Brown, gravelly sandy FILL ← OGS
0	4.5-5.0 1615			4	ML	-SILT LINER - Dark brown to black SILT; moist
0				5 ▼	SP	Dark Gray to Black, Fine to med. SAND w/10% gravel & w/5% fine red grains; No odor; wet
0	6.0-6.5 1620			6		
0				7	ML	Olive gray, stiff SILT with moderate plasticity no odor; moist
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Original ground surface = 4.0'

Collected DuB1-SB11-4.5-5.0 @1615
Collected DuB2-SB11-6.0-6.5 @1620
Collected ~~DuB2~~ B1-SB11-0-4 @1625

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DU B1/B2

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Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 7'
Groundwater ATD (ft bgs): N/A

Boring ID: B12

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0				0	5/8 minus	5/8-inch minus FILL Hard Drilling
				1		
0	1.5-2.0	DUB1-SB12 1.5-2.0 @0910		2	FILL	Brown dense, silty, sandy, Gravelly FILL; no odor; moist
0	30-3.5	DUB2-SB12-3.0-3.5 @0915		3	GW	
				4		
				5		
0				6		
				7		
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5'

Boring ID: B13

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0	1.0-1.5	DUB1-SB13-1.0-1.5 @0925		0	FILL	5/8 minus Roadbase FILL
0	2.0-2.5			1	SP	Brown, dense, fine to medium SAND; no odor; moist
0		DUB2-SB13-2.0-2.5 @ 0930		2		
0				3		
0				4		SAA. - no odor; moist
0				5		
0				6		SAA; no odor; ~~moist~~ wet
0				7	ML	Olive gray, firm SILT w/ low plasticity; no odor; wet
				8	OL	Organic-rich SILT w/ woody debris
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs):

Boring ID: B-14

Client: SSA.
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		Topsoil & Grass
0	0-0.5 @ 1210	DUB1-SB14 0-0.5			SP	Light Brown, m. dense, fine to med SAND; no odor Dry .5 to 1.0'
0	2-2.5 @ 1215			1		@1.0' Brown to dark Brown, m. dense, fine to med SAND, no odor, moist
0		DUB2-SB14 2-2.5		2		
				3		
0				4	concrete	Concrete 4'-5.5'
0				5	SP	Dark Brown, m. dense, fine to med SAND; no odor; wet
0				6	ML	Olive gray, stiff SILT with moderate plasticity; no odor;
				7		
				8	OL	Black organic-rich SILT
				9		
				10		
				11		0-5.5 - Al Jerome says this is pre-Treated soil FILL.
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2-B-15

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Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: EDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5'

Boring ID: B15

Client: SSA-1
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: AreaB

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
			0		Topsoil
0	@1325	DUB1-SB15-1.5-2.0			Light brown to brown, m.dense, gravelly, fine to coarse SAND w/10% silt; no odor; dry
0	1.5-2.0		1	FILL	
0			2	SW	(OLD FILL according to AL Jerome [pre-treatment])
0	3.0-3.5	DUB2-SB15-3-3.5	3		
0	@ 1330		4	SP	Dark brown to dark gray, m.dense, fine to medium SAND; no odor; moist
0			5		
0			6	ML	Olive gray, stiff SILT with medium plasticity no odor; no odor; moist
0			7		
			8		
			9		
			10		
			11		
			12		
			13		
			14		
			15		
			16		
			17		
			18		
			19		
			20		

1.5
3.0

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

Page 1 of 1

DuB1/B2-B-16

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Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: COI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5'

Boring ID: B16
Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
Ø			0	FILL	Light brown, sandy gravelly FILL
Ø	1.5-2.0	DUB1 SB16-1.5-2.0 @1355	1	SP	Dark brown to dark gray, m-dense, fine to med SAND; no odor; moist
Ø	2.0-2.5	DUB2 SB16-2.0-25 @1400	2		
Ø			3		
Ø			4		Dark Gray to black, m.dense, med. SAND w/ red grains ~<5%;
Ø			5 ▼		
Ø			6	ML	Olive gray, stiff SILT w/moderate plasticity no odor; wet
Ø			7	OL	Black organic silt w/abundant woody debris
			8		
			9		
			10		
			11		
			12		
			13		
			14		
			15		
			16		
			17		
			18		
			19		
			20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B

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Boring ID: B17

Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5'

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

original Ground surface

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0	0-1 @1525			0	Treated Soil	Treated Soil Laydown; Brown, m.dense, gravelly, f-m. SAND; no odor; moist
0	1.0-1.5 1515			1		-----← original ground surface
0				2	SP	Dark Gray, m.dense, fine to med SAND with <5% red grains no odor; moist
0				3		
0	4.5-5.0			4		SAN with red grains; no odor; wet
0	@ 1520			5	ML	Olive gray, stiff SILT with moderate plasticity no odor; wet
				6		
0				7		
0				8	OL	Dark Gray to Black organic SILT
				9		
				10		
				11		Treated Soil | OGS @ 1.0'
				12		0-0.5 = 1 to 1.5 - DUB1-SB17-1.0-1.5
				13		3.5-4.0 = 4.5-5.0 DUB2-SB17-4.5-5.0
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2-B-18

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Drill Date: 9/10/14
Logged By: G. Cisneros
Drilled By: COI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5'

Boring ID: B18

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0	0-1			0	Treated Soil/SW	Light brown, m.dense, F-C SAND w/30% gravel & 5% silt.
0	1.0-1.5			1		--- ← original Ground surface Dark gray, m.dense, silty fine SAND; no odor; moist
0				2	SM	
0	3.0-3.5			3	SP	Dark Gray to black, fine to med SAND w/5% fine red grains; no odor; moist
0				4		
0				5 ▼		SAA; no odor; wet
0				6		
0				7	ML	Olive gray, stiff SILT w/ moderate plasticity; no odor; moist
				8		
				9		
				10		
				11		Collected B-1-SB18-0-1.0 (Treated) @ 1600
				12		Collected DUB1-SB18-1.0-1.5 @ 1550 Collected DUB2-SB18-3.0-3.5 @ 1600
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Boring ID: B-19

Drill Date: 9/12/14
Logged By: G.Cisneros
Drilled By: COI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 15'
Groundwater ATD (ft bgs): 6.5

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Client: SSA
Project: RHOCD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		
0.1	0-5'			1		Light Brown to Brown, m.dense, fine to coarse SAND w/20% gravel & daramend remnants; slight chlorine odor; moist
0.1	B1-SB19-0-5 @1335			2	SW Treated Soil	
0.3				3		
1.2				4		SAA;
				5	—	← 5' bgs
1.0	5.5-6.0	DUB1-SB19-5.5-6.0 @1325		6		Dark gray to black, m.dense, fine to coarse SAND w/<5% fine red grains; moderate chlorine odor; wet.
2.1				7		
8.5					SP	
17.0				8		
	9-9.5	DUB2-SB19-9-9.5		9		SAA; strong chlorine (~~[illegible]~~) odor
50.1				10		
				11	ML	Olive gray, stiff SILT w/moderate plasticity; wet; strong chlorine odor
196				12		
207				13		SAA; moist; strong odor
				14		
417.0				15	SM	Dark brown to black, m.dense, silty, fine to med SAND; strong Burnt Chlorine odor; moist
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Drill Date: 9/10/14
Logged By: G.Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 5.5'

Boring ID: B20

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Client: SSA
Project: RHOCD
Task: 6200
Address: Tacoma

Remarks:

3.5-4.0 @1420
~~5.5-8.0~~ @1425
5.5-6.0

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		Topsoil & Grass
ø	0-2.5 Treated Soil 1430	B-1-~~SB~~20 0-2.5		1	SW FILL Treated soil	Light brown, m. dense, fine to coarse SAND w/15% gravel & 5% silt.
ø				2		
ø						- original soil surface @2.5'
ø	3.5-4.0 @ 1420	DUB1-SB20 3.5-4.0		3	SP	Dark Brown to Dark Gray, m. dense, fine to med SAND; no odor; Moist DUB1-SB20-3.5-4.0
9	5.5-6.0 @ 1425	DUB2-SB20 5.5-6.0		5 ▼		Dark Gray, m. dense, fine to coarse SAND with <5% red grains; no odor; SATURATED DUB2-SB20-5.5-6.0
ø				6		
ø				7	SP	SAA; no odor; sat.
				8		

OGS @ 2.5'

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUR1/B2-B-21

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Boring ID: B-21

Drill Date: 9/2/14
Logged By: G. Cisneros
Drilled By: CDT
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 8'
Groundwater ATD (ft bgs): 7.5

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	TREATED SOIL	Brown, m.dense, fine to coarse SAND w/ angular gravel & limestone clasts; no odor, moist to dry (Treated Soil)
0	0-2.5	B1-SB21-0-2.5		1		
0				2		
0						← OGS
				3	SM	Dark Gray, m.dense, silty, fine to med SAND; no odor; mois
0	3.5-4.0	DUB1-SB21 3.5-4.0		4		
0	@ 8.0			5	SP	Dark gray to black; m.dense, fine to med SAND w/ <5% fine red grains; no odor; moist.
0	6.0-6.5	DUB2-SB21 6.0-6.5		6		
Ø				7		
Ø				▼ 7.5		SAA; wet.
				8		
				9		
				10		
				11		Original Ground Surface @ 2.5'
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Drill Date: 9/12/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 20'
Groundwater ATD (ft bgs): 15.75

Boring ID: B-22

Client: SSA
Project: RHOCD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0		B1-SB22-0-13.5		0		Light brown to dark brown, gravelly, silty, fine to med SAND w/ limestone clasts and Daremend; no odor;
0				1		
0		@ 0900		2		
0				3		
0				4		
0				5		
0	0-13.5			6	Treated Soil	
0				7		SSA; slight chlorine odor; moist
0				8		
0				9		Original Ground surface @ 13.5'
0				10		
0		DUB1-SB22-13.5-14		11		
0		@ 0850		12		SAA; slight chlorine odor and daremend ~~lens~~ remnants
0	13.5-14			13		
0	850			14		Dark gray, m. dense, fine to med SAND with 5% fine red grains; moist
0				15	SP	wet @ 15.5'
0				▼ 16		SAA; no odor; saturated
0	17.5-18	DUB1-SB22-17.5-18		17	SM SP	silty sand lens @ 17; 3" thickness Dark Gray SAND
0		@ 0855		18	ML	Olive gray, stiff SILT w/ moderate plasticity; no odor; wet
0	@ 0855			19	OL	Black organic SILT
				20	ML	Olive gray, stiff SILT w/ mod. plasticity; moist

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2-B-23

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Boring ID: B23

Drill Date: 9/12/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: ~~Geo~~ GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 10'
Groundwater ATD (ft bgs): 9.5'

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0	B1-SB23-0-5.0 @ 1215		0–1		Dark Brown to gray, m.dense, gravelly, silty, fine to coarse SAND; slight odor; moist (Daramend & limestone clasts)
0			2–3	Treated Soil	
J			4		- Dark Brown to Gray, m.dense, silty, fine SAND w/ Daramend remnants; slight chlorine odor; moist
			5	- - - -	
0	5.5-6.0	DUB1-SB23-5.5-6.0	5.5–6	GP	Dark gray to black, fine to med SAND with <5% fine red grain; no odor; moist
0			7		
0	9.0-9.5	DUB2-SB23-9.0-9.5	9		SAA; no odor; wet
			9.5 ▼	———	
			10	ML	Olive gray, stiff SILT with moderate plasticity; no odor; moist

OGS @ 5'

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

Page 1 of 1

DuB1/B2

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Drill Date: 9/12/14
Logged By: G.Cisneros
Drilled By: G.Cisneros
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 15'
Groundwater ATD (ft bgs): 9.5'

Boring ID: B-24

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
∅				0		Brown, m.dense silty, gravelly, fine to coarse SAND w/ 20% gravel, 20% silt, & limestone clasts; slight chlorine odor; moist Treated Soil
	0-5	B-SB24-0-5 @ 1035		1	SW	
				2	Treated Soil	
∅				3		
				4	Treated SM	Dark Brown, m.dense, silty, gravelly fine SAND with 20% silt & 20% gravel w/ limestone clasts & Daramend remnants; slight chlorine odor; moist
∅				5		
	6.5-7.0 @1025	DUB1-SB24-6.5-7.0 @ 1025		6	SP	Dark Gray to Black, m.dense, fine to coarse SAND with fine red grains;
∅				7		
				8		
∅				9 ▼		SAA; No odor; moist
	10.0-10.5	DUB2-SB24-10.0-10.5 @ 1030		10	SP	SAA, no odor; saturated
∅				11		
			ML	12	ML	Olive gray, stiff SILT with medium plasticity; no odor; wet
∅			OL	13	OL	Black Organic SILT; moist
			ML	14	ML	olive gray, stiff SILT with low plasticity; no odor; moist.
				15		
				16		
				17		Original Ground surface @ 5.0'
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2

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Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Drill Date: 9/12/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 15'
Groundwater ATD (ft bgs): 10.5

Boring ID: B-25

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		
0	0-4.0			1	Treated	Brown to dark brown, m.dense, fine to med SAND w/20% gravel & 10% silt; slight chlorine odor
		B-1-SB25-0-4.0 @ 1215		2	Soil	
0				3		Dark brown, m.dense, silty, fine to med SAND w/20% silt; chlorine odor & daramend.
0	4.0-4.5	DUB1-SB25-4-4.5 @ 1205		4	TOPSOIL	Grassy former topsoil. Abundant plant debris. Reddish oxidation color.
				5	SP	Dark gray to black, m.dense, gravelly SAND w/ large cobbles & 25% gravel
0				6	GW	Gray, dense, sandy GRAVEL & COBBLES; no odor; moist
0	6.5-7.0	DUB2-SB25-6.5-7.0 @ 1210		7		
				8		
0				9		
				10 ▼		SAA; Large cobbles with sand & Gravel; no odor, wet
0				11		
				12	ML	Olive gray, stiff SILT w/low plasticity; no odor; moist
0			ML OL	13	OL	-Black organic SILT
			ML	14	ML	olive gray, stiff to hard SILT w/low plasticity; no odor, moist
				15		
				16		
				17		OGS @ 4.0'
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2-B-26

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Drill Date: 9/12/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: Cont.
Sample Method: GP
Boring Diameter: 2"
Boring Depth (ft bgs): 20'
Groundwater ATD (ft bgs): 16'

Boring ID: B26

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		Brown to dark brown, m. dense, fine to coarse SAND w/ gravel & angular clasts of Limestone/Dolomite.
0	0-14.5	B1-SB26-0-14.5 @ 0930		1		
				2		
0		Dup Collected @ 0932		3		
				4		
				5		
0				6	SW	SAA, slight chlorine odor; moist
				7		
				8	Treated Soil	
0				9		
				10		
				11		
0		DUB-SB26-15-15.5 @0920		12		
				13	SW / SM	Dark brown, m. dense, silty fine SAND with Dunamend remnants & limestone clasts; slight odor; moist
				14		Treat
						← OGS @ 14.5'
0	15-15.5	15-15.5		15		Dark gray, m. dense, fine to coarse SAND w/ 5% fine red grains. Wet; no odor;
				16	SP	
0		DUB2-SB26-18.5-19		17		SAA, no odor; saturated
0				18		
0	18.5-19	18.5-19 @ 0925		19	ML	olive gray, stiff SILT w/ moderate plasticity; no odor; moist
0				20	OL	Black Organic SILT; moist

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2-B-27

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Drill Date: 9/12/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 20'
Groundwater ATD (ft bgs): 13.75

Boring ID: B27

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
0	B-1-SB27-0-12.5 @ 1005			1	SW Treated Soil	Brown to dark Brown, loose to m. dense, fine to coarse SAND w/ gravel & limestone clasts & 5% silt; slight chlorine odor; dry
0				2		
0				3		
0				4		
0				5		
0				6		SAA; ~~no odor~~ slight chlorine odor; moist
0				8		
0				9		
0				11	SM Treated Soil	Dark Gray, m. dense, silty, fine to med SAND w/ 10% gravel. and limestone clasts and Daramend remnants; slight chlorine odor; moist
0				12		
0	13.5-14	DUB1-SB27-13.5-14 @ 0955		14 ▼	SP	Dark gray to black, m. dense, fine ~~med~~ to coarse SAND w/ 5% fine red grains; no odor; wet
0	15.0-15.5	DUB2-SB27-15.0-15.5 @ 1000		15		SAA; fine SAND; no odor; saturated.
				16	ML	- olive gray, stiff SILT with moderate plasticity; no odor; wet
					OL	-Black organic SILT
0				17	ML	-Olive gray, stiff SILT w/ low plasticity; no odor; moist
0				18		
0				19		

OGS @ 12.5'

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DU B1/B2-B-28

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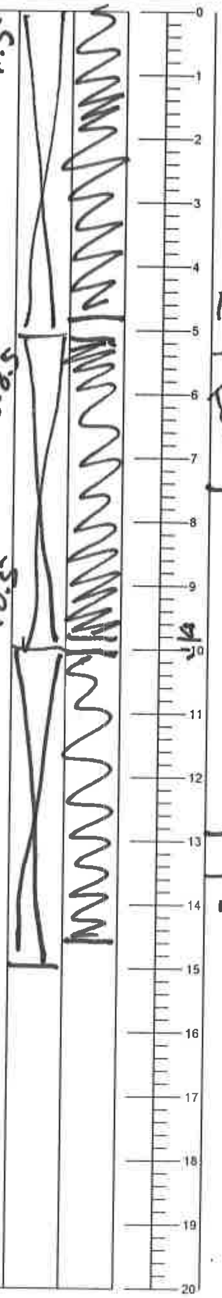
Drill Date: 9/12/14
Logged By: G Cisneros
Drilled By: COI Eli
Drill Type: GP
Sample Method: Cmt
Boring Diameter: 2"
Boring Depth (ft bgs): 15'
Groundwater ATD (ft bgs): 9.75'

Boring ID: B28

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:



PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
ø	0-7.5 @ 1110	B7-SB28-0-7.5		0–5	SW Treated Soil	Brown, m.dense, gravelly, Fine to coarse SAND w/ <5% silt & 25% gravel w/some daramend & limestone clasts; slight Chlorine odor; moist (Treated Soil)
ø						
ø						
ø				5.3–7.5	Treated Soil SM	Brown to dark brown, m.dense, silty, gravelly, fine to med SAND w/ daramend; chlorine odor; moist
				7.5		← OGS @ 7.5: AL Jerome agreed.
ø	8.0-8.5 @ 1100	DUB1-SB28-8.0-8.5		7.5–13	SP	Dark gray to black, m.dense, fine to coarse SAND w/ 5% fine red grains; no odor; moist
				9.75 ▼		wet
ø	10-10.5 @ 1105	DUB2-SB28-10-10.5		10–13		SAA; no odor; saturated
ø				13–13.5	SM	- Dark Gray to black, silty fine SAND; moist
				13.5–15	ML	Olive gray, stiff SILT; with moderate plasticity; no odor; moist.

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1|B2-B-29

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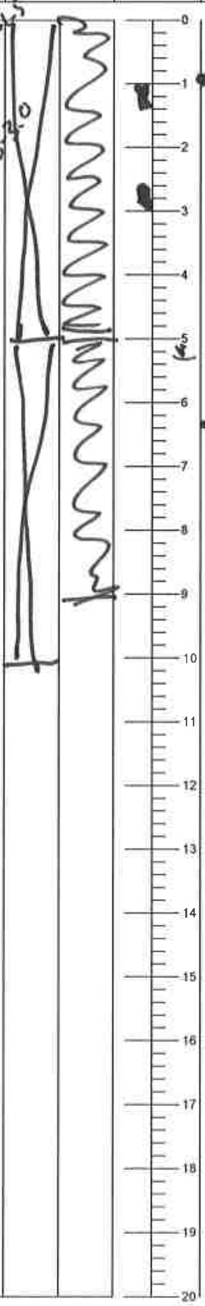
Drill Date: 9/12/14
Logged By: G. Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont.
Boring Diameter: 2"
Boring Depth (ft bgs): 9'
Groundwater ATD (ft bgs): 5.25'

Boring ID: B29

Client: SSA
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:



PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
			Topsoil	Brown, loose, silty SANDY Topsoil with abundant plant debris
0	1.0 1.5 @1135	DUB1-SB29-1.0-1.5 @1135	SP	Dark Brown to Dark Gray, m.dense, fine to med SAND w/ 5% fine red grains; no odor; moist
0	2.5-3.0 @ 1140	DUB2-SB29-2.5-3.0 @1140		
0				
0				Dark gray to Black, fine to coarse SAND w/ 5% fine red grains; no odor; wet
0			ML	Olive gray, stiff SILT with moderate plasticity; no odor, wet
0				SAA; Hard SILT; moist

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

DUB1/B2-B-30

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Boring ID: B30

Drill Date: 9/12/14
Logged By: G.Cisneros
Drilled By: CDI
Drill Type: GP
Sample Method: Cont
Boring Diameter: 2"
Boring Depth (ft bgs): 10'
Groundwater ATD (ft bgs): 4.5

Client: SSA RHOLD
Project: RHOLD
Task: 6200
Address: Tacoma

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location: Area B

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0	TP	TOPSOIL & GRASS
0	1.0-1.5	DUB1-SB30-1.0-1.5 @ 1520		1	SP	Dark Brown to Dark Gray, m. dense, fine to med SAND; no odor; moist
				2		
0	3.0-3.5	DUB2-SB30 3.0-3.5 @ 1525		3		
0				4		
				5		Dark Gray to Black, m. dense, fine to med SAND; no odor; wet
0				6	ML	Olive gray, stiff SILT w/ moderate plasticity
				7	OL	Black organic SILT
0				8	ML	olive gray, stiff, sandy, SILT w/ low plasticity; no odor; moist
0				9		
				10	SM	Dark gray, m. dense, silty fine SAND; no odor; moist
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

Reichold/SSA
Containers Facility

Supplemental Focused Remedial Investigation/ Supplemental Focused Feasibility Study

Appendix E
Data Validation Report

DATA VALIDATION REPORT

SSA Reichhold
Tacoma, WA

Prepared for:

Floyd/Snider
601 Union Street, Suite 600
Seattle, WA 98101

Prepared by:

EcoChem, Inc.
1011 Western Ave, Suite 1011
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EcoChem Project: C15220-2

January 6, 2015

Approved for Release:

Christine Ransom
Sr. Project Chemist
EcoChem, Inc.

PROJECT NARRATIVE

Basis for the Data Validation

This report summarizes the results of data validation performed on soil and quality control (QC) sample data for the SSA Reichhold project. The data received full validation (EPA Stage 4). A complete list of samples is provided in the **Sample Index**.

Analytical Resources, Inc. (Tukwila, Washington) performed the analysis. The analytical method and EcoChem project chemists are listed in the table below.

Analysis	Method	Primary Review	Secondary Review
Dioxin Furan Compounds	EPA 8290	M. Swanson	C. Ransom/A. Bodkin

The data were reviewed using guidance and quality control criteria documented in the analytical method; *Environmental Site Assessment Scope of Work, Moveable Modular Liquefaction System Project, Tacoma, Washington* (ERM, February 2014); and *USEPA National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Data Review* (USEPA, September 2011).

EcoChem's goal in assigning data assessment qualifiers is to assist in proper data interpretation. If values are estimated (J or UJ), data may be used for site evaluation and risk assessment purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet the data quality objectives as stated in the documents and methods referenced above.

Data qualifier definitions, reason codes, and validation criteria are included as **APPENDIX A**. A Qualified Data Summary Table is included in **APPENDIX B**. Data Validation Worksheets will be kept on file at EcoChem, Inc. A qualified laboratory electronic data deliverable (EDD) is also submitted with this report.

Sample Index
SSA Reichhold - Tacoma, WA

SDG	Sample ID	Laboratory ID	Dioxins
YY93	SSA-GW-103S-09/14	14-18079-YY93A	✓
	SSA-GW-104S-09/14	14-18080-YY93B	✓
	SSA-GW-105S-09/14	14-18081-YY93C	✓
	SSA-GW-106S-09/14	14-18082-YY93D	✓
	SSA-GW-109S-09/14	14-18083-YY93E	✓
	SSA-GW-107S-09/14	14-18084-YY93F	✓
YZ38	SB33-4-4.5	14-18295-YZ38A	✓
	SB33-4-4.5D	14-18296-YZ38B	✓
	SB31-3.5-4	14-18297-YZ38C	✓
	SB32-4-4.5	14-18298-YZ38D	✓
	SB34-4-4.5	14-18308-YZ38N	✓
ZA10	DUA1-MIS	14-18748-ZA10A	✓
ZA11	DUB1-MIS	14-18749-ZA11A	✓
ZA67	B-1-SB7-0-5	14-19204-ZA67A	✓
	B-1-SB9-0-6.5	14-19205-ZA67B	✓
	B-1-SB10-0-5	14-19206-ZA67C	✓
	B-1-SB11-0-4	14-19207-ZA67D	✓
	B-1-SB18-0-1	14-19208-ZA67E	✓
	B-1-SB19-0-5	14-19209-ZA67F	✓
	B-1-SB20-0-2.5	14-19210-ZA67G	✓
	B-1-SB21-0-2.5	14-19211-ZA67H	✓
	B-1-SB24-0-5	14-19212-ZA67I	✓
	B-1-SB25-0-4	14-19213-ZA67J	✓
	B-1-SB26-0-14.5	14-19214-ZA67K	✓
	B-1-SB28-0-7.5	14-19215-ZA67L	✓
ZD51	SB34-6-6.5	14-20901-ZD51A	✓
ZE01	DUB2-MIS	14-21115-ZE01A	✓
ZE02	DUA2-MIS	14-21116-ZE02A	✓
ZE03	DUB1-SB8-1.5-2	14-21190-ZE03A	✓
	DUB1-SB12-1.5-2	14-21191-ZE03B	✓
	DUB1-SB13-1-1.5	14-21192-ZE03C	✓
	DUB1-SB5-1.5-2	14-21193-ZE03D	✓
	DUB1-SB6-1.5-2	14-21194-ZE03E	✓
	DUB1-SB2-1.5-2	14-21195-ZE03F	✓
	DUB1-SB3-1.5-2	14-21196-ZE03G	✓
	DUB1-SB4-0-0.5	14-21197-ZE03H	✓
	DUB1-SB1-4.5-5	14-21198-ZE03I	✓
	DUB1-SB14-0-0.5	14-21199-ZE03J	✓
	DUB1-SB15-1.5-2	14-21200-ZE03K	✓
	DUB1-SB16-1.5-2	14-21201-ZE03L	✓

Sample Index
SSA Reichhold - Tacoma, WA

SDG	Sample ID	Laboratory ID	Dioxins
ZE71	DUA1-SB5-1-1.5	14-21488-ZE71A	✓
	DUA1-SB6-3-3.5	14-21489-ZE71B	✓
	DUA1-SB2-3-3.5	14-21490-ZE71C	✓
	DUA1-SB1-2.5-3	14-21491-ZE71D	✓
	DUA1-SB7-3-3.5	14-21492-ZE71E	✓
	DUA1-SB8-2-2.5	14-21493-ZE71F	✓
	DUA1-SB14-2.5-3	14-21494-ZE71G	✓
	DUA1-SB24-2.5-3	14-21495-ZE71H	✓
	DUA1-SB18-3.5-4	14-21496-ZE71I	✓
	DUA1-SB11-2-2.5	14-21497-ZE71J	✓
ZE72	DUA1-SB10-1.5-2	14-21498-ZE72A	✓
	DUA1-SB28-3-3.5	14-21499-ZE72B	✓
	DUA1-SB22-3.5-4	14-21500-ZE72C	✓
	DUA1-SB29-2.5-3	14-21501-ZE72D	✓
	DUA1-SB27-2.5-3	14-21502-ZE72E	✓
	DUA1-SB26-1.5-2	14-21503-ZE72F	✓
	DUA1-SB23-2.5-3	14-21504-ZE72G	✓
	DUA1-SB20-3-3.5	14-21505-ZE72H	✓
	DUA1-SB17-1.5-2	14-21506-ZE72I	✓
	DUA1-SB4-1.5-2	14-21507-ZE72J	✓
	DUA1-SB12-2-2.5	14-21508-ZE72K	✓
ZL62	DUB1-SB29-1-1.5	14-25400-ZL62A	✓
	DUB1-SB30-1-1.5	14-25401-ZL62B	✓
	DUB2-SB14-2-2.5	14-25402-ZL62C	✓
	DUB2-SB18-3-3.5	14-25403-ZL62D	✓
	DUB2-SB11-6-6.5	14-25404-ZL62E	✓
	DUB2-SB20-5.5-6	14-25405-ZL62F	✓
	DUB2-SB21-6-6.5	14-25406-ZL62G	✓
	DUB2-SB22-17.5-18	14-25407-ZL62H	✓
	DUB2-SB26-18.5-19	14-25408-ZL62I	✓
	DUB2-SB27-15-15.5	14-25409-ZL62J	✓
	DUB2-SB24-10-10.5	14-25410-ZL62K	✓
	DUB2-SB28-10-10.5	14-25411-ZL62L	✓
	DUB2-SB29-2.5-3	14-25412-ZL62M	✓
	DUB2-SB25-6.5-7	14-25413-ZL62N	✓
	DUB2-SB23-9-9.5	14-25414-ZL62O	✓
	DUB2-SB19-9-9.5	14-25415-ZL62P	✓
	DUB2-SB10-8-8.5	14-25416-ZL62Q	✓
	DUB2-SB9-9.5-10	14-25417-ZL62R	✓
	DUB2-SB7-7-7.5	14-25418-ZL62S	✓
	DUB2-SB30-3-3.5	14-25419-ZL62T	✓

DATA VALIDATION REPORT
SSA Reichhold – Tacoma, WA
Dioxin/Furan Compounds by Method 8290

This report documents the review of analytical data from the analysis of groundwater and soil samples and the associated laboratory quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc., Tukwila, Washington. Full validation (EPA Stage 4) was performed on all data. See the **Sample Index** for a complete list of samples.

SDG	Number of Samples
YY93	6 Groundwater
YZ38	5 Soil
ZA10	1 Soil
ZA11	1 Soil
ZA67	12 Soil
ZD51	1 Soil
ZE01	1 Soil
ZE02	1 Soil
ZE03	12 Soil
ZE71	10 Soil
ZE72	11 Soil
ZL62	20 Soil

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. EDD TO HARDCOPY VERIFICATION

A complete (100%) verification of the electronic data deliverable (EDD) was performed by comparison to the laboratory data package. No errors were noted.

III. TECHNICAL DATA VALIDATION

The quality control (QC) requirements reviewed are summarized in the following table:

1	Sample Receipt, Preservation, and Holding Times	2	Ongoing Precision and Recovery (OPR)
√	System Performance and Resolution Checks	2	Laboratory Duplicates
√	Initial Calibration (ICAL)	1	Field Duplicates
2	Calibration Verification	√	Target Analyte List
2	Method Blanks	2	Reported Results
1	Field Blanks	2	Compound Identification
2	Labeled Compound Recovery	1	Calculation Verification
1	Matrix Spike/Matrix Spike Duplicates (MS/MSD)		

√ Stated method quality objectives (MQO) and QC criteria have been met. No outliers are noted or discussed.

[1] Quality control results are discussed below, but no data were qualified.

[2] Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.

Sample Receipt, Preservation, and Holding Times

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. Several sample coolers arrived with temperatures outside the advisory limits, the lowest at 0.4°C and the highest at 9.4°C. These temperature outliers did not impact data quality; no action was taken.

Calibration Verification

SDG YY93: The percent difference (%D) value for OCDD in the continuing calibration (CCAL) from 9/22/14 at 22:17 was greater than the control limit and indicated a potential high bias. After qualification based on method blank contamination, OCDD was not detected in the associated sample; no action was necessary.

SDGs ZA10, ZA11: The %D values for OCDD in both CCAL analyzed on 10/6/14 were greater than the control limit and indicated a potential high bias. The associated OCDD results were estimated (J-5BH).

SDGs ZE01, ZE02: The %D values for OCDD in both CCAL were greater than the control limit and indicated a potential high bias. The associated OCDD results were estimated (J-5BH).

SDG ZE72: The %D value for OCDD in one of the CCAL analyzed on 11/1/14 was greater than the control limit and indicated a potential high bias. The associated OCDD results were estimated (J-5BH).

Method Blanks

In order to assess the impact of blank contamination on the reported sample results, action levels were established at five times the blank concentrations. If the concentrations in the associated field samples were less than the action levels, the results were qualified as not detected (U-7) at the reported concentrations.

The laboratory assigned an "EMPC" flag to an analyte result when a peak was detected but did not meet identification criteria. These values cannot be considered as positive identifications, but are “estimated maximum possible concentrations”. When a result in the method blank had an “EMPC” flag, the result was treated as not-detected at an elevated detection limit; therefore no action level was established for these analytes. Blank qualifiers are not assigned to homolog groups.

SDG YY93: The target analytes 1,2,3,4,6,7,8-HpCDD, OCDD, and 1,2,3,6,7,8-HxCDF were detected in the method blank associated with samples extracted on 9/11/2014 and 1,2,3,4,6,7,8-HpCDD, OCDD, 1,2,3,4,6,7,8-HpCDF, 1,2,3,4,7,8,9-HpCDF, and OCDF were detected in the method blank associated with the sample extracted on 9/15/2014. The results listed in the table below were qualified as not-detected (U-7).

Sample ID	U-7 Qualified Results
SSA-GW-103S-09/14	OCDD & 1,2,3,6,7,8-HxCDF
SSA-GW-105S-09/14	1,2,3,4,6,7,8-HpCDD & OCDD
SSA-GW-106S-09/14	1,2,3,6,7,8-HxCDF
SSA-GW-109S-09/14	1,2,3,4,6,7,8-HpCDD, OCDD, and OCDF

SDG YZ38: The target analytes 1,2,3,7,8-PeCDD, 1,2,3,4,6,7,8-HpCDD, OCDD, 1,2,3,4,6,7,8-HpCDF, and OCDF were detected in the method blank associated with the samples extracted on 9/15/2014 and 1,2,3,4,6,7,8-HpCDD and 1,2,3,6,7,8-HxCDF were detected in the method blank associated with samples extracted on 9/23/2014. All associated results were greater than the action levels; no data were qualified.

SDGs ZA10, ZA11, ZA67: The target analytes 1,2,3,4,6,7,8-HpCDD and OCDD were detected in the method blank. All associated results were greater than the action levels; no data were qualified.

SDGs ZE01, ZE02: The target analytes OCDF and OCDD were detected in the method blank. All associated results were greater than the action levels; no data were qualified.

SDGs ZD51, ZE03: The target analytes 1,2,3,4,6,7,8-HpCDD and OCDD were detected in the method blank. All associated results were greater than the action levels; no data were qualified.

SDGs ZE71, ZE72: Three method blanks were submitted with these SDG. Samples were extracted on 10/15/14, 10/17/17, and 11/7/14. For the 10/15/14 method blank, 1,2,3,4,6,7,8-HpCDD and OCDD were detected in the method blank. All associated results were greater than the action levels; no data were qualified.

For the 10/17/14 method blank, 1,2,3,7,8,9-HxCDD, 1,2,3,4,6,7,8-HpCDD, OCDD, 1,2,3,7,8-PeCDF, 1,2,3,4,7,8-HxCDF, 1,2,3,6,7,8-HxCDF, 2,3,4,6,7,8-HxCDF, 1,2,3,4,6,7,8-HpCDF, and OCDF were detected in the method blank. All associated results were greater than the action levels; no data were qualified.

For the 11/7/14 method blank, OCDD, 1,2,3,4,7,8-HxCDF, 1,2,3,7,8,9-HxCDF, and OCDF were detected in the method blank. The results for 1,2,3,7,8,9-HxCDF in Samples DUA1-SB2-3-3.5 and DUA1-SB8-2-2.5 were qualified as not-detected (U-7).

SDG ZL62: The target analytes 1,2,3,6,7,8-HxCDF, 1,2,3,4,6,7,8-HpCDD, 1,2,3,4,6,7,8-HpCDF, and OCDD were detected in the method blank. All associated results were greater than the action levels; no data were qualified.

Field Blanks

No field blanks were submitted.

Labeled Compound Recovery

SDG YZ38: The %R values for the labeled compounds noted below were greater than the upper control limit, indicating a potential high bias. The associated results were estimated (J-13H).

Sample ID	Labeled Compound
SB33-4-4.5	13C-1,2,3,4,6,7,8-HpCDD
	13C-1,2,3,4,6,7,8-HpCDF
SB33-4-4.5	13C-1,2,3,4,7,8-HxCDF
	13C-1,2,3,4,7,8,9-HpCDF
	13C-1,2,3,6,7,8-HxCDF
	13C-1,2,3,7,8-PeCDD
	13C-1,2,3,7,8-PeCDF
	13C-1,2,3,7,8,9-HxCDF
	13C-2,3,4,6,7,8-HxCDF
	13C-2,3,4,7,8-PeCDF
	13C-2,3,7,8-TCDD
	13C-2,3,7,8-TCDF
	13C-OCDD
SB33-4-4.5D	13C-1,2,3,4,6,7,8-HpCDD
	13C-1,2,3,4,6,7,8-HpCDF
	13C-1,2,3,4,7,8-HxCDD
	13C-1,2,3,4,7,8-HxCDF
	13C-1,2,3,4,7,8,9-HpCDF
	13C-1,2,3,6,7,8-HxCDD
	13C-1,2,3,6,7,8-HxCDF
	13C-1,2,3,7,8-PeCDD
	13C-1,2,3,7,8-PeCDF
	13C-1,2,3,7,8,9-HxCDF
	13C-2,3,4,6,7,8-HxCDF
	13C-2,3,4,7,8-PeCDF
	13C-2,3,7,8-TCDD
	13C-2,3,7,8-TCDF
	13C-OCDD
SB34-4-4.5	13C-OCDD

SDG ZA10: The %R value for 13C-OCDD was greater than the upper control limit in Sample DUA1-MIS, indicating a potential high bias. The OCDD and OCDF results for this sample were estimated (J-13H).

SDG ZA67: The %R values for the labeled compounds noted below were greater than the upper control limit, indicating a potential high bias. The associated results were estimated (J-13H).

Sample ID	**Labeled Compound**
B-1-SB9-0-6.5	13C-1,2,3,4,6,7,8-HpCDD
	13C-1,2,3,4,6,7,8-HpCDF
	13C-OCDD
B-1-SB19-0-5	13C-OCDD
B-1-SB20-0-2.5	13C-1,2,3,4,7,8-HxCDF
	13C-1,2,3,6,7,8-HxCDF
	13C-OCDD
B-1-SB24-0-5	13C-1,2,3,4,6,7,8-HpCDD
B-1-SB24-0-5	13C-1,2,3,4,6,7,8-HpCDF
	13C-1,2,3,4,7,8-HxCDF
	13C-OCDD (5x & 50x)
B-1-SB25-0-4	13C-OCDD

SDG ZE03: The %R values for the labeled compounds noted below were greater than the upper control limit, indicating a potential high bias. The associated results were estimated (J-13H).

Sample ID	**Labeled Compound**
DUB1-SB13-1-1.5	13C-1,2,3,4,6,7,8-HpCDF
	13C-OCDD
DUB1-SB4-0-0.5 DUB1-SB5-1.5-2	13C-OCDD

SDG ZE72: The %R value for 13C-OCDD was less than the lower control limit in Sample DUA1-SB26-1.5-2, indicating a potential low bias. The OCDD and OCDF results for this sample were estimated (J-13L).

SDG ZL62: The %R values for the labeled compounds noted below were outside the control limits. The associated results were estimated (J-13L/J-13H).

Sample ID	**Labeled Compound**	**Bias**
DUB1-SB29-1-1.5	13C-OCDD	Low
DUB2-SB18-3-3.5	13C-1,2,3,6,7,8-HxCDD	High
	13C-1,2,3,4,7,8-HxCDF	
	13C-1,2,3,6,7,8-HxCDF	
	13C-2,3,4,6,7,8-HxCDF	

Matrix Spike/Matrix Spike Duplicates

Matrix spike/matrix spike duplicate analyses were not performed. Accuracy was evaluated using the labeled compound and ongoing precision and recovery (OPR) standard results. Precision was evaluated from the laboratory and field duplicate results.

Ongoing Precision and Recovery

SDG YY93: The %R value for OCDD was greater than the upper control limit in the OPR sample extracted on 9/15/2014. The associated OCDD result was not detected; no action was necessary based on the potential high bias.

SDGs ZA10, ZA11: The OPR %R value for OCDD was greater than the upper control limit, indicating a potential high bias. The associated OCDD results were estimated (J-10H).

Laboratory Duplicates

For results greater than 5x the reporting limit (RL), the laboratory relative percent difference (RPD) control limit is 25%. If either result is less than 5x the RL, the difference between the sample and duplicate must be less than the 2x RL.

SDG ZA11: Sample DUB1-MIS was analyzed in duplicate. The relative percent difference (RPD) values for the total PeCDF and total HpCDD homolog groups were greater than the laboratory control limit. Results for these homolog groups were estimated (J-9) in the parent sample.

SDG ZE01: Sample DUB2-MIS was analyzed in duplicate. The RPD values for the congeners and homolog groups listed below were greater than the control limit. Results for these congeners and homolog groups were estimated (J/UJ-9) in the parent sample.

2,3,7,8-TCDF	1,2,3,4,7,8-HxCDD	1,2,3,4,6,7,8-HpCDD	Total HxCDF
1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDD	OCDF	Total HxCDD
1,2,3,6,7,8-HxCDF	1,2,3,4,6,7,8-HpCDF	OCDD	Total HpCDF
2,3,4,6,7,8-HxCDF	1,2,3,4,7,8,9-HpCDF	Total PeCDF	Total HpCDD
1,2,3,7,8,9-HxCDF			

SDG ZE02: Sample DUA2-MIS was analyzed in duplicate. The RPD values for the congeners and homolog groups listed below were greater than the control limit. Results for these congeners and homolog groups were estimated (J/UJ-9) in the parent sample.

2,3,4,7,8-PeCDF	1,2,3,7,8,9-HxCDF	Total TCDF	Total PeCDF
1,2,3,7,8-PeCDD	1,2,3,4,7,8-HxCDD	Total TCDD	Total PeCDD
1,2,3,6,7,8-HxCDF	1,2,3,7,8,9-HxCDD		

Field Duplicates

For results greater than 5x the reporting limit (RL), the RPD control limit is 50%. If either result is less than 5x the RL, the difference between the sample and duplicate must be less than the 2x RL.

SDG YZ38: Samples SB33-4-4.5 and SB33-4-4.5D were submitted as field duplicates. Field precision was acceptable.

Reported Results

The results for OCDD and OCDF were greater than the calibration range of the instrument in several samples; the lab flagged these results with an "E". The results that exceeded the calibration range were estimated (J-20).

Several samples were re-analyzed at dilution to high concentrations of target analytes in the original analyses. The laboratory reported only the most appropriate result from the various analyses. No action was necessary.

Compound Identification

The method requires the confirmation of 2,3,7,8-TCDF using an alternate GC column as the DB5 column that is typically used cannot fully separate 2,3,7,8-TCDF from closely eluting non-target TCDF isomers. The laboratory did not perform a second column confirmation; however the laboratory uses an RTX-Dioxin2 column. This column provides adequate resolution of the TCDF isomers as indicated by the acceptable peak to valley ratios. Since the 2,3,7,8-TCDF resolution was acceptable, no action was necessary.

The laboratory assigned an "EMPC" flag to one or more analytes to indicate that the ion ratio criterion for positive identification was not met. Since the ion abundance ratio is the primary identification criterion for high resolution mass spectroscopy, an outlier indicates that the reported result may be a false positive. When ion ratios did not meet the acceptance criteria, the results were qualified as not detected (U-25) at the reported concentration. The "EMPC" flagged results for total homolog groups were estimated (J-25).

SDG YY93: The chromatograms for Sample SSA-GW-109S-09/14 indicated the presence of diphenyl ether interferences for 1,2,3,7,8-PeCDF. The laboratory assigned an "X" flag to this result. The 1,2,3,7,8-PeCDF for this sample was estimated (J-23).

SDG ZE71: The chromatograms for Samples DUA1-SB7-3-3.5 and DUA1-SB18-3.5-4 indicated the presence of diphenyl ether interferences for 1,2,3,7,8-PeCDF and 2,3,4,7,8-PcCDF, respectively. The laboratory assigned an "X" flag to these results. Because these values were also reported as EMPCs, the results were estimated (UJ-23).

Calculation Verification

Several results were verified by recalculation from the raw data. No calculation or transcription errors were found.

IV. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. With the exceptions noted above, accuracy was acceptable as demonstrated by the labeled compound and OPR recoveries and precision was acceptable as demonstrated by the laboratory and field duplicate RPD values.

Detection limits were elevated based on ion ratio outliers and method blank contamination. Data were estimated due to labeled compound recovery outliers, OPR recovery outliers, laboratory duplicate RPD outliers, CCAL %D outliers, diphenyl ether interferences, results that exceeded the calibration range, and homolog group ion ratio outliers.

All data, as qualified, are acceptable for use.

ECOCHEM
Data Quality

APPENDIX A

DATA QUALIFIER DEFINITIONS
REASON CODES
AND CRITERIA TABLES

DATA VALIDATION QUALIFIER CODES
Based on National Functional Guidelines

The following definitions provide brief explanations of the qualifiers assigned to results in the data review process.

U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis indicates the presence of an analyte that has been “tentatively identified” and the associated numerical value represents the approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

The following is an EcoChem qualifier that may also be assigned during the data review process:

DNR	Do not report; a more appropriate result is reported from another analysis or dilution.

DATA QUALIFIER REASON CODES

Group	Code	Reason for Qualification
Sample Handling	1	Improper Sample Handling or Sample Preservation (i.e., headspace, cooler temperature, pH, summa canister pressure); Exceeded Holding Times
Instrument Performance	24	Instrument Performance (i.e., tune, resolution, retention time window, endrin breakdown, lock-mass)
	5A	Initial Calibration (RF, %RSD, r^2)
	5B	Calibration Verification (ICV, CCV, CCAL; RF, %D, %R) Use bias flags (H,L)[1] where appropriate
Blank Contamination	6	Field Blank Contamination (Equipment Rinsate, Trip Blank, etc.)
	7	Lab Blank Contamination (i.e., method blank, instrument blank, etc.) Use low bias flag (L)[1] for negative instrument blanks
Precision and Accuracy	8	Matrix Spike (MS &/or MSD) Recoveries Use bias flags (H,L)[1] where appropriate
	9	Precision (all replicates: LCS/LCSD, MS/MSD, Lab Replicate, Field Replicate)
	10	Laboratory Control Sample Recoveries (a.k.a. Blank Spikes) Use bias flags (H,L)[1] where appropriate
	12	Reference Material Use bias flags (H,L)[1] where appropriate
	13	Surrogate Spike Recoveries (a.k.a. labeled compounds, recovery standards) Use bias flags (H,L)[1] where appropriate
Interferences	16	ICP/ICP-MS Serial Dilution Percent Difference
	17	ICP/ICP-MS Interference Check Standard Recovery Use bias flags (H,L)[1] where appropriate
	19	Internal Standard Performance (i.e., area, retention time, recovery)
	22	Elevated Detection Limit due to Interference (i.e., chemical and/or matrix)
	23	Bias from Matrix Interference (i.e. diphenyl ether, PCB/pesticides)
Identification and Quantitation	2	Chromatographic pattern in sample does not match pattern of calibration standard
	3	2nd column confirmation (RPD or %D)
	4	Tentatively Identified Compound (TIC) (associated with NJ only)
	20	Calibration Range or Linear Range Exceeded
	25	Compound Identification (i.e., ion ratio, retention time, relative abundance, etc.)
Miscellaneous	11	A more appropriate result is reported (multiple reported analyses i.e., dilutions, re-extractions, etc. Associated with “R” and “DNR” only)
	14	Other (See DV report for details)
	26	Method QC information not provided

[1] H = high bias indicated
L = low bias indicated

Dioxin/Furan Analysis by HRMS
(Based on Dioxin NFG 2011 and Methods EPA 1613B and SW-846 8290)

QC Element	Acceptance Criteria	Source of Criteria	Action for Non-Conformance	Reason Code	Discussion and Comments
Sample Handling					
Cooler/Storage Temperature Preservation	Waters/Solids ≤ 6°C & in the dark Tissues <-10°C & in the dark **Preservation Aqueous:** If Cl_2 is present Thiosulfate must be added and if pH > 9 it must be adjusted to 7 - 9	NFG $^{(1)}$ Method$^{(2)}$	J(pos)/R(ND) if thiosulfate not added if Cl_2 present; J(pos)/UJ(ND) if pH not adjusted J(pos)/UJ(ND) if temp > 20°C	1	**EcoChem PJ, see TM-05** If there is evidence the samples have not been stored properly i.e. not chilled for several days
Holding Time	**If properly stored, 1 year or:** **Extraction (all matrices):** 30 days from collection **Analysis (all matrices)**: 45 days from extraction	NFG $^{(1)}$ Method$^{(2)}$	If not properly stored: J(pos)/UJ(ND) if HT exceedance	1	**EcoChem PJ, see TM-05** Gross exceedance = > 1 year 2011 NFG **Note:** Under CWA, SDWA, and RCRA the HT for H2O is 7 days.
Instrument Performance					
Mass Resolution (Tuning)	PFK (Perfluorokerosene) >=10,000 resolving power at m/z 304.9824. Exact mass of m/z 380.9760 w/in 5 ppm of theoretical value (380.97410 to 380.97790) . Analyzed prior to ICAL and at the start and end of each 12 hr. shift.	NFG $^{(1)}$ Method $^{(2)}$	R(pos/ND) all analytes in all samples associated with the tune	24	Notify PM
Windows Defining Mix	Peaks for first and last eluters must be within established retention time windows for each selector group (chlorination level)	NFG $^{(1)}$ Method $^{(2)}$	If peaks are not completely within windows (clipped): If natives are ok, J(pos)/UJ(ND) homologs (Totals) If natives are affected, R all results for that selector group	24	Notify PM
Column Performance Mix	Both mixes must be analyzed before ICAL and CCAL Valley < 25% (valley = (x/y)*100%) where x = ht. of TCDD (or TCDF) & y = baseline to bottom of valley For all isomers eluting near the 2378-TCDD (TCDF) peak (TCDD only for 8290)	NFG $^{(1)}$ Method $^{(2)}$	J(pos) if valley > 25%	24	**EcoChem PJ, see TM-05, Rev. 2**; Note: TCDF is evaluated only if second column confirmation is performed
Initial Calibration **Sensitivity**	S/N ratio > 10 for all native and labeled compounds in CS1 std.	NFG $^{(1)}$ Method $^{(2)}$	If <10, elevate Det. Limit or R(ND)	5A	
Initial Calibration **Selectivity**	Ion Abundance ratios within QC limits (Table 8 of method 8290) (Table 9 of method 1613B)	NFG $^{(1)}$ Method $^{(2)}$	If 2 or more ion ratios are out for one compound in ICAL, J(pos)	5A	**EcoChem PJ, see TM-05, Rev. 2**
Initial Calibration (Minimum 5 stds.) **Stability**	%RSD < 20% for native compounds %RSD <30% for labeled compounds (%RSD < 35% for labeled compounds under 1613b)	NFG $^{(1)}$ Method $^{(2)}$	J(pos) natives if %RSD > 20%	5A	
	Absolute RT of $^{13}C_{12}$-1234-TCDD >25 min on DB5 & >15 min on DB-225	NFG $^{(1)}$ Method $^{(2)}$	Narrate, no action		**EcoChem PJ, see TM-05, Rev. 2**
Continuing Calibration (Prior to each 12 hr. shift) **Sensitivity**	S/N ratio for CS3 standard > 10	NFG $^{(1)}$ Method $^{(2)}$	If <10, elevate Det. Limit or R(ND)	5B	
Continuing Calibration (Prior to each 12 hr. shift) **Selectivity**	Ion Abundance ratios within QC limits (Table 8 of method 8290) (Table 9 of method 1613B)	NFG $^{(1)}$ Method $^{(2)}$	No action if %D acceptable, review sample ion ratios, U(pos) if ion ratio outside limits	25	**EcoChem PJ, see TM-05**

Dioxin/Furan Analysis by HRMS
(Based on Dioxin NFG 2011 and Methods EPA 1613B and SW-846 8290)

QC Element	Acceptance Criteria	Source of Criteria	Action for Non-Conformance	Reason Code	Discussion and Comments
Instrument Performance (continued)					
Continuing Calibration (Prior to each 12 hr. shift) **Stability**	%D+/-20% for native compounds %D +/-30% for labeled compounds **(Must meet limits in Table 6, Method 1613B)** If %D in the closing CCAL are within 25%/35%, the mean RF from the two CCAL may be used to calculate samples **(Section 8.3.2.4 of 8290**).	NFG (1) Method (2)	**Labeled compounds:** Narrate, no action. **Native compounds:** 1613: J(pos)/UJ(ND)if %D is outside Table 6 limits J(pos)/R(ND) if %D is +/-75% of Table 6 limits 8290: J(pos)/UJ(ND) if %D = 20% - 75% J(pos)/R(ND) if %D > 75%	5B (H,L)[3]	
	Absolute RT of $^{13}C_{12}$-1234-TCDD and $^{13}C_{12}$-123789-HxCDD should be +/- 15 seconds of ICAL RRT for all other compounds must meet criteria listed in Table 2 Method 1316.	NFG (1) Method (2)	Narrate, no action	5B	**EcoChem PJ, see TM-05**
Blank Contamination					
Method Blank (MB)	MB: One per matrix per batch of (of ≤ 20 samples) No detected compounds > RL	NFG (1) Method (2)	U(pos) if result is < 5X action level.	7	**Hierarchy of blank review:** **#1 - Review MB, qualify as needed** **#2 - Review FB , qualify as needed**
Field Blank (FB)	FB: frequency as per QAPP No detected compounds > RL		U(pos) if result is < 5X action level.	6	
Precision and Accuracy					
MS/MSD (recovery)	**MS/MSD not typically required for HRMS analyses.** If lab analyzes MS/MSD then one set per matrix per batch (of ≤ 20 samples) Use most current laboratory control limits	EcoChem standard policy	Qualify parent only unless other QC indicates systematic problems: J(pos) if both %R > UCL - high bias J(pos)/UJ(ND) if both %R < LCL - low bias J(pos)/R(ND) if both %R < 10% - very low bias J(pos)/UJ(ND) if one > UCL & one < LCL, with no bias **PJ if only one %R outlier**	8 (H,L)[3]	No action if only one spike %R is outside criteria. No action if parent concentration is >4x the amount spiked. Qualify parent sample only.
MS/MSD (RPD)	**MS/MSD not typically required for HRMS analyses.** If lab analyzes MS/MSD then one set per matrix per batch (of ≤ 20 samples) Use most current laboratory control limits	EcoChem standard policy	J(pos) in parent sample if RPD > CL	9	Qualify parent sample only.
LCS (or OPR)	One per lab batch (of ≤ 20 samples) Use most current laboratory control limits **or** Limits from Table 6 of 1613B	NFG (1) Method (2)	Qualify all associated samples J(pos) if %R > UCL - high bias J(pos)/UJ(ND) if both %R < LCL - low bias J(pos)/R(ND) if both %R < 10% - very low bias J(pos)/UJ(ND) if one > UCL & one < LCL, with no bias **PJ if only one %R outlier**	10 (H,L)[3]	No action if only one spike %R is outside criteria, when LCSD is analyzed. Qualify all associated samples.
LCS/LCSD (RPD)	**LCSD not typically required for HRMS analyses.** One set per matrix and batch of 20 samples RPD < 35%	Method (2) Ecochem standard policy	J(pos) assoc. compound in all samples	9	Qualify all associated samples.
Lab Duplicate (RPD)	One per lab batch (of ≤ 20 samples) Use most current laboratory control limits	EcoChem standard policy	J(pos)/UJ(ND) if RPD > CL	9	

Dioxin/Furan Analysis by HRMS
(Based on Dioxin NFG 2011 and Methods EPA 1613B and SW-846 8290)

QC Element	Acceptance Criteria	Source of Criteria	Action for Non-Conformance	Reason Code	Discussion and Comments
Precision and Accuracy (continued)					
Labeled Compounds (Internal Standards)	Added to all samples %R = 40% - 135% in all samples 8290 %R must meet limits in Table 7 Method 1613B	NFG (1) Method (2)	J(pos) if %R > UCL - high bias J(pos)/UJ(ND) if %R < LCL - low bias J(pos)/R(ND) if %R < 10% - very low bias	13 (H,L)[3]	
Field Duplicates	Solids: RPD <50% OR difference < 2X RL (for results < 5X RL) Aqueous: RPD <35% OR difference < 1X RL (for results < 5X RL)	EcoChem standard policy	Narrate and qualify if required by project	9	**Use professional judgment**
Compound ID and Calculation					
Quantitation/ Identification	All ions for each isomer must maximize within +/- 2 seconds. S/N ratio >2.5 Ion ratios must meet criteria listed in Table 8 Method 8290, or Table 9 of 1613B; RRTs w/in limits in Table 2 of 1613B	NFG (1) Method (2)	Narrate in report; qualify if necessary NJ(pos) for retention time outliers. U(pos) for ion ratio outliers.	25	**EcoChem PJ, see TM-05**
EMPC (estimated maximum possible concentration)	If quantitation identification criteria are not met, laboratory should report an EMPC value.	NFG (1) Method (2)	If laboratory correctly reported an EMPC value, qualify the native compound U(pos) to indicate that the value is a detection limit and qualify total homolog groups J (pos)	25	**Use professional judgment See TM-18**
Interferences	Interferences from chlorodiphenyl ether compounds	NFG (1) Method (2)	J(pos)/UJ(ND) if present	23	**See TM-16**
	Lock masses must not deviate +/- 20% from values in Table 8 of 1613B	Method (2)	J(pos)/UJ(ND) if present	24	**See TM-17**
Second Column Confirmation	All 2,3,7,8-TCDF hits must be confirmed on a DB-225 (or equiv) column. All QC criteria must also be met for the confirmation analysis.	NFG (1) Method (2)	Report the DB-225 value. If not performed use PJ.	3	DNR-11 DB5 result if both results from both columns are reported. **EcoChem PJ, see TM-05**
Calculation Check	Check 10% of field & QC sample results	EcoChem standard policy	Contact laboratory for resolution and/or corrective action	na	Full data validation only.
Electronic Data Deliverable (EDD)					
Verification of EDD to hardcopy data	EcoChem verify @ 10% unless problems noted; then increase level up to 100% for next several packages.		Depending on scope of problem, correct at EcoChem (minor issues) to resubmittal by laboratory (major issues).	na	EcoChem Project Manager and/or Database Administrator will work with lab to provide long-term corrective action.
Dilutions, Re-extractions and/or Reanalyses	Report only one result per analyte	Standard reporting policy	Use "DNR" to flag results that will not be reported.	11	

(pos) - positive (detected) results; (ND) - not detected results

[1] National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) & Chlorinated Dibenzofurans (CDFs) Data Review, September 2011

[2] Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS), USEPA SW-846, Method 8290

[2] EPA Method 1613, Rev.B, Tetra-through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGS/HRMS, October 1994

[3] NFG 2013 suggests using "+ / -" to indicate bias; EcoChem has chosen "H" = high bias indicated; "L" = low bias indicated.

ECOCHEM
Data Quality

APPENDIX B

QUALIFIED DATA SUMMARY TABLE

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	1,2,3,4,7,8,9-HpCDF	0.94	pg/l	JEMPC	U	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	1,2,3,4,7,8-HxCDF	1.5	pg/l	JEMPC	U	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	1,2,3,6,7,8-HxCDD	0.98	pg/l	JEMPC	U	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	1,2,3,6,7,8-HxCDF	1.64	pg/l	BJ	U	7
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	1,2,3,7,8,9-HxCDD	1.52	pg/l	JEMPC	U	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	1,2,3,7,8,9-HxCDF	2.06	pg/l	JEMPC	U	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	1,2,3,7,8-PeCDF	1.68	pg/l	JEMPC	U	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	2,3,4,7,8-PeCDF	1.18	pg/l	JEMPC	U	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	2,3,7,8-TCDD	2.18	pg/l	BJEMPC	U	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	2,3,7,8-TCDF	1.18	pg/l	JEMPC	U	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	OCDD	60.7	pg/l	B	U	7
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	Total HpCDD	30	pg/l	EMPC	J	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	Total HpCDF	3.36	pg/l	EMPC	J	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	Total HxCDD	8.5	pg/l	EMPC	J	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	Total HxCDF	11.6	pg/l	EMPC	J	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	Total PeCDD	2.9	pg/l	EMPC	J	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	Total PeCDF	13.2	pg/l	EMPC	J	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	Total TCDD	2.88	pg/l	EMPC	J	25
SSA-GW-103S-09/14	14-18079-YY93A	SW8290	Total TCDF	6.16	pg/l	EMPC	J	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	1,2,3,4,7,8,9-HpCDF	1.88	pg/l	JEMPC	U	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	1,2,3,4,7,8-HxCDF	2.24	pg/l	JEMPC	U	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	1,2,3,6,7,8-HxCDD	3.52	pg/l	JEMPC	U	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	1,2,3,6,7,8-HxCDF	1.98	pg/l	BJEMPC	U	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	1,2,3,7,8,9-HxCDD	0.98	pg/l	JEMPC	U	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	1,2,3,7,8,9-HxCDF	2.32	pg/l	JEMPC	U	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	1,2,3,7,8-PeCDD	1.06	pg/l	JEMPC	U	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	1,2,3,7,8-PeCDF	1.56	pg/l	JEMPC	U	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	2,3,7,8-TCDD	1.64	pg/l	BJEMPC	U	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	Total HpCDF	67.4	pg/l	EMPC	J	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	Total HxCDD	25.5	pg/l	EMPC	J	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	Total HxCDF	43.7	pg/l	EMPC	J	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	Total PeCDD	2.46	pg/l	EMPC	J	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	Total PeCDF	23.1	pg/l	EMPC	J	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	Total TCDD	3.84	pg/l	EMPC	J	25
SSA-GW-104S-09/14	14-18080-YY93B	SW8290	Total TCDF	13	pg/l	EMPC	J	25
SSA-GW-105S-09/14	14-18081-YY93C	SW8290	1,2,3,4,6,7,8-HpCDD	3.06	pg/l	BJ	U	7
SSA-GW-105S-09/14	14-18081-YY93C	SW8290	1,2,3,4,7,8-HxCDF	0.64	pg/l	JEMPC	U	25
SSA-GW-105S-09/14	14-18081-YY93C	SW8290	1,2,3,6,7,8-HxCDF	0.78	pg/l	BJEMPC	U	25
SSA-GW-105S-09/14	14-18081-YY93C	SW8290	1,2,3,7,8,9-HxCDF	0.74	pg/l	JEMPC	U	25
SSA-GW-105S-09/14	14-18081-YY93C	SW8290	2,3,7,8-TCDD	1.54	pg/l	BJEMPC	U	25
SSA-GW-105S-09/14	14-18081-YY93C	SW8290	OCDD	20.5	pg/l	B	U	7
SSA-GW-105S-09/14	14-18081-YY93C	SW8290	Total HpCDF	2.27	pg/l	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
SSA-GW-105S-09/14	14-18081-YY93C	SW8290	Total HxCDF	4.6	pg/l	EMPC	J	25
SSA-GW-105S-09/14	14-18081-YY93C	SW8290	Total PeCDF	2.72	pg/l	EMPC	J	25
SSA-GW-105S-09/14	14-18081-YY93C	SW8290	Total TCDD	1.54	pg/l	EMPC	J	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	1,2,3,6,7,8-HxCDD	1.56	pg/l	JEMPC	U	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	1,2,3,6,7,8-HxCDF	1.73	pg/l	BJ	U	7
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	1,2,3,7,8-PeCDF	1.32	pg/l	JEMPC	U	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	2,3,4,6,7,8-HxCDF	0.98	pg/l	JEMPC	U	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	2,3,4,7,8-PeCDF	1	pg/l	JEMPC	U	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	OCDF	17.8	pg/l	JEMPC	U	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	Total HpCDF	27.2	pg/l	EMPC	J	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	Total HxCDD	11.6	pg/l	EMPC	J	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	Total HxCDF	23.4	pg/l	EMPC	J	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	Total PeCDF	14.7	pg/l	EMPC	J	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	Total TCDD	1.67	pg/l	EMPC	J	25
SSA-GW-106S-09/14	14-18082-YY93D	SW8290	Total TCDF	8.99	pg/l	EMPC	J	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	1,2,3,4,6,7,8-HpCDD	341	pg/l	B	U	7
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	1,2,3,4,6,7,8-HpCDF	46.7	pg/l	BEMPC	U	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	1,2,3,4,7,8-HxCDF	5.28	pg/l	BJEMPC	U	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	1,2,3,7,8,9-HxCDD	4.78	pg/l	JEMPC	U	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	1,2,3,7,8,9-HxCDF	3.36	pg/l	JEMPC	U	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	1,2,3,7,8-PeCDF	1.98	pg/l	JX	J	23
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	2,3,7,8-TCDD	1.36	pg/l	JEMPC	U	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	OCDD	7950	pg/l	B	U	7
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	OCDF	86.5	pg/l	B	U	7
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	Total HpCDF	154	pg/l	EMPC	J	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	Total HxCDD	92.1	pg/l	EMPC	J	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	Total HxCDF	98.7	pg/l	EMPC	J	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	Total PeCDD	31.5	pg/l	EMPC	J	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	Total PeCDF	31	pg/l	EMPC	J	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	Total TCDD	2.45	pg/l	EMPC	J	25
SSA-GW-109S-09/14	14-18083-YY93E	SW8290	Total TCDF	16.1	pg/l	EMPC	J	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	1,2,3,4,6,7,8-HpCDF	4.44	pg/l	BJEMPC	U	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	1,2,3,6,7,8-HxCDD	1.28	pg/l	JEMPC	U	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	1,2,3,6,7,8-HxCDF	1.48	pg/l	BJEMPC	U	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	1,2,3,7,8,9-HxCDD	0.96	pg/l	JEMPC	U	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	1,2,3,7,8,9-HxCDF	1.14	pg/l	JEMPC	U	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	1,2,3,7,8-PeCDF	1.24	pg/l	JEMPC	U	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	2,3,4,6,7,8-HxCDF	1.32	pg/l	JEMPC	U	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	2,3,4,7,8-PeCDF	0.76	pg/l	JEMPC	U	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	2,3,7,8-TCDD	1.2	pg/l	BJEMPC	U	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	Total HpCDF	12.3	pg/l	EMPC	J	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	Total HxCDD	34	pg/l	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	Total HxCDF	18.9	pg/l	EMPC	J	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	Total PeCDD	7.92	pg/l	EMPC	J	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	Total PeCDF	14.4	pg/l	EMPC	J	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	Total TCDD	2.67	pg/l	EMPC	J	25
SSA-GW-107S-09/14	14-18084-YY93F	SW8290	Total TCDF	9.13	pg/l	EMPC	J	25
SB33-4-4.5	14-18295-YZ38A	SW8290	2,3,7,8-TCDF	2560	pg/g		J	13
SB33-4-4.5	14-18295-YZ38A	SW8290	Total TCDF	25500	pg/g	EMPC	J	25
SB33-4-4.5	14-18295-YZ38A	SW8290	2,3,7,8-TCDD	121	pg/g	J	J	13
SB33-4-4.5	14-18295-YZ38A	SW8290	Total TCDD	12700	pg/g	EMPC	J	25
SB33-4-4.5	14-18295-YZ38A	SW8290	1,2,3,7,8-PeCDF	1330	pg/g		J	13
SB33-4-4.5	14-18295-YZ38A	SW8290	2,3,4,7,8-PeCDF	2380	pg/g		J	13
SB33-4-4.5	14-18295-YZ38A	SW8290	Total PeCDF	39600	pg/g	EMPC	J	25
SB33-4-4.5	14-18295-YZ38A	SW8290	1,2,3,7,8-PeCDD	1060	pg/g	EMPC	UJ	13,25
SB33-4-4.5	14-18295-YZ38A	SW8290	Total PeCDD	10200	pg/g	EMPC	J	25
SB33-4-4.5	14-18295-YZ38A	SW8290	1,2,3,4,7,8-HxCDF	9660	pg/g		J	13
SB33-4-4.5	14-18295-YZ38A	SW8290	1,2,3,6,7,8-HxCDF	3110	pg/g		J	13
SB33-4-4.5	14-18295-YZ38A	SW8290	2,3,4,6,7,8-HxCDF	4010	pg/g	EMPC	UJ	13,25
SB33-4-4.5	14-18295-YZ38A	SW8290	1,2,3,7,8,9-HxCDF	3670	pg/g		J	13
SB33-4-4.5	14-18295-YZ38A	SW8290	Total HxCDF	210000	pg/g	EMPC	J	25
SB33-4-4.5	14-18295-YZ38A	SW8290	1,2,3,4,6,7,8-HpCDF	95000	pg/g		J	13
SB33-4-4.5	14-18295-YZ38A	SW8290	1,2,3,4,7,8,9-HpCDF	6690	pg/g	EMPC	UJ	13,25
SB33-4-4.5	14-18295-YZ38A	SW8290	Total HpCDF	420000	pg/g	EMPC	J	25
SB33-4-4.5	14-18295-YZ38A	SW8290	1,2,3,4,6,7,8-HpCDD	568000	pg/g		J	13
SB33-4-4.5	14-18295-YZ38A	SW8290	OCDD	17000000	pg/g	E	J	13,20
SB33-4-4.5D	14-18296-YZ38B	SW8290	2,3,7,8-TCDF	2040	pg/g		J	13
SB33-4-4.5D	14-18296-YZ38B	SW8290	Total TCDF	24200	pg/g	EMPC	J	25
SB33-4-4.5D	14-18296-YZ38B	SW8290	Total TCDD	14400	pg/g	EMPC	J	25
SB33-4-4.5D	14-18296-YZ38B	SW8290	1,2,3,7,8-PeCDF	1420	pg/g	EMPC	UJ	13,25
SB33-4-4.5D	14-18296-YZ38B	SW8290	2,3,4,7,8-PeCDF	2140	pg/g	EMPC	UJ	13,25
SB33-4-4.5D	14-18296-YZ38B	SW8290	Total PeCDF	41100	pg/g	EMPC	J	25
SB33-4-4.5D	14-18296-YZ38B	SW8290	1,2,3,7,8-PeCDD	1100	pg/g		J	13
SB33-4-4.5D	14-18296-YZ38B	SW8290	Total PeCDD	10500	pg/g	EMPC	J	25
SB33-4-4.5D	14-18296-YZ38B	SW8290	1,2,3,4,7,8-HxCDF	10600	pg/g		J	13
SB33-4-4.5D	14-18296-YZ38B	SW8290	1,2,3,6,7,8-HxCDF	3340	pg/g	EMPC	U	25
SB33-4-4.5D	14-18296-YZ38B	SW8290	2,3,4,6,7,8-HxCDF	4090	pg/g		J	13
SB33-4-4.5D	14-18296-YZ38B	SW8290	1,2,3,7,8,9-HxCDF	4100	pg/g		J	13
SB33-4-4.5D	14-18296-YZ38B	SW8290	Total HxCDF	245000	pg/g	EMPC	J	25
SB33-4-4.5D	14-18296-YZ38B	SW8290	1,2,3,4,7,8-HxCDD	2020	pg/g		J	13
SB33-4-4.5D	14-18296-YZ38B	SW8290	1,2,3,6,7,8-HxCDD	14800	pg/g		J	13
SB33-4-4.5D	14-18296-YZ38B	SW8290	Total HxCDD	70500	pg/g	EMPC	J	25
SB33-4-4.5D	14-18296-YZ38B	SW8290	1,2,3,4,6,7,8-HpCDF	107000	pg/g		J	13
SB33-4-4.5D	14-18296-YZ38B	SW8290	1,2,3,4,7,8,9-HpCDF	8370	pg/g		J	13

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
SB33-4-4.5D	14-18296-YZ38B	SW8290	Total HpCDF	508000	pg/g	EMPC	J	25
SB33-4-4.5D	14-18296-YZ38B	SW8290	1,2,3,4,6,7,8-HpCDD	663000	pg/g		J	13
SB33-4-4.5D	14-18296-YZ38B	SW8290	OCDD	21000000	pg/g	E	J	13,20
SB31-3.5-4	14-18297-YZ38C	SW8290	Total TCDF	15.7	pg/g	EMPC	J	25
SB31-3.5-4	14-18297-YZ38C	SW8290	Total TCDD	38.9	pg/g	EMPC	J	25
SB31-3.5-4	14-18297-YZ38C	SW8290	Total PeCDF	27.9	pg/g	EMPC	J	25
SB31-3.5-4	14-18297-YZ38C	SW8290	Total PeCDD	67.1	pg/g	EMPC	J	25
SB31-3.5-4	14-18297-YZ38C	SW8290	2,3,4,6,7,8-HxCDF	3.03	pg/g	EMPC	U	25
SB31-3.5-4	14-18297-YZ38C	SW8290	1,2,3,7,8,9-HxCDF	5.81	pg/g	EMPC	U	25
SB31-3.5-4	14-18297-YZ38C	SW8290	Total HxCDF	139	pg/g	EMPC	J	25
SB31-3.5-4	14-18297-YZ38C	SW8290	1,2,3,4,7,8-HxCDD	13.1	pg/g	EMPC	U	25
SB31-3.5-4	14-18297-YZ38C	SW8290	Total HxCDD	186	pg/g	EMPC	J	25
SB31-3.5-4	14-18297-YZ38C	SW8290	Total HpCDF	335	pg/g	EMPC	J	25
SB31-3.5-4	14-18297-YZ38C	SW8290	OCDD	4660	pg/g	E	J	20
SB32-4-4.5	14-18298-YZ38D	SW8290	Total TCDF	10.1	pg/g	EMPC	J	25
SB32-4-4.5	14-18298-YZ38D	SW8290	Total TCDD	73.5	pg/g	EMPC	J	25
SB32-4-4.5	14-18298-YZ38D	SW8290	Total PeCDF	15.6	pg/g	EMPC	J	25
SB32-4-4.5	14-18298-YZ38D	SW8290	Total PeCDD	68.6	pg/g	EMPC	J	25
SB32-4-4.5	14-18298-YZ38D	SW8290	1,2,3,4,7,8-HxCDF	1.89	pg/g	EMPC	U	25
SB32-4-4.5	14-18298-YZ38D	SW8290	2,3,4,6,7,8-HxCDF	1.92	pg/g	EMPC	U	25
SB32-4-4.5	14-18298-YZ38D	SW8290	1,2,3,7,8,9-HxCDF	2.99	pg/g	EMPC	U	25
SB32-4-4.5	14-18298-YZ38D	SW8290	Total HxCDF	58.3	pg/g	EMPC	J	25
SB32-4-4.5	14-18298-YZ38D	SW8290	Total HxCDD	210	pg/g	EMPC	J	25
SB34-4-4.5	14-18308-YZ38N	SW8290	Total TCDF	8630	pg/g	EMPC	J	25
SB34-4-4.5	14-18308-YZ38N	SW8290	2,3,7,8-TCDD	72.6	pg/g	JEMPC	U	25
SB34-4-4.5	14-18308-YZ38N	SW8290	Total TCDD	1280	pg/g	EMPC	J	25
SB34-4-4.5	14-18308-YZ38N	SW8290	Total PeCDF	111000	pg/g	EMPC	J	25
SB34-4-4.5	14-18308-YZ38N	SW8290	Total PeCDD	3670	pg/g	EMPC	J	25
SB34-4-4.5	14-18308-YZ38N	SW8290	Total HxCDF	1520000	pg/g	EMPC	J	25
SB34-4-4.5	14-18308-YZ38N	SW8290	Total HpCDF	6230000	pg/g	EMPC	J	25
SB34-4-4.5	14-18308-YZ38N	SW8290	OCDF	4990000	pg/g	E	J	20
SB34-4-4.5	14-18308-YZ38N	SW8290	OCDD	39200000	pg/g	E	J	13,20
DUA1-MIS	14-18748-ZA10A	SW8290	2,3,7,8-TCDF	53.6	pg/g	JEMPC	U	25
DUA1-MIS	14-18748-ZA10A	SW8290	Total TCDF	545	pg/g	EMPC	J	25
DUA1-MIS	14-18748-ZA10A	SW8290	2,3,7,8-TCDD	32	pg/g	JEMPC	U	25
DUA1-MIS	14-18748-ZA10A	SW8290	Total TCDD	1470	pg/g	EMPC	J	25
DUA1-MIS	14-18748-ZA10A	SW8290	Total PeCDF	7250	pg/g	EMPC	J	25
DUA1-MIS	14-18748-ZA10A	SW8290	Total PeCDD	1680	pg/g	EMPC	J	25
DUA1-MIS	14-18748-ZA10A	SW8290	Total HxCDF	117000	pg/g	EMPC	J	25
DUA1-MIS	14-18748-ZA10A	SW8290	Total HxCDD	14400	pg/g	EMPC	J	25
DUA1-MIS	14-18748-ZA10ADL	SW8290	OCDD	3520000	pg/g		J	5BH,10H, 13
DUB1-MIS	14-18749-ZA11A	SW8290	2,3,7,8-TCDF	1160	pg/g	EMPC	U	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUB1-MIS	14-18749-ZA11A	SW8290	Total TCDF	5870	pg/g	EMPC	J	25
DUB1-MIS	14-18749-ZA11A	SW8290	2,3,7,8-TCDD	181	pg/g	JEMPC	U	25
DUB1-MIS	14-18749-ZA11A	SW8290	Total TCDD	4060	pg/g	EMPC	J	25
DUB1-MIS	14-18749-ZA11A	SW8290	Total PeCDF	126000	pg/g	EMPC	J	9,25
DUB1-MIS	14-18749-ZA11A	SW8290	Total HxCDF	883000	pg/g	EMPC	J	25
DUB1-MIS	14-18749-ZA11A	SW8290	Total HpCDF	1470000	pg/g	EMPC	J	25
DUB1-MIS	14-18749-ZA11A	SW8290	Total HpCDD	4840000	pg/g		J	9
DUB1-MIS	14-18749-ZA11ADL	SW8290	OCDD	37700000	pg/g	E	J	5BH,10H,20
B-1-SB7-0-5	14-19204-ZA67A	SW8290	2,3,7,8-TCDF	563	pg/g	EMPC	U	25
B-1-SB7-0-5	14-19204-ZA67A	SW8290	Total TCDF	3510	pg/g	EMPC	J	25
B-1-SB7-0-5	14-19204-ZA67A	SW8290	2,3,7,8-TCDD	68.4	pg/g	JEMPC	U	25
B-1-SB7-0-5	14-19204-ZA67A	SW8290	Total TCDD	2110	pg/g	EMPC	J	25
B-1-SB7-0-5	14-19204-ZA67A	SW8290	2,3,4,7,8-PeCDF	1390	pg/g	EMPC	U	25
B-1-SB7-0-5	14-19204-ZA67A	SW8290	Total PeCDF	32200	pg/g	EMPC	J	25
B-1-SB7-0-5	14-19204-ZA67A	SW8290	Total PeCDD	6640	pg/g	EMPC	J	25
B-1-SB7-0-5	14-19204-ZA67A	SW8290	Total HxCDF	134000	pg/g	EMPC	J	25
B-1-SB7-0-5	14-19204-ZA67A	SW8290	Total HpCDF	190000	pg/g	EMPC	J	25
B-1-SB7-0-5	14-19204-ZA67A	SW8290	OCDD	8510000	pg/g	E	J	20
B-1-SB9-0-6.5	14-19205-ZA67B	SW8290	Total TCDF	15800	pg/g	EMPC	J	25
B-1-SB9-0-6.5	14-19205-ZA67B	SW8290	2,3,7,8-TCDD	339	pg/g	JEMPC	U	25
B-1-SB9-0-6.5	14-19205-ZA67B	SW8290	Total TCDD	13000	pg/g	EMPC	J	25
B-1-SB9-0-6.5	14-19205-ZA67B	SW8290	Total PeCDF	160000	pg/g	EMPC	J	25
B-1-SB9-0-6.5	14-19205-ZA67B	SW8290	Total HxCDF	1110000	pg/g	EMPC	J	25
B-1-SB9-0-6.5	14-19205-ZA67B	SW8290	1,2,3,4,6,7,8-HpCDF	452000	pg/g		J	13
B-1-SB9-0-6.5	14-19205-ZA67B	SW8290	OCDF	867000	pg/g		J	13
B-1-SB9-0-6.5	14-19205-ZA67BDL	SW8290	OCDD	78200000	pg/g	E	J	20
B-1-SB10-0-5	14-19206-ZA67C	SW8290	Total TCDF	5730	pg/g	EMPC	J	25
B-1-SB10-0-5	14-19206-ZA67C	SW8290	Total TCDD	3510	pg/g	EMPC	J	25
B-1-SB10-0-5	14-19206-ZA67C	SW8290	Total PeCDF	47900	pg/g	EMPC	J	25
B-1-SB10-0-5	14-19206-ZA67C	SW8290	Total PeCDD	13100	pg/g	EMPC	J	25
B-1-SB10-0-5	14-19206-ZA67C	SW8290	Total HxCDF	333000	pg/g	EMPC	J	25
B-1-SB10-0-5	14-19206-ZA67C	SW8290	1,2,3,4,7,8,9-HpCDF	12700	pg/g	EMPC	U	25
B-1-SB10-0-5	14-19206-ZA67C	SW8290	Total HpCDF	626000	pg/g	EMPC	J	25
B-1-SB10-0-5	14-19206-ZA67C	SW8290	OCDD	16400000	pg/g	E	J	20
B-1-SB11-0-4	14-19207-ZA67D	SW8290	Total TCDF	2930	pg/g	EMPC	J	25
B-1-SB11-0-4	14-19207-ZA67D	SW8290	Total TCDD	3210	pg/g	EMPC	J	25
B-1-SB11-0-4	14-19207-ZA67D	SW8290	Total PeCDF	49500	pg/g	EMPC	J	25
B-1-SB11-0-4	14-19207-ZA67D	SW8290	1,2,3,7,8-PeCDD	1150	pg/g	JEMPC	U	25
B-1-SB11-0-4	14-19207-ZA67D	SW8290	Total PeCDD	10400	pg/g	EMPC	J	25
B-1-SB11-0-4	14-19207-ZA67D	SW8290	1,2,3,6,7,8-HxCDF	5190	pg/g	EMPC	U	25
B-1-SB11-0-4	14-19207-ZA67D	SW8290	Total HxCDF	336000	pg/g	EMPC	J	25
B-1-SB11-0-4	14-19207-ZA67D	SW8290	Total HxCDD	129000	pg/g	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
B-1-SB11-0-4	14-19207-ZA67D	SW8290	Total HpCDF	587000	pg/g	EMPC	J	25
B-1-SB11-0-4	14-19207-ZA67D	SW8290	OCDD	41200000	pg/g	E	J	20
B-1-SB18-0-1	14-19208-ZA67E	SW8290	Total TCDF	8260	pg/g	EMPC	J	25
B-1-SB18-0-1	14-19208-ZA67E	SW8290	Total TCDD	7780	pg/g	EMPC	J	25
B-1-SB18-0-1	14-19208-ZA67E	SW8290	Total PeCDF	63400	pg/g	EMPC	J	25
B-1-SB18-0-1	14-19208-ZA67E	SW8290	Total HxCDF	419000	pg/g	EMPC	J	25
B-1-SB18-0-1	14-19208-ZA67E	SW8290	Total HpCDF	790000	pg/g	EMPC	J	25
B-1-SB18-0-1	14-19208-ZA67EDL	SW8290	OCDD	24600000	pg/g	E	J	20
B-1-SB19-0-5	14-19209-ZA67F	SW8290	Total TCDF	3440	pg/g	EMPC	J	25
B-1-SB19-0-5	14-19209-ZA67F	SW8290	2,3,7,8-TCDD	51.9	pg/g	JEMPC	U	25
B-1-SB19-0-5	14-19209-ZA67F	SW8290	Total TCDD	1420	pg/g	EMPC	J	25
B-1-SB19-0-5	14-19209-ZA67F	SW8290	Total PeCDF	17700	pg/g	EMPC	J	25
B-1-SB19-0-5	14-19209-ZA67F	SW8290	Total PeCDD	3330	pg/g	EMPC	J	25
B-1-SB19-0-5	14-19209-ZA67F	SW8290	1,2,3,7,8,9-HxCDF	1900	pg/g	EMPC	U	25
B-1-SB19-0-5	14-19209-ZA67F	SW8290	Total HxCDF	78200	pg/g	EMPC	J	25
B-1-SB19-0-5	14-19209-ZA67F	SW8290	Total HpCDF	98400	pg/g	EMPC	J	25
B-1-SB19-0-5	14-19209-ZA67F	SW8290	OCDF	36200	pg/g		J	13
B-1-SB19-0-5	14-19209-ZA67F	SW8290	OCDD	3070000	pg/g	E	J	13,20
B-1-SB20-0-2.5	14-19210-ZA67G	SW8290	Total TCDF	2020	pg/g	EMPC	J	25
B-1-SB20-0-2.5	14-19210-ZA67G	SW8290	2,3,7,8-TCDD	35.9	pg/g	JEMPC	U	25
B-1-SB20-0-2.5	14-19210-ZA67G	SW8290	Total TCDD	1170	pg/g	EMPC	J	25
B-1-SB20-0-2.5	14-19210-ZA67G	SW8290	Total PeCDF	14700	pg/g	EMPC	J	25
B-1-SB20-0-2.5	14-19210-ZA67G	SW8290	1,2,3,4,7,8-HxCDF	4650	pg/g		J	13
B-1-SB20-0-2.5	14-19210-ZA67G	SW8290	1,2,3,6,7,8-HxCDF	1180	pg/g		J	13
B-1-SB20-0-2.5	14-19210-ZA67G	SW8290	Total HxCDF	81900	pg/g	EMPC	J	25
B-1-SB20-0-2.5	14-19210-ZA67G	SW8290	Total HpCDF	129000	pg/g	EMPC	J	25
B-1-SB20-0-2.5	14-19210-ZA67G	SW8290	OCDF	57000	pg/g		J	13
B-1-SB20-0-2.5	14-19210-ZA67G	SW8290	OCDD	4460000	pg/g	E	J	13,20
B-1-SB21-0-2.5	14-19211-ZA67H	SW8290	2,3,7,8-TCDF	3400	pg/g	EMPC	U	25
B-1-SB21-0-2.5	14-19211-ZA67H	SW8290	Total TCDF	25800	pg/g	EMPC	J	25
B-1-SB21-0-2.5	14-19211-ZA67H	SW8290	Total TCDD	21100	pg/g	EMPC	J	25
B-1-SB21-0-2.5	14-19211-ZA67H	SW8290	Total PeCDF	292000	pg/g	EMPC	J	25
B-1-SB21-0-2.5	14-19211-ZA67H	SW8290	Total HxCDF	2570000	pg/g	EMPC	J	25
B-1-SB21-0-2.5	14-19211-ZA67HDL	SW8290	OCDD	117000000	pg/g	E	J	20
B-1-SB24-0-5	14-19212-ZA67I	SW8290	Total TCDF	25800	pg/g	EMPC	J	25
B-1-SB24-0-5	14-19212-ZA67I	SW8290	Total TCDD	18000	pg/g	EMPC	J	25
B-1-SB24-0-5	14-19212-ZA67I	SW8290	Total PeCDF	358000	pg/g	EMPC	J	25
B-1-SB24-0-5	14-19212-ZA67I	SW8290	1,2,3,4,7,8-HxCDF	139000	pg/g		J	13
B-1-SB24-0-5	14-19212-ZA67I	SW8290	Total HxCDF	2370000	pg/g	EMPC	J	25
B-1-SB24-0-5	14-19212-ZA67I	SW8290	1,2,3,4,6,7,8-HpCDF	823000	pg/g		J	13
B-1-SB24-0-5	14-19212-ZA67I	SW8290	Total HpCDF	3720000	pg/g	EMPC	J	25
B-1-SB24-0-5	14-19212-ZA67IDL	SW8290	1,2,3,4,6,7,8-HpCDD	5780000	pg/g		J	13

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
B-1-SB24-0-5	14-19212-ZA67I	SW8290	OCDF	982000	pg/g		J	13
B-1-SB24-0-5	14-19212-ZA67IDL	SW8290	OCDD	93600000	pg/g	E	J	13,20
B-1-SB25-0-4	14-19213-ZA67J	SW8290	Total TCDF	10600	pg/g	EMPC	J	25
B-1-SB25-0-4	14-19213-ZA67J	SW8290	Total TCDD	8950	pg/g	EMPC	J	25
B-1-SB25-0-4	14-19213-ZA67J	SW8290	Total PeCDF	104000	pg/g	EMPC	J	25
B-1-SB25-0-4	14-19213-ZA67J	SW8290	Total HxCDF	705000	pg/g	EMPC	J	25
B-1-SB25-0-4	14-19213-ZA67J	SW8290	Total HpCDF	1350000	pg/g	EMPC	J	25
B-1-SB25-0-4	14-19213-ZA67J	SW8290	OCDF	650000	pg/g		J	13
B-1-SB25-0-4	14-19213-ZA67J	SW8290	OCDD	47500000	pg/g	E	J	13,20
B-1-SB26-0-14.5	14-19214-ZA67K	SW8290	Total TCDF	19800	pg/g	EMPC	J	25
B-1-SB26-0-14.5	14-19214-ZA67K	SW8290	2,3,7,8-TCDD	639	pg/g	JEMPC	U	25
B-1-SB26-0-14.5	14-19214-ZA67K	SW8290	Total TCDD	15800	pg/g	EMPC	J	25
B-1-SB26-0-14.5	14-19214-ZA67K	SW8290	Total PeCDF	285000	pg/g	EMPC	J	25
B-1-SB26-0-14.5	14-19214-ZA67K	SW8290	1,2,3,6,7,8-HxCDF	25100	pg/g	EMPC	U	25
B-1-SB26-0-14.5	14-19214-ZA67K	SW8290	Total HxCDF	1790000	pg/g	EMPC	J	25
B-1-SB26-0-14.5	14-19214-ZA67K	SW8290	Total HxCDD	756000	pg/g	EMPC	J	25
B-1-SB26-0-14.5	14-19214-ZA67K	SW8290	Total HpCDF	2800000	pg/g	EMPC	J	25
B-1-SB26-0-14.5	14-19214-ZA67K	SW8290	OCDD	65800000	pg/g	E	J	20
B-1-SB28-0-7.5	14-19215-ZA67L	SW8290	2,3,7,8-TCDF	2480	pg/g	JEMPC	U	25
B-1-SB28-0-7.5	14-19215-ZA67L	SW8290	Total TCDF	32500	pg/g	EMPC	J	25
B-1-SB28-0-7.5	14-19215-ZA67L	SW8290	2,3,7,8-TCDD	538	pg/g	JEMPC	U	25
B-1-SB28-0-7.5	14-19215-ZA67L	SW8290	Total TCDD	40100	pg/g	EMPC	J	25
B-1-SB28-0-7.5	14-19215-ZA67L	SW8290	Total PeCDF	408000	pg/g	EMPC	J	25
B-1-SB28-0-7.5	14-19215-ZA67L	SW8290	Total PeCDD	95900	pg/g	EMPC	J	25
B-1-SB28-0-7.5	14-19215-ZA67L	SW8290	Total HxCDF	1600000	pg/g	EMPC	J	25
B-1-SB28-0-7.5	14-19215-ZA67L	SW8290	OCDD	89900000	pg/g	E	J	20
SB34-6-6.5	14-20901-ZD51A	SW8290	Total TCDF	12.1	pg/g	EMPC	J	25
SB34-6-6.5	14-20901-ZD51A	SW8290	2,3,7,8-TCDD	1.47	pg/g	JEMPC	U	25
SB34-6-6.5	14-20901-ZD51A	SW8290	Total TCDD	3.21	pg/g	EMPC	J	25
SB34-6-6.5	14-20901-ZD51A	SW8290	1,2,3,7,8-PeCDF	1.76	pg/g	JEMPC	U	25
SB34-6-6.5	14-20901-ZD51A	SW8290	Total PeCDF	61.7	pg/g	EMPC	J	25
SB34-6-6.5	14-20901-ZD51A	SW8290	Total PeCDD	11.9	pg/g	EMPC	J	25
SB34-6-6.5	14-20901-ZD51A	SW8290	Total HxCDF	925	pg/g	EMPC	J	25
SB34-6-6.5	14-20901-ZD51A	SW8290	Total HxCDD	109	pg/g	EMPC	J	25
DUB2-MIS	14-21115-ZE01A	SW8290	2,3,7,8-TCDF	731	pg/g	EMPC	UJ	9,25
DUB2-MIS	14-21115-ZE01A	SW8290	Total TCDF	3290	pg/g	EMPC	J	25
DUB2-MIS	14-21115-ZE01A	SW8290	Total TCDD	2810	pg/g	EMPC	J	25
DUB2-MIS	14-21115-ZE01A	SW8290	2,3,4,7,8-PeCDF	783	pg/g	EMPC	U	25
DUB2-MIS	14-21115-ZE01A	SW8290	Total PeCDF	14500	pg/g	EMPC	J	9,25
DUB2-MIS	14-21115-ZE01A	SW8290	Total PeCDD	4830	pg/g	EMPC	J	25
DUB2-MIS	14-21115-ZE01A	SW8290	1,2,3,4,7,8-HxCDF	5320	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	1,2,3,6,7,8-HxCDF	1220	pg/g		J	9

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUB2-MIS	14-21115-ZE01A	SW8290	2,3,4,6,7,8-HxCDF	1800	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	1,2,3,7,8,9-HxCDF	2240	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	Total HxCDF	86200	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	1,2,3,4,7,8-HxCDD	1220	pg/g	EMPC	UJ	9,25
DUB2-MIS	14-21115-ZE01A	SW8290	1,2,3,6,7,8-HxCDD	7810	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	Total HxCDD	40300	pg/g	EMPC	J	9,25
DUB2-MIS	14-21115-ZE01A	SW8290	1,2,3,4,6,7,8-HpCDF	37600	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	1,2,3,4,7,8,9-HpCDF	3210	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	Total HpCDF	167000	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	1,2,3,4,6,7,8-HpCDD	251000	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	Total HpCDD	512000	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	OCDF	88500	pg/g		J	9
DUB2-MIS	14-21115-ZE01A	SW8290	OCDD	4480000	pg/g	E	J	5BH,9,20
DUA2-MIS	14-21116-ZE02A	SW8290	Total TCDF	396	pg/g	EMPC	J	9,25
DUA2-MIS	14-21116-ZE02A	SW8290	Total TCDD	11.1	pg/g	U	UJ	9
DUA2-MIS	14-21116-ZE02A	SW8290	2,3,4,7,8-PeCDF	8.32	pg/g	U	UJ	9
DUA2-MIS	14-21116-ZE02A	SW8290	Total PeCDF	1200	pg/g	EMPC	J	9,25
DUA2-MIS	14-21116-ZE02A	SW8290	1,2,3,7,8-PeCDD	10.9	pg/g	U	UJ	9
DUA2-MIS	14-21116-ZE02A	SW8290	Total PeCDD	161	pg/g	EMPC	J	9,25
DUA2-MIS	14-21116-ZE02A	SW8290	1,2,3,6,7,8-HxCDF	8.91	pg/g	U	UJ	9
DUA2-MIS	14-21116-ZE02A	SW8290	1,2,3,7,8,9-HxCDF	11.9	pg/g	U	UJ	9
DUA2-MIS	14-21116-ZE02A	SW8290	1,2,3,4,7,8-HxCDD	143	pg/g	EMPC	UJ	9,25
DUA2-MIS	14-21116-ZE02A	SW8290	1,2,3,6,7,8-HxCDD	688	pg/g	EMPC	U	25
DUA2-MIS	14-21116-ZE02A	SW8290	1,2,3,7,8,9-HxCDD	322	pg/g		J	9
DUA2-MIS	14-21116-ZE02A	SW8290	Total HxCDD	2800	pg/g	EMPC	J	25
DUA2-MIS	14-21116-ZE02A	SW8290	OCDD	132000	pg/g		J	5BH
DUB1-SB8-1.5-2	14-21190-ZE03A	SW8290	Total TCDF	23.3	pg/g	EMPC	J	25
DUB1-SB8-1.5-2	14-21190-ZE03A	SW8290	Total TCDD	10.7	pg/g	EMPC	J	25
DUB1-SB8-1.5-2	14-21190-ZE03A	SW8290	1,2,3,7,8-PeCDF	6.27	pg/g	JEMPC	U	25
DUB1-SB8-1.5-2	14-21190-ZE03A	SW8290	2,3,4,7,8-PeCDF	6.86	pg/g	JEMPC	U	25
DUB1-SB8-1.5-2	14-21190-ZE03A	SW8290	Total PeCDF	143	pg/g	EMPC	J	25
DUB1-SB8-1.5-2	14-21190-ZE03A	SW8290	1,2,3,7,8-PeCDD	5.92	pg/g	JEMPC	U	25
DUB1-SB8-1.5-2	14-21190-ZE03A	SW8290	Total PeCDD	35.6	pg/g	EMPC	J	25
DUB1-SB8-1.5-2	14-21190-ZE03A	SW8290	Total HxCDF	721	pg/g	EMPC	J	25
DUB1-SB8-1.5-2	14-21190-ZE03A	SW8290	Total HxCDD	344	pg/g	EMPC	J	25
DUB1-SB8-1.5-2	14-21190-ZE03A	SW8290	OCDD	55000	pg/g	E	J	20
DUB1-SB12-1.5-2	14-21191-ZE03B	SW8290	Total TCDF	71.6	pg/g	EMPC	J	25
DUB1-SB12-1.5-2	14-21191-ZE03B	SW8290	2,3,7,8-TCDD	4.19	pg/g	JEMPC	U	25
DUB1-SB12-1.5-2	14-21191-ZE03B	SW8290	Total TCDD	54.4	pg/g	EMPC	J	25
DUB1-SB12-1.5-2	14-21191-ZE03B	SW8290	Total PeCDF	497	pg/g	EMPC	J	25
DUB1-SB12-1.5-2	14-21191-ZE03B	SW8290	Total HxCDF	2770	pg/g	EMPC	J	25
DUB1-SB12-1.5-2	14-21191-ZE03B	SW8290	OCDD	214000	pg/g	E	J	20

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	Total TCDF	1090	pg/g	EMPC	J	25
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	Total TCDD	237	pg/g	EMPC	J	25
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	1,2,3,7,8-PeCDF	58.6	pg/g	EMPC	U	25
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	Total PeCDF	1230	pg/g	EMPC	J	25
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	Total PeCDD	285	pg/g	EMPC	J	25
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	2,3,4,6,7,8-HxCDF	110	pg/g	EMPC	U	25
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	Total HxCDF	4570	pg/g	EMPC	J	25
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	Total HxCDD	2530	pg/g	EMPC	J	25
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	1,2,3,4,6,7,8-HpCDF	1960	pg/g		J	13H
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	Total HpCDF	7900	pg/g	EMPC	J	25
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	OCDF	4670	pg/g		J	13H
DUB1-SB13-1-1.5	14-21192-ZE03C	SW8290	OCDD	364000	pg/g		J	13H
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	2,3,7,8-TCDF	99.4	pg/g	EMPC	U	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	Total TCDF	328	pg/g	EMPC	J	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	Total TCDD	207	pg/g	EMPC	J	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	2,3,4,7,8-PeCDF	46.9	pg/g	EMPC	U	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	Total PeCDF	870	pg/g	EMPC	J	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	Total PeCDD	212	pg/g	EMPC	J	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	1,2,3,6,7,8-HxCDF	52.8	pg/g	EMPC	U	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	Total HxCDF	3150	pg/g	EMPC	J	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	1,2,3,4,7,8-HxCDD	45.9	pg/g	EMPC	U	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	1,2,3,7,8,9-HxCDD	116	pg/g	EMPC	U	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	Total HxCDD	2240	pg/g	EMPC	J	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	Total HpCDF	4100	pg/g	EMPC	J	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	Total HpCDD	32300	pg/g	EMPC	J	25
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	OCDF	1650	pg/g		J	13H
DUB1-SB5-1.5-2	14-21193-ZE03D	SW8290	OCDD	464000	pg/g	E	J	13H,20
DUB1-SB6-1.5-2	14-21194-ZE03E	SW8290	Total TCDF	364	pg/g	EMPC	J	25
DUB1-SB6-1.5-2	14-21194-ZE03E	SW8290	Total TCDD	272	pg/g	EMPC	J	25
DUB1-SB6-1.5-2	14-21194-ZE03E	SW8290	2,3,4,7,8-PeCDF	74.9	pg/g	EMPC	U	25
DUB1-SB6-1.5-2	14-21194-ZE03E	SW8290	Total PeCDF	1550	pg/g	EMPC	J	25
DUB1-SB6-1.5-2	14-21194-ZE03E	SW8290	Total PeCDD	411	pg/g	EMPC	J	25
DUB1-SB6-1.5-2	14-21194-ZE03E	SW8290	Total HxCDF	6200	pg/g	EMPC	J	25
DUB1-SB6-1.5-2	14-21194-ZE03E	SW8290	OCDD	604000	pg/g	E	J	20
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	Total TCDF	21.3	pg/g	EMPC	J	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	2,3,7,8-TCDD	1.14	pg/g	JEMPC	U	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	Total TCDD	22.3	pg/g	EMPC	J	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	1,2,3,7,8-PeCDF	2.18	pg/g	JEMPC	U	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	Total PeCDF	41.7	pg/g	EMPC	J	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	Total PeCDD	25.8	pg/g	EMPC	J	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	1,2,3,6,7,8-HxCDF	2.48	pg/g	JEMPC	U	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	2,3,4,6,7,8-HxCDF	3.24	pg/g	JEMPC	U	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	Total HxCDF	147	pg/g	EMPC	J	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	1,2,3,4,7,8-HxCDD	2.76	pg/g	JEMPC	U	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	1,2,3,7,8,9-HxCDD	7.96	pg/g	JEMPC	U	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	Total HxCDD	131	pg/g	EMPC	J	25
DUB1-SB2-1.5-2	14-21195-ZE03F	SW8290	Total HpCDF	228	pg/g	EMPC	J	25
DUB1-SB3-1.5-2	14-21196-ZE03G	SW8290	Total TCDF	389	pg/g	EMPC	J	25
DUB1-SB3-1.5-2	14-21196-ZE03G	SW8290	2,3,7,8-TCDD	3.31	pg/g	JEMPC	U	25
DUB1-SB3-1.5-2	14-21196-ZE03G	SW8290	Total TCDD	123	pg/g	EMPC	J	25
DUB1-SB3-1.5-2	14-21196-ZE03G	SW8290	Total PeCDD	178	pg/g	EMPC	J	25
DUB1-SB3-1.5-2	14-21196-ZE03G	SW8290	Total HxCDD	2620	pg/g	EMPC	J	25
DUB1-SB3-1.5-2	14-21196-ZE03G	SW8290	Total HpCDF	8460	pg/g	EMPC	J	25
DUB1-SB3-1.5-2	14-21196-ZE03G	SW8290	OCDD	203000	pg/g	E	J	20
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	2,3,7,8-TCDF	27.2	pg/g	EMPC	U	25
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	Total TCDF	234	pg/g	EMPC	J	25
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	Total TCDD	99.5	pg/g	EMPC	J	25
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	1,2,3,7,8-PeCDF	96.9	pg/g	EMPC	U	25
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	Total PeCDF	2450	pg/g	EMPC	J	25
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	Total PeCDD	395	pg/g	EMPC	J	25
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	Total HxCDF	15000	pg/g	EMPC	J	25
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	1,2,3,4,7,8,9-HpCDF	551	pg/g	EMPC	U	25
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	Total HpCDF	27000	pg/g	EMPC	J	25
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	Total HpCDD	87200	pg/g	EMPC	J	25
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	OCDF	10500	pg/g		J	13H
DUB1-SB4-0-0.5	14-21197-ZE03H	SW8290	OCDD	762000	pg/g	E	J	13H,20
DUB1-SB1-4.5-5	14-21198-ZE03I	SW8290	Total TCDF	14.5	pg/g	EMPC	J	25
DUB1-SB1-4.5-5	14-21198-ZE03I	SW8290	Total TCDD	14.9	pg/g	EMPC	J	25
DUB1-SB1-4.5-5	14-21198-ZE03I	SW8290	Total PeCDF	30.1	pg/g	EMPC	J	25
DUB1-SB1-4.5-5	14-21198-ZE03I	SW8290	1,2,3,7,8-PeCDD	1.13	pg/g	JEMPC	U	25
DUB1-SB1-4.5-5	14-21198-ZE03I	SW8290	Total PeCDD	14.4	pg/g	EMPC	J	25
DUB1-SB1-4.5-5	14-21198-ZE03I	SW8290	1,2,3,6,7,8-HxCDF	2.11	pg/g	JEMPC	U	25
DUB1-SB1-4.5-5	14-21198-ZE03I	SW8290	Total HxCDF	93.6	pg/g	EMPC	J	25
DUB1-SB1-4.5-5	14-21198-ZE03I	SW8290	Total HxCDD	73	pg/g	EMPC	J	25
DUB1-SB14-0-0.5	14-21199-ZE03J	SW8290	Total TCDF	1200	pg/g	EMPC	J	25
DUB1-SB14-0-0.5	14-21199-ZE03J	SW8290	Total TCDD	911	pg/g	EMPC	J	25
DUB1-SB14-0-0.5	14-21199-ZE03J	SW8290	Total PeCDF	13200	pg/g	EMPC	J	25
DUB1-SB14-0-0.5	14-21199-ZE03J	SW8290	Total HxCDF	88400	pg/g	EMPC	J	25
DUB1-SB14-0-0.5	14-21199-ZE03J	SW8290	Total HpCDF	155000	pg/g	EMPC	J	25
DUB1-SB14-0-0.5	14-21199-ZE03J	SW8290	OCDD	5560000	pg/g	E	J	20
DUB1-SB15-1.5-2	14-21200-ZE03K	SW8290	Total TCDF	157	pg/g	EMPC	J	25
DUB1-SB15-1.5-2	14-21200-ZE03K	SW8290	2,3,7,8-TCDD	8.77	pg/g	JEMPC	U	25
DUB1-SB15-1.5-2	14-21200-ZE03K	SW8290	Total TCDD	460	pg/g	EMPC	J	25
DUB1-SB15-1.5-2	14-21200-ZE03K	SW8290	Total PeCDF	1240	pg/g	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUB1-SB15-1.5-2	14-21200-ZE03K	SW8290	Total PeCDD	627	pg/g	EMPC	J	25
DUB1-SB15-1.5-2	14-21200-ZE03K	SW8290	Total HxCDD	3710	pg/g	EMPC	J	25
DUB1-SB15-1.5-2	14-21200-ZE03K	SW8290	Total HpCDF	5310	pg/g	EMPC	J	25
DUB1-SB16-1.5-2	14-21201-ZE03L	SW8290	Total TCDF	204	pg/g	EMPC	J	25
DUB1-SB16-1.5-2	14-21201-ZE03L	SW8290	Total TCDD	172	pg/g	EMPC	J	25
DUB1-SB16-1.5-2	14-21201-ZE03L	SW8290	1,2,3,7,8-PeCDF	30.1	pg/g	JEMPC	U	25
DUB1-SB16-1.5-2	14-21201-ZE03L	SW8290	Total PeCDF	1020	pg/g	EMPC	J	25
DUB1-SB16-1.5-2	14-21201-ZE03L	SW8290	Total PeCDD	272	pg/g	EMPC	J	25
DUB1-SB16-1.5-2	14-21201-ZE03L	SW8290	1,2,3,4,7,8-HxCDD	93.6	pg/g	EMPC	U	25
DUB1-SB16-1.5-2	14-21201-ZE03L	SW8290	Total HxCDD	2240	pg/g	EMPC	J	25
DUB1-SB16-1.5-2	14-21201-ZE03L	SW8290	Total HpCDF	6160	pg/g	EMPC	J	25
DUA1-SB5-1-1.5	14-21488-ZE71A	SW8290	2,3,7,8-TCDF	0.745	pg/g	JEMPC	U	25
DUA1-SB5-1-1.5	14-21488-ZE71A	SW8290	Total TCDF	17.9	pg/g	EMPC	J	25
DUA1-SB5-1-1.5	14-21488-ZE71A	SW8290	2,3,7,8-TCDD	2.04	pg/g	JEMPC	U	25
DUA1-SB5-1-1.5	14-21488-ZE71A	SW8290	Total TCDD	81	pg/g	EMPC	J	25
DUA1-SB5-1-1.5	14-21488-ZE71A	SW8290	1,2,3,7,8-PeCDF	2.29	pg/g	JEMPC	U	25
DUA1-SB5-1-1.5	14-21488-ZE71A	SW8290	2,3,4,7,8-PeCDF	2.1	pg/g	JEMPC	U	25
DUA1-SB5-1-1.5	14-21488-ZE71A	SW8290	Total PeCDF	59.8	pg/g	EMPC	J	25
DUA1-SB5-1-1.5	14-21488-ZE71A	SW8290	Total PeCDD	81.5	pg/g	EMPC	J	25
DUA1-SB5-1-1.5	14-21488-ZE71A	SW8290	Total HxCDF	202	pg/g	EMPC	J	25
DUA1-SB5-1-1.5	14-21488-ZE71A	SW8290	Total HxCDD	221	pg/g	EMPC	J	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	Total TCDF	3.64	pg/g	EMPC	J	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	2,3,7,8-TCDD	2.49	pg/g	BJEMPC	U	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	Total TCDD	6.12	pg/g	EMPC	J	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	1,2,3,7,8-PeCDF	2.14	pg/g	JEMPC	U	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	Total PeCDF	7.87	pg/g	EMPC	J	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	1,2,3,4,7,8-HxCDF	2.47	pg/g	BJEMPC	U	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	1,2,3,6,7,8-HxCDF	2.52	pg/g	BJEMPC	U	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	2,3,4,6,7,8-HxCDF	2.62	pg/g	JEMPC	U	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	1,2,3,7,8,9-HxCDF	3.59	pg/g	BJEMPC	U	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	Total HxCDF	32	pg/g	EMPC	J	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	1,2,3,6,7,8-HxCDD	4.54	pg/g	JEMPC	U	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	1,2,3,7,8,9-HxCDD	4.54	pg/g	JEMPC	U	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	Total HxCDD	21.8	pg/g	EMPC	J	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	1,2,3,4,7,8,9-HpCDF	3.86	pg/g	BJEMPC	U	25
DUA1-SB6-3-3.5	14-21489-ZE71B	SW8290	Total HpCDF	63.9	pg/g	EMPC	J	25
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	Total TCDF	9.57	pg/g	EMPC	J	25
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	Total TCDD	13.5	pg/g	EMPC	J	25
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	1,2,3,7,8-PeCDF	2.34	pg/g	JEMPC	U	25
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	Total PeCDF	21.6	pg/g	EMPC	J	25
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	Total PeCDD	11	pg/g	EMPC	J	25
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	1,2,3,4,7,8-HxCDF	6.68	pg/g	BJEMPC	U	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	1,2,3,7,8,9-HxCDF	3.36	pg/g	BJ	U	7
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	Total HxCDF	77.1	pg/g	EMPC	J	25
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	1,2,3,4,7,8-HxCDD	2.79	pg/g	JEMPC	U	25
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	Total HxCDD	40.3	pg/g	EMPC	J	25
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	1,2,3,4,7,8,9-HpCDF	1.87	pg/g	BJEMPC	U	25
DUA1-SB2-3-3.5	14-21490-ZE71C	SW8290	Total HpCDF	97.3	pg/g	EMPC	J	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	Total TCDF	39.6	pg/g	EMPC	J	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	2,3,7,8-TCDD	3.28	pg/g	BJEMPC	U	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	Total TCDD	110	pg/g	EMPC	J	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	2,3,4,7,8-PeCDF	5.47	pg/g	BJEMPC	U	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	Total PeCDF	120	pg/g	EMPC	J	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	Total PeCDD	154	pg/g	EMPC	J	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	2,3,4,6,7,8-HxCDF	3.78	pg/g	JEMPC	U	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	1,2,3,7,8,9-HxCDF	7.16	pg/g	BJEMPC	U	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	Total HxCDF	305	pg/g	EMPC	J	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	Total HxCDD	198	pg/g	EMPC	J	25
DUA1-SB1-2.5-3	14-21491-ZE71D	SW8290	Total HpCDF	310	pg/g	EMPC	J	25
DUA1-SB7-3-3.5	14-21492-ZE71E	SW8290	2,3,7,8-TCDF	1.57	pg/g	JEMPC	U	25
DUA1-SB7-3-3.5	14-21492-ZE71E	SW8290	Total TCDF	17.9	pg/g	EMPC	J	25
DUA1-SB7-3-3.5	14-21492-ZE71E	SW8290	Total TCDD	44.7	pg/g	EMPC	J	25
DUA1-SB7-3-3.5	14-21492-ZE71E	SW8290	1,2,3,7,8-PeCDF	2.19	pg/g	JXEMPC	UJ	23,25
DUA1-SB7-3-3.5	14-21492-ZE71E	SW8290	Total PeCDF	20.1	pg/g	EMPC	J	25
DUA1-SB7-3-3.5	14-21492-ZE71E	SW8290	1,2,3,7,8-PeCDD	2.74	pg/g	BJEMPC	U	25
DUA1-SB7-3-3.5	14-21492-ZE71E	SW8290	Total PeCDD	13	pg/g	EMPC	J	25
DUA1-SB7-3-3.5	14-21492-ZE71E	SW8290	1,2,3,6,7,8-HxCDD	12.5	pg/g	EMPC	U	25
DUA1-SB7-3-3.5	14-21492-ZE71E	SW8290	Total HxCDD	48.9	pg/g	EMPC	J	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	Total TCDF	14.8	pg/g	EMPC	J	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	2,3,7,8-TCDD	2.33	pg/g	BJEMPC	U	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	Total TCDD	12.9	pg/g	EMPC	J	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	2,3,4,7,8-PeCDF	2.31	pg/g	BJEMPC	U	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	Total PeCDF	33.8	pg/g	EMPC	J	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	1,2,3,7,8-PeCDD	2.54	pg/g	BJEMPC	U	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	Total PeCDD	38.4	pg/g	EMPC	J	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	1,2,3,4,7,8-HxCDF	7.15	pg/g	BJEMPC	U	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	1,2,3,6,7,8-HxCDF	2.09	pg/g	BJEMPC	U	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	2,3,4,6,7,8-HxCDF	2.09	pg/g	JEMPC	U	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	1,2,3,7,8,9-HxCDF	3.55	pg/g	BJ	U	7
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	Total HxCDF	159	pg/g	EMPC	J	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	1,2,3,7,8,9-HxCDD	5.32	pg/g	JEMPC	U	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	Total HxCDD	161	pg/g	EMPC	J	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	1,2,3,4,7,8,9-HpCDF	7.79	pg/g	BJEMPC	U	25
DUA1-SB8-2-2.5	14-21493-ZE71F	SW8290	Total HpCDF	343	pg/g	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUA1-SB14-2.5-3	14-21494-ZE71G	SW8290	Total TCDF	98.2	pg/g	EMPC	J	25
DUA1-SB14-2.5-3	14-21494-ZE71G	SW8290	Total TCDD	9.37	pg/g	EMPC	J	25
DUA1-SB14-2.5-3	14-21494-ZE71G	SW8290	Total PeCDF	341	pg/g	EMPC	J	25
DUA1-SB14-2.5-3	14-21494-ZE71G	SW8290	Total PeCDD	30.2	pg/g	EMPC	J	25
DUA1-SB14-2.5-3	14-21494-ZE71G	SW8290	1,2,3,6,7,8-HxCDF	5.1	pg/g	JEMPC	U	25
DUA1-SB14-2.5-3	14-21494-ZE71G	SW8290	Total HxCDF	732	pg/g	EMPC	J	25
DUA1-SB14-2.5-3	14-21494-ZE71G	SW8290	1,2,3,7,8,9-HxCDD	5.26	pg/g	JEMPC	U	25
DUA1-SB14-2.5-3	14-21494-ZE71G	SW8290	Total HxCDD	134	pg/g	EMPC	J	25
DUA1-SB14-2.5-3	14-21494-ZE71G	SW8290	1,2,3,4,7,8,9-HpCDF	9.05	pg/g	JEMPC	U	25
DUA1-SB14-2.5-3	14-21494-ZE71G	SW8290	Total HpCDF	550	pg/g	EMPC	J	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	2,3,7,8-TCDF	1.74	pg/g	JEMPC	U	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	Total TCDF	21.8	pg/g	EMPC	J	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	Total TCDD	48.9	pg/g	EMPC	J	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	1,2,3,7,8-PeCDF	3.2	pg/g	JEMPC	U	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	Total PeCDF	24.1	pg/g	EMPC	J	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	1,2,3,7,8-PeCDD	4.39	pg/g	BJEMPC	U	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	Total PeCDD	157	pg/g	EMPC	J	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	1,2,3,6,7,8-HxCDF	3.05	pg/g	BJEMPC	U	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	2,3,4,6,7,8-HxCDF	2.77	pg/g	JEMPC	U	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	1,2,3,7,8,9-HxCDF	3.83	pg/g	BJEMPC	U	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	Total HxCDF	61.4	pg/g	EMPC	J	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	1,2,3,4,7,8-HxCDD	9.44	pg/g	JEMPC	U	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	1,2,3,7,8,9-HxCDD	12.7	pg/g	EMPC	U	25
DUA1-SB24-2.5-3	14-21495-ZE71H	SW8290	Total HxCDD	121	pg/g	EMPC	J	25
DUA1-SB18-3.5-4	14-21496-ZE71I	SW8290	Total TCDF	273	pg/g	EMPC	J	25
DUA1-SB18-3.5-4	14-21496-ZE71I	SW8290	2,3,7,8-TCDD	4.57	pg/g	BJEMPC	U	25
DUA1-SB18-3.5-4	14-21496-ZE71I	SW8290	Total TCDD	230	pg/g	EMPC	J	25
DUA1-SB18-3.5-4	14-21496-ZE71I	SW8290	2,3,4,7,8-PeCDF	26.8	pg/g	XEMPC	UJ	23,25
DUA1-SB18-3.5-4	14-21496-ZE71I	SW8290	Total PeCDF	553	pg/g	EMPC	J	25
DUA1-SB18-3.5-4	14-21496-ZE71I	SW8290	Total PeCDD	173	pg/g	EMPC	J	25
DUA1-SB18-3.5-4	14-21496-ZE71I	SW8290	Total HxCDF	2030	pg/g	EMPC	J	25
DUA1-SB18-3.5-4	14-21496-ZE71I	SW8290	Total HxCDD	1060	pg/g	EMPC	J	25
DUA1-SB18-3.5-4	14-21496-ZE71I	SW8290	Total HpCDF	4120	pg/g	EMPC	J	25
DUA1-SB18-3.5-4	14-21496-ZE71I	SW8290	OCDD	111000	pg/g	E	J	20
DUA1-SB11-2-2.5	14-21497-ZE71J	SW8290	2,3,7,8-TCDF	59	pg/g	JEMPC	U	25
DUA1-SB11-2-2.5	14-21497-ZE71J	SW8290	Total TCDF	353	pg/g	EMPC	J	25
DUA1-SB11-2-2.5	14-21497-ZE71J	SW8290	2,3,7,8-TCDD	22.7	pg/g	JEMPC	U	25
DUA1-SB11-2-2.5	14-21497-ZE71J	SW8290	Total TCDD	197	pg/g	EMPC	J	25
DUA1-SB11-2-2.5	14-21497-ZE71J	SW8290	1,2,3,7,8-PeCDF	65	pg/g	JEMPC	U	25
DUA1-SB11-2-2.5	14-21497-ZE71J	SW8290	2,3,4,7,8-PeCDF	87.1	pg/g	JEMPC	U	25
DUA1-SB11-2-2.5	14-21497-ZE71J	SW8290	Total PeCDF	1590	pg/g	EMPC	J	25
DUA1-SB11-2-2.5	14-21497-ZE71J	SW8290	Total PeCDD	281	pg/g	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUA1-SB11-2-2.5	14-21497-ZE71J	SW8290	Total HxCDF	6610	pg/g	EMPC	J	25
DUA1-SB10-1.5-2	14-21498-ZE72A	SW8290	2,3,7,8-TCDF	418	pg/g	EMPC	U	25
DUA1-SB10-1.5-2	14-21498-ZE72A	SW8290	Total TCDF	2710	pg/g	EMPC	J	25
DUA1-SB10-1.5-2	14-21498-ZE72A	SW8290	Total TCDD	1050	pg/g	EMPC	J	25
DUA1-SB10-1.5-2	14-21498-ZE72A	SW8290	Total PeCDF	37000	pg/g	EMPC	J	25
DUA1-SB10-1.5-2	14-21498-ZE72A	SW8290	Total PeCDD	4150	pg/g	EMPC	J	25
DUA1-SB10-1.5-2	14-21498-ZE72A	SW8290	OCDD	1480000	pg/g	E	J	5BH,20
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	2,3,7,8-TCDF	0.6	pg/g	JEMPC	U	25
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	Total TCDF	0.602	pg/g	EMPC	J	25
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	Total PeCDD	4.27	pg/g	EMPC	J	25
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	1,2,3,4,7,8-HxCDF	0.86	pg/g	BJEMPC	U	25
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	1,2,3,6,7,8-HxCDF	0.42	pg/g	BJEMPC	U	25
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	1,2,3,7,8,9-HxCDF	0.92	pg/g	BJEMPC	U	25
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	Total HxCDF	4.95	pg/g	EMPC	J	25
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	1,2,3,4,7,8-HxCDD	0.98	pg/g	JEMPC	U	25
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	Total HxCDD	7.12	pg/g	EMPC	J	25
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	1,2,3,4,6,7,8-HpCDF	3.08	pg/g	JEMPC	U	25
DUA1-SB28-3-3.5	14-21499-ZE72B	SW8290	Total HpCDF	10.2	pg/g	EMPC	J	25
DUA1-SB22-3.5-4	14-21500-ZE72C	SW8290	Total TCDF	23.8	pg/g	EMPC	J	25
DUA1-SB22-3.5-4	14-21500-ZE72C	SW8290	Total TCDD	41.7	pg/g	EMPC	J	25
DUA1-SB22-3.5-4	14-21500-ZE72C	SW8290	1,2,3,7,8-PeCDF	3.96	pg/g	JEMPC	U	25
DUA1-SB22-3.5-4	14-21500-ZE72C	SW8290	2,3,4,7,8-PeCDF	4.04	pg/g	BJEMPC	U	25
DUA1-SB22-3.5-4	14-21500-ZE72C	SW8290	Total PeCDF	116	pg/g	EMPC	J	25
DUA1-SB22-3.5-4	14-21500-ZE72C	SW8290	Total PeCDD	51.9	pg/g	EMPC	J	25
DUA1-SB22-3.5-4	14-21500-ZE72C	SW8290	1,2,3,6,7,8-HxCDF	8.67	pg/g	JEMPC	U	25
DUA1-SB22-3.5-4	14-21500-ZE72C	SW8290	1,2,3,7,8,9-HxCDF	7.75	pg/g	BJEMPC	U	25
DUA1-SB22-3.5-4	14-21500-ZE72C	SW8290	Total HxCDF	496	pg/g	EMPC	J	25
DUA1-SB22-3.5-4	14-21500-ZE72C	SW8290	Total HpCDF	1070	pg/g	EMPC	J	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	Total TCDF	2.5	pg/g	EMPC	J	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	Total TCDD	10.8	pg/g	EMPC	J	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	1,2,3,7,8-PeCDF	1.29	pg/g	JEMPC	U	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	2,3,4,7,8-PeCDF	1.13	pg/g	BJEMPC	U	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	Total PeCDF	27.3	pg/g	EMPC	J	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	Total PeCDD	15.3	pg/g	EMPC	J	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	1,2,3,4,7,8-HxCDF	7.56	pg/g	BJEMPC	U	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	1,2,3,6,7,8-HxCDF	2.75	pg/g	BJEMPC	U	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	Total HxCDF	208	pg/g	EMPC	J	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	Total HxCDD	84.9	pg/g	EMPC	J	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	1,2,3,4,7,8,9-HpCDF	4.53	pg/g	BJEMPC	U	25
DUA1-SB29-2.5-3	14-21501-ZE72D	SW8290	Total HpCDF	685	pg/g	EMPC	J	25
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	2,3,7,8-TCDF	18	pg/g	BJEMPC	U	25
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	Total TCDF	286	pg/g	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	2,3,7,8-TCDD	24.5	pg/g	JEMPC	U	25
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	Total TCDD	679	pg/g	EMPC	J	25
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	2,3,4,7,8-PeCDF	60.8	pg/g	JEMPC	U	25
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	Total PeCDF	1820	pg/g	EMPC	J	25
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	Total PeCDD	612	pg/g	EMPC	J	25
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	1,2,3,6,7,8-HxCDF	127	pg/g	EMPC	U	25
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	Total HxCDF	6420	pg/g	EMPC	J	25
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	Total HpCDF	12900	pg/g	EMPC	J	25
DUA1-SB27-2.5-3	14-21502-ZE72E	SW8290	OCDD	255000	pg/g		J	5BH
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	Total TCDF	0.487	pg/g	EMPC	J	25
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	Total TCDD	2.21	pg/g	EMPC	J	25
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	Total PeCDF	4.19	pg/g	EMPC	J	25
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	1,2,3,7,8-PeCDD	1.05	pg/g	BJEMPC	U	25
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	Total PeCDD	2.27	pg/g	EMPC	J	25
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	1,2,3,4,7,8-HxCDF	5.92	pg/g	BJEMPC	U	25
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	Total HxCDF	318	pg/g	EMPC	J	25
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	1,2,3,6,7,8-HxCDD	14.3	pg/g	EMPC	U	25
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	Total HxCDD	42.4	pg/g	EMPC	J	25
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	OCDF	3790	pg/g		J	13L
DUA1-SB26-1.5-2	14-21503-ZE72F	SW8290	OCDD	18800	pg/g		J	13L
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	Total TCDF	194	pg/g	EMPC	J	25
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	2,3,7,8-TCDD	13.8	pg/g	BJEMPC	U	25
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	Total TCDD	204	pg/g	EMPC	J	25
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	1,2,3,7,8-PeCDF	44.6	pg/g	BJEMPC	U	25
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	2,3,4,7,8-PeCDF	41.2	pg/g	BJEMPC	U	25
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	Total PeCDF	2520	pg/g	EMPC	J	25
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	1,2,3,7,8-PeCDD	35.8	pg/g	BJEMPC	U	25
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	Total PeCDD	634	pg/g	EMPC	J	25
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	1,2,3,6,7,8-HxCDF	221	pg/g	EMPC	U	25
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	Total HxCDF	39700	pg/g	EMPC	J	25
DUA1-SB23-2.5-3	14-21504-ZE72G	SW8290	OCDD	1600000	pg/g	E	J	5BH,20
DUA1-SB20-3-3.5	14-21505-ZE72H	SW8290	Total TCDF	2470	pg/g	EMPC	J	25
DUA1-SB20-3-3.5	14-21505-ZE72H	SW8290	2,3,7,8-TCDD	50.9	pg/g	JEMPC	U	25
DUA1-SB20-3-3.5	14-21505-ZE72H	SW8290	Total TCDD	632	pg/g	EMPC	J	25
DUA1-SB20-3-3.5	14-21505-ZE72H	SW8290	Total PeCDF	68700	pg/g	EMPC	J	25
DUA1-SB20-3-3.5	14-21505-ZE72H	SW8290	Total PeCDD	4070	pg/g	EMPC	J	25
DUA1-SB20-3-3.5	14-21505-ZE72H	SW8290	Total HpCDF	5160000	pg/g	EMPC	J	25
DUA1-SB20-3-3.5	14-21505-ZE72HDL	SW8290	OCDD	51400000	pg/g	E	J	20
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	Total TCDF	2730	pg/g	EMPC	J	25
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	2,3,7,8-TCDD	42.7	pg/g	JEMPC	U	25
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	Total TCDD	9480	pg/g	EMPC	J	25
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	1,2,3,7,8-PeCDF	99.6	pg/g	JEMPC	U	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	Total PeCDF	4110	pg/g	EMPC	J	25
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	Total PeCDD	12500	pg/g	EMPC	J	25
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	2,3,4,6,7,8-HxCDF	377	pg/g	EMPC	U	25
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	Total HxCDF	18000	pg/g	EMPC	J	25
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	Total HxCDD	13100	pg/g	EMPC	J	25
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	Total HpCDF	56700	pg/g	EMPC	J	25
DUA1-SB17-1.5-2	14-21506-ZE72I	SW8290	OCDD	615000	pg/g	E	J	5BH,20
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	Total TCDF	1.33	pg/g	EMPC	J	25
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	Total TCDD	2.28	pg/g	EMPC	J	25
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	Total PeCDF	24.3	pg/g	EMPC	J	25
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	1,2,3,7,8-PeCDD	2.84	pg/g	BJEMPC	U	25
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	Total PeCDD	2.83	pg/g	EMPC	J	25
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	1,2,3,6,7,8-HxCDF	2.8	pg/g	BJEMPC	U	25
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	Total HxCDF	113	pg/g	EMPC	J	25
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	1,2,3,6,7,8-HxCDD	15.5	pg/g	EMPC	U	25
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	Total HxCDD	61.7	pg/g	EMPC	J	25
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	1,2,3,4,7,8,9-HpCDF	3.55	pg/g	BJEMPC	U	25
DUA1-SB4-1.5-2	14-21507-ZE72J	SW8290	Total HpCDF	204	pg/g	EMPC	J	25
DUA1-SB12-2-2.5	14-21508-ZE72K	SW8290	Total TCDF	1.4	pg/g	EMPC	J	25
DUA1-SB12-2-2.5	14-21508-ZE72K	SW8290	Total TCDD	12.7	pg/g	EMPC	J	25
DUA1-SB12-2-2.5	14-21508-ZE72K	SW8290	Total PeCDD	12.4	pg/g	EMPC	J	25
DUA1-SB12-2-2.5	14-21508-ZE72K	SW8290	1,2,3,6,7,8-HxCDF	1.12	pg/g	BJEMPC	U	25
DUA1-SB12-2-2.5	14-21508-ZE72K	SW8290	Total HxCDF	6.07	pg/g	EMPC	J	25
DUA1-SB12-2-2.5	14-21508-ZE72K	SW8290	1,2,3,6,7,8-HxCDD	1.62	pg/g	JEMPC	U	25
DUA1-SB12-2-2.5	14-21508-ZE72K	SW8290	1,2,3,7,8,9-HxCDD	1.94	pg/g	JEMPC	U	25
DUA1-SB12-2-2.5	14-21508-ZE72K	SW8290	Total HxCDD	9.58	pg/g	EMPC	J	25
DUA1-SB12-2-2.5	14-21508-ZE72K	SW8290	1,2,3,4,6,7,8-HpCDF	6.72	pg/g	JEMPC	U	25
DUA1-SB12-2-2.5	14-21508-ZE72K	SW8290	Total HpCDF	22	pg/g	EMPC	J	25
DUB1-SB29-1-1.5	14-25400-ZL62A	SW8290	OCDD	42900000	pg/g	E	J	13L,20
DUB1-SB29-1-1.5	14-25400-ZL62A	SW8290	OCDF	1570000	pg/g		J	13L
DUB1-SB29-1-1.5	14-25400-ZL62A	SW8290	Total HpCDF	1600000	pg/g	EMPC	J	25
DUB1-SB29-1-1.5	14-25400-ZL62A	SW8290	Total HxCDD	338000	pg/g	EMPC	J	25
DUB1-SB29-1-1.5	14-25400-ZL62A	SW8290	Total HxCDF	936000	pg/g	EMPC	J	25
DUB1-SB29-1-1.5	14-25400-ZL62A	SW8290	Total PeCDF	142000	pg/g	EMPC	J	25
DUB1-SB29-1-1.5	14-25400-ZL62A	SW8290	Total TCDD	11300	pg/g	EMPC	J	25
DUB1-SB29-1-1.5	14-25400-ZL62A	SW8290	Total TCDF	14900	pg/g	EMPC	J	25
DUB1-SB30-1-1.5	14-25401-ZL62B	SW8290	1,2,3,6,7,8-HxCDD	33.9	pg/g	BJEMPC	U	25
DUB1-SB30-1-1.5	14-25401-ZL62B	SW8290	1,2,3,7,8,9-HxCDD	21.4	pg/g	BJEMPC	U	25
DUB1-SB30-1-1.5	14-25401-ZL62B	SW8290	1,2,3,7,8-PeCDF	7.35	pg/g	BJEMPC	U	25
DUB1-SB30-1-1.5	14-25401-ZL62B	SW8290	2,3,7,8-TCDD	14.9	pg/g	JEMPC	U	25
DUB1-SB30-1-1.5	14-25401-ZL62B	SW8290	Total HxCDD	168	pg/g	EMPC	J	25
DUB1-SB30-1-1.5	14-25401-ZL62B	SW8290	Total HxCDF	279	pg/g	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUB1-SB30-1-1.5	14-25401-ZL62B	SW8290	Total PeCDD	17.3	pg/g	EMPC	J	25
DUB1-SB30-1-1.5	14-25401-ZL62B	SW8290	Total PeCDF	64.1	pg/g	EMPC	J	25
DUB1-SB30-1-1.5	14-25401-ZL62B	SW8290	Total TCDD	28.5	pg/g	EMPC	J	25
DUB1-SB30-1-1.5	14-25401-ZL62B	SW8290	Total TCDF	16.9	pg/g	EMPC	J	25
DUB2-SB14-2-2.5	14-25402-ZL62C	SW8290	1,2,3,7,8-PeCDD	1190	pg/g	EMPC	U	25
DUB2-SB14-2-2.5	14-25402-ZL62C	SW8290	2,3,7,8-TCDD	129	pg/g	EMPC	U	25
DUB2-SB14-2-2.5	14-25402-ZL62C	SW8290	Total HpCDF	209000	pg/g	EMPC	J	25
DUB2-SB14-2-2.5	14-25402-ZL62C	SW8290	Total HxCDF	149000	pg/g	EMPC	J	25
DUB2-SB14-2-2.5	14-25402-ZL62C	SW8290	Total PeCDD	5080	pg/g	EMPC	J	25
DUB2-SB14-2-2.5	14-25402-ZL62C	SW8290	Total PeCDF	38700	pg/g	EMPC	J	25
DUB2-SB14-2-2.5	14-25402-ZL62C	SW8290	Total TCDD	2860	pg/g	EMPC	J	25
DUB2-SB14-2-2.5	14-25402-ZL62C	SW8290	Total TCDF	8350	pg/g	EMPC	J	25
DUB2-SB18-3-3.5	14-25403-ZL62D	SW8290	1,2,3,4,7,8-HxCDF	218000	pg/g		J	13H
DUB2-SB18-3-3.5	14-25403-ZL62D	SW8290	1,2,3,6,7,8-HxCDD	248000	pg/g		J	13H
DUB2-SB18-3-3.5	14-25403-ZL62D	SW8290	1,2,3,6,7,8-HxCDF	50600	pg/g		J	13H
DUB2-SB18-3-3.5	14-25403-ZL62D	SW8290	2,3,4,6,7,8-HxCDF	64000	pg/g		J	13H
DUB2-SB18-3-3.5	14-25403-ZL62D	SW8290	Total HpCDD	18200000	pg/g	EMPC	J	25
DUB2-SB18-3-3.5	14-25403-ZL62D	SW8290	Total HpCDF	7190000	pg/g	EMPC	J	25
DUB2-SB18-3-3.5	14-25403-ZL62D	SW8290	Total PeCDF	450000	pg/g	EMPC	J	25
DUB2-SB18-3-3.5	14-25403-ZL62D	SW8290	Total TCDF	42600	pg/g	EMPC	J	25
DUB2-SB18-3-3.5	14-25403-ZL62DDL	SW8290	OCDD	123000000	pg/g	E	J	20
DUB2-SB11-6-6.5	14-25404-ZL62E	SW8290	1,2,3,4,7,8,9-HpCDF	24.4	pg/g	JEMPC	U	25
DUB2-SB11-6-6.5	14-25404-ZL62E	SW8290	1,2,3,7,8,9-HxCDF	23	pg/g	BJEMPC	U	25
DUB2-SB11-6-6.5	14-25404-ZL62E	SW8290	2,3,7,8-TCDD	16	pg/g	JEMPC	U	25
DUB2-SB11-6-6.5	14-25404-ZL62E	SW8290	Total HpCDF	1450	pg/g	EMPC	J	25
DUB2-SB11-6-6.5	14-25404-ZL62E	SW8290	Total HxCDD	221	pg/g	EMPC	J	25
DUB2-SB11-6-6.5	14-25404-ZL62E	SW8290	Total HxCDF	345	pg/g	EMPC	J	25
DUB2-SB11-6-6.5	14-25404-ZL62E	SW8290	Total PeCDD	6.25	pg/g	EMPC	J	25
DUB2-SB11-6-6.5	14-25404-ZL62E	SW8290	Total TCDD	16	pg/g	EMPC	J	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	1,2,3,4,7,8,9-HpCDF	28.8	pg/g	JEMPC	U	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	1,2,3,6,7,8-HxCDF	11.7	pg/g	BJEMPC	U	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	1,2,3,7,8,9-HxCDD	19.8	pg/g	BJEMPC	U	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	1,2,3,7,8,9-HxCDF	24.6	pg/g	BJEMPC	U	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	1,2,3,7,8-PeCDD	4.88	pg/g	BJEMPC	U	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	1,2,3,7,8-PeCDF	8.29	pg/g	BJEMPC	U	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	2,3,4,6,7,8-HxCDF	11.7	pg/g	BJEMPC	U	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	2,3,7,8-TCDD	13.7	pg/g	JEMPC	U	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	Total HpCDD	6050	pg/g	EMPC	J	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	Total HpCDF	1470	pg/g	EMPC	J	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	Total HxCDD	249	pg/g	EMPC	J	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	Total HxCDF	669	pg/g	EMPC	J	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	Total PeCDD	4.88	pg/g	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	Total PeCDF	65.8	pg/g	EMPC	J	25
DUB2-SB20-5.5-6	14-25405-ZL62F	SW8290	Total TCDD	13.8	pg/g	EMPC	J	25
DUB2-SB21-6-6.5	14-25406-ZL62G	SW8290	1,2,3,7,8,9-HxCDF	7.44	pg/g	BJEMPC	U	25
DUB2-SB21-6-6.5	14-25406-ZL62G	SW8290	2,3,4,7,8-PeCDF	4.88	pg/g	BJEMPC	U	25
DUB2-SB21-6-6.5	14-25406-ZL62G	SW8290	Total HxCDD	32	pg/g	EMPC	J	25
DUB2-SB21-6-6.5	14-25406-ZL62G	SW8290	Total HxCDF	121	pg/g	EMPC	J	25
DUB2-SB21-6-6.5	14-25406-ZL62G	SW8290	Total PeCDF	16.2	pg/g	EMPC	J	25
DUB2-SB22-17.5-18	14-25407-ZL62H	SW8290	1,2,3,4,7,8-HxCDF	11.4	pg/g	BJEMPC	U	25
DUB2-SB22-17.5-18	14-25407-ZL62H	SW8290	1,2,3,6,7,8-HxCDD	9.46	pg/g	BJEMPC	U	25
DUB2-SB22-17.5-18	14-25407-ZL62H	SW8290	1,2,3,7,8,9-HxCDF	7.84	pg/g	BJEMPC	U	25
DUB2-SB22-17.5-18	14-25407-ZL62H	SW8290	2,3,4,6,7,8-HxCDF	4.32	pg/g	BJEMPC	U	25
DUB2-SB22-17.5-18	14-25407-ZL62H	SW8290	Total HxCDD	40.7	pg/g	EMPC	J	25
DUB2-SB22-17.5-18	14-25407-ZL62H	SW8290	Total HxCDF	129	pg/g	EMPC	J	25
DUB2-SB26-18.5-19	14-25408-ZL62I	SW8290	1,2,3,4,6,7,8-HpCDF	16	pg/g	BJEMPC	U	25
DUB2-SB26-18.5-19	14-25408-ZL62I	SW8290	1,2,3,7,8,9-HxCDF	8.75	pg/g	BJEMPC	U	25
DUB2-SB26-18.5-19	14-25408-ZL62I	SW8290	2,3,7,8-TCDD	16.8	pg/g	JEMPC	U	25
DUB2-SB26-18.5-19	14-25408-ZL62I	SW8290	Total HpCDF	65.2	pg/g	EMPC	J	25
DUB2-SB26-18.5-19	14-25408-ZL62I	SW8290	Total HxCDF	39.7	pg/g	EMPC	J	25
DUB2-SB26-18.5-19	14-25408-ZL62I	SW8290	Total TCDD	16.8	pg/g	EMPC	J	25
DUB2-SB27-15-15.5	14-25409-ZL62J	SW8290	2,3,4,6,7,8-HxCDF	15.6	pg/g	BJEMPC	U	25
DUB2-SB27-15-15.5	14-25409-ZL62J	SW8290	2,3,7,8-TCDD	19.8	pg/g	JEMPC	U	25
DUB2-SB27-15-15.5	14-25409-ZL62J	SW8290	Total HxCDD	504	pg/g	EMPC	J	25
DUB2-SB27-15-15.5	14-25409-ZL62J	SW8290	Total HxCDF	1230	pg/g	EMPC	J	25
DUB2-SB27-15-15.5	14-25409-ZL62J	SW8290	Total PeCDF	168	pg/g	EMPC	J	25
DUB2-SB27-15-15.5	14-25409-ZL62J	SW8290	Total TCDD	29.4	pg/g	EMPC	J	25
DUB2-SB24-10-10.5	14-25410-ZL62K	SW8290	1,2,3,6,7,8-HxCDF	5.64	pg/g	BJEMPC	U	25
DUB2-SB24-10-10.5	14-25410-ZL62K	SW8290	1,2,3,7,8,9-HxCDF	12.6	pg/g	BJEMPC	U	25
DUB2-SB24-10-10.5	14-25410-ZL62K	SW8290	Total HxCDD	76.4	pg/g	EMPC	J	25
DUB2-SB24-10-10.5	14-25410-ZL62K	SW8290	Total HxCDF	226	pg/g	EMPC	J	25
DUB2-SB24-10-10.5	14-25410-ZL62K	SW8290	Total PeCDF	27.2	pg/g	EMPC	J	25
DUB2-SB28-10-10.5	14-25411-ZL62L	SW8290	1,2,3,4,6,7,8-HpCDF	12.3	pg/g	BJEMPC	U	25
DUB2-SB28-10-10.5	14-25411-ZL62L	SW8290	OCDF	36.5	pg/g	BJEMPC	U	25
DUB2-SB28-10-10.5	14-25411-ZL62L	SW8290	Total HpCDF	29.2	pg/g	EMPC	J	25
DUB2-SB28-10-10.5	14-25411-ZL62L	SW8290	Total HxCDF	6.69	pg/g	EMPC	J	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	1,2,3,4,7,8,9-HpCDF	21.9	pg/g	JEMPC	U	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	1,2,3,6,7,8-HxCDF	8.54	pg/g	BJEMPC	U	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	1,2,3,7,8,9-HxCDD	7.5	pg/g	BJEMPC	U	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	1,2,3,7,8-PeCDF	5.83	pg/g	BJEMPC	U	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	2,3,4,6,7,8-HxCDF	10.8	pg/g	BJEMPC	U	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	2,3,7,8-TCDF	3.96	pg/g	JEMPC	U	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	Total HpCDF	888	pg/g	EMPC	J	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	Total HxCDD	164	pg/g	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	Total HxCDF	439	pg/g	EMPC	J	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	Total PeCDD	2.77	pg/g	EMPC	J	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	Total PeCDF	50.2	pg/g	EMPC	J	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	Total TCDD	3.25	pg/g	EMPC	J	25
DUB2-SB29-2.5-3	14-25412-ZL62M	SW8290	Total TCDF	4.02	pg/g	EMPC	J	25
DUB2-SB25-6.5-7	14-25413-ZL62N	SW8290	1,2,3,4,7,8-HxCDF	5.2	pg/g	BJEMPC	U	25
DUB2-SB25-6.5-7	14-25413-ZL62N	SW8290	1,2,3,6,7,8-HxCDD	5.2	pg/g	BJEMPC	U	25
DUB2-SB25-6.5-7	14-25413-ZL62N	SW8290	1,2,3,6,7,8-HxCDF	3.8	pg/g	BJEMPC	U	25
DUB2-SB25-6.5-7	14-25413-ZL62N	SW8290	1,2,3,7,8,9-HxCDF	8.4	pg/g	BJEMPC	U	25
DUB2-SB25-6.5-7	14-25413-ZL62N	SW8290	Total HxCDD	25.8	pg/g	EMPC	J	25
DUB2-SB25-6.5-7	14-25413-ZL62N	SW8290	Total HxCDF	72.5	pg/g	EMPC	J	25
DUB2-SB23-9-9.5	14-25414-ZL62O	SW8290	1,2,3,4,6,7,8-HpCDF	54.6	pg/g	BJEMPC	U	25
DUB2-SB23-9-9.5	14-25414-ZL62O	SW8290	1,2,3,4,7,8-HxCDF	12.2	pg/g	BJEMPC	U	25
DUB2-SB23-9-9.5	14-25414-ZL62O	SW8290	1,2,3,6,7,8-HxCDF	4.24	pg/g	BJEMPC	U	25
DUB2-SB23-9-9.5	14-25414-ZL62O	SW8290	1,2,3,7,8,9-HxCDD	7.76	pg/g	BJEMPC	U	25
DUB2-SB23-9-9.5	14-25414-ZL62O	SW8290	1,2,3,7,8,9-HxCDF	12.7	pg/g	BJEMPC	U	25
DUB2-SB23-9-9.5	14-25414-ZL62O	SW8290	2,3,7,8-TCDD	14.8	pg/g	JEMPC	U	25
DUB2-SB23-9-9.5	14-25414-ZL62O	SW8290	Total HpCDF	176	pg/g	EMPC	J	25
DUB2-SB23-9-9.5	14-25414-ZL62O	SW8290	Total HxCDD	31.3	pg/g	EMPC	J	25
DUB2-SB23-9-9.5	14-25414-ZL62O	SW8290	Total HxCDF	122	pg/g	EMPC	J	25
DUB2-SB23-9-9.5	14-25414-ZL62O	SW8290	Total TCDD	14.9	pg/g	EMPC	J	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	1,2,3,4,7,8,9-HpCDF	9.43	pg/g	JEMPC	U	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	1,2,3,6,7,8-HxCDF	18.4	pg/g	BJEMPC	U	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	1,2,3,7,8,9-HxCDF	26	pg/g	BJEMPC	U	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	1,2,3,7,8-PeCDD	57.7	pg/g	JEMPC	U	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	2,3,7,8-TCDD	18.6	pg/g	JEMPC	U	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	2,3,7,8-TCDF	24.4	pg/g	JEMPC	U	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	Total HpCDF	265	pg/g	EMPC	J	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	Total HxCDD	4230	pg/g	EMPC	J	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	Total HxCDF	884	pg/g	EMPC	J	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	Total PeCDD	3750	pg/g	EMPC	J	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	Total PeCDF	3590	pg/g	EMPC	J	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	Total TCDD	3850	pg/g	EMPC	J	25
DUB2-SB19-9-9.5	14-25415-ZL62P	SW8290	Total TCDF	16000	pg/g	EMPC	J	25
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	1,2,3,4,7,8,9-HpCDF	6.67	pg/g	JEMPC	U	25
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	1,2,3,4,7,8-HxCDD	3.22	pg/g	JEMPC	U	25
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	1,2,3,6,7,8-HxCDF	5.52	pg/g	BJEMPC	U	25
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	1,2,3,7,8,9-HxCDD	11	pg/g	BJEMPC	U	25
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	2,3,4,6,7,8-HxCDF	5.29	pg/g	BJEMPC	U	25
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	Total HpCDF	176	pg/g	EMPC	J	25
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	Total HxCDD	66.3	pg/g	EMPC	J	25
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	Total HxCDF	119	pg/g	EMPC	J	25

Qualified Data Summary Table
SSA Reichhold - Tacoma, WA

Sample ID	Laboratory ID	Method	Analyte	Result	Units	Lab Flag	DV Qualifier	Reason Code
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	Total PeCDF	7.73	pg/g	EMPC	J	25
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	Total TCDD	4.6	pg/g	EMPC	J	25
DUB2-SB10-8-8.5	14-25416-ZL62Q	SW8290	Total TCDF	7.47	pg/g	EMPC	J	25
DUB2-SB9-9.5-10	14-25417-ZL62R	SW8290	1,2,3,4,6,7,8-HpCDD	50.5	pg/g	BJEMPC	U	25
DUB2-SB9-9.5-10	14-25417-ZL62R	SW8290	1,2,3,6,7,8-HxCDF	2.11	pg/g	BJEMPC	U	25
DUB2-SB9-9.5-10	14-25417-ZL62R	SW8290	1,2,3,7,8,9-HxCDF	9.74	pg/g	BJEMPC	U	25
DUB2-SB9-9.5-10	14-25417-ZL62R	SW8290	Total HpCDD	92.4	pg/g	EMPC	J	25
DUB2-SB9-9.5-10	14-25417-ZL62R	SW8290	Total HxCDF	19.4	pg/g	EMPC	J	25
DUB2-SB9-9.5-10	14-25417-ZL62R	SW8290	Total PeCDF	3.82	pg/g	EMPC	J	25
DUB2-SB7-7-7.5	14-25418-ZL62S	SW8290	1,2,3,6,7,8-HxCDF	2.89	pg/g	BJEMPC	U	25
DUB2-SB7-7-7.5	14-25418-ZL62S	SW8290	Total HpCDF	41.7	pg/g	EMPC	J	25
DUB2-SB7-7-7.5	14-25418-ZL62S	SW8290	Total HxCDF	28.6	pg/g	EMPC	J	25
DUB2-SB30-3-3.5	14-25419-ZL62T	SW8290	1,2,3,4,6,7,8-HpCDD	66.5	pg/g	BJEMPC	U	25
DUB2-SB30-3-3.5	14-25419-ZL62T	SW8290	1,2,3,4,7,8,9-HpCDF	6	pg/g	JEMPC	U	25
DUB2-SB30-3-3.5	14-25419-ZL62T	SW8290	1,2,3,6,7,8-HxCDD	6.5	pg/g	BJEMPC	U	25
DUB2-SB30-3-3.5	14-25419-ZL62T	SW8290	1,2,3,7,8,9-HxCDD	7.75	pg/g	BJEMPC	U	25
DUB2-SB30-3-3.5	14-25419-ZL62T	SW8290	1,2,3,7,8,9-HxCDF	9.5	pg/g	BJEMPC	U	25
DUB2-SB30-3-3.5	14-25419-ZL62T	SW8290	2,3,4,6,7,8-HxCDF	4.5	pg/g	BJEMPC	U	25
DUB2-SB30-3-3.5	14-25419-ZL62T	SW8290	Total HpCDD	129	pg/g	EMPC	J	25
DUB2-SB30-3-3.5	14-25419-ZL62T	SW8290	Total HpCDF	61	pg/g	EMPC	J	25
DUB2-SB30-3-3.5	14-25419-ZL62T	SW8290	Total HxCDD	14.1	pg/g	EMPC	J	25
DUB2-SB30-3-3.5	14-25419-ZL62T	SW8290	Total HxCDF	27.6	pg/g	EMPC	J	25

Reichold/SSA
Containers Facility

Supplemental Focused Remedial Investigation/ Supplemental Focused Feasibility Study

Appendix F
2015 Memorandum: Puget Sound Burrowing Animals Analysis

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MEMORANDUM

To: Stephen Bentsen, P.E.
From: Jennifer Sampson, Senior Managing Ecologist
Date: October 2, 2015
Subject: Puget Sound Burrowing Animals Analysis
Project No.: C1497

The purpose of this memorandum is to summarize Integral's evaluation of whether the proposed soil cap described below presents an appropriate barrier to burrowing wildlife, and will prevent wildlife from contacting the soil or compromising the cap.

Attached is a table summarizing those vertebrate species that should be considered in evaluating the risk of disturbance due to burrowing animals to an in-place soil containment cap at the Reichhold/SSA Containers Site in Tacoma, WA. On the basis of a description of the cap provided Floyd Snider, we understand the cap to consist of either a geotextile fabric or GeoGrid covered by a layer of crushed rock that is about 1 ft. thick. The surrounding area consists of a former industrial operations area and is unvegetated soil.

To prepare the attached summary table, Integral first identified all mammals, reptiles, and amphibians that occur in Washington, except for ungulates (such as deer, which do not burrow) and marine mammals. If one of the Washington species has the potential to occur in the Puget Sound Lowlands based on its geographical range and preferred habitat, it was included in the summary table. Research was then conducted to identify birds that burrow for nesting or shelter; those that could occur in the Puget Sound were also added to the table. Following that, the burrowing activities and specific habitat requirements for each species identified in the first task were researched and a summary of those activities and habitats were added to the table for each species. The burrowing activities and habitat requirements of species that dig burrows, dens, nests, and/or tunnels (rather than using existing ones) were then compared to the site and capping methods described above and a rationale for why an exclusion for each species is appropriate was provided.

On the basis of this summary information and our professional judgement, we have concluded that none of the burrowing mammals, reptiles, or amphibians that have the potential to occur at the site would be expected to penetrate the cap or reduce its integrity. Our rationale for this conclusion includes consideration of:

1. The physical impediment of the 1 foot of compacted crushed rock and geotextile
2. The distance from a significant water resource, such as a river, lake, or wetland
3. The fact that compacted, deep crushed rock will not support plants. Therefore,
    a. Herbivorous burrowers such as voles and gophers are not likely to occupy the site.
    b. Insects will not be attracted, and insectivorous burrowers such as moles and shrews are not likely to occupy the site.
    c. The lack of cover will make the site unattractive for all small mammals, reptiles, and amphibians because of the threat of predation and lack of structural variation.

Table 1. Puget Sound Burrowing Animals Summary

Species [a]		Habitat/Range [b]	Burrow Activity/Description	Source	Exclusion Rationale
Mammals					
Black bear	*Ursus americanus*	Forested and semi open areas.	Den sites include tree cavities, hollow logs, small caves, and areas beneath large roots, stumps, logs, and rural buildings. They'll occasionally excavate a den in the side of a hill near shrubs or other cover.	1	Not a burrower, Burrow location preference - site too bare
Cougar	*Puma concolor*	All habitats.	Does not typically den or burrow.	1	Not a burrower
Bobcat	*Lynx rufus,*	All habitats.	Dens found in caves, rock crevices, or hollow logs or trees.	1	Not a burrower
Coyote	*Canis latrans*	All habitats.	Den dug under an uprooted tree, log, or thicket	1	Burrow location preference - site too bare
Red fox	*Vulpes vulpes*	Forests and woodlands. W lowlands. introduced	Den typically in the burrows of other animals	2	Not a burrower
Raccoon	*Procyon lotor*	Wooded areas. W lowlands	Den typically in the burrows of other animals	1	Not a burrower
Virginia opossum	*Didelphis virginiana*	Wooded habitats. Widespread in W lowlands, local E; introduced	Does not dig its own burrow	1	Not a burrower
Porcupine	*Erethizon dorsatum*	Open forest to shrub steppe.	Typically does not den or burrow	2	Not a burrower
Ermine (short-tailed weasel)	*Mustela erminea*	Forests. Throughout except Columbia Basin.	Dens in burrows of prey or natural cavities; does not burrow	3	Not a burrower
Long-tailed weasel	*Mustela frenata*	All habitats.	Dens in burrows of prey or natural cavities; does not burrow	3	Not a burrower
Western spotted skunk	*Spilogale gracilis*	Woodlands and thickets. W lowlands and Blue Mountains foothills.	Typically use deserted burrows. Dens are located under wood and rock piles, buildings, porches, and in standing or fallen hollow trees.	1	Burrow location preference - site too bare
Striped skunk	*Mephitis mephitis*	All habitats except sagebrush, more in open areas than preceding species.			Burrow location preference - site too bare
Townsend's mole	*Scapanus townsendii*	Non-forested; Meadows. W lowlands.	Surface tunnels are located 1 to 4 inches below the surface. Surface tunnels connect with deeper runways that are located 3 to 12 inches below the surface, but may be as deep as 40 inches. Prefer moist, loose soil. Mostly insectivorous.	1	Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Coast mole	*Scapanus orarius*	Most habitats. W lowlands			Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Shrew-mole	*Neurotrichus gibbsii*	Moist forests. Cascades to coast.			Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Vagrant shrew	*Sorex vagrans*	Marshes, meadows, and moist forests	Prefer moist environments; shallow burrowers. Mostly insectivorous.	1	Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Trowbridge's shrew	*Sorex trowbridgii*	Forests. Cascades to coast.			Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Pacific water shrew	*Sorex bendirii*	Marshes and stream banks. W of Cascades.			Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Gapper's red-backed vole	*Clethrionomys gapperi*	Forests. Throughout except Columbia Basin.	Shallow underground passages (no deeper than 10 cm deep), nest chamber can be up to 75 cm deep. Herbivorous diet.	4	Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Townsend's vole	*Microtus townsendii*	Marshes, wet meadows, and riparian woodlands. W lowlands.			Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Long-tailed vole	*Microtus longicaudus*	Moist habitats, lowlands and mountains.			Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Creeping vole	*Microtus oregoni*	Moist habitats. Cascades to coast.			Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Mazama/Western pocket gopher	*Thomomys mazama*	Meadows in forested areas. Olympics and lower Puget Sound S	Tunnels 4-12 in below surface; nest/food storage as deep as 6 ft. Feeds on roots/tubers.	1	Shallow burrower, Impeded by crushed rock, Lack of food source [c]
Mountain beaver	*Aplodontia rufa*	Forests and clearings. Cascades to coast.	Intricate tunnel system with many openings, as deep as 10 ft. Feed on below ground parts of plants.	1	Lack of food source
Snowshoe Hare	*Lepus americanus*	Forests. Throughout except Columbia Basin.	Nests and dens are located in or near brushy fencerows or field edges, brush piles, gullies containing shrubs, and landscaped areas with suitable cover.	1	Burrow location preference - site too bare
Eastern Cottontail	*Sylvilagus floridanus*	Meadows and open woodlands. Local in lowlands; introduced			Burrow location preference - site too bare

Table 1. Puget Sound Burrowing Animals Summary

Species [a]		Habitat/Range [b]	Burrow Activity/Description	Source	Exclusion Rationale
River otter	*Lontra canadensis*	Marine and freshwater. Throughout but only in large rivers E of Cascades.	Den sites include hollow logs, log jams, piles of driftwood or boulders, and abandoned lodges and bank dens made by nutria or beaver.	1	Habitat – occurs in wetlands/riparian zones
American beaver	*Castor canadensis*	Wetlands	Does not burrow terrestrially	1	Habitat – occurs in wetlands/riparian zones
Nutria	*Myocastor coypus*	Wetlands. Established locally both W and E of Cascades; introduced	Does not burrow terrestrially	1	Habitat – occurs in wetlands/riparian zones
Muskrat	*Ondatra zibethicus*	Wetlands	Tunnel upward from below the water surface into the soil to make dens	1	Habitat – occurs in wetlands/riparian zones
Mink	*Mustela vison*	Throughout but rare in Columbia Basin.	Burrow only on stream and river banks	5	Habitat – occurs in wetlands/riparian zones
Norway rat/Brown rat	*Rattus norvegicus*	Most habitats, especially near habitations. Mostly W lowlands; introduced	Burrows are typically less than 18 inches deep, along building foundation walls, under slabs, in overgrown weedy areas, beneath debris and buildings, and in moist areas in and around gardens and fields.	1	Burrow location preference - site too bare
Black rat	*Rattus rattus*	Most habitats, especially near habitations. Mostly W lowlands;			Burrow location preference - site too bare
Pacific jumping mouse	*Zaphus trinotatus*	Forest clearings and meadows. Cascades to coast.			Burrow location preference - site too bare
Deer mouse	*Peromyscus maniculatus* ,	All habitats but much less common in wet forests inhabited by next species.			Burrow location preference - site too bare
Forest deer mouse	*Peromyscus keenii*	Forests. Cascades and W lowlands, often with preceding species.			Burrow location preference - site too bare
Bushy-tailed woodrat	*Neotoma cinerea*	Talus and rocky areas at all elevations.		1	Burrow location preference - site too bare
Townsend's chipmunk	*Tamias townsendii*	Wet forests from E slope of Cascades to coast.	Nest in the ground near rocks, bushes and fallen logs	2	Burrow location preference - site too bare
California ground squirrel	*Spermophilus beecheyi*	Grasslands and oak woodlands. Puget Sound	Requires deep non-compacted soil for digging burrows	6	Burrow location preference - impeded by crushed rock
Eastern gray squirrel	*Sciurus carolinensis*	Cities and towns. Puget Trough, Yakima Valley, and Spokane; introduced	Tree squirrels; not burrowers	1	Not a burrower
Western gray squirrel	*Sciurus griseus*	Oak woodlands. Either side of Cascades from Pierce and Okanogan counties southward			Not a burrower
Douglas' squirrel	*Tamiasciurus douglasii*	Conifer forests. Cascades to coast.			Not a burrower
Amphibians					
Western toad	*Anaxyrus boreas*	Many habitats, usually near water. Throughout state except	Does not burrow. Uses natural cavities/root canals.	1	Not a burrower, Habitat – occurs in wetlands/riparian zones
Bullfrog	*Lithobates catesbeianus*	In ponds and lakes. Introduced widely throughout lowlands of state.	Does not burrow. Uses natural cavities/root canals.	1	Not a burrower, Habitat – occurs in wetlands/riparian zones
Northern red-legged frog	*Rana aurora*	Near or in ponds, especially in forest. West of Cascades.	Does not burrow. Uses natural cavities/root canals.	1	Not a burrower, Habitat – occurs in wetlands/riparian zones
Pacific treefrog	*Pseudacris regilla*	Almost ubiquitous, especially near water. Throughout state.	Does not burrow. Uses natural cavities/root canals.	1	Not a burrower, Habitat – occurs in wetlands/riparian zones
Olympic torrent salamander	*Rhyacotriton olympicus*	In streams. Olympic Peninsula.	Does not burrow. Uses natural cavities/root canals.	2	Not a burrower, Habitat – occurs in wetlands/riparian zones
Rough-skinned newt	*Taricha granulosa*	In and near ponds. From east slope of Cascades to coast, including islands.	Does not burrow. Uses natural cavities/root canals.	2	Not a burrower, Habitat – occurs in wetlands/riparian zones
Van Dyke's salamander	*Plethodon vandykei*	Rocky or mossy areas near streams and seeps. Olympic Peninsula and local south of Puget Sound in and west of Cascades.	Does not burrow. Uses natural cavities/root canals.	1	Not a burrower, Habitat – occurs in wetlands/riparian zones
Western red-backed salamander	*Plethodon vehiculum*	In conifer forest. Throughout west of Cascades.	Does not burrow. Uses natural cavities/root canals.	2	Not a burrower, Habitat – occurs in wetlands/riparian zones
Ensatina	*Ensatina eschscholtzii*	In forest. Throughout west of Cascades.	Does not burrow. Uses natural cavities/root canals.	2	Not a burrower, Habitat – occurs in wetlands/riparian zones
Cope's Giant salamander	*Dicamptodon copei*	Larvae in streams, only rarely undergo metamorphosis in nature. Olympic Peninsula and south and west of Puget Sound.	Does not burrow. Uses natural cavities/root canals.	1	Not a burrower, Habitat – occurs in wetlands/riparian zones
Northwestern salamander	*Ambystoma gracile*	In and near ponds and slow streams. West of Cascades.	Does not burrow. Uses rodent burrows.	2	Not a burrower, Habitat – occurs in wetlands/riparian zones
Long-toed salamander	*Ambystoma macrodactylum*	In many habitats, usually near water. Throughout state.	Does not burrow. Uses natural cavities/root canals.	2	Not a burrower, Habitat – occurs in wetlands/riparian zones

Table 1. Puget Sound Burrowing Animals Summary

Species [a]		Habitat/Range [b]	Burrow Activity/Description	Source	Exclusion Rationale
Reptiles					
Northern alligator lizard	*Elgaria coerulea*	Forest. Northern border of state and from east slope of Cascades west to coast.	Over-winter in hibernacula, but does not make its own burrow	1	Not a burrower
Western pond turtle	*Actinemys marmorata*	Ponds and slow streams. Formerly local near Puget Sound in King, Pierce, and Thurston counties	Hibernates in winter by burrowing into mud (not crushed rock)	1	Burrow location preference - impeded by crushed rock; Habitat – occurs in wetlands/riparian zones
Western fencelizard	*Sceloporus occidentalis*	Many habitats, usually wooded. Local around Puget Sound, east slope of Cascades, and Blue Mountains.	Does not burrow	1	Not a burrower
Terrestrial gartersnake	*Thamnophis elegans*	Open woodland, wetlands, also streams in steppe. Throughout state but more local west of Cascades than other garter snakes.	Dens are also used include rodent burrows, spaces under logs and tree stumps, rock crevices, and lumber and rock piles.	1	Not a burrower
Northwestern gartersnake	*Thamnophis ordinoides*	Moist woodland, wetlands, and meadows. West of Cascades and local in Kittitas County.			Not a burrower
Common gartersnake	*Thamnophis sirtalis*	Open woodland, meadows, wetlands, also lakes and streams in steppe. Throughout state.			Not a burrower
Birds (Burrowers only)					
Belted kingfisher	*Megaceryle alcyon*	Varied; range throughout North America	Will create nest burrow on crushed rock slopes away from water, 3-6 feet into the hill (sloped upward)	7	Burrow location preference - site is not sloped

Source:
1 = WA Dept. of Fish and Wildlife
2 = OR Dept. of Fish and Wildlfe
3 = CA Ministry of Environment
4 = Askham & Sipes 1991
5 = GA Dept. of Natural Resources
6 = USDA Forest Service
7 = Cornell Lab of Ornithology

Notes:

[a] All vertebrate species likely to occur in the Puget Sound Lowlands based on range and habitat descriptions from the Univ. of Puget Sound Slater Museum of Natural History. Marine mammals and ungulates were not considered. Only birds that dig burrows were considered.

[b] Geographic locations refer to within the state of Washington. If none is indicated, species occurs throughout state.

[c] While food storage and nest cavities are typically deep, they tend to be connected to a network of shallower passageways, which would not be dug in non-vegetated, compacted crushed rock.

Reichold/SSA
Containers Facility

Supplemental Focused Remedial Investigation/ Supplemental Focused Feasibility Study

Appendix G
Cost Estimate Spreadsheets

Alternative 1
Consolidation, Capping, and Institutional Controls

Activity	Amount	Units	Cost per	Total Cost	Comments
Excavation and Capping Construction					
General					
Mobilization/Demobilization	1	LS	$ 66,000	$ 66,000	5% of total cost.
Temporary Erosion and Sediment Control	1	LS	$ 50,000	$ 50,000	
Stockpile Area Prep/Site Setup	1	LS	$ 25,000	$ 25,000	
Utility Clearance	8	HR	$ 125	$ 1,000	
Area A					
Pre-Excavation Extent Investigation and Reporting	1	Event	$ 125,000	$ 125,000	Assumes 16 samples in each of the six hot spots for a total of 96 samples. Field event will require two field staff and a direct-push probe rig for 7 days. Includes event prep (e.g., SAP/QAPP and utility locate), mobilization, analytical testing, data validation, and final data reporting.
Contaminated Soil Excavation in Area A	496	CY	$ 13	$ 6,500	Assumes 1.4 tons/CY.
Soil Stockpile Management	1	LS	$ 10,000	$ 10,000	
Purchase, Place, and Compact Soil Backfill in Area A	524	TON	$ 40	$ 20,900	Includes material, haul, and compaction.
Purchase, Place, and Compact Gravel Backfill in Area A	139	TON	$ 40	$ 5,600	Assumes 1-foot of imported crushed rock/quarry spalls.
Consolidate and Transport Area A Soil to Area B	496	CY	$ 8	$ 4,000	Based on 2009 Reichhold cost of $7.15/CY.
Area A Compliance Soil Sampling and Reporting	1	LS	$ 55,000	$ 55,000	Assumes 5 soil samples in each of the 6 hot spots for a total of 30 samples.
Area B					
Cap Area Grading	317,000	SF	$ 0.25	$ 79,300	
Installation of Geotextile Fabric or Geogrid	317,000	SF	$ 0.70	$ 221,900	
Base Course Crushed Surfacing Purchase, Placement, and Compaction	8,806	TON	$ 40	$ 352,200	Assumes 6" of imported base course crushed surfacing.
Top Course Crushed Surfacing Purchase, Placement, and Compaction	8,806	TON	$ 40	$ 352,200	Assumes 6" of imported top course crushed surfacing.
Post-Construction Survey	1	LS	$ 6,000	$ 6,000	
			Subtotal	**$ 1,380,000**	
Groundwater Monitoring					
Semi-Annual Groundwater Monitoring (3 Years)	6	Event	$ 8,500	$ 51,000	Assumes two field staff for 1 day. Includes event prep, mobilization, and analytical testing.
Reporting	3	YR	$ 5,000	$ 15,000	Assumes annual reporting of monitoring results.
			Subtotal	**$ 70,000**	
Planning, Oversight and Alternative Totals					
Direct Costs				$ 1,450,000	
Engineering Design	1	LS	$ 87,000	$ 87,000	6% of Direct Cost.
Engineering Oversight and Construction Reporting	1	LS	$ 75,000	$ 75,000	
Institutional Controls Development and Implementation	1	LS	$ 30,000	$ 30,000	
Permitting	1	LS	$ 14,500	$ 14,500	1% of project construction cost.
			Subtotal	**$ 1,610,000**	
Contingency, 30%				$ 480,000	
			Grand Total	**$ 2,090,000**	

Alternative 2
Full Removal by Excavation and Disposal

Activity	Amount	Units	Cost per	Total Cost	Comments
Construction					
Area A Pre-Excavation Extent Investigation and Reporting	1	Event	$ 125,000	$ 125,000	Assumes 16 samples in each of the six hot spots for a total of 96 samples. Field event will require two field staff and a direct push probe rig for 7 days. Includes event prep (e.g. SAP/QAPP and utility locate), mobilization, analytical testing, data validation, and final data reporting.
Mobilization/Demobilization	1	LS	$ 100,000	$ 100,000	5% of total cost.
Temporary Erosion and Sediment Control	1	LS	$ 20,000	$ 20,000	
Utility Clearance	8	HR	$ 125	$ 1,000	
Stockpile Area Prep/Site Setup	1	LS	$ 20,000	$ 20,000	
Contaminated Soil Excavation in Areas A and B	56,233	CY	$ 13	$ 731,000	Assumes 1.4 tons/CY.
Soil Stockpile Management	1	LS	$ 60,000	$ 60,000	
Purchase, Place, and Compact Soil Backfill in Areas A and B	64,205	TON	$ 40	$ 2,570,000	Includes material, haul, and compaction.
Purchase, Place, and Compact Gravel Backfill in Areas A and B	15,514	TON	$ 40	$ 620,500	Assumes 1-foot of imported crushed rock/quarry spalls.
Contaminated Soil Transport and Disposal	78,726	TON	$ 323	$ 25,430,000	Disposal at WM for CAMU-Eligible soil disposal, $248/ton plus $75/ton trucking fee.
Compliance Soil Sampling and Reporting in Area A and B	1	LS	$ 105,000	$ 105,000	Assumes 30 soil samples in Area A and 20 soil samples in Area B.
			Subtotal	**$ 29,780,000**	
Groundwater Monitoring					
Semi-Annual Groundwater Monitoring (3 Years)	6	EVENT	$ 8,500	$ 51,000	Assumes two field staff for 1 day. Includes event prep, mobilization, and analytical testing.
Reporting	3	YR	$ 5,000	$ 15,000	Assumes annual reporting of monitoring results.
			Subtotal	**$ 66,000**	
Planning, Oversight and Alternative Totals					
Direct Costs				$ 29,850,000	
Engineering Design	1	LS	$ 1,791,000	$ 1,790,000	6% of Direct Cost.
Engineering Oversight and Construction Reporting	1	LS	$ 150,000	$ 150,000	
Permitting	1	LS	$ 298,500	$ 299,000	1% of project construction cost.
			Subtotal	**$ 32,090,000**	
Contingency, 30%				$ 9,630,000	
			Grand Total	**$ 41,720,000**	

Alternative 3
Consolidation, Solidification, and Institutional Controls

Activity	Amount	Units	Cost per	Total Cost	Comments
Excavation and Capping Construction					
General					
Mobilization/Demobilization	1	LS	$ 276,000	$ 276,000	5% of total cost.
Temporary Erosion and Sediment Control	1	LS	$ 50,000	$ 50,000	
Stockpile Area Prep/Site Setup	1	LS	$ 25,000	$ 25,000	
Utility Clearance	8	HR	$ 125	$ 1,000	
Area A					
Pre-Excavation Extent Investigation and Reporting	1	Event	$ 125,000	$ 125,000	Assumes 16 samples in each of the six hot spots for a total of 96 samples. Field event will require two field staff and a direct-push probe rig for 7 days. Includes event prep (e.g., SAP/QAPP and utility locate), mobilization, analytical testing, data validation, and final data reporting.
Contaminated Soil Excavation in Area A	496	CY	$ 13	$ 6,500	Assumes 1.4 tons/CY.
Soil Stockpile Management	1	LS	$ 10,000	$ 10,000	
Purchase, Place, and Compact Soil Backfill in Area A	524	TON	$ 40	$ 20,900	Includes material, haul, and compaction.
Purchase, Place, and Compact Gravel Backfill in Area A	139	TON	$ 40	$ 5,600	Assumes 1-foot of imported crushed rock/quarry spalls.
Consolidate and Transport Area A Soil to Area B	496	CY	$ 8	$ 4,000	Based on 2009 Reichhold cost of $7.15/CY.
Area A Compliance Soil Sampling and Reporting	1	LS	$ 55,000	$ 55,000	Assumes 5 soil samples in each of the six hot spots for a total of 30 samples.
Area B					
Cap Area Grading	317,000	SF	$ 0.25	$ 79,300	
Mixing Agent	16,000	TON	$ 0.70	$ 11,200	Assumes 20% volume addition.
Soil Stabilization	68,400	CY	$ 75	$ 5,130,000	Assumes 57,000 CY plus 20 percent reagent, USEPA document cites cost at $70 to $145/CY. $75/CY assumes soil is dry and at surface.
Post-Construction Survey	1	LS	$ 6,000	$ 6,000	
			Subtotal	**$ 5,810,000**	
Groundwater Monitoring					
Semi-Annual Groundwater Monitoring (3 Years)	6	Event	$ 8,500	$ 51,000	Assumes two field staff for 1 day. Includes event prep, mobilization, and analytical testing.
Reporting	3	YR	$ 5,000	$ 15,000	Assumes annual reporting of monitoring results.
			Subtotal	**$ 70,000**	
Planning, Oversight and Alternative Totals					
Direct Costs				$ 5,880,000	
Engineering Design	1	LS	$ 352,800	$ 352,800	6% of Direct Cost.
Engineering Oversight and Construction Reporting	1	LS	$ 75,000	$ 75,000	
Institutional Controls Development and Implementation	1	LS	$ 30,000	$ 30,000	
Permitting	1	LS	$ 58,800	$ 58,800	1% of project construction cost.
			Subtotal	**$ 6,310,000**	
Contingency, 30%				$ 1,890,000	
			Grand Total	**$ 8,200,000**	