SUPPLEMENTAL REMEDIAL INVESTIGATION REPORT FINAL

Former Frontier Leather Tannery Property

1210 SW Oregon Street

Sherwood, Oregon

Cooperative Agreement BF-00J93201

Prepared for:

City of Sherwood
22580 SW Pine Street
Sherwood, OR 97140

Prepared by:

Amec Foster Wheeler Environment & Infrastructure, Inc.
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June 2016

Project No. 5-61M-130820.3

June 17, 2016
Project No. 5-61M-130820.3

City of Sherwood
22580 SW Pine Street
Sherwood, Oregon 97140

Attention: Ms. Julia Hajduk

Subject: Supplemental Remedial Investigation Report – Final
Former Frontier Leather Tannery Property
1210 SW Oregon Street – Sherwood, Oregon
Cooperative Agreement BF-00J93201

Dear Julia:

Amec Foster Wheeler Environment & Infrastructure, Inc. is pleased to submit this Supplemental Remedial Investigation Report for the above-referenced property in Sherwood, Oregon. The report was revised to address comments received from the Oregon Department of Environmental Quality (DEQ) dated March 8, 2016. The United States Environmental Protection Agency did not provide comments. Responses to DEQ comments are presented in Appendix H.

We appreciate the opportunity to serve you on this project. If you have any questions or require further information, please feel free to contact us at (503) 639-3400.

Sincerely,

Amec Foster Wheeler
Environment & Infrastructure, Inc.

Michelle L. Peterson, RG
Project Manager

Charles T. Esler, CHMM
Principal Environmental Scientist

Attachment: Supplemental Remedial Investigation Report – Final

MLP/lp/ay

c: Brandon Perkins, US Environmental Protection Agency
Mark Pugh, Oregon Department of Environmental Quality

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1.0 INTRODUCTION

On behalf of the City of Sherwood (City), Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) has prepared this Supplemental Remedial Investigation Report (Supplemental RI) to document the environmental site assessment of Tax Lot 602 at the Former Frontier Leather Property located at 1210 SW Oregon Street in Sherwood, Oregon. The City was awarded a United States Environmental Protection Agency (EPA) Site-Specific Brownfields Assessment Grant in 2014 to conduct assessment and cleanup planning for Tax Lots 600 and 602, collectively referred to as the Site. The Oregon Department of Environmental Quality (DEQ) previously conducted a Remedial Investigation (RI) of Tax Lot 600 (GeoEngineers, 2004), and thus the site assessment reported in this Supplemental RI focused on evaluating Tax Lot 602 which had not previously been assessed. All grant work performed by the City and its contractors was performed in accordance with the Cooperative Agreement (BF-00J93201) executed by the EPA and the City.

2.0 PROJECT BACKGROUND

This section provides a summary of the Site history, a site description, the proposed development plan, a summary of previous investigations, and the project objectives.

2.1 SITE HISTORY

The two tax lots that comprise the Site were historically part of a large tannery operation that existed from the late 1940s through the early 1990s and covered approximately 33 acres on six tax lots. The portion of the Site being assessed under this grant consists of two tax lots (600 and 602) used for landfilling of hide-splits (the non-valued part of the hide) and for processing various tannery wastes. These historical uses indicated the potential for impacts to soil and shallow groundwater from a variety of contaminants associated with the tanning process and waste treatment.

2.2 SITE DESCRIPTION

The Site is located in Washington County, in Township 2 South, Range 1 West of the Willamette Meridian at the southwest corner of Section 29 (Figure 1). The Site consists of two vacant tax lots (Tax Lots 600 and 602) covering approximately 24 acres located in an industrially-zoned area of Sherwood, Oregon along SW Oregon Street (Figure 2). The Site is surrounded by industrially zoned land on the west, north, and east. A railroad right-of-way borders the Site on the north. A residential neighborhood is located south of the Site, across SW Oregon Street. The Site contains wetland areas and is identified as part of the Rock Creek Unit of the Tualatin River National Wildlife Refuge. Rock Creek crosses the northeastern most tip of Tax Lot 600. Washington County currently owns the property as a result of property tax foreclosure.

Current Site features from historical operations include one small shed, two former sedimentation lagoons and their associated bermed perimeters, two shallow depressions from historical aeration ponds used to treat tanning wastes before they were discharged to the bermed sedimentation lagoons, an access road that enters the property from the west, extending to the east between the two aeration ponds, a surficial drainage ditch that runs parallel to the railroad tracks along the northern property boundary, and seven monitoring wells (installed during DEQ's RI in 2003). Prior investigations also identified a hide-split landfill along the western edge of Tax Lot 600.

2.3 PROPOSED DEVELOPMENT PLAN

The Site is being considered for redevelopment as the new location for the City's public works facility. Additionally, those parts of the Site that may not be suitable for development are being considered for potential open space and/or to provide access to the Tualatin River National Wildlife Refuge. Re-locating the public works facilities away from the downtown core will promote downtown development consistent with the permitted uses within the current Old Town zoning overlay for the City of Sherwood (City of Sherwood Code of Ordinances, Title 16, Division IX, Chapter 16.162), and put out-of-use industrial land back into productive service for the community. Development of access to the Tualatin River National Wildlife Refuge is consistent with the City's Parks and Recreation Master Plan (City of Sherwood, 2006).

2.4 PREVIOUS INVESTIGATIONS

Previous investigations conducted at the Site include the RI performed by DEQ in 2003 and 2004 (GeoEngineers, 2004), and subsequent groundwater monitoring conducted by DEQ between 2005 and 2007 (DEQ, 2015b). Additional information pertaining to the nature of potential impacts at the Site are included in a Staff Report prepared by DEQ for the Ken Foster Farms Site (DEQ, 2015a),

located approximately 0.5 miles south of the Site. The Ken Foster Farms Site is related because it also received tannery wastes generated at the Former Frontier Leather Tannery property.

The scope and findings of the investigations are summarized below, with additional details presented in the project Quality Assurance Project Plan & Sampling and Analysis Plan (QAPP-SAP) (Amec Foster Wheeler, 2015). Additional information for each site is also available in the relevant DEQ cleanup file. The DEQ file number for the sedimentation lagoon portion of the Former Frontier Leather Property is #2638. The DEQ file number for the Ken Foster Farms Site is #2516.

Remedial Investigation Report, GeoEngineers on behalf of DEQ, June 2004

The RI was conducted in 2003 and 2004 to evaluate potential impacts on Tax Lot 600 (in Section 29) and Tax Lot 400 (in Section 28) from historical tannery operations. Tax Lot 600 is part of the Site covered by this project, while Tax Lot 400 is excluded from the Site. DEQ assigned ECSI #2638 to the property it investigated that contained the sedimentation lagoons and wetland areas extending east to Rock Creek. Tax Lot 602 was not included in the RI completed in 2004 because DEQ was not able to secure access to conduct the investigation.

The RI evaluated the vertical and horizontal extent of hide-splits, and the potential impacts in soil, sediment, groundwater, and surface water. The field investigation was robust and included completion of 24 test pits, 63 hand auger borings, and installation of 7 monitoring wells, which resulted in the sampling and analysis of more than 150 soil samples, 9 sediment samples, 23 groundwater samples, 19 surface water samples from upland seeps, and 8 samples of surface water from Rock Creek. Samples were analyzed for one or more of the following:

- Ten project-specific metals (antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, and zinc) using EPA Methods 6000/7000 series;
- Hexavalent chromium using EPA Method 7196;
- Volatile organic compounds (VOCs) using EPA Method 8260B;
- Semivolatile organic compounds (SVOCs) using EPA Method 8270C and 8270-SIM (selected ion mode);
- Organochlorine insecticides (OCIs) using EPA Method 8081A;
- Polychlorinated biphenyls (PCBs) using EPA Method 8082A; and
- Chloride, nitrate, nitrite, and sulfate using EPA Method 300.0.

A summary of the key findings from the RI is provided below.

- The hide-split landfill extends along the western edge of Tax Lots 600 to the north and south of Tax Lot 602. Hides are present from the ground surface to depths of up to 8 feet below ground surface (bgs). The distribution of hides observed during the RI suggested they extended onto Tax Lot 602.
- The depth to groundwater is shallow and varies from a few feet bgs (MW-1) to greater than 15 feet bgs (MW-4), except at MW-3 and MW-5 where the depth to water is artificially deep because these wells are completed on the lagoon berms which are elevated from the surrounding topography.
- Groundwater flow is to the northeast toward Rock Creek at a gradient of approximately 0.04 feet per foot across the Site.
- Metals were widely detected in all media as described below.
  - Concentrations of metals in soil are the highest within the hide-split landfill, within the sedimentation lagoons, and downstream of the breaches in each lagoon berm. All metals were found at concentrations greater than naturally occurring levels in at least a few samples, but arsenic, copper, lead, nickel, and zinc were found primarily at background levels, except at a few locations associated with hide-splits. Chromium concentrations were the highest of the metals most commonly exceeding background levels, with a maximum concentration of 21,000 milligrams per kilogram (mg/kg) detected in TP-3 at 4 feet bgs.
  - All metals detected in the sediments of Rock Creek were found at concentrations consistent with naturally occurring background levels, with the exception of chromium and manganese which were each detected in one sample near the railroad drainage ditch at concentrations above the background level. The railroad drainage ditch appears to have been a historical transport pathway to Rock Creek.
  - Most metals were detected in groundwater or surface water at least once, with chromium and manganese being the mostly frequently detected.
- VOCs and SVOCs were largely not detected in the media where they were analyzed. Three VOCs (1,2-dichlorobenzene; 1,4-dichlorobenzene; chlorobenzene) were detected in groundwater at one monitoring well (MW-4) at concentrations of less than 10 micrograms per liter (µg/L). One SVOC (phenol) was detected in a single soil sample collected within the footprint of the hide-split landfill, at a concentration just above the detection limit.
- A few OCIs (4,4'-DDD; 4,4'-DDE; 4,4'-DDT; chlordane) were detected in about half of the soil and sediment samples, but were not found in the hide-split landfill, and thus are not considered to be site-related. As stated in the RI report, detected OCIs are believed to be representative of regional conditions (GeoEngineers, 2004).

- PCBs were not detected in soil, sediment, surface water, or groundwater.
- The human health risk assessment (HHRA) concluded that:
  - Chromium was the only constituent of potential concern (COPC) identified for soil and sediment, because it was found at concentrations greater than background levels in these media and the concentrations either exceeded the industrial soil Preliminary Remediation Goal (PRG) established by EPA at the time of the investigation, or contributed to an unacceptable level of potential risk when evaluated cumulatively with all other detected metals.
  - Evaluation of groundwater and surface water was not needed because there is no beneficial human use of either.
  - There was no unacceptable risk to human receptors from direct contact with soil or sediment containing total chromium or hexavalent chromium (based on the screening criteria and toxicity information available at the time of the DEQ assessment).
- The ecological risk assessment (ERA) concluded that:
  - The site is used by a wide range of ecological receptors in both aquatic (wetland) and terrestrial (upland) habitats. Federally-listed threatened and endangered species occur in the vicinity of the site, but none were observed at or adjacent to the site during DEQ's assessment.
  - Nine metals were identified as constituents of potential ecological concern (CPECs): (1) antimony, (2) cadmium, (3) copper, (4) total chromium, (5) hexavalent chromium, (6) lead, (7) manganese, (8) mercury, and (9) zinc.
  - There was no unacceptable risk to ecological receptors identified for the CPECs detected in Rock Creek surface water (i.e. total chromium, hexavalent chromium, and manganese).
  - There was unacceptable risk to ecological receptors identified for chromium in soil (or sediment), based on a Streamlined Level III ERA that was prepared to evaluate potential risks to the American Robin as a representative specie using all the habitat types present at the site and exposed to chromium (the most prevalent metal) through bioaccumulation (consumption of worms in direct contact with contaminated soil/sediment).
    - Unacceptable risks were determined to be limited to the chromium management area defined as part of the Streamlined Level III ERA, which includes isolated areas of the northern sedimentation lagoon, the majority of the southern sedimentation lagoon, wetland areas downstream of the breaches in each lagoon, and all of the hide-split landfill area (based on the presumption that elevated chromium concentrations would be widespread in the area where hide-splits were known to be present).

- Ecological hot spots for chromium were identified in three small areas covering approximately 10% of the northern sedimentation lagoon, in two areas covering approximately 30% of the southern sedimentation lagoon, and covering the entire area of the hide-split landfill on Tax Lot 600.

– All other metals samples with soil or sediment concentrations exceeding their respective screening criteria fell within the established chromium management area, except for two isolated samples (HA-55 and HA-64) having elevated concentrations of lead.

Groundwater and Surface Water Data, Collected from the Former Frontier Leather Tannery Property by DEQ, 2005-2007

After the RI was completed, DEQ collected and analyzed groundwater from MW-2, MW-3, MW-5, and MW-7; and of surface water from five locations, in 2005, 2006, and 2007. Groundwater samples were analyzed for dissolved chromium and manganese. Surface water samples were analyzed for total chromium and manganese. Results from the sampling conducted between 2005 and 2007 are consistent with results from samples collected in 2003 and 2004.

Staff Report – Draft, DEQ Northwest Region Office, July 2015

The Ken Foster Farms Site (ECSI #2516) is located approximately a half-mile south of the Former Frontier Leather Tannery Property, and received wastes from the Former Frontier Leather Tannery property from the 1960s through the early 1970s. In the 1980s, the Ken Foster Farms Site was subdivided into 17 large residential lots and single family homes were constructed on many of them. Investigations and cleanups were conducted on four tax lots by the company that constructed the homes, and DEQ issued No Further Action (NFA) determinations for these four lots. DEQ also issued an NFA determination for one additional tax lot following investigation conducted by EPA.

In 2013, DEQ conducted a RI of the remaining tweleve tax lots to evaluate the nature and extent of impacts from tannery wastes to soil, groundwater, sediment, and surface water (DEQ, 2015a). Samples were tested for selected metals (hexavalent chromium, total chromium, lead, and mercury). Hexavalent chromium and mercury concentrations were found to exceed levels protective of residential uses in soil, but were less than risk-based concentrations (RBCs) protective of occupational uses. Hexavalent chromium concentrations also exceeded levels protective of drinking water use in one domestic water supply well, and resulted in implementation of an interim action by DEQ to disconnect the water supply well from the residence and connect the residence to the city water supply. DEQ has completed a Feasibility Study to evaluate multiple cleanup alternatives to address the soil impacts. DEQ is in the process of developing a cleanup plan.

2.5 PROJECT OBJECTIVES

The objective of this assessment was to fill data gaps associated with potential contamination at the Site that were not addressed during the previous RI. The primary data gap was a lack of information on Tax Lot 602 about the nature and extent of potential impacts in soil and groundwater, and the extent of the hide-split landfill. These gaps were filled by conducting a geophysical investigation and collecting soil and groundwater samples for analytical testing on Tax Lot 602. The results of the assessment are presented in Sections 3.0 through 5.0.

3.0 ASSESSMENT ACTIVITIES

The pre-field and assessment activities performed for this project are discussed in this section. All work was performed in accordance with the approved QAPP-SAP (Amec Foster Wheeler, 2015).

3.1 PRE-FIELD ACTIVITIES

A series of pre-field activities were performed prior to conducting the subsurface investigation to ensure compliance with regulatory requirements and to be ready to safely perform the subsurface investigation.

3.1.1 Section 7 ESA and Section 106 NHPA Compliance

In order to comply with Section 7 of the Endangered Species Act (ESA) and Section 106 of the National Historic Preservation Act (NHPA), Amec Foster Wheeler provided notification to the EPA and the State Historic Preservation Officer (SHPO) of the planned scope of work prior to beginning field activities. Amec Foster Wheeler also provided notification to the four federally-recognized Native American Tribes in Oregon that claim Washington County as ancestral territory prior to beginning field work. Notifications were provided on April 3, 2015.

A summary of the responses from each agency or tribe, and how questions were addressed for each is provided below.

- EPA – The EPA posed two questions about the proposed assessment: (1) one question pertained to the potential presence of wetlands in the area to be investigated, and (2) the other question was about potential impacts to listed plants, if present, during the assessment. The question pertaining to wetlands was based on a desktop review of state and/or federal wetland inventory maps. The consultant verified that wetlands are not present in the area of Tax Lot 602 to be investigated by providing a figure illustrating site topography and indicating the investigation would be conducted in upland areas only, and not in lower elevation areas with wetlands that are located in the far northeast corner of Tax

Lot 602. The consultant also confirmed that the assessment would occur after blooms and seeds had formed (late summer/early fall timeframe) to minimize the impact to listed plants, should any be present at the Site. Correspondence regarding potential effects of the investigation was completed on April 30, 2015.

- SHPO – The SHPO provided two letters documenting its determination about the proposed assessment. In a letter dated April 23, 2015, SHPO confirmed there would be no impact to aboveground historic resources. In a letter dated April 30, 2015, SHPO indicated the Site was in an area with a high potential for archeological sites and/or buried human remains to be present and to use caution during ground disturbing activities. SHPO further stated that activities should stop if archeological objects are discovered during ground disturbance work until a professional archeologist can perform an evaluation.
- Warm Springs Tribe – This tribe expressed concern about the high potential for buried archeological sites and/or remains and requested an archeological monitor to be on-site during the investigation. The consultant proposed preparing an Inadvertent Discovery Plan in lieu of using an archeological monitor because the cost of an archeological monitor was not included in the project, and because a review of boring logs for an investigation completed on an adjacent parcel suggested a limited subsurface stratigraphy that could maintain significant archeological evidence. The Warm Springs Tribe agreed to the proposal in an e-mail on May 19, 2915.
- Coquille Tribe – This tribe indicated it would defer to other tribes in an e-mail dated May 1, 2015.

No concerns or requests were expressed by the Grand Ronde tribe and the Siletz tribe.

3.1.2 Health & Safety Planning

A Health and Safety Plan (HASP), as required by Oregon Occupational Safety and Health Division (OR-OSHA) Safety and Health Act, was prepared to describe field safety protocol for Amec Foster Wheeler employees engaged in the project. The HASP was reviewed by Brenda Pittman, Certified Industrial Hygienist (CIH) with Amec Foster Wheeler. Ms. Pittman reviewed the historical analytical soil results to determine that dust monitoring would not be required during the investigation. No dust monitoring was determined to be necessary.

3.1.3 Utility Clearance

Amec Foster Wheeler notified the Oregon Utility Notification Center (UNC) of the intent to drill on the Site and requested marking of underground utilities. Amec Foster Wheeler also contracted with GeoPotential to verify that the sampling locations were not in conflict with underground utilities.

3.1.4 Geophysical Investigation

GeoPotential of Brightwood, Oregon conducted a geophysical investigation to determine the location of Site subsurface features between November 2 and 4, 2015. Prior to conducting the geophysical investigation, proposed boring locations were flagged in the field. An area around each proposed boring location was scanned with ground penetrating radar (GPR) to determine if any natural or manmade subsurface features were present. Pipe and cable locators were used to map the locations of buried utilities and piping remaining from historical Site use. Several proposed boring locations were minimally adjusted based on the geophysical investigation.

3.2 INVESTIGATION AND SAMPLING METHODS

The Site investigation was conducted between November 2 and 11, 2015. The following sections describe field methods to facilitate the investigation.

3.2.1 Geophysical Investigation

A geophysical investigation was conducted between November 2 and 4, 2015 on Tax Lot 602. The objective of the geophysical investigation was to map the conditions of the hide-split landfill within the tax lot boundary. Previous investigations mapped the hide-split landfill for the Site with the exception of Tax Lot 602.

The geophysical investigation was conducted using GPR by acquiring a series of GPR profiles across the Site to identify landfill materials to a depth of approximately 8 to 10 feet bgs. GPR uses short impulses of high frequency radio waves directed into the ground to acquire information about the subsurface. The energy radiated into the ground is reflected back to the antenna by features having different electrical properties to that of the surrounding material.

GeoPotential assessed the GPR data to determine the extent of landfill materials. The geophysical investigation indicated that the hide-split landfill extended onto Tax Lot 602 in its southwest corner, south of the central access road, and around the perimeter of the northern aeration pond to the west, north, and east. Landfill debris was not identified within the north or south aeration ponds or within the central access road. The extent of the estimated hide-split landfill for the entire Site is depicted on Figure 3. The geophysical report is included in Appendix A.

3.2.2 Subsurface Investigation

The subsurface investigation was conducted on November 10 and 11, 2015 using a track-mounted direct-push drill rig operated by Pacific Soil and Water of Tigard, Oregon. Using the drill rig, 24 subsurface borings were installed to a maximum depth of 20 feet bgs, though most borings were advanced to approximately 5 feet bgs. Seven boring were installed within the northern aeration

pond footprint; four borings were installed within the southern aeration pond footprint; and the remaining borings were spatially distributed throughout Tax Lot 602. Groundwater "grab" samples were collected from five borings. Boring locations are shown on Figure 3. Boring logs are provided in Appendix B-1. Field forms are provided in Appendix B-2.

3.2.3 Soil Sampling

Soil samples were collected from each boring with the exception of borings DP-3A, DP-3B, and DP-3C. A surface sample was collected from each boring to maximum depth of 1.5 feet bgs. A deeper sample was collected in each boring between 3.5 and 6 feet bgs. In six borings, the deepest samples were collected between 9 and 15 feet bgs. Soil samples were collected for visual inspection, classification, and field screening (i.e., headspace vapor and water sheen testing). Samples were collected by placing soil into laboratory-provided sample containers and submitted to the analytical laboratory for chemical analytical testing for a selection of the following analyses:

- Total metals (antimony, arsenic, cadmium, copper, lead, manganese, mercury, nickel, and zinc by EPA Method 6020;
- Total chromium by EPA Method 200.8;
- Hexavalent chromium by EPA Method 7199; and,
- Petroleum hydrocarbons by northwest total petroleum hydrocarbons hydrocarbon identification method (NWTPH-HCID).

Laboratory analytical testing for petroleum hydrocarbons and total metals (except for total chromium) was conducted by Apex Laboratories in Tigard, Oregon. Total chromium and hexavalent chromium analyses were conducted by Brooks Rand Laboratories in Bothell, Washington.

3.2.4 Groundwater Sampling

Groundwater "grab" samples were collected from borings DP-2, DP-3, DP-6, DP-13, and DP-17. For each groundwater sample a temporary polyvinyl chloride (PVC) screen was installed into the open borehole. A peristaltic pump and dedicated polyethylene tubing was installed into the PVC screen to extract groundwater. Prior to collecting groundwater samples, water quality field parameters (temperature, pH, specific conductivity, turbidity, dissolved oxygen, and oxygen reduction potential) were collected and recorded. Groundwater samples were then collected by pumping directly into laboratory-supplied sample containers. Groundwater samples for dissolved metals analysis were field filtered. Groundwater samples were analyzed by Apex Laboratories for the following analyses:

- Total and dissolved metals (antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, and zinc by EPA Method 6020;
- VOCs by EPA Method 8260; and,
- Chloride by EPA Method 300.0/9056.

3.3 WASTE CHARACTERIZATION & DISPOSAL

To facilitate waste characterization and disposal, composite soil samples were generated by Apex Laboratories. Composite samples were generated by mixing an equal soil aliquot from each soil jar. This composite sample was determined to be representative of the single investigation derived waste soil drum generated during the Site investigation. The composite sample (DP-Composite) was analyzed using the Toxicity Characteristic Leaching Procedure (TCLP) and subsequently analyzed for lead and chromium using EPA Method 1311 and EPA Method 6020. TCLP lead and chromium results from the soil composite sample were both below laboratory reporting limits (0.0500 milligrams per liter [mg/L] and 0.100 mg/L, respectively). Therefore the soil drum was determined to be non-hazardous waste and transported to International Resource Management in Portland, Oregon, on February 12, 2016 by WasteXpress.

Groundwater sample results were used to determine that the decontamination water drum was also non-hazardous. The decontamination water was transported to International Resource Management in Portland, Oregon, on February 12, 2016, also by WasteXpress.

Copies of the waste manifests and facility ticket are included in Appendix C-1. The laboratory analytical results are provided in Appendix C-2.

3.4 DEVIATIONS FROM THE QAPP-SAP

The scope of work described in the QAPP-SAP (Amec Foster Wheeler, 2015) was completed as described. Four additional borings were also advanced during field activities in response to field observations of potential impact at boring DP-3. Three borings (DP-3A, DP-3B, and DP-3C) were completed surrounding DP-3 in the northern aeration pond to further characterize the upper 5 feet around DP-3. One additional boring (DP-21) was completed approximately 40 feet downgradient of the DP-3 location to evaluate soil and groundwater conditions to a depth of approximately 15 feet bgs.

4.0 ASSESSMENT RESULTS

The results of the site characterization activities are presented in this section.

4.1 SUBSURFACE CONDITIONS

The descriptions provided in this section are based on regional geologic and hydrogeologic reference documents, logs of the subsurface conditions observed during field activities from the assessment conducted in November 2015 and the previous RI conducted in 2003-2004, and logs of surrounding wells which were identified during the beneficial water use determination.

4.1.1 Soils & Geology

The site is located within the Tualatin Valley, which is filled with fine to coarse grained flood sediments. Fine alluvium deposited by the Missoula Flood approximately 21,000 to 12,000 years ago fill the Tualatin Valley at depths from 65 to 80 feet thick, up to 115 feet thick (DOGAMI, 2012). Fine alluvium from channels and floodplains of the Tualatin River overlies the Missoula Flood deposits in the Tualatin River floodplain. The entire area is underlain by the basalts of the Columbia River Basalt Group, which erupted 14 to 16 million years ago from fissure volcanoes near the border of Idaho. Bedrock is exposed at Bull Mountain, north of the site, and Pleasant Hill, south of the site (DOGAMI, 2012).

The National Resources Conservation Service maps the site soils as Quatama loam, Aloha silt loam, and Cove clay. The Quatama loam soil series is characterized by moderately well drained loam and clay loam, and a depth to water from 2 to 3 feet bgs. The Aloha silt loam soil series is mapped in the southwest portion of the site and characterized by somewhat poorly drained silt loam from 0 to 65 inches, and a depth to water from 1.5 to 2 feet bgs. The Cove clay soil series is mapped in the east portion of the site, near Rock Creek, and is characterized by poorly drained clay, and a depth to water from 0 to 1 foot bgs.

Field observations correspond with mapped soil series. Most soils identified were fine-grained, primarily silts, and fine to medium sands with trace to some clay. Observation of gravel near the surface is likely associated with imported fill. Possible evidence of disturbance from historical Site operations (e.g., wood, leather scraps, and gravel debris) was observed in some borings as described below.

- DP-3 – A thin (approximately 2 inches) layer of black silty fine sand was observed at approximately 1 foot bgs. Small areas of intermittent staining, decreasing with depth, were observed below this layer through approximately 6.5 feet bgs. A burnt organic-like odor and faint/degraded petroleum-like odor were observed between approximately 1 and 6.5 feet bgs, but there was no sheen on any samples or on the water collected for analytical testing. Soil samples at DP-3 were collected at four intervals (0 to 1 foot bgs; 3.5 to 4.5 feet bgs; 9 to 10 feet bgs; and 14.5 to 15 bgs) and a groundwater sample was collected for potential analytical testing. Three step-out borings, placed approximately 15 feet away from DP-3,

were advanced to five feet bgs (DP-3A, B, and C). Similar black staining was not observed in these borings, indicating that conditions in DP-3 are isolated.

- DP-10 – Fibers, likely leather, observed through the boring to 5 feet bgs.
- DP-15 – Light-weight soil (possibly degraded hides) encountered at 4.5 to 5 feet bgs.
- DP-11 – Wood debris observed at 1.5 feet bgs.
- DP-17 – Trace black wood debris and rootlets were observed at 15 feet bgs.
- DP-21 – This additional boring was added to the scope of investigation to evaluate soil and groundwater conditions downgradient of the DP-3 location. Wood and gravel debris observed at 3 feet bgs; however, no evidence of impact was noted.

4.1.2 Groundwater & Hydrogeology

Based on local topography and the location relative to the Rock Creek, groundwater flow appears to be northeast. Well logs on file with the Oregon Water Resources Department (OWRD) indicate a shallow groundwater layer with significant seasonal variation from 2 to 30 feet bgs and a deeper aquifer 75 to 200 feet bgs. This is consistent with the findings of the previous RI which indicates depths to water ranging from approximately 1.5 feet bgs to greater than 15 feet bgs.

During field activities, groundwater was encountered at approximately 5 feet bgs while drilling at DP-2; 2.6 feet bgs at DP-3; 0.5 foot bgs while drilling at DP-4; 12.5 feet bgs after drilling at DP-13; and 7 feet while drilling at DP-17. Groundwater depths in aeration pond borings (DP-2, DP-3, and DP-4) is shallower compared with those outside of the ponds (DP-13 and DP-17). DP-13 is located at a higher elevation relative to DP-17, which is why the depth to groundwater is greater.

4.2 SOIL SAMPLING RESULTS

The metals soil analytical results are presented on Table 1A (metals) and Table 1B (total petroleum hydrocarbons). Metals background values published by DEQ for the Portland Basin (DEQ, 2013) are also presented on Table 1A. A review of the data quality was conducted and is presented in Appendix D-1. Laboratory analytical reports are provided in Appendix D-2.

4.2.1 Metals

Each metal analyzed was detected at least once. Antimony and mercury were detected the least frequently, with antimony detected in just one sample, and mercury detected in only ten samples. The majority of metals concentrations were below background levels, with the following exceptions:

- Antimony, cadmium, copper, lead, nickel, and zinc were each detected at a concentration exceeding its respective background level in one sample (DP-15-4-5). This sample was

collected within the footprint of the hide-split landfill and the soil texture suggested that a portion of the sample was comprised of degraded hide fibers. All other detections of these metals were below their respective background levels.

- Manganese was also detected at a concentration exceeding its background level in one sample (DP-10-0-1). This sample location is near a small area of hide-splits exposed at the ground surface. All other detections of manganese were below its background level.
- Chromium concentrations exceeded background levels in 11 samples in multiple locations. The presence of chromium concentrations above background levels is consistent with historical Site use.
- Mercury concentrations exceeded background levels in five samples that are typically co-located with elevated concentrations of chromium.
- Hexavalent chromium was detected in each of the nine samples where it was analyzed. Concentrations ranged from 0.212 milligrams per kilogram (mg/kg) to 6.43 mg/kg. The two highest concentrations are from soils within the hide-split landfill collected at boring DP-17.

These metals analytical results are consistent with metals detected in soil and sediment samples analyzed as part of the previous RI, where the highest metals concentrations were found in samples from test pits completed within the hide-split landfill, and from samples collected within the two sedimentation lagoons and downgradient of the breaches in the lagoon berms. Metals concentrations located away from the hide-split, vertically and horizontally, are consistent with naturally occurring background levels.

4.2.2 Total Petroleum Hydrocarbons

In addition to metals testing, a limited number of soil samples were also tested for petroleum hydrocarbons based on field evidence of potential impact at one location (DP-3) within the northern aeration pond. Petroleum hydrocarbons were not detected above laboratory reporting limits in any of the analyzed samples. No additional testing of soil or testing of groundwater was performed because petroleum hydrocarbons were not detected in soil samples from DP-3.

4.3 GROUNDWATER SAMPLING RESULTS

The groundwater analytical results are presented on Table 2A (dissolved metals), Table 2B (total metals), Table 2C (VOCs) and Table 2D (chloride). Metals background values for freshwater published by DEQ (DEQ, 2010) are also presented on Tables 2A and 2B. A review of the data quality was conducted and is presented in Appendix D-1. Laboratory analytical reports are provided in Appendix D-2.

4.3.1 Total & Dissolved Metals

Most metals were detected in groundwater analyzed for total concentrations, while only six metals were detected in groundwater analyzed for dissolved concentrations. Antimony and mercury were not detected in either analysis. Cadmium and zinc were not detected in the dissolved analysis.

Most total and dissolved metals concentrations exceeded their naturally occurring background levels. The total concentrations were greater than the dissolved concentrations for each detected metal, which is expected for unfiltered groundwater "grab" samples that have high turbidity levels as is common for water samples collected using direct-push techniques. Concentrations were the greatest at DP-17 which is located within the footprint of the hide-split landfill and is on the downgradient side of the Tax Lot 602. The lowest concentrations were found at DP-13, which is outside the footprint of the hide-split landfill and located on the upgradient side of Tax Lot 602.

In general, groundwater analytical results are consistent with the results from previously collected groundwater samples (Tables 4C and 4D). Chromium and manganese are the most commonly detected metals. Metals groundwater concentrations are greatest around and immediately downgradient of source areas (aeration ponds and sedimentation lagoons) and are lowest at cross gradient locations and at depth below the Site within the first layer of basalt bedrock.

4.3.2 VOCs

One VOC was detected in the sample collected from DP-6. 1,2-Dichlorobenze was detected at a concentration of 0.057 µg/L, only slightly above the reporting limit of 0.5 µg/L. No other VOCs were detected in DP-6. No VOCs were detected in DP-2, DP-13, or DP-17. These results are consistent with the VOC results from the previous RI, where just three VOCs (chlorobenzene, 1,2-dichlorobenzene, and 1,4-doichlorbenzen) were detected at very low concentrations in MW-4 during a single sampling event.

4.3.3 Chloride

Chloride was detected in all four groundwater samples at concentrations ranging from 11.4 mg/L (duplicate sample from DP-13) to 225 mg/L (DP-6). The highest concentrations were found within the southern aeration pond (DP-6) and downgradient of the ponds (DP-17). These results are consistent with the chloride results from the previous RI, which indicated the more elevated concentrations of chloride are observed at well downgradient of the aeration ponds, as compared to lower concentrations of chloride observed at wells crossgradient to the aeration ponds.

5.0 CONCEPTUAL SITE MODEL & RISK EVALUATION

The Conceptual Site Model (CSM) describes the potentially complete exposure pathways through which receptors can come into contact with site-related contamination. The CSM is developed through a review of land and water use records to determine the reasonably likely current and future site uses, and review of the available information regarding the nature and extent of potential contamination and its potential for migration away from source areas to other media where exposures could occur. Based on the CSM, an evaluation of potential risks to human and ecological receptors is performed to determine if there are unacceptable risks from exposure to site-related contamination that require mitigation to protect human health or the environment. The risk evaluation was conducted in general accordance with DEQ's Risk-Based Decision Making for Petroleum Contaminated Sites (DEQ, 2003) and DEQ's Human Health Risk Assessment Guidance (DEQ, 2010).

This section defines the locality of facility based on the investigations completed to date, presents the land and beneficial water use evaluations, and provides an evaluation of the potential risks for human and ecological receptors.

5.1 LOCALITY OF FACILITY

The Locality of Facility (LOF) is defined in Oregon Administrative Rules (OAR) 340-122-0115(35) rules to be "any point where a human or ecological receptor contacts or is reasonably likely to come into contact with facility-related hazardous substances…". The LOF also takes into account the potential for contaminant migration based on physical and chemical properties that control fate and transport processes that could affect the distribution of contaminated site media. The LOF was previously defined in the RI to include the majority of Tax Lot 600 west of Rock Creek and the northern portion of Tax Lot 400. The southern margin of each tax lot fell outside the LOF based on the presence of metals concentrations consistent with background levels and no detections of SVOCs, OCIs, or PCBs from samples collected during the previous RI. There are no impacts from historical site operations anticipated for property located south of the site, and thus the residential neighborhood south of the site falls outside of the LOF.

The results of the assessment indicate the LOF should be expanded to include Tax Lot 602. The areal extent of the LOF is illustrated on Figure 4. Based on the limited detection of metals in groundwater at MW-5 (completed in the top of the basalt), the LOF only extends vertically to the top of the first layer of basalt bedrock.

5.2 LAND USE DETERMINATION

The Site (Tax Lots 600 and 602) is currently zoned for light industrial (LI) use, and is located in an area of industrially zoned land. The Site is partially fenced, but access is not controlled nor monitored. The City is considering use of the upland portion of the Site to relocate the City's public works facility out of its downtown core. This future land use would be consistent with the current and reasonably likely future zoning.

The Site is also part of the Rock Creek Unit of the Tualatin River National Wildlife Refuge, and the lower elevation portions of the Site may not be suitable for industrial development. The City envisions preserving those portions of the Site that are not suitable for development to provide open space or overlook access to the Tualatin River National Wildlife Refuge, thus protecting Rock Creek as a Goal 5 resource. This is consistent with the Site's location within the Tualatin River National Wildlife Refuge, with the City's Parks and Recreation Master Plan (City of Sherwood, 2006), and would provide improved access to this resource for residentially developed areas located south of the Site.

Based on current zoning and potential future use, the potential receptors at the Site are current trespasser, future occupational/industrial workers, future construction and excavation workers, and future recreational users. Note that future occupational/industrial workers will not use all parts of the Site equally because only a portion of the Site is anticipated to be developable. The remainder of the Site is expected to remain as open space with potential park uses.

5.3 BENEFICIAL WATER USE DETERMINATION

The objective of the beneficial water use determination (BWUD) is to provide information regarding current and reasonably likely future uses of groundwater and surface water based on information obtained from the OWRD records for supply wells and surface water rights, and to confirm that the conclusions of the BWUD provide in the previous RI are still valid.

DEQ lists general categories of water use in the Guidance for Conducting Beneficial Water Use Determinations at Environmental Cleanup Sites (DEQ, 1998). With respect to groundwater, these general categories can be described as "direct" or "indirect" uses. Direct uses of groundwater include: drinking water, irrigation, livestock, and industrial uses. Indirect uses of groundwater are considered to be uses involving discharge to surface water and include aquatic habitat, recreation, and aesthetic quality.

A search of water well logs and active water rights permits available in the on-line database maintained by the OWRD was conducted and covered an area approximately within 1 mile of the

LOF. The source of drinking water for the City of Sherwood was also verified through on-line research at the City of Sherwood's webpage. A summary of the beneficial water used identified from the desktop research is provided in the sections that follow.

5.3.1 Current Beneficial Water Uses

Current beneficial water uses within the LOF include aquatic habitat and a water right for irrigation and livestock. Beneficial water uses in the surrounding area include industry, irrigation, and livestock. Drinking water in the area is provided by City of Sherwood and originates from the Willamette River Water Treatment Plant in Wilsonville, approximately 6 miles southeast of Sherwood (City of Sherwood, 2015). Four groundwater wells are also maintained by the City of Sherwood for backup drinking water supply. These wells are located more than 0.5 miles south and upgradient of the Site.

5.3.2 Groundwater Use

No drinking water wells were identified within the LOF. An approximately 1-mile radius surrounding the LOF is captured within Township 2 S, Range 1 W, Sections 28, 29, 32, and 33. A review of well logs within these four sections identified 127 total well logs on file with the OWRD. Categories of use identified on the well logs included domestic (106 wells), irrigation (4 wells), community (5 wells), livestock (3 wells), industrial (3 wells), and dewatering (41 wells). The five community well logs include two which the City of Sherwood reports are no longer in use (Well #1 and Well #2) and two which are used as backup (Well #5 and Well #6). The two active backup community wells draw from a deep basalt aquifer that is deeper than the LOF. One log is improperly categorized as industrial, and is actually a community well (Well #3) registered to City of Sherwood in 1946 and drilled to a depth of 339 feet below ground surface (bgs). No screen information is provided, but it is likely the screened interval occurs at similar depths to the other community wells which are deeper than the LOF. All community wells are located greater than 0.5 mile south and upgradient of the LOF.

A total of 106 domestic well logs are reported within 1 mile of the LOF. The average depth of the domestic wells is 175 feet with average depth to first water at 160 feet. Most wells were drilled from the 1950's to 1970's, and 20% have been reported abandoned. The majority (84%) of wells are drilled greater than 100 feet into the deep basalt aquifer. All wells with location information are located greater than 0.4 mile from the LOF. It is possible that some of these wells are no longer in use, given the availability of potable water through the City of Sherwood. Those which are currently in use are likely producing from the deeper aquifer, which occurs below the LOF for the Site. Based on this information, shallow groundwater does not appear to be used for drinking water.

Of the three industrial wells, one has been abandoned. The two active industrial wells are registered to Tri County Gun Club and Larry Wellens & Associates Inc. The well registered to Tri County Gun Club is located approximately 1 mile southeast of the LOF, in a crossgradient position relative to the LOF, and drilled to 330 feet bgs with perforations from 290 to 330 feet bgs. The well registered to Larry Wellens & Associates Inc. is located approximately 0.4 mile northeast of the site in an inferred downgradient position relative to the LOF, but below the extent of the LOF. The well is drilled to 155 feet bgs and sealed from ground surface to 35 feet bgs. Therefore, only deep groundwater is used for industrial purposes in the 1-mile radius containing the LOF. The 41 dewatering wells are associated with construction of Sherwood Library, and were drilled in 2009. Ten have been registered as abandoned, although it is likely all 41 are abandoned. Although the irrigation and livestock wells do not have exact location, all wells are greater than 0.4 mile from the LOF based on the provided township, range, and quarter-quarter section, except for one livestock well located in the SW quarter of 2S, 1W, section 28. No other location information is provided for the livestock well, and no associated water rights were identified. The well was drilled to 104 feet with a water level of 60 feet below ground surface, and is therefore likely below the LOF.

A search of water rights within the one-mile radius identified 11 non-cancelled groundwater rights. Water rights are maintained by the OWRD. Designated uses for the groundwater permits are irrigation and municipal. The municipal water rights are for the City of Sherwood groundwater wells, of which only four are currently maintained. All four backup wells draw from a deep basalt aquifer, greater than 200 feet bgs. All irrigation water groundwater rights are located greater than 0.5 mile from the LOF.

5.3.3 Surface Water Use

Rock Creek, a tributary of Tualatin River, flows through the LOF. The City of Sherwood Stormwater System Master Plan includes plans to construct a water quality facility within the LOF to treat stormwater prior to discharge into Rock Creek (City of Sherwood, 2007). The portion of Rock Creek which runs through the LOF is also included within the acquisition area for the Tualatin Wildlife Refuge. Beneficial water use of Tualatin River and its tributaries within the greater Tualatin Wildlife Refuge is planned to remain for aquatic and wildlife purposes. The point of diversion for a surface water right issued John/Gladys Cereghino is located on Rock Creek within the LOF, for irrigation and livestock use. The place of use is identified as approximately 22.8 acres surrounding the point of diversion, most of which is within the LOF. No active or recent use of this water right has been applied, based on observations on the site and recent site history. Records for this surface water right are provided in Appendix E.

A total of 17 surface water right permits were identified through a search of permits maintained by the OWRD. Primary uses designated for the water rights are irrigation, livestock, and wildlife. It is

unclear how many water rights are actively used, since the water right only determines availability and does not represent current activities.

5.3.4 BWUD Summary

The findings of this BWUD are consistent with those identified during the previous RI. No drinking water wells are located within the LOF. There is no known use of shallow groundwater (above the first layer of basalt) for domestic purposes within 1 mile of the LOF. The closest wells to the Site are two industrial wells, both of which are completed at depths below the LOF. Shallow groundwater does discharge to wetland areas and to Rock Creek within the LOF.

There is a surface water right point of diversion for irrigation and livestock use within the LOF, but there is no evidence of recent use. Therefore, the reasonably likely future beneficial water uses in the LOF are determined to include irrigation, livestock, and to support wildlife and aquatic habitat.

5.4 HUMAN HEALTH RISK EVALUATION

A human health risk evaluation was prepared for the Site to evaluate potential health risks to current and future receptors from potential exposures to site-related contaminants within the LOF. The evaluation incorporates the land and beneficial water use information presented above in Sections 5.2 (Land Use Determination) and 5.3 (Beneficial Water Use Determination). The evaluation also incorporates the data generated on Tax Lot 602 during the investigation described above in Section 3.0 (Assessment Activities) and Section 4.0 (Assessment Results), as well as the data generated at Tax Lots 600 and 400 by DEQ between 2003 and 2007 to quantitatively assess potential health risks.

5.4.1 Exposure Pathways & Potentially Exposed Populations

The exposure pathway defines how chemicals physically enter the human body (i.e., through ingestion, dermal contact, or inhalation). An exposure pathway is considered incomplete if any of the following four elements is missing:

- A source of the chemical
- A transport medium (such as soil or groundwater)
- An exposure point (the point where human contact occurs)
- An exposure route (such as ingestion)

Potentially exposed populations were identified based on the results of the land and beneficial water use determinations and include the following receptor types:

- Current trespassers
- Future recreational users
- Future occupational workers
- Future construction workers
- Future excavation workers

Current residential receptors south of the Site are not considered a potentially exposed population because: (1) Site-related contaminants in soil are generally not mobile; (2) the results of the prior RI demonstrate that Site-related contamination does not extend to the property boundary at Oregon Street; (3) Site-related contaminants in groundwater, surface water, and sediment, if mobile, would move to the east-northeast toward Rock Creek, or north with the flow of Rock Creek, and thus would migrate away from the neighborhood area; (4) stormwater runoff generated at the Site from rainfall would remain on-Site and drain toward Rock Creek; and (5) the primary contaminants (metals) found at the Site are not volatile and thus are not expected to pose potential risks through inhalation. Future residential receptors are not reasonably likely to be present at the Site because it is zoned for industrial use.

The following paragraphs describe how each potentially exposed population (i.e. receptor) is anticipated to use the Site and which exposure pathways are potentially complete for each.

Current Trespasser/Future Recreational User

A trespasser is a current receptor that would use the Site to play or escape public sight. The Site is large and heavily vegetated and is less likely to be accessed independently by children younger than 6. A recreational user is a future receptor that would come to the Site to access the Tualatin River National Wildlife Refuge or other local trail systems. Both receptor types could include children and adults and the site-specific RBCs calculated for this receptor type includes children of all ages and adults.

A current trespasser or future recreational user are considered to use the Site at similar frequencies and durations. It is not likely that children or adults would use the site at greater than 8 hours per day because there is no current evidence of overnight use and future uses are not anticipated to include overnight activities. Local weather conditions are anticipated to limit use to 6 months of the year, primarily during late spring, summer, and early fall (approximately April to September). During this period, use would also be limited by the magnitude of other recreational and summer break opportunities available locally and regionally, and thus this receptor type is assumed to be present at the Site 18 days per year or less (approximately 3 days a month

between April and September). Additional discussion regarding this receptor is provided in Appendix F.

Trespassers and recreational users could be exposed to surface soils or sediments, but would not be exposed to subsurface soils, groundwater (no drinking water use), surface water (most use occurs during drier months and both receptor types are assumed to avoid standing water), or indoor air (outdoor uses only). Inhalation of volatilized contaminants in outdoor air is not considered a complete exposure pathway because of the infrequent and low VOC concentrations detected in groundwater at the Site.

Future Occupational/Industrial Workers

The City of Sherwood currently envisions redeveloping the upland portion of the Site for its public works facility. Future occupational/industrial workers would use the site for parking, maintenance and repairs, staging, storage, and administrative functions.

These receptors could be exposed to surface soils in unpaved areas, or to subsurface soils where shallow excavations might be necessary for utilities repair, landscaping, or installation/maintenance of other shallow infrastructure (upper 3 feet). Future occupational or industrial workers could infrequently contact groundwater during shallow excavations, but this is not considered significant because groundwater occurs at greater than 5 feet below ground surface across much of the upland portion of the Site. Inhalation of volatilized contaminants in indoor or outdoor air is not considered a complete exposure pathway because of the infrequent and low VOC concentrations detected in groundwater at the Site. This receptor will not be in contact with sediment or surface water because a future public works facility will be located on the upland portion of the Site, away from Rock Creek.

Future Construction Workers

Future construction workers will be on-Site during redevelopment to construct the new public works facility infrastructure. These receptors could be exposed to surface and subsurface soils during construction, as well as to groundwater if encountered during excavations. These receptors are assumed not to contact sediment or surface water because these media are not located where construction would occur. Inhalation of volatilized contaminants in outdoor air is not considered a complete exposure pathway because of the infrequent and low VOC concentrations detected in groundwater at the Site.

Future Excavation Workers

Future excavation workers may also be on-Site during redevelopment to construct the new public works facility infrastructure, or periodically after development is complete for maintenance or repair activities. These receptors could be exposed to surface and subsurface soils during excavation, as well as to groundwater if encountered during excavations. These receptors are assumed not to contact sediment or surface water because these media are not located where construction would occur. Inhalation of volatilized contaminants in outdoor air is not considered a complete exposure pathway because of the infrequent and low VOC concentrations detected in groundwater at the Site.

5.4.2 Selection of Exposure Units & Data Sets

Two exposure units (EUs) were defined for the Site to support characterization of risk to the receptors described above. The two exposure units are shown on Figure 4 and described below.

- Upland EU – This exposure unit consists of the western one-third of the Site, which is located primarily west of the two sedimentation lagoons. This area consists of the river terrace that overlooks the flood plain of Rock Creek, and is anticipated to be the developable portion of the Site.
- Wetland EU – This exposure unit consists of the eastern two-thirds of the Site and includes both sedimentation lagoons and the wetland areas that comprise the flood plain of Rock Creek. For the purpose of this risk evaluation, the sediments within Rock Creek are also included based on similarities between the sediment analytical results and the analytical results of soil samples collected within the Rock Creek wetland area (away from areas known to be impacted by chromium) during the previous RI.

A single groundwater exposure unit was defined for the Site because of the limited number of sample locations and because construction or excavation workers could potentially come into contact with groundwater anywhere at the Site.

All data collected from Tax Lots 602, 600, and 400 by either the City of Sherwood or DEQ were included in the data sets established for each EU. The following data sets were evaluated:

- Upland EU – 0 to 5 feet (trespasser/recreational user; occupational workers) and 0 to 15 feet (construction workers; excavation workers)
- Wetland EU – 0 to 5 feet (trespasser/recreational user; construction workers; excavation workers)
- Groundwater Exposure Unit – all results from monitoring wells and direct-push borings.

5.4.3 Selection of Screening Criteria

Appropriate screening levels for the Site receptors and exposure pathways were selected from RBCs published by DEQ (DEQ, 2015c). An EPA Regional Screening Level (RSL; EPA 2015) was selected to evaluate compounds for which DEQ does not publish an RBC. For some receptors and exposure pathways, EPA does not publish an RSL for a comparable receptor. In these instances, a review of the RSLs developed for each exposure route was conducted to determine if it was reasonable to rely on a route-specific RSL. Where a route-specific RSL was selected, a note was included in the table providing the rationale. Where a route-specific RSL was not selected, these chemicals will be discussed further in the uncertainty section.

Additionally, a site-specific RBC was developed to evaluate the current trespasser/future recreational user as described above in Section 5.4.1 (Exposure Pathways & Potentially Exposed Populations) and as discussed in more detail in Appendix F. The site-specific RBC was developed by making changes to selected exposure assumptions in DEQ's excel version of the RBC table and recalculating the RBCs for both carcinogenic and non-carcinogenic endpoints. The lowest RBC was selected for the constituents of interest for the Site for use in evaluating potential health risks.

5.4.4 Identification of COPCs & Risk Screening

The quantitative evaluation of health risks focuses on metals in soil and groundwater. Other compounds detected in soil, sediment, or groundwater were not identified as COPCs for the following reasons:

- VOCs – Three VOCs were detected in one monitoring well (MW-4) and one VOC was detected in one direct-push boring (DP-6).
  - Chlorobenzene was detected at 9.8 µg/L (MW-4), which is well below the RBC for groundwater in an excavation of 10,000 µg/L. The detected concentration is also well below its solubility limit indicating this chemical is not contributing to potential health risks through volatilization.
  - 1,2-Dichlorobenze was detected at 0.57 µg/L (DP-6) and 4.2 µg/L (MW-4), and is well below the RBC for groundwater in an excavation of 37,000 µg/L. The detected concentration is also well below its solubility limit indicating this chemical is not contributing to potential health risks through volatilization.
  - 1,4-Dichlorobenzene was detected at 1.9 µg/L (MW-4), which is well below the RBC for groundwater in an excavation of 1,500 µg/L. The detected concentration of 1,4-dichlorobezne is also below its groundwater RBC for occupational receptors for

volatilization to outdoor air (21,000 µg/L) and for vapor intrusion to indoor air (7,100 µg/L).

- SVOCs – One SVOC, phenol, was detected once in soil at a concentration of 0.078 mg/kg. DEQ does not publish an RBC for this analyte, but the detected concentration is well below the EPA Industrial Soil RSL of 2.5×10^5 mg/kg. SVOCs were not detected in groundwater (except for the detection of 1,2-dichlorbenzene described under VOCs) sediment or surface water.
- OCIs – One potentially site-related OCI (chlordane) was detected in one soil sample, and one potentially site-related OCI (lindane) was detected in one monitoring well (MW-4). Chlordane was detected at a concentration of 0.0028 mg/kg in a soil sample from the Rock Creek wetland area (HA-40), which is well below the recreational user / trespasser RBC of 12 mg/kg. Lindane was detected at a concentration of 0.13 µg/L, which is well below the groundwater in an excavation RBC of 100 µg/L. The only other OCIs detected were DDx compounds found in wetland soil and sediment. These compounds are not considered to be site-related because there is no record of their use at the Site as part of historical industrial activities, they were not detected in upland soil samples, and are likely representative of regional background levels in the area (GeoEngineers, 2004).
- PCBs – PCBs were not detected in soil, sediment, groundwater, or surface water.

The identification of COPCs from the metals analytical results was conducted by comparing the detected concentrations of each metal in each sample to the each applicable RBC (or RSL). All data in each EU (independent of depth) were conservatively included in the risk screening to ensure all potential COPCs were identified for further evaluation. The results of the screening step are shown on Tables 4A, 4B, 4C, and 4D and illustrated on Figures 6A, 6B, 6C, and 6D. A summary of the screening results for each EU is provided below.

Upland Exposure Unit

Four metals were detected at concentrations that exceeded one or more of the applicable RBCs for recreational users/trespassers, occupational workers, construction workers, and excavation workers:

1. Arsenic – Arsenic exceeded its RBC in just one sample (TP-5-5) at a concentration of 24 mg/kg.
2. Copper – Copper exceeded its RBC in just one sample (DP-15-4-5) at a concentration of 56,000 mg/kg.
3. Lead – Lead exceeded its RBC in two samples (TP-5-1 and DP-15-4-5) at concentrations of 760 mg/kg and 1,420 mg/kg, respectively.

4. Hexavalent chromium – Hexavalent chromium exceeded its RBC in just one sample (DP-17-0-1) at a concentration of 6.43 mg/kg.

Each of these samples is located within the footprint of the hide-split landfill.

Wetland Exposure Unit

One metal (arsenic) was detected at concentrations that exceed one or more of the applicable RBCs for recreational users/trespassers, construction workers, and excavation workers. Arsenic was detected in two samples (HA-46-0.5 and SS-6) at concentrations of 11 mg/kg in each sample. All other detections of arsenic in the wetland exposure unit are consistent with background levels of arsenic at concentrations less than 8.8 mg/kg (DEQ, 2013).

Groundwater Exposure Unit

No concentrations of total or dissolved metals in groundwater exceed the applicable RBCs for groundwater in an excavation. No further quantitative evaluation of groundwater is warranted.

5.4.5 Development of Exposure Point Concentrations

The exposure point concentration (EPC) is the concentration of a particular contaminant in a particular medium at the point of contact by a receptor. DEQ rules require that an upper estimate of the EPC be used in human health risk assessments, and specifies the 90% upper confidence limit (UCL) of the arithmetic mean to be an appropriate upper estimate representative of the reasonable maximum exposure. This approach is considered appropriate for most human receptors because they typically move across the entire site, rather than working exclusively in one single location. The exception to this is the excavation worker where the exposure is more likely to occur in a single excavation over a relatively short duration, and thus using a maximum concentration is considered more representative of the potential EPC.

ProUCL (version 5.0) was used to calculate EPCs following a 2-step process. In the first step, the 95% UCL was calculated to allow ProUCL to identify the distribution of each data set and recommend the appropriate statistical method to calculate the UCL. In the second step, the 90% confidence level was specified to calculate UCLs. The UCLs used as the EPCs are those generated at the 90% confidence level using the statistical method recommended by ProUCL at the 95% confidence level. In some cases, a UCL with a higher confidence level (95%, 97.5%, or 99%) is selected as the EPC if ProUCL makes this recommendation based on the distribution of the data. In cases where ProUCL calculates an EPC that is greater than the maximum detected concentrations, or in cases where there are too few detections to calculate a UCL, the maximum detected concentration can be used in the risk assessment.

The data sets that were used in the calculation of EPCs for each EU are described below.

- Upland EU – Surface Soil (0 to 5 feet) – All samples collected from the upper 5 feet of soil are included and will be used to evaluate current trespassers, future recreational users, future occupational workers, future construction workers, and future excavation workers.
- Upland EU – Subsurface Soil (0 to 15 feet) – All soil samples collected between 0 and 15 feet are included and will be used to evaluate current trespassers, future recreational users, future construction workers, and future excavation workers.
- Wetland EU – Surface Soil (0 to 5 feet) – All samples collected from the upper 5 feet of soil are included and will be used to evaluate current trespassers, future recreational users, future construction workers, and future excavation workers.

The analytical results were used in the calculation of EPCs as described below.

- Results rejected during data quality review were excluded.
- Results qualified with a "J" (estimated value) or "N" (presumptively identified) were included.
- Results qualified with a "U" (not detected) were included as non-detect values.
- Duplicate results were handled as follows:
  - If both results were detections, the higher of the two values is used.
  - If both results were non-detections, the lower of the two reporting limits is used.
  - If one result was non-detect, then the detected value was used.

A statistical summary and the EPCs for each exposure unit and data set are presented in Table 4. ProUCL output for each data set and each EU are provided in Appendix G.

5.4.6 Evaluation of Human Health Risks

The estimate of the potential health risk based on the reasonable maximum exposure was prepared for each exposure unit. The paragraphs that follow summarize the conclusions provided for each EU and data set.

Upland EU - Surface Soil (0 to 5 feet)

Risk calculations are provided in Tables 6A through 6E. An unacceptable hazard index of 1.9 was identified for the future excavation worker exposed to lead in surface soil in the Upland EU. The acceptable hazard index is 1.0. It is important to recognize that the level of hazard predicted for a future excavation worker is based on the following assumptions: (1) the EPC is equal to the maximum detected concentration, and (2) the excavation will occur at the one location at the Site

where the maximum concentration is located or that all potential excavation locations will have the maximum detected concentration of lead present. The maximum concentration is located within the footprint of the hide-split landfill, as are all the lead concentrations that exceed the naturally occurring background levels. Lead concentrations in soil outside of the footprint of the hide-split landfill are consistent with naturally occurring levels of lead in the Portland Basin.

An unacceptable risk of 3×10^{-6} was identified for the future occupational worker exposed to arsenic in surface soil in the Upland EU. The acceptable individual risk level is 1×10^{-6}. No unacceptable risk was identified at the cumulative risk level of 1×10^{-5}. It is important to recognize that the level of risk predicted for a future occupational worker is based on an EPC of 5.26 mg/kg, which is consistent with the naturally occurring background level of arsenic in Portland Basin soils of 8.8 mg/kg. It should also be noted that arsenic was detected in only one (TP-5-5) of 78 upland soil samples at a concentration greater than its naturally occurring background level. As with the lead results, the arsenic concentrations for all soil samples outside the hide-split landfill are consistent with naturally occurring background levels.

No unacceptable risk or hazard was identified for the recreational user/trespasser or future construction worker.

Upland EU – Subsurface Soil (0 to 15 feet)

Risk calculations for subsurface soils (0 to 15 feet) in the Upland EU are provided in Tables 7A through 7D. An unacceptable hazard index of 1.9 was identified for the future excavation worker exposed to lead in subsurface soil in the Upland EU. The acceptable hazard index is 1.0. It is important to recognize that the level of hazard predicted for a future excavation worker from exposure to subsurface soil is the same as that predicted for surface soil. This is because: (1) the maximum detected concentration of lead is found in both data sets, (2) the EPC is equal to the maximum detected concentration, and (3) using the maximum detected concentration assumes that the excavation will occur at the one location at the Site where the maximum concentration is located or that all potential excavation locations will have the maximum detected concentration of lead present. The maximum concentration is located within the footprint of the hide-split landfill, as are all the lead concentrations that exceed the naturally occurring background levels. Lead concentrations in soil outside of the footprint of the hide-split landfill are consistent with naturally occurring levels of lead in the Portland Basin.

No unacceptable risk or hazard was identified for the recreational user/trespasser or future construction worker.

Wetland EU

Risk calculations are provided on Table 8. No unacceptable risk was identified for receptors exposed to arsenic in soil or sediment.

5.4.7 Uncertainty Analysis

Risk assessment uses multiple sources of information and evaluation methods. Even when the actual chemical intake for an exposed individual may be measured relatively accurately, assumptions are still required to evaluate the associated potential risk. The use of professional judgment, inferences based on analogy, the use of default values, model estimation techniques, and other assumptions result in uncertainty of varying degrees. The risk assessment process and the uncertainties incorporated in that process are generally constructed such that risk estimates tend towards overestimation of the overall risk. Elements of the risk assessment process contributing to uncertainty in the findings are discussed below.

A conservative screening process was employed to identify COPCs. The process identified COPCs based on a sample-by-sample evaluation of potential risks. When considering all the data that was evaluated, it is clear the potential health risks from exposure to metals in Upland EU soils are controlled by one or two elevated detections of a particular metal. In each case, the samples with the highest concentration are located within the footprint of the hide-split landfill. In contrast, samples collected from areas outside the hide-split landfill in the Upland EU have metals concentrations that are indicative of naturally occurring background levels. Thus it is reasonable to conclude that the greatest potential for exposures to site-related chemicals in Upland EU soils occurs within the footprint of the hide-split landfill, and that areas outside the footprint of the hide-split landfill do not contribute to predicted health risks.

For two metals (antimony and zinc), neither DEQ nor EPA publish risk-based screening criteria that are appropriate for use to evaluate the recreational user/trespasser, construction worker, or excavation worker. Review of the data presented for the Upland EU and Wetland EU in Tables 4A and 4B indicates that the highest concentrations of these two metals are co-located with higher concentrations of chromium from samples that are within areas of known site-related impacts (the hide-split landfill and the two sedimentation lagoons). Thus, potential health risks from exposure to these two metals would likely be greatest in these areas. For antimony, most detected concentrations are elevated above the naturally occurring background level of 0.56 mg/kg, but in locations away from areas of impact, concentrations are typically less than 3 mg/kg. For zinc, detected concentrations are all below its naturally occurring background level of 180 mg/kg, except for one sample (DP-15-4-5) located within the hide-split landfill (where the maximum detected concentrations of chromium, copper, and lead were also found) and in one sample (HA-42) located

in the northern sedimentation lagoon (where antimony, chromium, and manganese results are also elevated).

5.4.8 Human Health Risk Evaluation Summary

The human health risk evaluation assessed potential health risks to current trespassers, future recreational users, future occupational workers, future construction workers, and future excavation workers from site-related COPCs. Current residential receptors were not evaluated because the extent of Site-related contamination does not extend off-site to the south. Future residential receptors were not evaluated because the Site is industrially zoned and does not allow for residential use.

The data sets used to evaluate potential health risks included data from the previous RI and the data from this assessment. An evaluation of potential health risks was conducted for three EUs based on anticipated receptors use: (1) Upland EU soils (all receptors), (2) Wetland EU soils (all receptors except occupational workers, and (3) Groundwater EU, Site-wide, (construction worker and excavation worker only). Of the constituents analyzed at the Site during both investigations, only metals were identified as potential COPCs. The specific metals identified for further quantitative evaluation in each EU were:

- Upland EU soils – Arsenic, copper, lead, and hexavalent chromium. Concentrations of other constituents were less than their respective RBCs.
- Wetland EU soils – Arsenic. Concentrations of other constituents were less than their respective RBCs.
- Groundwater EU (site-wide) – None. No constituents exceeded their respective RBCs.

Of the constituents evaluated, unacceptable health risks were identified for only for two constituents: (1) arsenic and (2) lead. The effected receptors include the occupational worker exposed to arsenic in the upper 5 feet of soil in the Upland EU, and the excavation worker exposed to lead in the upper 5 feet of soil, and down to 15 feet, in the Upland EU. In both cases, the predicted health risks are driven by a single elevated detection of arsenic or lead that is found within the footprint of the hide-split landfill. No unacceptable health risks were identified for copper or hexavalent chromium.

5.5 ECOLOGICAL RISK EVALUATION

An ERA was prepared for Tax Lots 400 and 600 in 2004 as part of the previous RI. It concluded that:

- There was no unacceptable risk to ecological receptors identified for CPECs in Rock Creek surface water (antimony, cadmium, total chromium, hexavalent chromium, copper, lead, manganese, mercury, and zinc).
- The unacceptable risks to ecological receptors (based on an evaluation of the American Robin as a representative specie using all site habitat types) in soil (or sediment) are mostly limited to the chromium management area defined as part of the Streamlined Level III ERA. The chromium management area includes isolated areas of the northern sedimentation lagoon, the majority of the southern sedimentation lagoon, wetland areas downstream of the breaches in each lagoon, and all of the hide-split landfill area based on the presumption that elevated chromium concentrations would be widespread in the area where hide-splits were known to be present. There are some areas outside of the chromium management area where there is also the potential for unacceptable risks from manganese and mercury, but these areas are not extensive.

An update to the ERA was not required for this assessment for the following reasons:

- No ecological habitat is anticipated to exist in upland areas of the Site following redevelopment by the City, and thus no evaluation of ecological risks of upland areas of the Site is needed.
- No new data were generated in wetland areas during the assessment that would require an updated evaluation of potential ecological risks.
- There has been no change to types of ecological habitat present at the Site since the RI was completed.
- The assumptions and approach used to evaluate potential ecological risks to the American Robin and identify the chromium management area are still considered valid and reflect a conservative and protective estimate of the area where there is unacceptable risk to ecological receptors. Thus, there are no changes to the conclusions presented in the ERA.

6.0 CONCLUSIONS & NEXT STEPS

The assessment of Tax Lot 602 was completed in November 2015. The previous RI of Tax Lot 600 and 400 was completed in 2003 and 2004, with a limited amount of additional groundwater sampling conducted by DEQ between 2005 and 2007. The investigations completed to date have defined the nature and extent of potential impacts in soil, groundwater, sediment, and surface water from historical operations that treated and disposed of tannery wastes on Site. The following conclusions can be drawn from the results of these investigations:

1. The data gap on Tax Lot 602 was filled through completion of the assessment conducted in November 2015.
2. The extent of the hide-split landfill has been defined (Figure 4).
3. The results from the November 2015 assessment are consistent with the results of the previous RI and define the nature and extent of Site-related impacts.
4. The areas of impact associated with Site-related activities are defined to be within the following historical Site features: (a) the footprint of the hide-split landfill, (b) within the two aeration ponds, (c) within the two sedimentation lagoons, (d) downgradient of the breaches in the berms of each sediment lagoon, and (e) in one small segment of Rock Creek downgradient of the breach in the north sedimentation lagoon.
5. Potential health risks were identified in the Upland EU for the occupational receptor from exposure to arsenic in soil and for the excavation worker from exposure to lead in soil. However, the calculated health risks are likely overestimated as summarized below.
    a. Arsenic – The exposure point concentration evaluated is less than the naturally occurring background level for arsenic. All arsenic concentrations in the Upland EU are consistent with naturally occurring background levels, except one sample within the footprint of the hide-split landfill.
    b. Lead – The health risks are overestimated because they are based on the maximum detected concentration (as required for the evaluation of an excavation worker with the potential for a very focused exposure). All lead concentrations in the Upland EU are consistent with naturally occurring background levels, except for two samples within the footprint of the hide-split landfill.

    No unacceptable health risks were identified for other metals in soil, including hexavalent chromium.
6. The occupational worker and excavation worker receptors are not currently present at the Site, and future redevelopment would incorporate cleanup actions to mitigate the areas of soil impact contributing to human health risks.
7. No unacceptable risks were identified for human receptors exposed to metals in soil or sediment in the Wetland EU.
8. No unacceptable risks were identified for human receptors exposed to metals in groundwater through direct contact. Shallow groundwater is not used for drinking water within the LOF.
9. No unacceptable risks were identified for VOCs, SVOCs, OCIs, or PCBs in any other media at the Site.

10. There are unacceptable risks to ecological receptors in soil (or sediment) from within the chromium management area defined during the previous RI. This conclusion is based on an evaluation of the American Robin as a representative specie using all habitat types present at the site, through the bioaccumulation pathway (consumption of worms in direct contact with soil/sediment). The metals contributing to the unacceptable risk include antimony, lead, chromium, manganese, and mercury. There are some areas outside of the chromium management area where there is also the potential for unacceptable risks from manganese and mercury, but these areas are not extensive.

Based on the assessments performed to date, the investigation of Site-related impacts is complete and the potential risks to human health and ecological receptors have been identified and characterized. The results of the assessments will be used to prepare an Analysis of Brownfields Cleanup Alternatives (ABCA) for the Site. The ABCA will incorporate, where applicable, the Feasibility Study prepared by GeoEngineers, on behalf of DEQ in 2004 and will incorporate the City's conceptual redevelopment plans for the Site.

We appreciate the opportunity to be of service to City of Sherwood on this project. If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

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MLP/lp/ay

REFERENCES

Amec Foster Wheeler, 2015. Quality Assurance Project Plan & Sampling and Analysis Plan, prepare for the City of Sherwood. September 4, 2015.

City of Sherwood, 2006. Parks and Recreation Master Plan, prepared by GreenPlay LLC, October 17, 2006.

City of Sherwood, 2007. Stormwater System Master Plan, prepared by Murray, Smith & Associates, Inc. and Financial Consulting Solutions Group, Inc., June 2007.

City of Sherwood, 2015. Draft Water System Master Plan Update, prepared by Murray, Smith & Associates Inc., February 2015.

City of Sherwood Code of Ordinances, Title 16, Division IX, Chapter 16.162

GeoEngineers, 2004. Remedial Investigation Report, DEQ Frontier Leather Site, Sherwood, Oregon, prepared for the Oregon Department of Environmental Quality. June 22, 2004.

Oregon Department of Environmental Quality (DEQ), 1998. Guidance for Conducting Beneficial Water Use Determinations at Environmental Cleanup Sites, Waste Management and Cleanup Division, July 1, 1998.

DEQ, 2003. Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites, September 2003.

DEQ, 2010. Human Health Risk Assessment Guidance, prepared by the DEQ Environmental Cleanup Program. October 2010.

DEQ, 2013. Development of Oregon Background Metals Concentrations in Soil Technical Report, Land Quality Division Cleanup Program, March 2013.

DEQ, 2015a. Staff Report – Draft, Recommended Remedial Action for Ken Foster Farm Site, Sherwood, Oregon, prepared by the DEQ Northwest Region Office. July 2015.

DEQ, 2015b. Groundwater and surface water data collected by DEQ from the Former Frontier Leather Tannery property between 2005 and 2007, data provided to Amec Foster Wheeler via e-mail by Mark Pugh on July 13, 2015.

DEQ, 2015c. Risk-Based Criteria Table. Updated November 1, 2015.

Oregon Department of Geology and Mineral Industries (DOGAMI), 2012. Lidar-Based Surficial Geologic Map and Database of the Greater Portland Area, Clackamas, Columbia, Marion, Multnomah, Washington, and Yamhill Counties, Oregon, and Clark County, Washington. Open-File Report O-12-02.

Unites States Environmental Protection Agency (EPA), 2015. Regional Screening Level Summary Table, November 2015.

LIMITATIONS

This report was prepared exclusively for the City of Sherwood by Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in Amec Foster Wheeler services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This Supplemental Remedial Investigation Report is intended to be used by the City of Sherwood for the Site only, subject to the terms and conditions of its contract with Amec Foster Wheeler. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

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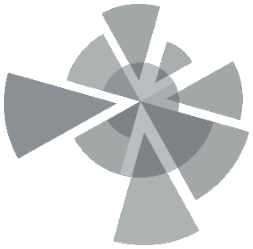

TABLES

TABLE 1A
SOIL ANALYTICAL RESULTS - TOTAL METALS
(EPA Methods 200.8, 6020, 7199)
Former Frontier Leather Property

Location ID	Sample Date	Sample ID	Start Depth (feet)	End Depth (feet)	Antimony	Arsenic	Cadmium	Chromium	Chromium (VI)	Copper	Lead	Manganese	Mercury	Nickel	Zinc
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Background Value [1]					0.56	8.8	0.63	76	--	34	79	1,800	0.23	47	180
DP-01	11/10/15	DP-01-0-1	0	1	1.33 U	**4.05**	**0.306**	**456 J**	NT	**18.6**	**9.82**	**674**	0.107 U	**22.2**	**61.1**
DP-01	11/10/15	DP-01-3.5-4.5	3.5	5	1.35 U	**3.17**	0.270 U	**16.4**	NT	**17.9**	**5.58**	**875**	0.108 U	**21.3**	**50.8**
DP-02	11/10/15	DP-2-0-1	0	1	1.38 U	**6.22**	0.276 U	**31.6**	**1.36**	**13.7**	**8.39**	**1,480**	0.111 U	**14.9**	**54.9**
DP-02	11/10/15	DP-2-3.5-4.5	3.5	5	1.20 U	**4.01**	**0.287**	**18.3**	**0.266**	**18.3**	**5.30**	**860**	0.0957 U	**23.3**	**49.6**
DP-02	11/10/15	DP-2-8-9	8	9	1.29 U	**2.89**	0.258 U	**31.3**	NT	**17.7**	**5.93**	**282**	0.103 U	**15.8**	**52.8**
DP-03	11/10/15	DP-03-0-1	0	1	1.45 U	**2.16**	**0.405**	**31.3**	NT	**16.9**	**9.24**	**742**	0.116 U	**14.1**	**58.9**
DP-03	11/10/15	DP-03-3.5-4.5	3.5	5	2.64 U	**4.46**	**0.290**	**19.7**	NT	**19.8**	**4.84**	**1,530**	0.106 U	**24.7**	**55.1**
DP-04	11/10/15	DP-04-0-1	0	1	1.32 U	**4.37**	**0.304**	**599**	NT	**19.9**	**11.3**	**719**	0.106 U	**23.2**	**64.8**
DP-04	11/10/15	DP-04-3.5-4.5	3.5	5	1.41 U	**4.21**	**0.296**	**580**	NT	**21.1**	**14.2**	**905**	**0.137**	**22.9**	**66.8**
DP-05	11/11/15	DP-05-0-1.5	0	2	2.56 U	**4.60**	0.256 U	**203**	NT	**23.1**	**8.10**	**734**	**0.427**	**17.7**	**62.0**
DP-05	11/11/15	DP-05-3.5-4.5	3.5	5	2.80 U	**1.96**	0.280 U	**22.0**	NT	**18.9**	**5.85**	**523**	0.112 U	**15.6**	**56.6**
DP-06	11/10/15	DP-06-5-6	5	6	2.74 U	**2.56**	0.274 U	**19.1**	**0.0620 J**	**17.1**	**5.29**	**523**	0.110 U	**13.9**	**44.6**
DP-06	11/10/15	DP-06-5-6-DUP	5	6	2.70 U	**2.70**	0.270 U	**22.7**	**0.247 J**	**17.4**	**5.49**	**616**	0.108 U	**13.9**	**48.2**
DP-06	11/10/15	DP-06-0-1	0	1	3.36 U	**4.38**	0.336 U	**989**	**0.212**	**24.4**	**14.2**	**465**	**0.646**	**17.9**	**79.0**
DP-06	11/10/15	DP-06-12-13	12	13	1.31 U	**1.67**	0.263 U	**32.5**	**0.284**	**15.9**	**7.60**	**955**	**0.164**	**6.19**	**87.1**
DP-07	11/10/15	DP-07-0-1	0	1	2.68 U	**5.57**	0.268 U	**46.2 J**	NT	**17.7**	**5.35**	**1,010**	**0.137**	**25.6**	**52.0**
DP-07	11/10/15	DP-07-3.5-4.5	3.5	5	2.62 U	**3.72**	0.262 U	**22.0**	NT	**20.8**	**6.66**	**588**	0.105 U	**18.0**	**58.3**
DP-08	11/10/15	DP-08-0-1	0	1	2.83 U	**3.65**	0.283 U	**60.6**	NT	**22.4**	**8.87**	**539**	0.113 U	**18.2**	**60.6**
DP-08	11/10/15	DP-08-3.5-4.5	3.5	5	2.80 U	**5.88**	0.280 U	**301**	NT	**18.0**	**9.98**	**1,580**	0.112 U	**15.6**	**61.6**
DP-09	11/11/15	DP-9-0-1	0	1	1.24 U	**4.83**	**0.358**	**26.1**	NT	**19.1**	**10.1**	**1,030**	0.0989 U	**19.7**	**78.9**
DP-09	11/11/15	DP-9-3.5-4.5	3.5	5	1.16 U	**1.30**	0.232 U	**13.7**	NT	**13.7**	**3.22**	**592**	0.0926 U	**14.4**	**40.1**
DP-10	11/11/15	DP-10-0-1	0	1	1.19 U	**3.89**	**0.263**	**23.0**	NT	**22.2**	**6.29**	**2,410**	0.0955 U	**17.7**	**53.0**
DP-10	11/11/15	DP-10-3.5-4.5	3.5	5	1.31 U	**3.74**	**0.289**	**24.0**	NT	**12.7**	**15.5**	**1,190**	0.105 U	**14.8**	**97.5**
DP-11	11/11/15	DP-11-0-1	0	1	1.23 U	**4.80**	0.246 U	**60.1**	NT	**17.1**	**24.8**	**696**	**0.888**	**14.4**	**77.5**
DP-11	11/11/15	DP-11-3.5-4.5	3.5	5	1.16 U	**4.24 J**	**0.284**	**32.2**	NT	**15.8 J**	**7.38**	**546 J**	0.103 U	**17.6 J**	**59.4**
DP-11	11/11/15	DP-11-3.5-4.5 DUP	3.5	5	1.16 U	**6.64 J**	**0.289**	**33.3**	NT	**26.1 J**	**8.98**	**904 J**	0.0925 U	**24.0 J**	**71.9**
DP-12	11/11/15	DP-12-0-1	0	1	1.26 U	**5.26**	**0.289**	**25.1**	NT	**25.3**	**8.37**	**809**	0.101 U	**26.2**	**69.6**
DP-12	11/11/15	DP-12-3.5-4.5	3.5	5	1.31 U	**4.27**	**0.353**	**29.8**	NT	**29.3**	**6.69**	**820**	0.105 U	**26.2**	**60.7**
DP-13	11/11/15	DP-13-0-1	0	1	2.51 U	**3.84**	**0.264**	**27.7**	**0.213**	**17.4**	**14.3**	**724**	0.100 U	**13.1**	**71.5**
DP-13	11/11/15	DP-13-3-5	3	5	1.38 U	**4.85**	**0.331**	**22.0**	**0.342**	**23.5**	**7.51**	**883**	0.110 U	**25.5**	**65.4**
DP-13	11/11/15	DP-13-3-5-DUP	3	5	1.33 U	**3.91**	**0.306**	**20.1**	NT	**24.6**	**6.99**	**950 J**	0.106 U	**26.5**	**59.8**
DP-13	11/11/15	DP-13-8-9	8	9	1.29 U	**2.83**	0.259 U	**19.2**	NT	**17.0**	**5.55**	**612**	0.104 U	**17.1**	**49.1**
DP-14	11/11/15	DP-14-0-1	0	1	2.58 U	**4.24**	**0.258**	**354**	NT	**22.1**	**15.8**	**924**	0.103 U	**20.5**	**80.4**
DP-14	11/11/15	DP-14-3.5-4.5	3.5	5	2.61 U	**4.03**	0.261 U	**20.6**	NT	**21.3**	**6.18**	**679**	0.104 U	**24.8**	**57.2**
DP-15	11/11/15	DP-15-0-1	0	1	1.21 U	**5.56**	**0.363**	**310**	NT	**17.3**	**11.9**	**1,030**	0.0968 U	**16.1**	**63.2**
DP-15	11/11/15	DP-15-4-5	4.0	5	**2.92**	**5.36**	**6.77**	**32,300**	NT	**56,000**	**1,420**	**1,190**	**0.527**	**68.1**	**6,800**
DP-16	11/10/15	DP-16-0-1	0	1	1.12 UJ	**3.86**	**0.348**	**1,550**	NT	**20.5**	**9.76**	**674**	**0.144**	**22.7**	**67.4**
DP-16	11/10/15	DP-16-3.5-4.5	3.5	5	1.39 U	**6.95**	0.279 U	**60.2**	NT	**14.5**	**8.55**	**1,280**	0.111 U	**16.6**	**57.8**
DP-17	11/10/15	DP-17-0-1	0	1	1.27 U	**4.80**	**0.369**	**181**	**6.43**	**20.9**	**15.2**	**759**	**1.52**	**21.1**	**71.5**
DP-17	11/10/15	DP-17-3.5-4.5	3.5	5	1.28 U	**4.95**	**0.384**	**44.9**	**2.26**	**19.4**	**8.76**	**827**	0.102 U	**25.2**	**71.2**
DP-17	11/10/15	DP-17-8-9	8	9	1.41 U	**5.91**	0.283 U	**16.4**	NT	**18.3**	**7.96**	**1,010**	0.113 U	**18.1**	**55.8**
DP-18	11/11/15	DP-18-0-1	0	1	2.20 U	**1.54**	0.220 U	**51.7**	NT	**19.6**	**5.17**	**525**	**0.100**	**9.58**	**47.6**
DP-18	11/11/15	DP-18-3.5-4.5	3.5	5	2.63 U	**4.09**	0.263 U	**43.9**	NT	**23.6**	**6.60**	**739**	0.105 U	**22.6**	**56.2**
DP-19	11/10/15	DP-19-0-1	0	1	1.33 U	**5.32**	**0.346**	**45.2**	NT	**18.8**	**9.78**	**883**	0.106 U	**21.2**	**71.7**
DP-19	11/10/15	DP-19-3.5-4.5	3.5	5	1.22 U	**6.71**	**0.317**	**42.8**	NT	**15.4**	**8.36**	**1,050**	0.0975 U	**20.2**	**88.3**
DP-20	11/10/15	DP-20-0-1	0	1	1.18 U	**3.92**	**0.272**	**24.9**	NT	**19.3**	**8.27**	**1,060**	**0.0981**	**19.5**	**58.6**
DP-20	11/10/15	DP-20-3.5-4.5	3.5	5	1.24 U	**4.17**	**0.347**	**24.3**	NT	**18.1**	**6.32**	**791**	0.0992 U	**21.1**	**57.3**

Notes:

Data reported to method reporting limit
BOLD = detection
DUP = Field Duplicate
mg/kg = milligrams per kilogram
shaded Exceeds background value

-- = Not Published
J = estimated result
U = not detected at or above the stated level
EPA = United States Environmental Protection Agency
NT = Not tested

Chemical analytical testing performed by Apex Laboratories, LLC in Tigard, OR and Brooks Applied Labs in Bothell, WA.
Amec Foster Wheeler completed a data quality review and qualifiers added during the review are included in this table.
[1] Development of Oregon Background Metals Concentrations in Soil, Oregon Department of Environmental Quality (DEQ) Technical Report, Table 4 - Portland Basin, DEQ 2013.

TABLE 1B
SOIL ANALYTICAL RESULTS - TOTAL PETROLEUM HYDROCARBONS
(NWTPH-HCID)
Former Frontier Leather Tannery Property

Location ID	Sample Date	Sample ID	Start Depth (feet)	End Depth (feet)	Diesel Range Hydrocarbons	Gasoline Range Hydrocarbon	Residual Range Hydrocarbon
					mg/kg	mg/kg	mg/kg
DP-03	11/10/15	DP-03-0-1	0	1	63.3 U	25.3 U	127 U
DP-03	11/10/15	DP-03-3.5-4.5	3.5	5	62.5 U	25.0 U	125 U
DP-03	11/11/15	DP-3-9-10	9	10	60.5 U	24.2 U	121 U
DP-03	11/11/15	DP-3-14.5-15	15	15	64.6 U	25.8 U	129 U

Notes:
Data reported to method reporting limit
BOLD = detection
DUP = Field Duplicate
mg/kg = milligrams per kilogram
U = not detected at or above the stated level
EPA = United States Environmental Protection Agency

Chemical analytical testing performed by Apex Laboratories, LLC in Tigard, OR.
Amec Foster Wheeler completed a data quality review
and qualifiers added during the review are included in this table.

TABLE 2A
GROUNDWATER ANALYTICAL RESULTS - TOTAL METALS
(EPA Method 6020A)
Former Frontier Leather Tannery Property

Location ID	Sample Date	Sample ID	Start Depth (feet)	End Depth (feet)	Antimony µg/L	Arsenic µg/L	Cadmium µg/L	Chromium µg/L	Copper µg/L	Lead µg/L	Manganese µg/L	Mercury µg/L	Nickel µg/L	Zinc µg/L
Background Value [1]					< 1	2	< 1	1	9	13	--	< 0.1	6	38
DP-02	11/10/15	DP-2-GW	10	15	2.00 U	**9.56**	**0.411**	**53.9**	**30.3**	**10.3**	**735**	0.0800 U	**28.0**	**68.1**
DP-06	11/10/15	DP-6-GW	7	12	2.00 U	**7.73**	**0.300**	**32.1**	**10.0**	**2.73**	**1,690**	0.0800 U	**6.39**	**23.3**
DP-13	11/11/15	DP-13-GW	15	20	2.00 U	**1.40 J**	**0.211 J**	**9.36 J**	**10.2 J**	**4.70 J**	**521 J**	0.0800 U	**10.1 J**	**25.4**
DP-13	11/11/15	DP-13-W-DUP	15	20	1.00 U	**3.09 J**	**0.867 J**	**31.1 J**	**61.3 J**	**9.23 J**	**3,780 J**	0.0800 U	**55.5 J**	**146**
DP-17	11/10/15	DP-17-GW	10	15	10.0 UJ	**24.1 J**	**2.74**	**931**	**448**	**108**	**4,350**	0.800 U	**211 J**	**511**

Notes:
Data reported to method reporting limit
BOLD = detection
DUP = Field Duplicate
µg/L = micrograms per liter
J = estimated result
U = not detected at or above the stated level
R = rejected
EPA = United States Environmental Protection Agency
shaded Exceeds background value

Chemical analytical testing performed by Apex Laboratories, LLC in Tigard, OR.

TABLE 2B
GROUNDWATER ANALYTICAL RESULTS - DISSOLVED METALS
(EPA Method 6020)
Former Frontier Leather Tannery Property

Location ID	Sample Date	Sample ID	Start Depth (feet)	End Depth (feet)	Antimony µg/L	Arsenic µg/L	Cadmium µg/L	Chromium µg/L	Copper µg/L	Lead µg/L	Manganese µg/L	Mercury µg/L	Nickel µg/L	Zinc µg/L
Background Value [1]					< 1	2	< 1	1	9	13	--	< 0.1	6	38
DP-02	11/10/15	DP-2-GW	10	15	1.00 U	1.00 U	0.200 U	**29.4**	**2.90**	0.200 U	**106**	0.0800 U	**12.2**	4.00 U
DP-06	11/10/15	DP-6-GW	7	12	1.00 U	**7.54**	0.200 U	**7.13**	2.00 U	0.200 U	**918**	0.0800 U	**3.51**	4.00 U
DP-13	11/11/15	DP-13-GW	15	20	1.00 U	1.00 U	0.200 U	**3.64**	2.00 UJ	0.200 UJ	**10.3**	0.0800 U	1.00 U	4.00 U
DP-13	11/11/15	DP-13-W-DUP	15	20	1.00 U	1.00 U	0.200 U	**3.97**	**17.2 J**	**0.400 J**	**11.2**	0.0800 U	1.00 U	4.00 U
DP-17	11/10/15	DP-17-GW	10	15	1.00 U	1.00 U	0.200 U	**11.5**	2.00 U	0.200 U	**530**	0.0800 U	**21.1**	4.00 U

Notes:
Data reported to method reporting limit
BOLD = detection
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µg/L = micrograms per liter
J = estimated result
U = not detected at or above the stated level
EPA = United States Environmental Protection Agency
shaded Exceeds background value

Chemical analytical testing performed by APEX Laboratories, LLC in Tigard, OR.
AMEC completed a data quality review and qualifiers added during the review are included in this table.

[1] Background values from DEQ's Human Health Risk Assessment Guidance, Table 1 - Oregon Default Background Concentrations for Inorganic Chemicals (Freshwater), DEQ 2010.

TABLE 2C
GROUNDWATER ANALYTICAL RESULTS - VOLATILE ORGANIC COMPOUNDS
(EPA Method 8260B)
Former Frontier Leather Tannery Property

Location ID	Sample Date	Sample ID	Start Depth (feet)	End Depth (feet)	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene	1,3-Dichloropropane	1,4-Dichlorobenzene	2,2-Dichloropropane	2-Butanone (MEK)
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DP-02	11/10/15	DP-2-GW	10	15	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	1.00 U	2.00 U	1.00 U	2.00 U	1.00 U	5.00 U	0.500 U	0.500 U	0.500 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	1.00 U	10.0 UJ
DP-06	11/10/15	DP-6-GW	7	12	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	1.00 U	2.00 U	1.00 U	2.00 U	1.00 U	5.00 U	0.500 U	**0.570**	0.500 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	1.00 U	10.0 UJ
DP-13	11/11/15	DP-13-GW	15	20	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	1.00 U	2.00 U	1.00 U	2.00 U	1.00 U	5.00 U	0.500 U	0.500 U	0.500 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	1.00 U	10.0 U
DP-13	11/11/15	DP-13-W-DUP	15	20	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	1.00 U	2.00 U	1.00 U	2.00 U	1.00 U	5.00 U	0.500 U	0.500 U	0.500 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	1.00 U	10.0 U
DP-17	11/10/15	DP-17-GW	10	15	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	1.00 U	2.00 U	1.00 U	2.00 U	1.00 U	5.00 U	0.500 U	0.500 U	0.500 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	1.00 U	10.0 UJ

Location ID	Sample Date	Sample ID	Start Depth (feet)	End Depth (feet)	2-Chlorotoluene	2-Hexanone	4-Chlorotoluene	4-Isopropyltoluene	4-Methyl-2-Pentanone (MIBK)	Acetone	Benzene	Bromobenzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane	Carbon tetrachloride	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromochloromethane	Dibromomethane	Dichlorodifluoromethane
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DP-02	11/10/15	DP-2-GW	10	15	1.00 U	10.0 UJ	1.00 U	1.00 U	10.0 U	20.0 UJ	0.200 U	0.500 U	1.00 U	1.00 U	1.00 U	5.00 U	1.00 U	0.500 U	5.00 U	1.00 U	5.00 U	0.500 U	1.00 U	1.00 U	1.00 U	1.00 U
DP-06	11/10/15	DP-6-GW	7	12	1.00 U	10.0 UJ	1.00 U	1.00 U	10.0 U	20.0 UJ	0.200 U	0.500 U	1.00 U	1.00 U	1.00 U	5.00 U	1.00 U	0.500 U	5.00 U	1.00 U	5.00 U	0.500 U	1.00 U	1.00 U	1.00 U	1.00 U
DP-13	11/11/15	DP-13-GW	15	20	1.00 U	10.0 U	1.00 U	1.00 U	10.0 U	20.0 U	0.200 U	0.500 U	1.00 U	1.00 U	1.00 U	5.00 U	1.00 U	0.500 U	5.00 U	1.00 U	5.00 U	0.500 U	1.00 U	1.00 U	1.00 U	1.00 U
DP-13	11/11/15	DP-13-W-DUP	15	20	1.00 U	10.0 U	1.00 U	1.00 U	10.0 U	20.0 U	0.200 U	0.500 U	1.00 U	1.00 U	1.00 U	5.00 U	1.00 U	0.500 U	5.00 U	1.00 U	5.00 U	0.500 U	1.00 U	1.00 U	1.00 U	1.00 U
DP-17	11/10/15	DP-17-GW	10	15	1.00 U	10.0 UJ	1.00 U	1.00 U	10.0 U	20.0 UJ	0.200 U	0.500 U	1.00 U	1.00 U	1.00 U	5.00 U	1.00 U	0.500 U	5.00 U	1.00 U	5.00 U	0.500 U	1.00 U	1.00 U	1.00 U	1.00 U

Notes:
Data reported to method reporting limit
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U = not detected at or above the stated level
EPA = Environmental Protection Agency

Chemical analytical testing performed by Apex Laboratories, LLC in Tigard, OR.
Amec Foster Wheeler completed a data quality review and qualifiers added during the review are included in this table.

TABLE 2C
GROUNDWATER ANALYTICAL RESULTS - VOLATILE ORGANIC COMPOUNDS
(EPA Method 8260B)
Former Frontier Leather Tannery Property

Location ID	Sample Date	Sample ID	Start Depth (feet)	End Depth (feet)	Ethylbenzene	Hexachlorobutadiene	Isopropylbenzene	m,p-Xylene	Methyl tert-Butyl Ether (MTBE)	Methylene chloride	Naphthalene	n-Butylbenzene	n-Propylbenzene	o-Xylene	sec-Butylbenzene	Styrene	tert-Butylbenzene	Tetrachloroethene	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichloroethene	Trichlorofluoromethane	Vinyl chloride
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DP-02	11/10/15	DP-2-GW	10	15	0.500 U	5.00 U	1.00 U	1.00 U	1.00 U	5.00 U	2.00 U	1.00 U	0.500 U	0.500 U	1.00 U	1.00 U	1.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	2.00 U	0.500 U
DP-06	11/10/15	DP-6-GW	7	12	0.500 U	5.00 U	1.00 U	1.00 U	1.00 U	5.00 U	2.00 U	1.00 U	0.500 U	0.500 U	1.00 U	1.00 U	1.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	2.00 U	0.500 U
DP-13	11/11/15	DP-13-GW	15	20	0.500 U	5.00 U	1.00 U	1.00 U	1.00 U	5.00 U	2.00 U	1.00 U	0.500 U	0.500 U	1.00 U	1.00 U	1.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	2.00 U	0.500 U
DP-13	11/11/15	DP-13-W-DUP	15	20	0.500 U	5.00 U	1.00 U	1.00 U	1.00 U	5.00 U	2.00 U	1.00 U	0.500 U	0.500 U	1.00 U	1.00 U	1.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	2.00 U	0.500 U
DP-17	11/10/15	DP-17-GW	10	15	0.500 U	5.00 U	1.00 U	1.00 U	1.00 U	5.00 U	2.00 U	1.00 U	0.500 U	0.500 U	1.00 U	1.00 U	1.00 U	0.500 U	1.00 U	0.500 U	1.00 U	0.500 U	2.00 U	0.500 U

Notes:
Data reported to method reporting limit
BOLD = detection
DUP = Field Duplicate
µg/L = micrograms per liter
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Chemical analytical testing performed by Apex Laboratories, LLC in Tigard, OR.
Amec Foster Wheeler completed a data quality review and qualifiers added during the review are included in this table.

TABLE 2D
GROUNDWATER ANALYTICAL RESULTS - CHLORIDE
(EPA Method 300.0)
Former Frontier Leather Tannery Property

Location ID	Sample Date	Sample ID	Start Depth (feet)	End Depth (feet)	Chloride (as Cl)
					mg/L
DP-02	11/10/15	DP-2-GW	10	15	**24.7**
DP-06	11/10/15	DP-6-GW	7	12	**225**
DP-13	11/11/15	DP-13-GW	15	20	**11.8**
DP-13	11/11/15	DP-13-W-DUP	15	20	**11.4**
DP-17	11/10/15	DP-17-GW	10	15	**125**

Notes:
Data reported to method reporting limit
BOLD = detection
DUP = Field Duplicate
mg/L = milligrams per liter
EPA = United States Environmental Protection Agency

Chemical analytical testing performed by Apex Laboratories, LLC in Tigard, OR.
Amec Foster Wheeler completed a data quality review and qualifiers added during the review are included in this table.

TABLE 3A
RISK SCREENING - METALS SOIL ANALYTICAL RESULTS
Upland Exposure Unit
Former Frontier Leather Tannery Property

Location	Sample ID	Sample Date	Depth (ft bgs)	Antimony [4]	Arsenic	Cadmium	Chromium	Hexavalent Chromium	Copper	Lead	Manganese	Mercury	Nickel	Zinc [4]
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Recreational User / Trespasser RBC [1]				--	10.0	1,500	> Max	6.5	61,000	400	36,000	460	30,000	--
Occupational RBC [2]				470	1.9	1,100	> Max	6.3	47,000	800	25,000	350	22,000	350,000
Construction Worker RBC [2]				--	15	350	530,000	49	14,000	800	8,200	110	7,000	--
Excavation Worker RBC [2]				--	420	9,700	> Max	1,400	390,000	800	230,000	2,900	190,000	--
Background Value [3]				0.56	8.8	0.63	76	--	34	79	1,800	0.23	47	180
North Landfill Area														
HA-52	HA-52-0.5	6/6/2003	0.5	**4.1**	**1.7**	0.13 U	**200**	NT	**19**	**160**	**220**	**0.29**	**15**	**91**
HA-52	HA-52-3.0	6/6/2003	3.0	**1.9**	**3.4**	0.13 U	**37**	NT	**21**	**6.2**	**590**	0.017 U	**17**	**53**
MW-1	MW-1-12.0	6/5/2003	12.0	**1.8**	**0.89**	**0.25**	**18**	NT	**17**	**4.1**	**280**	0.079 U	**9.8**	**52**
TP-1	TP-1-1	6/5/2003	1	**21**	2.9 U	**0.41**	**1800**	NT	**22**	**200**	**580**	**2.4**	**12**	**72**
TP-1	TP-1-2	6/5/2003	2	**17**	3 U	**0.57**	**1500**	NT	**29**	**72**	**580**	**1.9**	**17**	**110**
TP-1	TP-1-8	6/5/2003	8	**16**	3.2 U	**0.44**	**1400**	NT	**20**	**13**	**210**	**0.15**	**19**	**63**
TP-2	TP-2-4	6/5/2003	4	**59**	16 U	**0.6**	**5200**	NT	**35**	**43**	**740**	**0.91**	**18**	**96**
TP-2	TP-2-9	6/5/2003	9	**66**	14 U	**0.55**	**6300**	0.28 U	**41**	**52**	**830**	**1.1**	**16**	**95**
TP-3	TP-3-1	6/5/2003	1	**3.3**	**2.9**	**0.52**	**100**	NT	**20**	**14**	**850**	**0.5**	**19**	**60**
TP-3	TP-3-4	6/5/2003	4	**220**	42 U	**0.24**	**21000**	NT	**19**	**28**	**400**	**6.2**	**10**	**54**
TP-3	TP-3-10	6/5/2003	10	**2.6**	**3.3**	**0.48**	**56**	NT	**19**	**4**	**590**	0.017 U	**29**	**54**
TP-4	TP-4-8	6/5/2003	8	**2.2**	**3.6**	**0.54**	**35**	NT	**19**	**5.1**	**1000**	**0.021**	**25**	**65**
TP-5	TP-5-1	6/5/2003	1	**13**	0.6 U	**0.6**	**670**	NT	**22**	**760**	**900**	**0.62**	**14**	**120**
TP-5	TP-5-4	6/5/2003	4	**3.2**	**3.5**	**0.32**	**170**	NT	**44**	**51**	**390**	**0.21**	**17**	**65**
TP-5	TP-5-5	6/5/2003	5	**6.6**	**24**	**1.2**	**66**	NT	**51**	**140**	**830**	**0.33**	**11**	**91**
TP-22	TP-22-4.5	6/6/2003	4.5	**120**	0.63 U	**0.22**	**11000**	NT	**26**	**100**	**560**	**13**	**15**	**120**
Central Area														
DP-01	DP-01-0-1	11/10/2015	1	1.33 U	**4.05**	**0.306**	**456 J**	NT	**18.6**	**9.82**	**674**	0.107 U	**22.2**	**61.1**
DP-01	DP-01-3.5-4.5	11/10/2015	5	1.35 U	**3.17**	0.270 U	**16.4**	NT	**17.9**	**5.58**	**875**	0.108 U	**21.3**	**50.8**
DP-02	DP-2-0-1	11/10/2015	1	1.38 U	**6.22**	0.276 U	**31.6**	**1.36**	**13.7**	**8.39**	**1,480**	0.111 U	**14.9**	**54.9**
DP-02	DP-2-3.5-4.5	11/10/2015	5	1.20 U	**4.01**	**0.287**	**18.3**	**0.266**	**18.3**	**5.30**	**860**	0.0957 U	**23.3**	**49.6**
DP-02	DP-2-8-9	11/10/2015	9	1.29 U	**2.89**	0.258 U	**31.3**	NT	**17.7**	**5.93**	**282**	0.103 U	**15.8**	**52.8**
DP-03	DP-03-0-1	11/10/2015	1	1.45 U	**2.16**	**0.405**	**31.3**	NT	**16.9**	**9.24**	**742**	0.116 U	**14.1**	**58.9**
DP-03	DP-03-3.5-4.5	11/10/2015	5	2.64 U	**4.46**	**0.290**	**19.7**	NT	**19.8**	**4.84**	**1,530**	0.106 U	**24.7**	**55.1**
DP-04	DP-04-0-1	11/10/2015	1	1.32 U	**4.37**	**0.304**	**599**	NT	**19.9**	**11.3**	**719**	0.106 U	**23.2**	**64.8**
DP-04	DP-04-3.5-4.5	11/10/2015	5	1.41 U	**4.21**	**0.296**	**580**	NT	**21.1**	**14.2**	**905**	**0.137**	**22.9**	**66.8**
DP-05	DP-05-0-1.5	11/11/2015	2	2.56 U	**4.60**	0.256 U	**203**	NT	**23.1**	**8.10**	**734**	**0.427**	**17.7**	**62.0**
DP-05	DP-05-3.5-4.5	11/11/2015	5	2.80 U	**1.96**	0.280 U	**22.0**	NT	**18.9**	**5.85**	**523**	0.112 U	**15.6**	**56.6**
DP-06	DP-06-5-6	11/10/2015	6	2.74 U	**2.56**	0.274 U	**19.1**	**0.0620 J**	**17.1**	**5.29**	**523**	0.110 U	**13.9**	**44.6**
DP-06	DP-06-5-6-DUP	11/10/2015	6	2.70 U	**2.70**	0.270 U	**22.7**	**0.247 J**	**17.4**	**5.49**	**616**	0.108 U	**13.9**	**48.2**
DP-06	DP-06-0-1	11/10/2015	1	3.36 U	**4.38**	0.336 U	**989**	**0.212**	**24.4**	**14.2**	**465**	**0.646**	**17.9**	**79.0**
DP-06	DP-06-12-13	11/10/2015	13	1.31 U	**1.67**	0.263 U	**32.5**	**0.284**	**15.9**	**7.60**	**955**	**0.164**	**6.19**	**87.1**
DP-07	DP-07-0-1	11/10/2015	1	2.68 U	**5.57**	0.268 U	**46.2 J**	NT	**17.7**	**5.35**	**1,010**	**0.137**	**25.6**	**52.0**
DP-07	DP-07-3.5-4.5	11/10/2015	5	2.62 U	**3.72**	0.262 U	**22.0**	NT	**20.8**	**6.66**	**588**	0.105 U	**18.0**	**58.3**
DP-08	DP-08-0-1	11/10/2015	1	2.83 U	**3.65**	0.283 U	**60.6**	NT	**22.4**	**8.87**	**539**	0.113 U	**18.2**	**60.6**
DP-08	DP-08-3.5-4.5	11/10/2015	5	2.80 U	**5.88**	0.280 U	**301**	NT	**18.0**	**9.98**	**1,580**	0.112 U	**15.6**	**61.6**
DP-09	DP-9-0-1	11/11/2015	1	1.24 U	**4.83**	**0.358**	**26.1**	NT	**19.1**	**10.1**	**1,030**	0.0989 U	**19.7**	**78.9**
DP-09	DP-9-3.5-4.5	11/11/2015	5	1.16 U	**1.30**	0.232 U	**13.7**	NT	**13.7**	**3.22**	**592**	0.0926 U	**14.4**	**40.1**
DP-10	DP-10-0-1	11/11/2015	1	1.19 U	**3.89**	**0.263**	**23.0**	NT	**22.2**	**6.29**	**2,410**	0.0955 U	**17.7**	**53.0**
DP-10	DP-10-3.5-4.5	11/11/2015	5	1.31 U	**3.74**	**0.289**	**24.0**	NT	**12.7**	**15.5**	**1,190**	0.105 U	**14.8**	**97.5**
DP-11	DP-11-0-1	11/11/2015	1	1.23 U	**4.80**	0.246 U	**60.1**	NT	**17.1**	**24.8**	**696**	**0.888**	**14.4**	**77.5**
DP-11	DP-11-3.5-4.5	11/11/2015	5	1.16 U	**4.24 J**	**0.284**	**32.2**	NT	**15.8 J**	**7.38**	**546 J**	0.103 U	**17.6 J**	**59.4**
DP-11	DP-11-3.5-4.5 DUP	11/11/2015	5	1.16 U	**6.64 J**	**0.289**	**33.3**	NT	**26.1 J**	**8.98**	**904 J**	0.0925 U	**24.0 J**	**71.9**
DP-12	DP-12-0-1	11/11/2015	1	1.26 U	**5.26**	**0.289**	**25.1**	NT	**25.3**	**8.37**	**809**	0.101 U	**26.2**	**69.6**
DP-12	DP-12-3.5-4.5	11/11/2015	5	1.31 U	**4.27**	**0.353**	**29.8**	NT	**29.3**	**6.69**	**820**	0.105 U	**26.2**	**60.7**
DP-13	DP-13-0-1	11/11/2015	1	2.51 U	**3.84**	**0.264**	**27.7**	**0.213**	**17.4**	**14.3**	**724**	0.100 U	**13.1**	**71.5**
DP-13	DP-13-3-5	11/11/2015	5	1.38 U	**4.85**	**0.331**	**22.0**	**0.342**	**23.5**	**7.51**	**883**	0.110 U	**25.5**	**65.4**
DP-13	DP-13-3-5-DUP	11/11/2015	5	1.33 U	**3.91**	**0.306**	**20.1**	NT	**24.6**	**6.99**	**950 J**	0.106 U	**26.5**	**59.8**
DP-13	DP-13-8-9	11/11/2015	9	1.29 U	**2.83**	0.259 U	**19.2**	NT	**17.0**	**5.55**	**612**	0.104 U	**17.1**	**49.1**
DP-14	DP-14-0-1	11/11/2015	1	2.58 U	**4.24**	**0.258**	**354**	NT	**22.1**	**15.8**	**924**	0.103 U	**20.5**	**80.4**
DP-14	DP-14-3.5-4.5	11/11/2015	5	2.61 U	**4.03**	0.261 U	**20.6**	NT	**21.3**	**6.18**	**679**	0.104 U	**24.8**	**57.2**
DP-15	DP-15-0-1	11/11/2015	1	1.21 U	**5.56**	**0.363**	**310**	NT	**17.3**	**11.9**	**1,030**	0.0968 U	**16.1**	**63.2**
DP-15	DP-15-4-5	11/11/2015	5	**2.92**	**5.36**	**6.77**	**32,300**	NT	**56,000**	**1,420**	**1,190**	**0.527**	**68.1**	**6,800**
DP-16	DP-16-0-1	11/10/2015	1	1.12 UJ	**3.86**	**0.348**	**1,550**	NT	**20.5**	**9.76**	**674**	**0.144**	**22.7**	**67.4**
DP-16	DP-16-3.5-4.5	11/10/2015	5	1.39 U	**6.95**	0.279 U	**60.2**	NT	**14.5**	**8.55**	**1,280**	0.111 U	**16.6**	**57.8**
DP-17	DP-17-0-1	11/10/2015	1	1.27 U	**4.80**	**0.369**	**181**	**6.43**	**20.9**	**15.2**	**759**	**1.52**	**21.1**	**71.5**
DP-17	DP-17-3.5-4.5	11/10/2015	5	1.28 U	**4.95**	**0.384**	**44.9**	**2.26**	**19.4**	**8.76**	**827**	0.102 U	**25.2**	**71.2**
DP-17	DP-17-8-9	11/10/2015	9	1.41 U	**5.91**	0.283 U	**16.4**	NT	**18.3**	**7.96**	**1,010**	0.113 U	**18.1**	**55.8**
DP-18	DP-18-0-1	11/11/2015	1	2.20 U	**1.54**	0.220 U	**51.7**	NT	**19.6**	**5.17**	**525**	**0.100**	**9.58**	**47.6**
DP-18	DP-18-3.5-4.5	11/11/2015	5	2.63 U	**4.09**	0.263 U	**43.9**	NT	**23.6**	**6.60**	**739**	0.105 U	**22.6**	**56.2**
DP-19	DP-19-0-1	11/10/2015	1	1.33 U	**5.32**	**0.346**	**45.2**	NT	**18.8**	**9.78**	**883**	0.106 U	**21.2**	**71.7**
DP-19	DP-19-3.5-4.5	11/10/2015	5	1.22 U	**6.71**	**0.317**	**42.8**	NT	**15.4**	**8.36**	**1,050**	0.0975 U	**20.2**	**88.3**
DP-20	DP-20-0-1	11/10/2015	1	1.18 U	**3.92**	**0.272**	**24.9**	NT	**19.3**	**8.27**	**1,060**	**0.0981**	**19.5**	**58.6**
DP-20	DP-20-3.5-4.5	11/10/2015	5	1.24 U	**4.17**	**0.347**	**24.3**	NT	**18.1**	**6.32**	**791**	0.0992 U	**21.1**	**57.3**

TABLE 3A
RISK SCREENING - METALS SOIL ANALYTICAL RESULTS
Upland Exposure Unit
Former Frontier Leather Tannery Property

Location	Sample ID	Sample Date	Depth (ft bgs)	Antimony [4]	Arsenic	Cadmium	Chromium	Hexavalent Chromium	Copper	Lead	Manganese	Mercury	Nickel	Zinc [4]
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Recreational User / Trespasser RBC [1]				--	10.0	1,500	> Max	6.5	61,000	400	36,000	460	30,000	--
Occupational RBC [2]				470	1.9	1,100	> Max	6.3	47,000	800	25,000	350	22,000	350,000
Construction Worker RBC [2]				--	15	350	530,000	49	14,000	800	8,200	110	7,000	--
Excavation Worker RBC [2]				--	420	9,700	> Max	1,400	390,000	800	230,000	2,900	190,000	--
Background Value [3]				0.56	8.8	0.63	76	--	34	79	1,800	0.23	47	180
South Landfill Area														
MW-6	MW-6-12	6/17/2003	12	**1.5**	**3.6**	**0.52**	**19**	NT	**22**	**4.1**	**110**	0.017 U	**22**	**65**
MW-7	MW-7-7	6/17/2003	7	**2.3**	**4.2**	**0.94**	**14**	NT	**21**	**3.1**	**850**	0.016 U	**11**	**55**
TP-6	TP-6-5	6/5/2003	5	**3.2**	**3.5**	**0.42**	**92**	NT	**20**	**8.7**	**950**	**0.11**	**19**	**54**
TP-7	TP-7-9	6/5/2003	9	**2.4**	**2.7**	**0.38**	**34**	0.26 U	**19**	**4.4**	**650**	0.017 U	**19**	**50**
TP-8	TP-8-7	6/5/2003	7	**1.8**	**1.9**	**0.38**	**17**	NT	**19**	**4.7**	**660**	0.017 U	**20**	**52**
TP-9	TP-9-1	6/5/2003	1	**2.8**	**3.5**	**0.47**	**33**	NT	**14**	**7.3**	**630**	**0.028**	**15**	**69**
TP-9	TP-9-3.5	6/5/2003	3.5	**5.1**	**2**	**0.47**	**240**	NT	**16**	**12**	**830**	**0.14**	**17**	**81**
TP-9	TP-9-5	6/5/2003	5	**1.8**	**2.5**	**0.43**	**50**	NT	**18**	**4.5**	**790**	0.017 U	**17**	**48**
TP-10	TP-10-6	6/5/2003	6	**2.2**	**4.6**	**0.46**	**19**	NT	**20**	**5.5**	**650**	0.017 U	**19**	**53**
TP-11	TP-11-2.5	6/5/2003	2.5	**2.7**	**4.4**	**0.6**	**28**	NT	**20**	**6.2**	**770**	**0.023**	**23**	**61**
TP-12	TP-12-2	6/5/2003	2	**2.1**	**3.8**	**0.38**	**27**	NT	**19**	**6.1**	**720**	0.082 U	**24**	**62**
TP-13	TP-13-2	6/5/2003	2	**2.1**	**3.9**	**0.36**	**29**	NT	**18**	**6.5**	**600**	0.081 U	**20**	**62**
TP-14	TP-14-3	6/5/2003	3	**2**	**1.8**	**0.29**	**23**	0.23 U	**13**	**5.6**	**1600**	0.077 U	**16**	**80**
TP-14	DUP-19	6/5/2003	3	**2**	0.6 U	**0.29**	**21**	**0.28**	**13**	**5.6**	**1700**	0.078 U	**16**	**84**
TP-16	TP-16-2.5	6/5/2003	2.5	**2**	**3.7**	**0.34**	**19**	NT	**20**	**5.2**	**910**	0.083 U	**19**	**51**
TP-17	TP-17-3	6/5/2003	3	**2**	**2.5**	**0.28**	**17**	NT	**20**	**5**	**690**	0.083 U	**18**	**51**
TP-18	TP-18-2.5	6/5/2003	2.5	**1.5**	**2.2**	**0.25**	**17**	NT	**19**	**4.3**	**890**	0.084 U	**20**	**46**
TP-21	TP-21-2.5	6/6/2003	2.5	**1.8**	**1.7**	**0.26**	**13**	NT	**16**	**2.7**	**960**	0.014 U	**14**	**54**

Notes:

Data reported to method reporting limit
BOLD = detection
U = not detected at or above the stated level
J = estimated result
mg/kg = milligrams per kilogram
NT = not tested

DUP = Field Duplicate
DEQ = Oregon Department of Environmental Quality
EPA = United States Environmental Protection Agency
RBC = Risk-Based Concentration
-- = Not Published
shaded Concentration exceeds 1 or more RBCs

ft = feet
bgs = below ground surface

> Max = The RBC is greater than 1,000,000 mg/kg, therefore, this analyte is not deemed to pose risk for the indicated exposure pathway.

Analytical results from one of the following: EPA Methods 200.8, 6010B, 6020, 7471, 7196A, or 7199.

[1] Site-Specific RBC for Recreational User/Trespasser (Appendix F of this Supplemental RI Report).

[2] DEQ RBCs for direct contact (soil ingestion-dermal contact-inhalation), November 2015.

[3] Development of Oregon Background Metals Concentrations in Soil, DEQ Technical Report , Table 4 - Portland Basin, DEQ 2013.

[4] EPA Industrial Regional Screening Levels for soil, November 2015.

TABLE 3B
RISK SCREENING - METALS SOIL ANALYTICAL RESULTS
Wetland Exposure Unit
Former Frontier Leather Tannery Property

Location	Sample ID	Sample Date	Depth (ft bgs)	Antimony	Arsenic	Cadmium	Chromium	Hexavalent Chromium	Copper	Lead	Manganese	Mercury	Nickel	Zinc
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Recreational User / Trespasser RBC [1]				--	10.0	1,500	> Max	6.5	61,000	400	36,000	460	30,000	--
Construction Worker RBC [2]				--	15	350	530,000	49	14,000	800	8,200	110	7,000	--
Excavation Worker RBC [2]				--	420	9,700	> Max	1,400	390,000	800	230,000	2,900	190,000	--
Background Value [3]				0.56	8.8	0.63	76	--	34	79	1,800	0.23	47	180
Rock Creek Wetland														
DRAIN-1	DRAIN-1-5	6/6/2003	5	**1.1**	**1**	**0.11**	**25**	NT	**16**	**5.4**	**98**	**0.019**	**12**	**56**
HA-1	HA-1-0.5	6/10/2003	0.5	**16**	12 U	**0.83**	**1800**	0.24 U	**27**	**13**	**190**	**33**	**13**	**61**
HA-1	HA-1-2.0	6/10/2003	2.0	1.3 U	**1.5**	**0.51**	**20**	NT	**16**	**4.3**	**210**	0.082 U	**12**	**47**
HA-2	HA-2-0.5	6/10/2003	0.5	**5.7**	**3.8**	**1.6**	**380**	NT	**9.4**	**8.5**	**2900**	**0.66**	**17**	**43**
HA-2	DUP-14	6/10/2003	0.5	**4.9**	**5.9**	**1.2**	**300**	NT	**9.3**	**9.2**	**4100**	**0.24**	**20**	**44**
HA-2	HA-2-2.0	6/10/2003	2.0	**6.4**	1.2 U	**1.6**	**510**	NT	**15**	**4.4**	**1300**	**1.9**	**9.2**	**49**
HA-3	HA-3-1.0	6/10/2003	1.0	**35**	24 U	**1.1**	**4200**	NT	**22**	**12**	**250**	**2.4**	**14**	**62**
HA-3	HA-3-3.5	6/10/2003	3.5	1.3 U	**1.5**	**0.69**	**23**	NT	**23**	**6.5**	**90**	**0.12**	**13**	**54**
HA-4	HA-4-0.5	6/10/2003	0.5	**16**	14 U	**0.72**	**1900**	NT	**17**	**14**	**130**	**14**	**12**	**59**
HA-4	HA-4-3.0	6/10/2003	3.0	1.9 U	**7.4**	**0.82**	**35**	NT	**28**	**7.8**	**120**	**0.13**	**12**	**76**
HA-5	HA-5-0.5	6/10/2003	0.5	1.5 U	**4.5**	**0.7**	**44**	NT	**16**	**10**	**180**	**0.55**	**11**	**43**
HA-5	DUP-13	6/10/2003	0.5	1.6 U	**3.9**	**0.4**	**45**	NT	**14**	**12**	**170**	**0.11**	**12**	**46**
HA-5	HA-5-3.0	6/10/2003	3.0	**1.5**	**2.4**	**0.69**	**19**	NT	**17**	**5**	**110**	0.093 U	**13**	**54**
HA-6	HA-6-0.5	6/10/2003	0.5	**3.5**	**1.7**	**0.7**	**240**	NT	**15**	**5.1**	**150**	**0.19**	**13**	**48**
HA-6	HA-6-4.0	6/10/2003	4.0	**1.3**	**1.6**	**0.47**	**15**	NT	**18**	**7**	**120**	0.086 U	**9.2**	**60**
HA-7	HA-7-0.5	6/10/2003	0.5	**12**	1.2 U	**0.65**	**1400**	NT	**19**	**11**	**240**	**2.9**	**16**	**56**
HA-7	DUP-11	6/10/2003	0.5	**8.9**	1.2 U	**0.6**	**990**	NT	**18**	**10**	**280**	**0.4**	**17**	**57**
HA-7	HA-7-2.5	6/10/2003	2.5	1.2 U	**1.9**	**0.39**	**22**	NT	**14**	**4.7**	**110**	0.08 U	**16**	**47**
HA-8	HA-8-0.5	6/10/2003	0.5	**1.7**	**2.9**	**0.52**	**63**	NT	**12**	**6.7**	**100**	**0.19**	**11**	**53**
HA-8	HA-8-1.5	6/10/2003	1.5	**1.3**	**1.8**	**0.51**	**19**	NT	**17**	**4.5**	**130**	0.077 U	**14**	**55**
HA-9	HA-9-0.5	6/10/2003	0.5	**1.7**	**3**	**0.43**	**52**	NT	**13**	**10**	**440**	**0.91**	**14**	**50**
HA-9	HA-9-3.0	6/10/2003	3.0	1.4 U	**2.4**	**0.4**	**16**	NT	**18**	**5.9**	**110**	0.088 U	**18**	**58**
HA-10	HA-10-0.5	6/9/2003	0.5	1.3 U	**3.5**	**0.28**	**34**	NT	**13**	**11**	**120**	**0.13**	**0.93**	**43**
HA-10	DUP-12	6/10/2003	0.5	**3.3**	**2.5**	**0.54**	**190**	NT	**16**	**8.4**	**230**	**0.2**	**14**	**64**
HA-10	HA-10-1.5	6/9/2003	1.5	1.3 U	**1.5**	**0.19**	**21**	NT	**11**	**3.5**	**80**	0.017 U	**8.1**	**42**
HA-11	HA-11-0.5	6/9/2003	0.5	**39**	32 U	**0.44**	**4900**	0.31 U	**22**	**21**	**230**	**2.8**	**15**	**73**
HA-11	HA-11-3.5	6/9/2003	3.5	2.4 U	**2.8**	**0.24**	**36**	NT	**18**	**4.8**	**89**	0.031 U	**14**	**52**
HA-12	HA-12-0.5	6/9/2003	0.5	**20**	14 U	**0.78**	**2200**	NT	**18**	**13**	**1300**	**0.52**	**21**	**120**
HA-12	DUP-10	6/9/2003	0.5	**30**	15 U	**1.5**	**3400**	NT	**18**	**17**	**1200**	**0.65**	**22**	**130**
HA-12	HA-12-2.5	6/9/2003	2.5	**4.4**	**3.2**	**0.45**	**260**	NT	**17**	**7.3**	**1100**	**0.033**	**17**	**64**
HA-13	HA-13-0.5	6/9/2003	0.5	**74**	62 U	**0.71**	**8800**	NT	**23**	**32**	**330**	**2.5**	**17**	**110**
HA-13	HA-13-3.5	6/9/2003	3.5	**3.5**	**3.7**	**0.48**	**190**	NT	**16**	**7.9**	**800**	**0.055**	**16**	**62**
HA-14	HA-14-1.0	6/9/2003	1.0	**1.8**	**5**	**0.62**	**21**	NT	**18**	**5.2**	**4300**	0.016 U	**16**	**52**
HA-14	HA-14-2.5	6/9/2003	2.5	**1.8**	**2.1**	**0.39**	**40**	NT	**11**	**7.9**	**190**	**0.034**	**13**	**44**
HA-15	HA-15-0.5	6/9/2003	0.5	**21**	13 U	**0.37**	**2600**	NT	**17**	**17**	**130**	**1.1**	**9.5**	**49**
HA-15	HA-15-2.0	6/9/2003	2.0	**2.5**	1.4 U	**0.19**	**160**	NT	**11**	**5.2**	**61**	**0.15**	**7.6**	**23**
HA-16	HA-16-0.5	6/9/2003	0.5	**22**	13 U	**0.52**	**2500**	NT	**19**	**13**	**240**	**1.8**	**14**	**66**
HA-16	HA-16-2.5	6/9/2003	2.5	**6.7**	6.4 U	**0.3**	**720**	NT	**15**	**8.4**	**110**	**0.17**	**13**	**48**
HA-17	HA-17-0.5	6/10/2003	0.5	**13**	1.2 U	**0.71**	**1500**	NT	**13**	**13**	**660**	**3.7**	**12**	**68**
HA-17	HA-17-2.5	6/10/2003	2.5	**1.3**	**1.8**	**0.37**	**28**	NT	**12**	**3.3**	**89**	0.076 U	**11**	**48**
HA-18	HA-18-0.5	6/10/2003	0.5	**6.7**	**1.8**	**0.77**	**550**	NT	**20**	**12**	**300**	**0.46**	**18**	**82**
HA-18	HA-18-2.5	6/10/2003	2.5	**1.4**	**3**	**0.37**	**30**	NT	**9.9**	**5.8**	**150**	**0.03**	**12**	**57**
HA-19	HA-19-1.0	6/9/2003	1.0	**2.9**	**3.2**	**0.57**	**95**	NT	**18**	**5.3**	**200**	**0.079**	**19**	**58**
HA-19	HA-19-2.0	6/9/2003	2.0	**1.6**	**3**	**0.44**	**12**	NT	**16**	**4.5**	**240**	0.017 U	**14**	**48**
HA-20	HA-20-1.0	6/9/2003	1.0	**35**	24 U	**0.56**	**4000**	**2.1**	**16**	**16**	**270**	**0.36**	**13**	**72**
HA-20	DUP-8	6/9/2003	1.0	**22**	12 U	**0.81**	**2400**	**0.34**	**14**	**14**	**280**	**0.44**	**13**	**68**
HA-20	HA-20-3.5	6/9/2003	3.5	**1.7**	**1.7**	**0.61**	**23**	NT	**17**	**4.7**	**190**	0.017 U	**12**	**50**
HA-20	DUP-9	6/9/2003	3.5	**1.9**	**2.1**	**0.9**	**57**	NT	**15**	**4.9**	**200**	**0.18**	**12**	**52**
HA-21	HA-21-0.5	6/9/2003	0.5	**30**	24 U	**0.56**	**3600**	NT	**13**	**18**	**480**	**1.1**	**13**	**65**
HA-21	HA-21-2.5	6/9/2003	2.5	**1.5**	**3.7**	**0.68**	**31**	NT	**13**	**5.4**	**130**	0.017 U	**13**	**53**
HA-22	HA-22-1.0	6/6/2003	1.0	**1.6**	**3**	**0.15**	**42**	NT	**13**	**6.7**	**800**	**0.026**	**14**	**53**
HA-22	HA-22-2.5	6/6/2003	2.5	**1.7**	**2.9**	**0.093**	**47**	NT	**8.8**	**11**	**690**	**0.075**	**9.3**	**47**
HA-23	HA-23-0.5	6/6/2003	0.5	**3.2**	**0.82**	**0.11**	**220**	NT	**12**	**9.8**	**840**	**0.3**	**12**	**49**
HA-23	HA-23-4.0	6/6/2003	4.0	2.4 U	**4.7**	0.24 U	**22**	NT	**17**	**4.1**	**130**	0.031 U	**18**	**51**
HA-24	HA-24-0.5	6/9/2003	0.5	**2.2**	**3.8**	**0.49**	**71**	NT	**10**	**11**	**400**	**0.083**	**10**	**57**
HA-24	HA-24-2.0	6/9/2003	2.0	**3.3**	**1.5**	**0.64**	**190**	NT	**4.8**	**7.2**	**150**	**0.05**	**9.4**	**41**
HA-25	HA-25-0.5	6/9/2003	0.5	**5.2**	**3.6**	**0.75**	**420**	NT	**11**	**8.9**	**250**	**0.036**	**11**	**56**
HA-25	HA-25-2.5	6/9/2003	2.5	**2**	**8**	**1.1**	**28**	NT	**15**	**7**	**3200**	0.016 U	**24**	**59**
HA-26	HA-26-1.0	6/9/2003	1.0	**13**	1.3 U	**1.2**	**1300**	NT	**22**	**14**	**1000**	**0.063**	**16**	**76**
HA-26	HA-26-2.5	6/9/2003	2.5	**2.1**	**6.8**	**0.99**	**21**	NT	**22**	**7.9**	**1300**	0.018 U	**15**	**57**
HA-27	HA-27-0.5	6/4/2003	0.5	**14**	3 U	**0.23**	**1300**	NT	**12**	**13**	**190**	**0.12**	**12**	**69**
HA-27	HA-27-2.0	6/4/2003	2.0	**6.6**	**1.9**	**0.39**	**620**	NT	**8.8**	**8.7**	**570**	**0.026**	**11**	**66**
HA-28	HA-28-0.5	6/4/2003	0.5	**4.3**	**2.3**	**0.34**	**220**	NT	**18**	**7.4**	**690**	**0.12**	**20**	**65**
HA-28	HA-28-2.5	6/4/2003	2.5	**1.4**	**3.4**	**0.22**	**20**	NT	**8.2**	**7.6**	**2300**	**0.019**	**11**	**53**

TABLE 3B
RISK SCREENING - METALS SOIL ANALYTICAL RESULTS
Wetland Exposure Unit
Former Frontier Leather Tannery Property

Location	Sample ID	Sample Date	Depth (ft bgs)	Antimony	Arsenic	Cadmium	Chromium	Hexavalent Chromium	Copper	Lead	Manganese	Mercury	Nickel	Zinc
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Recreational User / Trespasser RBC [1]				--	10.0	1,500	> Max	6.5	61,000	400	36,000	460	30,000	--
Construction Worker RBC [2]				--	15	350	530,000	49	14,000	800	8,200	110	7,000	--
Excavation Worker RBC [2]				--	420	9,700	> Max	1,400	390,000	800	230,000	2,900	190,000	--
Background Value [3]				0.56	8.8	0.63	76	--	34	79	1,800	0.23	47	180
HA-29	HA-29-0.8	6/4/2003	0.8	**4.5**	**3.9**	**0.23**	**220**	NT	**12**	**7.5**	**810**	0.017 U	**13**	**57**
HA-29	HA-29-2.5	6/4/2003	2.5	**2**	**6.6**	**0.36**	**40**	NT	**8.5**	**8.2**	**2700**	0.018 U	**17**	**54**
HA-30	HA-30-0.8	6/4/2003	0.8	**37**	14 U	**0.34**	**4000**	NT	**22**	**27**	**710**	**0.5**	**19**	**89**
HA-30	HA-30-2.6	6/4/2003	2.6	**2.7**	**3**	**0.27**	**84**	NT	**14**	**7.8**	**1300**	0.019 U	**17**	**62**
HA-31	HA-31-0.7	6/4/2003	0.7	**3.2**	0.65 U	**0.27**	**120**	NT	**15**	**4.7**	**200**	**0.22**	**9.7**	**46**
HA-31	DUP-1	6/4/2003	0.7	**2.5**	**3.5**	**0.24**	**78**	NT	**16**	**4.7**	**240**	**0.11**	**9.9**	**45**
HA-31	HA-31-2.0	6/4/2003	2.0	**2.6**	**2.5**	**0.21**	**80**	NT	**7.4**	**6.9**	**510**	0.017 U	**13**	**46**
HA-31	DUP-2	6/4/2003	2.0	**1.7**	**2.1**	**0.14**	**30**	NT	**6.4**	**7.1**	**540**	0.018 U	**12**	**40**
HA-32	HA-32-0.5	6/4/2003	0.5	**3.3**	**2.6**	**0.36**	**130**	NT	**17**	**6.7**	**170**	**0.089**	**12**	**57**
HA-32	HA-32-2.0	6/4/2003	2.0	**2.1**	**6.8**	**0.34**	**32**	NT	**9.3**	**7.2**	**570**	0.017 U	**15**	**59**
HA-33	HA-33-1.0	6/4/2003	1.0	**2.4**	**4.9**	**0.42**	**45**	NT	**15**	**6.5**	**1700**	0.016 U	**15**	**57**
HA-33	HA-33-3.5	6/4/2003	3.5	**2.1**	**2.8**	**0.29**	**31**	NT	**18**	**8**	**680**	**0.023**	**14**	**41**
HA-34	HA-34-0.5	6/4/2003	0.5	**1.7**	**2.2**	**0.39**	**20**	0.25 U	**16**	**5**	**740**	0.016 U	**15**	**52**
HA-34	HA-34-2.0	6/4/2003	2.0	**2.1**	0.63 U	**0.25**	**50**	NT	**7.5**	**7.7**	**400**	0.016 U	**11**	**52**
HA-35	HA-35-0.6	6/4/2003	0.6	**30**	13 U	**0.49**	**3300**	NT	**21**	**19**	**530**	0.017 U	**16**	**81**
HA-35	HA-35-5.0	6/4/2003	5.0	**1.7**	**3.2**	**0.39**	**24**	NT	**18**	**4.6**	**740**	0.017 U	**19**	**53**
HA-36	HA-36-0.5	6/4/2003	0.5	**26**	7.6 U	**0.42**	**2700**	NT	**21**	**13**	**320**	**0.4**	**21**	**69**
HA-36	DUP-5	6/4/2003	0.5	**38**	15 U	**0.26**	**4000**	NT	**21**	**19**	**250**	**0.25**	**21**	**68**
HA-36	HA-36-2.0	6/4/2003	2.0	**2**	0.7 U	**0.27**	**44**	NT	**19**	**5.2**	**150**	0.018 U	**18**	**52**
HA-36	DUP-6	6/4/2003	2.0	**2.3**	0.7 U	**0.23**	**70**	NT	**19**	**5.5**	**150**	0.018 U	**17**	**52**
HA-37	HA-37-0.5	6/4/2003	0.5	**3.4**	**2.3**	**0.26**	**170**	NT	**17**	**6.4**	**870**	0.017 U	**15**	**53**
HA-37	HA-37-1.5	6/4/2003	1.5	**2.2**	**4.8**	**0.28**	**19**	NT	**19**	**5.8**	**910**	0.018 U	**16**	**58**
HA-38	HA-38-0.5	6/4/2003	0.5	**2.1**	**5.7**	**0.28**	**22**	NT	**15**	**6.7**	**1400**	0.017 U	**15**	**58**
HA-38	HA-38-1.5	6/4/2003	1.5	**2.3**	**7.6**	**0.31**	**20**	NT	**13**	**5.9**	**1600**	0.016 U	**14**	**51**
HA-39	HA-39-0.5	6/6/2003	0.5	**1.9**	1.2 U	0.12 U	**53**	NT	**9.7**	**4.6**	**170**	**0.22**	**9.8**	**53**
HA-39	HA-39-3.5	6/6/2003	3.5	**3**	1.3 U	0.13 U	**150**	NT	**11**	**5.2**	**520**	**3**	**14**	**45**
HA-40	HA-40-1.0	6/4/2003	1.0	**18**	3.3 U	**0.2**	**1600**	**4.2**	**15**	**20**	**230**	**2**	**11**	**68**
HA-40	DUP-3	6/4/2003	1.0	**8.1**	3.2 U	**0.2**	**700**	0.26 U	**11**	**9.9**	**210**	**1.3**	**9.7**	**57**
HA-40	HA-40-3.5	6/4/2003	3.5	**1.5**	**2.1**	**0.11**	**22**	NT	**15**	**5.7**	**540**	**0.057**	**11**	**46**
HA-40	DUP-4	6/4/2003	3.5	**1.7**	**1.2**	**0.13**	**33**	NT	**15**	**5.8**	**490**	**0.042**	**11**	**49**
HA-41	HA-41-1.0	6/6/2003	1.0	**1.9**	**8**	0.13 U	**30**	NT	**13**	**5.5**	**170**	**0.022**	**11**	**55**
HA-41	HA-41-2.5	6/6/2003	2.5	**2.6**	**2.5**	0.14 U	**61**	NT	**5.7**	**8.6**	**870**	**0.027**	**17**	**59**
HA-42	HA-42-0.5	6/6/2003	0.5	**130**	29 U	2.9 U	**13000**	NT	**46**	**76**	**5200**	**6.3**	**56**	**280**
HA-42	HA-42-2.5	6/6/2003	2.5	1.2 U	**2.1**	0.12 U	**20**	NT	**5.8**	**6.4**	**410**	**0.018**	**7.5**	**36**
HA-43	HA-43-1.0	6/6/2003	1.0	**3.3**	**3.7**	0.13 U	**180**	0.26 U	**13**	**7.6**	**2200**	**0.11**	**18**	**70**
HA-43	HA-43-2.5	6/6/2003	2.5	1.4 U	**1.7**	0.14 U	**29**	NT	**13**	**7.1**	**340**	**0.031**	**11**	**42**
HA-44	HA-44-0.5	6/6/2003	0.5	**2.3**	1.3 U	0.13 U	**80**	NT	**15**	**7.2**	**130**	**0.48**	**11**	**52**
HA-44	HA-44-2.5	6/6/2003	2.5	1.2 U	**2.3**	0.12 U	**19**	NT	**4.2**	**5.4**	**240**	0.016 U	**9.1**	**36**
HA-45	HA-45-1.0	6/5/2003	1.0	**1.6**	**1.1**	0.064 U	**60**	0.25 U	**8.5**	**5.3**	**160**	**0.26**	**8.8**	**44**
HA-45	HA-45-2.5	6/5/2003	2.5	**1.7**	**1.8**	**0.14**	**21**	NT	**11**	**5.9**	**790**	0.082 U	**11**	**41**
HA-46	HA-46-0.5	6/6/2003	0.5	**2.6**	**11**	0.13 U	**44**	NT	**16**	**5.7**	**530**	**0.024**	**13**	**69**
HA-46	HA-46-1.5	6/6/2003	1.5	**1.4**	**1.3**	0.12 U	**23**	NT	**8.2**	**5.8**	**1400**	0.016 U	**11**	**39**
HA-47	HA-47-0.5	6/5/2003	0.5	**2.5**	**6.1**	**0.24**	**44**	NT	**18**	**7.4**	**1300**	0.018 U	**16**	**58**
HA-47	HA-47-1.5	6/5/2003	1.5	**1.8**	**7.4**	**0.14**	**21**	NT	**17**	**4.9**	**3500**	0.017 U	**16**	**57**
HA-48	HA-48-0.5	6/5/2003	0.5	**2.2**	**2.8**	**0.081**	**41**	NT	**16**	**5.1**	**570**	0.017 U	**14**	**49**
HA-48	HA-48-1.0	6/5/2003	1.0	**1.8**	**4.6**	**0.078**	**27**	NT	**14**	**6.3**	**730**	0.017 U	**14**	**55**
HA-49	HA-49-0.5	6/5/2003	0.5	**2.7**	**2.1**	**0.13**	**71**	NT	**24**	**8.5**	**430**	**0.02**	**17**	**54**
HA-49	HA-49-1.0	6/5/2003	1.0	**1.5**	**1.9**	**0.1**	**15**	NT	**16**	**5.2**	**220**	**0.023**	**13**	**49**
HA-50	HA-50-0.5	6/5/2003	0.5	**5.8**	0.75 U	**0.12**	**500**	NT	**17**	**7.7**	**210**	**1.2**	**21**	**62**
HA-50	HA-50-2.0	6/5/2003	2.0	0.68 U	**1.7**	**0.087**	**15**	NT	**10**	**2.3**	**99**	0.018 U	**11**	**30**
HA-51	HA-51-0.5	6/5/2003	0.5	**2.9**	**6.7**	**0.18**	**82**	NT	**12**	**5.8**	**2500**	0.017 U	**16**	**59**
HA-51	DUP-7	6/5/2003	0.5	**2.3**	**7.9**	**0.25**	**35**	NT	**12**	**5.5**	**2700**	0.017 U	**16**	**58**
HA-51	HA-51-2.0	6/5/2003	2.0	**2**	**4.6**	**0.17**	**20**	NT	**11**	**6.3**	**4600**	0.018 U	**15**	**59**
HA-53	HA-53-1.0	6/6/2003	1.0	**1.5**	**4.5**	0.14 U	**29**	NT	**13**	**16**	**1600**	**0.032**	**17**	**62**
HA-53	HA-53-2.5	6/6/2003	2.5	**1.6**	**3.7**	0.13 U	**27**	NT	**9**	**5.9**	**1400**	0.016 U	**15**	**49**
HA-54	HA-54-1.5	6/6/2003	1.5	**1.4**	**3.2**	0.13 U	**25**	NT	**16**	**6.6**	**640**	**0.02**	**18**	**54**
HA-54	HA-54-3.0	6/6/2003	3.0	**1.7**	**2.9**	0.13 U	**81**	NT	**9.1**	**5.8**	**460**	**0.04**	**9.6**	**54**
HA-55	HA-55-0.5	6/11/2003	0.5	**2.6**	**5.2**	**0.56**	**150**	**1.7**	**14**	**18**	**720**	**0.11**	**14**	**61**
HA-55	HA-55-2.5	6/11/2003	2.5	1.7 U	**3.2**	**0.48**	**32**	NT	**27**	**5.5**	**320**	**0.047**	**16**	**41**
HA-56	HA-56-0.5	6/11/2003	0.5	1.5 U	**3.3**	**0.39**	**26**	NT	**9.3**	**8.3**	**160**	**0.12**	**11**	**43**
HA-56	DUP-16	6/11/2003	0.5	**1.9**	**2.4**	0.15 U	**26**	NT	**8.4**	**6.5**	**190**	**0.075**	**9.6**	**40**
HA-56	HA-56-2.5	6/11/2003	2.5	1.8 U	**2**	**0.39**	**35**	NT	**12**	**5.9**	**130**	**0.056**	**12**	**43**
HA-57	HA-57-0.5	6/11/2003	0.5	**2.4**	**3.8**	0.14 U	**24**	NT	**11**	**10**	**330**	**0.12**	**11**	**58**
HA-57	HA-57-2.5	6/11/2003	2.5	2.3 U	2.3 U	0.23 U	**25**	NT	**22**	**3.3**	**77**	**0.065**	**15**	**38**
HA-58	HA-58-1.0	6/11/2003	1.0	**2.4**	**4.7**	0.17 U	**29**	**4.8**	**18**	**14**	**380**	**0.097**	**14**	**54**

TABLE 3B
RISK SCREENING - METALS SOIL ANALYTICAL RESULTS
Wetland Exposure Unit
Former Frontier Leather Tannery Property

Location	Sample ID	Sample Date	Depth (ft bgs)	Antimony	Arsenic	Cadmium	Chromium	Hexavalent Chromium	Copper	Lead	Manganese	Mercury	Nickel	Zinc
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Recreational User / Trespasser RBC [1]				--	10.0	1,500	> Max	6.5	61,000	400	36,000	460	30,000	--
Construction Worker RBC [2]				--	15	350	530,000	49	14,000	800	8,200	110	7,000	--
Excavation Worker RBC [2]				--	420	9,700	> Max	1,400	390,000	800	230,000	2,900	190,000	--
Background Value [3]				0.56	8.8	0.63	76	--	34	79	1,800	0.23	47	180
HA-58	HA-58-2.0	6/11/2003	2.0	3.1 U	3.1 U	0.31 U	**17**	NT	**19**	**2.7**	**58**	0.041 U	**12**	**28**
HA-59	HA-59-0.5	6/11/2003	0.5	**2**	**4.1**	0.17 U	**26**	NT	**14**	**9.9**	**310**	**0.35**	**12**	**55**
HA-59	HA-59-2.5	6/11/2003	2.5	3.8 U	**6.5**	0.38 U	**13**	NT	**19**	2.3 U	**78**	0.05 U	**12**	**27**
HA-60	HA-60-0.5	6/11/2003	0.5	**2**	**2.4**	0.13 U	**28**	NT	**11**	**13**	**200**	**0.16**	**9.2**	**54**
HA-60	HA-60-2.5	6/11/2003	2.5	3.3 U	**4**	0.33 U	**28**	NT	**28**	**5.3**	**200**	0.043 U	**17**	**42**
HA-61	HA-61-0.5	6/11/2003	0.5	**1.9**	**2.1**	0.14 U	**30**	NT	**10**	**8.6**	**200**	**0.21**	**8.8**	**40**
HA-61	HA-61-3.5	6/11/2003	3.5	3.6 U	3.6 U	0.36 U	**9.3**	NT	**14**	2.1 U	**64**	0.046 U	**8.6**	**18**
HA-64	HA-64-0.5	6/11/2003	0.5	**3**	**2.7**	0.14 U	**18**	0.28 U	**13**	**17**	**480**	**0.05**	**7.8**	**98**
HA-64	HA-64-1.0	6/11/2003	1.0	**3.4**	**2.9**	0.12 U	**18**	NT	**3.4**	**4.7**	**180**	**0.017**	**5.9**	**53**
HA-65	HA-65(0-0.5)	12/19/2003	0 - 0.5	**1.2**	NT	**0.36**	**24**	NT	**10**	NT	**280**	NT	NT	**44**
HA-66	HA-66(0-0.5)	12/19/2003	0 - 0.5	**6.6**	NT	**0.28**	**890**	NT	**10**	NT	**280**	NT	NT	**40**
HA-67	HA-67(0-0.5)	12/19/2003	0 - 0.5	**1.2**	NT	**0.31**	**24**	NT	**10**	NT	**240**	NT	NT	**35**
HA-68	HA-68(0-0.5)	12/19/2003	0 - 0.5	**4.1**	NT	**0.26**	**260**	NT	**11**	NT	**390**	NT	NT	**34**
HA-69	HA-69(0-0.5)	12/19/2003	0 - 0.5	**3.5**	NT	**0.4**	**23**	NT	**14**	NT	**740**	NT	NT	**53**
HA-70	HA-70(0-0.5)	12/19/2003	0 - 0.5	**1.3**	NT	**0.28**	**21**	NT	**12**	NT	**350**	NT	NT	**42**
HA-71	HA-71(0-0.5)	12/19/2003	0 - 0.5	**1.6**	NT	**0.18**	**65**	NT	**8.2**	NT	**760**	NT	NT	**37**
HA-72	HA-72(0-0.5)	12/19/2003	0 - 0.5	**3.4**	NT	**0.32**	**160**	NT	**8.9**	NT	**820**	NT	NT	**67**
HA-73	HA-73(0-0.5)	12/19/2003	0 - 0.5	**2.4**	NT	**0.16**	**250**	NT	**8.4**	NT	**830**	NT	NT	**44**
HA-74	HA-74(0-0.5)	12/19/2003	0 - 0.5	**6.7**	NT	**0.54**	**480**	NT	**11**	NT	**3100**	NT	NT	**100**
HA-75	HA-75(0-0.5)	12/19/2003	0 - 0.5	**2.2**	NT	**0.14**	**68**	NT	**11**	NT	**970**	NT	NT	**49**
MW-2	MW-2-11.0	6/5/2003	11.0	**1.6**	0.66 U	**0.19**	**16**	NT	**17**	**4.6**	**200**	0.086 U	**15**	**47**
MW-3	MW-3-20	6/17/2003	20	**1.4**	**1.7**	**0.2**	**15**	NT	**8.8**	**3.8**	**120**	0.017 U	**7.7**	**36**
MW-4	MW-4-16	6/18/2003	16	**1.6**	**2.9**	**0.28**	**10**	NT	**15**	**2.8**	**200**	0.017 U	**16**	**41**
MW-4	MW-4B-19	6/17/2003	19	1.5 U	**3.4**	**0.23**	**13**	NT	**12**	**3.1**	**87**	0.019 U	**15**	**46**
MW-5	MW-5-25	6/17/2003	25	**4.2**	**2.9**	**1.8**	**28**	NT	**19**	**2.9**	**680**	0.019 U	**7.3**	**86**
Rock Creek Sediment														
SS-2	SS-2	6/12/2003	0 - 0.5	3.1 U	3.1 U	**0.45**	**29**	**3.7**	**18**	**13**	**440**	**0.075**	**11**	**81**
DUP-17	DUP-17	6/12/2003	0 - 0.5	3.4 U	3.4 U	**0.57**	**39**	NT	**19**	**15**	**490**	**0.11**	**14**	**94**
SS-3	SS-3	6/12/2003	0 - 0.5	2.5 U	**3.3**	**0.4**	**22**	2.4 U	**13**	**9.8**	**560**	**0.065**	**9.5**	**63**
SS-4	SS-4	6/12/2003	0 - 0.5	**2.5**	**2.8**	**0.42**	**55**	2.2 U	**13**	**8.5**	**540**	**0.073**	**12**	**62**
SS-5	SS-5	6/11/2003	0 - 0.5	**2.5**	**2.8**	0.23 U	**37**	2.4 U	**12**	**11**	**1,900**	**0.088**	**10**	**74**
SS-6	SS-6	6/11/2003	0 - 0.5	**14**	**11**	**13**	**420**	2.9 U	**25**	**18**	**140**	**0.063**	**22**	**47**
SS-7	SS-7	12/19/2003	0 - 0.5	1.0 U	NT	**0.11**	**23**	NT	**5.3**	NT	**67**	NT	NT	**15**
SS-9	SS-9	12/19/2003	0 - 0.5	1.0 U	NT	1.0 U	**5.8**	NT	**6.1**	NT	**65**	NT	NT	**9.5**

Notes:
Data reported to method reporting limit
BOLD = detection
U = not detected at or above the stated level
J = estimated result
mg/kg = milligrams per kilogram
NT = not tested

DUP = Field Duplicate
DEQ = Oregon Department of Environmental Quality
EPA = United Stated Environmental Protection Agency
RBC = Risk-Based Concentration
-- = Not Published
shaded Concentration exceeds 1 or more RBCs

ft = feet
bgs = below ground surface

> Max = The RBC is greater than 1,000,000 mg/kg, therefore, this analyte is not deemed to pose risk for the indicated exposure pathway.

Analytical results from one of the following: EPA Methods 200.8, 6010B, 6020, 7471, 7196A, or 7199.
[1] Site-Specific RBC for Recreational User/Trespasser (Appendix F of this Supplemental RI Report).
[2] DEQ RBCs for direct contact (soil ingestion-dermal contact-inhalation), November 2015.
[3] Development of Oregon Background Metals Concentrations in Soil, DEQ Technical Report , Table 4 - Portland Basin, DEQ 2013.

TABLE 3C
RISK SCREENING - TOTAL METALS GROUNDWATER ANALYTICAL RESULTS
Groundwater Exposure Unit
Former Frontier Leather Tannery Property

Location ID	Sample Date	Sample ID	Screened Interval (ft bgs)	Antimony [3]	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Mercury	Nickel	Zinc [3]
				ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Excavation Worker RBC [1]				270	6,300	130,000	> S	5,400,000	> S	3,200,000	> S	> S	2,300,000
Background Value [2]				< 1	2	< 1	1	9	13	--	< 0.1	6	38
DP-02	11/10/2015	DP-2-GW	10 - 15	2.00 U	**9.56**	**0.411**	**53.9**	**30.3**	**10.3**	**735**	0.0800 U	**28.0**	**68.1**
DP-06	11/10/2015	DP-6-GW	7 - 12	2.00 U	**7.73**	**0.300**	**32.1**	**10.0**	**2.73**	**1,690**	0.0800 U	**6.39**	**23.3**
DP-13	11/11/2015	DP-13-GW	15 - 20	2.00 U	**1.40 J**	**0.211 J**	**9.36 J**	**10.2 J**	**4.70 J**	**521 J**	0.0800 U	**10.1 J**	**25.4**
DP-13	11/11/2015	DP-13-W-DUP	15 - 20	1.00 U	**3.09 J**	**0.867 J**	**31.1 J**	**61.3 J**	**9.23 J**	**3,780 J**	0.0800 U	**55.5 J**	**146**
DP-17	11/10/2015	DP-17-GW	10 - 15	10.0 UJ	**24.1 J**	**2.74**	**931**	**448**	**108**	**4,350**	0.800 U	**211 J**	**511**
MW-1	6/23/2003	--	5 - 15	NT	NT	NT	**3.6**	NT	NT	**3,000**	NT	NT	NT
MW-1	12/19/2003	--	5 - 15	NT	NT	NT	**3.2**	NT	NT	**3,200**	NT	NT	NT
MW-1	3/10/2004	--	5 - 15	NT	NT	NT	**3.4**	NT	NT	**3,200**	NT	NT	NT
MW-3	6/23/2003	--	13.5 - 23.5	NT	NT	NT	**3.9**	NT	NT	**940**	NT	NT	NT
MW-3	12/19/2003	--	13.5 - 23.5	NT	NT	NT	**3.4**	NT	NT	**460**	NT	NT	NT
MW-3	3/10/2004	--	13.5 - 23.5	NT	NT	NT	**4.6**	NT	NT	**840**	NT	NT	NT
MW-5	6/23/2003	--	14.5 - 29.5	NT	NT	NT	10.0 U	NT	NT	**3,000**	NT	NT	NT
MW-5	12/19/2003	--	14.5 - 29.5	NT	NT	NT	1.00 U	NT	NT	**4,800**	NT	NT	NT
MW-5	3/10/2004	--	14.5 - 29.5	NT	NT	NT	1.00 U	NT	NT	**5,100**	NT	NT	NT
MW-7	6/23/2003	--	4 - 14	NT	NT	NT	**8.4**	NT	NT	**120**	NT	NT	NT
MW-7	12/19/2003	--	4 - 14	NT	NT	NT	**1.4**	NT	NT	**20**	NT	NT	NT
MW-7	3/10/2004	--	4 - 14	NT	NT	NT	**6.0**	NT	NT	**5**	NT	NT	NT

Notes:

Data reported to method reporting limit
BOLD = detection
U = not detected at or above the stated level
J = estimated result
ug/L = micrograms per liter
NT = not tested

DUP = Field Duplicate
DEQ = Oregon Department of Environmental Quality
EPA = United Stated Environmental Protection Agency
RBC = Risk-Based Concentration
-- = Not Published
shaded Concentration exceeds 1 or more RBCs

ft = feet
bgs = below ground surface
> S = This RBC exceeds the solubility limit. No potential risk is anticipated for these metals because their concentrations are below their respective solubilities (as provide on the "ChemData" tab of the DEQ RBC excel workbook, November 2015).

Analytical results from one of the following: EPA Methods 6010B, 6020, 7470A.
[1] DEQ RBCs for groundwater in an exacavation, November 2015.
[2] Background values from DEQ's Human Health Risk Assessment Guidance, Table 1 - Oregon Default Background Concentrations for Inorganic Chemicals (Freshwater), DEQ 2010.
[3] EPA Residential Tapwater Regional Screening Levels - dermal route only (child) as a conservative surrogate, November 2015.

TABLE 3D
RISK SCREENING - DISSOLVED METALS GROUNDWATER ANALYTICAL RESULTS
Groundwater Exposure Unit
Former Frontier Leather Tannery Property

Location ID	Sample Date	Sample ID	Screened Interval (ft bgs)	Antimony [3]	Arsenic	Cadmium	Chromium	Hexavalent Chromium	Copper	Lead	Manganese	Mercury	Nickel	Zinc [3]
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Excavation Worker RBC [1]				270	6,300	130,000	> S	9,400	5,400,000	> S	3,200,000	> S	> S	2,300,000
Background Value [2]				< 1	2	< 1	1	--	9	13	--	< 0.1	6	38
DP-02	11/10/2015	DP-2-GW	10 - 15	1.00 U	1.00 U	0.200 U	**29.4**	**NT**	**2.90**	0.200 U	**106**	0.0800 U	**12.2**	4.00 U
DP-06	11/10/2015	DP-6-GW	7 - 12	1.00 U	**7.54**	0.200 U	**7.13**	NT	2.00 U	0.200 U	**918**	0.0800 U	**3.51**	4.00 U
DP-13	11/11/2015	DP-13-GW	15 - 20	1.00 U	1.00 U	0.200 U	**3.64**	NT	2.00 UJ	0.200 UJ	**10.3**	0.0800 U	1.00 U	4.00 U
DP-13	11/11/2015	DP-13-W-DUP	15 - 20	1.00 U	1.00 U	0.200 U	**3.97**	**NT**	**17.2 J**	**0.400 J**	**11.2**	0.0800 U	1.00 U	4.00 U
DP-17	11/10/2015	DP-17-GW	10 - 15	1.00 U	1.00 U	0.200 U	**11.5**	NT	2.00 U	0.200 U	**530**	0.0800 U	**21.1**	4.00 U
HA-11	6/9/2003	HA-11	NA	10 U	**11**	**4.6**	**13**	**6**	**8.2**	6.00 U	**480**	0.13 U	**17**	**93**
HA-17	6/10/2003	HA-17	NA	10 U	10 U	10 U	**3.2**	5.00 U	3.00 U	6.00 U	**1,800**	0.13 U	**98**	**44**
MW-1	6/23/2003	MW-1	5 - 15	10 U	10 U	10 U	**3.6**	5.00 U	**5.6**	6.00 U	**3,000**	0.13 U	**14**	**32**
MW-1	12/19/2003	MW-1	5 - 15	10 U	NT	1.00 U	**3.2**	NT	3.00 U	NT	**3,200**	NT	NT	20 U
MW-1	3/10/2004	MW-1	5 - 15	**16**	NT	1.00 U	**3.4**	NT	3.00 U	NT	**3,200**	NT	NT	**66**
MW-2	6/23/2003	MW-2	5 - 15	10 U	10 U	10 U	**2.6**	5.00 U	**3.3**	6.00 U	**48**	0.13 U	5.00 U	20 U
MW-2	6/23/2003	DUP-18	5 - 15	10 U	10 U	10 U	**2.6**	5.00 U	**3.7**	6.00 U	**25**	0.13 U	5.00 U	20 U
MW-2	12/19/2003	MW-2	5 - 15	10 U	NT	1.00 U	**2.1**	NT	3.00 U	NT	**8.8**	NT	NT	20 U
MW-2	3/10/2004	MW-2	5 - 15	**11**	NT	1.00 U	**2.3**	NT	3.00 U	NT	**11**	NT	NT	20 U
MW-2	12/28/2005	MW-2	5 - 15	NT	NT	NT	**3.3**	NT	NT	NT	**2.9**	NT	NT	NT
MW-2	12/6/2006	MW-2	5 - 15	NT	NT	NT	**3.48**	NT	NT	NT	2.00 U	NT	NT	NT
MW-2	12/11/2007	MW-2	5 - 15	NT	NT	NT	**3.1**	NT	NT	NT	2.00 U	NT	NT	NT
MW-3	6/23/2003	MW-3	13.5 - 23.5	10 U	10 U	10 U	**3.9**	5.00 U	**6.6**	6.00 U	**940**	0.13 U	**5.3**	20 U
MW-3	12/19/2003	MW-3	13.5 - 23.5	10 U	NT	1.00 U	**3.4**	NT	**8.2**	NT	**460**	NT	NT	20 U
MW-3	3/10/2004	MW-3	13.5 - 23.5	10 U	NT	1.00 U	**4.6**	NT	3.00 U	NT	**840**	NT	NT	20 U
MW-3	12/28/2005	MW-3	13.5 - 23.5	NT	NT	NT	**4.56**	NT	NT	NT	**724**	NT	NT	NT
MW-3	12/6/2006	MW-3	13.5 - 23.5	NT	NT	NT	**5.47**	NT	NT	NT	**516**	NT	NT	NT
MW-3	12/11/2007	MW-3	13.5 - 23.5	NT	NT	NT	**5.22**	NT	NT	NT	**675**	NT	NT	NT
MW-4	6/23/2003	MW-4	10 - 20	10 U	**11**	10 U	**4**	5.00 U	**4.3**	6.00 U	**7,000**	0.13 U	**44**	20 U
MW-4	12/19/2003	MW-4	10 - 20	10 U	NT	1.00 U	**3.9**	NT	3.00 U	NT	**4,800**	NT	NT	20 U
MW-4	3/10/2004	MW-4	10 - 20	10 U	NT	1.00 U	**3.1**	NT	3.00 U	NT	**3,500**	NT	NT	20 U
MW-5	6/23/2003	MW-5	14.5 - 29.5	10 U	10 U	10 U	1.00 U	5.00 U	**8.7**	6.00 U	**3,000**	0.13 U	5.00 U	20 U
MW-5	12/19/2003	MW-5	14.5 - 29.5	10 U	NT	1.00 U	1.00 U	NT	3.00 U	NT	**4,800**	NT	NT	20 U
MW-5	3/10/2004	MW-5	14.5 - 29.5	10 U	NT	1.00 U	1.00 U	NT	3.00 U	NT	**5,100**	NT	NT	20 U
MW-5	12/28/2005	MW-5	14.5 - 29.5	NT	NT	NT	1.00 U	NT	NT	NT	**2,040**	NT	NT	NT
MW-5	12/6/2006	MW-5	14.5 - 29.5	NT	NT	NT	1.00 U	NT	NT	NT	**1,020**	NT	NT	NT
MW-5	12/11/2007	MW-5	14.5 - 29.5	NT	NT	NT	1.00 U	NT	NT	NT	**101**	NT	NT	NT
MW-6	6/23/2003	MW-6	5 - 15	10 U	10 U	10 U	1.00 U	5.00 U	**4**	6.00 U	**280**	0.13 U	5.00 U	20 U
MW-6	12/19/2003	MW-6	5 - 15	10 U	NT	1.00 U	**2.4**	NT	3.00 U	NT	**65**	NT	NT	20 U
MW-6	3/10/2004	MW-6	5 - 15	10 U	NT	1.00 U	**2.8**	NT	3.00 U	NT	**9.6**	NT	NT	20 U
MW-7	6/23/2003	MW-7	4 - 14	10 U	10 U	10 U	**8.4**	5.00 U	**3.9**	6.00 U	**120.0**	0.13 U	5.00 U	20 U
MW-7	12/19/2003	MW-7	4 - 14	**19**	NT	1.00 U	**1.4**	NT	3.00 U	NT	**20.0**	NT	NT	20 U
MW-7	3/10/2004	MW-7	4 - 14	10 U	NT	1.00 U	**6**	NT	3.00 U	NT	**4.9**	NT	NT	20 U
MW-7A	12/28/2005	MW-7A	4 - 14	NT	NT	NT	**6.91**	NT	NT	NT	**2.3**	NT	NT	NT
MW-7A	12/28/2005	MW-7B (dupe)	4 - 14	NT	NT	NT	**6.1**	NT	NT	NT	2.00 U	NT	NT	NT
MW-7A	12/6/2006	MW-7A	4 - 14	NT	NT	NT	**9.1**	NT	NT	NT	2.00 U	NT	NT	NT
MW-7A	12/6/2006	MW-7B (dupe)	4 - 14	NT	NT	NT	**8.7**	NT	NT	NT	2.00 U	NT	NT	NT
MW-7A	12/11/2007	MW-7A	4 - 14	NT	NT	NT	**3.28**	NT	NT	NT	2.00 U	NT	NT	NT
MW-7A	12/11/2007	MW-7B (dupe)	4 - 14	NT	NT	NT	**3.23**	NT	NT	NT	2.00 U	NT	NT	NT

Notes:

Data reported to method reporting limit
BOLD = detection
U = not detected at or above the stated level
J = estimated result
µg/L = micrograms per liter
NT = not tested

DUP = Field Duplicate
DEQ = Oregon Department of Environmental Quality
EPA = United Stated Environmental Protection Agency
RBC = Risk-Based Concentration
-- = Not Published
shaded Concentration exceeds 1 or more RBCs

ft = feet
bgs = below ground surface

> S = This RBC exceeds the solubility limit. No potential risk is anticipated for these metals because their concentrations are below their respective solubilities (as provide on the "ChemData" tab of the DEQ RBC excel workbook, November 2015).

Analytical results from one of the following: EPA Methods 6010B, 6020, 7470A.
[1] DEQ RBCs for groundwater in an excavation, November 2015.
[2] Background values from DEQ's Human Health Risk Assessment Guidance, Table 1 - Oregon Default Background Concentrations for Inorganic Chemicals (Freshwater), DEQ 2010.
[3] EPA Residential Tapwater Regional Screening Levels - dermal route only (child), November 2015.

TABLE 4
SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR COPCS
Former Frontier Leather Tannery Property

Analyte	Number of Samples	Number of Detections	Frequency of Detection	Minimum Concentration (mg/kg)	Mean Concentration (mg/kg)	Maximum Concentration (mg/kg)	Maximum Concentration Sample Location	Minimum RL (mg/kg)	Maximum RL (mg/kg)	90% UCL [A]	UCL Calculation Method	Exposure Point Concentration [B]
Upland Exposure Unit (0-5 feet)												
Arsenic	62	56	90%	1.3	4.33	24	TP-5-5	0.6	42	5.262	90% KM Chebyshev	5.262
Copper	62	62	100%	12.7	923.7	56,000	DP-15-4-5	NA	NA	3,632	90% Chebyshev (Mean,Sd)	3,632
Lead	62	62	100%	2.7	55.2	1,420	DP-15-4-5	NA	NA	132.6	90% Chebyshev (Mean,Sd)	132.6
Hexavalent Chromium	8	7	88%	0.21	1.58	6.43	DP-17-0-1	0.23	0.23	2.5	90% KM (t)	2.5
Upland Exposure Unit (0-15 feet)												
Arsenic	77	69	90%	0.89	4.1	24	TP-5-5	0.6	42	4.27	90% KM (BCA)	4.27
Copper	77	77	100%	12.7	747.7	56,000	DP-15-4-5	NA	NA	2,929	90% Chebyshev (Mean,Sd)	2,929
Lead	77	77	100%	2.7	46.17	1420	DP-15-4-5	NA	NA	108.7	90% Chebyshev (Mean,Sd)	108.7
Hexavalent Chromium	12	9	75%	0.21	1.29	6.43	DP-17-0-1	0.23	0.28	3.35	95% KM Chebyshev	3.35
Wetland Exposure Unit												
Arsenic	128	96	75%	0.82	3.57	11	HA-46-0.5; SS-6	0.63	62	3.45	90% KM (BCA)	3.45

Notes:
[A] The 90% UCLs are as calculated by ProUCL (version 5; output files provided in Appendix G). If ProUCL recommended two UCLs, then the higher of the two values was conservatively selected for use in the risk evaluation.
[B] The 90% UCL is the exposure point concentration, except for the excavation worker where the maximum detected concentration is used at the exposure point concentration to reflect the focused exposure that is possible for this receptor.

mg/kg - milligrams per kilogram
NA = not applicable
RL = reporting limit
UCL = upper confidence limit

TABLE 5A
CALCULATION OF RME RISKS - UPLAND EXPOSURE UNIT
Surface Soil (0-5 feet)
Recreational User / Trespasser

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{SS} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{SS} * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBC_{SS} (mg/kg)	Noncarcinogenic RME RBC_{SS} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Metals						
Arsenic	c	5.26E+00	1.00E+01	NA	5E-07	NA
Copper	nc	3.63E+03	NA	6.10E+04	NA	6.0E-02
Lead	NA	1.33E+02	NA	4.00E+02	NA	3.3E-01
Hexavalent chromium	c	2.50E+00	6.50E+00	NA	4E-07	NA
Total					9E-07	3.9E-01

Notes:
c - carcinogen
EPC - exposure point concentration
mg/kg - milligrams per kilogram
NA - not applicable
nc - non-carcinogen
RBC_{SS} - direct contact (site-specific RBCs for this receptor are provided in Appendix F)
RME - reasonable maximum exposure

TABLE 5B
CALCULATION OF RME RISKS - UPLAND EXPOSURE UNIT
Surface Soil (0-5 feet)
Occupational Worker

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{SS} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{SS} * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBC_{SS} (mg/kg)	Noncarcinogenic RME RBC_{SS} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Metals						
Arsenic	c	5.26E+00	1.90E+00	NA	3E-06	NA
Copper	nc	3.63E+03	NA	4.70E+04	NA	7.7E-02
Lead	NA	1.33E+02	NA	8.00E+02	NA	1.7E-01
Hexavalent chromium	c	2.50E+00	6.30E+00	NA	4E-07	NA
Total					3E-06	2.4E-01

Notes:
c - carcinogen
EPC - exposure point concentration
mg/kg - milligrams per kilogram
NA - not applicable
nc - non-carcinogen
RBC_{SS} - direct contact
RME - reasonable maximum exposure

TABLE 5C
CALCULATION OF RME RISKS - UPLAND EXPOSURE UNIT
Surface Soil (0-5 feet)
Construction Worker

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{SS} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{SS} * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBC_{SS} (mg/kg)	Noncarcinogenic RME RBC_{SS} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Metals						
Arsenic	c	5.26E+00	1.50E+01	NA	4E-07	NA
Copper	nc	3.63E+03	NA	1.40E+04	NA	2.6E-01
Lead	NA	1.33E+02	NA	8.00E+02	NA	1.7E-01
Hexavalent chromium	c	2.50E+00	4.90E+01	NA	5E-08	NA
Total					4E-07	4.3E-01

Notes:
c - carcinogen
EPC - exposure point concentration
mg/kg - milligrams per kilogram
NA - not applicable
nc - non-carcinogen
RBC_{SS} - direct contact
RME - reasonable maximum exposure

TABLE 5D
CALCULATION OF RME RISKS - UPLAND EXPOSURE UNIT
Surface Soil (0-5 feet)
Excavation Worker

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{SS} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{SS} * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBC_{SS} (mg/kg)	Noncarcinogenic RME RBC_{SS} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Metals						
Arsenic	c	2.40E+01	4.20E+02	NA	6E-08	NA
Copper	nc	5.60E+04	NA	3.90E+05	NA	1.4E-01
Lead	NA	1.42E+03	NA	8.00E+02	NA	1.8E+00
Hexavalent chromium	c	6.43E+00	1.40E+03	NA	5E-09	NA
Total					6E-08	1.9E+00

Notes:
c - carcinogen
EPC - exposure point concentration
mg/kg - milligrams per kilogram
NA - not applicable
nc - non-carcinogen
RBC_{SS} - direct contact
RME - the maximum concentration is conservatively assumed to be the reasonable maximum exposure for the excavation worker because their exposure is focused in a small area

TABLE 5E
SUMMARY OF RME RISKS - UPLAND EXPOSURE UNIT
Surface Soil (0-5 feet)

Source / Pathway	Excess Lifetime Cancer Risk	Hazard Index
Recreational User / Trespasser		
Surface Soil / Direct Contact	9E-07	3.9E-01
Occupational Worker		
Surface Soil / Direct Contact	3E-06	2.4E-01
Construction Worker		
Surface Soil / Direct Contact	4E-07	4.3E-01
Excavation Worker		
Surface Soil / Direct Contact	6E-08	1.9E+00
DEQ Acceptable Risk Levels	***1E-05***	***1.0E+00***

Notes:
RME - reasonable maximum exposure

TABLE 6A
CALCULATION OF RME RISKS - UPLAND EXPOSURE UNIT
Subsurface Soil (0-15 feet)
Recreational User / Trespasser

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{SS} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{SS} * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBC_{SS} (mg/kg)	Noncarcinogenic RME RBC_{SS} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Metals						
Arsenic	c	4.27E+00	1.00E+01	NA	4E-07	NA
Copper	nc	2.93E+03	NA	6.10E+04	NA	4.8E-02
Lead	NA	1.09E+02	NA	4.00E+02	NA	2.7E-01
Hexavalent chromium	c	3.35E+00	6.50E+00	NA	5E-07	NA
Total					9E-07	3.2E-01

Notes:
c - carcinogen
EPC - exposure point concentration
mg/kg - milligrams per kilogram
NA - not applicable
nc - non-carcinogen
RBC_{SS} - direct contact (site-specific RBCs for this receptor are provided in Appendix F)
RME - reasonable maximum exposure

TABLE 6B
CALCULATION OF RME RISKS - UPLAND EXPOSURE UNIT
Subsurface Soil (0-15 feet)
Construction Worker

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{SS} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{SS} * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBC_{SS} (mg/kg)	Noncarcinogenic RME RBC_{SS} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Metals						
Arsenic	c	4.27E+00	1.50E+01	NA	3E-07	NA
Copper	nc	2.93E+03	NA	1.40E+04	NA	2.1E-01
Lead	NA	1.09E+02	NA	8.00E+02	NA	1.4E-01
Hexavalent chromium	c	3.35E+00	4.90E+01	NA	7E-08	NA
Total					4E-07	3.5E-01

Notes:
c - carcinogen
EPC - exposure point concentration
mg/kg - milligrams per kilogram
NA - not applicable
nc - non-carcinogen
RBC_{SS} - direct contact
RME - reasonable maximum exposure

TABLE 6C
CALCULATION OF RME RISKS - UPLAND EXPOSURE UNIT
Subsurface Soil (0-15 feet)
Excavation Worker

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{SS} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{SS} * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBC_{SS} (mg/kg)	Noncarcinogenic RME RBC_{SS} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Metals						
Arsenic	c	2.40E+01	4.20E+02	NA	6E-08	NA
Copper	nc	5.60E+04	NA	3.90E+05	NA	1.4E-01
Lead	NA	1.42E+03	NA	8.00E+02	NA	1.8E+00
Hexavalent chromium	c	6.43E+00	1.40E+03	NA	5E-09	NA
Total					6E-08	1.9E+00

Notes:
c - carcinogen
EPC - exposure point concentration
mg/kg - milligrams per kilogram
NA - not applicable
nc - non-carcinogen
RBC_{SS} - direct contact
RME - the maximum concentration is conservatively assumed to be the reasonable maximum exposure for the excavation worker because their exposure is focused in a small area

TABLE 6D
SUMMARY OF RME RISKS - UPLAND EXPOSURE UNIT
Subsurface Soil (0-15 feet)

Source / Pathway	Excess Lifetime Cancer Risk	Hazard Index
Recreational User / Trespasser		
Subsurface Soil / Direct Contact	9E-07	3.2E-01
Construction Worker		
Subsurface Soil / Direct Contact	4E-07	3.5E-01
Excacavation Worker		
Subsurface Soil / Direct Contact	6E-08	1.9E+00
DEQ Acceptable Risk Levels	***1E-05***	***1.0E+00***

Notes:
RME - reasonable maximum exposure

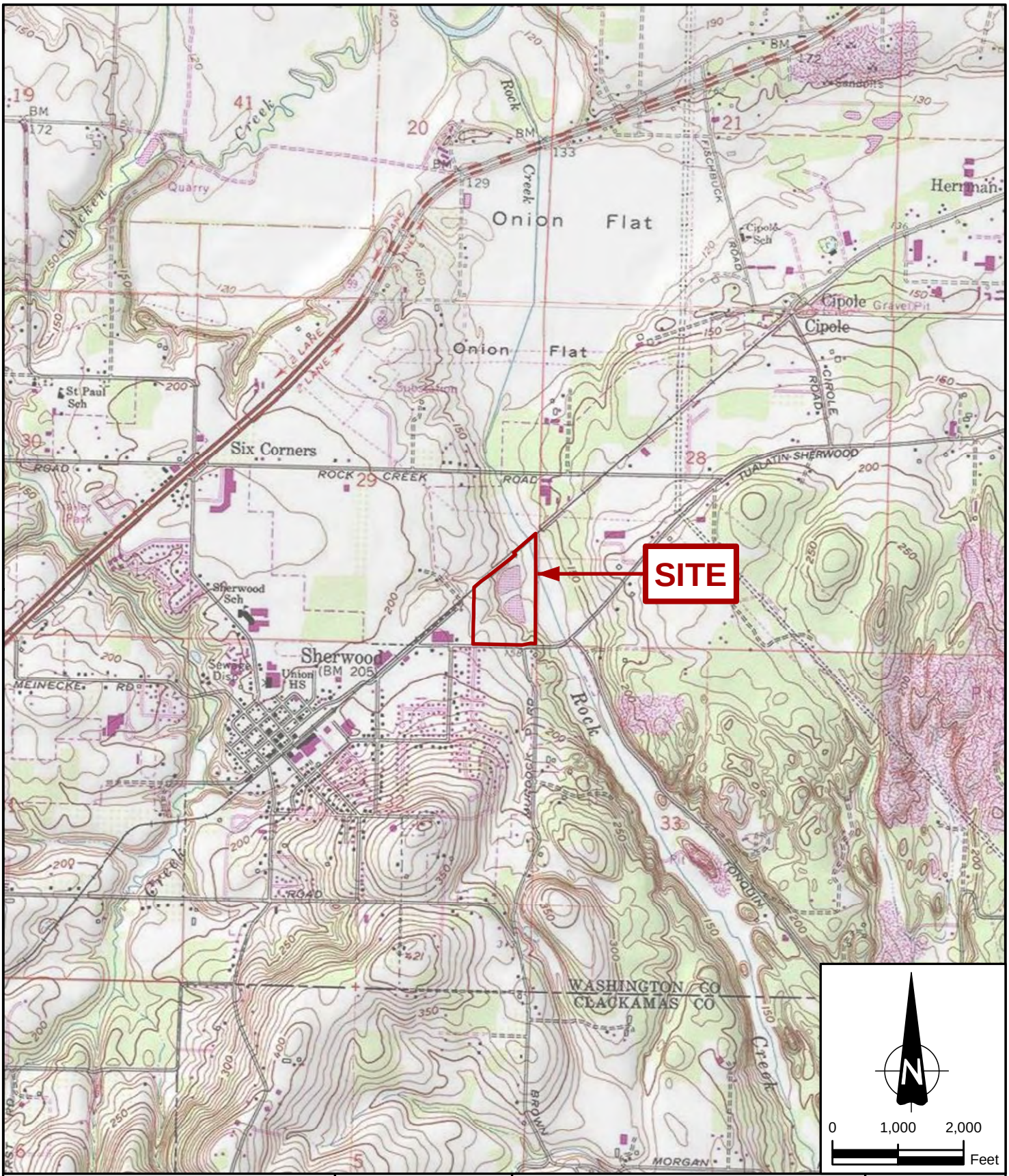
TABLE 7
CALCULATION & SUMMARY OF RME RISKS - WETLAND EXPOSURE UNIT

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{SS} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{SS} * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBC_{SS} (mg/kg)	Noncarcinogenic RME RBC_{SS} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Recreational User / Trespasser						
Arsenic	c	1.10E+01	1.00E+01	NA	1E-06	NA
Construction Worker						
Arsenic	c	1.10E+01	1.50E+01	NA	7E-07	NA
Excavation Worker						
Arsenic	c	1.10E+01	4.20E+02	NA	3E-08	NA
DEQ Acceptable Risk Levels					***1E-05***	***1.0E+00***

Notes:
c - carcinogen
EPC - exposure point concentration
mg/kg - milligrams per kilogram
NA - not applicable
nc - non-carcinogen
RBC_{SS} - direct contact (site-specific RBCs for the recreational user / trespasser receptor are provided in Appendix F)
RME - reasonable maximum exposure

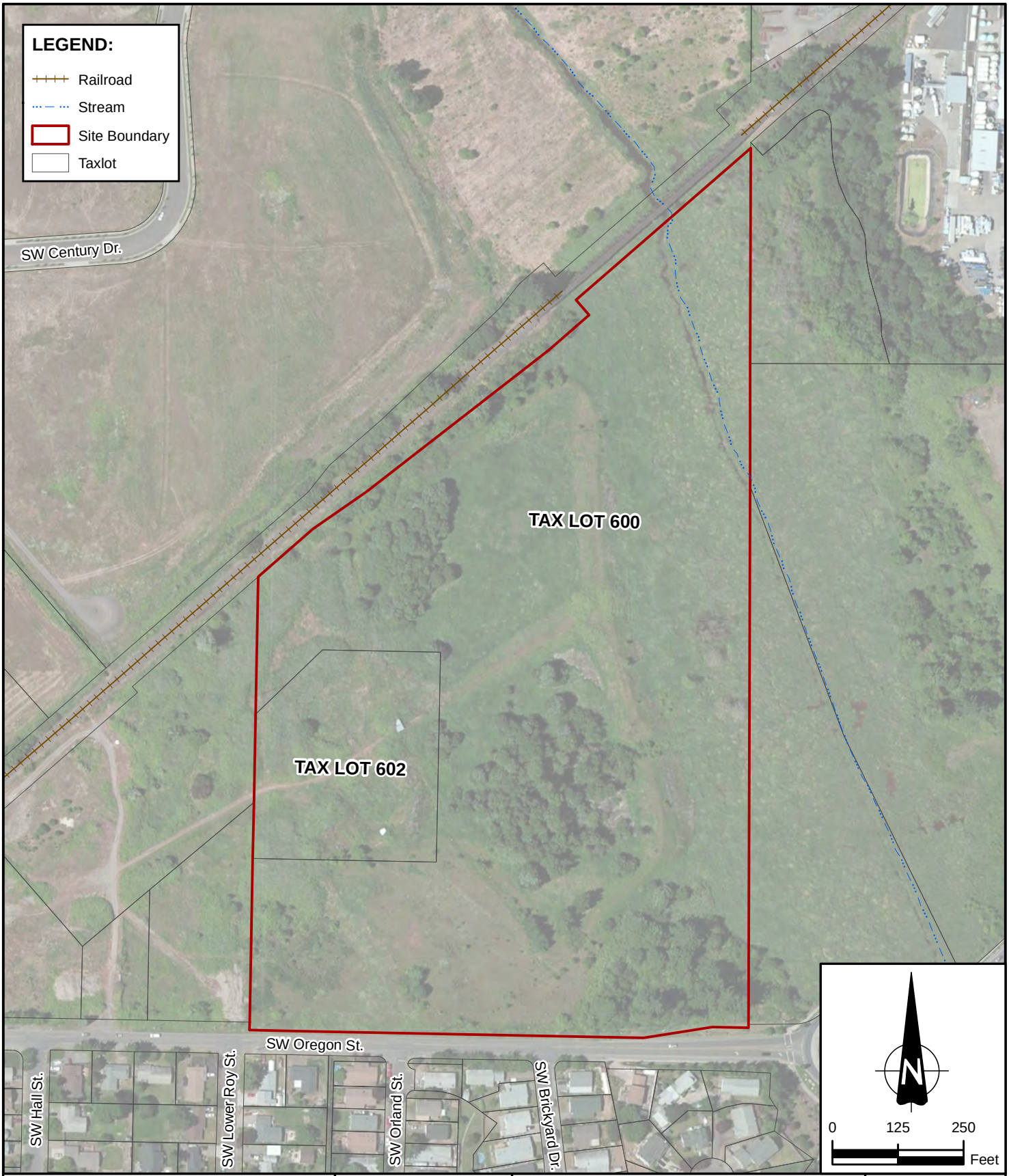
FIGURES



CITY OF SHERWOOD	amec foster wheeler	FORMER FRONTIER LEATHER PROPERTY SHERWOOD, OREGON	DATE: JANUARY 2016
			SCALE: 1 " = 2,000 '
Amec Foster Wheeler Environment & Infrastructure, Inc. 7376 S.W. Durham Road Portland, OR 97224		SITE LOCATION MAP	PROJECT NO.: 5-61M-130820-03
			FIGURE: 1

DRAWN BY: SD CHECKED BY: MP

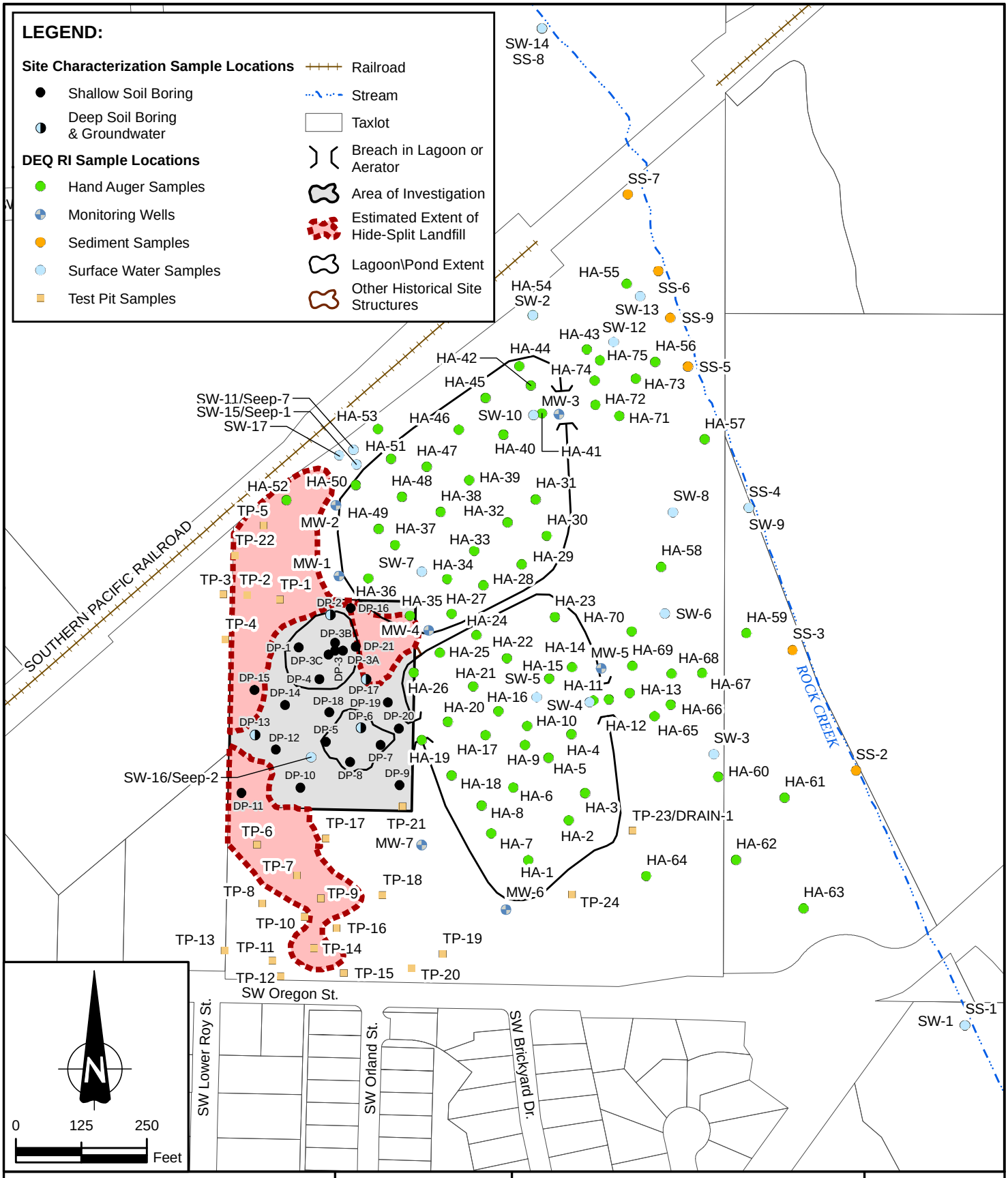
K:\13000\13000\13082\DWG_Site_Characterization\Figure 1 - Site Location Map.mxd - stephane.descombes - 1/29/2016 - 11:45:44 AM



CITY OF SHERWOOD	amec foster wheeler	FORMER FRONTIER LEATHER PROPERTY SHERWOOD, OREGON	DATE: FEBRUARY 2016
			SCALE: 1 " = 250 '
Amec Foster Wheeler Environment & Infrastructure, Inc. 7376 S.W. Durham Road Portland, OR 97224		SITE PLAN	PROJECT NO.: 5-61M-130820-03
			FIGURE: 2

DRAWN BY: SD CHECKED BY: MP

K:\13000\13000\13082\DWG_Site_Characterization\Figure 2 - Site Plan.mxd - stephane.descombes - 2/3/2016 - 8:34:02 AM



CITY OF SHERWOOD

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Portland, OR 97224

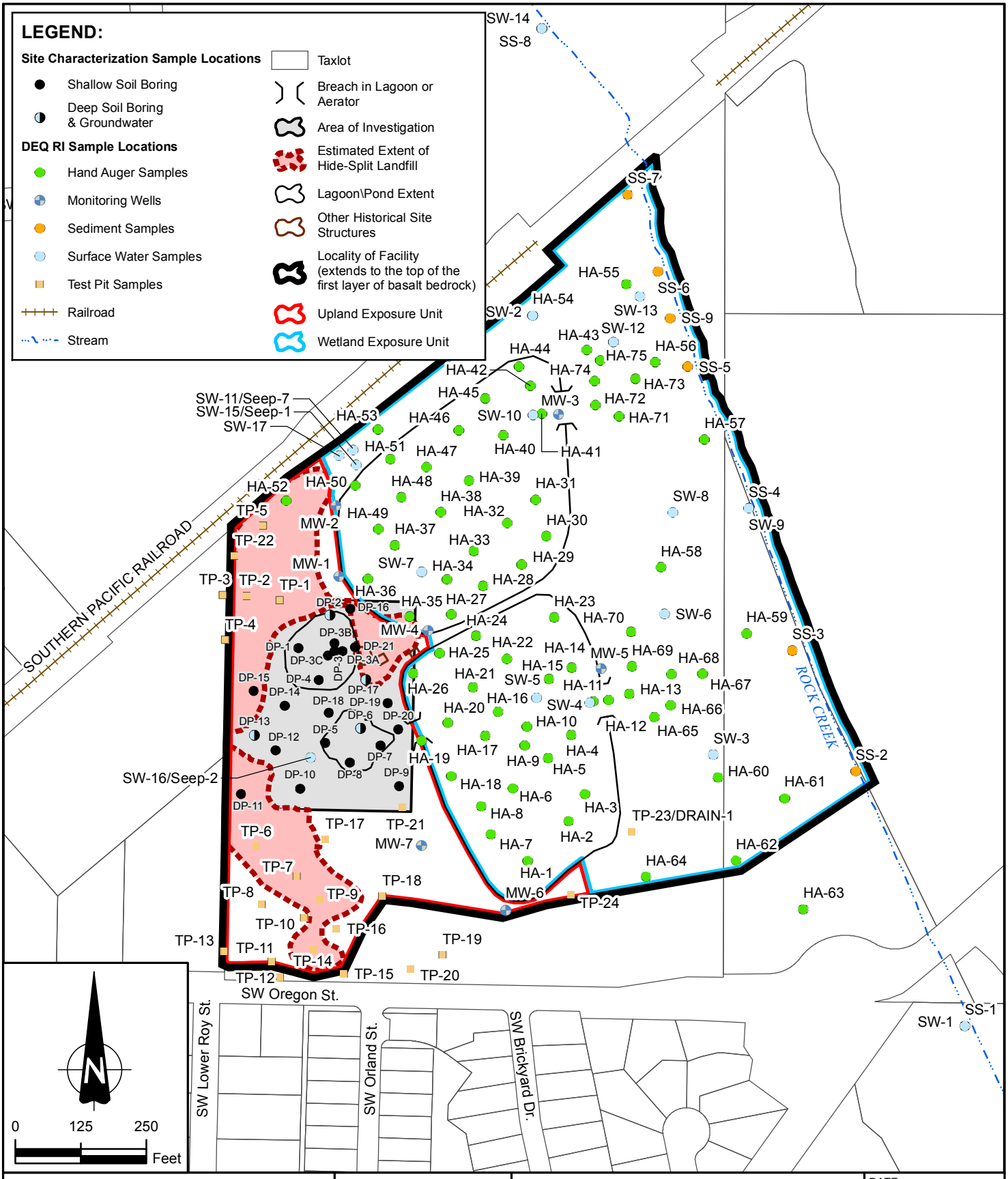
FORMER FRONTIER LEATHER PROPERTY
SHERWOOD, OREGON

SAMPLING LOCATIONS & ESTIMATED EXTENT OF HIDE-SPLIT LANDFILL

DATE: FEBRUARY 2016
SCALE: 1 " = 250 '
PROJECT NO.: 5-61M-130820
FIGURE: 3

DRAWN BY: SD CHECKED BY: MP

K:\13000\13000\13082\DWG_Site_Characterization\Figure 3 - Sampling Locations and Estimated Extent of Hide-Split Landfill.mxd - stephane.descombes - 2/3/2016 - 8:37:11 AM



CITY OF SHERWOOD

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FORMER FRONTIER LEATHER PROPERTY SHERWOOD, OREGON

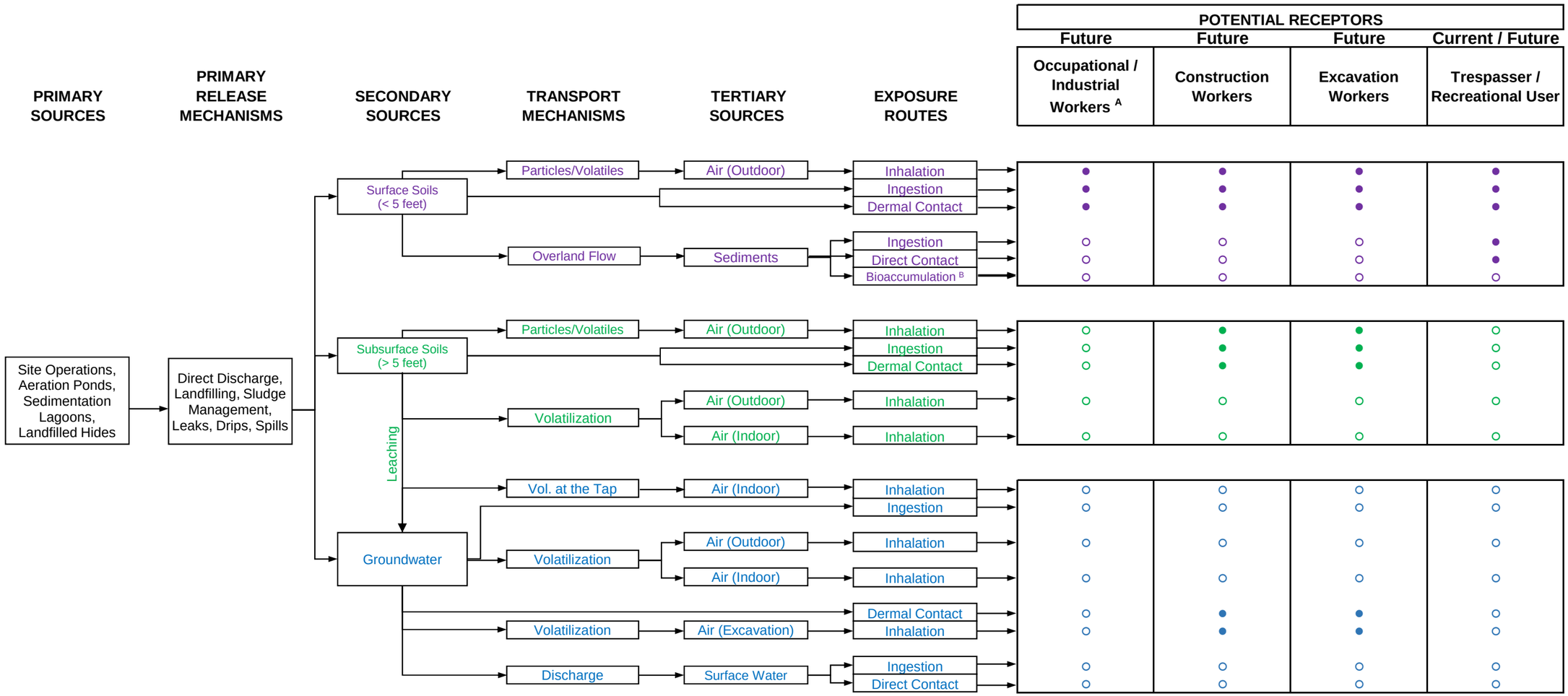
LOCALITY OF FACILITY & EXPOSURE UNITS

DATE: JUNE 2016
SCALE: 1 " = 250 '
PROJECT NO.: 5-61M-130820
FIGURE: 4

DRAWN BY: SD CHECKED BY: MP

K:\13000\13000\13082\DWG_Site_Characterization\Figure 4 - Locality of Facility & Exposure Units.mxd - stephane.descombes - 6/17/2016 - 12:11:39 PM

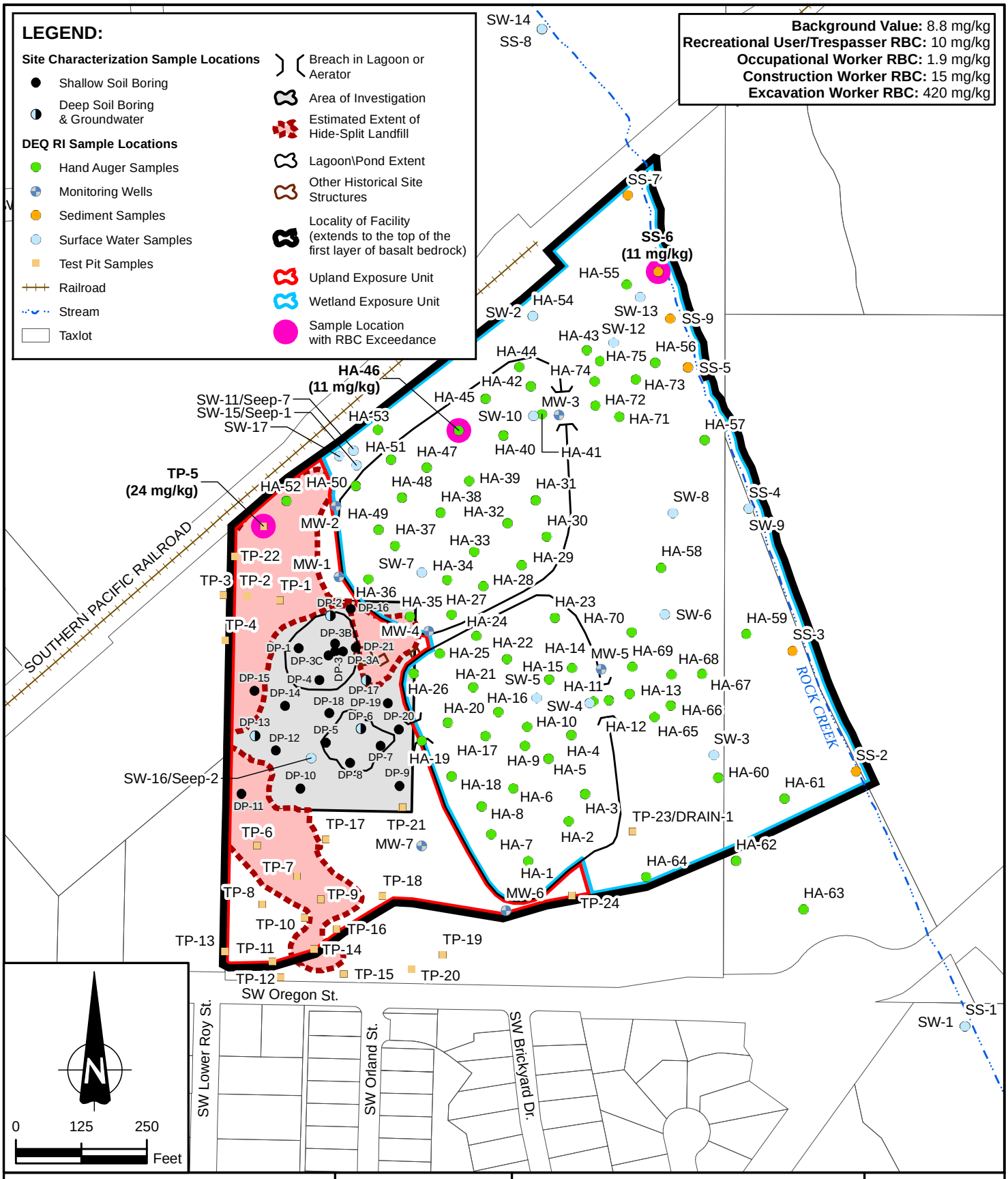
FIGURE 5
CONCEPTUAL SITE MODEL FOR HUMAN RECEPTORS
Former Frontier Leather Tannery Property



Notes:
● This route is a primary source of exposure.
○ There is no exposure by this route.

[A] Occupational/industrial workers are anticipated to use only the upland portion of the site.
[B] Assumes receptors at the Site do not consume fish from Rock Creek.

Additional evaluation of ecological receptors is not planned because the results of the ecological risk assessment (ERA) prepared in 2004 during the remedial investigation (GeoEngineers, 2004) are still valid and because no ecological habitat is anticipated for the upland portion of the Site following redevelopment.
The results of the 2004 ERA are summarized in Section 5.5 provides the rationale that support the 2004 conclusions as still valid.



CITY OF SHERWOOD

FORMER FRONTIER LEATHER PROPERTY
SHERWOOD, OREGON

DATE
FEBRUARY 2016

SCALE
1 " = 250 '

PROJECT NO.
5-61M-130820

FIGURE
6A

SAMPLE LOCATIONS WHERE ARSENIC CONCENTRATIONS EXCEEDED RBCs

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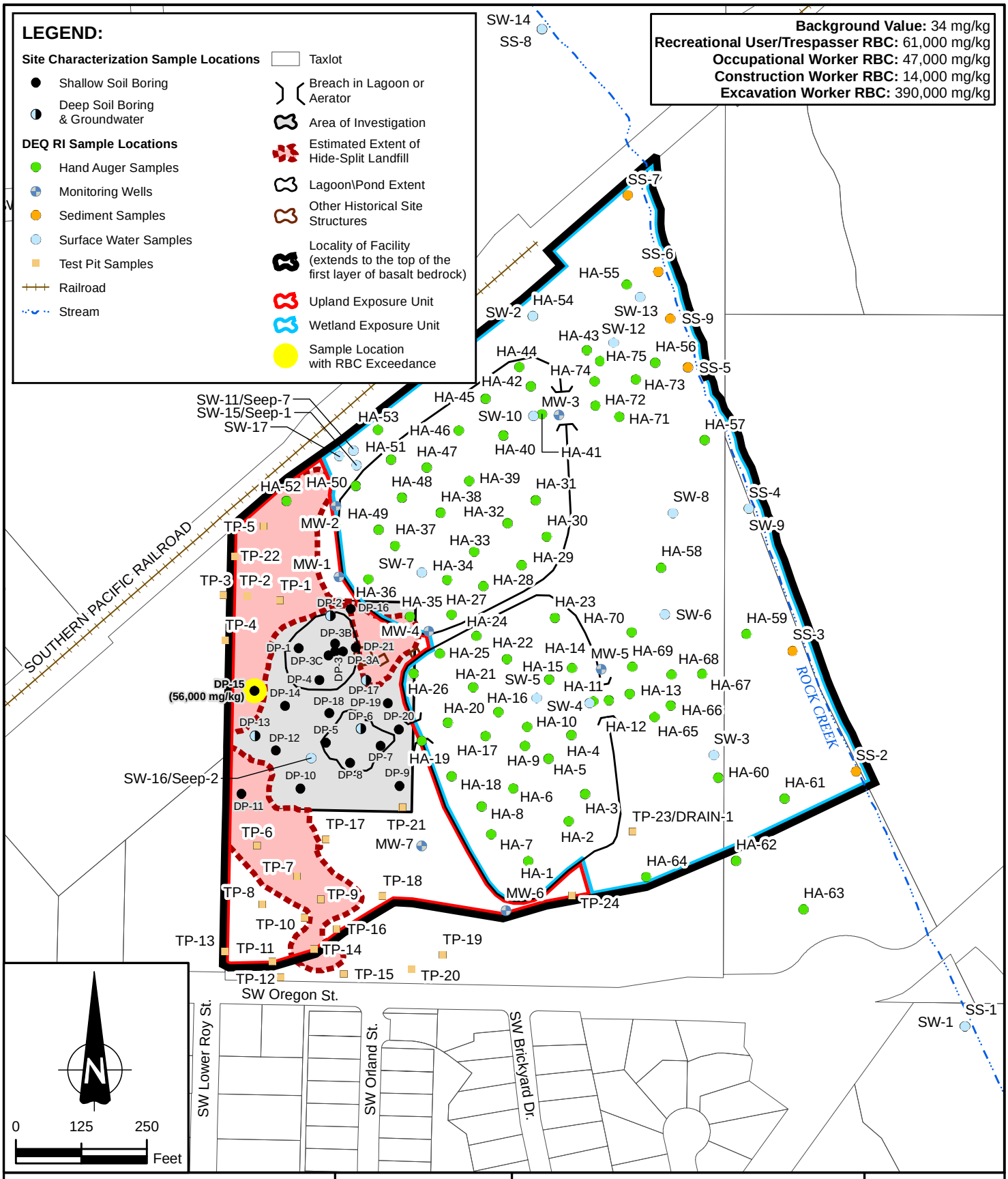
K:\13000\13000\13082\DWG_Site_Characterization\Figure 6A - Sample Locations where Arsenic Concentrations Exceeded RBCs.mxd - stephane.descombes - 2/3/2016 - 8:40:59 AM



CITY OF SHERWOOD

FORMER FRONTIER LEATHER PROPERTY
SHERWOOD, OREGON

SAMPLE LOCATIONS WHERE COPPER CONCENTRATIONS EXCEEDED RBCs

DATE: FEBRUARY 2016
SCALE: 1 " = 250 '
PROJECT NO.: 5-61M-130820
FIGURE: 6B

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Portland, OR 97224

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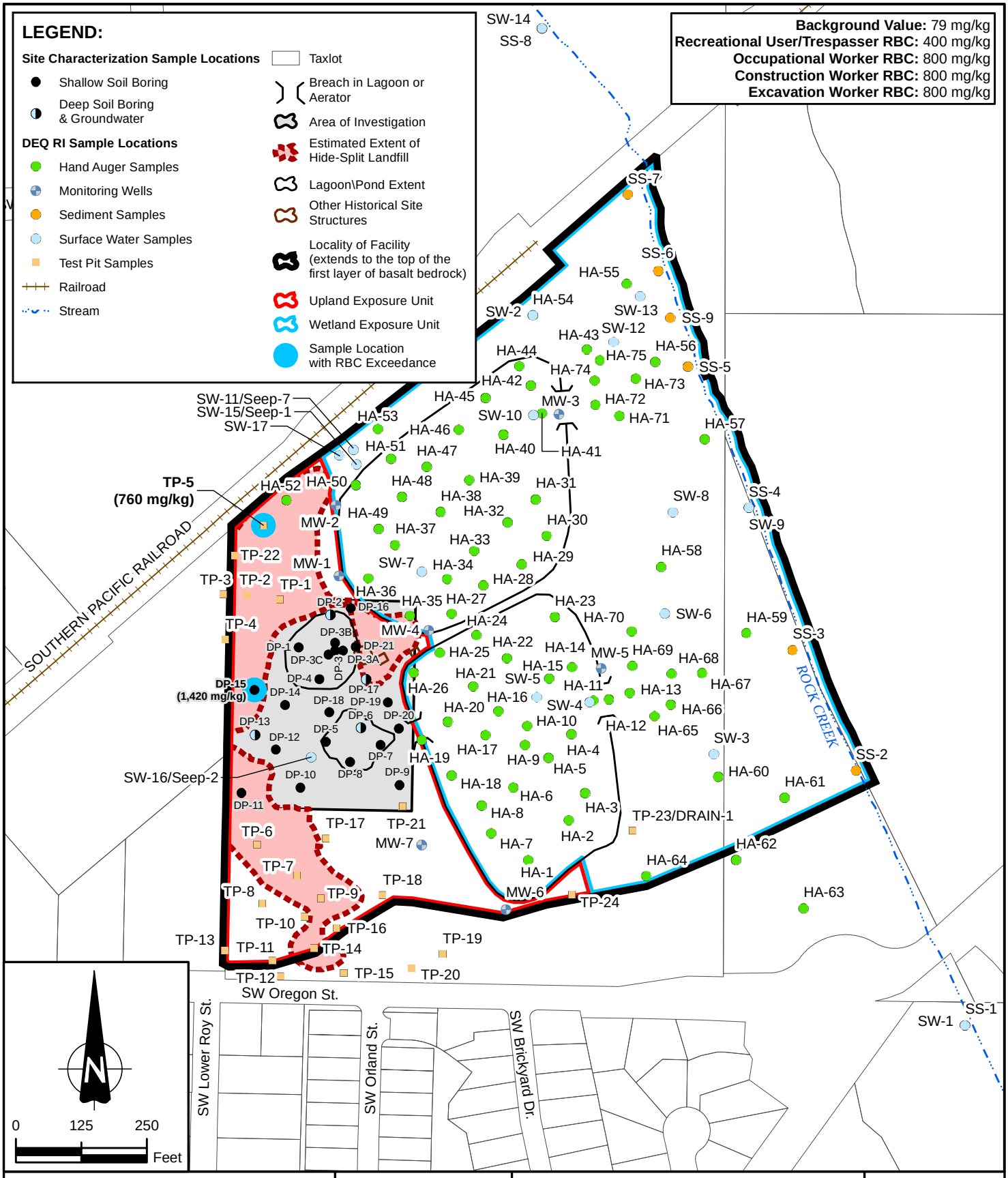
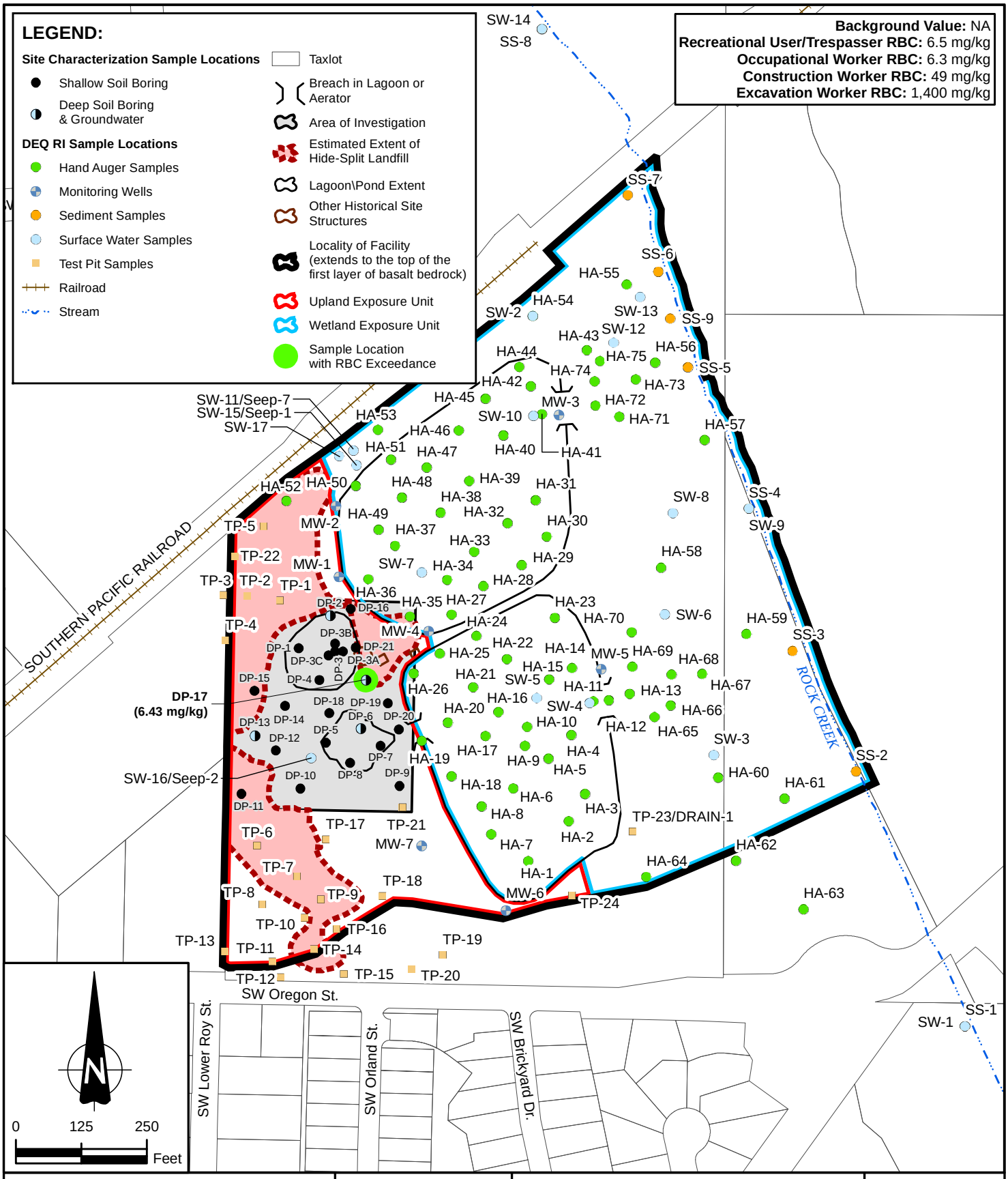
K:\13000\13000\13082\DWG_Site_Characterization\Figure 6B - Sample Locations where Copper Concentrations Exceeded RBCs.mxd - stephane.descombes - 2/3/2016 - 8:40:33 AM



CITY OF SHERWOOD		FORMER FRONTIER LEATHER PROPERTY SHERWOOD, OREGON	DATE: FEBRUARY 2016
			SCALE: 1 " = 250 '
Amec Foster Wheeler Environment & Infrastructure, Inc. 7376 S.W. Durham Road Portland, OR 97224	amec foster wheeler	SAMPLE LOCATIONS WHERE LEAD CONCENTRATIONS EXCEEDED RBCs	PROJECT NO. 5-61M-130820
			FIGURE 6C

DRAWN BY: SD CHECKED BY: MP

K:\13000\13000\13082\DWG_Site_Characterization\Figure 6C - Sample Locations where Lead Concentrations Exceeded RBCs.mxd - stephane.descombes - 2/3/2016 - 8:43:35 AM



CITY OF SHERWOOD

FORMER FRONTIER LEATHER PROPERTY
SHERWOOD, OREGON

DATE
FEBRUARY 2016

SCALE
1 " = 250 '

PROJECT NO.
5-61M-130820

FIGURE
6D

SAMPLE LOCATIONS WHERE HEXAVALENT CHROMIUM CONCENTRATIONS EXCEEDED RBCs

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7376 S.W. Durham Road
Portland, OR 97224

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K:\13000\13000\13082\DWG_Site_Characterization\Figure 6D - Sample Locations where Hexavalent Chromium Concentrations Exceeded RBCs.mxd - stephane.descombes - 2/3/2016 - 8:43:11 AM

APPENDIX A

Geophysical Investigation Report

GeoPotential

ENVIRONMENTAL & EXPLORATION GEOPHYSICS

22323 East Wild Fern Lane, Brightwood, Oregon 97011 • PH (503) 622-0154 • FAX (503) 622-0526
WEB http://www.geopotential.biz/ E-MAIL GeoPotential@geopotential.biz

SUMMARY REPORT

SUBSURFACE MAPPING SURVEY TO DETECT LANDFILL DEBRIS

FORMER FRONTIER LEATHER PROPERTY
SW LOWER ROY AND OREGON STREET
SHERWOOD, OREGON

CLIENT
Amec Foster Wheeler
7376 SW Durham Road
Portland, Oregon
97224

DATE OF SURVEY

November 2-4, 2015

GeoPotential Project Number: 9446

CONTENTS

FIGURES

APPENDIX

SUMMARY

A geophysical survey was conducted upon an unimproved property located near the intersection of SW Lower Roy and Oregon Street, Sherwood, Oregon for the purpose of identifying potential landfill areas which may contain leather hide splits.

A GPR Survey was performed for the landfill search.

Areas containing hide splits were identified and categorized during the survey; a GPS map was created.

A Borehole Clearance Survey (BHCS) was performed on twenty proposed boreholes.

INTRODUCTION

Anthony Bartruff and Jose Martinez of GeoPotential conducted the Subsurface Mapping Survey (SMS); Graeme Taylor represented AMEC FOSTER WHEELER onsite. Fieldwork was carried out on November 2-4, 2015. The report was completed and e-mailed to AMEC FOSTER WHEELER on November 12, 2015.

Subsurface mapping surveys are geophysical surveys utilizing geophysical methods and data to detect and locate natural and manmade subsurface features. Ground Penetrating Radar (GPR) Surveys are used to map both natural and manmade subsurface features such as USTs, utilities; backfilled pits, etc. (see Appendix A). Pipe and cable locators are used to map the locations of buried utilities and piping.

GPR surveys are used to map the locations, depths, sizes and shapes of objects.

SURVEY OBJECTIVES

The objectives of this subsurface mapping survey are:

1. Search for and map all landfill areas containing hide splits.
2. Map the extents of former holding ponds onsite.
3. Clear 20 proposed boreholes.

SURVEY SITE

The survey location is depicted on Figure 1 and 2. The SMS was performed on portions of a former leather tannery located near Lower Roy and Oregon Street, Sherwood, Oregon. The survey Site consists of approximately three acres generally sloping down to the East-Northeast. Bisecting two former holding pounds located within the middle of the Site is a gravel road running East-West. The site was relatively clear of vegetation and appeared to have been cleared recently. Surface debris related to the former facility, including concrete, metal pipes, and general debris is spread though out the site.

SURVEY EQUIPMENT

The following geophysical instruments were used to conduct the survey:

- Mala RAMAC Ground Penetrating Radar System with a 250 MHz antenna (GPR Survey).
- Schonstedt GA52 Magnetic Gradiometer.
- Aqua-Tronics A6 Pipe & Cable locator.
- Heath Sure-Lock Pipe & Cable locator.
- Trimble A132 Global Positioning System (GPS Survey)

This equipment and the procedures used to meet the survey objectives of this project have been proven effective in detecting buried landfill material.

Geophysical techniques are excellent at detecting changes in the subsurface caused by natural and manmade objects; however, they are poor at actually identifying subsurface features. Complementary methods may be used to assist in the interpretation; however, the only sure way of identifying a buried feature is by excavation.

PROCEDURE

GPR Survey

The GPR Survey consisted of acquiring a number of GPR Profiles across the Site to search for landfill debris to a depth of 8-10 feet.

Pipe & Cable Survey

Magnetic and electromagnetic scans were conducted to search for utilities which could be impacted by planned drilling operations.

RESULTS

Results were marked on the Site and are shown on Figures 1 and 2.

In general, the site appeared to have two types of hide split fill:

1. Hide splits below the surface: typically buried by approximately 2 feet of soil fill. The hide splits outcrop in a topographic terrace located on the western half of the site and are depicted within Figure 2.

2. Hide splits at ground surface: these appear to be hide splits originally deposited on the surface or displaced post-deposition. They are located primarily and sporadically above the two holding ponds as shown within Figure 2.

Both holding ponds were mapped and profiled; the North pond appears to have disturbed sediment to a depth of at least 6 feet. The South pond appears to have sediments to a depth of four feet.

20 proposed boreholes were cleared of utilities which may affect drilling operations.

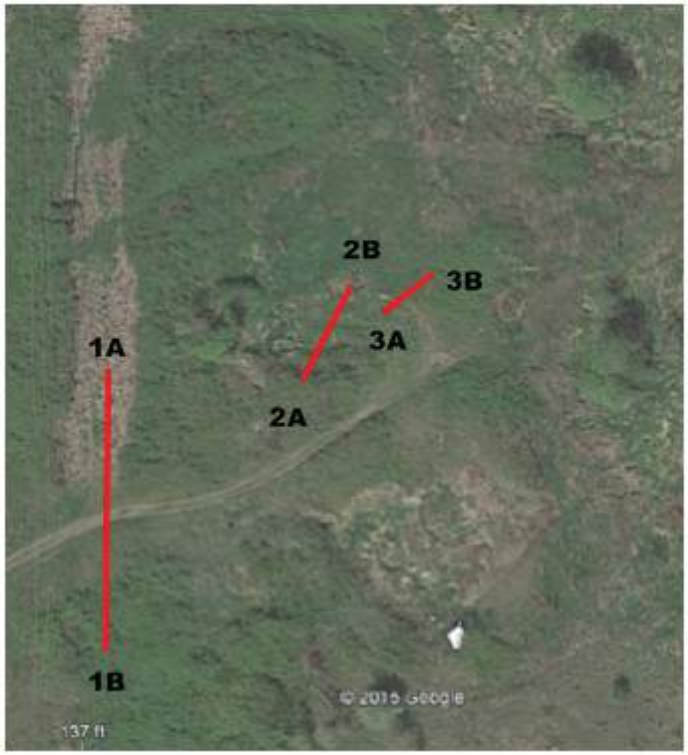
LIMITATIONS

Limitations of magnetometer and GPR surveys can be seen in the Appendices.

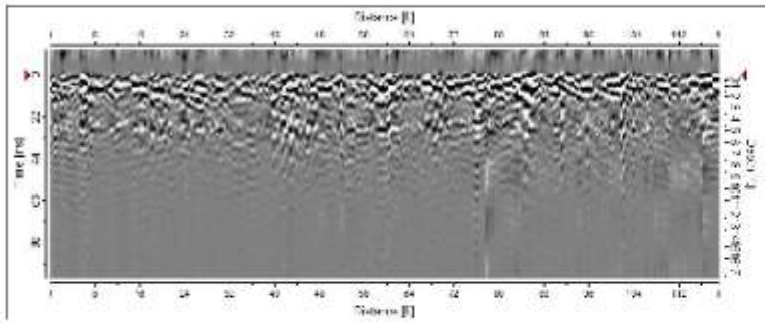
Geophysical surveys consist of interpreting geophysical responses from subsurface features. Since a variety of subsurface features can produce identical geophysical responses, it is necessary to confirm the geophysical interpretation with intrusive investigations such as excavating or drilling. In addition, many subsurface features may produce no geophysical response.

Ralph Soule
GeoPotential

Anthony Bartruff
GeoPotential



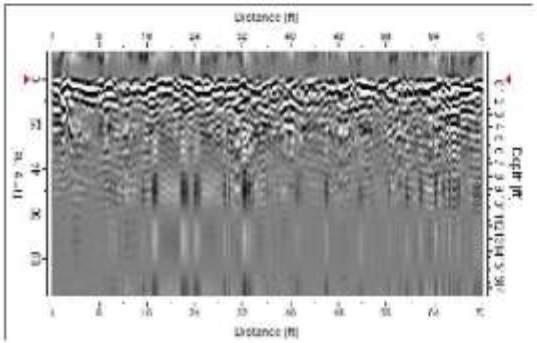
2A



2B

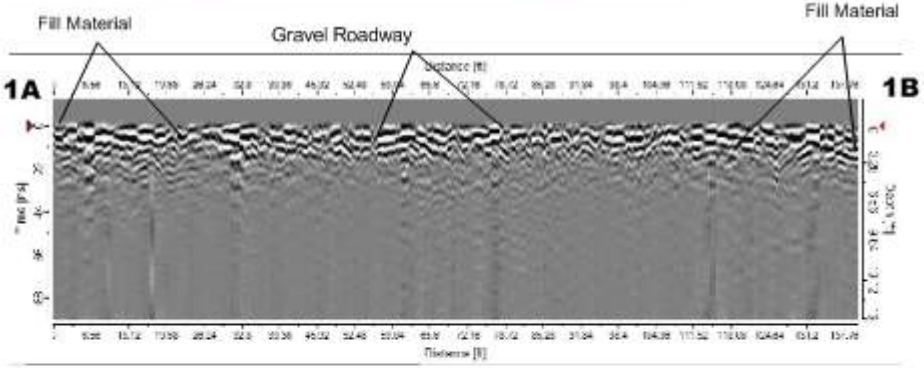
Sediment stack of the settling pond

3A



3B

Fill material/hide splits located immediately to the Northeast of the settling pond.



Cross-section showing an example of the hide split fill material in conjuction with the gravel roadway.

GeoPotential

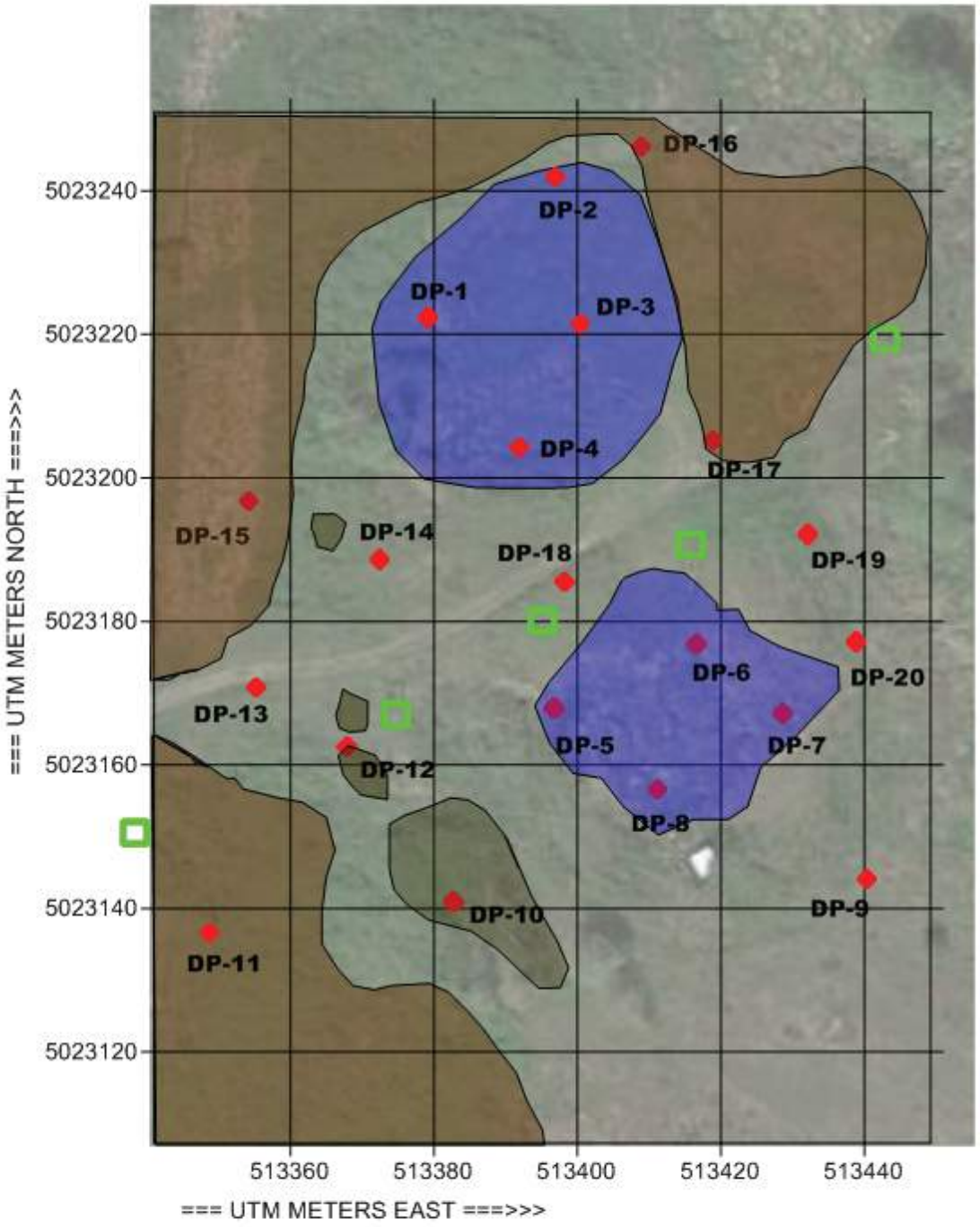
ENVIRONMENTAL & EXPLORATION GEOPHYSICS

DATE: August 24, 2015 SUBSURFACE MAPPING SURVEY PROJECT No. 9448

LOCATION: Former Frontier Leather Property, NW Oregon Street, Sherwood, OR

Figure 1. Radar Profile Examples

CLIENT: Amec Foster Wheeler



Hide Splits Below Ground Surface Within the Fill Area

Hide Splits Above Ground Surface Not Within the Fill Area

Utility Vault

Former Settling Pond

Proposed Borehole

GeoPotential

SUBSURFACE MAPPING SURVEY

Former Frontier Leather Property
SW Oregon Street
Sherwood, OR

Figure 2
Interpretation Map

Amec Foster Wheeler

GeoPotential

ENVIRONMENTAL & EXPLORATION GEOPHYSICS

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GROUND PENETRATING RADAR SURVEYS

Ground Penetrating Radar (GPR) can be a valuable tool to accurately locate both metallic and non-metallic UST's and utilities, buried drums and hazardous material at some sites. It may detect objects below reinforced concrete floors and slabs. GPR may delineate trenches and excavations and, under some conditions, it may be used to locate contaminant plumes. It has been used as an archaeological tool to look for buried artifacts. It may accurately profile fresh water lake bottoms either from a boat or from a frozen lake surface. GPR may be used to locate voids below roads and runways. GPR has numerous engineering applications. It can be used in non-destructive testing of engineering material, for example, locating rebar in concrete structures and determining the thickness of concrete and other structural material.

GPR uses short impulses of high frequency radio waves directed into the ground to acquire information about the subsurface. The energy radiated into the ground is reflected back to the antenna by features having different electrical properties to that of the surrounding material. The greater the contrast, the stronger the reflection. Typical reflectors include water table, bedrock, bedding, fractures, voids, contaminant plumes and man-made objects such as UST's and metal and plastic utilities. Materials having little electrical contrast like clay and concrete pipes may not produce strong reflections and may not be seen. Data are digitally recorded or downloaded to a laptop computer for filtering and processing.

The frequency of the radar signal used for a survey is a trade off. Low frequencies (250 MHz – 50 MHz) give better penetration but low resolution so that pipes and utilities may not be seen. Pipes and utilities may be seen using higher frequencies (500 MHz) but the depth of penetration may be limited to only a few feet especially in the wet, clayey soils found in many areas of the NW USA. The GPR frequency is dependent upon the antenna. Once an antenna is selected, nothing the operator can do can increase the depth of penetration.

Radar data is ambiguous. Many buried objects produce echoes that may be similar to the echo expected from the target object. Boulders and debris produce reflections that are similar to pipes and tanks. Subtle changes in the electrical properties along a traverse caused by changes in soil type, mineralogy, grain size, and moisture content all produce “noise” that can make interpretation difficult. Interpreting radargrams is an art as much as a science.

Under some conditions, although a UST itself may not be clearly visible in a GPR record, the excavation or trench in which the UST is buried is evident. Usually GPR data is used to compliment data from other “tools”. For example, a trench-like reflection but no clear UST reflection, combined with a “tank” shaped magnetic anomaly suggests the presence of a UST. Although the UST itself could not be seen using GPR, the radar showed a trench-like reflection. The magnetic data showed a large ferrous object. We would report a possible UST at that location.

GPR is often used in conjunction with magnetometer surveys. Magnetometer Surveys are very fast and large areas can be covered cost effectively. Magnetic anomalies are marked in the field, and then may be further investigated using radar.

GPR, like other geophysical tools, is excellent at detecting changes across a site, but it is poor at actually identifying the cause of the change. **The only definite way to identify buried objects is through excavation.**

ADVANTAGES - General

- When GPR data is properly interpreted subsurface objects can usually be confidently identified. This often requires the GPR data be combined with other geophysical data, surface features and historical information.
- GPR provides continuous records along traverses which, depending on the goal of the survey, may be interpreted in the field.
- At flat, open sites, for reconnaissance purposes, the antenna can be towed behind a vehicle at several mph.
- Many GPR antennas are shielded and are unaffected by surface and overhead objects and power lines.
- GPR can be used in conjunction with magnetic or EM surveys to accurately locate buried objects.

ADVANTAGES – Site specific

- With a low frequency antenna, in clean, dry, sandy soil, reflections from targets as deep as 100 feet are possible. Geologic features such as bedrock and cross bedding may be seen at some sites.
- The resolution of data is very high particularly for high frequency antennas.
- Shallow, man-made objects generally can be detected.
- Fiberglass UST's and plastic pipes can be detected using GPR.

LIMITATIONS - General

- To acquire the highest quality data, proper coupling between the antenna and the ground surface is necessary. Poor data may be obtained at sites covered with debris, an uneven surface, tall grass and brush. Objects located at curbs are difficult to see.
- Acquiring GPR data is slow. The antenna must be over the target. The signal from the antenna is cone-shaped. Reflections from objects to the side of the antenna may be seen, but their actual location relative to the antenna is not obvious.
- Penetration of the GPR signal is "site specific" and its depth of penetration at a particular site cannot be predicted ahead of time. Near surface conductive material, such as salty or contaminated ground water and wet, clay-rich soil, may attenuate the radar signal, limiting the effective depth of the survey to several feet. Reinforced concrete also can attenuate the signal. Rebar may produce reflections that look like pipes.

- GPR may not be cost-effective for some projects. For a detailed survey mapping underground storage tanks and utilities, it may be necessary to collect data in orthogonal directions at 5-foot line spacing.

LIMITATIONS – Interpretation

- Interpretation can be difficult. Radar data are ambiguous. Subsurface objects can be detected but, in general, they cannot be identified. USTs and utilities have a characteristic reflection, however, large rocks and boulders have a similar reflection.

- The reflection visible in a GPR record is very complex and may be caused by small changes in the electrical properties of the soil. The target in mind may not produce the reflection. Due to "noise", the target may be missed. USTs and deep utilities may be missed if they are under debris and/or other pipes.

- Other methods may be necessary to aid in the interpretation of the data (use a magnetometer to detect a large metallic mass, then GPR to determine if the object is tank-like, or a utility locator to determine if there are feed lines and fill pipes leading to the object).

- Adequate contrast between the ground and the target is required to obtain reflections. UST's may be missed if they are badly corroded. Utilities made of "earth" materials like clay and concrete may not be detected since their electrical properties are similar to the surrounding soil.

- To determine the depth to an object without "ground truth", assumptions must be made regarding soil properties. Even with ground truth at several locations on the same site, changes in material across a site (therefore changes in signal velocity) can cause errors in depth measurements at other locations.

APPENDIX B

Boring Logs & Field Forms

APPENDIX B-1

Boring Logs

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SW	Brown, moist, fine to coarse SAND, trace silt.						DP-01 0-1
			Wet at 3 feet bgs.						DP-01 3.5-4.5
		ML	Light brown to gray, wet, clayey SILT, trace fine sand.						
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
LOCATION: North Aeration Pond

BOREHOLE DIAMETER:
REMARKS:

DRILL RIG: NA
GROUND SURFACE ELEVATION: NA

CONTRACTOR: Pacific Soil & Water, Inc.

LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/10/2015 - 11/10/2015

Former Frontier Leather Property
Sherwood, Oregon

5-61M-130820

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Environment & Infrastructure, Inc.
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LOG OF BORING DP-01

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	TESTING AND LABORATORY DATA
0	ML	Gray with orange mottling, moist, sandy SILT.	DP-02 0-1
			DP-02 3.5-4.5
5	SP	Medium dense, moist, poorly graded, medium SAND, trace mica. Increased orange mottling at 5 feet bgs.	
	SM	Gray with trace orange mottling, moist, silty SAND.	DP-02 8-9
10		Brown at 9 feet bgs. Wet at 9.5 feet bgs. Very wet at 10 feet bgs. Increased sand from 10 to 11 feet bgs.	
15		End of boring at 15 feet bgs.	
20			
25			
30			

GRAPHIC LOG · SAMPLE · VOLATILE READING (ppm) · GROUNDWATER · GW SCREENED INTERVAL · FIELD TESTING

BORING METHOD: Direct Push
BOREHOLE DIAMETER:
DRILL RIG: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
DRILLING DATES: 11/10/2015 - 11/10/2015

LOCATION: North Aeration Pond
REMARKS:

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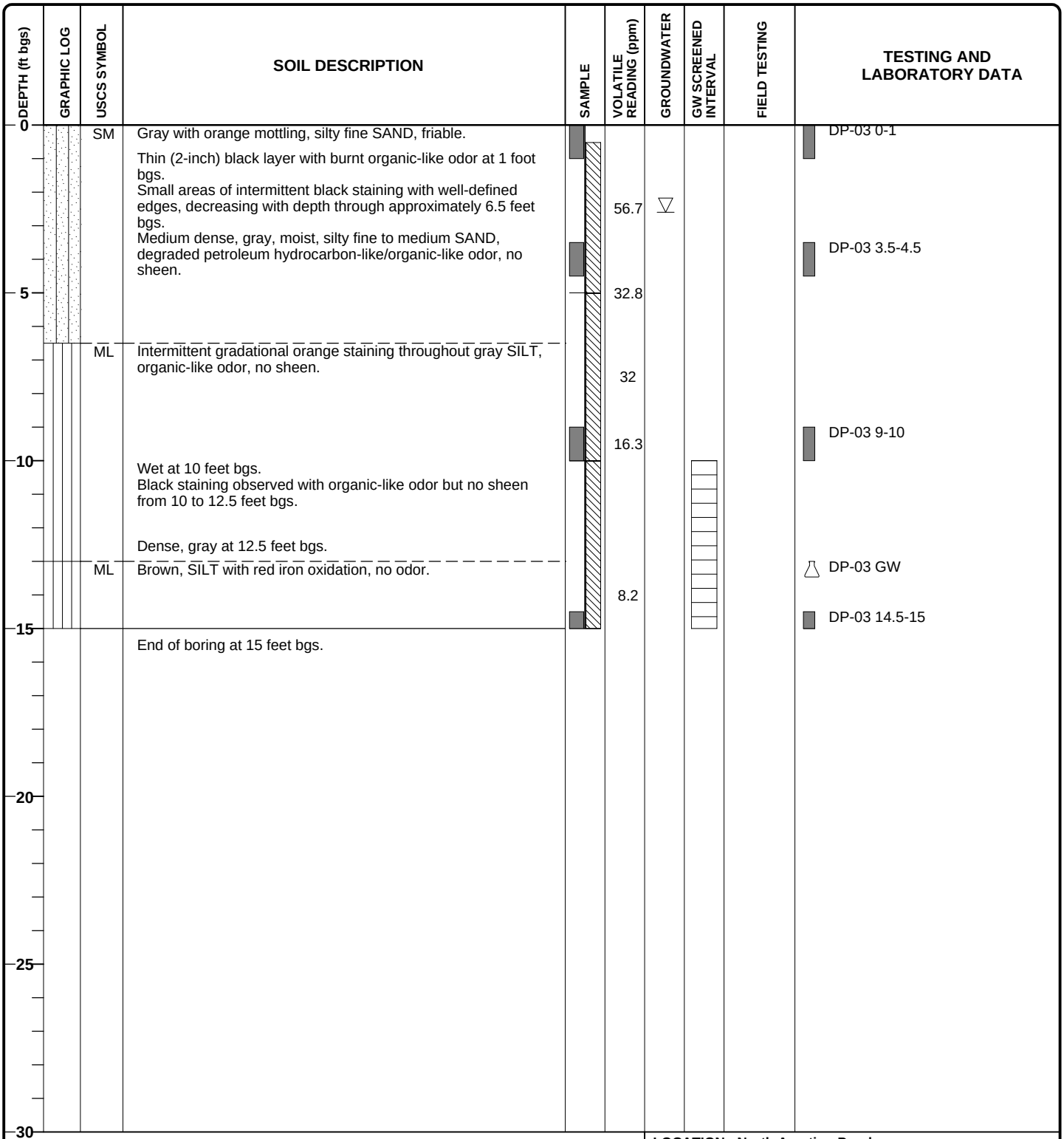
LOG OF BORING DP-02



BORING METHOD: Direct Push
BOREHOLE DIAMETER:
DRILL RIG: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
DRILLING DATES: 11/10/2015 - 11/11/2015

LOCATION: North Aeration Pond

REMARKS:
Conditions at DP-03 appear to be localized.

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LOG OF BORING DP-03

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Brown with orange mottling, dry, SILT with sand.						
		SM	Gray, sandy SILT, slight organic odor.						
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
LOCATION: North Aeration Pond

BOREHOLE DIAMETER:
REMARKS:

DRILL RIG: NA
GROUND SURFACE ELEVATION: NA

CONTRACTOR: Pacific Soil & Water, Inc.

LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/11/2015 - 11/11/2015

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LOG OF BORING DP-03A

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SM	Brown, fine sandy SILT with rust mottling.						
			Coarse sand with depth, minimal black staining.						
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
LOCATION: North Aeration Pond

BOREHOLE DIAMETER:
REMARKS:

DRILL RIG: NA
GROUND SURFACE ELEVATION: NA

CONTRACTOR: Pacific Soil & Water, Inc.

LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/11/2015 - 11/11/2015

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LOG OF BORING DP-03B

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Clayey SILT.						
			End of boring at 3.5 feet bgs due to refusal on pipe or gravel bottom.						
5									
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
LOCATION: North Aeration Pond

BOREHOLE DIAMETER:
REMARKS:

DRILL RIG: NA
GROUND SURFACE ELEVATION: NA

CONTRACTOR: Pacific Soil & Water, Inc.

LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/11/2015 - 11/11/2015

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LOG OF BORING DP-03C

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SM	Light brown to gray, moist, sandy SILT, fine to medium sand, organics (rootlets).			▽			DP-04 0-1
			Trace subangular gravel and coarse sand at 3 feet bgs.						DP-04 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push

BOREHOLE DIAMETER:

DRILL RIG: NA

CONTRACTOR: Pacific Soil & Water, Inc.

LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

DRILLING DATES: 11/10/2015 - 11/10/2015

LOCATION: North Aeration Pond

REMARKS:
Poor recovery, pushed twice.

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LOG OF BORING DP-04

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		GC	Brown, clayey GRAVEL.						DP-05 0-1.5
		SM	Medium dense, gray, moist, silty fine to coarse SAND.						
		ML	Gray, moist, SILT with fine sand.						DP-05 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
LOCATION: South Aeration Pond

BOREHOLE DIAMETER:
REMARKS:

DRILL RIG: NA
GROUND SURFACE ELEVATION: NA

CONTRACTOR: Pacific Soil & Water, Inc.

LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/11/2015 - 11/11/2015

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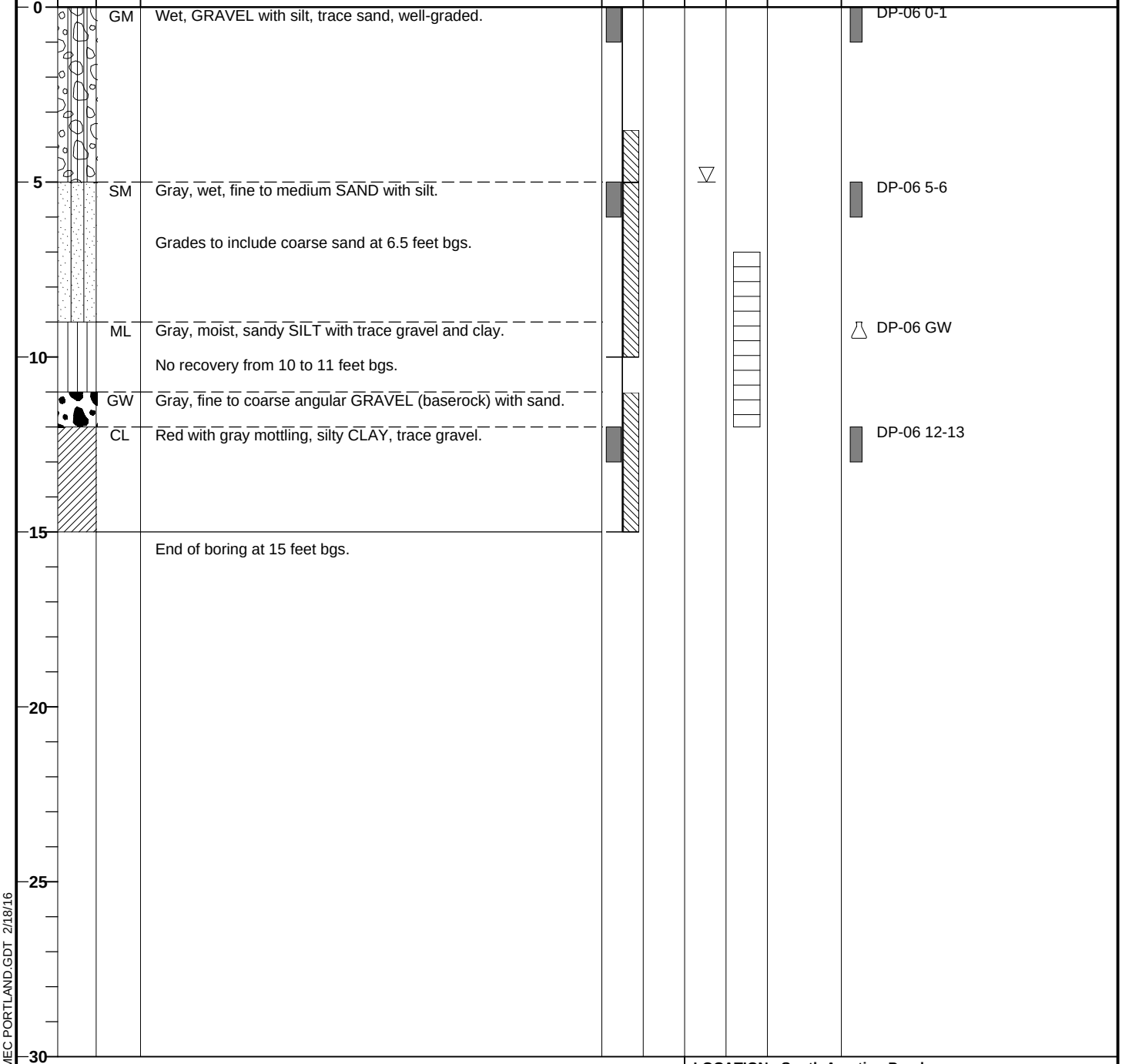
LOG OF BORING DP-05

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16



BORING METHOD: Direct Push
BOREHOLE DIAMETER:
DRILL RIG: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
DRILLING DATES: 11/10/2015 - 11/10/2015

LOCATION: South Aeration Pond

REMARKS:
Shallow refusal (2 feet bgs) in first attempt; stepout boring.

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LOG OF BORING DP-06

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SM	Medium dense, brown, dry to moist, silty fine to medium SAND.						DP-07 0-1
		ML	Gray, dry to moist, sandy SILT, fine sand.						DP-07 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER:
DRILL RIG: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
DRILLING DATES: 11/10/2015 - 11/10/2015

LOCATION: South Aeration Pond
REMARKS:

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LOG OF BORING DP-07

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Brown, moist, SILT with trace sand and clay, organics (rootlets).						DP-08 0-1
									DP-08 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
LOCATION: South Aeration Pond

BOREHOLE DIAMETER:
REMARKS:

DRILL RIG: NA
GROUND SURFACE ELEVATION: NA

CONTRACTOR: Pacific Soil & Water, Inc.

LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/10/2015 - 11/10/2015

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LOG OF BORING DP-08

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Brown, dry, SILT, trace fine sand, organics (rootlets).						DP-09 0-1
		SP	Brown to gray, dry, medium SAND.						DP-09 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: NA
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/11/2015 - 11/11/2015

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LOG OF BORING DP-09

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Brown, SILT, trace fine sand, trace gravel, fibers (hide splits?).						DP-10 0-1
			Increased sand, orange mottling, friable at 4 feet bgs.						
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: NA
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/11/2015 - 11/11/2015

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

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LOG OF BORING DP-10

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Dark brown, moist, SILT with clay, trace coarse sand.						DP-11 0-1
			Organics (wood debris) at 1.5 feet bgs.						
		ML	Light brown to gray, dry, sandy SILT, fine sand.						DP-11 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER:
DRILL RIG: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
DRILLING DATES: 11/11/2015 - 11/11/2015

REMARKS:

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LOG OF BORING DP-11

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Brown, dry, sandy SILT, very fine sand.						DP-12 0-1
			Moist at 3.5 feet bgs. Increasing sand content, trace clay from 4 to 5 feet bgs.						DP-12 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: NA
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/11/2015 - 11/11/2015

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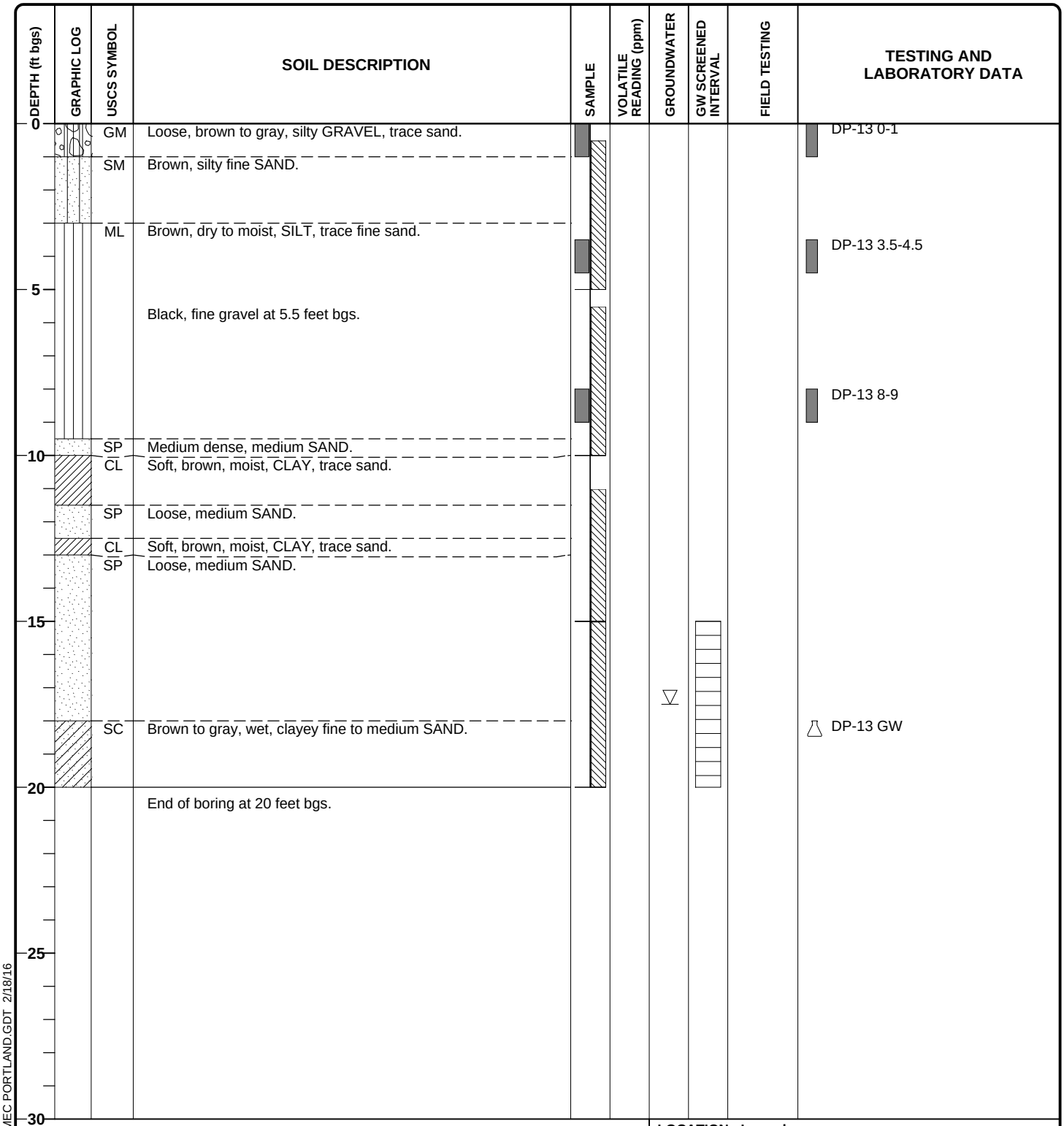
LOG OF BORING DP-12

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16



BORING METHOD: Direct Push
BOREHOLE DIAMETER:
DRILL RIG: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
DRILLING DATES: 11/11/2015 - 11/11/2015

LOCATION: In roadway
REMARKS:

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

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LOG OF BORING DP-13

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Light brown with orange mottling, dry, SILT with trace fine sand.						DP-14 0-1
			Trace clay.						DP-14 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: NA
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/11/2015 - 11/11/2015

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

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LOG OF BORING DP-14

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Brown, moist, SILT, trace clay, organics (roots and wood debris).						DP-15 0-1
		ML	Olive-gray with white mottles, very dry, sandy SILT, notably light weight, friable.						DP-15 4-5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push

BOREHOLE DIAMETER:

DRILL RIG: NA

CONTRACTOR: Pacific Soil & Water, Inc.

LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

DRILLING DATES: 11/11/2015 - 11/11/2015

LOCATION: Within Hide Split Landfill Footprint

REMARKS:
Resistance at 3 feet bgs.

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LOG OF BORING DP-15

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Light brown, dry, fine sandy SILT.						DP-16 0-1
		SM	Medium dense, dark brown and gray with orange mottling, silty SAND, trace clay.						DP-16 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: NA
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/10/2015 - 11/10/2015

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

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LOG OF BORING DP-16

DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	TESTING AND LABORATORY DATA
0	SM	Medium dense, medium brown with trace orange mottling, silty SAND, trace mica.	DP-17 0-1
			DP-17 3.5-4.5
5	ML	Soft, medium brown with increased orange mottling, moist, clayey SILT with trace fines and trace mica to SILT with gray clay.	
			DP-17 8-9
	ML	Brown with orange mottles, moist, fine sandy SILT.	
10	SW	Medium dense, red mottling, well-graded, medium SAND. Lens of gray at 12 feet bgs.	
		Entirely gray at 13.5 feet bgs.	DP-17 GW
		Silty loam, trace organics (black wood debris and rootlets).	
15		End of boring at 15 feet bgs.	
20			
25			
30			

BORING METHOD: Direct Push
BOREHOLE DIAMETER:
DRILL RIG: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
DRILLING DATES: 11/10/2015 - 11/10/2015

REMARKS:

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

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Tel (503) 639-3400

LOG OF BORING DP-17

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SM	Dense, light brown with orange mottling, silty fine to medium SAND.						DP-18 0-1 DP-18 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: NA
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/10/2015 - 11/10/2015

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

Former Frontier Leather Property
Sherwood, Oregon

5-61M-130820

Amec Foster Wheeler
Environment & Infrastructure, Inc.
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400

LOG OF BORING DP-18

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Brown with orange mottling, dry, sandy SILT.						DP-19 0-1
			Gray color dominant with brown at 2 feet bgs.						DP-19 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: NA
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira
DRILLING DATES: 11/10/2015 - 11/10/2015

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

Former Frontier Leather Property
Sherwood, Oregon

5-61M-130820

Amec Foster Wheeler
Environment & Infrastructure, Inc.
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400

LOG OF BORING DP-19

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SM	Medium dense, brown with orange mottling, silty fine to medium SAND.						DP-20 0-1
			Increased sand at 4 feet bgs.						DP-20 3.5-4.5
5			End of boring at 5 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push

BOREHOLE DIAMETER:

DRILL RIG: NA

CONTRACTOR: Pacific Soil & Water, Inc.

LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

DRILLING DATES: 11/10/2015 - 11/10/2015

LOCATION: Directly in front of South Aeration Pond

REMARKS:

Former Frontier Leather Property
Sherwood, Oregon

5-61M-130820

Amec Foster Wheeler
Environment & Infrastructure, Inc.
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400

LOG OF BORING DP-20

DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	TESTING AND LABORATORY DATA
0	ML	Medium dense, brown with trace orange mottles, very fine sandy SILT.	7	DP-21 0-1
		Hard (more dense) with clay nodules and occasional debris (wood, gravel) at 3 feet bgs.		DP-21 3.5-4.5
5		Trace clay content.	8.2	
		Gray mottling.		
	SP	Dense, red, dry, fine to coarse SAND.		DP-21 8-9
	SP	Dense, gray with orange mottling, poorly graded, medium SAND.	11.9	
10		Moist to wet, increased clay content, mixed with gray sand from 10 to 11 feet bgs.		
	ML	Gray, moist to wet, sandy SILT, faint organic odor.		
15		End of boring at 15 feet bgs.	7.4	DP-21 14.5-15
20				
25				
30				

GRAPHIC LOG: SAMPLE

GROUNDWATER | GW SCREENED INTERVAL | FIELD TESTING

BORING METHOD: Direct Push
BOREHOLE DIAMETER:
DRILL RIG: NA
CONTRACTOR: Pacific Soil & Water, Inc.
LOGGED BY: G. Taylor & G. Ferreira

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
DRILLING DATES: 11/11/2015 - 11/11/2015

REMARKS:

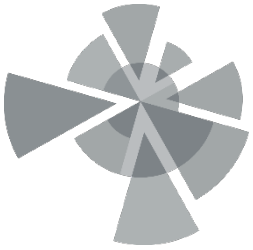
DIRECT PUSH BORING 5-61M-130820.03.GPJ AMEC PORTLAND.GDT 2/18/16

Former Frontier Leather Property
Sherwood, Oregon

5-61M-130820

Amec Foster Wheeler
Environment & Infrastructure, Inc.
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400

LOG OF BORING DP-21



APPENDIX B-2

Field Forms

Amec Foster Wheeler Environment & Infrastructure, Inc.

GROUNDWATER SAMPLING FIELD FORM

Project Name: Frontier Leather
Project #:
Boring ID: DP-0602 of

Field Personnel: Graeme Taylor & Gabi F.
Date: 11-10-15
Weather Conditions: overcast
Approx. Air Temp (F):

INITIAL WELL DATA

PID (ppm) Background: NA
In-well Casing:
PID Calibration Standard: ~~isobutylene 100 ppm~~
PID Calibration Date: NA

Date/Time of Measurement: 11/10/15 1130
Depth Well Bottom (TOC - ft.): 15
Depth to Water Level (TOC - ft.): 5
Depth to Free Product (TOC - ft.): -
Calculated Column Height (ft.): 10
Casing Diameter (in.): 3/4
Quantity of Free Product Collected (gal.): -
Obsevation of sheen or LNAPL: -

Depth to Water Measuring Technique: WLM
Detection Method of Free Product: -
Conversions Factors (casing dia. = gallons/linear ft.) Circle One
0.75" = 0.02 1" = 0.04 2" = 0.17 3" = 0.37
4" = 0.66 6" = 1.47 8" = 2.61 12" = 5.88
Three Well Purge Volumes (gallons) = 3 x _____ = _____
Method of Collecting Free Product: -
Observation of DNAPL: -

INITIAL WELL DATA & WELL PURGING INFORMATION

Purge Pumping Rate (approx. L/m): ~200 mL/min
Approx. Pump/Intake Depth: 15
Well Yield: High / Moderate / Low
Purge Method (circle one): Disposable Bailer / Peristalic Pump / DV Pump / Dedicated / Other = _____
Sampling Method (circle one): Disposable Bailer / Peristalic Pump / DV Pump / Dedicated / Other = _____
Decontamination Method: _____ Water Disposal: _____
Instrument Type & Number: YSI Instrument Calibration Date & Time:

SAMPLING INFORMATION / DATA

Date Sampled: 11/10/2015 Time Sampled: 1230
QA/QC Sample (circle one): DUP Lab MS/MSD Equip Blank Trip Blank Interlaboratory Split

Sample ID	Bottles (total)	Bottles (size)	Bottles (type)	Preservative	Destination Laboratory	QA/QC Sample	Analytical Parameters (in order of priority)
	3	40 mL	G	HCl			VOCs 8260B
	1	250 mL	P	HNO_3			Total metals 6020
	1	250 mL	P	HNO_3			Dissolved metals 6020
	1	250 mL	P	None			Chloride 300.0

All samples were immediately placed into a cooler and packed with ice or "Blue Ice", unless otherwise noted: YES / NO

SAMPLING INFORMATION / DATA

Field Observations/Notes of Sampling Event:

temp 12.57°C
pH 6.26
cond 1280 µs/cm
ORP 88.5 mV
DO 0.54 mg/L
turb 714 NTU

CERTIFICATION STATEMENT

By signing below, the listed AMEC sampler states that the information provided on this page is accurate.

Sampler (Print): Sampler Signature: Date Signed:

Amec Foster Wheeler Environment & Infrastructure, Inc.

GROUNDWATER SAMPLING FIELD FORM

Project Name: Former Frontier Leather
Project #: 561M130820
Boring ID: DP-17

Field Personnel: G. Taylor, GABJ.F.
Date: 11-10-2015

Weather Conditions: overcast, cold
Approx. Air Temp (F): 45°F

INITIAL WELL DATA

PID (ppm) Background: NA
In-well Casing:
PID Calibration Standard: ~~isobutylene 100 ppm~~ N/A
PID Calibration Date: NA

Date/Time of Measurement: 11/10/2015 1430
Depth to Water Measuring Technique: sander
Depth Well Bottom (TOC - ft.): 15
Detection Method of Free Product: —
Depth to Water Level (TOC - ft.): 7.5
Depth to Free Product (TOC - ft.): —
Calculated Column Height (ft.): 7.5
Casing Diameter (in.): 3/4"
Quantity of Free Product Collected (gal.): NA
Method of Collecting Free Product: NA
Obsevation of sheen or LNAPL: NA
Observation of DNAPL: NA

Conversions Factors (casing dia. = gallons/linear ft.) Circle One

0.75" = 0.02	1" = 0.04	2" = 0.17	3" = 0.37
4" = 0.66	6" = 1.47	8" = 2.61	12" = 5.88

Three Well Purge Volumes (gallons) = 3 x _____ = _____

INITIAL WELL DATA & WELL PURGING INFORMATION

Purge Pumping Rate (approx. L/m): ~~100~~ 200 mL/min
Approx. Pump/Intake Depth: 15
Well Yield: High / Moderate / (Low)
Purge Method (circle one): Disposable Bailer / ~~Peristalic Pump~~ / DV Pump / Dedicated / Other = _____
Sampling Method (circle one): Disposable Bailer / Peristalic Pump / DV Pump / Dedicated / Other = _____
Decontamination Method: _____ Water Disposal: _____
Instrument Type & Number: YSI Instrument Calibration Date & Time:

SAMPLING INFORMATION / DATA

Date Sampled: 11/10/2015
Time Sampled: 1035

QA/QC Sample (circle one): DUP Lab MS/MSD Equip Blank Trip Blank Interlaboratory Split

Sample ID	Bottles (total)	(size)	(type)	Preservative	Destination Laboratory	QA/QC Sample	Analytical Parameters (in order of priority)
DP-17-GW	3	40 mL	G	HCl	APEX		VOCs 8260B
	1	250 mL	P	HNO_3			Total metals 6020
	1	250 mL	P	HNO_3			Dissolved metals 6020
	1	250 mL	P	None			Chloride 300.0

All samples were immediately placed into a cooler and packed with ice or "Blue Ice", unless otherwise noted: (YES) / NO

SAMPLING INFORMATION / DATA

Field Observations/Notes of Sampling Event: parameters collected on 11/11/2015

Temp	°C	12.93	13.22	13.15
Cond	MS/cm	1199	1207	1215
DO	mg/L	.48	.54	.31
pH		6.74	6.75	6.76
ORP	mV	-70.5	-70.1	-74.9
Turbidity	NTU	~~999~~ 28.2		11.4

CERTIFICATION STATEMENT

By signing below, the listed AMEC sampler states that the information provided on this page is accurate.

Sampler (Print): Graeme Taylor
Sampler Signature: Graeme Taylor
Date Signed: 11/10/15

Revised: July 21, 2015

Amec Foster Wheeler Environment & Infrastructure, Inc. **GROUNDWATER** **SAMPLING FIELD FORM**	Project Name: Frontier Leather Project #: Boring ID: DP-06

Field Personnel: Coralee Taylor & Craig Ferreira Date: 11-10-15

Weather Conditions: cold, partly cloudy Approx. Air Temp (F):

INITIAL WELL DATA

PID (ppm) Background: In-well Casing:	PID Calibration Standard: isobutylene 100 ppm PID Calibration Date:
Date/Time of Measurement: 11/10/15 /	Depth to Water Measuring Technique:
Depth Well Bottom (TOC - ft.): 15	Detection Method of Free Product:
Depth to Water Level (TOC - ft.):	Conversions Factors (casing dia. = gallons/linear ft.) Circle One 0.75" = 0.02 1" = 0.04 2" = 0.17 3" = 0.37 4" = 0.66 6" = 1.47 8" = 2.61 12" = 5.88
Depth to Free Product (TOC - ft.):	
Calculated Column Height (ft.):	Three Well Purge Volumes (gallons) = 3 x _____ = _____
Casing Diameter (in.): 3/4	Method of Collecting Free Product:
Quantity of Free Product Collected (gal.): -	Observation of DNAPL:
Obsevation of sheen or LNAPL: -	

INITIAL WELL DATA & WELL PURGING INFORMATION

Purge Pumping Rate (approx. L/m): _____ Approx. Pump/Intake Depth: _____

Well Yield: High / Moderate / Low

Purge Method (circle one): Disposable Bailer / Peristalic Pump / DV Pump / Dedicated / Other = _____

Sampling Method (circle one): Disposable Bailer / Peristalic Pump / DV Pump / Dedicated / Other = _____

Decontamination Method: _____ Water Disposal: _____

Instrument Type & Number: YSI Instrument Calibration Date & Time: _____

SAMPLING INFORMATION / DATA

Date Sampled: 11-10-15 Time Sampled: 1600

QA/QC Sample (circle one): DUP Lab MS/MSD Equip Blank Trip Blank Interlaboratory Split

Sample ID	Bottles (total)	Bottles (size)	Bottles (type)	Preservative	Destination Laboratory	QA/QC Sample	Analytical Parameters (in order of priority)
DP-6-GW	3	40 mL	G	HCl			VOCs 8260B
	1	250 mL	P	HNO_3			Total metals 6020
	1	250 mL	P	HNO_3			Dissolved metals 6020
	1	250 mL	P	None			Chloride 300.0

All samples were immediately placed into a cooler and packed with ice or "Blue Ice", unless otherwise noted: YES / NO

SAMPLING INFORMATION / DATA

Field Observations/Notes of Sampling Event:

temp 12.51
cond 2395
DO 0.10
pH 7.31
ORP -158.4
turb 419

CERTIFICATION STATEMENT

By signing below, the listed AMEC sampler states that the information provided on this page is accurate.

Sampler (Print): Sampler Signature: Date Signed:

Amec Foster Wheeler Environment & Infrastructure, Inc.

GROUNDWATER SAMPLING FIELD FORM

Project Name: Former Frontier Leather
Project #: 56111130870
Boring ID: DP-13

Field Personnel: G. Taylor
Date: 11/11/15
Weather Conditions: cloudy
Approx. Air Temp (F): 50

INITIAL WELL DATA

PID (ppm) Background: –
In-well Casing:
PID Calibration Standard: isobutylene 100 ppm
PID Calibration Date:

Date/Time of Measurement: 11/11/2015 1
Depth Well Bottom (TOC - ft.): 20
Depth to Water Level (TOC - ft.): 12.5
Depth to Free Product (TOC - ft.): –
Calculated Column Height (ft.): 7.5
Casing Diameter (in.): 3/4"
Quantity of Free Product Collected (gal.): –
Obsevation of sheen or LNAPL: –

Depth to Water Measuring Technique: –
Detection Method of Free Product: –
Conversions Factors (casing dia. = gallons/linear ft.) Circle One
0.75" = 0.02 1" = 0.04 2" = 0.17 3" = 0.37
4" = 0.66 6" = 1.47 8" = 2.61 12" = 5.88
Three Well Purge Volumes (gallons) = 3 x _____ = _____
Method of Collecting Free Product: –
Observation of DNAPL: –

INITIAL WELL DATA & WELL PURGING INFORMATION

Purge Pumping Rate (approx. L/m): 200 ml/min
Approx. Pump/Intake Depth: 20
Well Yield: High / Moderate / Low
Purge Method (circle one): Disposable Bailer / Peristalic Pump / DV Pump / Dedicated / Other = _____
Sampling Method (circle one): Disposable Bailer / Peristalic Pump / DV Pump / Dedicated / Other = _____
Decontamination Method: _____ Water Disposal: _____
Instrument Type & Number: YSI Instrument Calibration Date & Time: 11/11/2015 1130

SAMPLING INFORMATION / DATA

Date Sampled: 11/11/15
Time Sampled: 1210
QA/QC Sample (circle one): DUP Lab MS/MSD Equip Blank Trip Blank Interlaboratory Split

Sample ID	Bottles (total)	Bottles (size)	Bottles (type)	Preservative	Destination Laboratory	QA/QC Sample	Analytical Parameters (in order of priority)
DP-13	3	40 mL	G	HCl	APEX	APEX	VOCs 8260B
	1	250 mL	P	HNO_3	"	"	Total metals 6020
	1	250 mL	P	HNO_3	"	"	Dissolved metals 6020
	1	250 mL	P	None	"	"	Chloride 300.0

All samples were immediately placed into a cooler and packed with ice or "Blue Ice", unless otherwise noted: YES / NO

SAMPLING INFORMATION / DATA

Field Observations/Notes of Sampling Event:

Temp 13.53 °C
Cond 258 µs/cm
DO 4.44
pH 7.03
ORP 27.1
Turbidity 219

CERTIFICATION STATEMENT

By signing below, the listed AMEC sampler states that the information provided on this page is accurate.

Sampler (Print): Grayce Taylor
Sampler Signature: Grayce Taylor
Date Signed: 11/11/15

Revised: July 21, 2015

Amec Foster Wheeler Environment & Infrastructure, Inc.

GROUNDWATER SAMPLING FIELD FORM

Project Name: Former Frontier Leather
Project #: 5611130822
Boring ID: DP-3

Field Personnel: G. Taylor
Date: 11/11/2015
Weather Conditions: Cloudy
Approx. Air Temp (F): 50

INITIAL WELL DATA

PID (ppm) Background:	In-well Casing:
PID Calibration Standard:	isobutylene 100 ppm
PID Calibration Date:	
Date/Time of Measurement:	11/11/2015 1
Depth Well Bottom (TOC - ft.):	15
Depth to Water Level (TOC - ft.):	2.6
Depth to Free Product (TOC - ft.):	—
Calculated Column Height (ft.):	12.4
Casing Diameter (in.):	3/4
Quantity of Free Product Collected (gal.):	—
Depth to Water Measuring Technique:	—
Detection Method of Free Product:	—
Conversions Factors (casing dia. = gallons/linear ft.) Circle One	
0.75" = 0.02	1" = 0.04
2" = 0.17	3" = 0.37
4" = 0.66	6" = 1.47
8" = 2.61	12" = 5.88
Three Well Purge Volumes (gallons) = 3 x _____ = _____	
Method of Collecting Free Product:	—
Obsevation of sheen or LNAPL:	—
Observation of DNAPL:	—

INITIAL WELL DATA & WELL PURGING INFORMATION

Purge Pumping Rate (approx. L/m): 0.200 mL/min Approx. Pump/Intake Depth: 15
Well Yield: High / ~~Moderate~~ / Low
Purge Method (circle one): Disposable Bailer / ~~Peristalic Pump~~ / DV Pump / Dedicated / Other = _____
Sampling Method (circle one): Disposable Bailer / ~~Peristalic Pump~~ / DV Pump / Dedicated / Other = _____
Decontamination Method: _____ Water Disposal: _____
Instrument Type & Number: YSI Instrument Calibration Date & Time: _____

SAMPLING INFORMATION / DATA

Date Sampled: 11/11/2015 Time Sampled: 1415
QA/QC Sample (circle one): DUP Lab MS/MSD Equip Blank Trip Blank Interlaboratory Split

Sample ID	Bottles (total)	(size)	(type)	Preservative	Destination Laboratory	QA/QC Sample	Analytical Parameters (in order of priority)
DP-3	~~3~~	~~40 mL~~	~~G~~	~~HCl~~			~~VOCs 8260B~~
	~~1~~	~~250 mL~~	~~P~~	~~HNO_3~~			~~Total metals 6020~~
	~~1~~	~~250 mL~~	~~P~~	~~HNO_3~~			~~Dissolved metals 6020~~
	~~1~~	~~250 mL~~	~~P~~	~~None~~			~~Chloride 300.0~~
	2	1L	P	HCl			

All samples were immediately placed into a cooler and packed with ice or "Blue Ice", unless otherwise noted: YES / NO

SAMPLING INFORMATION / DATA

Field Observations/Notes of Sampling Event:

Temp 13.35 °C
cond 1551 MS/cm
DO 0.38 MG/L
PH 6.88
ORP -77.2 MV
Turbidity 739 NTU

CERTIFICATION STATEMENT

By signing below, the listed AMEC sampler states that the information provided on this page is accurate.

Sampler (Print): Graeme Taylor Sampler Signature: [signature] Date Signed: 11/11/15

Revised: July 21, 2015

APPENDIX C

Waste Disposal Records

APPENDIX C-1

Disposal Facility Receipts

NON-HAZARDOUS WASTE MANIFEST

Please print or type (Form designed for use on elite (12 pitch) typewriter)

NON-HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. CESQG

Manifest Document No. 28823803

2. Page 1 of 1

3. Generator's Name and Mailing Address City of Sherwood
1210 SW Oregon St.
Sherwood OR

4. Generator's Phone (503) 224-3206

5. Transporter 1 Company Name WASTEXPRESS

6. US EPA ID Number ORQ0000231500

A. State Transporter's ID 881007

B. Transporter 1 Phone 503-224-3206

7. Transporter 2 Company Name

8. US EPA ID Number

C. State Transporter's ID

D. Transporter 2 Phone

9. Designated Facility Name and Site Address INTERNATIONAL RESOURCE MANAGEMENT
11618 N. LOMBARD ST
PORTLAND OR 97203

10. US EPA ID Number ORQ0000011643

E. State Facility's ID

F. Facility's Phone 503 224-3206

11. WASTE DESCRIPTION	Containers No.	Containers Type	13. Total Quantity	14. Unit Wt./Vol.
a. Non-Regulated Material, Liquids, N.O.S., (IDW Water)	1	AM	25	G
b. Non-Regulated Material, Solid, N.O.S., (IDW Soil)	1	DM	35	G
c.				
d.				

G. Additional Descriptions for Materials Listed Above

a. IRM-P

b. IRM-SW

H. Handling Codes for Wastes Listed Above

a. c.

b. d.

15. Special Handling Instructions and Additional Information

16. GENERATOR'S CERTIFICATION: I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.

Printed/Typed Name	Signature	Date: Month	Day	Year
		12	16	

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date: Month	Day	Year
Trevor Lane		12	16	

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date: Month	Day	Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of the waste materials covered by this manifest, except as noted in item 19.

Printed/Typed Name	Signature	Date: Month	Day	Year

NON-HAZARDOUS WASTE

APPENDIX C-2

Laboratory Reports

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Wednesday, January 13, 2016

Michelle Peterson
AMEC Foster Wheeler
7376 SW Durham Road
Portland, OR 97224

RE: Former Frontier Leather / 561M13082

Enclosed are the results of analyses for work order A5K0450, which was received by the laboratory on 11/12/2015 at 4:37:00PM.

Thank you for using Apex Labs. We appreciate your business and strive to provide the highest quality services to the environmental industry.

If you have any questions concerning this report or the services we offer, please feel free to contact me by email at: pnerenberg@apex-labs.com, or by phone at 503-718-2323.

Apex Laboratories

Philip Nerenberg, Lab Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
DP-Composite	A5K0450-61	Soil	11/10/15 14:25	11/12/15 16:37

Apex Laboratories

Philip Nerenberg, Lab Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

ANALYTICAL SAMPLE RESULTS

TCLP Metals by EPA 6020 (ICPMS)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
DP-Composite (A5K0450-61)			**Matrix: Soil**					
Batch: 5120493								
Chromium	ND	---	0.100	mg/L	5	12/16/15 13:34	1311/6020A	
Lead	ND	---	0.0500	"	"	"	"	

Apex Laboratories

Philip Nerenberg, Lab Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

QUALITY CONTROL (QC) SAMPLE RESULTS

TCLP Metals by EPA 6020 (ICPMS)

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5120493 - EPA 1311/3015									Soil			
Blank (5120493-BLK1)					Prepared: 12/16/15 10:18 Analyzed: 12/16/15 13:16							
1311/6020A												
Chromium	ND	---	0.100	mg/L	5	---	---	---	---	---	---	TCLP
Lead	ND	---	0.0500	"	"	---	---	---	---	---	---	TCLP
LCS (5120493-BS1)					Prepared: 12/16/15 10:18 Analyzed: 12/16/15 13:19							
1311/6020A												
Chromium	2.65	---	0.100	mg/L	5	2.50	---	106	80-120%	---	---	TCLP
Lead	2.65	---	0.0500	"	"	"	---	106	"	---	---	TCLP

Apex Laboratories

Philip Nerenberg, Lab Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

SAMPLE PREPARATION INFORMATION

TCLP Metals by EPA 6020 (ICPMS)

Prep: EPA 1311/3015

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 5120493							
A5K0450-61	Soil	1311/6020A	11/10/15 14:25	12/16/15 10:18	5mL/50mL	5mL/50mL	1.00

Apex Laboratories

Philip Nerenberg, Lab Director

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503-718-2323 Phone
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AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

Notes and Definitions

Qualifiers:

TCLP	This batch QC sample was prepared with TCLP or SPLP fluid from preparation batch 5120493.

Notes and Conventions:

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis. Results listed as 'wet' or without 'dry'designation are not dry weight corrected.
RPD	Relative Percent Difference
MDL	If MDL is not listed, data has been evaluated to the Method Reporting Limit only.
WMSC	Water Miscible Solvent Correction has been applied to Results and MRLs for volatiles soil samples per EPA 8000C.
Batch QC	Unless specifically requested, this report contains only results for Batch QC derived from client samples included in this report. All analyses were performed with the appropriate Batch QC (including Sample Duplicates, Matrix Spikes and/or Matrix Spike Duplicates) in order to meet or exceed method and regulatory requirements. Any exceptions to this will be qualified in this report. Complete Batch QC results are available upon request. In cases where there is insufficient sample provided for Sample Duplicates and/or Matrix Spikes, a Lab Control Sample Duplicate (LCS Dup) is analyzed to demonstrate accuracy and precision of the extraction and analysis.
Blank Policy	Apex assesses blank data for potential high bias down to a level equal to ½ the method reporting limit (MRL), except for conventional chemistry and HCID analyses which are assessed only to the MRL. Sample results flagged with a B or B-02 qualifier are potentially biased high if they are less than ten times the level found in the blank for inorganic analyses or less than five times the level found in the blank for organic analyses. For accurate comparison of volatile results to the level found in the blank; water sample results should be divided by the dilution factor, and soil sample results should be divided by 1/50 of the sample dilution to account for the sample prep factor. Results qualified as reported below the MRL may include a potential high bias if associated with a B or B-02 qualified blank. B and B-02 qualifications are not applied to J qualified results reported below the MRL.
---	QC results are not applicable. For example, % Recoveries for Blanks and Duplicates, % RPD for Blanks, Blank Spikes and Matrix Spikes, etc.
***	Used to indicate a possible discrepancy with the Sample and Sample Duplicate results when the %RPD is not available. In this case, either the Sample or the Sample Duplicate has a reportable result for this analyte, while the other is Non Detect (ND).

Apex Laboratories

Philip Nerenberg, Lab Director

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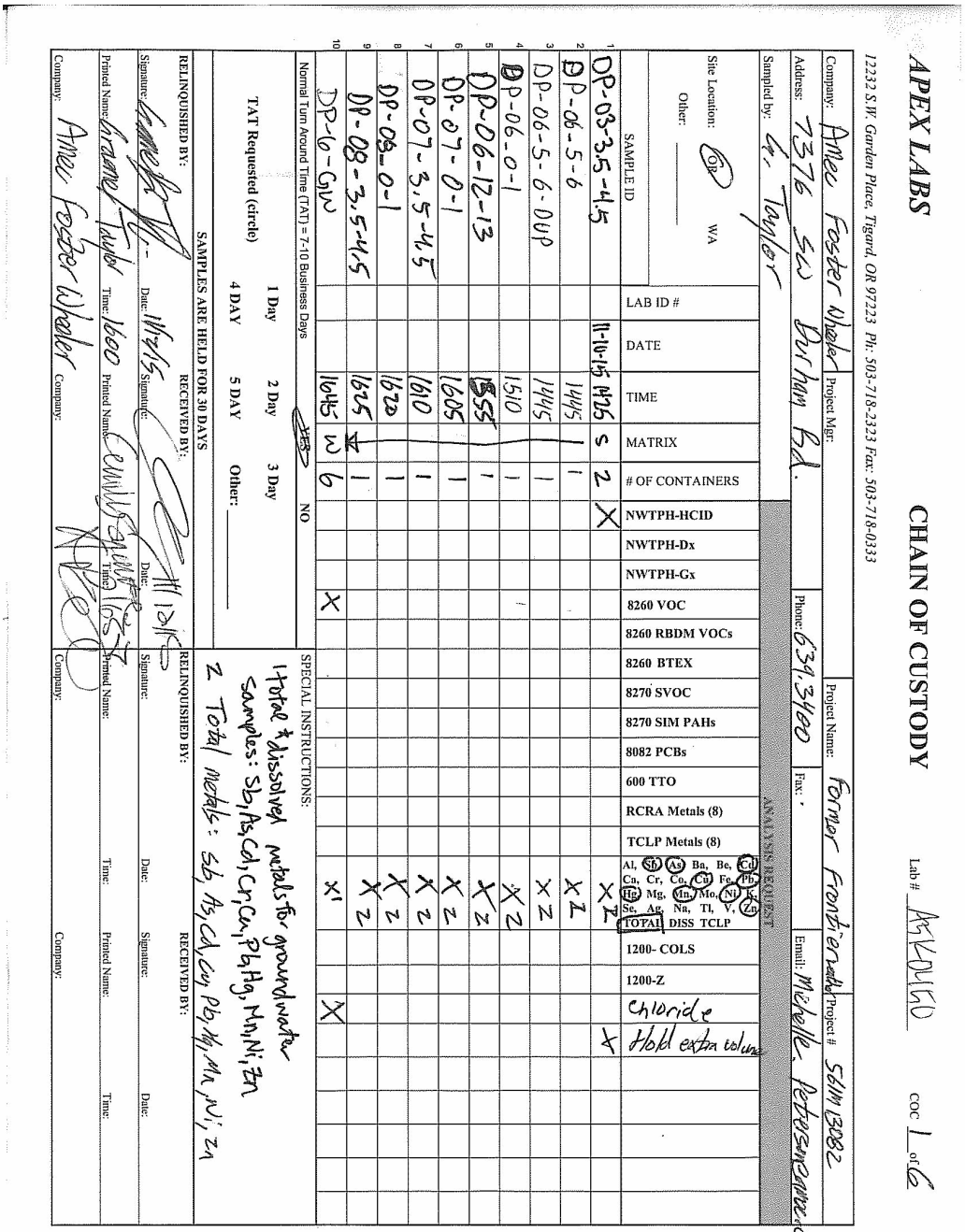
Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26



APEX LABS

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

CHAIN OF CUSTODY

Lab # ARKD1460 COC 1 of 1

Company: AMEC Foster Wheeler Project Mgr:

Address: 7376 SW Durham Rd. Phone: 639.3160

Sampled by: C. Taylor

Site Location: OR WA

Other:

Project Name: Former Frontier Leather Fax:

Project #: 561M13082

Email: Michelle.Peterson@amec.com

SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200- COLS	1200-Z	
1 DP-03-3.5-4.5		11-10-15	1425	S	2	X												XZ			
2 DP-06-5-6			1445		1													XZ			
3 DP-06-5-6-DUP			1445		1													XZ			
4 DP-06-0-1			1510		1													XZ			
5 DP-06-12-13			1555		1													XZ			
6 DP-07-0-1			1605		1													XZ			
7 DP-07-3.5-4.5			1610		1													XZ			
8 DP-08-0-1			1622		1													XZ			
9 DP-08-3.5-4.5			1625		1													XZ			
10 DP-16-GW			1645	W	6				X									X'		X	
																				Chloride	
																				Hold extra volume	

Normal Turn Around Time (TAT) = 7-10 Business Days

TAT Requested (circle) 1 Day 2 Day 3 Day 4 DAY 5 DAY Other:

SPECIAL INSTRUCTIONS:

1 total & dissolved metals for groundwater samples: Sb, As, Cd, Cr, Cu, Pb, Hg, Mn, Ni, Zn

2 Total metals: Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Zn

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY: Signature: Date: 1/12/15 Printed Name: Time: Company:

RECEIVED BY: Signature: Date: 1/12/15 Printed Name: Time: 1600 Company: AMEC Foster Wheeler

RELINQUISHED BY: Signature: Date: Printed Name: Time: Company:

RECEIVED BY: Signature: Date: Printed Name: Time: Company:

RELINQUISHED BY: Signature: Date: Printed Name: Time: Company:

RECEIVED BY: Signature: Date: Printed Name: Time: Company:

Apex Laboratories

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Philip Nerenberg

Philip Nerenberg, Lab Director

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

APEX LABS — CHAIN OF CUSTODY

Lab # A5K0450 COC 2 of 6

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company: Amec Foster Wheeler Project Mgr: Michelle Peterson Project Name: Former Frontier Leather Project # 561M13082

Address: 7376 SW Durham Rd. Phone: 639.3900 Fax: Email: Michelle.Peterson@amec.com

Sampled by: G. Taylor

Site Location: (OR) WA Other:

ANALYSIS REQUEST

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, (Sb), (As), Ba, Be, (Cd), Ca, Cr, Co, (Cu), Fe, (Pb), Hg, Mg, (Mn), Mo, (Ni), K, Se, Ag, Na, Tl, V, (Zn) (TOTAL) DISS TCLP	1200-COLS	1200-Z
1	DP-05-0-1.5		11/11/15	945	S	1													X Z		
2	DP-05-3.5-4.5			950		1													X Z		
3	DP-18-0-1			1005		1													X Z		
4	DP-18-3.5-4.5			1010		1													X Z		
5	DP-14-0-1			1015		1													X Z		
6	DP-14-3.5-4.5			1020		1													X Z		
7	DP-13-0-1			1030		1													X Z		
8	DP-B3-5			1035		1													X Z		
9	DP-B3-5 Dup			1035		1													X Z		
10	DP-13-8-9			1040		1													X Z		

Normal Turn Around Time (TAT) = 7-10 Business Days (YES) NO

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: ________

SAMPLES ARE HELD FOR 30 DAYS

SPECIAL INSTRUCTIONS: Z-Total Metals: Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Zn

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature] Date: 11/12/15	Signature: [signature] Date: 11/12/15	Signature: Date:	Signature: Date:
Printed Name: Graeme Taylor Time: 1600	Printed Name: Ceeuly Ewing Time: 1634	Printed Name: Time:	Printed Name: Time:
Company: Amec Foster Wheeler	Company: APEX	Company:	Company:

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

APEX LABS **CHAIN OF CUSTODY** Lab # A5K0450 COC 3 of 6

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company: Amec Foster Wheeler Project Mgr: Michelle Peterson Project Name: Former Frontier Leather Project # 561M13082

Address: 4376 SW Durham Rd Phone: 639.3400 Fax: Email: Michelle.Peterson@amec.com

Sampled by: G. Taylor

Site Location: (OR) WA Other:

ANALYSIS REQUEST

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, (Sb), (As), Ba, Be, (Cd), Ca, Cr, Co, (Cu), Fe, (Pb), (Hg), Mg, (Mn), Mo, (Ni), K, Se, Ag, Na, Tl, V, (Zn) (TOTAL) DISS TCLP	1200-COLS	1200-Z	Chloride
1	DP-16-3.5-4.5		11-16-15	1115	S	1													X 2			
2	DP-2-0-1			1130		1													X 2			
3	DP-2-3.5-4.5			1135		1													X 2			
4	DP-2-8-9			1150		1													X 2			
5	DP-2GW			1230		6				X									X 1			X
6	DP-01-0-1			1340		1													X 2			
7	DP-01-3.5-4.5			1345		1													X 2			
8	DP-04-0-1			1350		1													X 2			
9	DP-04-3.5-4.5			1355		1													X 2			
10	DP-03-0-1			1420		1	X												X 2			

Normal Turn Around Time (TAT) = 7-10 Business Days (YES) NO

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: ______

SAMPLES ARE HELD FOR 30 DAYS

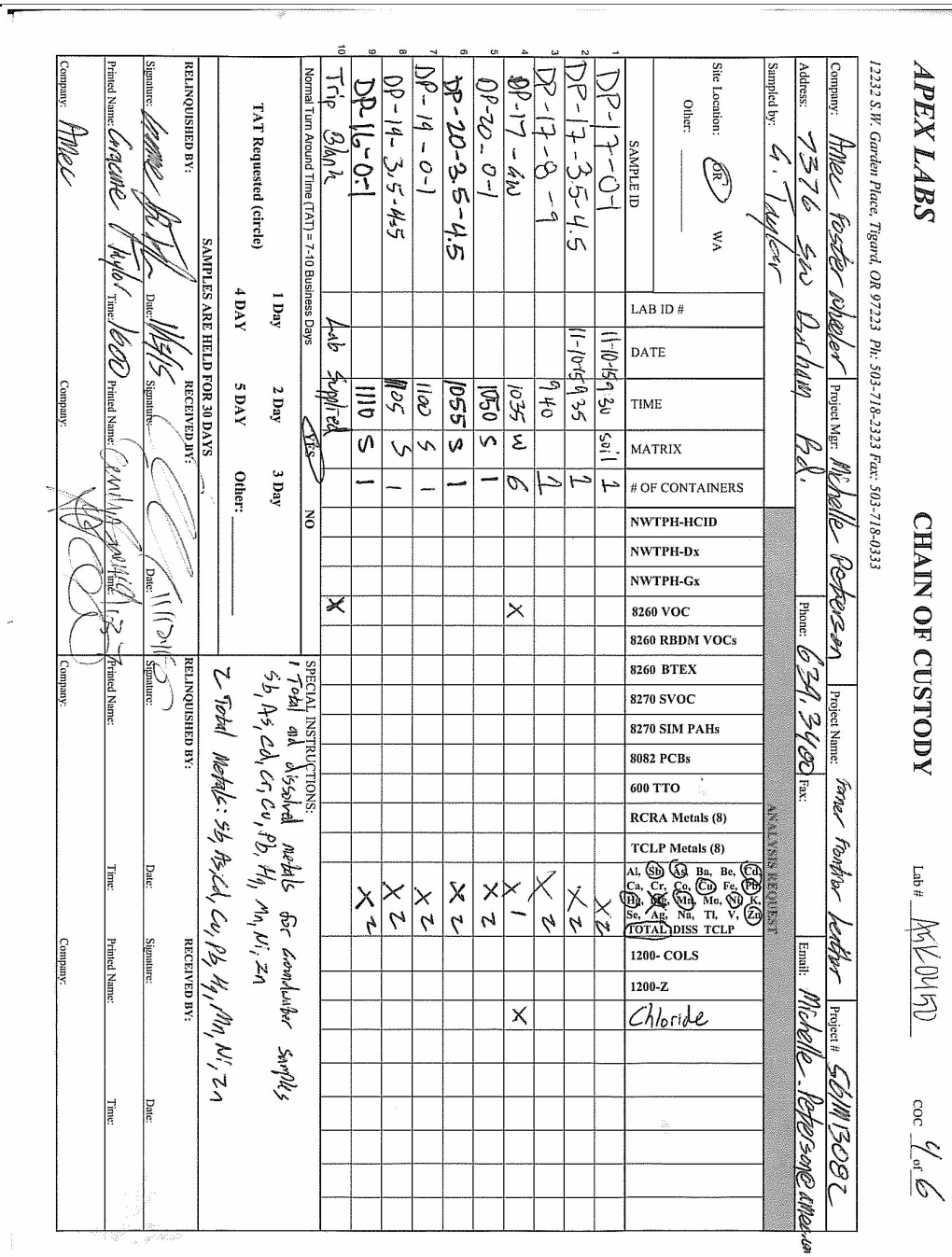
SPECIAL INSTRUCTIONS:
1 Total and dissolved metals for groundwater samples Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Zn, Cr
2 Total Metals: Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Zn

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature] Date: 11/13/15	Signature: [signature] Date: 11/13/15	Signature: Date:	Signature: Date:
Printed Name: Graeme Taylor Time: 1600	Printed Name: Cammy Gnamm Time: 1637	Printed Name: Time:	Printed Name: Time:
Company: Amec	Company: APEX	Company:	Company:

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26



APEX LABS

CHAIN OF CUSTODY

Lab # [illegible] COC 1 of 6

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company: AMEC Foster Wheeler | Project Mgr: Michelle Peterson | Project Name: Former Frontier Leather | Project #: 561M13082

Address: 7376 SW Durham Rd. | Phone: 639-3400 | Fax: | Email: Michelle.Peterson@amec.com

Sampled by: G. Taylor

Site Location: OR / WA

Other: _____

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	1200- COLS	1200-Z	
1	DP-17-01		11-10-15	930	Soil	1															
2	DP-17-3.5-4.5		11-10-15	935		1												XZ			
3	DP-17-8-9			940		1												XZ			
4	DP-17-4W			1035	W	6				X								X			X
5	DP-20-01			1050	S	1												X			
6	DP-20-3.5-4.5			1055	S	1												XZ			
7	DP-19-01			1100	S	1												XZ			
8	DP-19-3.5-4.5			1105	S	1												XZ			
9	DP-16-01			1110	S	1												XZ			
10	Trip Blank									X											

Normal Turn Around Time (TAT) = 7-10 Business Days

TAT Requested (circle): 1 Day | 2 Day | 3 Day | 4 DAY | 5 DAY | Other: _____

Lab Supplied Jars? YES / NO

SPECIAL INSTRUCTIONS:
1 Total and dissolved metals for composite samples
Sb, As, Cd, Cr, Cu, Pb, Hg, Mn, Ni, Zn
2 Total Metals: Sb, As, Cd, Cr, Pb, Hg, Mn, Ni, Zn

ANALYSIS REQUEST

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY: | RECEIVED BY:

Signature: | Signature: | Date: 1/11/16

Printed Name: Graeme Taylor | Printed Name: [illegible] | Time: 1600

Company: AMEC | Company:

RELINQUISHED BY: | RECEIVED BY:

Signature: | Signature: | Date: | Time:

Printed Name: | Printed Name: | Time:

Company: | Company:

RELINQUISHED BY: | RECEIVED BY:

Signature: | Signature: | Date: | Time:

Printed Name: | Printed Name: | Time:

Company: | Company:

Apex Laboratories

Philip Nerenberg

Philip Nerenberg, Lab Director

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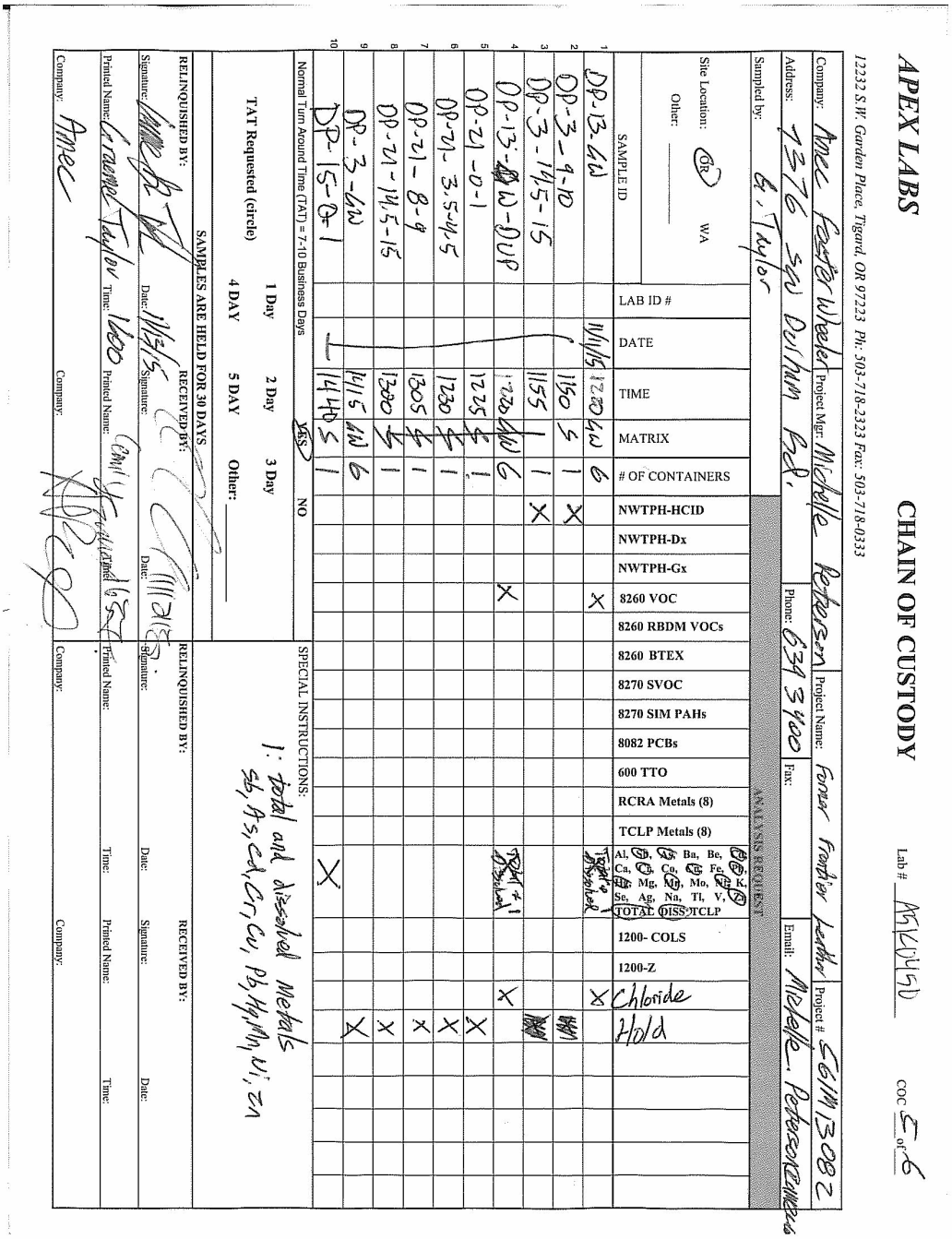
Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26



APEX LABS — CHAIN OF CUSTODY

12232 S.W. Garden Place, Tigard, OR 97223 PH: 503-718-2323 FAX: 503-718-0333

Lab # [illegible] COC 5 of 6

Company: AMEC Foster Wheeler | Project Mgr: Michelle Peterson | Project Name: Former Frontier Leather | Project #: 561M13082

Address: 7376 SW Durham Rd. | Phone: 639 3400 | Fax: | Email: Michelle.Peterson@amec.com

Sampled by: K. Taylor

Site Location: (OR) WA

Other: _____

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	1200- COLS	1200-Z	
1	DP-13-GW		11/19/15	1220	GW	6				X											
2	DP-3-9-10			1150	S	1	X														
3	DP-3-14.5-15			1155		1	X														
4	DP-13-GW-DUP			1220	GW	6				X											
5	DP-21-0-1			1225	S	1															
6	DP-21-3.5-4.5			1230		1															
7	DP-21-8-9			1305		1														X	
8	DP-21-14.5-15			1300		1														X	
9	DP-3-GW			1415	GW	6														X	
10	DP-15-01			1440	S	1												X			

Normal Turn Around Time (TAT) = 7-10 Business Days — YES / NO

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: _____

SPECIAL INSTRUCTIONS:
1: total and dissolved metals
Sb, As, Cd, Cr, Cu, Pb, Hg, Mn, Ni, Zn

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [illegible]	Signature: [illegible]	Signature:	Signature:
Date: 11/19/15	Date:	Date:	Date:
Printed Name: K. Taylor	Printed Name:	Printed Name:	Printed Name:
Time: 1600	Time:	Time:	Time:
Company: AMEC	Company:	Company:	Company:

Apex Laboratories

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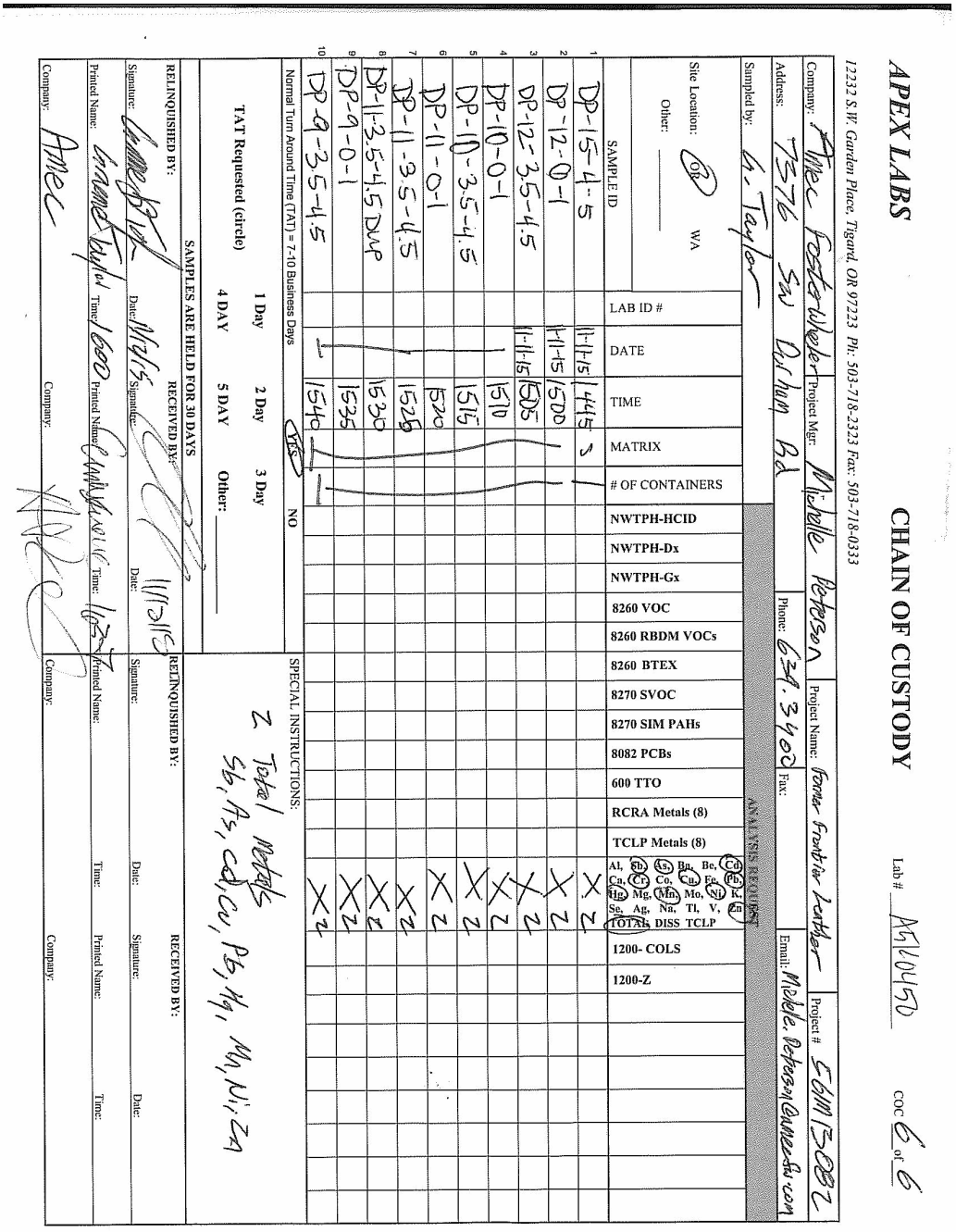
Philip Nerenberg

Philip Nerenberg, Lab Director

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26



APEX LABS — CHAIN OF CUSTODY

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Lab # AG10450 COC 6 of 6

Company: AMEC Foster Wheeler | Project Mgr: Michelle Peterson | Project Name: Former Frontier Leather | Project # 561M13082

Address: 7376 SW Durham Rd | Phone: 639.3400 | Fax: | Email: Michelle.Peterson@amec.com

Sampled by: L. Taylor

Site Location: OR WA

Other: _____

ANALYSIS REQUEST

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200- COLS	1200-Z
1	DP-15-4-5		11-11-15	1445	S	1													X Z		
2	DP-12-0-1		11-11-15	1500															X Z		
3	DP-12-3.5-4.5		11-11-15	1505															X Z		
4	DP-10-0-1			1510															X Z		
5	DP-10-3.5-4.5			1515															X Z		
6	DP-11-0-1			1520															X Z		
7	DP-11-3.5-4.5			1525															X Z		
8	DP-11-3.5-4.5 DUP			1530															X Z		
9	DP-9-0-1			1535															X Z		
10	DP-9-3.5-4.5			1540															X Z		

Normal Turn Around Time (TAT) = 7-10 Business Days — RUSH — NO

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: _____

SPECIAL INSTRUCTIONS: Z Total Metals Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Zn

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY: Signature: _____ Date/Time: 1/13/15 1600 Printed Name: Lauren Taylor Company: AMEC

RECEIVED BY: Signature: _____ Date: 1/13/15 Printed Name: _____ Company: _____

RELINQUISHED BY: Signature: _____ Date: _____ Printed Name: _____ Company: _____

RECEIVED BY: Signature: _____ Date: _____ Printed Name: _____ Company: _____

Apex Laboratories

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Philip Nerenberg

Philip Nerenberg, Lab Director

APPENDIX D

Data Quality Review & Laboratory Reports

APPENDIX D-1

Data Quality Review Report

DATA QUALITY REVIEW REPORT

Former Frontier Leather Property

1210 SW Oregon Street

Sherwood, Oregon

Cooperative Agreement BF-00J93201

Prepared for:

City of Sherwood
22580 SW Pine Street
Sherwood, OR 97140

Prepared by:

Amec Foster Wheeler Environment & Infrastructure, Inc.
7376 SW Durham Road
Portland, Oregon 97224
(503) 639-3400

January 2016

Project No. 561M120820.03.****

TABLE OF CONTENTS

Page

TABLES

ACRONYMS

%	percent
µg/L	micrograms per liter
Amec Foster Wheeler	Amec Foster Wheeler Environment & Infrastructure, Inc.
Apex	Apex Laboratories
BAL	Brooks Applied Labs
CLP	Contract Laboratory Program
COC	chain of custody
DEQ	Department of Environmental Quality
EPA	United States Environmental Protection Agency
ID	identification
LCS	laboratory control sample
mg/kg	milligrams per kilogram
MS	matrix spike
MSD	matrix spike duplicate
NWTPH-HCID	Northwest Total Petroleum Hydrocarbon - Hydrocarbon Identification
QC	quality control
RL	reporting limit
RPD	relative percent difference
VOC	volatile organic compound

DATA QUALITY REVIEW REPORT
Former Frontier Leather Property
Sherwood, Oregon

1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) collected 46 primary soil samples, 3 field duplicates and 1 composite; 4 primary groundwater samples and 1 field duplicate; and 1 aqueous trip blank on November 10 and November 11, 2015. Amec Foster Wheeler submitted the samples to Apex Laboratories (Apex) in Tigard, Oregon, where they were assigned to work order A5K0450. Apex analyzed the samples for chloride by United States Environmental Protection Agency (EPA) method 300.0, total and dissolved metals by EPA method 6020, volatile organic compounds (VOCs) by EPA method 8260B, and/or hydrocarbons by Department of Environmental Quality (DEQ) method Northwest Total Petroleum Hydrocarbon - Hydrocarbon Identification (NWTPH-HCID). Select soil samples were also submitted to Brooks Applied Labs (BAL) in Bothell, Washington where they were assigned to work order 1546054 and were analyzed for total chromium by EPA method 200.8 and hexavalent chromium by EPA method 7199. A list of these samples by field sample identification (ID), matrix, collection date, Apex sample ID, and BAL sample ID is presented in Table 1.

2.0 DATA VALIDATION METHODOLOGY

Amec Foster Wheeler performed a Stage 2A review of the data provided by Apex and BAL. The Stage 2A review includes review of the quality control (QC) results in the laboratory's analytical report, but does not include review or validation of the analytical instrument performance or raw analytical data. This data quality review has been performed in general accordance with:

- EPA, 2004. SW-846 Test Methods for Evaluating Solid Wastes, Update IIIB.
- EPA, 2014. EPA Contract Laboratory Program (CLP) National Functional Guidelines for Superfund Organic Methods Data Review, EPA-540-R-014-002.
- EPA, 2014. EPA CLP National Functional Guidelines for Inorganic Superfund Data Review, EPA-540-R-013-001.

The CLP guidelines were written specifically for the CLP, and have been modified for the purposes of this data review where they differ from method-specific QC requirements.

The laboratory's certified analytical report and supporting documentation were reviewed to assess the following:

- Data package deliverable completeness;
- Chain of custody (COC) compliance;
- Holding time compliance;
- Presence or absence of laboratory contamination as demonstrated by laboratory blanks;
- Accuracy and bias as demonstrated by recovery laboratory control sample (LCS) and matrix spike (MS) samples;
- Analytical precision as relative percent difference (RPD) of analyte concentration between laboratory duplicates, MSs and MS duplicates (MSDs), and field duplicates; and
- Insofar as possible, the degree of conformance to method requirements and good laboratory practices.

In general, it is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but any reported value may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during data validation are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

LCSs are aliquots of analyte free matrices that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked matrix is then processed through the same analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory’s ability to successfully perform an analytical method in an interference free matrix.

3.2 MATRIX SPIKE RECOVERIES

MSs and MSDs are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The spiked sample is

then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch.

MS recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.3 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are similar to target analytes in chemical composition and behavior in the analytical process.

3.4 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Laboratory blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

Trip blanks are aliquots of analyte-free water that are placed in sample containers at the analytical laboratory and are then sent into the field with the sample containers that are used to collect field samples. Trip blanks are not opened in the field, but accompany the field samples back to the laboratory, where they are analyzed as samples. Trip blanks are used to monitor for contamination that result from sample shipping and storage.

When target analytes are detected in blanks, analyte concentrations in associated samples less than five times the concentration detected in the blank (ten times the concentration for common laboratory contaminants) will be U qualified as being not detected.

3.5 LABORATORY AND FIELD DUPLICATES

Laboratory and field duplicate analysis verifies acceptable method precision by the laboratory at the time of preparation and analysis and/or sampling precision at the time of collection.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE ADDED DURING DATA VALIDATION

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

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 result is 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.

5.0 QUALIFICATION REASON CODES

FD High RPD between parent sample and field duplicate results. Possible sampling or analytical imprecision.

HD High RPD between laboratory duplicate results. Potential analytical imprecision.

HM High MS/MSD recovery. Potential high analytical bias.

LD Low post-digestion spike recovery. Potential low analytical bias.

LM Low MS/MSD recovery. Potential low analytical bias.

LL Low LCS recovery. Potential low analytical bias.

6.0 CHAIN OF CUSTODY AND SAMPLE RECEIPT CONDITION DOCUMENTATION

The samples were received at the laboratories intact and under proper COC, properly preserved, and at temperatures not exceeding 6.0 degrees Celsius.

7.0 SPECIFIC DATA VALIDATION FINDINGS

Results from these samples may be considered usable with the limitations and exceptions described in Sections 7.1 through 8.0.

7.1 TOTAL CHROMIUM BY EPA METHOD 200.8

Total chromium results generated by BAL may be considered usable with the limitations described in section 7.1.1 through 7.1.6.

7.1.1 Holding Times

Samples were extracted for total chromium within the EPA-recommended maximum holding time of 180 days from sample collection.

7.1.2 Laboratory Blanks

Target analytes were not detected in the laboratory blanks associated with these samples.

7.1.3 Laboratory Duplicates

Duplicate analysis was performed on samples DP-01-0-1, DP-07-0-1, DP-10-0-1, DP-14-3.5-4.5, and DP-20-3.5-4.5. RPDs between laboratory duplicate results were less than 20 percent (%), or the difference between primary and duplicate results were less than the reporting limit (RL), indicating acceptable sampling and analytical precision. Exceptions are noted below:

- The RPD between duplicate analyses of sample DP-01-0-1 was high at 178%. Amec Foster Wheeler J qualified the detected chromium result from this sample because of potential analytical imprecision. (J-HD)
- The RPD between duplicate analyses of sample DP-07-0-1 was high at 60%. Amec Foster Wheeler J qualified the detected chromium result from this sample because of potential analytical imprecision. (J-HD)

7.1.4 Laboratory Control Sample Accuracy

LCS recoveries were within QAPP-specified 90 to 110% limits.

7.1.5 Matrix Spike/Matrix Spike Duplicate Accuracy and Precision

MS and MSDs were performed on samples DP-01-0-1, DP-07-0-1, DP-10-0-1, DP-14-3.5-4.5, and DP-20-3.5-4.5. MS/MSD recoveries were within QAPP-specified 85 to 115% limits and RPDs were below 20%, with the following exceptions:

- Recovery was low at 73% in the MSD performed on sample DP-07-0-1 and the RPD was high at 41%. Amec Foster Wheeler J qualified the chromium result from this sample because of potential low analytical bias and potential analytical imprecision. (J-LM, HD)
- The concentration of chromium in the native unspiked sample DP-01-0-1, 456.2 milligrams per kilogram (mg/kg) was greater than four times the spike concentration, 57.02 mg/kg. It is not possible to evaluate analytical performance using the MS/MSD results for this sample.

7.1.6 Data Reporting and Analytical Procedures

There were no data anomalies associated with the reporting of this data.

7.2 CHLORIDE BY EPA METHOD 300.0

Chloride results generated by Apex may be considered usable without qualification.

7.2.1 Holding Times

Samples were analyzed for chloride within the EPA-recommended maximum holding time of 28 days from sample collection.

7.2.2 Laboratory Blanks

Target analytes were not detected in the laboratory blanks associated with these samples.

7.2.3 Laboratory Duplicates

Apex performed duplicate analysis of sample DP-13-GW. RPDs between laboratory duplicate results were less than 30%, or the difference between primary and duplicate results were less than the RL, indicating acceptable sampling and analytical precision.

7.2.4 Laboratory Control Sample Accuracy

LCS recoveries were within QAPP-specified 80 to 120% limits.

7.2.5 Matrix Spike/Matrix Spike Duplicate Accuracy and Precision

Apex performed an MS on sample DP-13-GW, but did not report results of an MSD. MS recoveries were within QAPP-specified 75 to 125% limits. Precision was evaluated by evaluating laboratory duplicate results.

7.2.6 Data Reporting and Analytical Procedures

Apex did not report detected results below the RL. There were no data anomalies associated with the reporting of this data.

7.3 TOTAL AND DISSOLVED METALS BY EPA METHOD 6020

Metals results generated by Apex may be considered usable with the limitations described in section 7.3.1 through 7.3.7.

7.3.1 Holding Times

Samples were analyzed for metals within the EPA-recommended maximum holding time of 180 days from sample collection.

7.3.2 Laboratory Blanks

Target analytes were not detected in the laboratory blanks associated with these samples.

7.3.3 Laboratory Duplicates

Duplicate analysis was performed on samples DP-03-3.5-4.5, DP-13-3-5-DUP, DP-16-0-1, and DP-17-GW for total metals; and samples DP-13-GW and DP-17-GW for dissolved metals. RPDs between laboratory duplicate results were less than 30%, or the difference between primary and duplicate results were less than the RL, indicating acceptable sampling and analytical precision. Exceptions are noted below.

- The RPD between total manganese results was high at 42% in the duplicate analysis of sample DP-13-3-5-DUP. Amec Foster Wheeler J qualified the detected manganese result from this sample because of potential analytical imprecision. (J-HD)
- The RPD between total arsenic results was high at 27% in the duplicate analysis of sample DP-17-GW. Amec Foster Wheeler J qualified the detected arsenic result from this sample because of potential analytical imprecision. (J-HD)

7.3.4 Laboratory Control Sample Accuracy

LCS and recoveries were within QAPP-specified 80 to 120% limits.

7.3.5 Matrix Spike/Matrix Spike Duplicate Accuracy and Precision

Apex performed MSs on samples DP-03-3.5-4.5, DP-13-0-1, DP-13-3-5-DUP, DP-16-01, DP-17-GW, and DP-20-0-1 for total metals; and samples DP-13-GW and DP-17-GW for dissolved metals. Apex did not report MSD results for these samples and analytical precision was determined by evaluated laboratory duplicate results whenever possible. MS recoveries were within QAPP-specified 75 to 125% limits, with the exceptions noted below:

- Total antimony results were low at 71% in the MS performed on sample DP-16-0-1. Amec Foster Wheeler UJ qualified the nondetected antimony result from this sample because of potential low analytical bias (UJ-LM)
- Total antimony (not recovered above the RL), chromium (234%), copper (153%), manganese (452%), nickel (126%), and zinc (195%) recoveries were outside QAPP-specified limits in the MS performed on sample DP-17-GW. Although total antimony was not recovered in the MS performed on this sample, it was recovered within method-specified limits in the post spike. Data limitations are summarized below.
  - Amec Foster Wheeler UJ qualified the nondetected antimony result from sample DP-17-GW because of potential low analytical bias. (UJ-LM)
  - Amec Foster Wheeler J qualified the detected nickel result from this sample because of potential high analytical bias. (J-HM)
  - The concentrations of chromium (931 micrograms per liter [µg/L]), copper (448 µg/L), manganese (4,350 µg/L), and zinc (511 µg/L) detected in the native unspiked sample were more than four times greater than the spike concentration, 55.6 µg/L, and it is not possible to evaluate analytical performance using the MS results for these analytes in this sample.
- Total manganese recovery was below QC limits at -62% in the MS performed on sample DP-03-3.5-4.5. The concentration of manganese detected in the native unspiked sample (1,530 mg/kg) was more than four times greater than the spike concentration (66.7 mg/kg). It is not possible to evaluate analytical performance using the MS result for this analyte in this sample.
- Total manganese recovery was below QC limits at -72% in the MS performed on sample DP-13-0-1. The concentration of manganese detected in the native unspiked sample (724 mg/kg) was more than four times greater than the spike concentration (62.8 mg/kg). It is not possible to evaluate analytical performance using the MS result for this analyte in this sample.
- Total manganese recovery was below QC limits at -293% in the MS performed on sample DP-13-3-5-DUP. The concentration of manganese detected in the native unspiked sample (950 mg/kg) was more than four times greater than the spike concentration (61.8 mg/kg). It is not possible to evaluate analytical performance using the MS result for this analyte in this sample.

7.3.6 Post Digestion Spike

Apex performed post digestion spikes on samples DP-16-0-1 and DP-17-GW for total antimony. Recoveries were within method-specified 80 to 120% limits, with the following exception:

- Antimony recovery was low at 60% in the post digestion spike performed on sample DP-16-0-1. Amec Foster Wheeler UJ qualified the nondetected total antimony result from this sample because of potential low analytical bias. (UJ-LD)

7.3.7 Data Reporting and Analytical Procedures

Apex did not report detected results below the RL. There were no data anomalies associated with the reporting of this data.

7.4 HEXAVALENT CHROMIUM BY EPA METHOD 200.8

Hexavalent chromium results generated by BAL may be considered usable without qualification.

7.4.1 Holding Times

Samples were extracted for hexavalent chromium within the EPA-recommended maximum holding time of 30 days from sample collection, and were analyzed within 7 days of extraction.

7.4.2 Laboratory Blanks

Hexavalent chromium was detected in the laboratory blanks associated with these samples at concentrations below the RL, ranging from 0.007 mg/kg to 0.012 mg/kg. Sample concentrations were greater than five times the concentration in the associated laboratory blank, and data usability is not adversely affected.

7.4.3 Laboratory Duplicates

Duplicate analysis was performed on sample DP-13-3-5. RPDs between laboratory duplicate results were less than 20%, or the difference between primary and duplicate results were less than the RL, indicating acceptable sampling and analytical precision.

7.4.4 Laboratory Control Sample Accuracy

LCS recoveries were within QAPP-specified 90 to 110% limits.

7.4.5 Matrix Spike/Matrix Spike Duplicate Accuracy and Precision

MS and MSDs were performed on sample DP-13-3-5. MS/MSD recoveries were within QAPP-specified 85 to 115% limits and RPDs were below 20%.

7.4.6 Data Reporting and Analytical Procedures

There were no data anomalies associated with the reporting of this data.

7.5 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260B

VOC results generated by Apex may be considered usable with the limitations described in section 7.5.1 through 7.5.8.

7.5.1 Holding Times

Samples were analyzed for VOCs within the method-specified maximum holding time of 14 days for preserved samples.

7.5.2 Laboratory Blanks

VOCs were not detected in the laboratory blanks associated with the analysis of these samples.

7.5.3 Trip Blanks

VOCs were not detected in the trip blank associated with the analysis of these samples.

7.5.4 Laboratory Duplicates

Duplicate analysis was performed on sample DP-6-GW. RPDs between laboratory duplicate results were less than 50% for organic analyses, or the difference between primary and duplicate results were less than the RL, indicating acceptable sampling and analytical precision.

7.5.5 Laboratory Control Sample Accuracy

LCS recoveries were within QAPP-specified 70 to 130% limits, with the following exceptions:

- Acetone (63%), 2-butanone (57%), carbon tetrachloride (172%), and 2-hexanone (68%) recoveries were outside QAPP-specified limits in the LCS associated with the analysis of samples DP-2-GW, DP-6-GW, DP-17-GW, and the trip blank. Data limitations are summarized below.
  - Amec Foster Wheeler UJ qualified the nondetected acetone, 2-butanone, and 2-hexanone results from samples DP-2-GW, DP-6-GW, and DP-17-GW because of potential low analytical bias. (UJ-LL)
  - Amec Foster Wheeler does not qualify trip blank results.
  - Carbon tetrachloride was not detected in any of the samples associated with the LCS, and data usability is not adversely affected by the potential high analytical bias.

7.5.6 Matrix Spike/Matrix Spike Duplicate Accuracy and Precision

MS/MSDs for VOCs were not performed on samples submitted with work order A5K0450.

7.5.7 Surrogate Recoveries

Surrogate recoveries associated with the VOC analysis of these samples were within QAPP-specified 60 to 140% limits.

7.5.8 Data Reporting and Analytical Procedures

Apex did not report detected results below the RL. There were no anomalous results associated with the VOC analysis of these samples.

7.6 HYDROCARBONS BY NWTPH-HCID

Hydrocarbon results generated by Apex may be considered fully usable without qualification.

7.6.1 Holding Times

Samples were analyzed for hydrocarbons within the method-specified maximum holding time of 14 days for preserved samples.

7.6.2 Laboratory Blanks

Hydrocarbons were not detected in the laboratory blanks associated with the analysis of these samples.

7.6.3 Trip Blanks

Hydrocarbons were not detected in the trip blank associated with the analysis of these samples.

7.6.4 Laboratory Duplicates

Apex did not perform duplicate hydrocarbon analysis on any of the samples from work order A5K0450.

7.6.5 Laboratory Control Sample Accuracy

Apex did not include LCS information related to hydrocarbon analyses in work order A5K0450.

7.6.6 Matrix Spike/Matrix Spike Duplicate Accuracy and Precision

MS/MSDs for hydrocarbons are not required by the text method and were not performed on samples submitted with work order A5K0450.

7.6.7 Surrogate Recoveries

Surrogate recoveries associated with the gasoline analysis of these samples were within QAPP-specified 60 to 140% limits.

7.6.8 Data Reporting and Analytical Procedures

Apex did not report detected results below the RL. There were no anomalous results associated with the hydrocarbon analysis of these samples.

8.0 FIELD DUPLICATES

Amec Foster Wheeler collected field duplicates of samples DP-06-5-6 (DP-06-5-6-DUP), DP-11-3.5-4.5 (DP-11-3.5-4.5-DUP), DP-13-3-5 (DP-13-3-5-DUP), and DP-13-GW (DP-13-W-DUP). Detections in the field duplicate pairs are summarized in Table 2. RPDs between primary and field duplicate results were either less than 30% for hexavalent chromium, chloride, and metals; less than 50% for VOCs; or the difference between primary and duplicate results were less than the RL, indicating acceptable sampling and analytical precision, with the following exceptions:

- The RPD was high at 120% between hexavalent chromium results from sample DP-06-5-6 and it's field duplicate, DP-06-5-6-DUP. Amec Foster Wheeler J qualified the detected hexavalent chromium results from this sample and its duplicate because of potential sampling or analytical imprecision. (J-FD)
- RPDs were high between arsenic (44%), copper (49%), manganese (49%), and nickel (31%) results from sample DP-11-3.5-4.5 and its field duplicate DP-11-3.5-4.5-DUP. Amec Foster Wheeler J qualified the detected results of these analytes from sample DP-11-3.5-4.5 and its duplicate because of potential sampling or analytical imprecision. (J-FD)
- RPDs were high between arsenic (75%), cadmium (122%), chromium (107%), copper (143%), lead (65%), manganese (152%), and nickel (138%) results from sample DP-13-GW and its field duplicate, DP-13-W-DP. Additionally, dissolved copper (17.2 mg/kg) and dissolved lead (0.400 mg/kg) were detected in the duplicate sample at concentrations greater than twice the RL, but were not detected in the primary sample, DP-13-GW. Amec Foster Wheeler J qualified the detected and UJ qualified the nondetected results of these analytes from sample DP-13-GW and its duplicate because of potential sampling or analytical imprecision. (J/UJ-FD)

9.0 SUMMARY AND CONCLUSIONS

Amec Foster Wheeler evaluated a total of 974 data records from field samples during the validation. Amec Foster Wheeler J qualified 44 results (4.5%) because of high laboratory duplicate RPDs, low post-digestion spike recoveries, low LCS recovery, low MS/MSD recovery, high MS/MSD recovery, and high field duplicate RPDs. No data were rejected, and the data may be considered 100% usable as presented in Apex's and BAL's laboratory reports.

REFERENCES

EPA, 2004. SW 846 Test Methods for Evaluating Solid Wastes, Update IIIB.

EPA, 2014. EPA Contract Laboratory Program (CLP) National Functional Guidelines for Superfund Organic Methods Data Review, EPA-540-R-014-002.

EPA, 2014. EPA Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic Superfund Data Review, EPA-540-R-013-001.

LIMITATIONS

This report was prepared exclusively for the City of Sherwood by Amec Foster Wheeler Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in Amec Foster Wheeler services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This data validation report is intended to be used by the City of Sherwood only, subject to the terms and conditions of its contract with Amec Foster Wheeler. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

TABLES

TABLE 1
List of Field Samples Submitted to Apex Laboratory and Brooks Applied Labs
Former Frontier Leather Property
Sherwood, Oregon

Field Sample ID	Sample Matrix	Collection Date	Apex Sample ID	BAL Sample ID	Notes
DP-03-3.5-4.5	Soil	11/10/2015	A5K0450-01	1546054-18	
DP-06-5-6	Soil	11/10/2015	A5K0450-02	1546054-19	
DP-06-5-6-DUP	Soil	11/10/2015	A5K0450-03	1546054-20	Field Duplicate of DP-06-5-6
DP-06-0-1	Soil	11/10/2015	A5K0450-04	1546054-21	
DP-06-12-13	Soil	11/10/2015	A5K0450-05	1546054-22	
DP-07-0-1	Soil	11/10/2015	A5K0450-06	1546054-23	
DP-07-3.5-4.5	Soil	11/10/2015	A5K0450-07	1546054-24	
DP-08-0-1	Soil	11/10/2015	A5K0450-08	1546054-25	
DP-08-3.5-4.5	Soil	11/10/2015	A5K0450-09	1546054-26	
DP-6-GW	Water	11/10/2015	A5K0450-10	Not Submitted	
DP-05-0-1.5	Soil	11/11/2015	A5K0450-11	1546054-27	
DP-05-3.5-4.5	Soil	11/11/2015	A5K0450-12	1546054-28	
DP-18-0-1	Soil	11/11/2015	A5K0450-13	1546054-29	
DP-18-3.5-4.5	Soil	11/11/2015	A5K0450-14	1546054-30	
DP-14-0-1	Soil	11/11/2015	A5K0450-15	1546054-44	
DP-14-3.5-4.5	Soil	11/11/2015	A5K0450-16	1546054-45	
DP-13-0-1	Soil	11/11/2015	A5K0450-17	1546054-40	
DP-13-3-5	Soil	11/11/2015	A5K0450-18	1546054-41	
DP-13-3-5-DUP	Soil	11/11/2015	A5K0450-19	1546054-42	Field Duplicate of DP-13-3-5
DP-13-8-9	Soil	11/11/2015	A5K0450-20	1546054-43	
DP-16-3.5-4.5	Soil	11/10/2015	A5K0450-21	1546054-09	
DP-2-0-1	Soil	11/10/2015	A5K0450-22	1546054-10	
DP-2-3.5-4.5	Soil	11/10/2015	A5K0450-23	1546054-11	
DP-2-8-9	Soil	11/10/2015	A5K0450-24	1546054-12	
DP-2-GW	Water	11/10/2015	A5K0450-25	Not Submitted	
DP-01-0-1	Soil	11/10/2015	A5K0450-26	1546054-13	
DP-01-3.5-4.5	Soil	11/10/2015	A5K0450-27	1546054-14	
DP-04-0-1	Soil	11/10/2015	A5K0450-28	1546054-15	
DP-04-3.5-4.5	Soil	11/10/2015	A5K0450-29	1546054-16	
DP-03-0-1	Soil	11/10/2015	A5K0450-30	1546054-17	
DP-17-0-1	Soil	11/10/2015	A5K0450-31	1546054-01	
DP-17-3.5-4.5	Soil	11/10/2015	A5K0450-32	1546054-02	
DP-17-8-9	Soil	11/10/2015	A5K0450-33	1546054-03	
DP-17-GW	Water	11/10/2015	A5K0450-34	Not Submitted	
DP-20-0-1	Soil	11/10/2015	A5K0450-35	1546054-04	
DP-20-3.5-4.5	Soil	11/10/2015	A5K0450-36	1546054-05	
DP-19-0-1	Soil	11/10/2015	A5K0450-37	1546054-06	
DP-19-3.5-4.5	Soil	11/10/2015	A5K0450-38	1546054-07	
DP-16-0-1	Soil	11/10/2015	A5K0450-39	1546054-08	
TRIP BLANK	Water	11/10/2015	A5K0450-40	Not Submitted	Trip Blank
DP-13-GW	Water	11/11/2015	A5K0450-41	Not Submitted	
DP-3-9-10	Soil	11/11/2015	A5K0450-42	Not Submitted	
DP-3-14.5-15	Soil	11/11/2015	A5K0450-43	Not Submitted	
DP-13-W-DUP	Water	11/11/2015	A5K0450-44	Not Submitted	Field Duplicate of DP-13-GW
DP-15-0-1	Soil	11/11/2015	A5K0450-50	1546054-46	
DP-15-4-5	Soil	11/11/2015	A5K0450-51	1546054-47	
DP-12-0-1	Soil	11/11/2015	A5K0450-52	1546054-38	
DP-12-3.5-4.5	Soil	11/11/2015	A5K0450-53	1546054-39	
DP-10-0-1	Soil	11/11/2015	A5K0450-54	1546054-31	
DP-10-3.5-4.5	Soil	11/11/2015	A5K0450-55	1546054-32	
DP-11-0-1	Soil	11/11/2015	A5K0450-56	1546054-33	

TABLE 1
List of Field Samples Submitted to Apex Laboratory and Brooks Applied Labs
Former Frontier Leather Property
Sherwood, Oregon

Field Sample ID	Sample Matrix	Collection Date	Apex Sample ID	BAL Sample ID	Notes
DP-11-3.5-4.5	Soil	11/11/2015	A5K0450-57	1546054-34	
DP-11-3.5-4.5 DUP	Soil	11/11/2015	A5K0450-58	1546054-35	Field Duplicate of DP-11-3.5-14.5
DP-9-0-1	Soil	11/11/2015	A5K0450-59	1546054-36	
DP-9-3.5-4.5	Soil	11/11/2015	A5K0450-60	1546054-37	
DP-COMPOSITE	Soil	11/10/2015	A5K0450-61	Not Submitted	

Notes:
BAL = Brooks Applied Labs ID = identification

TABLE 2
Field Duplicate Detections
Former Frontier Leather Property
Sherwood, Oregon

Method	Analyte	Average RL (mg/kg)	Primary Sample (mg/kg)	Field Duplicate (mg/kg)	Relative Percent Difference	Notes
Samples DP-06-5-6 and DP-06-5-6-DUP						
6020	Arsenic	1.36	2.56	2.70	5%	
	Copper	1.36	17.1	17.4	2%	
	Lead	0.272	5.29	5.49	4%	
	Manganese	1.36	523	616	16%	
	Nickel	1.36	13.9	13.9	0%	
	Zinc	5.44	44.6	48.2	8%	
EPA 200.8	Total Chromium	1.43	19.1	22.7	17%	
SW7199	Hexavalent Chromium	0.028	0.062	0.247	120%	J-FD
Samples DP-11-3.5-4.5 and DP-11-3.5-4.5-DUP						
EPA 200.8	Total Chromium	1.14	32.2	33.3	3%	
6020	Arsenic	1.23	4.24	6.64	44%	J-FD
	Cadmium	0.245	0.284	0.289	2%	
	Copper	1.23	15.8	26.1	49%	J-FD
	Lead	0.245	7.38	8.98	20%	
	Manganese	1.23	546	904	49%	J-FD
	Nickel	1.23	17.6	24.0	31%	J-FD
	Zinc	4.90	59.4	71.9	19%	
Samples DP-13-3-5 and DP-13-3-5-DUP						
EPA 200.8	Total Chromium	1.20	22	20.1	9%	
6020	Arsenic	2.02	4.85	3.91	21%	
	Cadmium	0.271	0.331	0.306	8%	
	Copper	1.36	23.5	24.6	5%	
	Lead	0.271	7.51	6.99	7%	
	Manganese	1.36	883	950	7%	
	Nickel	2.02	25.5	26.5	4%	
	Zinc	5.42	65.4	59.8	9%	
SW7199	Hexavalent Chromium	0.026	0.342	NT	NC	

TABLE 2
Field Duplicate Detections
Former Frontier Leather Property
Sherwood, Oregon

Method	Analyte	Average RL (µg/L)	Primary Sample (µg/L)	Field Duplicate (µg/L)	Relative Percent Difference	Notes
Samples DP-13-GW and DP-13-W-DUP						
EPA 300.0	Chloride	1.00	11.8	11.4	3%	
6020	Arsenic	1.00	1.40	3.09	75%	J-FD
	Cadmium	0.200	0.211	0.867	122%	J-FD
	Chromium	1.00	9.36	31.1	107%	J-FD
	Copper	1.00	10.2	61.3	143%	J-FD
	Lead	0.200	4.70	9.23	65%	J-FD
	Manganese	10.5	521	3780	152%	J-FD
	Nickel	1.00	10.1	55.5	138%	J-FD
	Zinc	4.00	25.4	146	19%	
	Dissolved Copper	2.00	2.00 U	17.2	NC	J/UJ-FD
	Dissolved Chromium	1.00	3.64	3.97	9%	
	Dissolved Lead	0.200	0.200 U	0.400	NC	J/UJ-FD
	Dissolved Manganese	1.00	10.3	11.2	8%	

Notes:
mg/kg = milligrams per kilogram
NC = Not Calculable
NT = Not Tested
RL = Reporting Limit

Qualifier Definitions:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample qantiation limit. However, the reported quanitation limit is approximate and may or may not represent the actual limit of quanitation necessary to accurately and precisely measure the analyte in the sample.

Reason Codes
FD = High RPD between parent sample and field duplicate results.

TABLE 3
Qualifiers Added During Data Quality Review
Former Frontier Leather Property
Sherwood, Oregon

Sample ID	Analytical Method	Analyte	Concentration	Qualifiers and Bias/Reason Codes	
DP-01-0-1	EPA 200.8	Chromium	456 mg/kg	J	HD
DP-06-5-6	7199	Hexavalent Chromium	0.062 mg/kg	J	FD
DP-06-5-6-DUP	7199	Hexavalent Chromium	0.247 mg/kg	J	FD
DP-07-0-1	EPA 200.8	Chromium	46.2 mg/kg	J	LM, HD
DP-11-3.5-4.5	6020	Arsenic	4.24 mg/kg	J	FD
		Copper	15.8 mg/kg	J	FD
		Manganese	546 mg/kg	J	FD
		Nickel	17.6 mg/kg	J	FD
DP-11-3.5-4.5 DUP	6020	Arsenic	6.64 mg/kg	J	FD
		Copper	26.1 mg/kg	J	FD
		Manganese	904 mg/kg	J	FD
		Nickel	24.0 mg/kg	J	FD
DP-13-3-5-DUP	6020	Manganese	950 mg/kg	J	HD
DP-13-GW	6020	Arsenic	1.40 µg/L	J	FD
		Cadmium	0.211 µg/L	J	FD
		Chromium	9.36 µg/L	J	FD
		Copper	10.2 µg/L	J	FD
		Lead	4.70 µg/L	J	FD
		Manganese	521 µg/L	J	FD
		Nickel	10.10 µg/L	J	FD
		Dissolved Copper	2 µg/L	UJ	FD
		Dissolved Lead	0.200 µg/L	UJ	FD
DP-13-W-DUP	6020	Arsenic	3.09 µg/L	J	FD
		Cadmium	0.867 µg/L	J	FD
		Chromium	31.1 µg/L	J	FD
		Copper	61.3 µg/L	J	FD
		Lead	9.23 µg/L	J	FD
		Manganese	3780 µg/L	J	FD
		Nickel	55.5 µg/L	J	FD
		Dissolved Copper	17.2 µg/L	J	FD
		Dissolved Lead	0.400 µg/L	J	FD
DP-16-0-1	6020	Antimony	1.12 mg/kg	UJ	LD, LM
DP-17-GW	6020	Antimony	10.0 µg/L	UJ	LM
		Arsenic	24.1 µg/L	J	HD
		Nickel	211 µg/L	J	HM
	8260B	2-Butanone	10.0 µg/L	UJ	LL
		2-Hexanone	10.0 µg/L	UJ	LL
		Acetone	20.0 µg/L	UJ	LL
DP-2-GW	8260B	2-Butanone	10.0 µg/L	UJ	LL
		2-Hexanone	10.0 µg/L	UJ	LL
		Acetone	20.0 µg/L	UJ	LL

TABLE 3
Qualifiers Added During Data Quality Review
Former Frontier Leather Property
Sherwood, Oregon

Sample ID	Analytical Method	Analyte	Concentration	Qualifiers and Bias/Reason Codes	
DP-6-GW	8260B	2-Butanone	10.0 µg/L	UJ	LL
		2-Hexanone	10.0 µg/L	UJ	LL
		Acetone	20.0 µg/L	UJ	LL

Notes:
µg/L = micrograms per liter
mg/kg = milligrams per kilogram

Qualifier Definitions:
J = The analyte was positively identified; the associated numerical value is the approximate concentration
UJ = The analyte was not detected above the reported sample qantiation limit. However, the reported quanitation limit is approximate and may or may not represent the actual limit of quanitation necessary to accurately and precisely measure the

Reasion Codes
FD = High RPD between parent sample and field duplicate results. Potential sampling or analytical imprecision.
HD = High RPD between laboratory duplicate results. Potential analytical imprecision.
HM = High MS/MSD recovery. Potential high analytical bias.
LD = Low post-digestion spike recovery. Potential low analytical bias.
LM = Low MS/MSD recovery. Potential low analytical bias.
LL = Low LCS recovery. Potential low analytical bias.

APPENDIX D-2

Laboratory Reports

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Wednesday, January 13, 2016

Michelle Peterson
AMEC Foster Wheeler
7376 SW Durham Road
Portland, OR 97224

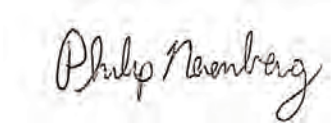
RE: Former Frontier Leather / 561M13082

Enclosed are the results of analyses for work order A5K0450, which was received by the laboratory on 11/12/2015 at 4:37:00PM.

Thank you for using Apex Labs. We appreciate your business and strive to provide the highest quality services to the environmental industry.

If you have any questions concerning this report or the services we offer, please feel free to contact me by email at: pnerenberg@apex-labs.com, or by phone at 503-718-2323.

Apex Laboratories



Philip Nerenberg, Lab Director

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

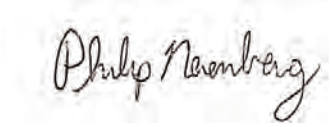
AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
DP-Composite	A5K0450-61	Soil	11/10/15 14:25	11/12/15 16:37

Apex Laboratories



Philip Nerenberg, Lab Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

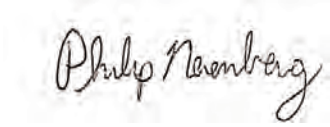
AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

ANALYTICAL SAMPLE RESULTS

TCLP Metals by EPA 6020 (ICPMS)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
DP-Composite (A5K0450-61)			**Matrix: Soil**					
Batch: 5120493								
Chromium	ND	---	0.100	mg/L	5	12/16/15 13:34	1311/6020A	
Lead	ND	---	0.0500	"	"	"	"	

Apex Laboratories



Philip Nerenberg, Lab Director

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Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

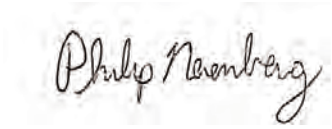
AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

QUALITY CONTROL (QC) SAMPLE RESULTS

TCLP Metals by EPA 6020 (ICPMS)

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5120493 - EPA 1311/3015									Soil			
Blank (5120493-BLK1)					Prepared: 12/16/15 10:18 Analyzed: 12/16/15 13:16							
1311/6020A												
Chromium	ND	---	0.100	mg/L	5	---	---	---	---	---	---	TCLP
Lead	ND	---	0.0500	"	"	---	---	---	---	---	---	TCLP
LCS (5120493-BS1)					Prepared: 12/16/15 10:18 Analyzed: 12/16/15 13:19							
1311/6020A												
Chromium	2.65	---	0.100	mg/L	5	2.50	---	106	80-120%	---	---	TCLP
Lead	2.65	---	0.0500	"	"	"	---	106	"	---	---	TCLP

Apex Laboratories



Philip Nerenberg, Lab Director

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Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

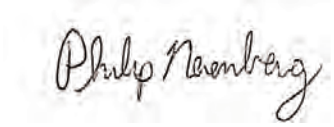
SAMPLE PREPARATION INFORMATION

TCLP Metals by EPA 6020 (ICPMS)

Prep: EPA 1311/3015

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 5120493							
A5K0450-61	Soil	1311/6020A	11/10/15 14:25	12/16/15 10:18	5mL/50mL	5mL/50mL	1.00

Apex Laboratories



Philip Nerenberg, Lab Director

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Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26

Notes and Definitions

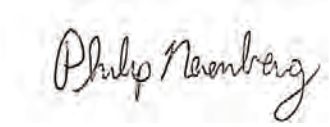
Qualifiers:

TCLP	This batch QC sample was prepared with TCLP or SPLP fluid from preparation batch 5120493.

Notes and Conventions:

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis. Results listed as 'wet' or without 'dry'designation are not dry weight corrected.
RPD	Relative Percent Difference
MDL	If MDL is not listed, data has been evaluated to the Method Reporting Limit only.
WMSC	Water Miscible Solvent Correction has been applied to Results and MRLs for volatiles soil samples per EPA 8000C.
Batch QC	Unless specifically requested, this report contains only results for Batch QC derived from client samples included in this report. All analyses were performed with the appropriate Batch QC (including Sample Duplicates, Matrix Spikes and/or Matrix Spike Duplicates) in order to meet or exceed method and regulatory requirements. Any exceptions to this will be qualified in this report. Complete Batch QC results are available upon request. In cases where there is insufficient sample provided for Sample Duplicates and/or Matrix Spikes, a Lab Control Sample Duplicate (LCS Dup) is analyzed to demonstrate accuracy and precision of the extraction and analysis.
Blank Policy	Apex assesses blank data for potential high bias down to a level equal to ½ the method reporting limit (MRL), except for conventional chemistry and HCID analyses which are assessed only to the MRL. Sample results flagged with a B or B-02 qualifier are potentially biased high if they are less than ten times the level found in the blank for inorganic analyses or less than five times the level found in the blank for organic analyses. For accurate comparison of volatile results to the level found in the blank; water sample results should be divided by the dilution factor, and soil sample results should be divided by 1/50 of the sample dilution to account for the sample prep factor. Results qualified as reported below the MRL may include a potential high bias if associated with a B or B-02 qualified blank. B and B-02 qualifications are not applied to J qualified results reported below the MRL.
---	QC results are not applicable. For example, % Recoveries for Blanks and Duplicates, % RPD for Blanks, Blank Spikes and Matrix Spikes, etc.
***	Used to indicate a possible discrepancy with the Sample and Sample Duplicate results when the %RPD is not available. In this case, either the Sample or the Sample Duplicate has a reportable result for this analyte, while the other is Non Detect (ND).

Apex Laboratories



Philip Nerenberg, Lab Director

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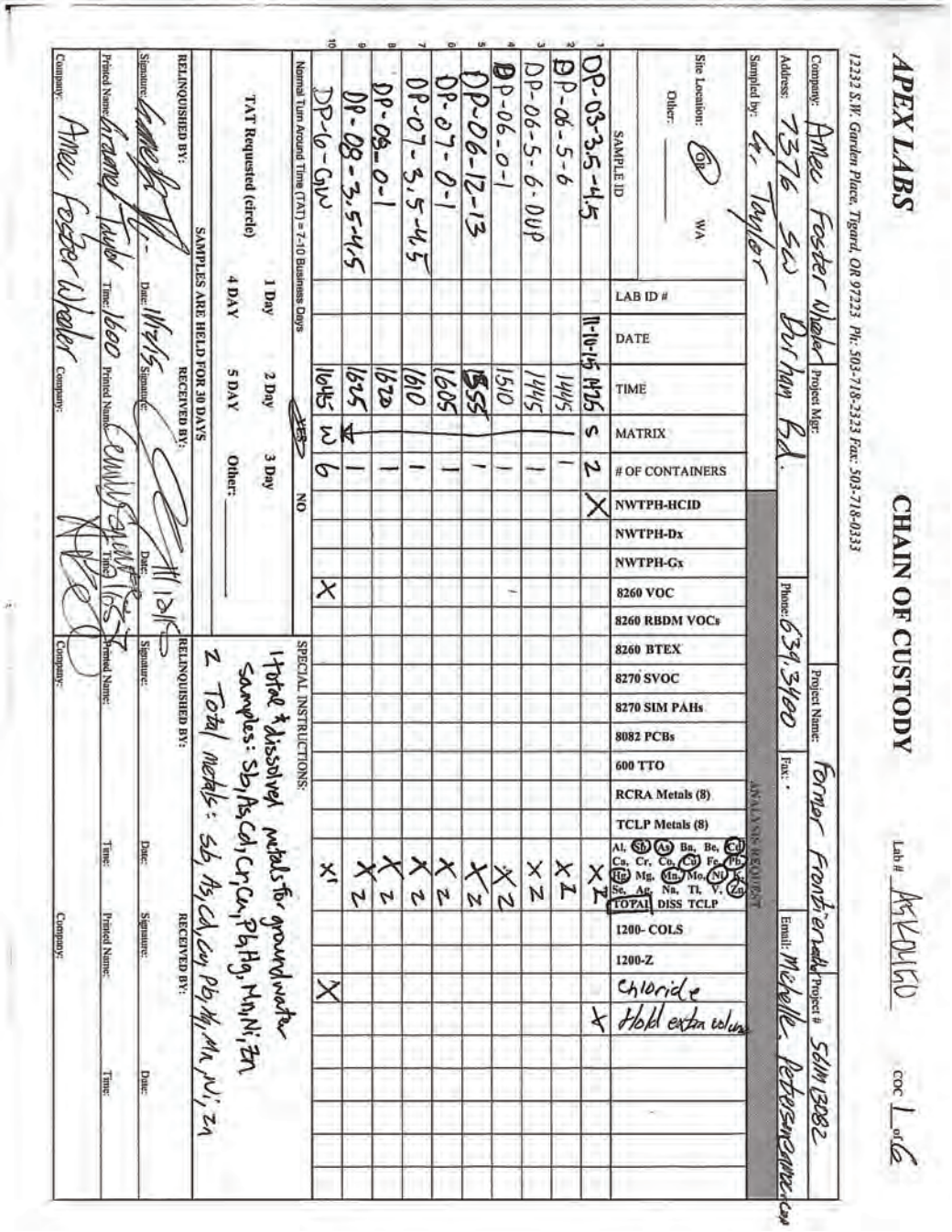
Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26



APEX LABS — CHAIN OF CUSTODY

12232 S.W. Garden Place, Tigard, OR 97223 PH: 503-718-2323 Fax: 503-718-0333

Lab # AK50460 COC 1 of 6

Company: Amec Foster Wheeler — Project Mgr: — Project Name: Former Frontier Leather — Project #: 561M13082

Address: 7376 SW Durham Rd. — Phone: 639.3160 — Fax: — Email: Michelle.Peterson@amec.com

Sampled by: C. Taylor

Site Location: OR WA — Other: ____

ANALYSIS REQUEST

#	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8) Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn — TOTAL / DISS TCLP	1200- COLS	1200-Z		
1	DP-03-3.5-4.5		11-10-15	1425	S	2	X											XZ				
2	DP-06-5-6			1445		1												XZ				
3	DP-06-5-6-DUP			1445		1												XZ				
4	DP-06-0-1			1510		1												XZ				
5	DP-06-12-13			1555		1												XZ				
6	DP-07-0-1			1605		1												XZ				
7	DP-07-3.5-4.5			1610		1												XZ				
8	DP-08-0-1			1620		1												XZ				
9	DP-08-3.5-4.5			1625		1												XZ				
10	DP-16-GW			1645	W	6				X								X'		X		

Normal Turn Around Time (TAT) = 7-10 Business Days — NO

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: ____

SPECIAL INSTRUCTIONS:
1 total & dissolved metals for groundwater samples: Sb, As, Cd, Cr, Cu, Pb, Hg, Mn, Ni, Zn
2 Total metals: Sb, As, Cd, Cr, Cu, Pb, Hg, Mn, Ni, Zn

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY: — Signature: — Date: 1/7/15 — RECEIVED BY: — Signature: — Date:

RELINQUISHED BY: — Signature: — Printed Name: Graeme Taylor — Time: 1600 — RECEIVED BY: — Signature: — Printed Name: — Time:

RELINQUISHED BY: — Company: AMEC Foster Wheeler — RECEIVED BY: — Company:

RELINQUISHED BY: — Signature: — Date: — RECEIVED BY: — Signature: — Date:

RELINQUISHED BY: — Signature: — Printed Name: — Time: — RECEIVED BY: — Signature: — Printed Name: — Time:

RELINQUISHED BY: — Company: — RECEIVED BY: — Company:

Apex Laboratories

Philip Nerenberg

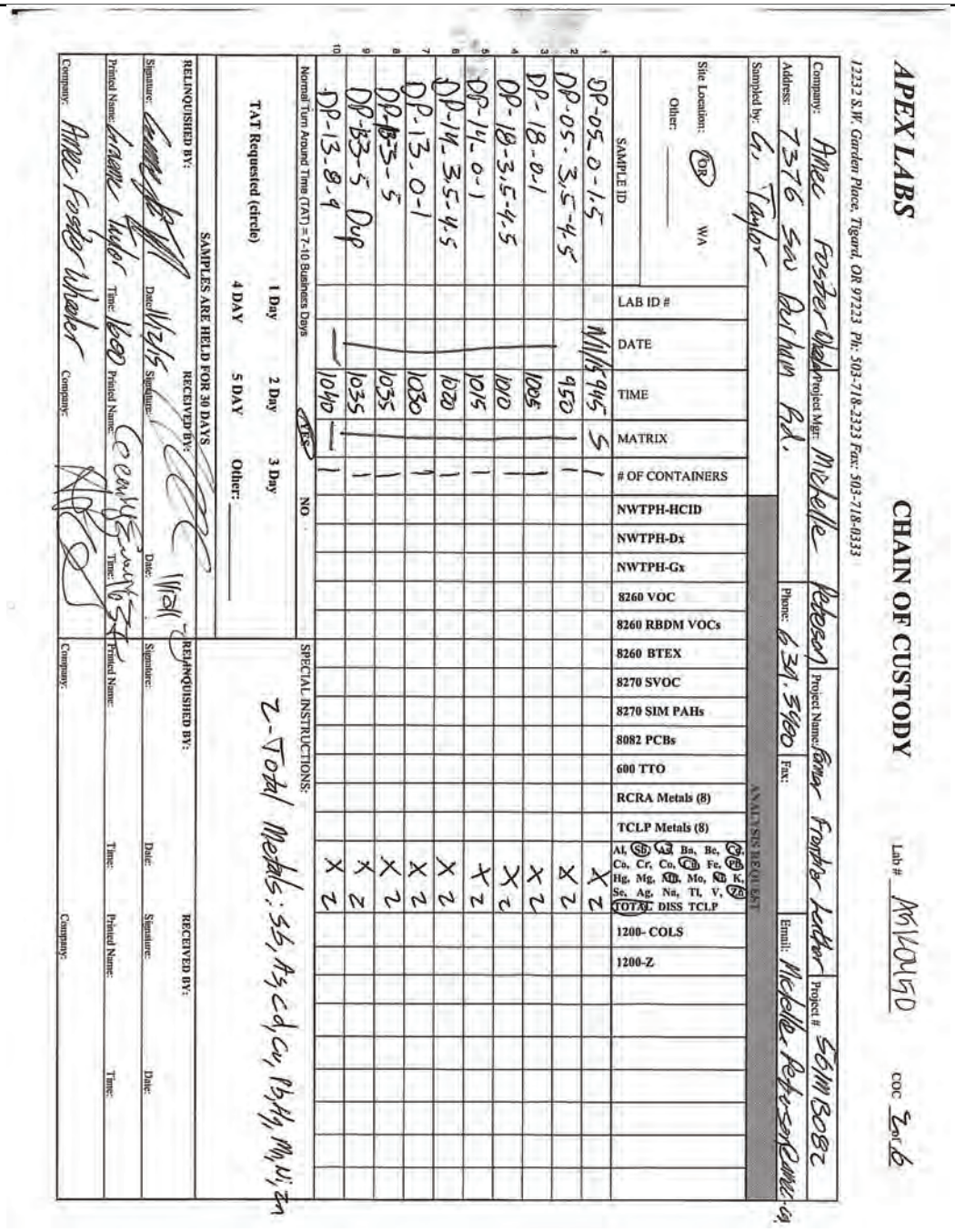
Philip Nerenberg, Lab Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26



APEX LABS — CHAIN OF CUSTODY

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Lab # 151045 COC 2 of 2

Company: AMEC Foster Wheeler Project Mgr: Michelle Peterson Project Name: Former Frontier Leather Project # 561M13082

Address: 7376 SW Durham Rd. Phone: 639.3400 Fax: Email: Michelle.Peterson@amec.com

Sampled by: G. Taylor

Site Location: OR WA Other: _____

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8) Al, Sb, As, Ba, Be, Cd, Co, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200- COLS	1200-Z
1	DP-05-0-1.5		1/13/16	945	S	1												X	Z	
2	DP-05-3.5-4.5			950		1												X	Z	
3	DP-18-0-1			1005		1												X	Z	
4	DP-18-3.5-4.5			1010		1												X	Z	
5	DP-14-0-1			1015		1												X	Z	
6	DP-14-3.5-4.5			1020		1												X	Z	
7	DP-13-0-1			1030		1												X	Z	
8	DP-B3-5			1035		1												X	Z	
9	DP-B3-5 Dup			1035		1												X	Z	
10	DP-13-8-9			1040		1												X	Z	

Normal Turn Around Time (TAT) = 7-10 Business Days YES NO

TAT Requested (circle) 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: _____

SPECIAL INSTRUCTIONS: Z-Total Metals: Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Zn

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY: Signature: Date: 1/13/16 — RECEIVED BY: Signature: Date: 1/13/16

RELINQUISHED BY: Printed Name: Graeme Taylor Time: 1600 — RECEIVED BY: Printed Name: Time:

RELINQUISHED BY: Company: AMEC Foster Wheeler — RECEIVED BY: Company:

RELINQUISHED BY: Signature: Date: — RECEIVED BY: Signature: Date:

RELINQUISHED BY: Printed Name: Time: — RECEIVED BY: Printed Name: Time:

RELINQUISHED BY: Company: — RECEIVED BY: Company:

Apex Laboratories

Philip Nerenberg

Philip Nerenberg, Lab Director

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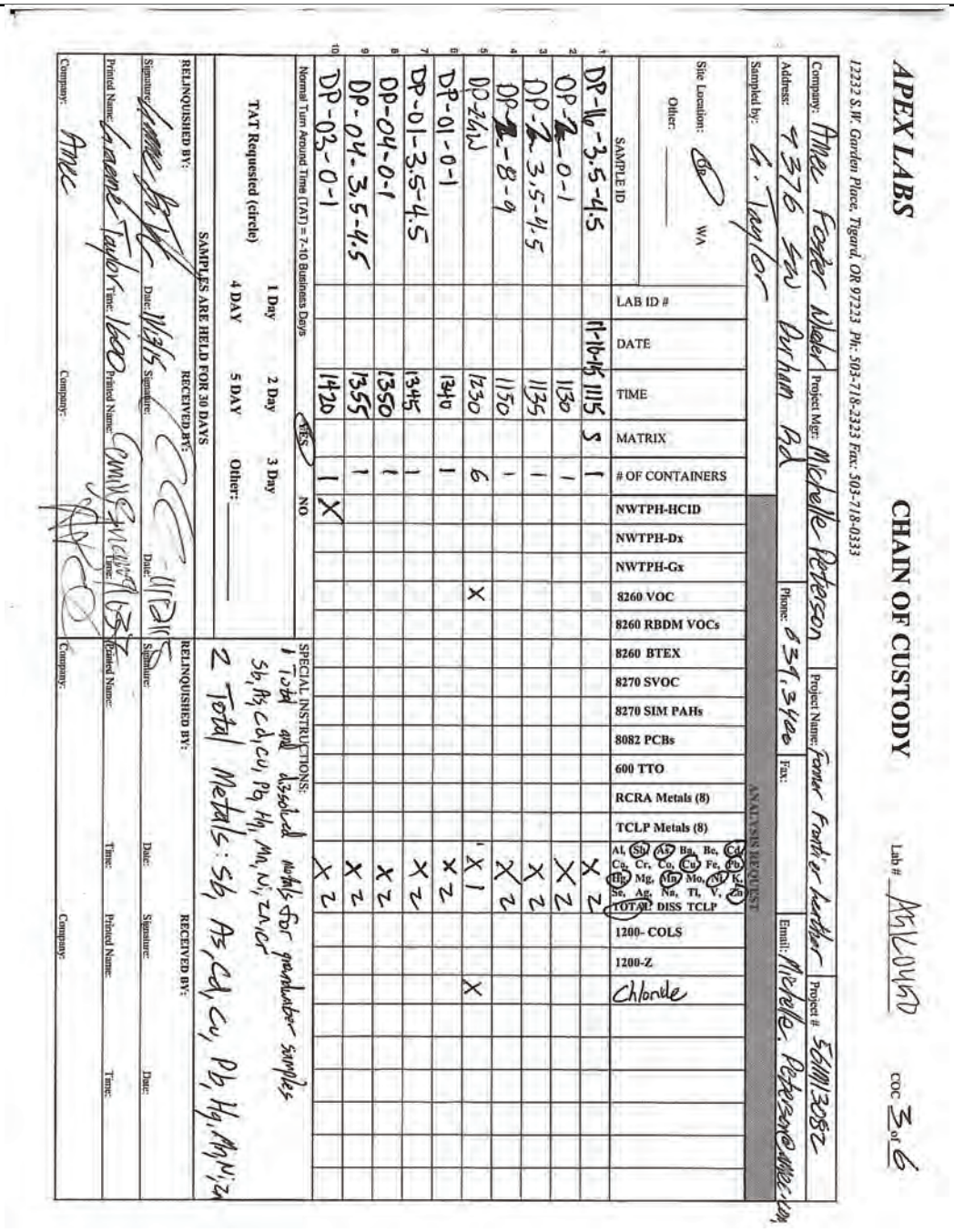
Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26



APEX LABS — CHAIN OF CUSTODY

12232 S.W. Garden Place, Tigard, OR 97223 PH: 503-718-2323 Fax: 503-718-0333

Lab # ANL0040 COC 3 of 6

Company: AMEC Foster Wheeler — Project Mgr: Michelle Peterson — Project Name: Former Frontier Leather — Project # 561M13082

Address: 7376 SW Durham Rd — Phone: 971.344.3420 — Fax: — Email: Michelle.Peterson@amec.com

Sampled by: G. Taylor

Site Location: OR WA — Other: _____

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8) Al, Sb, As, Ba, Be, Cd, Cu, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200- COLS	1200-Z	Chloride
1	DP-W-3.5-4.5	11-1645		1115	S	1												X Z			
2	DP-Z-0-1			1130		1												X Z			
3	DP-Z-3.5-4.5			1135		1												X Z			
4	DP-Z-8-9			1150		1												X Z			
5	DP-Z-W			1230		6				X								X			X
6	DP-01-0-1			1340		1												X Z			
7	DP-01-3.5-4.5			1345		1												X Z			
8	DP-04-0-1			1350		1												X Z			
9	DP-04-3.5-4.5			1355		1												X Z			
10	DP-03-0-1			1420		1	X											X Z			

Normal Turn Around Time (TAT) = 7-10 Business Days — RES / NO

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: _____

SPECIAL INSTRUCTIONS: # Total and dissolved Metals for groundwater samples Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Zn, Cr

2 Total Metals: Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Zn

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY: — Signature: _____ Date: 1/13/16 — Printed Name: Laramie Taylor Time: 1600 — Company: AMEC

RECEIVED BY: — Signature: _____ Date: 1/13/16 — Printed Name: CHRISTINA Time: 1600 — Company: _____

RELINQUISHED BY: — Signature: _____ Date: _____ — Printed Name: _____ Time: _____ — Company: _____

RECEIVED BY: — Signature: _____ Date: _____ — Printed Name: _____ Time: _____ — Company: _____

Apex Laboratories

Philip Nerenberg

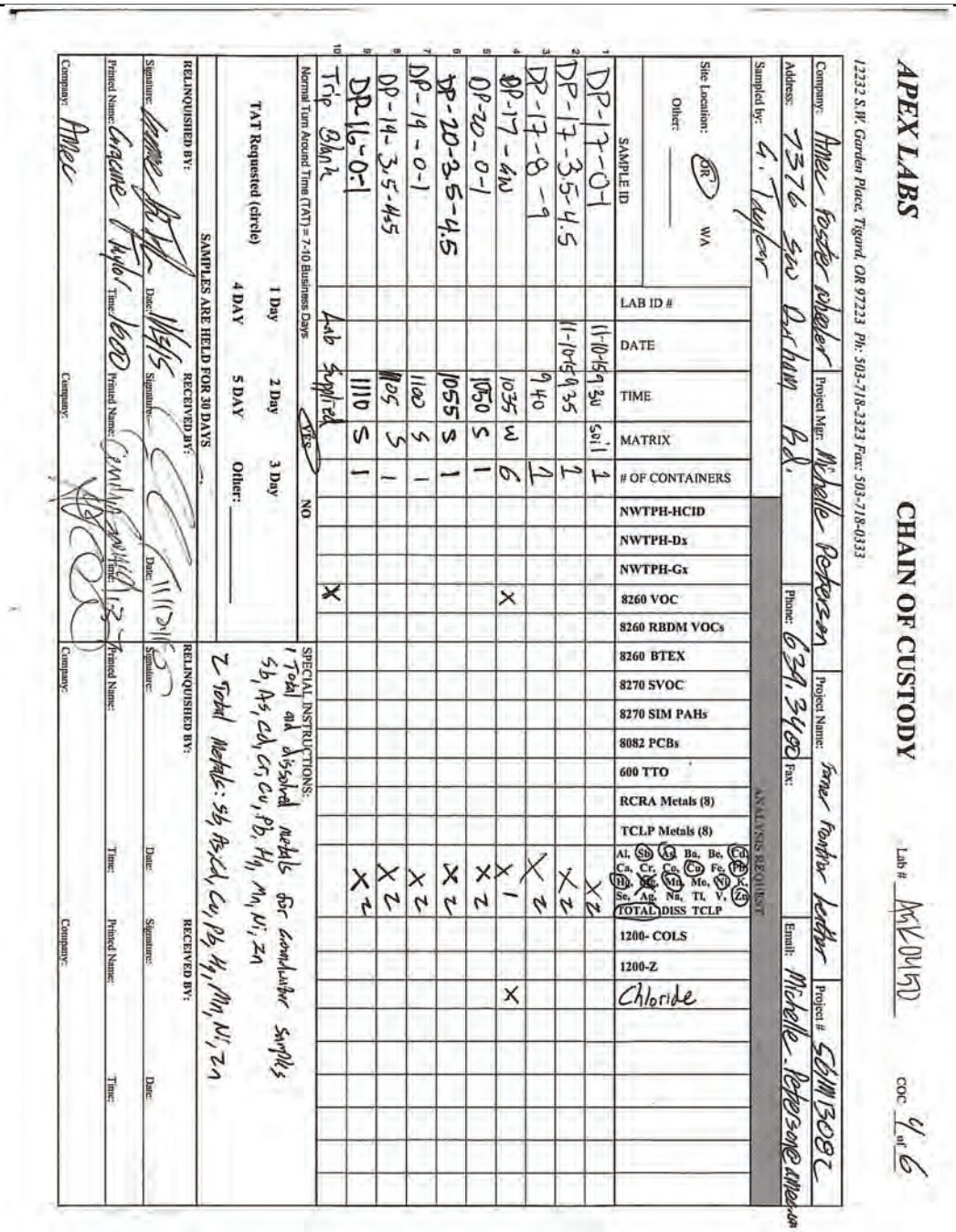
Philip Nerenberg, Lab Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26



APEX LABS — CHAIN OF CUSTODY — Lab # ANK0151 — COC 4 of 6

12232 S.W. Garden Place, Tigard, OR 97223 PH: 503-718-2323 Fax: 503-718-0333

Company: AMEC Foster Wheeler — Project Mgr: Michelle Peterson — Project Name: Former Frontier Leather — Project #: 561M13082

Address: 7376 SW Durham Rd. — Phone: 639.3400 — Fax: — Email: Michelle.Peterson@amec.com

Sampled by: G. Taylor

Site Location: (OR) WA — Other: ____

ANALYSIS REQUEST

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8) Al, (Sb), As, Ba, Be, (Cd), (Pb), Ca, Cr, Co, (Cu), Fe, (K), (Zn), (Ni), (Mg), Mo, (Ag), Na, Tl, V, TOTAL, DISS, TCLP	1200- COLS	1200-Z
1	DP-17-01		11-10-15	930	Soil	1													XZ	Chloride
2	DP-17-3.5-4.5		11-10-15	935		2													XZ	
3	DP-17-8-9			940		1													XZ	
4	DP-17-GW			1035	W	6				X									X	X
5	DP-20-01			1050	S	1													XZ	
6	DP-20-3.5-4.5			1055	S	1													XZ	
7	DP-19-01			1100	S	1													XZ	
8	DP-19-3.5-4.5			1105	S	1													XZ	
9	DP-16-01			1110	S	1													XZ	
10	Trip Blank	Lab Supplied																		

Normal Turn Around Time (TAT) = 7-10 Business Days — Lab Supplied: YES / NO

TAT Requested (circle): 1 Day — 2 Day — 3 Day — 4 DAY — 5 DAY — Other: ____

SPECIAL INSTRUCTIONS:
1 Total and dissolved metals for groundwater samples
Sb, As, Cd, Cr, Cu, Pb, Hg, Mn, Ni, Zn
2 Total Metals: Sb, As, Cd, Cr, Cu, Pb, Hg, Mn, Ni, Zn

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY: — Signature: — Date: 1/11/16 — Time: 1600 — Printed Name: Graeme Taylor — Company: AMEC

RECEIVED BY: — Signature: — Date: — Time: — Printed Name: — Company:

RELINQUISHED BY: — Signature: — Date: — Time: — Printed Name: — Company:

RECEIVED BY: — Signature: — Date: — Time: — Printed Name: — Company:

Apex Laboratories

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Philip Nerenberg

Philip Nerenberg, Lab Director

Apex Labs

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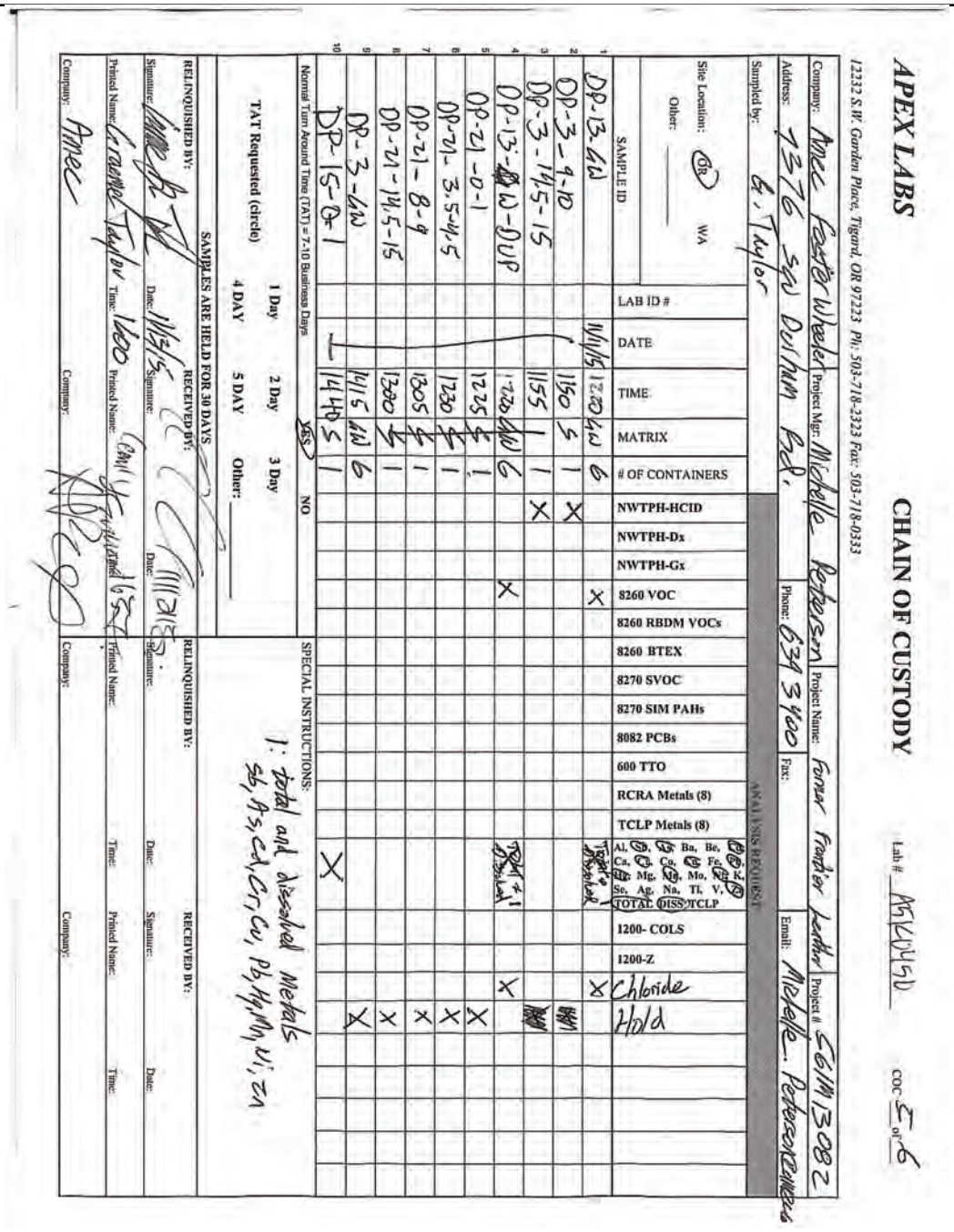
AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26



APEX LABS — CHAIN OF CUSTODY

12232 S.W. Garden Place, Tigard, OR 97223 PH: 503-718-2323 FAX: 503-718-0333

Lab # [illegible] COC 1 of 1

Company: AMEC Foster Wheeler | Project Mgr: Michelle Peterson | Project Name: Former Frontier Leather | Project # 561M13082

Address: 7376 SW Durham Rd. | Phone: 639 3400 | Fax: | Email: Michelle.Peterson@amec.com

Sampled by: E. Taylor

Site Location: OR WA Other: _____

ANALYSIS REQUEST

#	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8) Al, Sb, As, Ba, Be, Ca, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, TOTAL DISS TCLP	1200- COLS	1200-Z	
1	DP-13-GW		11/4/15	1220	GW	6				X											
2	DP-3-9-10			1150	S	1	X														
3	DP-3-14.5-15			1155		1	X														
4	DP-13-GW-DUP			1220	GW	6				X								TCLP + Dissolved			
5	DP-21-0-1			1225	S	1														X	
6	DP-21-3.5-4.5			1230		1														X	
7	DP-21-8-9			1305		1														X	
8	DP-21-14.5-15			1300		1														X	
9	DP-3-GW			1415	GW	6														X	
10	DP-15-01			1440	S	1												X			

Normal Turn Around Time (TAT) = 7-10 Business Days — SPECIAL INSTRUCTIONS: 1: total and dissolved Metals Sb, As, Cd, Cr, Cu, Pb, Hg, Mn, Ni, Zn

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: _____

SAMPLES ARE HELD FOR 30 DAYS — YES / NO

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature:	Signature:	Signature:	Signature:
Date: 11/4/15	Date:	Date:	Date:
Printed Name:	Printed Name:	Printed Name:	Printed Name:
Time: 1600	Time:	Time:	Time:
Company: AMEC	Company:	Company:	Company:

Chloride Hold

Apex Laboratories

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Philip Nerenberg

Philip Nerenberg, Lab Director

Apex Labs

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Tigard, OR 97223
503-718-2323 Phone
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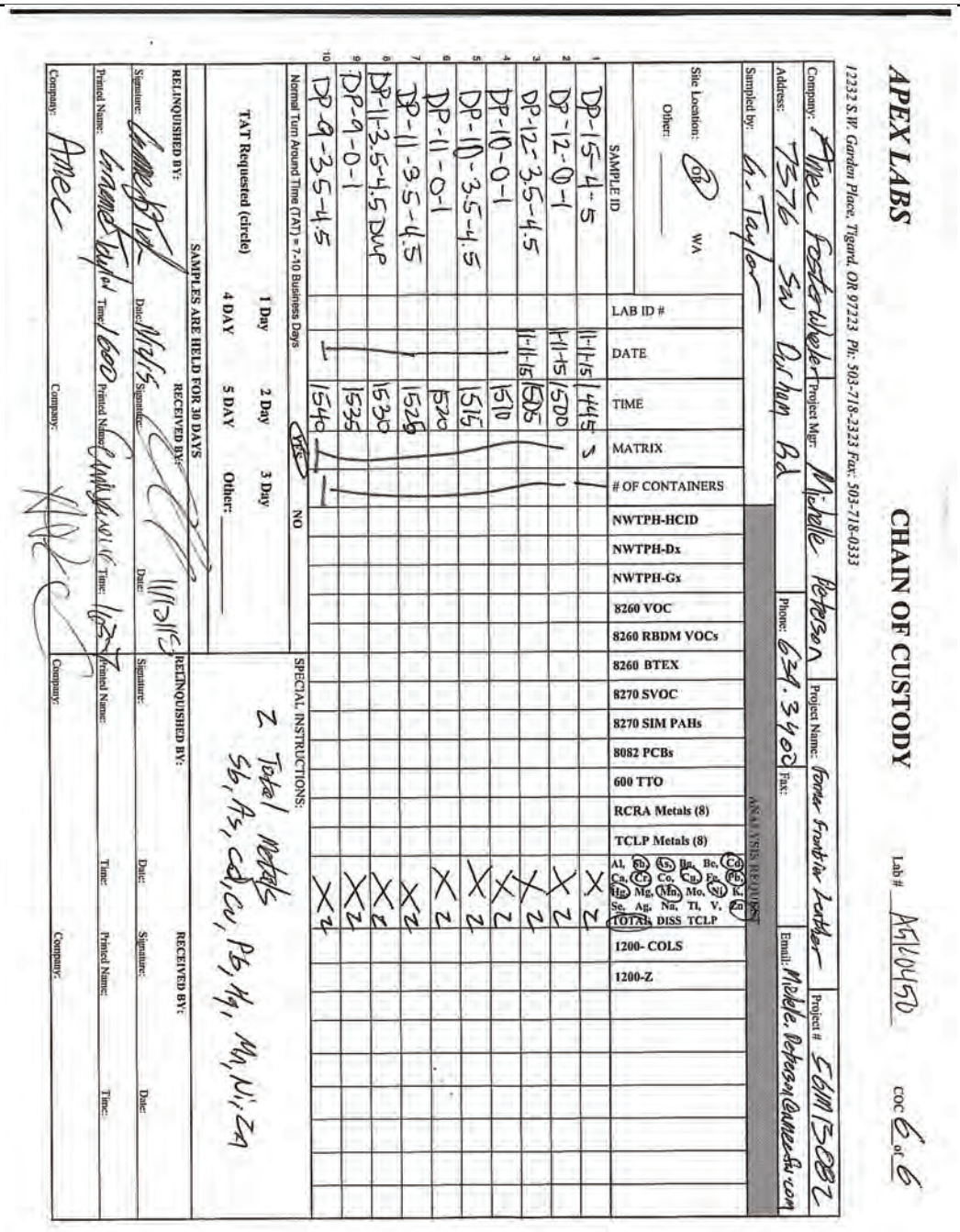
AMEC Foster Wheeler	Project: **Former Frontier Leather**	
7376 SW Durham Road	Project Number: 561M13082	**Reported:**
Portland, OR 97224	Project Manager: Michelle Peterson	01/13/16 16:26



APEX LABS — CHAIN OF CUSTODY

12232 S.W. Garden Place, Tigard, OR 97223 PH: 503-718-2323 Fax: 503-718-0333

Lab # AGL0450 COC 6 of 6

Company: AMEC Foster Wheeler | Project Mgr: Michelle Peterson | Project Name: Former Frontier Leather | Project # 561M13082

Address: 7376 SW Durham Rd | Phone: 639.3400 | Fax: | Email: Michelle.Peterson@amec.com

Sampled by: K. Taylor

Site Location: OR WA Other: ____

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	1200- COLS	1200-Z
1	DP-15-4-5		11-11-15	1445	S	1				X		X						X2		
2	DP-12-0-1		11-11-15	1500		1				X		X						X2		
3	DP-12-3.5-4.5		11-11-15	1505		1				X		X						X2		
4	DP-10-0-1			1510		1				X		X						X2		
5	DP-10-3.5-4.5			1515		1				X		X						X2		
6	DP-11-0-1			1520		1				X		X						X2		
7	DP-11-3.5-4.5			1525		1				X		X						X2		
8	DP-11-3.5-4.5 DUP			1530		1				X		X						X2		
9	DP-9-0-1			1535		1				X		X						X2		
10	DP-9-3.5-4.5			1540		1				X		X						X2		

ANALYSIS REQUEST

Normal Turn Around Time (TAT) = 7-10 Business Days — RUSH — NO

TAT Requested (circle): 1 Day | 2 Day | 3 Day | 4 DAY | 5 DAY | Other: ____

SPECIAL INSTRUCTIONS:
2 Total Metals
Sb, As, Cd, Cu, Pb, Hg, Mn, Ni, Zn

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY: Signature: [signature] Date/Time: 11/13/15 1600 Printed Name: Kristine Taylor Company: AMEC

RECEIVED BY: Signature: [signature] Date/Time: 11/13/15 1600 Printed Name: [illegible] Company: [illegible]

RELINQUISHED BY: Signature: Date: Printed Name: Company:

RECEIVED BY: Signature: Date: Time: Printed Name: Company:

Apex Laboratories

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Philip Nerenberg

Philip Nerenberg, Lab Director

BROOKS APPLIED LABS
18804 North Creek Parkway, Ste 100, Bothell, WA 98011 • USA • T: 206 632 6206 F: 206 632 6017 • info@brooksapplied.com

December 21, 2015

Michelle Peterson RG, LG
Amec Foster Wheeler
7376 SW Durham Road
Portland, OR 97224
(503) 639-3400
michelle.peterson@amecfw.com

RE: Amec Foster Wheeler Project Number 561M130820

Ms. Peterson,

Attached is the report associated with the forty-seven (47) soil samples submitted for chromium analyses. All samples were received in acceptable condition on November 13, 2015 in a sealed cooler at 4.0˚C. Hexavalent chromium determination was performed by an EPA 3060A extraction followed by quantitation via ion chromatography inductively coupled plasma dynamic reaction cell mass spectrometry. Total chromium determination was performed by an EPA 3050B digestion followed by quantitation via inductively coupled plasma triple quadrupole mass spectrometry. Any issues associated with the analyses are addressed in the attached report.

BAL, an accredited laboratory, certifies that the reported results of all analyses for which BAL is NELAP accredited meet all NELAP requirements. For more details, please see the Report Information page in your report.

Please feel free to contact me if you have any questions regarding this report.

Sincerely,

Ben Wozniak

Ben Wozniak
Project Manager
ben@brooksapplied.com

Case Narrative

1. Sample Reception

Forty-seven (47) soil samples were submitted to Brooks Applied Labs (BAL) for total chromium quantitation; ten (10) of these samples also were submitted for hexavalent chromium quantitation. The samples were received in acceptable condition on November 13, 2015 in a sealed cooler at 4.0°C.

All samples were received in a laminar flow clean hood, void of trace metals contamination and ultra-violet radiation, and designated discrete sample identifiers. Each sample submitted in a HDPE jar was stored in a secure, monitored refrigerator (maintained at a temperature of ≤6°C) until all preparatory and analytical procedures could be performed.

It was noted upon receipt that the sample identified on the COC as DP-3.5-4.5 was not received, but a sample bottle labeled as DP-9-3.5-4.5 with the same collection date and time as the missing sample was instead received. The client was contacted regarding this discrepancy and confirmed that the sample ID recorded on the bottle was correct; consequently, results for this sample have been reported using the DP-9-3.5-4.5 identifier.

It should also be noted that one of the original chain of custody (COC) forms was missing from the sample shipment. BAL staff generated a COC for those samples which were absent from the COCs that were included in the shipment. The client was contacted about the missing COC and emailed BAL a copy of the missing form. Both the COC completed by BAL staff and the original COC sent at a later date have been included in this report.

2. Sample Preparation

All sample preparation is performed in laminar flow clean hoods known to be free from trace metals contamination. All applied water for dilutions and sample preservatives are also monitored for contamination to account for any biases associated with the sample results.

Hexavalent Chromium Quantitation by IC-ICP-DRC-MS (Soils) All samples were extracted in accordance with EPA Method 3060A. In summary, a known mass of each sample was weighed into a polypropylene vial. A buffered alkaline extraction solution, $MgCl_2$, and a phosphate buffer solution were then applied to each sample. All vials were then heated, with constant agitation, at 90-95°C in a hotblock apparatus for a minimum of one (1) hour. The resulting extracts were cooled, filtered, and injected directly into autosampler vials. All extracts were analyzed for hexavalent chromium via ion chromatography inductively coupled plasma dynamic reaction cell mass spectrometry (IC-ICP-DRC-MS).

Three sets of laboratory fortified blanks (BS) and matrix spikes (MS/MSD) were prepared with the extraction to identify the extraction efficiency and the capacity of the extraction procedure and/or sample matrices to induce interconversion of trivalent chromium and hexavalent chromium. The first set was prepared with an aqueous trivalent chromium [Cr(III)] standard,

the second set was prepared with an aqueous hexavalent chromium [Cr(VI)] standard, and the third set was prepared with a solid lead chromate [$PrCrO_4$] standard.

Total Chromium Quantitation by ICP-QQQ-MS (Soils) A known mass of each sample was weighed into a polypropylene vial. All samples were then digested with aliquots of concentrated HNO3 and H2O2 in a hot block apparatus, in accordance with EPA Method 3050B. The resulting digests were analyzed for total chromium via inductively coupled plasma triple quadrupole mass spectrometry (ICP-QQQ-MS).

3. Sample Analysis

All sample analysis is preceded by a minimum of a five-point calibration curve spanning the entire concentration range of interest. All calibration curves, associated with each species of interest, are standardized by linear regression resulting in a response factor. All sample results are **instrument blank corrected** to account for any operational biases.

Prior to sample analysis, all calibration curves are verified using second source standards which are identified as initial calibration verification standards (ICV).

Ongoing instrument performance is identified by the analysis of continuing calibration verification standards (CCV) and continuing calibration blanks (CCB) at a minimum interval of every ten analytical runs.

Hexavalent Chromium Quantitation by IC-ICP-DRC-MS All sample extracts for hexavalent chromium quantitation were analyzed via a modified EPA Method 7199, employing ion chromatography inductively coupled plasma dynamic reaction cell mass spectrometry (IC-ICP-DRC-MS). Aliquots of each sample extract are injected onto an anion exchange column and mobilized by an alkaline (pH > 7) gradient. The eluting chromium species are then introduced into a radio frequency (RF) plasma where energy-transfer processes cause desolvation, atomization, and ionization. The ions are extracted from the plasma through a differentially-pumped vacuum interface and travel through a pressurized chamber (DRC) containing a specific reactive gas which preferentially reacts with interfering ions of the same target mass to charge (m/z) ratios. A solid-state detector detects ions transmitted through the mass analyzer, on the basis of their mass-to-charge ratio (m/z), and the resulting current is processed by a data handling system.

The retention time for hexavalent chromium is compared to known standards for species identification.

Total Chromium Quantitation by ICP-QQQ-MS The sample digests for total chromium quantitation were analyzed via a modified EPA Method 200.8, employing inductively coupled plasma triple quadrupole mass spectrometry (ICP-QQQ-MS). Aliquots of each sample digest are introduced into a radio frequency (RF) plasma where energy-transfer processes cause desolvation, atomization, and ionization. The ions are extracted from the plasma through a differentially-pumped vacuum interface and travel through an initial quadrupole (Q1), which filters the target masses prior to their entrance into a second chamber. The second chamber contains specific reactive gasses or collision gasses that preferentially react either with

interfering ions of the same target mass to charge ratios (m/z) or with the target analyte, producing an entirely different mass to charge ratio (m/z) which can then be differentiated from the initial interferences. The ions then exit the collision/reaction chamber into the mass analyzer (Q2). A solid-state detector detects ions transmitted through the mass analyzer, on the basis of their mass-to-charge ratio (m/z), and the resulting current is processed by a data handling system.

Total Solids (Percent Moisture) Analysis All samples were analyzed for total solids content in accordance with SM2540G.

4. Analytical Issues and Discussion

In instances where a matrix spike/matrix spike duplicate (MS/MSD) set was spiked at a level less than the native sample concentration, the recoveries and the relative percent difference (RPD) are not considered valid indicators of data quality. In such instances, the recoveries of the laboratory fortified blanks (BS) and/or certified reference materials (SRM) demonstrate the accuracy of the applied methods. When the spiking level was less than 25% of the native sample concentration, the spike recovery was not reported (NR) and the relative percent difference (RPD) of the MS/MSD set was not calculated (N/C).

All data is reported without qualification, aside from concentration qualifiers, and all other associated quality control results meet acceptance criteria with the following exceptions:

The relative percent difference (RPD) associated with the matrix duplicate B152040-DUP2 performed on the sample identified as DP-1-0-1 was above the control limit of 25% for total chromium (178%). Similarly, the RPD associated with the matrix duplicate B152040-DUP3 performed on the sample identified as DP-7-0-1 was also elevated for total chromium (60%). Three other matrix duplicate sets associated with batch B152040 – identified as B152040-DUP1, B152040-DUP4, and B152040-DUP5 – were within control, demonstrating the precision of the applied methods. Both B152040-DUP2 and B152040-DUP3 (and their associated native samples) were re-analyzed and the reported results were confirmed. Samples DP-1-0-1 and DP-7-0-1 were then visually inspected and found to be heterogeneous. The elevated RPDs associated with the matrix duplicates performed on these samples are therefore attributed this heterogeneity, and the total chromium results for these two samples have been qualified **M** to reflect the observed variability.

The recovery of the matrix spike duplicate B152040-MSD3 performed on the sample identified as DP-7-0-1 was below the control limit of 75% for total chromium (73%). The RPD associated with this matrix spike duplicate was also above the control limit of 25% for total chromium (41%). As previously mentioned, sample DP-7-0-1 was observed to be heterogeneous with regards to its total chromium content. Since the acceptable recoveries of the three laboratory fortified blanks, the three certified reference materials, and three other matrix spike duplicate sets (B152040-MS1/-MSD1, B152040-MS4/-MSD4, and B152040-MS5/-MSD5) associated with batch B152040 demonstrate the accuracy of the applied methods, the failing recovery and RPD associated with B152040-MSD3 is attributed to the heterogeneity noted for its native sample. As the total chromium result for sample DP-7-0-1

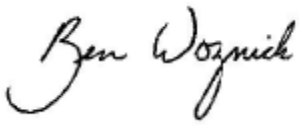
was already qualified **M** due to the matrix duplicate failure, no further qualification was required.

The total chromium result associated with sample DP-15-4-5 exceeded the calibration curve for chromium during the analysis of Batch B152040. A linear range verification standard at a concentration above that of this sample was included as part of the analytical sequence, and its recovery was within acceptance limits at 96.5%. Since the linearity of the instrument response was demonstrated at a concentration above that of sample DP-15-4-5, no qualification of this sample result was necessary.

It should be noted that the method detection limit (MDL) for hexavalent chromium has been calculated as three times the standard deviation of the replicate analyses of the lowest standard in the calibration curve. The MDL for total chromium has been calculated as the absolute value of the average of the four method blanks plus three times the standard deviation of these same blanks. All MDLs have been set no lower than one-tenth the associated method reporting limit (MRL).

If you have any questions or concerns regarding this report, please feel free to contact me.

Sincerely,



Ben Wozniak
Project Manager
ben@brooksapplied.com

Report Information

Laboratory Accreditation

BAL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BAL is also certified by many other states to perform environmental analyses. For a current list of our accreditations/certifications, please visit our website at <http://www.brooksapplied.com/resources/certificates-permits/>. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

BLK	method blank	**MS**	matrix spike
BAL	Brooks Applied Labs	**MSD**	matrix spike duplicate
BS	laboratory fortified blank	**ND**	non-detect
CAL	calibration standard	**NR**	non-reportable
CCB	continuing calibration blank	**N/C**	not calculated
CCV	continuing calibration verification	**PS**	post preparation spike
COC	chain of custody record	**REC**	percent recovery
D	dissolved fraction	**RPD**	relative percent difference
DUP	duplicate	**RSD**	relative standard deviation
IBL	instrument blank	**SCV**	secondary calibration verification
ICV	initial calibration verification	**SOP**	standard operating procedure
MDL	method detection limit	**SRM**	standard reference material
MRL	method reporting limit	**T**	total recoverable fraction

Definition of Data Qualifiers

(Effective 9/23/09)

J	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Result is estimated.
J-1	Estimated value. A full explanation is presented in the narrative.
J-M	Duplicate precision (RPD) for associated QC sample was not within acceptance criteria. Result is estimated.
J-N	Spike recovery for associated QC sample was not within acceptance criteria. Result is estimated.
M	Duplicate precision (RPD) was not within acceptance criteria. Result is estimated.
N	Spike recovery was not within acceptance criteria. Result is estimated.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.

These qualifiers are based on those previously utilized by Brooks Applied Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BAL.

18804 North Creek Parkway, Suite 100, Bothell, WA 98011 · P(206) 632-6206 · F(206) 632-6017 · info@brooksapplied.com · www.brooksapplied.com

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
DP-17-0-1	1546054-01	Soil	Sample	11/10/2015	11/13/2015
DP-17-3.5-4.5	1546054-02	Soil	Sample	11/10/2015	11/13/2015
DP-17-8-9	1546054-03	Soil	Sample	11/10/2015	11/13/2015
DP-20-0-1	1546054-04	Soil	Sample	11/10/2015	11/13/2015
DP-20-3.5-4.5	1546054-05	Soil	Sample	11/10/2015	11/13/2015
DP-19-0-1	1546054-06	Soil	Sample	11/10/2015	11/13/2015
DP-19-3.5-4.5	1546054-07	Soil	Sample	11/10/2015	11/13/2015
DP-16-0-1	1546054-08	Soil	Sample	11/10/2015	11/13/2015
DP-16-3.5-4.5	1546054-09	Soil	Sample	11/10/2015	11/13/2015
DP-2-0-1	1546054-10	Soil	Sample	11/10/2015	11/13/2015
DP-2-3.5-4.5	1546054-11	Soil	Sample	11/10/2015	11/13/2015
DP-2-8-9	1546054-12	Soil	Sample	11/10/2015	11/13/2015
DP-1-0-1	1546054-13	Soil	Sample	11/10/2015	11/13/2015
DP-1-3.5-4.5	1546054-14	Soil	Sample	11/10/2015	11/13/2015
DP-4-0-1	1546054-15	Soil	Sample	11/10/2015	11/13/2015
DP-4-3.5-4.5	1546054-16	Soil	Sample	11/10/2015	11/13/2015
DP-03-0-1	1546054-17	Soil	Sample	11/10/2015	11/13/2015
DP-03-3.5-4.5	1546054-18	Soil	Sample	11/10/2015	11/13/2015
DP-06-5-6	1546054-19	Soil	Sample	11/10/2015	11/13/2015
DP-06-5-6-DUP	1546054-20	Soil	Field Duplicate	11/10/2015	11/13/2015
DP-6-0-1	1546054-21	Soil	Sample	11/10/2015	11/13/2015
DP-6-12-13	1546054-22	Soil	Sample	11/10/2015	11/13/2015
DP-7-0-1	1546054-23	Soil	Sample	11/10/2015	11/13/2015
DP-7-3.5-4.5	1546054-24	Soil	Sample	11/10/2015	11/13/2015
DP-8-0-1	1546054-25	Soil	Sample	11/10/2015	11/13/2015
DP-8-3.5-4.5	1546054-26	Soil	Sample	11/10/2015	11/13/2015
DP-5-0-1.5	1546054-27	Soil	Sample	11/11/2015	11/13/2015
DP-5-3.5-4.5	1546054-28	Soil	Sample	11/11/2015	11/13/2015
DP-18-0-1	1546054-29	Soil	Sample	11/11/2015	11/13/2015
DP-18-3.5-4.5	1546054-30	Soil	Sample	11/11/2015	11/13/2015
DP-10-0-1	1546054-31	Soil	Sample	11/11/2015	11/13/2015
DP-10-3.5-4.5	1546054-32	Soil	Sample	11/11/2015	11/13/2015
DP-11-0-1	1546054-33	Soil	Sample	11/11/2015	11/13/2015
DP-11-3.5-4.5	1546054-34	Soil	Sample	11/11/2015	11/13/2015
DP-11-3.5-4.5 Dup	1546054-35	Soil	Field Duplicate	11/11/2015	11/13/2015
DP-9-0-1	1546054-36	Soil	Sample	11/11/2015	11/13/2015
DP-9-3.5-4.5	1546054-37	Soil	Sample	11/11/2015	11/13/2015
DP-12-0-1	1546054-38	Soil	Sample	11/11/2015	11/13/2015
DP-12-3.5-4.5	1546054-39	Soil	Sample	11/11/2015	11/13/2015
DP-13-0-1	1546054-40	Soil	Sample	11/11/2015	11/13/2015
DP-13-3-5	1546054-41	Soil	Sample	11/11/2015	11/13/2015

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Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
DP-13-3-5 Dup	1546054-42	Soil	Field Duplicate	11/11/2015	11/13/2015
DP-13-8-9	1546054-43	Soil	Sample	11/11/2015	11/13/2015
DP-14-0-1	1546054-44	Soil	Sample	11/11/2015	11/13/2015
DP-14-3.5-4.5	1546054-45	Soil	Sample	11/11/2015	11/13/2015
DP-15-0-1	1546054-46	Soil	Sample	11/11/2015	11/13/2015
DP-15-4-5	1546054-47	Soil	Sample	11/11/2015	11/13/2015

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Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
%TS	Soil/Sediment	SM 2540G	12/09/2015	12/14/2015	B152048	N/A
Cr	Soil/Sediment	EPA 200.8	11/24/2015	12/08/2015	B152040	1501042
Cr(VI)	Soil/Sediment	IC-ICP-MS	12/01/2015	12/03/2015	B152141	1501027

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Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
DP-03-0-1										
1546054-17	%TS	Soil	NA	79.47		0.003	0.01	%	B152048	N/A
1546054-17	Cr	Soil	dry	31.3		0.243	1.16	mg/kg	B152040	1501042
DP-03-3.5-4.5										
1546054-18	%TS	Soil	NA	79.56		0.003	0.01	%	B152048	N/A
1546054-18	Cr	Soil	dry	19.7		0.250	1.19	mg/kg	B152040	1501042
DP-06-5-6										
1546054-19	%TS	Soil	NA	71.39		0.003	0.01	%	B152048	N/A
1546054-19	Cr	Soil	dry	19.1		0.325	1.55	mg/kg	B152040	1501042
1546054-19	Cr(VI)	Soil	dry	0.062		0.006	0.028	mg/kg	B152141	1501027
DP-06-5-6-DUP										
1546054-20	%TS	Soil	NA	72.85		0.003	0.01	%	B152048	N/A
1546054-20	Cr	Soil	dry	22.7		0.277	1.32	mg/kg	B152040	1501042
1546054-20	Cr(VI)	Soil	dry	0.247		0.006	0.027	mg/kg	B152141	1501027
DP-10-0-1										
1546054-31	%TS	Soil	NA	81.36		0.003	0.01	%	B152048	N/A
1546054-31	Cr	Soil	dry	23.0		0.261	1.24	mg/kg	B152040	1501042
DP-1-0-1										
1546054-13	%TS	Soil	NA	80.78		0.003	0.01	%	B152048	N/A
1546054-13	Cr	Soil	dry	456	M	0.260	1.24	mg/kg	B152040	1501042
DP-10-3.5-4.5										
1546054-32	%TS	Soil	NA	80.51		0.003	0.01	%	B152048	N/A
1546054-32	Cr	Soil	dry	24.0		0.239	1.14	mg/kg	B152040	1501042
DP-11-0-1										
1546054-33	%TS	Soil	NA	79.31		0.003	0.01	%	B152048	N/A
1546054-33	Cr	Soil	dry	60.1		0.245	1.17	mg/kg	B152040	1501042
DP-11-3.5-4.5										
1546054-34	%TS	Soil	NA	83.35		0.003	0.01	%	B152048	N/A
1546054-34	Cr	Soil	dry	32.2		0.252	1.20	mg/kg	B152040	1501042

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Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
DP-11-3.5-4.5 Dup										
1546054-35	%TS	Soil	NA	85.73		0.003	0.01	%	B152048	N/A
1546054-35	Cr	Soil	dry	33.3		0.224	1.07	mg/kg	B152040	1501042
DP-12-0-1										
1546054-38	%TS	Soil	NA	75.00		0.003	0.01	%	B152048	N/A
1546054-38	Cr	Soil	dry	25.1		0.275	1.31	mg/kg	B152040	1501042
DP-12-3.5-4.5										
1546054-39	%TS	Soil	NA	77.49		0.003	0.01	%	B152048	N/A
1546054-39	Cr	Soil	dry	29.8		0.281	1.34	mg/kg	B152040	1501042
DP-1-3.5-4.5										
1546054-14	%TS	Soil	NA	75.10		0.003	0.01	%	B152048	N/A
1546054-14	Cr	Soil	dry	16.4		0.281	1.34	mg/kg	B152040	1501042
DP-13-0-1										
1546054-40	%TS	Soil	NA	88.73		0.003	0.01	%	B152048	N/A
1546054-40	Cr	Soil	dry	27.7		0.233	1.11	mg/kg	B152040	1501042
1546054-40	Cr(VI)	Soil	dry	0.213		0.005	0.023	mg/kg	B152141	1501027
DP-13-3-5										
1546054-41	%TS	Soil	NA	78.22		0.003	0.01	%	B152048	N/A
1546054-41	Cr	Soil	dry	22.0		0.264	1.26	mg/kg	B152040	1501042
1546054-41	Cr(VI)	Soil	dry	0.342		0.006	0.026	mg/kg	B152141	1501027
DP-13-3-5 Dup										
1546054-42	%TS	Soil	NA	78.89		0.003	0.01	%	B152048	N/A
1546054-42	Cr	Soil	dry	20.1		0.240	1.14	mg/kg	B152040	1501042
DP-13-8-9										
1546054-43	%TS	Soil	NA	78.90		0.003	0.01	%	B152048	N/A
1546054-43	Cr	Soil	dry	19.2		0.251	1.19	mg/kg	B152040	1501042
DP-14-0-1										
1546054-44	%TS	Soil	NA	79.03		0.003	0.01	%	B152048	N/A
1546054-44	Cr	Soil	dry	354		0.254	1.21	mg/kg	B152040	1501042

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Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
DP-14-3.5-4.5										
1546054-45	%TS	Soil	NA	78.85		0.003	0.01	%	B152048	N/A
1546054-45	Cr	Soil	dry	20.6		0.257	1.22	mg/kg	B152040	1501042
DP-15-0-1										
1546054-46	%TS	Soil	NA	79.64		0.003	0.01	%	B152048	N/A
1546054-46	Cr	Soil	dry	310		0.266	1.26	mg/kg	B152040	1501042
DP-15-4-5										
1546054-47	%TS	Soil	NA	68.37		0.003	0.01	%	B152048	N/A
1546054-47	Cr	Soil	dry	32300		0.311	1.48	mg/kg	B152040	1501042
DP-16-0-1										
1546054-08	%TS	Soil	NA	87.95		0.003	0.01	%	B152048	N/A
1546054-08	Cr	Soil	dry	1550		0.243	1.16	mg/kg	B152040	1501042
DP-16-3.5-4.5										
1546054-09	%TS	Soil	NA	78.63		0.003	0.01	%	B152048	N/A
1546054-09	Cr	Soil	dry	60.2		0.265	1.26	mg/kg	B152040	1501042
DP-17-0-1										
1546054-01	%TS	Soil	NA	82.71		0.003	0.01	%	B152048	N/A
1546054-01	Cr	Soil	dry	181		0.245	1.17	mg/kg	B152040	1501042
1546054-01	Cr(VI)	Soil	dry	6.43		0.005	0.024	mg/kg	B152141	1501027
DP-17-3.5-4.5										
1546054-02	%TS	Soil	NA	81.37		0.003	0.01	%	B152048	N/A
1546054-02	Cr	Soil	dry	44.9		0.249	1.18	mg/kg	B152040	1501042
1546054-02	Cr(VI)	Soil	dry	2.26		0.005	0.025	mg/kg	B152141	1501027
DP-17-8-9										
1546054-03	%TS	Soil	NA	75.41		0.003	0.01	%	B152048	N/A
1546054-03	Cr	Soil	dry	16.4		0.258	1.23	mg/kg	B152040	1501042
DP-18-0-1										
1546054-29	%TS	Soil	NA	83.91		0.003	0.01	%	B152048	N/A
1546054-29	Cr	Soil	dry	51.7		0.245	1.17	mg/kg	B152040	1501042

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Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
DP-18-3.5-4.5										
1546054-30	%TS	Soil	NA	77.64		0.003	0.01	%	B152048	N/A
1546054-30	Cr	Soil	dry	43.9		0.265	1.26	mg/kg	B152040	1501042
DP-19-0-1										
1546054-06	%TS	Soil	NA	80.78		0.003	0.01	%	B152048	N/A
1546054-06	Cr	Soil	dry	45.2		0.256	1.22	mg/kg	B152040	1501042
DP-19-3.5-4.5										
1546054-07	%TS	Soil	NA	80.11		0.003	0.01	%	B152048	N/A
1546054-07	Cr	Soil	dry	42.8		0.271	1.29	mg/kg	B152040	1501042
DP-20-0-1										
1546054-04	%TS	Soil	NA	82.76		0.003	0.01	%	B152048	N/A
1546054-04	Cr	Soil	dry	24.9		0.248	1.18	mg/kg	B152040	1501042
DP-2-0-1										
1546054-10	%TS	Soil	NA	78.68		0.003	0.01	%	B152048	N/A
1546054-10	Cr	Soil	dry	31.6		0.265	1.26	mg/kg	B152040	1501042
1546054-10	Cr(VI)	Soil	dry	1.36		0.006	0.026	mg/kg	B152141	1501027
DP-20-3.5-4.5										
1546054-05	%TS	Soil	NA	80.67		0.003	0.01	%	B152048	N/A
1546054-05	Cr	Soil	dry	24.3		0.263	1.25	mg/kg	B152040	1501042
DP-2-3.5-4.5										
1546054-11	%TS	Soil	NA	80.75		0.003	0.01	%	B152048	N/A
1546054-11	Cr	Soil	dry	18.3		0.263	1.25	mg/kg	B152040	1501042
1546054-11	Cr(VI)	Soil	dry	0.266		0.005	0.025	mg/kg	B152141	1501027
DP-2-8-9										
1546054-12	%TS	Soil	NA	79.71		0.003	0.01	%	B152048	N/A
1546054-12	Cr	Soil	dry	31.3		0.263	1.25	mg/kg	B152040	1501042
DP-4-0-1										
1546054-15	%TS	Soil	NA	76.07		0.003	0.01	%	B152048	N/A
1546054-15	Cr	Soil	dry	599		0.258	1.23	mg/kg	B152040	1501042

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Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
DP-4-3.5-4.5										
1546054-16	%TS	Soil	NA	74.63		0.003	0.01	%	B152048	N/A
1546054-16	Cr	Soil	dry	580		0.267	1.27	mg/kg	B152040	1501042
DP-5-0-1.5										
1546054-27	%TS	Soil	NA	75.85		0.003	0.01	%	B152048	N/A
1546054-27	Cr	Soil	dry	203		0.269	1.28	mg/kg	B152040	1501042
DP-5-3.5-4.5										
1546054-28	%TS	Soil	NA	76.71		0.003	0.01	%	B152048	N/A
1546054-28	Cr	Soil	dry	22.0		0.276	1.31	mg/kg	B152040	1501042
DP-6-0-1										
1546054-21	%TS	Soil	NA	72.62		0.003	0.01	%	B152048	N/A
1546054-21	Cr	Soil	dry	989		0.278	1.32	mg/kg	B152040	1501042
1546054-21	Cr(VI)	Soil	dry	0.212		0.006	0.028	mg/kg	B152141	1501027
DP-6-12-13										
1546054-22	%TS	Soil	NA	73.83		0.003	0.01	%	B152048	N/A
1546054-22	Cr	Soil	dry	32.5		0.270	1.28	mg/kg	B152040	1501042
1546054-22	Cr(VI)	Soil	dry	0.284		0.006	0.027	mg/kg	B152141	1501027
DP-7-0-1										
1546054-23	%TS	Soil	NA	80.85		0.003	0.01	%	B152048	N/A
1546054-23	Cr	Soil	dry	46.2	M	0.259	1.23	mg/kg	B152040	1501042
DP-7-3.5-4.5										
1546054-24	%TS	Soil	NA	76.52		0.003	0.01	%	B152048	N/A
1546054-24	Cr	Soil	dry	22.0		0.275	1.31	mg/kg	B152040	1501042
DP-8-0-1										
1546054-25	%TS	Soil	NA	76.02		0.003	0.01	%	B152048	N/A
1546054-25	Cr	Soil	dry	60.6		0.290	1.38	mg/kg	B152040	1501042
DP-8-3.5-4.5										
1546054-26	%TS	Soil	NA	75.88		0.003	0.01	%	B152048	N/A
1546054-26	Cr	Soil	dry	301		0.273	1.30	mg/kg	B152040	1501042

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Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
DP-9-0-1										
1546054-36	%TS	Soil	NA	80.78		0.003	0.01	%	B152048	N/A
1546054-36	Cr	Soil	dry	26.1		0.264	1.26	mg/kg	B152040	1501042
DP-9-3.5-4.5										
1546054-37	%TS	Soil	NA	89.63		0.003	0.01	%	B152048	N/A
1546054-37	Cr	Soil	dry	13.7		0.244	1.16	mg/kg	B152040	1501042

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Accuracy & Precision Summary

Batch: B152040
Lab Matrix: Soil/Sediment
Method: EPA 200.8

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B152040-BS1	**Laboratory Fortified Blank, (1549001)**						
	Cr		50.00	51.35	mg/kg	103% 75-125	
B152040-BS2	**Laboratory Fortified Blank, (1549001)**						
	Cr		50.00	51.02	mg/kg	102% 75-125	
B152040-BS3	**Laboratory Fortified Blank, (1549001)**						
	Cr		50.00	52.19	mg/kg	104% 75-125	
B152040-SRM1	**Certified Reference Material, (NC00378, CRM052-50G Loamy Clay 1 - 3050B)**						
	Cr		334.0	342.3	mg/kg	102% 75-125	
B152040-SRM2	**Certified Reference Material, (NC00378, CRM052-50G Loamy Clay 1 - 3050B)**						
	Cr		334.0	340.8	mg/kg	102% 75-125	
B152040-SRM3	**Certified Reference Material, (NC00378, CRM052-50G Loamy Clay 1 - 3050B)**						
	Cr		334.0	335.7	mg/kg	101% 75-125	
B152040-DUP1	**Duplicate, (1546054-05)**						
	Cr	24.28		23.16	mg/kg		5% 25
B152040-MS1	**Matrix Spike, (1546054-05)**						
	Cr	24.28	62.90	88.51	mg/kg	102% 75-125	
B152040-MSD1	**Matrix Spike Duplicate, (1546054-05)**						
	Cr	24.28	64.70	95.60	mg/kg	110% 75-125	8% 25
B152040-DUP2	**Duplicate, (1546054-13)**						
	Cr	456.2		25.94	mg/kg		*178%* 25
B152040-MS2	**Matrix Spike, (1546054-13)**						
	Cr	456.2	57.02	92.47	mg/kg	NR 75-125	
B152040-MSD2	**Matrix Spike Duplicate, (1546054-13)**						
	Cr	456.2	59.86	121.3	mg/kg	NR 75-125	N/C 25

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Accuracy & Precision Summary

Batch: B152040
Lab Matrix: Soil/Sediment
Method: EPA 200.8

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B152040-DUP3	**Duplicate, (1546054-23)**						
	Cr	46.17		24.82	mg/kg		*60%* 25
B152040-MS3	**Matrix Spike, (1546054-23)**						
	Cr	46.17	60.93	113.5	mg/kg	111% 75-125	
B152040-MSD3	**Matrix Spike Duplicate, (1546054-23)**						
	Cr	46.17	59.53	89.58	mg/kg	*73%* 75-125	*41%* 25
B152040-DUP4	**Duplicate, (1546054-31)**						
	Cr	23.05		21.19	mg/kg		8% 25
B152040-MS4	**Matrix Spike, (1546054-31)**						
	Cr	23.05	57.16	78.43	mg/kg	97% 75-125	
B152040-MSD4	**Matrix Spike Duplicate, (1546054-31)**						
	Cr	23.05	63.95	91.09	mg/kg	106% 75-125	9% 25
B152040-DUP5	**Duplicate, (1546054-45)**						
	Cr	20.63		20.54	mg/kg		0.4% 25
B152040-MS5	**Matrix Spike, (1546054-45)**						
	Cr	20.63	64.59	88.75	mg/kg	105% 75-125	
B152040-MSD5	**Matrix Spike Duplicate, (1546054-45)**						
	Cr	20.63	65.43	91.20	mg/kg	108% 75-125	2% 25

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Accuracy & Precision Summary

Batch: B152048
Lab Matrix: Soil/Sediment
Method: SM 2540G

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B152048-DUP1	**Duplicate, (1546054-41)**						
	%TS	78.22		78.49	%		0.3% 15
B152048-DUP2	**Duplicate, (1546054-42)**						
	%TS	78.89		78.70	%		0.2% 15
B152048-DUP3	**Duplicate, (1546054-43)**						
	%TS	78.90		78.66	%		0.3% 15
B152048-DUP4	**Duplicate, (1546054-44)**						
	%TS	79.03		80.75	%		2% 15
B152048-DUP5	**Duplicate, (1546054-45)**						
	%TS	78.85		78.43	%		0.5% 15

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Accuracy & Precision Summary

Batch: B152141
Lab Matrix: Soil/Sediment
Method: IC-ICP-MS

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B152141-BS1	**Laboratory Fortified Blank, Cr(III) (NC00005)**						
	Cr(VI)		20.04	0.026	mg/kg	0.1% 0-1%	
B152141-BS2	**Laboratory Fortified Blank, Cr(VI) (NC00016)**						
	Cr(VI)		20.00	18.60	mg/kg	93% 80-120	
B152141-BS3	**Laboratory Fortified Blank, PbCrO4 (NC00442)**						
	Cr(VI)		656.5	559.2	mg/kg	85% 80-120	
B152141-SRM1	**Certified Reference Material, (NC00366, NIST 2701-Hexavalent Chromium in Soil)**						
	Cr(VI)		551.2	530.9	mg/kg	96% 75-125	
B152141-DUP1	**Duplicate, (1546054-41)**						
	Cr(VI)	0.342		0.322	mg/kg		6% 25
B152141-MS1	**Matrix Spike, Cr(III) (1546054-41)**						
	Cr(VI)	0.342	25.47	1.492	mg/kg	5% 0-15%	
B152141-MS2	**Matrix Spike, Cr(VI) (1546054-41)**						
	Cr(VI)	0.342	25.32	23.40	mg/kg	91% 75-125	
B152141-MS3	**Matrix Spike, PbCrO4 (1546054-41)**						
	Cr(VI)	0.342	812.7	768.1	mg/kg	95% 75-125	
B152141-MSD1	**Matrix Spike Duplicate, Cr(III) (1546054-41)**						
	Cr(VI)	0.342	25.62	1.650	mg/kg	5% 0-15%	12% N/A
B152141-MSD2	**Matrix Spike Duplicate, Cr(VI) (1546054-41)**						
	Cr(VI)	0.342	25.48	23.34	mg/kg	90% 75-125	0.9% 25
B152141-MSD3	**Matrix Spike Duplicate, PbCrO4 (1546054-41)**						
	Cr(VI)	0.342	802.4	742.9	mg/kg	93% 75-125	2% 25

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Method Blanks & Reporting Limits

Batch: B152040
Matrix: Soil/Sediment
Method: EPA 200.8
Analyte: Cr

Sample	Result	Units
B152040-BLK1	-0.021	mg/kg wet
B152040-BLK2	0.006	mg/kg wet
B152040-BLK3	-0.001	mg/kg wet
B152040-BLK4	0.009	mg/kg wet

Average: -0.002 **Standard Deviation:** 0.014 **MDL:** 0.042
Limit: 0.092 **Limit:** 0.028 **MRL:** 0.200

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Project ID: AEM-PR1501
PM: Ben Wozniak

Client PM: Michelle Peterson

Method Blanks & Reporting Limits

Batch: B152048
Matrix: Soil/Sediment
Method: SM 2540G
Analyte: %TS

Sample	Result	Units
B152048-BLK1	0.002	%
B152048-BLK2	0.001	%

Average: 0.00
Limit: 0.01

MDL: 0.003
MRL: 0.01

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Method Blanks & Reporting Limits

Batch: B152141
Matrix: Soil/Sediment
Method: IC-ICP-MS
Analyte: Cr(VI)

Sample	Result	Units
B152141-BLK1	0.008	mg/kg wet
B152141-BLK2	0.007	mg/kg wet
B152141-BLK3	0.008	mg/kg wet
B152141-BLK4	0.012	mg/kg wet

Average: 0.009
Limit: 0.020

MDL: 0.004
MRL: 0.020

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Sample Containers

Lab ID: 1546054-01
Sample: DP-17-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-02
Sample: DP-17-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-03
Sample: DP-17-8-9
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-04
Sample: DP-20-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-05
Sample: DP-20-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-06
Sample: DP-19-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

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Sample Containers

Lab ID: 1546054-07
Sample: DP-19-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-08
Sample: DP-16-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-09
Sample: DP-16-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-10
Sample: DP-2-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-11
Sample: DP-2-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-12
Sample: DP-2-8-9
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

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Sample Containers

Lab ID: 1546054-13
Sample: DP-1-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-14
Sample: DP-1-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-15
Sample: DP-4-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-16
Sample: DP-4-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-17
Sample: DP-03-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-18
Sample: DP-03-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

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Sample Containers

Lab ID: 1546054-19
Sample: DP-06-5-6
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-20
Sample: DP-06-5-6-DUP
Report Matrix: Soil
Sample Type: Field Duplicate
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-21
Sample: DP-6-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-22
Sample: DP-6-12-13
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-23
Sample: DP-7-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-24
Sample: DP-7-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

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Sample Containers

Lab ID: 1546054-25
Sample: DP-8-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-26
Sample: DP-8-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/10/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-27
Sample: DP-5-0-1.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-28
Sample: DP-5-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-29
Sample: DP-18-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-30
Sample: DP-18-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

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Sample Containers

Lab ID: 1546054-31
Sample: DP-10-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-32
Sample: DP-10-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-33
Sample: DP-11-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-34
Sample: DP-11-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-35
Sample: DP-11-3.5-4.5 Dup
Report Matrix: Soil
Sample Type: Field Duplicate
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-36
Sample: DP-9-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

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Sample Containers

Lab ID: 1546054-37
Sample: DP-9-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-38
Sample: DP-12-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-39
Sample: DP-12-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-40
Sample: DP-13-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-41
Sample: DP-13-3-5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-42
Sample: DP-13-3-5 Dup
Report Matrix: Soil
Sample Type: Field Duplicate
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

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Sample Containers

Lab ID: 1546054-43
Sample: DP-13-8-9
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-44
Sample: DP-14-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-45
Sample: DP-14-3.5-4.5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-46
Sample: DP-15-0-1
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

Lab ID: 1546054-47
Sample: DP-15-4-5
Report Matrix: Soil
Sample Type: Sample
Collected: 11/11/2015
Received: 11/13/2015

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	8oz jar	Not Provided	None			Cooler

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Shipping Containers

Cooler

Received: November 13, 2015 9:40
Tracking No: 774968498241 via FedEx
Coolant Type: Blue Ice
Temperature: 4.0 °C

Description: Cooler
Damaged in transit? No
Returned to client? No

Custody seals present? Yes
Custody seals intact? Yes
COC present? Yes

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Chain-of-Custody Form

BROOKS APPLIED LABS

Ship samples to:
18804 North Creek Parkway, Suite 100
Bothell, WA 98011

BAL Report 1546054

For BAL use only
Received by: Jen Wallin Date: 11/13/15
Work Order ID: 1546054 Time: 9:40
Project ID: AEM-PR1501

Client: Amec Foster Wheeler
Contact: Graeme Taylor
Client Project ID: 5-61-M-13062
Samples Collected By: Graeme Taylor

PO Number:
Phone: 503-639-3400
Email: graeme.taylor@amec.com

Mailing Address: 7376 SW Durham Road
Portland, OR 97224
Email Receipt Confirmation? No
BAL PM:

Requested TAT (business days)
☑ 20 (standard)
☐ 15*
☐ 10*
☐ 5*
☐ Other ____
*Surcharges may apply to expedited TATs

	Sample ID	Collection: Date	Collection: Time	Client Sample Info: Matrix Type	Number of Containers	Field Filtered?	Preservation Type	BRL Analyses Required: Total Hg, EPA 1631	Methyl Hg, EPA 1630	ICP-MS Metals (specify)	As Species (specify)	Se Species (specify)	Filtration	Hexavelent Chromium	Chromium Speciation	Comments
1	DP-17-0-1	11-10-15	9:30	Soil	1	N	None			X				X		Specify Here
2	DP-17-3.5-4.5		9:35		1	N				X				X		Chromium
3	DP-17-8-9		940		1	N				X						Chromium
4	DP-20-0-1		1050		1	N				X						Chromium
5	DP-20-3.5-4.5		1055		1	N				X						Chromium
6	DP-19-0-1		1100		1	N				X						Chromium
7	DP-19-3.5-4.5		1105		1	N				X						Chromium
8	DP-16-0-1		1110		1	N				X						Chromium
9	DP-16-3.5-4.5		1115		1	N				X						Chromium
10	DP-2-0-1		1130		1	N				X				X		Chromium
	Trip Blank (specify)															Chromium

Relinquished By: Graeme Taylor	Date: 11/12/15	Time: 1515	Relinquished By:	Date: Time:
Received By:	Date:	Time:	Total Number of Packages:	

Page 1 of 5 List Hazardous Contaminants: _____

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Ship samples to:
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Bothell, WA 98011

For BAL use only BAL Report 1546054

Received by: Jen Waller Date: 11/13/15

Work Order ID: 1546054 Time: 9:40

Project ID: AEM-PR1501

Client: Amec Foster Wheeler
Contact: Graeme Taylor
Client Project ID: 5-61-M-13062
Samples Collected By: Graeme Taylor

PO Number:
Phone: 503-639-3400
Email: graeme.taylor@amec.com

Mailing Address: 7376 SW Durham Road
Portland, OR 97224

Email Receipt Confirmation? No

BAL PM:

Requested TAT (business days)

- ☑ 20 (standard)
- ☐ 15*
- ☐ 10*
- ☐ 5*
- ☐ Other ____

*Surcharges may apply to expedited TATs

	Sample ID	Collection: Date	Collection: Time	Client Sample Info: Matrix Type	Client Sample Info: Number of Containers	Client Sample Info: Field Filtered?	Client Sample Info: Preservation Type	BRL Analyses Required: Total Hg, EPA 1631	Methyl Hg, EPA 1630	ICP-MS Metals (specify)	As Species (specify)	Se Species (specify)	Filtration	Hexavelent Chromium	Chromium Speciation	Comments
1	DP-2-3.5-4.5	11-10-15	1135	Soil	1	N	None			X				X		Chromium
2	DP-2-8-9		1150			N				X						Chromium
3	DP-1-0-1		1340							X						Chromium
4	DP-1-3.5-4.5		1345							X						Chromium
5	DP-4-0-1		1350							X						Chromium
6	DP-4-3.5-4.5		1355							X						Chromium
7	DP-03-0-1		1420			N				X						Chromium
8	DP-03-3.5-4.5		1425			N				X						Chromium
9	DP-06-5-6		1445							X				X		Chromium
10	DP-06-5-6-DUP		1445							X				X		Chromium
	Trip Blank (specify)															Chromium

yes, please analyze Specify Here

Relinquished By:	Date: 11/12/15	Time: 1515	Relinquished By:	Date:	Time:
Received By:	Date:	Time:	Total Number of Packages:		

Page 2 of 5 List Hazardous Contaminants: _____

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For BAL use only — BAL Report 1546054

Received by: Jen Ewalt — Date: 11/13/15
Work Order ID: 1546054 — Time: 9:40
Project ID: AEM-PR1501

Client: Amec Foster Wheeler
Contact: Graeme Taylor
Client Project ID: 5-61-M-13062
Samples Collected By: Graeme Taylor

PO Number:
Phone: 503-639-3400
Email: graeme.taylor@amec.com

Mailing Address: 7376 SW Durham Road
Portland, OR 97224

Email Receipt Confirmation? No
BAL PM:

Requested TAT (business days)
- ☑ 20 (standard)
- ☐ 15*
- ☐ 10*
- ☐ 5*
- ☐ Other ____

*Surcharges may apply to expedited TATs

	Sample ID	Collection: Date	Collection: Time	Client Sample Info: Matrix Type	Number of Containers	Field Filtered?	Preservation Type	BRL Analyses Required: Total Hg, EPA 1631	Methyl Hg, EPA 1630	ICP-MS Metals (specify)	As Species (specify)	Se Species (specify)	Filtration	Hexavelent Chromium	Chromium Speciation	Comments: Specify Here
1	DP-6-0-1	11/10/15	1510	S	1	N	none			X				X		Chromium
2	DP-6-12-13	11/10/15	1555	S	1	N				X				X		Chromium
3	DP-7-0-1	"	1605	S	1	N				X						Chromium
4	DP-7-3.5-4.5		1610	S	1	N				X						Chromium
5	DP-8-0-1		1620	S	1	N				X						Chromium
6	DP-8-3.5-4.5		1625	S	1	N				X						Chromium
7	DP-5-0-1.5	11/11/15	945	S	1	N				X						Chromium
8	DP-5-3.5-4.5	"	950	S	1	N				X						Chromium
9	DP-18-0-1	"	1005	S	1	N				X						Chromium
10	DP-18-3.5-4.5	"	1010	S	1	N				X						Chromium
	Trip Blank (specify)															Chromium

Relinquished By:	Date: 11/12/15	Time: 1515	Relinquished By:	Date:	Time:
Received By:	Date:	Time:	Total Number of Packages:		

Page 3 of 5

List Hazardous Contaminants: _____

Print

Chain-of-Custody Form

BROOKS APPLIED LABS

Ship samples to:
18804 North Creek Parkway, Suite 100
Bothell, WA 98011

For BAL use only BAL Report 1546054

Received by: Jo Wallin Date: 11/13/15

Work Order ID: 1546054 Time: 9:40

Project ID: AEM - PR1501

Client: Amec Foster Wheeler
Contact: Graeme Taylor
Client Project ID: 5-61-M-13062
Samples Collected By: Graeme Taylor

PO Number:
Phone: 503-639-3400
Email: graeme.taylor@amec.com

Mailing Address: 7376 SW Durham Road
Portland, OR 97224

Email Receipt Confirmation? No

BAL PM:

Requested TAT (business days)

- ☑ 20 (standard)
- ☐ 15*
- ☐ 10*
- ☐ 5*
- ☐ Other ____

*Surcharges may apply to expedited TATs

	Sample ID	Collection: Date	Collection: Time	Client Sample Info: Matrix Type	Client Sample Info: Number of Containers	Client Sample Info: Field Filtered?	Client Sample Info: Preservation Type	BRL Analyses Required: Total Hg, EPA 1631	BRL Analyses Required: Methyl Hg, EPA 1630	BRL Analyses Required: ICP-MS Metals (specify)	BRL Analyses Required: As Species (specify)	BRL Analyses Required: Se Species (specify)	BRL Analyses Required: Filtration	BRL Analyses Required: Hexavelent Chromium	BRL Analyses Required: Chromium Speciation	Comments: Specify Here
1	DP-10-0-1	11-11-15	1510	S	1	N	N			X						Chromium
2	DP-10-3.5-4.5	"	1515	"	"	"	"			X						Chromium
3	DP-11-0-1	"	1520	"	"	"	"			X						Chromium
4	DP-11-3.5-4.5	"	1525	"	"	"	"			X						Chromium
5	DP-11-3.5-4.5 DUP	"	1530	"	"	"	"			X						Chromium
6	DP-9-0-1	"	1535	"	"	"	"			X						Chromium
7	DP-35-4.5	"	1540	"	"	"	"			X						Chromium
8																Chromium
9																Chromium
10																Chromium
	Trip Blank (specify)															Chromium

Relinquished By:	Date:	Time:	Relinquished By:	Date:	Time:
Received By:	Date:	Time:	Total Number of Packages:		

Page 5 of 5

List Hazardous Contaminants: _____

Print

Chain-of-Custody Form

BROOKS APPLIED LABS

Ship samples to:
18804 North Creek Parkway, Suite 100
Bothell, WA 98011

For BAL use only

Received by: Jen Wallin *Date:* 11/13/15

Work Order ID: 1546054 *Time:* 9:40

Project ID: AEM - PR 1501

Client: Amec Foster Wheeler PO Number: Mailing Address:

Contact: Graeme Taylor Phone:

Client Project ID: Email: Email Receipt Confirmation? (Yes/No)

Samples Collected By: BAL PM: Ben

Requested TAT (business days)

- ☐ 20 (standard)
- ☐ 15*
- ☐ 10*
- ☐ 5*
- ☐ Other ____

*Surcharges may apply to expedited TATs

	Sample ID	Collection: Date	Collection: Time	Client Sample Info: Matrix Type	Client Sample Info: Number of Containers	Client Sample Info: Field Filtered? (Yes/No)	Client Sample Info: Preservation Type HCl /HNO_3/Other	BAL Analyses Required: Total Hg, EPA 1631	BAL Analyses Required: Methyl Hg, EPA 1630	BAL Analyses Required: ICP-MS Metals (specify)	BAL Analyses Required: As Species (specify) InOrg, III, V, MMA, DMA	BAL Analyses Required: Se Species (specify) Se(IV), Se(VI), SeCN, Uknown	BAL Analyses Required: Filtration	BAL Analyses Required: Other (specify)	BAL Analyses Required: Other (specify)	Comments: Specify Here
(1)	1 DP-12-0-1	11/11/15	15:00	Soil	1	No	None			X						
(1)	2 DP 12-3.5-4.5		15:05		1					X						Total Cr
(1)	3 DP-13-0-1		10:30		1					X						
(1)	4 DP 13-3-5		10:35		1					X						
(1)	5 DP-13-3-5-Dup		10:35		1					X						
(1)	6 DP-13-8-9		10:40		1					X						
(1)	7 DP-14-0-1		10:15		1					X						
(1)	8 DP-14-3.5-4.5		10:20		1					X						
(1)	9 DP-15-0-1		14:40		1					X						
(1)	10 DP-15-4-5		14:45		1					X						
	Trip Blank									X						

Relinquished By:	Date:	Time:	Relinquished By:	Date:	Time:
Received By:	Date:	Time:	Total Number of Packages:		

Page ____ of ____ List Hazardous Contaminants:

(1) Samples not included on original COCs, this COC was made by BAL upon receipt - JW 11/14/15

ORIGIN ID:BNOA (503) 639-3400
AMEC FOSTER & WHEELER, INC.
AMEC FOSTER & WHEELER, INC.
7376 SW DURHAM ROAD

PORTLAND, OR 97224
UNITED STATES US

SHIP DATE: 12NOV15
ACTWGT: 70.00 LB
CAD: 2628710/INET3670
DIMS: 30x12x14 IN

BILL SENDER

TO BEN WOZNIAK
BROOKS APPLIED LABS
18804 NORTH CREEK PARKWAY, STE 100

BOTHELL WA 98011
(206) 632-6206 REF: 561M1308203 GT
INV
PO DEPT:

11/13/15 9:40
COC CS
Blue Ice
4.0°C
Client Provided 8oz Jars HDPE

539J2/3F56/31D0

FedEx Express

E

J153015091001uv

FRI - 13 NOV 10:30A
PRIORITY OVERNIGHT

TRK# 0201 7749 6849 8241

DSR
98011
WA-US SEA

85 PAEA

After printing this label:
1. Use the 'Print' button on this page to print your label to your laser or inkjet printer.
2. Fold the printed page along the horizontal line.
3. Place label in shipping pouch and affix it to your shipment so that the barcode portion of the label can be read and scanned.

Warning: Use only the printed original label for shipping. Using a photocopy of this label for shipping purposes is fraudulent and could result in additional billing charges, along with the cancellation of your FedEx account number.
Use of this system constitutes your agreement to the service conditions in the current FedEx Service Guide, available on fedex.com.FedEx will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, non-delivery,misdelivery,or misinformation, unless you declare a higher value, pay an additional charge, document your actual loss and file a timely claim.Limitations found in the current FedEx Service Guide apply. Your right to recover from FedEx for any loss, including intrinsic value of the package, loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental,consequential, or special is limited to the greater of $100 or the authorized declared value. Recovery cannot exceed actual documented loss.Maximum for items of extraordinary value is $1,000, e.g. jewelry, precious metals, negotiable instruments and other items listed in our ServiceGuide. Written claims must be filed within strict time limits, see current FedEx Service Guide.

Chain-of-Custody Form

BROOKS APPLIED LABS

Ship samples to:
18804 North Creek Parkway, Suite 100
Bothell, WA 98011

For BAL use only BAL Report 1546054
Received by: _____ *Date:* _____
Work Order ID: _____ *Time:* _____
Project ID: _____

Client: Amec Foster Wheeler
Contact: Graeme Taylor
Client Project ID: 5-61-M-13062
Samples Collected By: Graeme Taylor

PO Number:
Phone: 503-639-3400
Email: graeme.taylor@amec.com

Mailing Address: 7376 SW Durham Road
Portland, OR 97224

Email Receipt Confirmation? No
BAL PM:

Requested TAT (business days)
- ☑ 20 (standard)
- ☐ 15*
- ☐ 10*
- ☐ 5*
- ☐ Other ____

*Surcharges may apply to expedited TATs

	Sample ID	Collection: Date	Collection: Time	Client Sample Info: Matrix Type	Client Sample Info: Number of Containers	Client Sample Info: Field Filtered?	Client Sample Info: Preservation Type	BRL Analyses Required: Total Hg, EPA 1631	Methyl Hg, EPA 1630	ICP-MS Metals (specify)	As Species (specify)	Se Species (specify)	Filtration	Hexavelent Chromium	Chromium Speciation	Comments: Specify Here
1	DP-14-0-1	11-11-15	1015	S	1	N	None			X						Chromium
2	DP-14-3.5-4.5		1020							X						Chromium
3	DP-13-0-1		1030							X				X		Chromium
4	DP-13-3-5		1035							X				X		Chromium
5	DP-13-3-5 Dup		1035							X						Chromium
6	DP-13-8-9		1040							X				X		Chromium
7	DP-15-0-1		1440							X						Chromium
8	DP-15-3-5 DP-15-4.5		1445							X						Chromium
9	DP-12-0-1		1500							X						Chromium
10	DP-12-3.5-4.5		1505							X						Chromium
	Trip Blank (specify)	↓														Chromium

No, please do not analyze.

Relinquished By:	Date: 11/12/15	Time: 1515	Relinquished By:	Date: / Time:
Received By:	Date:	Time:	Total Number of Packages:	

Page 4 of 5

List Hazardous Contaminants: _____

APPENDIX E

Surface Water Right Records within the LOF

IN THE CIRCUIT COURT OF THE STATE OF OREGON

FOR THE COUNTY OF WASHINGTON

IN THE MATTER OF THE DETERMINATION)
OF THE RELATIVE RIGHTS TO THE USE)
OF THE WATERS OF TUALATIN RIVER)
AND ITS TRIBUTARIES, WASHINGTON AND)
OTHER COUNTIES.)

DECREE
No. 21-830

Now at this time the above entitled matter coming before the Court for entry of decree upon the Findings of Fact and Order of Determination of the State Engineer, and this Court having heretofore heard the arguments of counsel for the objectors and exceptors to said Findings of Fact and Order of Determination, and having received petitions for certain amendments and corrections to typographical errors therein contained, being now fully advised in the premises and having entered its Memorandum Opinion on the 27th day of July, 1960:

IT IS CONSIDERED, ORDERED, ADJUDGED AND DECREED:

(a) That the exceptions and objections of all claimants, be, and they hereby are disallowed and denied.

(b) That the proceedings of the State Engineer in this matter, be, and they hereby are approved as hereinafter amended.

(c) That the Findings of Fact and Order of Determination of the State Engineer, as filed in this Court on the 10th day of December, 1959, are hereby made the Findings and Order of Determination and Decree of this Court, subject however, to the following modifications:

I

That, relative to Statement and Proof of Claim No. 21 in the name of John and Gladys Cereghino, treated under Finding No. 21 appearing on page 118 of the Findings of Fact and Order of Determination of the State Engineer, Mr. Fred A. Anderson, Counsel for claimants, petitioned the Court for an amendment of said Claim No. 21 to show the acreage for which a right for irrigation was being claimed, to coincide with the acreage found to be irrigated by the State Engineer's survey, as shown on the map prepared and made a part of the record herein, being 12.1 acres within the SW¼ SW¼ Section 28, T. 2 S., R. 1 W., W.M. That the 7.0 acres for which a right was asserted in Statement of Proof of Claim No. 21 was an inadvertent error which was overlooked in checking said claim before filing same.

The petition for amendment having been considered and there being no objections thereto, it is hereby ordered that the right of John and Gladys Cereghino under Proof No. 21, appearing in the tabulation on page 142, for the irrigation of 7.0 acres within the SW¼ SW¼, Section 28, T. 2 S., R. 1 W., W.M., be, and the same hereby is amended and modified to read 12.1 acres in said subdivision, section, township and range.

That, upon request of the State Engineer for the correction of certain typographical errors appearing in the Findings of Fact and Order of Determination, which were detected and called to the attention of the Court prior to the hearing before the Court, it is hereby ordered that the following corrections be made:

(a) On page 118 under Finding No. 28, in the third line of the first paragraph, "section 29" shall be changed to read "section 28."

(b) On page 140, under tabulation of rights allowed, Proof No. 3, Nels and Eleanor Anderson, the first line in the last column shall be changed to read "20.0 acres in SE¼ SW¼."

(c) On page 146, under tabulation of rights allowed, Proof No. 49, Don and Bessie Galbreath, the second line in the last column shall be changed to read, "4.0 acres in SE¼ SW¼."

IT IS FURTHER CONSIDERED, ORDERED, ADJUDGED AND DECREED: that, in accordance with said Findings of Fact and Order of Determination of the State Engineer as modified and amended herein, the various claimants are entitled to the use of the waters of Tualatin River and its tributaries as contained in these Findings and this Decree, and they, and each of them, their successors and assigns, and all persons claiming under them, are hereby enjoined and prohibited from using any of the waters of said stream system in any other amount, manner and priorities than herein found, nor upon any lands or place of use other than herein set out and described without first having complied with the provisions of ORS 540.510 to 540.550 inclusive, or statutory legislation supplementary thereto.

ENTERED in open Court this 9th day of September, 1960.

SGD/J. S. Bohannon
J. S. Bohannon, Circuit Judge

SGD/Glen Hieber
Glen Hieber, Circuit Judge

STATE OF OREGON,)
) SS
County of Washington)

I, Roger Thomssen, County Clerk and ex-officio Clerk of the Circuit Court of the State of Oregon for the County of Washington, do hereby certify that the foregoing copy of

Decree

has been by me compared with the original and that it is a correct transcript therefrom, and the whole of such original Decree as the same appears of record at my office and in my custody. IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of said court this 4th day of October, A. D., 1960.

ROGER THOMSSEN, COUNTY CLERK

By E. Donohue
Deputy

STATE OF OREGON)
)
) ss.
COUNTY OF MARION)

I, Lewis A. Stanley, State Engineer of the State of Oregon, do hereby certify that the foregoing copy of Decree In the Matter of the Determination of the Relative Rights to the Use of the Waters of Tualatin River and its Tributaries, Washington and Other Counties, is a full and correct copy of such Decree of the Circuit Court as the same was received in this office and entered of record herein this 5th day of October, 1960.

IN WITNESS WHEREOF, I have hereunto set my hand this 5th day of October, 1960.

Lewis A. Stanley
State Engineer

Court—1M—10-55

STATE OF OREGON

COUNTY OF Washington

CERTIFICATE OF WATER RIGHT

This Is to Certify, *That* JOHN AND GLADYS CEREGHINO
JAMES AND CHRISTINA CEREGHINO
of Route 4, Sherwood, *State of* Oregon, *has a right to the use of*

the waters of Rock Creek

for the purpose of Irrigation for Tract 1 and Stock Drinking directly from the source, and is limited not to exceed 20 head for Tract 2.
and that said right has been confirmed by decree of the Circuit Court of the State of Oregon for Washington *County, and the said decree entered of record at Salem, in the Order Record of the STATE ENGINEER, in Volume* 16, *at page* 419; *that the priority of the right thereby confirmed dates from* 1890

that the amount of water to which such right is entitled, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 0.130 c.f.s. for Tract 1 and shall be further limited to the provisions of Finding No. 58 of said Decree for Tract 2.

A description of the lands irrigated under such right, and to which the water is appurtenant (or, if for other purposes, the place where such water is put to beneficial use), is as follows:

Tract 1
0.7 acre in NE¼SE¼
9.7 acres in SE¼SE¼
Section 29
T. 2 S., R. 1 W., W.M.
Being within the east half of the E½ SE¼ said Section 29 lying south of the Southern Pacific Railroad r/w.

Tract 2
NE¼SE¼ and SE¼SE¼
Section 29
T. 2 S., R. 1 W., W.M.
Within the above described tract of land.

And said right shall be subject to all other conditions and limitations contained in said decree.
The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the State Engineer, affixed

this 10th *day of* January, *19* 62.

LEWIS A. STANLEY
State Engineer

Recorded in State Record of Water Right Certificates, Volume 21, *page* 29190

APPENDIX F

Updated Recreational User RBCs

Urban Residential RBCs revised to reflect recreational user / trespasser exposure assumptions

RISK-BASED CONCENTRATIONS

Contaminated Medium		SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)						
Exposure Pathway		Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{saw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}						
Receptor Scenario		Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residenti
Direct or Indirect Pathway (see notes)		DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW		IVW
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		
83-32-9	Acenaphthene	nc, v	4,700	>Csat	91,000	>Csat	70,000	>Csat	21,000	>Csat	590,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	510		-	>S	2,500		-
107-13-1	Acrylonitrile	c, v	0.86		28		4.0		40		1,100		1.3		9.3		5.8		0.079		0.56		1.0		0.00036		0.026		0.0017		0.052		3.7		0.25		2,200
309-00-2	Aldrin	c, v	0.031		0.77		0.13		1.1		30	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.023		2.1		0.10		0.00092		0.084		0.0042		-
120-12-7	Anthracene	nc, v	23,000	>Csat	460,000	>Csat	350,000	>Csat	110,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S	-
7440-38-2	Arsenic	c, nv	0.43		10		1.9		15		420		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		0.052		2.0		0.31		-
7440-39-3	Barium	nc, nv	15,000		300,000		220,000		69,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		4,000		140,000		33,000		-
56-55-3	Benz[a]anthracene	c, v	0.15		3.3		2.9		24	>Csat	660	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.64		-	>Csat	8.8		0.012		0.71		0.17		-
71-43-2	Benzene	c, v	8.2		270		37		380		11,000	>Csat	11		81		50		0.16		1.1		2.1		0.023		1.6		0.10		0.46		32		2.1		3,100
92-87-5	Benzidine	c, nv	0.00052		0.011		0.0100		0.082		2.3		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.000038		0.0012		0.00070		0.00011		0.0033		0.0019		-
50-32-8	Benzo[a]pyrene (BaP equivalents)	c, nv	0.015		0.33		0.29		2.4		67	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.60		-	>Csat	-	>Csat	0.0034		0.11		0.064		-
205-99-2	Benzo[b]fluoranthene	c, nv	0.15		3.3		2.9		24	>Csat	670	>Csat	-	NV	-	NV	-	NV	-	NV	6.2		-	>Csat	-	>Csat	-	>Csat	0.034		1.1		0.64		-
207-08-9	Benzo[k]fluoranthene	c, nv	1.5		33	>Csat	29	>Csat	240	>Csat	6,700	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.34		-	>S	-	>S	-
7440-41-7	Beryllium	c, nv	1,500		210,000		6,700		170,000		-	>Max	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S	-		-
117-81-7	Bis(2-ethylhexyl)phthalate	c, nv	39		940	>Csat	160	>Csat	1,300	>Csat	37,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	5.6		220		33		-
75-27-4	Bromodichloromethane	c, v	3.4		190		15		230		6,300	>Csat	2.4		17		11		0.041		0.29		0.53		0.0020		0.21		0.0088		0.13		14		0.60		1,400
75-25-2	Bromoform	c, v	57		1,900	>Csat	260		2,700	>Csat	74,000	>Csat	81		580		360		8.2		58		110		0.046		3.3		0.22		3.3		240		16		130,000
74-83-9	Bromomethane	nc, v	46		1,500		750		370		10,000	>Csat	170		500		700		1.3		4.0		17		0.083		5.7		0.40		7.5		520		36		32,000
7440-43-9	Cadmium	c, nv	2,100		280,000		9,000		220,000		-	>Max	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S	-		-
56-23-5	Carbon tetrachloride	c, v	7.5		220		34		320		8,900	>Csat	15		110		65		0.12		0.85		1.6		0.013		0.76		0.058		0.46		27		2.1		1,800
108-90-7	Chlorobenzene	nc, v	530		18,000	>Csat	8,700	>Csat	4,700	>Csat	130,000	>Csat	-	>Csat	-	>Csat	-	>Csat	77		230		-	>Csat	5.8		430		27		77		5,800		350		-
124-48-1	Chlorodibromomethane (dibromochloromethane)	c, v	3.7		160		17		210		5,800	>Csat	3.3		24		14		0.22		1.6		2.9		0.0024		0.22		0.011		0.17		16		0.77		3,900
75-00-3	Chloroethane (ethyl chloride)	nc, v	160,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	310		-	>Csat	1,300		21,000		2,200,000		88,000		-
67-66-3	Chloroform	c, v	5.8		360		26		410		11,000	>Csat	3.9		28		17		0.031		0.22		0.41		0.0034		0.37		0.015		0.22		25		0.98		1,400
74-87-3	Chloromethane	nc, v	1,400	>Csat	84,000	>Csat	25,000	>Csat	25,000	>Csat	700,000	>Csat	-	>Csat	-	>Csat	-	>Csat	24		73		300		2.2		230		9.1		190		20,000		790		440,000
12789-03-6	Chordane	c, v	1.7		42	>Csat	7.4		61	>Csat	1,700	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.45		-	>Csat	2.1		0.045		4.1		0.21		-
16065-83-1	Chromium (III)	nc, nv	120,000		-	>Max	-	>Max	530,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		30,000		1,100,000		250,000		-
18540-29-9	Chromium (VI)	c, nv	0.30		6.5		6.3		49		1,400		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		0.050		1.5		0.90		-
218-01-9	Chrysene	c, nv	15	>Csat	330	>Csat	290	>Csat	2,400	>Csat	67,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S	-
7440-50-8	Copper	nc, nv	3,100		61,000		47,000		14,000		390,000		-	NV	-	NV	-	NV	-	NV	*		*		*		800		29,000		6,500		-
74-90-8	Cyanide (hydrogen cyanide) A	nc, nv	47		910		700		210		5,900		-	NV	-	NV	-	NV	-	NV	*		*		*		12		430		98		-
72-54-8	DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	2.7		64		12		94		2,600	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.1		36		2.6		0.031		1.0		0.074		-
72-55-9	DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	1.8		45		8.2		66		1,800		-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	1.6		150		7.5		0.046		4.2		0.21		-
50-29-3	DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	1.9		45		8.5		66		1,800	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	12		-	>Csat	70		0.23		-	>S	1.4		-
53-70-3	Dibenz[a,h]anthracene	c, nv	0.015		0.33		0.29		2.4		67	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.0		-	>Csat	-	>Csat	0.0034		0.11		0.064		-
95-50-1	1,2-Dichlorobenzene	nc, v	2,200	>Csat	79,000	>Csat	36,000	>Csat	20,000	>Csat	560,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	36		-	>Csat	160		300		23,000		1,400		-
106-46-7	1,4-Dichlorobenzene	c, v	14		1,300	>Csat	64		1,300	>Csat	36,000	>Csat	8.1		58		36		0.99		7.0		13		0.057		6.8		0.25		0.48		58		2.1		4,900
91-94-1	3,3-Dichlorobenzidine	c, nv	1.2		29	>Csat	5.1		42	>Csat	1,200	>Csat	-	NV	-	NV	-	NV	-	NV	0.17		6.5		1.00		0.17		6.7		1.0		-
75-34-3	1,1-Dichloroethane	c, v	58		2,400	>Csat	260		3,200	>Csat	89,000	>Csat	56		400		240		0.45		3.2		5.9		0.044		3.9		0.20		2.8		240		13		16,000
75-35-4	1,1-Dichloroethene	nc, v	1,800	>Csat	54,000	>Csat	29,000	>Csat	13,000	>Csat	370,000	>Csat	-	>Csat	-	>Csat	-	>Csat	54		160		680		6.7		450		32		280		19,000		1,400		570,000
156-59-2	cis-1,2-Dichloroethene	nc, v	160		3,000	>Csat	2,300	>Csat	710		20,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	0.63		24		4.5		36		1,300		260		-
156-60-5	trans-1,2-Dichloroethene	nc, v	1,600		30,000	>Csat	23,000	>Csat	7,100	>Csat	200,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	7.0		260		51		360		13,000		2,600		-
111-44-4	Dichloroethylether	c, v	0.29		12		1.3		16		450		0.53		3.7		6.9		0.53		3.7		6.9		0.00019		0.017		0.00087		0.014		1.3		0.063		5,700
75-09-2	Dichloromethane	c, v	76		1,600		1,600		12,000	>Csat	340,000	>Csat	-	>Csat	-	>Csat	-	>Csat	26		150		950		0.14		4.4		2.4		11		370		200		1,000,000
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	630	>Csat	12,000	>Csat	8,200	>Csat	2,700	>Csat	74,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.3		86		16		170		6,500		1,200		-
60-57-1	Dieldrin	c, nv	0.034		0.82		0.14		1.2		33	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.010		0.36		0.030		0.0017		0.059		0.0050		-
606-20-2	2,6-Dinitrotoluene	nc, nv	19		370	>Csat	250		80		2,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.0		37		7.8		5.6		210		43		-
621-64-7	Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	0.078		1.9		0.33		2.7		74		-	NV	-	NV	-	NV	-	NV	0.00094		0.036		0.0054		0.011		0.42		0.062		-
123-91-1	1,4-Dioxane	c, v	5.4		150		24		210		5,900		28		200		370		28		200		370		0.0023		0.13		0.012		0.46		25		2.4		820,000
86-30-6	Diphenylnitrosamine	c, nv	110		2,700	>Csat	470	>Csat	3,800	>Csat	110,000	>Csat	-	NV	-	NV	-	NV	-	NV	10		-	>Csat	45		13		480		57		-
106-93-4	EDB (1,2-dibromoethane)	c, v	0.16		6.9		0.73		9.0		250		0.15		1.1		0.65		0.012		0.085		0.16		0.00012		0.011		0.00056		0.0075		0.68		0.034		180
107-06-2	EDC (1,2-dichloroethane)	c, v	3.6		150		16		200		5,600	>Csat	3.4		24		15		0.077		0.55		1.0		0.0028		0.25		0.013		0.17		15		0.78		2,100
115-29-7	Endosulfan (alpha-beta)	nc, v	380	>Csat	7,400	>Csat	4,900	>Csat	1,600	>Csat	45,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	98		-	>S	-	>S	-
72-20-8	Endrin	nc, nv	19	>Csat	370	>Csat	250	>Csat	80	>Csat	2,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	11		-	>Csat	-	>Csat	1.9		92		8.6		-
100-41-4	Ethylbenzene	c, v	34		1,300	>Csat	150		1,700	>Csat	49,000	>Csat	36		250		160		1.3		9.1		17		0.22		16		0.90		1.5		110		6.4		9,900
206-44-0	Fluoranthene	nc, nv	2,400	>Csat	46,000	>Csat	30,000	>Csat	10,000	>Csat	280,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S	-
86-73-7	Fluorene	nc, v	3,100	>Csat	61,000	>Csat	47,000	>Csat	14,000	>Csat	390,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	280		-	>S	1,300		-
50-00-0	Formaldehyde	c, v	15		2,000		64		1,600		44,000	>Csat	48		340		630		48		340		630		0.0020		0.27		0.0086		0.43		60		1.9		1,500,000
76-44-8	Heptachlor	c, v	0.11		2.9		0.45		4.0		110		18		130		230		18		130		230		0.017		0.74		0.048		0.0014		0.059		0.0039		-
1024-57-3	Heptachlor Epoxide	c, v	0.055		1.4		0.24		2.0		56		28		-	>Csat	-	>Csat	28		-	>Csat	-	>Csat	0.0042		0.28		0.016		0.0014		0.092		0.0053		-
118-74-1	Hexachlorobenzene	c, v	0.21		8.6		0.93		11		320		1.0		7.2		13		1.0		7.2		13		0.018		1.7		0.084		0.0098		0.89		0.045		-
319-84-6	alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	0.086		2.1		0.36		3.0		83	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.0063		0.23		0.023		0.0075		0.27		0.027		-
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	c, nv	0.49		12		2.1		17		470	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.036		1.3		0.13		0.043		1.5		0.16		-
67-72-1	Hexachloroethane	c, v	7.4		290		32		370		10,000	>Csat	8.1		58		36		0.58		4.1		7.6		0.022		1.5		0.087		0.34		24		1.3		5,000
193-39-5	Indeno[1,2,3-cd]pyrene	c, nv	0.15		3.3	>Csat	2.9	>Csat	24	>Csat	670	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.034		-	>S	-	>S	-
7439-92-1	Lead	NA, nv	400	L	400	L	800	L	800	L	800		L	NV	-	NV	-	NV	-	NV	-	NV	-	NV	30	L	30	L	30	L	15	L	15	L	15	L	-
7439-96-5	Manganese	nc, nv	1,800		36,000		25,000		8,200		230,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		480		17,000		3,900		-
94-74-6	MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	32		610	>Csat	410	>Csat	130		3,700	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.097		3.9		0.61		7.4		290		47		-
7439-97-6	Mercury	nc, nv	23		460		350		110		2,900		-	NV	-	NV	-	NV	-	NV	*		*		*		6.0		-	>S	49		-
1634-04-4	MTBE (methyl t-butyl ether)	c, v	250		8,300	>Csat	1,100		12,000	>Csat	320,000	>Csat	340		2,400		1,500		8.5		60		110		0.11		8.4		0.54		14		1,100		68		350,000
91-20-3	Naphthalene	c, v	5.3		730	>Csat	23		580	>Csat	16,000	>Csat	6.4		45		83		6.4		45		83		0.077		11		0.34		0.17		23		0.72		3,600
7440-02-0	Nickel	c, nv	14,000		-	>Max	62,000		-	>Max	-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S	-
87-86-5	Pentachlorophenol	c, nv	1.0		25		4.0		34		960		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.066		2.2		0.17		0.044		1.5		0.12		-

RISK-BASED CONCENTRATIONS

Medium →	GROUNDWATER µg/L (ppb)					GROUNDWATER µg/L (ppb)					GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
hway →	Volatilization to Outdoor Air RBC_{wo}					Vapor Intrusion into Buildings RBC_{wi}					GW in Excavation RBC_{we}		Vapor Intrusion into Buildings RBC_{sv}						Inhalation RBC_{air}					
nario →	al	Urban Residential		Occupational		Residential		Urban Residential		Occupational			Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)		IVW		IVW		IVW		IVW		IVW			DCW		ICA		ICA		ICA		DCA		DCA		DCA	
Chemical	Note	Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
Acenaphthene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Acrylonitrile	c, v		16,000		9,800		700		5,000		9,200		250		8.3		59		180		0.041		0.29		0.18	
Aldrin	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.5		0.11		0.81		2.5		0.00057		0.0041		0.0025	
Anthracene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Arsenic	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	6,300		-	NV	-	NV	-	NV	0.00065		0.0046		0.0029	
Barium	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.7E+07		-	NV	-	NV	-	NV	0.52		1.6		2.2	
Benz[a]anthracene	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	0.0092		0.054		0.11	
Benzene	c, v		22,000		14,000		210		1,500		2,800		1,800		72		510		1,600		0.36		2.6		1.6	
Benzidine	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	17		-	NV	-	NV	-	NV	0.000015		0.000088		0.00018	
Benzo[a]pyrene (BaP equivalents)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.00092		0.0054		0.011	
Benzo[b]fluoranthene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0092		0.054		0.11	
Benzo[k]fluoranthene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0092		-	>Pv	-	>Pv
Beryllium	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0012		0.0083		0.0051	
Bis(2-ethylhexyl)phthalate	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Bromodichloromethane	c, v		9,700		6,000		180		1,300		2,300		450		15		110		330		0.076		0.54		0.33	
Bromoform	c, v		900,000		550,000		36,000		250,000		470,000		14,000		510		3,600		11,000		2.6		18		11	
Bromomethane	nc, v		96,000		130,000		2,100		6,300		27,000		1,200		1,000		3,100		22,000		5.2		16		22	
Cadmium	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0016		0.011		0.0068	
Carbon tetrachloride	c, v		12,000		7,700		92		650		1,200		1,800		94		660		2,000		0.47		3.3		2.0	
Chlorobenzene	nc, v	>S	-	>S	-	>S	67,000		200,000		-	>S	10,000		10,000		31,000		220,000		52		160		220	
Chlorodibromomethane (dibromochloromethane)	c, v		28,000		17,000		980		6,900		13,000		610		21		150		450		0.10		0.74		0.45	
Chloroethane (ethyl chloride)	nc, v	>S	-	>S	-	>S	2,800,000		-	>S	-	>S	2,400,000		2,100,000		6,300,000		4.4E+07		10,000		31,000		44,000	
Chloroform	c, v		10,000		6,300		120		880		1,600		720		24		170		530		0.12		0.87		0.53	
Chloromethane	nc, v		1,300,000		1,800,000		26,000		78,000		330,000		22,000		19,000		56,000		390,000		94		280		390	
Chordane	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	5.6		40		-	>Pv	0.028		0.20		0.12	
Chromium (III)	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.0E+15		3.1E+15		4.4E+15	
Chromium (VI)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	9,400		-	NV	-	NV	-	NV	0.000012		0.000070		0.00015	
Chrysene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.092		0.54		1.1	
Copper	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	5,400,000		-	NV	-	NV	-	NV	1.0E+15		3.1E+15		4.4E+15	
Cyanide (hydrogen cyanide) A	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	81,000		-	NV	-	NV	-	NV	0.83		2.5		3.5	
DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	31		-	NV	-	NV	-	NV	0.041		0.29		0.18	
DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	5.8		41		-	>Pv	0.029		0.21		0.13	
DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.029		0.21		0.13	
Dibenz[a,h]anthracene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
1,2-Dichlorobenzene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	37,000		42,000		130,000		880,000		210		630		880	
1,4-Dichlorobenzene	c, v		35,000		21,000		540		3,800		7,100		1,500		51		360		1,100		0.26		1.8		1.1	
3,3-Dichlorobenzidine	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0083		0.059		0.036	
1,1-Dichloroethane	c, v		110,000		68,000		1,100		7,800		14,000		10,000		350		2,500		7,700		1.8		12		7.7	
1,1-Dichloroethene	nc, v		1,700,000		2,400,000		29,000		86,000		360,000		44,000		42,000		130,000		880,000		210		630		880	
cis-1,2-Dichloroethene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	18,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
trans-1,2-Dichloroethene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	180,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Dichloroethylether	c, v		40,000		30,000		2,300		16,000		30,000		51		1.7		12		37		0.0085		0.060		0.037	
Dichloromethane	c, v		6,100,000		1.3E+07		90,000		520,000		3,300,000		640,000		20,000		120,000		1,200,000		100		590		1,200	
2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	77,000		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Dieldrin	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.4		-	NV	-	NV	-	NV	0.00061		0.0043		0.0027	
2,6-Dinitrotoluene	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	5,300		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	370		-	NV	-	NV	-	NV	0.0014		0.0100		0.0061	
1,4-Dioxane	c, v		5,800,000		4,500,000		340,000		2,400,000		4,500,000		3,400		110		800		2,500		0.56		4.0		2.5	
Diphenylnitrosamine	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.1		7.7		4.7	
EDB (1,2-dibromoethane)	c, v		1,300		790		45		320		590		27		0.94		6.6		20		0.0047		0.033		0.020	
EDC (1,2-dichloroethane)	c, v		15,000		9,000		300		2,100		3,900		630		22		150		470		0.11		0.77		0.47	
Endosulfan (alpha-beta)	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Endrin	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	170		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Ethylbenzene	c, v		70,000		43,000		620		4,400		8,200		4,500		220		1,600		4,900		1.1		8.0		4.9	
Fluoranthene	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Fluorene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Formaldehyde	c, v		1.1E+07		8,500,000		650,000		4,600,000		8,500,000		1,300		43		310		940		0.22		1.5		0.94	
Heptachlor	c, v	>S	-	>S	-	>S	88		-	>S	-	>S	1.8		0.43		3.1		9.4		0.0022		0.015		0.0094	
Heptachlor Epoxide	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.2		0.22		1.5		4.7		0.0011		0.0077		0.0047	
Hexachlorobenzene	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1.2		8.7		27		0.0061		0.043		0.027	
alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	18		-	NV	-	NV	-	NV	0.0016		0.011		0.0068	
gamma-Hexachlorocyclohexane (Lindane)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	100		-	NV	-	NV	-	NV	0.0091		0.064		0.040	
Hexachloroethane	c, v		35,000		22,000		570		4,100		7,500		860		51		360		1,100		0.26		1.8		1.1	
Indeno[1,2,3-cd]pyrene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Lead	NA, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Manganese	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	3,200,000		-	NV	-	NV	-	NV	0.052		0.16		0.22	
MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,700		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Mercury	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.31		0.94		1.3	
MTBE (methyl t-butyl ether)	c, v		2,500,000		1,500,000		67,000		470,000		870,000		63,000		2,200		15,000		47,000		11		77		47	
Naphthalene	c, v		25,000		16,000		840		5,900		11,000		500		17		120		360		0.083		0.59		0.36	
Nickel	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.011		0.077		0.047	
Pentachlorophenol	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	53		-	NV	-	NV	-	NV	0.55		3.9		2.4	

RISK-BASED CONCENTRATIONS

Contaminated Medium →			SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)						
Exposure Pathway →			Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}						
Receptor Scenario →			Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residenti
Direct or Indirect Pathway (see notes)			DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW		IVW
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note	
11097-69-1	Polychlorinated biphenyls (Total PCBs)	c, v	0.23		6.0	>Csat	0.74	>Csat	8.4	>Csat	230	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.24		-	>Csat	1.1		0.0060		0.55		0.028		-
98-82-8	iso-Propylbenzene (cumene)	nc, v	3,500	>Csat	110,000	>Csat	57,000	>Csat	27,000	>Csat	750,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	96		-	>Csat	-	>Csat	440		29,000		2,000		-
129-00-0	Pyrene	nc, v	1,800	>Csat	35,000	>Csat	23,000	>Csat	7,500	>Csat	210,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	110		-	>S	-	>S	-
7440-22-4	Silver	nc, nv	390		7,600		5,800		1,800		49,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		100		3,600		820		-
100-42-5	Styrene	nc, v	7,900	>Csat	230,000	>Csat	130,000	>Csat	56,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	170		-	>Csat	800		1,200		75,000		5,700		-
1746-01-6	2,3,7,8-TCDD (dioxin) equivalents	c, v	4.7E-06		0.00012		0.000016		0.00017		0.0048		0.010		0.073		0.13		0.010		0.073		0.13		6.8E-06		0.00063		0.000031		9.1E-08		8.4E-06		4.2E-07		0.022
127-18-4	Tetrachloroethene (PCE)	c, v	220	>Csat	7,200	>Csat	1,000	>Csat	10,000	>Csat	280,000	>Csat	-	>Csat	-	>Csat	-	>Csat	2.8		20		36		0.46		28		1.9		12		700		48		64,000
108-88-3	Toluene	nc, v	5,800	>Csat	120,000	>Csat	88,000	>Csat	28,000	>Csat	770,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	83		-	>Csat	490		1,100		46,000		6,300		-
8001-35-2	Toxaphene	c, nv	0.49		12		2.1		17		470		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.36		12		0.93		0.015		0.52		0.040		-
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	400,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	55,000		-	>S	-	>S	-
71-55-6	1,1,1-Trichloroethane	nc, v	53,000	>Csat	-	>Max	870,000	>Csat	470,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	190		-	>Csat	880		8,000		600,000		37,000		-
79-00-5	1,1,2-Trichloroethane	c, v	5.8		240		26		320		8,900	>Csat	5.6		40		24		0.32		2.3		4.2		0.0063		0.56		0.029		0.28		25		1.3		4,700
79-01-6	Trichloroethene	NA, v	6.7		17		51		470	>Csat	13,000	>Csat	15		33		96		0.12		0.26		2.3		0.013		0.053		0.087		0.49		2.0		3.3		3,300
75-69-4	Trichlorofluoromethane (Freon 11)	nc, v	7,600	>Csat	270,000	>Csat	130,000	>Csat	69,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	190		560		-	>Csat	61		-	>Csat	280		1,100		86,000		5,200		780,000
88-06-2	2,4,6-Trichlorophenol	c, nv	49		1,200		210		1,700		47,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.4		86		8.9		4.4		160		16		-
95-63-6	1,2,4-Trimethylbenzene	nc, v	110		6,500	>Csat	2,000	>Csat	2,000	>Csat	54,000	>Csat	230		700		980		16		49		210		2.8		300		12		15		1,600		61		-
108-67-8	1,3,5-Trimethylbenzene	nc, v	780	>Csat	15,000	>Csat	12,000	>Csat	3,500	>Csat	98,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	21		-	>Csat	110		110		4,900		600		-
75-01-4	Vinyl chloride	c, v	0.36		7.9		4.4		34		950	>Csat	5.3		20		89		0.043		0.16		2.2		0.00057		0.014		0.010		0.027		0.68		0.49		350
1330-20-7	Xylenes	nc, v	1,400	>Csat	71,000	>Csat	25,000	>Csat	20,000	>Csat	560,000	>Csat	-	>Csat	-	>Csat	-	>Csat	160		-	>Csat	-	>Csat	23		-	>Csat	100		190		18,000		830		-

For a complete explanation of notes, please see "Notes to Accompany Risk-Based Concentrations for Individual Chemicals."

Ψ WARNI

Ψ WARNING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.

RISK-BASED CONCENTRATIONS

Medium →		GROUNDWATER µg/L (ppb)					GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
hway →		Volatilization to Outdoor Air RBC_{wo}					Vapor Intrusion into Buildings RBC_{wi}						GW in Excavation RBC_{we}		Vapor Intrusion into Buildings RBC_{sv}						Inhalation RBC_{air}					
nario →		al	Urban Residential		Occupational		Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			IVW		IVW		IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
Chemical	Note	Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
Polychlorinated biphenyls (Total PCBs)	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	30		0.99		7.0		22		0.0038		0.027		0.017	
iso-Propylbenzene (cumene)	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	51,000		83,000		250,000		1,800,000		420		1,300		1,800	
Pyrene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Silver	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,100,000		-	NV	-	NV	-	NV	1.0E+15		3.1E+15		4.4E+15	
Styrene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	170,000		210,000		630,000		4,400,000		1,000		3,100		4,400	
2,3,7,8-TCDD (dioxin) equivalents	c, v		0.15		0.11		0.0083		0.059		0.11		0.00045		0.000015		0.00010		0.00032		5.7E-08		4.0E-07		2.5E-07	
Tetrachloroethene (PCE)	c, v		-	>S	-	>S	3,700		26,000		48,000		34,000		2,200		15,000		47,000		11		77		47	
Toluene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	220,000		1,000,000		3,100,000		2.2E+07		5,200		16,000		22,000	
Toxaphene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	18		-	NV	-	NV	-	NV	0.0088		0.062		0.038	
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	6,300,000		1.9E+07		1.3E+08		31,000		94,000		130,000	
1,1,1-Trichloroethane	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1,100,000		1,000,000		3,100,000		2.2E+07		5,200		16,000		22,000	
1,1,2-Trichloroethane	c, v		34,000		21,000		870		6,200		11,000		1,000		35		250		770		0.18		1.2		0.77	
Trichloroethene	NA, v		6,900		20,000		200		430		3,700		3,000		95		200		2,900		0.47		1.0		2.9	
Trichlorofluoromethane (Freon 11)	nc, v		-	>S	-	>S	36,000		110,000		460,000		160,000		150,000		440,000		3,100,000		730		2,200		3,100	
2,4,6-Trichlorophenol	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	11,000		-	NV	-	NV	-	NV	0.91		6.4		4.0	
1,2,4-Trimethylbenzene	nc, v	>S	-	>S	-	>S	5,800		17,000		-	>S	1,700		1,500		4,400		31,000		7.3		22		31	
1,3,5-Trimethylbenzene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	15,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Vinyl chloride	c, v		1,300		5,900		17		64		880		960		33		120		2,800		0.17		0.61		2.8	
Xylenes	nc, v	>S	-	>S	-	>S	86,000		-	>S	-	>S	23,000		21,000		63,000		440,000		100		310		440	

ING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.

Urban Residential RBCs revsied to reflect recreational user/tresspasser exposure assumptions - alternate toxicity endpoint selected

RISK-BASED CONCENTRATIONS

Contaminated Medium		SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)						
Exposure Pathway		Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}						
Receptor Scenario		Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residenti
Direct or Indirect Pathway (see notes)		DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW		IVW
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		
83-32-9	Acenaphthene	nc, v	4,700	>Csat	91,000	>Csat	70,000	>Csat	21,000	>Csat	590,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	510		-	>S	2,500		-
107-13-1	Acrylonitrile	c, v	0.86		28		4.0		40		1,100		1.3		9.3		5.8		0.079		0.56		1.0		0.00036		0.026		0.0017		0.052		3.7		0.25		2,200
309-00-2	Aldrin	c, v	0.031		0.77		0.13		1.1		30	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.023		2.1		0.10		0.00092		0.084		0.0042		-
120-12-7	Anthracene	nc, v	23,000	>Csat	460,000	>Csat	350,000	>Csat	110,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S	-
7440-38-2	Arsenic	c, nv	0.43		10		1.9		15		420		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		0.052		2.0		0.31		-
7440-39-3	Barium	nc, nv	15,000		300,000		220,000		69,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		4,000		140,000		33,000		-
56-55-3	Benz[a]anthracene	c, v	0.15		3.3		2.9		24	>Csat	660	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.64		-	>Csat	8.8		0.012		0.71		0.17		-
71-43-2	Benzene	c, v	8.2		270		37		380		11,000	>Csat	11		81		50		0.16		1.1		2.1		0.023		1.6		0.10		0.46		32		2.1		3,100
92-87-5	Benzidine	c, nv	0.00052		0.011		0.0100		0.082		2.3		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.000038		0.0012		0.00070		0.00011		0.0033		0.0019		-
50-32-8	Benzo[a]pyrene (BaP equivalents)	c, nv	0.015		0.33		0.29		2.4		67	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.60		-	>Csat	-	>Csat	0.0034		0.11		0.064		-
205-99-2	Benzo[b]fluoranthene	c, nv	0.15		3.3		2.9		24	>Csat	670	>Csat	-	NV	-	NV	-	NV	-	NV	6.2		-	>Csat	-	>Csat	0.034		1.1		0.64		-
207-08-9	Benzo[k]fluoranthene	c, nv	1.5		33	>Csat	29	>Csat	240	>Csat	6,700	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.34		-	>S	-	>S	-
7440-41-7	Beryllium	nc, nv	160		3,000		2,300		700		19,000		-	NV	-	NV	-	NV	-	NV	*		*		*		40		1,400		330		-
117-81-7	Bis(2-ethylhexyl)phthalate	c, nv	39		940	>Csat	160	>Csat	1,300	>Csat	37,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	5.6		220		33		-
75-27-4	Bromodichloromethane	c, v	3.4		190		15		230		6,300	>Csat	2.4		17		11		0.041		0.29		0.53		0.0020		0.21		0.0088		0.13		14		0.60		1,400
75-25-2	Bromoform	c, v	57		1,900	>Csat	260		2,700	>Csat	74,000	>Csat	81		580		360		8.2		58		110		0.046		3.3		0.22		3.3		240		16		130,000
74-83-9	Bromomethane	nc, v	46		1,500		750		370		10,000	>Csat	170		500		700		1.3		4.0		17		0.083		5.7		0.40		7.5		520		36		32,000
7440-43-9	Cadmium	nc, nv	78		1,500		1,100		350		9,700		-	NV	-	NV	-	NV	-	NV	*		*		*		20		710		160		-
56-23-5	Carbon tetrachloride	c, v	7.5		220		34		320		8,900	>Csat	15		110		65		0.12		0.85		1.6		0.013		0.76		0.058		0.46		27		2.1		1,800
108-90-7	Chlorobenzene	nc, v	530		18,000	>Csat	8,700	>Csat	4,700	>Csat	130,000	>Csat	-	>Csat	-	>Csat	-	>Csat	77		230		-	>Csat	5.8		430		27		77		5,800		350		-
124-48-1	Chlorodibromomethane (dibromochloromethane)	c, v	3.7		160		17		210		5,800	>Csat	3.3		24		14		0.22		1.6		2.9		0.0024		0.22		0.011		0.17		16		0.77		3,900
75-00-3	Chloroethane (ethyl chloride)	nc, v	160,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	310		-	>Csat	1,300		21,000		2,200,000		88,000		-
67-66-3	Chloroform	c, v	5.8		360		26		410		11,000	>Csat	3.9		28		17		0.031		0.22		0.41		0.0034		0.37		0.015		0.22		25		0.98		1,400
74-87-3	Chloromethane	nc, v	1,400	>Csat	84,000	>Csat	25,000	>Csat	25,000	>Csat	700,000	>Csat	-	>Csat	-	>Csat	-	>Csat	24		73		300		2.2		230		9.1		190		20,000		790		440,000
12789-03-6	Chordane	c, v	1.7		42	>Csat	7.4		61	>Csat	1,700	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.45		-	>Csat	2.1		0.045		4.1		0.21		-
16065-83-1	Chromium (III)	nc, nv	120,000		-	>Max	-	>Max	530,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		30,000		1,100,000		250,000		-
18540-29-9	Chromium (VI)	c, nv	0.30		6.5		6.3		49		1,400		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		0.050		1.5		0.90		-
218-01-9	Chrysene	c, nv	15	>Csat	330	>Csat	290	>Csat	2,400	>Csat	67,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S	-
7440-50-8	Copper	nc, nv	3,100		61,000		47,000		14,000		390,000		-	NV	-	NV	-	NV	-	NV	*		*		*		800		29,000		6,500		-
74-90-8	Cyanide (hydrogen cyanide) A	nc, nv	47		910		700		210		5,900		-	NV	-	NV	-	NV	-	NV	*		*		*		12		430		98		-
72-54-8	DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	2.7		64		12		94		2,600	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.1		36		2.6		0.031		1.0		0.074		-
72-55-9	DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	1.8		45		8.2		66		1,800		-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	1.6		150		7.5		0.046		4.2		0.21		-
50-29-3	DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	1.9		45		8.5		66		1,800	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	12		-	>Csat	70		0.23		-	>S	1.4		-
53-70-3	Dibenz[a,h]anthracene	c, nv	0.015		0.33		0.29		2.4		67	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.0		-	>Csat	-	>Csat	0.0034		0.11		0.064		-
95-50-1	1,2-Dichlorobenzene	nc, v	2,200	>Csat	79,000	>Csat	36,000	>Csat	20,000	>Csat	560,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	36		-	>Csat	160		300		23,000		1,400		-
106-46-7	1,4-Dichlorobenzene	c, v	14		1,300	>Csat	64		1,300	>Csat	36,000	>Csat	8.1		58		36		0.99		7.0		13		0.057		6.8		0.25		0.48		58		2.1		4,900
91-94-1	3,3-Dichlorobenzidine	c, nv	1.2		29	>Csat	5.1		42	>Csat	1,200	>Csat	-	NV	-	NV	-	NV	-	NV	0.17		6.5		1.00		0.17		6.7		1.0		-
75-34-3	1,1-Dichloroethane	c, v	58		2,400	>Csat	260		3,200	>Csat	89,000	>Csat	56		400		240		0.45		3.2		5.9		0.044		3.9		0.20		2.8		240		13		16,000
75-35-4	1,1-Dichloroethene	nc, v	1,800	>Csat	54,000	>Csat	29,000	>Csat	13,000	>Csat	370,000	>Csat	-	>Csat	-	>Csat	-	>Csat	54		160		680		6.7		450		32		280		19,000		1,400		570,000
156-59-2	cis-1,2-Dichloroethene	nc, v	160		3,000	>Csat	2,300	>Csat	710		20,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	0.63		24		4.5		36		1,300		260		-
156-60-5	trans-1,2-Dichloroethene	nc, v	1,600		30,000	>Csat	23,000	>Csat	7,100	>Csat	200,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	7.0		260		51		360		13,000		2,600		-
111-44-4	Dichloroethylether	c, v	0.29		12		1.3		16		450		0.53		3.7		6.9		0.53		3.7		6.9		0.00019		0.017		0.00087		0.014		1.3		0.063		5,700
75-09-2	Dichloromethane	c, v	76		1,600		1,600		12,000	>Csat	340,000	>Csat	-	>Csat	-	>Csat	-	>Csat	26		150		950		0.14		4.4		2.4		11		370		200		1,000,000
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	630	>Csat	12,000	>Csat	8,200	>Csat	2,700	>Csat	74,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.3		86		16		170		6,500		1,200		-
60-57-1	Dieldrin	c, nv	0.034		0.82		0.14		1.2		33	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.010		0.36		0.030		0.0017		0.059		0.0050		-
606-20-2	2,6-Dinitrotoluene	nc, nv	19		370	>Csat	250		80		2,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.0		37		7.8		5.6		210		43		-
621-64-7	Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	0.078		1.9		0.33		2.7		74		-	NV	-	NV	-	NV	-	NV	0.00094		0.036		0.0054		0.011		0.42		0.062		-
123-91-1	1,4-Dioxane	c, v	5.4		150		24		210		5,900		28		200		370		28		200		370		0.0023		0.13		0.012		0.46		25		2.4		820,000
86-30-6	Diphenylnitrosamine	c, nv	110		2,700	>Csat	470	>Csat	3,800	>Csat	110,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	10		-	>Csat	45		13		480		57		-
106-93-4	EDB (1,2-dibromoethane)	c, v	0.16		6.9		0.73		9.0		250		0.15		1.1		0.65		0.012		0.085		0.16		0.00012		0.011		0.00056		0.0075		0.68		0.034		180
107-06-2	EDC (1,2-dichloroethane)	c, v	3.6		150		16		200		5,600	>Csat	3.4		24		15		0.077		0.55		1.0		0.0028		0.25		0.013		0.17		15		0.78		2,100
115-29-7	Endosulfan (alpha-beta)	nc, v	380	>Csat	7,400	>Csat	4,900	>Csat	1,600	>Csat	45,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	98		-	>S	-	>S	-
72-20-8	Endrin	nc, nv	19	>Csat	370	>Csat	250	>Csat	80	>Csat	2,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	11		-	>Csat	-	>Csat	1.9		92		8.6		-
100-41-4	Ethylbenzene	c, v	34		1,300	>Csat	150		1,700	>Csat	49,000	>Csat	36		250		160		1.3		9.1		17		0.22		16		0.90		1.5		110		6.4		9,900
206-44-0	Fluoranthene	nc, nv	2,400	>Csat	46,000	>Csat	30,000	>Csat	10,000	>Csat	280,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S	-
86-73-7	Fluorene	nc, v	3,100	>Csat	61,000	>Csat	47,000	>Csat	14,000	>Csat	390,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	280		-	>S	1,300		-
50-00-0	Formaldehyde	nc, v	330		19,000		2,900		2,800		78,000	>Csat	2,300		6,900		29,000		2,300		6,900		29,000		0.092		9.8		0.39		20		2,200		86		7.3E+07
76-44-8	Heptachlor	c, v	0.11		2.9		0.45		4.0		110		18		130		230		18		130		230		0.017		0.74		0.048		0.0014		0.059		0.0039		-
1024-57-3	Heptachlor Epoxide	c, v	0.055		1.4		0.24		2.0		56		28		-	>Csat	-	>Csat	28		-	>Csat	-	>Csat	0.0042		0.28		0.016		0.0014		0.092		0.0053		-
118-74-1	Hexachlorobenzene	c, v	0.21		8.6		0.93		11		320		1.0		7.2		13		1.0		7.2		13		0.018		1.7		0.084		0.0098		0.89		0.045		-
319-84-6	alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	0.086		2.1		0.36		3.0		83	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.0063		0.23		0.023		0.0075		0.27		0.027		-
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	c, nv	0.49		12		2.1		17		470	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.036		1.3		0.13		0.043		1.5		0.16		-
67-72-1	Hexachloroethane	nc, v	41		830	>Csat	540	>Csat	180		5,100	>Csat	-	>Csat	-	>Csat	-	>Csat	71		210		-	>Csat	0.39		19		1.9		6.0		290		30		-
193-39-5	Indeno[1,2,3-cd]pyrene	c, nv	0.15		3.3	>Csat	2.9	>Csat	24	>Csat	670	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.034		-	>S	-	>S	-
7439-92-1	Lead	NA, nv	400	L	400	L	800	L	800	L	800		L	NV	-	NV	-	NV	-	NV	-	NV	-	NV	30	L	30	L	30	L	15	L	15	L	15	L	-
7439-96-5	Manganese	nc, nv	1,800		36,000		25,000		8,200		230,000		-	NV	-	NV	-	NV	-	NV	*		*		*		480		17,000		3,900		-
94-74-6	MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	32		610	>Csat	410	>Csat	130		3,700	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.097		3.9		0.61		7.4		290		47		-
7439-97-6	Mercury	nc, nv	23		460		350		110		2,900		-	NV	-	NV	-	NV	-	NV	*		*		*		6.0		-	>S	49		-
1634-04-4	MTBE (methyl t-butyl ether)	c, v	250		8,300	>Csat	1,100		12,000	>Csat	320,000	>Csat	340		2,400		1,500		8.5		60		110		0.11		8.4		0.54		14		1,100		68		350,000
91-20-3	Naphthalene	c, v	5.3		730	>Csat	23		580	>Csat	16,000	>Csat	6.4		45		83		6.4		45		83		0.077		11		0.34		0.17		23		0.72		3,600
7440-02-0	Nickel	nc, nv	1,500		30,000		22,000		7,000		190,000		-	NV	-	NV	-	NV	-	NV	*		*		*		400		14,000		3,300		-
87-86-5	Pentachlorophenol	c, nv	1.0		25		4.0		34		960		-	NV	-	NV	-	NV	-	NV	0.066		2.2		0.17		0.044		1.5		0.12		-

RISK-BASED CONCENTRATIONS

Medium →	GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
hway →	Volatilization to Outdoor Air RBC_{wo}						Vapor Intrusion into Buildings RBC_{wi}						GW in Excavation RBC_{we}		Vapor Intrusion into Buildings RBC_{sv}						Inhalation RBC_{air}					
nario →	al	Urban Residential		Occupational			Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)		IVW		IVW			IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
Chemical	Note	Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
Acenaphthene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Acrylonitrile	c, v		16,000		9,800		700		5,000		9,200		250		8.3		59		180		0.041		0.29		0.18	
Aldrin	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.5		0.11		0.81		2.5		0.00057		0.0041		0.0025	
Anthracene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Arsenic	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	6,300		-	NV	-	NV	-	NV	0.00065		0.0046		0.0029	
Barium	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.7E+07		-	NV	-	NV	-	NV	0.52		1.6		2.2	
Benz[a]anthracene	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	0.0092		0.054		0.11	
Benzene	c, v		22,000		14,000		210		1,500		2,800		1,800		72		510		1,600		0.36		2.6		1.6	
Benzidine	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	17		-	NV	-	NV	-	NV	0.000015		0.000088		0.00018	
Benzo[a]pyrene (BaP equivalents)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.00092		0.0054		0.011	
Benzo[b]fluoranthene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0092		0.054		0.11	
Benzo[k]fluoranthene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0092		-	>Pv	-	>Pv
Beryllium	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	270,000		-	NV	-	NV	-	NV	0.021		0.063		0.088	
Bis(2-ethylhexyl)phthalate	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Bromodichloromethane	c, v		9,700		6,000		180		1,300		2,300		450		15		110		330		0.076		0.54		0.33	
Bromoform	c, v		900,000		550,000		36,000		250,000		470,000		14,000		510		3,600		11,000		2.6		18		11	
Bromomethane	nc, v		96,000		130,000		2,100		6,300		27,000		1,200		1,000		3,100		22,000		5.2		16		22	
Cadmium	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	130,000		-	NV	-	NV	-	NV	0.010		0.031		0.044	
Carbon tetrachloride	c, v		12,000		7,700		92		650		1,200		1,800		94		660		2,000		0.47		3.3		2.0	
Chlorobenzene	nc, v	>S	-	>S	-	>S	67,000		200,000		-	>S	10,000		10,000		31,000		220,000		52		160		220	
Chlorodibromomethane (dibromochloromethane)	c, v		28,000		17,000		980		6,900		13,000		610		21		150		450		0.10		0.74		0.45	
Chloroethane (ethyl chloride)	nc, v	>S	-	>S	-	>S	2,800,000		-	>S	-	>S	2,400,000		2,100,000		6,300,000		4.4E+07		10,000		31,000		44,000	
Chloroform	c, v		10,000		6,300		120		880		1,600		720		24		170		530		0.12		0.87		0.53	
Chloromethane	nc, v		1,300,000		1,800,000		26,000		78,000		330,000		22,000		19,000		56,000		390,000		94		280		390	
Chordane	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	5.6		40		-	>Pv	0.028		0.20		0.12	
Chromium (III)	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.0E+15		3.1E+15		4.4E+15	
Chromium (VI)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	9,400		-	NV	-	NV	-	NV	0.000012		0.000070		0.00015	
Chrysene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.092		0.54		1.1	
Copper	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	5,400,000		-	NV	-	NV	-	NV	1.0E+15		3.1E+15		4.4E+15	
Cyanide (hydrogen cyanide) A	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	81,000		-	NV	-	NV	-	NV	0.83		2.5		3.5	
DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	31		-	NV	-	NV	-	NV	0.041		0.29		0.18	
DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	5.8		41		-	>Pv	0.029		0.21		0.13	
DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.029		0.21		0.13	
Dibenz[a,h]anthracene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
1,2-Dichlorobenzene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	37,000		42,000		130,000		880,000		210		630		880	
1,4-Dichlorobenzene	c, v		35,000		21,000		540		3,800		7,100		1,500		51		360		1,100		0.26		1.8		1.1	
3,3-Dichlorobenzidine	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0083		0.059		0.036	
1,1-Dichloroethane	c, v		110,000		68,000		1,100		7,800		14,000		10,000		350		2,500		7,700		1.8		12		7.7	
1,1-Dichloroethene	nc, v		1,700,000		2,400,000		29,000		86,000		360,000		44,000		42,000		130,000		880,000		210		630		880	
cis-1,2-Dichloroethene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	18,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
trans-1,2-Dichloroethene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	180,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Dichloroethylether	c, v		40,000		30,000		2,300		16,000		30,000		51		1.7		12		37		0.0085		0.060		0.037	
Dichloromethane	c, v		6,100,000		1.3E+07		90,000		520,000		3,300,000		640,000		20,000		120,000		1,200,000		100		590		1,200	
2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	77,000		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Dieldrin	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.4		-	NV	-	NV	-	NV	0.00061		0.0043		0.0027	
2,6-Dinitrotoluene	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	5,300		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	370		-	NV	-	NV	-	NV	0.0014		0.0100		0.0061	
1,4-Dioxane	c, v		5,800,000		4,500,000		340,000		2,400,000		4,500,000		3,400		110		800		2,500		0.56		4.0		2.5	
Diphenylnitrosamine	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.1		7.7		4.7	
EDB (1,2-dibromoethane)	c, v		1,300		790		45		320		590		27		0.94		6.6		20		0.0047		0.033		0.020	
EDC (1,2-dichloroethane)	c, v		15,000		9,000		300		2,100		3,900		630		22		150		470		0.11		0.77		0.47	
Endosulfan (alpha-beta)	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Endrin	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	170		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Ethylbenzene	c, v		70,000		43,000		620		4,400		8,200		4,500		220		1,600		4,900		1.1		8.0		4.9	
Fluoranthene	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Fluorene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Formaldehyde	nc, v		2.2E+08		3.9E+08		3.1E+07		9.2E+07		3.9E+08		2,400		2,000		6,100		43,000		10		31		43	
Heptachlor	c, v	>S	-	>S	-	>S	88		-	>S	-	>S	1.8		0.43		3.1		9.4		0.0022		0.015		0.0094	
Heptachlor Epoxide	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.2		0.22		1.5		4.7		0.0011		0.0077		0.0047	
Hexachlorobenzene	c, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1.2		8.7		27		0.0061		0.043		0.027	
alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	18		-	NV	-	NV	-	NV	0.0016		0.011		0.0068	
gamma-Hexachlorocyclohexane (Lindane)	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	100		-	NV	-	NV	-	NV	0.0091		0.064		0.040	
Hexachloroethane	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	700		6,300		19,000		130,000		31		94		130	
Indeno[1,2,3-cd]pyrene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Lead	NA, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Manganese	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	3,200,000		-	NV	-	NV	-	NV	0.052		0.16		0.22	
MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,700		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
Mercury	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.31		0.94		1.3	
MTBE (methyl t-butyl ether)	c, v		2,500,000		1,500,000		67,000		470,000		870,000		63,000		2,200		15,000		47,000		11		77		47	
Naphthalene	c, v		25,000		16,000		840		5,900		11,000		500		17		120		360		0.083		0.59		0.36	
Nickel	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.3E+07		-	NV	-	NV	-	NV	0.094		0.28		0.39	
Pentachlorophenol	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	53		-	NV	-	NV	-	NV	0.55		3.9		2.4	

RISK-BASED CONCENTRATIONS

Contaminated Medium →			SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)						
Exposure Pathway →			Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}						
Receptor Scenario →			Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residenti
Direct or Indirect Pathway (see notes)			DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW		IVW
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note	
11097-69-1	Polychlorinated biphenyls (Total PCBs)	nc, v	0.33		2.6	>Csat	0.59	>Csat	4.9	>Csat	140	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	0.63		-	>Csat	-	>Csat	0.016		0.57		0.13		-
98-82-8	iso-Propylbenzene (cumene)	nc, v	3,500	>Csat	110,000	>Csat	57,000	>Csat	27,000	>Csat	750,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	96		-	>Csat	-	>Csat	440		29,000		2,000		-
129-00-0	Pyrene	nc, v	1,800	>Csat	35,000	>Csat	23,000	>Csat	7,500	>Csat	210,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	110		-	>S	-	>S	-
7440-22-4	Silver	nc, nv	390		7,600		5,800		1,800		49,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		100		3,600		820		-
100-42-5	Styrene	nc, v	7,900	>Csat	230,000	>Csat	130,000	>Csat	56,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	170		-	>Csat	800		1,200		75,000		5,700		-
1746-01-6	2,3,7,8-TCDD (dioxin) equivalents	c, v	4.7E-06		0.00012		0.000016		0.00017		0.0048		0.010		0.073		0.13		0.010		0.073		0.13		6.8E-06		0.00063		0.000031		9.1E-08		8.4E-06		4.2E-07		0.022
127-18-4	Tetrachloroethene (PCE)	nc, v	270	>Csat	7,300	>Csat	4,300	>Csat	1,800	>Csat	50,000	>Csat	-	>Csat	-	>Csat	-	>Csat	11		32		140		1.6		93		7.7		40		2,400		200		-
108-88-3	Toluene	nc, v	5,800	>Csat	120,000	>Csat	88,000	>Csat	28,000	>Csat	770,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	83		-	>Csat	490		1,100		46,000		6,300		-
8001-35-2	Toxaphene	c, nv	0.49		12		2.1		17		470		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.36		12		0.93		0.015		0.52		0.040		-
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	400,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	55,000		-	>S	-	>S	-
71-55-6	1,1,1-Trichloroethane	nc, v	53,000	>Csat	-	>Max	870,000	>Csat	470,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	190		-	>Csat	880		8,000		600,000		37,000		-
79-00-5	1,1,2-Trichloroethane	nc, v	3.2		180		55		54		1,500	>Csat	6.7		20		28		0.38		1.1		4.8		0.0094		1.00		0.040		0.41		44		1.7		5,600
79-01-6	Trichloroethene	NA, v	6.7		17		51		470	>Csat	13,000	>Csat	15		33		96		0.12		0.26		2.3		0.013		0.053		0.087		0.49		2.0		3.3		3,300
75-69-4	Trichlorofluoromethane (Freon 11)	nc, v	7,600	>Csat	270,000	>Csat	130,000	>Csat	69,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	190		560		-	>Csat	61		-	>Csat	280		1,100		86,000		5,200		780,000
88-06-2	2,4,6-Trichlorophenol	nc, nv	63		1,200		820		270		7,400	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	6.3		270		35		12		500		65		-
95-63-6	1,2,4-Trimethylbenzene	nc, v	110		6,500	>Csat	2,000	>Csat	2,000	>Csat	54,000	>Csat	230		700		980		16		49		210		2.8		300		12		15		1,600		61		-
108-67-8	1,3,5-Trimethylbenzene	nc, v	780	>Csat	15,000	>Csat	12,000	>Csat	3,500	>Csat	98,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	21		-	>Csat	110		110		4,900		600		-
75-01-4	Vinyl chloride	c, v	0.36		7.9		4.4		34		950	>Csat	5.3		20		89		0.043		0.16		2.2		0.00057		0.014		0.010		0.027		0.68		0.49		350
1330-20-7	Xylenes	nc, v	1,400	>Csat	71,000	>Csat	25,000	>Csat	20,000	>Csat	560,000	>Csat	-	>Csat	-	>Csat	-	>Csat	160		-	>Csat	-	>Csat	23		-	>Csat	100		190		18,000		830		-

For a complete explanation of notes, please see "Notes to Accompany Risk-Based Concentrations for Individual Chemicals."

Ψ WARNI

Ψ WARNING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.

RISK-BASED CONCENTRATIONS

Medium →		GROUNDWATER µg/L (ppb)					GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
hway →		Volatilization to Outdoor Air RBC_{wo}					Vapor Intrusion into Buildings RBC_{wi}						GW in Excavation RBC_{we}		Vapor Intrusion into Buildings RBC_{sv}						Inhalation RBC_{air}					
nario →		al	Urban Residential		Occupational		Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			IVW		IVW		IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
Chemical	Note	Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
Polychlorinated biphenyls (Total PCBs)	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
iso-Propylbenzene (cumene)	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	51,000		83,000		250,000		1,800,000		420		1,300		1,800	
Pyrene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Silver	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,100,000		-	NV	-	NV	-	NV	1.0E+15		3.1E+15		4.4E+15	
Styrene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	170,000		210,000		630,000		4,400,000		1,000		3,100		4,400	
2,3,7,8-TCDD (dioxin) equivalents	c, v		0.15		0.11		0.0083		0.059		0.11		0.00045		0.000015		0.00010		0.00032		5.7E-08		4.0E-07		2.5E-07	
Tetrachloroethene (PCE)	nc, v	>S	-	>S	-	>S	14,000		43,000		180,000		5,600		8,300		25,000		180,000		42		130		180	
Toluene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	220,000		1,000,000		3,100,000		2.2E+07		5,200		16,000		22,000	
Toxaphene	c, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	18		-	NV	-	NV	-	NV	0.0088		0.062		0.038	
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	6,300,000		1.9E+07		1.3E+08		31,000		94,000		130,000	
1,1,1-Trichloroethane	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1,100,000		1,000,000		3,100,000		2.2E+07		5,200		16,000		22,000	
1,1,2-Trichloroethane	nc, v		17,000		24,000		1,000		3,100		13,000		49		42		130		880		0.21		0.63		0.88	
Trichloroethene	NA, v		6,900		20,000		200		430		3,700		3,000		95		200		2,900		0.47		1.0		2.9	
Trichlorofluoromethane (Freon 11)	nc, v		-	>S	-	>S	36,000		110,000		460,000		160,000		150,000		440,000		3,100,000		730		2,200		3,100	
2,4,6-Trichlorophenol	nc, nv	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,700		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
1,2,4-Trimethylbenzene	nc, v	>S	-	>S	-	>S	5,800		17,000		-	>S	1,700		1,500		4,400		31,000		7.3		22		31	
1,3,5-Trimethylbenzene	nc, v	>S	-	>S	-	>S	-	>S	-	>S	-	>S	15,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
Vinyl chloride	c, v		1,300		5,900		17		64		880		960		33		120		2,800		0.17		0.61		2.8	
Xylenes	nc, v	>S	-	>S	-	>S	86,000		-	>S	-	>S	23,000		21,000		63,000		440,000		100		310		440	

ING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.

Exposure Factors: Reasonable Maximum Exposure

Parameter (unit)	Symbol	Residential	Note	Urban Residential	Note	Occupational	Note	Construction Worker	Note	Excavation Worker	Note
ACCEPTABLE RISK LEVELS											
Acceptable Risk Level - Carcinogens	ARLc	1.00E-06	1	=		=		=		=	
Acceptable Risk Level - Noncarcinogens	ARLn	1	1	=		=		=		=	
EXPOSURE PARAMETERS											
Averaging Time - Carcinogen (yr)	ATc	70	3	=		=		=		=	
Averaging Time - Noncarcinogen (yr)	ATn	26	3	11	2	25	3	1	3	1	3
Averaging Time - Noncarcinogen, Child (yr)	ATnc	6	3	6	3	NA		NA		NA	
Body Weight - Adult (kg)	BWa	80	3	=		=		=		=	
Body Weight - Child (kg)	BWc	15	3	=		NA		NA		NA	
Exposure Duration - Adult (yr)	ED	26	3	11	4	25	3	1	21	1	6
Exposure Duration - Child (yr)	EDc	6	3	6	4	NA		NA		NA	
Exposure Frequency (day/yr)	EF	350	3	18	3c	250	6	250	6	9	6
Exposure Time (hr/day)	ET	24		8		8		8		8	
Event Frequency - Groundwater (events/day)	EvF	1	24	1	24	2	24	2	6	=	
Event Time - Groundwater (hr/event) (age adjusted)	t_{event}	0.67	25	0.62	25	2	24	2	6	=	
Soil Ingestion Rate - Adult (mg/day)	IRS	100	6	100	6	100	6	330	21	330	21
Soil Ingestion Rate - Child (mg/day)	IRSc	200	4	200	4	NA		NA		NA	
Water Ingestion Rate - Adult (L/day)	IRW	2.5	3a	2.5	3a	0.7	4a	NA		NA	
Water Ingestion Rate - Child (L/day)	IRWc	0.78	3b	=		NA		NA		NA	
Skin Surface Area - Adult to Soil (cm^2)	SA	6032	4	6032	4	3527	4	3527	4	3527	4
Skin Surface Area - Child to Soil (cm^2)	SAc	2373	3	=		NA		NA		NA	
Skin Surface Area - Adult to Groundwater (cm^2)	SAw	20900	3	20900	3	3527	3	6032	4	6032	4
Skin Surface Area - Child to Groundwater (cm^2)	SAwc	6378	3	6378	3	NA		NA		NA	
Soil to Skin Adherence Factor - Adult (mg/cm^2-day)	AF	0.07	5a	0.07	5a	0.12	5b	0.30	5c	0.30	5c
Soil to Skin Adherence Factor - Child (mg/cm^2-day)	AFc	0.20	5d	=		NA		NA		NA	
AGE-ADJUSTED EXPOSURE FACTORS											
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	105	7	86	7a	NA		NA		NA	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0.94	7	0.47	7a	NA		NA		NA	
Surface Area Tapwater-age adjusted (cm2-yr/kg)	SAwadj	6174	7	3857	7	NA		NA		NA	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	295	7	216	7a	NA		NA		NA	

SITE PARAMETERS											
Soil Bulk Density (g/cm^3)	ρ_b	1.70	8	=		=		=		=	
Soil Particle Density (g/cm^3)	ρ_s	2.74	9	=		=		=		=	
Soil Porosity	n	0.38	8	=		=		=		=	
Air Content - Vadose Zone Soils	n_a	0.26	10	=		=		=		=	
Air Content - Cap. Fringe Soils	n_{acap}	0.038	10	=		=		=		=	
Air Content - Foundation Cracks	n_{acrk}	0.26	10	=		=		=		=	
Water Content - Vadose Zone Soils	n_w	0.12	8	=		=		=		=	
Water Content - Cap. Fringe Soils	n_{wcap}	0.342	8	=		=		=		=	
Water Content - Foundation Cracks	n_{wcrk}	0.12	11	=		=		=		=	
Vadose Zone Thickness (cm)	L_v	295	12	=		=		=		=	
Capillary Fringe Thickness (cm)	L_{cap}	5.00	8	=		=		=		=	
Fraction Organic Carbon (shallow soil)	f_{oc}	0.005	8a	=		=		=		=	
Depth to Groundwater (cm)	L_w	300	8	=		=		=		=	
Groundwater Dilution-Attenuation Factor	DAF	60	19	=		=		=		=	
SOIL CONTAMINATION PARAMETERS											
Thickness of Contaminated Surface Soils (cm)	L_{ss}	100	8	=		=		=		=	
Fraction of Site with Surface Soil Contamination	f_{ss}	0.50	16	=		=		=		=	
Thickness of Clean Surface Soils (cm)	L_c	100	8	=		=		=		=	
Thickness of Subsurface Contamination (cm)	L_s	200	8	=		=		=		=	
Soil Gas Attenuation Factor for Chlorinated Hydrocarbons	AF_{ch}	200	23	200	23	1000	23	NA		NA	
Soil Gas Attenuation Factor for Petroleum Hydrocarbons	AF_{ph}	200	23	200	23	1000	23	NA		NA	
Fraction of Site with Subsurface Vol. To Outdoor Air	f_{so}	0.50	17	=		=		=		=	
Thickness of Clean Soils Under Building (cm)	L_{cb}	100	8	=		=		=		=	
Thickness of Contaminated Soils Under Building (cm)	L_{sb}	200	8	=		=		=		=	
Fraction of Contaminated Soils Under Building	f_{sb}	0.50	18	=		=		=		=	
Particulate Emission Factor for Soils (kg/m^3)	PEF	7.58E-10	13	=		=		=		=	
BUILDING PARAMETERS											
Building Air Exchange Rate (1/day)	ER	24	14	=		48	14	NA		NA	
Building Height (indoor air mixing zone) (cm)	L_B	200	8	=		300	8	NA		NA	
Foundation Wall Thickness (cm)	L_{crk}	15	8	=		=		NA		NA	
Foundation Crack Fraction	f_{crk}	0.0010	15	=		=		NA		NA	
VOLATILIZATION FACTORS											
Averaging time for Volatilization -Adults (yr)	t_{vol}	25	16	=		=		=		=	
Averaging time for Volatilization -Children (yr)	t_{volc}	6	16	=		NA		NA		NA	
Max. Soil to Building Vol. Factor (kg/m^3)	$VF_{si}max$	3.88E-03	18	3.88E-03	18	1.29E-03	18	NA		NA	
Max. Surface Soil Vol. Factor - Adult (kg/m^3)	$VF_{ss}max$	1.57E-05	16	1.57E-05	16	1.57E-05	16	1.57E-05	16	1.57E-05	16
Max. Surface Soil Vol. Factor - Child (kg/m^3)	$VF_{ss}max$	6.53E-05	16	=		NA		NA		NA	
Max. Soil to Outdoor Air Vol. Factor - Adult (kg/m^3)	$VF_{so}max$	3.13E-05	17	3.13E-05	17	3.13E-05	17	NA		NA	
Volatile Organics Dispersion Term (g/m^2-s per kg/m^3)	Q/C	6.88E+01	13	=		=		=		=	
MISCELLANEOUS PARAMETERS											
Ideal Gas Law Constant (m^3-atm/K-mol)	R	8.21E-05	20	=		=		=		=	
Absolute Temperature (K)	T	2.93E+02	20	=		=		=		=	

Additional Information for Early Life-Stage Factor Calculations

Early Life-Stage Factors - Residential	Symbol	0 - 2 Years		3 - 6 Years		7 - 16 Years		17 - 26 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	2		4		10		10		26	
Body Weight (kg)	BW	15		15		80		80		NA	
Soil Ingestion Rate (mg/day)	IRs	200		200		100		100		NA	
Air Inhalation Rate (m^3/day)	IRa	10		10		20		20		NA	
Water Ingestion Rate (L/day) -adults	IRw	0.78		0.78		2.5		2.5		NA	
Age-dependent Adjustment Factor	ADAF	10		3		3		1		NA	
Soil to Skin Adherence Factor (mg/cm^2)	AF	0.2		0.2		0.07		0.07		NA	
Skin Surface Area - Adult to Soil (cm^2)	SA	2690		2690		6032		6032		NA	
Skin Surface Area - to tapwater (cm2)	SAtw	6378		6378		20900		20900		NA	
Adjusted Exposure Duration (yr)	EDadj	20		12		30		10		72	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	267		160		38		13		477	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	1		1		1		0		3	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	717		430		158		53		1359	
Surface Area Tapwater-age adjusted (cm2-yr/kg)	Sawr_adj	8504		5102		7838		2613		24056	

Early Life-Stage Factors - Urban Residential	Symbol	0 - 2 Years		3 - 6 Years		7 - 16 Years		17 - 26 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	2		4		0		5		11	
Adjusted Exposure Duration (yr)	EDadj	20		12		0		5		37	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	267		160		0		6		433	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	1.04		0.624		0		0.16		2	
Surface Area Tapwater-age adjusted (cm2-yr/kg)	Sawu_adj	8504		5102		0		1306		14913	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	717		430		0		26		1174	

Early Life-Stage Factors - Vinyl Chloride Residential	Symbol	0 - 6 Years		0 - 6 Years		7 - 30 Years		7 - 70 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	6		6		24		64		100	
Adjusted Exposure Duration (yr)	EDadj	6		6		24		64		100	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	80		80		30		80		270	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0.3		0.3		0.8		2.0		3.4	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	190		190		127		338		844	

Early Life-Stage Factors - Vinyl Chloride Urban Residential	Symbol	0 - 6 Years		0 - 6 Years		7 - 11 Years		7 - 70 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	6		6		5		64		81	
Adjusted Exposure Duration (yr)	EDadj	6		6		5		64		81	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	80		80		6.3		80		246	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0.3		0.3		0.2		2.0		2.8	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	190		190		26		338		744	

For explanation of notes, please see "Notes to Accompany Risk-Based Concentrations for Individual Chemicals."

APPENDIX G

ProUCL Output

APPENDIX G-1

Upland EU (0-5 feet)

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	1/30/2016 4:36:35 PM
From File	Upland_EU_surfacedata_0-5.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	62	Number of Distinct Observations	56
Number of Detects	56	Number of Non-Detects	6
Number of Distinct Detects	51	Number of Distinct Non-Detects	6
Minimum Detect	1.3	Minimum Non-Detect	0.6
Maximum Detect	24	Maximum Non-Detect	42
Variance Detects	8.944	Percent Non-Detects	9.677%
Mean Detects	4.327	SD Detects	2.991
Median Detects	4.02	CV Detects	0.691
Skewness Detects	5.292	Kurtosis Detects	34.94
Mean of Logged Detects	1.345	SD of Logged Detects	0.462

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.542	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.232	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.118	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	4.112	Standard Error of Mean	0.383
SD	2.956	95% KM (BCA) UCL	4.75
95% KM (t) UCL	4.752	95% KM (Percentile Bootstrap) UCL	4.752
95% KM (z) UCL	4.743	95% KM Bootstrap t UCL	5.178
90% KM Chebyshev UCL	5.262	95% KM Chebyshev UCL	5.782
97.5% KM Chebyshev UCL	6.505	99% KM Chebyshev UCL	7.924

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.009	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.147	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.119	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.32	k star (bias corrected MLE)	4.1
Theta hat (MLE)	1.002	Theta star (bias corrected MLE)	1.055
nu hat (MLE)	483.8	nu star (bias corrected)	459.2
MLE Mean (bias corrected)	4.327	MLE Sd (bias corrected)	2.137

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.935	nu hat (KM)	239.9
Approximate Chi Square Value (239.94, α)	205.1	Adjusted Chi Square Value (239.94, β)	204.3
95% Gamma Approximate KM-UCL (use when n>=50)	4.811	95% Gamma Adjusted KM-UCL (use when n<50)	4.829

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.281	Mean	4.085
Maximum	24	Median	3.895
SD	2.97	CV	0.727
k hat (MLE)	2.954	k star (bias corrected MLE)	2.822
Theta hat (MLE)	1.383	Theta star (bias corrected MLE)	1.447
nu hat (MLE)	366.3	nu star (bias corrected)	350
MLE Mean (bias corrected)	4.085	MLE Sd (bias corrected)	2.431
		Adjusted Level of Significance (β)	0.0461
Approximate Chi Square Value (349.95, α)	307.6	Adjusted Chi Square Value (349.95, β)	306.7
95% Gamma Approximate UCL (use when n>=50)	4.647	95% Gamma Adjusted UCL (use when n<50)	4.661

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.171	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.118	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.134	Mean in Log Scale	1.288
SD in Original Scale	2.917	SD in Log Scale	0.489
95% t UCL (assumes normality of ROS data)	4.753	95% Percentile Bootstrap UCL	4.789
95% BCA Bootstrap UCL	5.073	95% Bootstrap t UCL	5.194
95% H-UCL (Log ROS)	4.59		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.434	Mean in Log Scale	1.272
SD in Original Scale	3.692	SD in Log Scale	0.694
95% t UCL (Assumes normality)	5.217	95% H-Stat UCL	5.422

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	5.782

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Copper

General Statistics

Total Number of Observations	62	Number of Distinct Observations	50
		Number of Missing Observations	0
Minimum	12.7	Mean	923.7
Maximum	56000	Median	19.7
SD	7109	Std. Error of Mean	902.9
Coefficient of Variation	7.697	Skewness	7.874

Normal GOF Test

Shapiro Wilk Test Statistic	0.129	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.533	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2432	95% Adjusted-CLT UCL (Chen-1995)	3374
		95% Modified-t UCL (Johnson-1978)	2582

Gamma GOF Test

A-D Test Statistic	24.33	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.915	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.541	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.126	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.199	k star (bias corrected MLE)	0.2
Theta hat (MLE)	4640	Theta star (bias corrected MLE)	4614
nu hat (MLE)	24.69	nu star (bias corrected)	24.82
MLE Mean (bias corrected)	923.7	MLE Sd (bias corrected)	2064
		Approximate Chi Square Value (0.05)	14.48
Adjusted Level of Significance	0.0461	Adjusted Chi Square Value	14.29

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1584	95% Adjusted Gamma UCL (use when n<50)	1605

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.307	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.352	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.542	Mean of logged Data	3.129
Maximum of Logged Data	10.93	SD of logged Data	1.037

Assuming Lognormal Distribution

95% H-UCL	52.9	90% Chebyshev (MVUE) UCL	56.91
95% Chebyshev (MVUE) UCL	65.18	97.5% Chebyshev (MVUE) UCL	76.67
99% Chebyshev (MVUE) UCL	99.24		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	2409	95% Jackknife UCL	2432
95% Standard Bootstrap UCL	2332	95% Bootstrap-t UCL	1354600
95% Hall's Bootstrap UCL	613687	95% Percentile Bootstrap UCL	2729
95% BCA Bootstrap UCL	3633		
90% Chebyshev(Mean, Sd) UCL	3632	95% Chebyshev(Mean, Sd) UCL	4859
97.5% Chebyshev(Mean, Sd) UCL	6562	99% Chebyshev(Mean, Sd) UCL	9907

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	4859

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	62	Number of Distinct Observations	60
		Number of Missing Observations	0
Minimum	2.7	Mean	55.2
Maximum	1420	Median	8.625
SD	203.1	Std. Error of Mean	25.79
Coefficient of Variation	3.679	Skewness	5.85

Normal GOF Test

Shapiro Wilk Test Statistic	0.276	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.408	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	98.27	95% Adjusted-CLT UCL (Chen-1995)	118.1
		95% Modified-t UCL (Johnson-1978)	101.5

Gamma GOF Test

A-D Test Statistic	11.44	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.831	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.384	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.121	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.436	k star (bias corrected MLE)	0.425
Theta hat (MLE)	126.7	Theta star (bias corrected MLE)	129.7
nu hat (MLE)	54.04	nu star (bias corrected)	52.75
MLE Mean (bias corrected)	55.2	MLE Sd (bias corrected)	84.63
		Approximate Chi Square Value (0.05)	37.07
Adjusted Level of Significance	0.0461	Adjusted Chi Square Value	36.76

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	78.56	95% Adjusted Gamma UCL (use when n<50)	79.22

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.758	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	1.873E-13	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.245	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.993	Mean of logged Data	2.521
Maximum of Logged Data	7.258	SD of logged Data	1.224

Assuming Lognormal Distribution

95% H-UCL	37.56	90% Chebyshev (MVUE) UCL	40.94
95% Chebyshev (MVUE) UCL	47.8	97.5% Chebyshev (MVUE) UCL	57.32
99% Chebyshev (MVUE) UCL	76.01		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	97.62	95% Jackknife UCL	98.27
95% Standard Bootstrap UCL	96.81	95% Bootstrap-t UCL	269.1
95% Hall's Bootstrap UCL	263.8	95% Percentile Bootstrap UCL	103
95% BCA Bootstrap UCL	123.5		
90% Chebyshev(Mean, Sd) UCL	132.6	95% Chebyshev(Mean, Sd) UCL	167.6
97.5% Chebyshev(Mean, Sd) UCL	216.3	99% Chebyshev(Mean, Sd) UCL	311.8

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	167.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Hexavalent Chromium

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	50
Number of Detects	7	Number of Non-Detects	1
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.212	Minimum Non-Detect	0.23
Maximum Detect	6.43	Maximum Non-Detect	0.23
Variance Detects	5.172	Percent Non-Detects	12.5%
Mean Detects	1.583	SD Detects	2.274
Median Detects	0.342	CV Detects	1.436
Skewness Detects	2.079	Kurtosis Detects	4.447
Mean of Logged Detects	-0.359	SD of Logged Detects	1.356

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.697	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.412	Standard Error of Mean	0.772
SD	2.021	95% KM (BCA) UCL	2.704
95% KM (t) UCL	2.874	95% KM (Percentile Bootstrap) UCL	2.697
95% KM (z) UCL	2.681	95% KM Bootstrap t UCL	6.911
90% KM Chebyshev UCL	3.727	95% KM Chebyshev UCL	4.776
97.5% KM Chebyshev UCL	6.232	99% KM Chebyshev UCL	9.091

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.619	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.737	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.307	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.323	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.734	k star (bias corrected MLE)	0.515
Theta hat (MLE)	2.158	Theta star (bias corrected MLE)	3.077
nu hat (MLE)	10.27	nu star (bias corrected)	7.204
MLE Mean (bias corrected)	1.583	MLE Sd (bias corrected)	2.207

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.488	nu hat (KM)	7.809
Approximate Chi Square Value (7.81, α)	2.625	Adjusted Chi Square Value (7.81, β)	1.929
95% Gamma Approximate KM-UCL (use when n>=50)	4.2	95% Gamma Adjusted KM-UCL (use when n<50)	5.717

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.387
Maximum	6.43	Median	0.304
SD	2.178	CV	1.571
k hat (MLE)	0.519	k star (bias corrected MLE)	0.408
Theta hat (MLE)	2.671	Theta star (bias corrected MLE)	3.4
nu hat (MLE)	8.307	nu star (bias corrected)	6.525
MLE Mean (bias corrected)	1.387	MLE Sd (bias corrected)	2.171
		Adjusted Level of Significance (β)	0.0195
Approximate Chi Square Value (6.52, α)	1.914	Adjusted Chi Square Value (6.52, β)	1.348
95% Gamma Approximate UCL (use when n>=50)	4.728	95% Gamma Adjusted UCL (use when n<50)	6.709

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.272	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.405	Mean in Log Scale	-0.545
SD in Original Scale	2.165	SD in Log Scale	1.361
95% t UCL (assumes normality of ROS data)	2.855	95% Percentile Bootstrap UCL	2.793
95% BCA Bootstrap UCL	3.488	95% Bootstrap t UCL	6.932
95% H-UCL (Log ROS)	13.79		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.507	95% H-UCL (KM -Log)	8.567
KM SD (logged)	1.238	95% Critical H Value (KM-Log)	4.036
KM Standard Error of Mean (logged)	0.473		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.4	Mean in Log Scale	-0.584
SD in Original Scale	2.169	SD in Log Scale	1.408
95% t UCL (Assumes normality)	2.852	95% H-Stat UCL	16.37

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.874	95% KM (Percentile Bootstrap) UCL	2.697

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	1/30/2016 4:40:26 PM
From File	Upland_EU_surfacedata_0-5.xls
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	62	Number of Distinct Observations	56
Number of Detects	56	Number of Non-Detects	6
Number of Distinct Detects	51	Number of Distinct Non-Detects	6
Minimum Detect	1.3	Minimum Non-Detect	0.6
Maximum Detect	24	Maximum Non-Detect	42
Variance Detects	8.944	Percent Non-Detects	9.677%
Mean Detects	4.327	SD Detects	2.991
Median Detects	4.02	CV Detects	0.691
Skewness Detects	5.292	Kurtosis Detects	34.94
Mean of Logged Detects	1.345	SD of Logged Detects	0.462

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.542	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.232	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.118	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	4.112	Standard Error of Mean	0.383
SD	2.956	90% KM (BCA) UCL	4.668
90% KM (t) UCL	4.609	90% KM (Percentile Bootstrap) UCL	4.613
90% KM (z) UCL	4.603	90% KM Bootstrap t UCL	4.989
90% KM Chebyshev UCL	5.262	95% KM Chebyshev UCL	5.782
97.5% KM Chebyshev UCL	6.505	99% KM Chebyshev UCL	7.924

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.009	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.147	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.119	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.32	k star (bias corrected MLE)	4.1
Theta hat (MLE)	1.002	Theta star (bias corrected MLE)	1.055
nu hat (MLE)	483.8	nu star (bias corrected)	459.2
MLE Mean (bias corrected)	4.327	MLE Sd (bias corrected)	2.137

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.935	nu hat (KM)	239.9
Approximate Chi Square Value (239.94, α)	212.3	Adjusted Chi Square Value (239.94, β)	211.8
90% Gamma Approximate KM-UCL (use when n>=50)	4.647	90% Gamma Adjusted KM-UCL (use when n<50)	4.658

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.281	Mean	4.085
Maximum	24	Median	3.895
SD	2.97	CV	0.727
k hat (MLE)	2.954	k star (bias corrected MLE)	2.822
Theta hat (MLE)	1.383	Theta star (bias corrected MLE)	1.447
nu hat (MLE)	366.3	nu star (bias corrected)	350
MLE Mean (bias corrected)	4.085	MLE Sd (bias corrected)	2.431
		Adjusted Level of Significance (β)	0.0957
Approximate Chi Square Value (349.95, α)	316.5	Adjusted Chi Square Value (349.95, β)	315.9
90% Gamma Approximate UCL (use when n>=50)	4.516	90% Gamma Adjusted UCL (use when n<50)	4.525

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.171	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.118	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.134	Mean in Log Scale	1.288
SD in Original Scale	2.917	SD in Log Scale	0.489
90% t UCL (assumes normality of ROS data)	4.614	90% Percentile Bootstrap UCL	4.663
90% BCA Bootstrap UCL	4.846	90% Bootstrap t UCL	5.052
90% H-UCL (Log ROS)	4.468		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.434	Mean in Log Scale	1.272
SD in Original Scale	3.692	SD in Log Scale	0.694
90% t UCL (Assumes normality)	5.041	90% H-Stat UCL	5.199

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Copper

General Statistics

Total Number of Observations	62	Number of Distinct Observations	50
		Number of Missing Observations	0
Minimum	12.7	Mean	923.7
Maximum	56000	Median	19.7
SD	7109	Std. Error of Mean	902.9
Coefficient of Variation	7.697	Skewness	7.874

Normal GOF Test

Shapiro Wilk Test Statistic	0.129	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.533	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

90% Normal UCL		90% UCLs (Adjusted for Skewness)	
90% Student's-t UCL	2093	90% Adjusted-CLT UCL (Chen-1995)	2726
		90% Modified-t UCL (Johnson-1978)	2244

Gamma GOF Test

A-D Test Statistic	24.33	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.915	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.541	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.126	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.199	k star (bias corrected MLE)	0.2
Theta hat (MLE)	4640	Theta star (bias corrected MLE)	4614
nu hat (MLE)	24.69	nu star (bias corrected)	24.82
MLE Mean (bias corrected)	923.7	MLE Sd (bias corrected)	2064
		Approximate Chi Square Value (0.1)	16.33
Adjusted Level of Significance	0.0957	Adjusted Chi Square Value	16.2

Assuming Gamma Distribution

90% Approximate Gamma UCL (use when n>=50))	1404	90% Adjusted Gamma UCL (use when n<50)	1415

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.307	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.352	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.542	Mean of logged Data	3.129
Maximum of Logged Data	10.93	SD of logged Data	1.037

Assuming Lognormal Distribution

90% H-UCL	119.2	90% Chebyshev (MVUE) UCL	56.91
95% Chebyshev (MVUE) UCL	65.18	97.5% Chebyshev (MVUE) UCL	76.67
99% Chebyshev (MVUE) UCL	99.24		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

90% CLT UCL	2081	90% Jackknife UCL	2093
90% Standard Bootstrap UCL	2065	90% Bootstrap-t UCL	1193500
90% Hall's Bootstrap UCL	531786	90% Percentile Bootstrap UCL	1828
90% BCA Bootstrap UCL	2730		
90% Chebyshev(Mean, Sd) UCL	3632	95% Chebyshev(Mean, Sd) UCL	4859
97.5% Chebyshev(Mean, Sd) UCL	6562	99% Chebyshev(Mean, Sd) UCL	9907

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coeficient

Lead

General Statistics

Total Number of Observations	62	Number of Distinct Observations	60
		Number of Missing Observations	0
Minimum	2.7	Mean	55.2
Maximum	1420	Median	8.625
SD	203.1	Std. Error of Mean	25.79
Coefficient of Variation	3.679	Skewness	5.85

Normal GOF Test

Shapiro Wilk Test Statistic	0.276	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.408	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

90% Normal UCL		**90% UCLs (Adjusted for Skewness)**	
90% Student's-t UCL	88.61	90% Adjusted-CLT UCL (Chen-1995)	101.9
		90% Modified-t UCL (Johnson-1978)	91.81

Gamma GOF Test

A-D Test Statistic	11.44	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.831	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.384	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.121	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.436	k star (bias corrected MLE)	0.425
Theta hat (MLE)	126.7	Theta star (bias corrected MLE)	129.7
nu hat (MLE)	54.04	nu star (bias corrected)	52.75
MLE Mean (bias corrected)	55.2	MLE Sd (bias corrected)	84.63
		Approximate Chi Square Value (0.1)	40.09
Adjusted Level of Significance	0.0957	Adjusted Chi Square Value	39.88

Assuming Gamma Distribution

90% Approximate Gamma UCL (use when n>=50))	72.63	90% Adjusted Gamma UCL (use when n<50)	73.02

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.758	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	1.873E-13	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.245	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.993	Mean of logged Data	2.521
Maximum of Logged Data	7.258	SD of logged Data	1.224

Assuming Lognormal Distribution

90% H-UCL	46.4	90% Chebyshev (MVUE) UCL	40.94
95% Chebyshev (MVUE) UCL	47.8	97.5% Chebyshev (MVUE) UCL	57.32
99% Chebyshev (MVUE) UCL	76.01		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

90% CLT UCL	88.25	90% Jackknife UCL	88.61
90% Standard Bootstrap UCL	87.7	90% Bootstrap-t UCL	195.9
90% Hall's Bootstrap UCL	255.4	90% Percentile Bootstrap UCL	93.04
90% BCA Bootstrap UCL	107.1		
90% Chebyshev(Mean, Sd) UCL	132.6	95% Chebyshev(Mean, Sd) UCL	167.6
97.5% Chebyshev(Mean, Sd) UCL	216.3	99% Chebyshev(Mean, Sd) UCL	311.8

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coeficient

Hexavalent Chromium

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	50
Number of Detects	7	Number of Non-Detects	1
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.212	Minimum Non-Detect	0.23
Maximum Detect	6.43	Maximum Non-Detect	0.23
Variance Detects	5.172	Percent Non-Detects	12.5%
Mean Detects	1.583	SD Detects	2.274
Median Detects	0.342	CV Detects	1.436
Skewness Detects	2.079	Kurtosis Detects	4.447
Mean of Logged Detects	-0.359	SD of Logged Detects	1.356

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.697	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.412	Standard Error of Mean	0.772
SD	2.021	90% KM (BCA) UCL	2.317
90% KM (t) UCL	2.504	90% KM (Percentile Bootstrap) UCL	2.333
90% KM (z) UCL	2.401	90% KM Bootstrap t UCL	4.218
90% KM Chebyshev UCL	3.727	95% KM Chebyshev UCL	4.776
97.5% KM Chebyshev UCL	6.232	99% KM Chebyshev UCL	9.091

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.619	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.737	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.307	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.323	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.734	k star (bias corrected MLE)	0.515
Theta hat (MLE)	2.158	Theta star (bias corrected MLE)	3.077
nu hat (MLE)	10.27	nu star (bias corrected)	7.204
MLE Mean (bias corrected)	1.583	MLE Sd (bias corrected)	2.207

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.488	nu hat (KM)	7.809
Approximate Chi Square Value (7.81, α)	3.363	Adjusted Chi Square Value (7.81, β)	2.807
90% Gamma Approximate KM-UCL (use when n>=50)	3.278	90% Gamma Adjusted KM-UCL (use when n<50)	3.927

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.387
Maximum	6.43	Median	0.304
SD	2.178	CV	1.571
k hat (MLE)	0.519	k star (bias corrected MLE)	0.408
Theta hat (MLE)	2.671	Theta star (bias corrected MLE)	3.4
nu hat (MLE)	8.307	nu star (bias corrected)	6.525
MLE Mean (bias corrected)	1.387	MLE Sd (bias corrected)	2.171
		Adjusted Level of Significance (β)	0.0607
Approximate Chi Square Value (6.52, α)	2.532	Adjusted Chi Square Value (6.52, β)	2.065
90% Gamma Approximate UCL (use when n>=50)	3.573	90% Gamma Adjusted UCL (use when n<50)	4.382

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.272	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.405	Mean in Log Scale	-0.545
SD in Original Scale	2.165	SD in Log Scale	1.361
90% t UCL (assumes normality of ROS data)	2.488	90% Percentile Bootstrap UCL	2.409
90% BCA Bootstrap UCL	2.806	90% Bootstrap t UCL	4.181
90% H-UCL (Log ROS)	6.574		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.507	90% H-UCL (KM -Log)	4.609
KM SD (logged)	1.238	90% Critical H Value (KM-Log)	2.712
KM Standard Error of Mean (logged)	0.473		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.4	Mean in Log Scale	-0.584
SD in Original Scale	2.169	SD in Log Scale	1.408
90% t UCL (Assumes normality)	2.485	90% H-Stat UCL	7.422

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

APPENDIX G-2

Upland EU (0-15 feet)

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	1/30/2016 10:53:25 AM
From File	Upland_EU_alldata.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	77	Number of Distinct Observations	68
Number of Detects	69	Number of Non-Detects	8
Number of Distinct Detects	61	Number of Distinct Non-Detects	8
Minimum Detect	0.89	Minimum Non-Detect	0.6
Maximum Detect	24	Maximum Non-Detect	42
Variance Detects	7.758	Percent Non-Detects	10.39%
Mean Detects	4.103	SD Detects	2.785
Median Detects	3.89	CV Detects	0.679
Skewness Detects	5.45	Kurtosis Detects	38.87
Mean of Logged Detects	1.289	SD of Logged Detects	0.477

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.572	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.207	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.107	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	3.914	Standard Error of Mean	0.318
SD	2.737	95% KM (BCA) UCL	4.544
95% KM (t) UCL	4.444	95% KM (Percentile Bootstrap) UCL	4.462
95% KM (z) UCL	4.437	95% KM Bootstrap t UCL	4.771
90% KM Chebyshev UCL	4.868	95% KM Chebyshev UCL	5.3
97.5% KM Chebyshev UCL	5.9	99% KM Chebyshev UCL	7.078

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.71	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.755	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.12	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.108	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.225	k star (bias corrected MLE)	4.051
Theta hat (MLE)	0.971	Theta star (bias corrected MLE)	1.013
nu hat (MLE)	583.1	nu star (bias corrected)	559.1
MLE Mean (bias corrected)	4.103	MLE Sd (bias corrected)	2.039

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.045	nu hat (KM)	314.9
Approximate Chi Square Value (314.94, α)	274.8	Adjusted Chi Square Value (314.94, β)	274.1
95% Gamma Approximate KM-UCL (use when n>=50)	4.485	95% Gamma Adjusted KM-UCL (use when n<50)	4.497

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.275	Mean	3.887
Maximum	24	Median	3.74
SD	2.743	CV	0.706
k hat (MLE)	3.152	k star (bias corrected MLE)	3.038
Theta hat (MLE)	1.233	Theta star (bias corrected MLE)	1.279
nu hat (MLE)	485.4	nu star (bias corrected)	467.9
MLE Mean (bias corrected)	3.887	MLE Sd (bias corrected)	2.23
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (467.86, α)	418.7	Adjusted Chi Square Value (467.86, β)	417.8
95% Gamma Approximate UCL (use when n>=50)	4.343	95% Gamma Adjusted UCL (use when n<50)	4.352

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.107	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.921	Mean in Log Scale	1.235
SD in Original Scale	2.705	SD in Log Scale	0.497
95% t UCL (assumes normality of ROS data)	4.435	95% Percentile Bootstrap UCL	4.489
95% BCA Bootstrap UCL	4.776	95% Bootstrap t UCL	4.822
95% H-UCL (Log ROS)	4.327		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.211	Mean in Log Scale	1.232
SD in Original Scale	3.412	SD in Log Scale	0.668
95% t UCL (Assumes normality)	4.859	95% H-Stat UCL	4.98

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	4.544

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Copper

General Statistics

Total Number of Observations	77	Number of Distinct Observations	53
		Number of Missing Observations	0
Minimum	12.7	Mean	747.7
Maximum	56000	Median	19.3
SD	6379	Std. Error of Mean	727
Coefficient of Variation	8.532	Skewness	8.775

Normal GOF Test

Shapiro Wilk Test Statistic	0.116	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.53	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.101	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1958	95% Adjusted-CLT UCL (Chen-1995)	2720
		95% Modified-t UCL (Johnson-1978)	2079

Gamma GOF Test

A-D Test Statistic	30.43	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.911	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.538	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.208	k star (bias corrected MLE)	0.209
Theta hat (MLE)	3595	Theta star (bias corrected MLE)	3586
nu hat (MLE)	32.03	nu star (bias corrected)	32.11
MLE Mean (bias corrected)	747.7	MLE Sd (bias corrected)	1637
		Approximate Chi Square Value (0.05)	20.16
Adjusted Level of Significance	0.0469	Adjusted Chi Square Value	19.98

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1191	95% Adjusted Gamma UCL (use when n<50)	1202

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.301	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.34	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.101	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.542	Mean of logged Data	3.1
Maximum of Logged Data	10.93	SD of logged Data	0.936

Assuming Lognormal Distribution

95% H-UCL	43.57	90% Chebyshev (MVUE) UCL	46.92
95% Chebyshev (MVUE) UCL	52.71	97.5% Chebyshev (MVUE) UCL	60.75
99% Chebyshev (MVUE) UCL	76.55		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	1944	95% Jackknife UCL	1958
95% Standard Bootstrap UCL	1941	95% Bootstrap-t UCL	984666
95% Hall's Bootstrap UCL	431829	95% Percentile Bootstrap UCL	2202
95% BCA Bootstrap UCL	3656		
90% Chebyshev(Mean, Sd) UCL	2929	95% Chebyshev(Mean, Sd) UCL	3917
97.5% Chebyshev(Mean, Sd) UCL	5288	99% Chebyshev(Mean, Sd) UCL	7981

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	3917

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	77	Number of Distinct Observations	74
		Number of Missing Observations	0
Minimum	2.7	Mean	46.17
Maximum	1420	Median	8.1
SD	182.9	Std. Error of Mean	20.85
Coefficient of Variation	3.962	Skewness	6.529

Normal GOF Test

Shapiro Wilk Test Statistic	0.251	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.41	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.101	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	80.88	95% Adjusted-CLT UCL (Chen-1995)	97.03
		95% Modified-t UCL (Johnson-1978)	83.47

Gamma GOF Test

A-D Test Statistic	14.36	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.831	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.379	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.108	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.447	k star (bias corrected MLE)	0.439
Theta hat (MLE)	103.2	Theta star (bias corrected MLE)	105.2
nu hat (MLE)	68.9	nu star (bias corrected)	67.55
MLE Mean (bias corrected)	46.17	MLE Sd (bias corrected)	69.71
		Approximate Chi Square Value (0.05)	49.64
Adjusted Level of Significance	0.0469	Adjusted Chi Square Value	49.34

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	62.83	95% Adjusted Gamma UCL (use when n<50)	63.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.756	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.227	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.101	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.993	Mean of logged Data	2.388
Maximum of Logged Data	7.258	SD of logged Data	1.168

Assuming Lognormal Distribution

95% H-UCL	29.82	90% Chebyshev (MVUE) UCL	31.8
95% Chebyshev (MVUE) UCL	36.59	97.5% Chebyshev (MVUE) UCL	43.24
99% Chebyshev (MVUE) UCL	56.31		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	80.46	95% Jackknife UCL	80.88
95% Standard Bootstrap UCL	80.29	95% Bootstrap-t UCL	223.5
95% Hall's Bootstrap UCL	214	95% Percentile Bootstrap UCL	85.06
95% BCA Bootstrap UCL	108.5		
90% Chebyshev(Mean, Sd) UCL	108.7	95% Chebyshev(Mean, Sd) UCL	137
97.5% Chebyshev(Mean, Sd) UCL	176.4	99% Chebyshev(Mean, Sd) UCL	253.6

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 137

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Hexavalent Chromium

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	61
Number of Detects	9	Number of Non-Detects	3
Number of Distinct Detects	9	Number of Distinct Non-Detects	3
Minimum Detect	0.212	Minimum Non-Detect	0.23
Maximum Detect	6.43	Maximum Non-Detect	0.28
Variance Detects	4.217	Percent Non-Detects	25%
Mean Detects	1.29	SD Detects	2.053
Median Detects	0.284	CV Detects	1.591
Skewness Detects	2.414	Kurtosis Detects	6.055
Mean of Logged Detects	-0.574	SD of Logged Detects	1.25

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.614	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.345	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.023	Standard Error of Mean	0.533
SD	1.739	95% KM (BCA) UCL	1.945
95% KM (t) UCL	1.98	95% KM (Percentile Bootstrap) UCL	1.964
95% KM (z) UCL	1.899	95% KM Bootstrap t UCL	4.816
90% KM Chebyshev UCL	2.621	95% KM Chebyshev UCL	3.345
97.5% KM Chebyshev UCL	4.349	99% KM Chebyshev UCL	6.322

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.119	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.753	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.361	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.29	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.725	k star (bias corrected MLE)	0.558
Theta hat (MLE)	1.779	Theta star (bias corrected MLE)	2.314
nu hat (MLE)	13.05	nu star (bias corrected)	10.04
MLE Mean (bias corrected)	1.29	MLE Sd (bias corrected)	1.728

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.346	nu hat (KM)	8.301
Approximate Chi Square Value (8.30, α)	2.911	Adjusted Chi Square Value (8.30, β)	2.446
95% Gamma Approximate KM-UCL (use when n>=50)	2.918	95% Gamma Adjusted KM-UCL (use when n<50)	3.472

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.97
Maximum	6.43	Median	0.257
SD	1.844	CV	1.901
k hat (MLE)	0.421	k star (bias corrected MLE)	0.371
Theta hat (MLE)	2.307	Theta star (bias corrected MLE)	2.615
nu hat (MLE)	10.09	nu star (bias corrected)	8.905
MLE Mean (bias corrected)	0.97	MLE Sd (bias corrected)	1.593
		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (8.90, α)	3.269	Adjusted Chi Square Value (8.90, β)	2.77
95% Gamma Approximate UCL (use when n>=50)	2.643	95% Gamma Adjusted UCL (use when n<50)	3.12

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.787	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.322	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.01	Mean in Log Scale	-0.879
SD in Original Scale	1.823	SD in Log Scale	1.204
95% t UCL (assumes normality of ROS data)	1.955	95% Percentile Bootstrap UCL	1.955
95% BCA Bootstrap UCL	2.451	95% Bootstrap t UCL	4.784
95% H-UCL (Log ROS)	2.837		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1	Mean in Log Scale	-0.945
SD in Original Scale	1.828	SD in Log Scale	1.26
95% t UCL (Assumes normality)	1.948	95% H-Stat UCL	3.138

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	4.349

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	1/30/2016 10:55:41 AM
From File	Upland_EU_alldata.xls
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	77	Number of Distinct Observations	68
Number of Detects	69	Number of Non-Detects	8
Number of Distinct Detects	61	Number of Distinct Non-Detects	8
Minimum Detect	0.89	Minimum Non-Detect	0.6
Maximum Detect	24	Maximum Non-Detect	42
Variance Detects	7.758	Percent Non-Detects	10.39%
Mean Detects	4.103	SD Detects	2.785
Median Detects	3.89	CV Detects	0.679
Skewness Detects	5.45	Kurtosis Detects	38.87
Mean of Logged Detects	1.289	SD of Logged Detects	0.477

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.572	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.207	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.107	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	3.914	Standard Error of Mean	0.318
SD	2.737	90% KM (BCA) UCL	4.268
90% KM (t) UCL	4.325	90% KM (Percentile Bootstrap) UCL	4.342
90% KM (z) UCL	4.322	90% KM Bootstrap t UCL	4.632
90% KM Chebyshev UCL	4.868	95% KM Chebyshev UCL	5.3
97.5% KM Chebyshev UCL	5.9	99% KM Chebyshev UCL	7.078

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.71	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.755	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.12	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.108	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.225	k star (bias corrected MLE)	4.051
Theta hat (MLE)	0.971	Theta star (bias corrected MLE)	1.013
nu hat (MLE)	583.1	nu star (bias corrected)	559.1
MLE Mean (bias corrected)	4.103	MLE Sd (bias corrected)	2.039

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.045	nu hat (KM)	314.9
Approximate Chi Square Value (314.94, α)	283.2	Adjusted Chi Square Value (314.94, β)	282.8
90% Gamma Approximate KM-UCL (use when n>=50)	4.352	90% Gamma Adjusted KM-UCL (use when n<50)	4.359

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.275	Mean	3.887
Maximum	24	Median	3.74
SD	2.743	CV	0.706
k hat (MLE)	3.152	k star (bias corrected MLE)	3.038
Theta hat (MLE)	1.233	Theta star (bias corrected MLE)	1.279
nu hat (MLE)	485.4	nu star (bias corrected)	467.9
MLE Mean (bias corrected)	3.887	MLE Sd (bias corrected)	2.23
		Adjusted Level of Significance (β)	0.0966
Approximate Chi Square Value (467.86, α)	429.1	Adjusted Chi Square Value (467.86, β)	428.5
90% Gamma Approximate UCL (use when n>=50)	4.237	90% Gamma Adjusted UCL (use when n<50)	4.243

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.107	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.921	Mean in Log Scale	1.235
SD in Original Scale	2.705	SD in Log Scale	0.497
90% t UCL (assumes normality of ROS data)	4.32	90% Percentile Bootstrap UCL	4.322
90% BCA Bootstrap UCL	4.471	90% Bootstrap t UCL	4.648
90% H-UCL (Log ROS)	4.221		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.211	Mean in Log Scale	1.232
SD in Original Scale	3.412	SD in Log Scale	0.668
90% t UCL (Assumes normality)	4.714	90% H-Stat UCL	4.809

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Copper

General Statistics

Total Number of Observations	77	Number of Distinct Observations	53
		Number of Missing Observations	0
Minimum	12.7	Mean	747.7
Maximum	56000	Median	19.3
SD	6379	Std. Error of Mean	727
Coefficient of Variation	8.532	Skewness	8.775

Normal GOF Test

Shapiro Wilk Test Statistic	0.116	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.53	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.101	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

90% Normal UCL		90% UCLs (Adjusted for Skewness)	
90% Student's-t UCL	1688	90% Adjusted-CLT UCL (Chen-1995)	2199
		90% Modified-t UCL (Johnson-1978)	1809

Gamma GOF Test

A-D Test Statistic	30.43	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.911	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.538	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.208	k star (bias corrected MLE)	0.209
Theta hat (MLE)	3595	Theta star (bias corrected MLE)	3586
nu hat (MLE)	32.03	nu star (bias corrected)	32.11
MLE Mean (bias corrected)	747.7	MLE Sd (bias corrected)	1637
		Approximate Chi Square Value (0.1)	22.36
Adjusted Level of Significance	0.0966	Adjusted Chi Square Value	22.24

Assuming Gamma Distribution

90% Approximate Gamma UCL (use when n>=50))	1074	90% Adjusted Gamma UCL (use when n<50)	1080

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.301	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.34	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.101	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.542	Mean of logged Data	3.1
Maximum of Logged Data	10.93	SD of logged Data	0.936

Assuming Lognormal Distribution

90% H-UCL	41.17	90% Chebyshev (MVUE) UCL	46.92
95% Chebyshev (MVUE) UCL	52.71	97.5% Chebyshev (MVUE) UCL	60.75
99% Chebyshev (MVUE) UCL	76.55		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

90% CLT UCL	1679	90% Jackknife UCL	1688
90% Standard Bootstrap UCL	1657	90% Bootstrap-t UCL	862515
90% Hall's Bootstrap UCL	383997	90% Percentile Bootstrap UCL	1475
90% BCA Bootstrap UCL	2202		
90% Chebyshev(Mean, Sd) UCL	2929	95% Chebyshev(Mean, Sd) UCL	3917
97.5% Chebyshev(Mean, Sd) UCL	5288	99% Chebyshev(Mean, Sd) UCL	7981

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coeficient

Lead

General Statistics

Total Number of Observations	77	Number of Distinct Observations	74
		Number of Missing Observations	0
Minimum	2.7	Mean	46.17
Maximum	1420	Median	8.1
SD	182.9	Std. Error of Mean	20.85
Coefficient of Variation	3.962	Skewness	6.529

Normal GOF Test

Shapiro Wilk Test Statistic	0.251	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.41	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.101	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

90% Normal UCL		**90% UCLs (Adjusted for Skewness)**	
90% Student's-t UCL	73.12	90% Adjusted-CLT UCL (Chen-1995)	83.96
		90% Modified-t UCL (Johnson-1978)	75.7

Gamma GOF Test

A-D Test Statistic	14.36	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.831	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.379	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.108	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.447	k star (bias corrected MLE)	0.439
Theta hat (MLE)	103.2	Theta star (bias corrected MLE)	105.2
nu hat (MLE)	68.9	nu star (bias corrected)	67.55
MLE Mean (bias corrected)	46.17	MLE Sd (bias corrected)	69.71
		Approximate Chi Square Value (0.1)	53.15
Adjusted Level of Significance	0.0966	Adjusted Chi Square Value	52.95

Assuming Gamma Distribution

90% Approximate Gamma UCL (use when n>=50))	58.68	90% Adjusted Gamma UCL (use when n<50)	58.89

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.756	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.227	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.101	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.993	Mean of logged Data	2.388
Maximum of Logged Data	7.258	SD of logged Data	1.168

Assuming Lognormal Distribution

90% H-UCL	27.57	90% Chebyshev (MVUE) UCL	31.8
95% Chebyshev (MVUE) UCL	36.59	97.5% Chebyshev (MVUE) UCL	43.24
99% Chebyshev (MVUE) UCL	56.31		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

90% CLT UCL	72.89	90% Jackknife UCL	73.12
90% Standard Bootstrap UCL	73.3	90% Bootstrap-t UCL	151.4
90% Hall's Bootstrap UCL	206.6	90% Percentile Bootstrap UCL	73.49
90% BCA Bootstrap UCL	88.54		
90% Chebyshev(Mean, Sd) UCL	108.7	95% Chebyshev(Mean, Sd) UCL	137
97.5% Chebyshev(Mean, Sd) UCL	176.4	99% Chebyshev(Mean, Sd) UCL	253.6

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coeficient

Hexavalent Chromium

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	61
Number of Detects	9	Number of Non-Detects	3
Number of Distinct Detects	9	Number of Distinct Non-Detects	3
Minimum Detect	0.212	Minimum Non-Detect	0.23
Maximum Detect	6.43	Maximum Non-Detect	0.28
Variance Detects	4.217	Percent Non-Detects	25%
Mean Detects	1.29	SD Detects	2.053
Median Detects	0.284	CV Detects	1.591
Skewness Detects	2.414	Kurtosis Detects	6.055
Mean of Logged Detects	-0.574	SD of Logged Detects	1.25

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.614	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.345	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.023	Standard Error of Mean	0.533
SD	1.739	90% KM (BCA) UCL	1.769
90% KM (t) UCL	1.749	90% KM (Percentile Bootstrap) UCL	1.639
90% KM (z) UCL	1.706	90% KM Bootstrap t UCL	3.419
90% KM Chebyshev UCL	2.621	95% KM Chebyshev UCL	3.345
97.5% KM Chebyshev UCL	4.349	99% KM Chebyshev UCL	6.322

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.119	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.753	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.361	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.29	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.725	k star (bias corrected MLE)	0.558
Theta hat (MLE)	1.779	Theta star (bias corrected MLE)	2.314
nu hat (MLE)	13.05	nu star (bias corrected)	10.04
MLE Mean (bias corrected)	1.29	MLE Sd (bias corrected)	1.728

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.346	nu hat (KM)	8.301
Approximate Chi Square Value (8.30, α)	3.693	Adjusted Chi Square Value (8.30, β)	3.34
90% Gamma Approximate KM-UCL (use when n>=50)	2.3	90% Gamma Adjusted KM-UCL (use when n<50)	2.543

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.97
Maximum	6.43	Median	0.257
SD	1.844	CV	1.901
k hat (MLE)	0.421	k star (bias corrected MLE)	0.371
Theta hat (MLE)	2.307	Theta star (bias corrected MLE)	2.615
nu hat (MLE)	10.09	nu star (bias corrected)	8.905
MLE Mean (bias corrected)	0.97	MLE Sd (bias corrected)	1.593
		Adjusted Level of Significance (β)	0.0752
Approximate Chi Square Value (8.90, α)	4.103	Adjusted Chi Square Value (8.90, β)	3.728
90% Gamma Approximate UCL (use when n>=50)	2.106	90% Gamma Adjusted UCL (use when n<50)	2.318

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.787	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.322	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.01	Mean in Log Scale	-0.879
SD in Original Scale	1.823	SD in Log Scale	1.204
90% t UCL (assumes normality of ROS data)	1.728	90% Percentile Bootstrap UCL	1.695
90% BCA Bootstrap UCL	1.988	90% Bootstrap t UCL	2.956
90% H-UCL (Log ROS)	1.996		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1	Mean in Log Scale	-0.945
SD in Original Scale	1.828	SD in Log Scale	1.26
90% t UCL (Assumes normality)	1.72	90% H-Stat UCL	2.143

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

APPENDIX G-3

Wetland EU

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	1/30/2016 10:48:08 AM
From File	Wetland_EU_data.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	128	Number of Distinct Observations	62
Number of Detects	96	Number of Non-Detects	32
Number of Distinct Detects	48	Number of Distinct Non-Detects	20
Minimum Detect	0.82	Minimum Non-Detect	0.63
Maximum Detect	11	Maximum Non-Detect	62
Variance Detects	4.205	Percent Non-Detects	25%
Mean Detects	3.571	SD Detects	2.051
Median Detects	3	CV Detects	0.574
Skewness Detects	1.522	Kurtosis Detects	2.489
Mean of Logged Detects	1.132	SD of Logged Detects	0.527

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.856	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	2.074E-13	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.164	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0904	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	3.199	Standard Error of Mean	0.197
SD	2.08	95% KM (BCA) UCL	3.512
95% KM (t) UCL	3.525	95% KM (Percentile Bootstrap) UCL	3.522
95% KM (z) UCL	3.522	95% KM Bootstrap t UCL	3.555
90% KM Chebyshev UCL	3.789	95% KM Chebyshev UCL	4.056
97.5% KM Chebyshev UCL	4.427	99% KM Chebyshev UCL	5.156

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.098	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.757	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0961	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0918	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.709	k star (bias corrected MLE)	3.6
Theta hat (MLE)	0.963	Theta star (bias corrected MLE)	0.992
nu hat (MLE)	712.1	nu star (bias corrected)	691.2
MLE Mean (bias corrected)	3.571	MLE Sd (bias corrected)	1.882

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.365	nu hat (KM)	605.4
Approximate Chi Square Value (605.42, α)	549.3	Adjusted Chi Square Value (605.42, β)	548.7
95% Gamma Approximate KM-UCL (use when n>=50)	3.525	95% Gamma Adjusted KM-UCL (use when n<50)	3.529

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0781	Mean	3.125
Maximum	11	Median	2.793
SD	2.036	CV	0.651
k hat (MLE)	2.139	k star (bias corrected MLE)	2.094
Theta hat (MLE)	1.461	Theta star (bias corrected MLE)	1.492
nu hat (MLE)	547.6	nu star (bias corrected)	536.1
MLE Mean (bias corrected)	3.125	MLE Sd (bias corrected)	2.159
		Adjusted Level of Significance (β)	0.0481
Approximate Chi Square Value (536.08, α)	483.4	Adjusted Chi Square Value (536.08, β)	482.8
95% Gamma Approximate UCL (use when n>=50)	3.465	95% Gamma Adjusted UCL (use when n<50)	3.469

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0598	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0904	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.174	Mean in Log Scale	0.991
SD in Original Scale	1.96	SD in Log Scale	0.573
95% t UCL (assumes normality of ROS data)	3.461	95% Percentile Bootstrap UCL	3.468
95% BCA Bootstrap UCL	3.481	95% Bootstrap t UCL	3.511
95% H-UCL (Log ROS)	3.491		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.958	95% H-UCL (KM -Log)	3.64
KM SD (logged)	0.664	95% Critical H Value (KM-Log)	1.926
KM Standard Error of Mean (logged)	0.0645		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3.93	Mean in Log Scale	1.06
SD in Original Scale	3.712	SD in Log Scale	0.805
95% t UCL (Assumes normality)	4.474	95% H-Stat UCL	4.613

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	3.512

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	1/30/2016 10:49:33 AM
From File	Wetland_EU_data.xls
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	128	Number of Distinct Observations	62
Number of Detects	96	Number of Non-Detects	32
Number of Distinct Detects	48	Number of Distinct Non-Detects	20
Minimum Detect	0.82	Minimum Non-Detect	0.63
Maximum Detect	11	Maximum Non-Detect	62
Variance Detects	4.205	Percent Non-Detects	25%
Mean Detects	3.571	SD Detects	2.051
Median Detects	3	CV Detects	0.574
Skewness Detects	1.522	Kurtosis Detects	2.489
Mean of Logged Detects	1.132	SD of Logged Detects	0.527

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.856	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	2.074E-13	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.164	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0904	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	3.199	Standard Error of Mean	0.197
SD	2.08	90% KM (BCA) UCL	3.445
90% KM (t) UCL	3.452	90% KM (Percentile Bootstrap) UCL	3.451
90% KM (z) UCL	3.451	90% KM Bootstrap t UCL	3.481
90% KM Chebyshev UCL	3.789	95% KM Chebyshev UCL	4.056
97.5% KM Chebyshev UCL	4.427	99% KM Chebyshev UCL	5.156

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.098	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.757	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0961	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0918	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.709	k star (bias corrected MLE)	3.6
Theta hat (MLE)	0.963	Theta star (bias corrected MLE)	0.992
nu hat (MLE)	712.1	nu star (bias corrected)	691.2
MLE Mean (bias corrected)	3.571	MLE Sd (bias corrected)	1.882

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.365	nu hat (KM)	605.4
Approximate Chi Square Value (605.42, α)	561.3	Adjusted Chi Square Value (605.42, β)	560.9
90% Gamma Approximate KM-UCL (use when n>=50)	3.45	90% Gamma Adjusted KM-UCL (use when n<50)	3.453

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0781	Mean	3.125
Maximum	11	Median	2.793
SD	2.036	CV	0.651
k hat (MLE)	2.139	k star (bias corrected MLE)	2.094
Theta hat (MLE)	1.461	Theta star (bias corrected MLE)	1.492
nu hat (MLE)	547.6	nu star (bias corrected)	536.1
MLE Mean (bias corrected)	3.125	MLE Sd (bias corrected)	2.159
		Adjusted Level of Significance (β)	0.0979
Approximate Chi Square Value (536.08, α)	494.6	Adjusted Chi Square Value (536.08, β)	494.2
90% Gamma Approximate UCL (use when n>=50)	3.387	90% Gamma Adjusted UCL (use when n<50)	3.39

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0598	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0904	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.174	Mean in Log Scale	0.991
SD in Original Scale	1.96	SD in Log Scale	0.573
90% t UCL (assumes normality of ROS data)	3.397	90% Percentile Bootstrap UCL	3.398
90% BCA Bootstrap UCL	3.404	90% Bootstrap t UCL	3.419
90% H-UCL (Log ROS)	3.415		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.958	90% H-UCL (KM -Log)	3.546
KM SD (logged)	0.664	90% Critical H Value (KM-Log)	1.481
KM Standard Error of Mean (logged)	0.0645		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3.93	Mean in Log Scale	1.06
SD in Original Scale	3.712	SD in Log Scale	0.805
90% t UCL (Assumes normality)	4.353	90% H-Stat UCL	4.46

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

APPENDIX H

Response to Comments

APPENDIX H
Response to Comments
Draft Supplemental Remedial Investigation Report (dated February 19, 2016)
Former Frontier Leather Tannery Property
Cooperative Agreement BF-00J93201

Reviewer	Reviewer Title	Comment #	Comment	Response
DEQ comments received via letter dated 3/8/2016				
Mark Pugh	DEQ Project Manager	1	**Page 3, Remedial Investigation Report, GeoEngineers on behalf of DEQ, June 2004.** In this section it could be noted that DEQ could not secure access to Tax Lot 602 (formerly Tax Lot 502), and thus it was not sampled during DEQ's RI.	The following sentence was added at the end of the first paragraph under the heading identified in DEQ's comment: "Tax Lot 602 was not included in the RI completed in 2004 because DEQ was not able to secure access to conduct the investigation."
		2	**Page 4, first bullet.** Consider adding this statement: "The distribution of hides observed during the RI suggested they extended onto Tax Lot 602".	The suggested statement was added to the end if the first bullet on Page 4.
		3	**Page 5, first line.** Because chromium levels detected during DEQ's RI were below current DEQ RBCs for human health, it would be informative to provide the basis for why it was identified as a contaminant of potential concern in the DEQ RI (i.e., it exceeded the EPA Preliminary Remediation Goal).	The first line on Page 5 was expanded to read as follows: "Chromium was the only constituent of potential concern (COPC) identified for soil and sediment, because it was found at concentrations greater than background levels in these media and the concentrations either exceeded the industrial soil Preliminary Remediation Goal (PRG) established by EPA at the time of the investigation, or contributed to an unacceptable level of potential risk when evaluated cumulatively with all other detected metals."
		4	**Page 5, first bullet.** It would be informative to state what receptor and pathway accounted for the unacceptable ecological risk (i.e., terrestrial birds exposed to surface soil/sediment), and to include a discussion of ecological hotspots.	The first bullet on Page 5 provides a summary of the ecological risk assessment and was revised as follows: 1. Two sub-bullets were added at the beginning to summarize ecological receptor types, including presence/absence of threatened & endangered (T&E) species. 2. The third sub-bullet now correctly lists those metals that are CPECs in waters at the site. 3. The fourth sub-bullet identifies the receptor and exposure pathway evaluated in the Level III ERA and presents the conclusions of the Level III ERA as two sub-bullets presenting the chromium management area and ecological receptor hot spots.
		5	**Page 6, first full paragraph.** In additional to an RI, Geosyntec, on behalf of DEQ, also completed a feasibility study (Geosyntec, Feasibility Study, Former Ken Foster Farm, 23000 to 23500 SW Murdock Road Sherwood, Oregon. June 18, 2015). DEQ is currently developing a site wide cleanup plan.	The last sentence of the reference paragraph was revised to read: "DEQ has completed a Feasibility Study to evaluate multiple cleanup alternatives to address the soil impacts. DEQ is in the process of developing a cleanup plan."
		6	**Section 5.0 Conceptual Site Model and Risk Evaluation** Should DEQ's Risk-Based Decision Making guidance be cited here?	The last sentence in the first paragraph of Section 5.0 was modified to also reference DEQ's Risk-Based Decision Making Guidance from 2003: "The risk evaluation was conducted in general accordance with DEQ's Risk-Based Decision Making for Petroleum Contaminated Sites (DEQ, 2003) and DEQ's Human Health Risk Assessment Guidance (DEQ, 2010)."
		7	**Page 27, first complete sentence.** "Table 4", rather than "Table 5" should be referenced here.	The correction was made as noted by DEQ.
		8	**Section 5.4.6 Evaluation of Human Health Risk, third paragraph.** The text states "....risk from exposure to arsenic is driven by a single detection of arsenic that exceeds RBCs.....". An alternative and perhaps clearer way to state this is to say there is only one of XXX upland soil samples with an arsenic concentration above its expected naturally occurring concentration. It would be helpful to identify which sample this is (i.e., TP-5-5 collected from 5 feet bgs).	The statement referenced in DEQ's comment was revised as follows: "It should also be noted that arsenic was detected in only one of 78 upland soil samples (TP-5-5) at a concentration greater than its naturally occurring background level."
		9	**Page 30, first paragraph.** I suggest you characterize the risk as "potentially unacceptable".	The word "potentially" was incorporated into the sentence as suggested.
		10	**Page 32, Item 6.** The text implies that occupational and excavation worker exposure pathways are currently complete. I suggest you clarify that trespasser is the only current exposure pathway, and that future exposure pathways will include occupational, construction and excavation worker.	The sentence was revised to state that the occupational and excavation worker exposure pathway are ***not*** complete.
EPA comments received via telephone conversation on 4/7/2016				
B Perkins	EPA Project Officer	NA	No comments provided.	n/a