


# FINAL WORK PLAN ADDENDUM

## Columbia Gorge Aluminum Smelter Site

**Revision 1**
**Goldendale, WA**
**Facility Site ID #95415874**

**Agreed Order DE 10483**

**SEPTEMBER 18, 2020**

*On behalf of:*

Lockheed Martin Corporation
6801 Rockledge Drive
Bethesda MD 20817

NSC Smelter LLC
3313 West Second Street
The Dalles OR 97058

*Prepared by:*

Tetra Tech, Inc.
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# Acronyms

| | |
|---|---|
| AOC | Area of Concern |
| AST | Above-ground Storage Tank |
| BAL | Basalt Aquifer – Lower Zone |
| BAU | Basalt Aquifer – Upper Zone |
| bgs | Below ground surface |
| BMEC | Blue Mountain Environmental Consulting, Inc. |
| BPA | Bonneville Power Administration |
| BTEX | Benzene, toluene, ethylbenzene, and total xylenes |
| %C | Percent Completeness |
| CLARC | Ecology Cleanup Level and Risk Calculation database |
| CoC | Chain-of-Custody |
| COC | Chemical of Concern |
| COPC | Chemical of Potential Concern |
| cPAHs | Carcinogenic Polycyclic Aromatic Hydrocarbons |
| CRMP | Cultural Resources Monitoring Protocol |
| DQO | Data Quality Objective |
| Ecology | Washington Department of Ecology |
| EDD | Electronic Data Deliverable |
| EELF | East End Landfill |
| EIMS | Ecology's Environmental Information Management System |
| EPA | U.S. Environmental Protection Agency |
| ESI | East Surface Impoundment |
| FS | Feasibility Study |
| FSP | Field Sampling Plan |
| ft | Feet |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| GWAOC | Groundwater Area of Concern |
| HASP | Health and Safety Plan |
| HDPE | High-Density Polyethylene |
| HEAF | High Efficiency Air Filtration |
| HEAST | Health Effects Assessment Summary Table |
| HMW | High Molecular-Weight |
| I&M | Industrial & Monitoring |
| IDW | Investigation-Derived Waste |

| | |
|---|---|
| IRIS | U.S. EPA's Integrated Risk Information System database |
| LcS | Laboratory Control Sample |
| Lockheed Martin | Lockheed Martin Corporation |
| LMW | Low Molecular-Weight |
| MCL | Maximum Contaminant Level |
| mg/kg | Milligrams per kilogram |
| mg/L | Milligrams per Liter |
| MS | Matrix Spike |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| MTCA | Model Toxics Control Act |
| NCEA | National Center for Environmental Assessment database |
| NESI | North of the East Surface Impoundment |
| NPDES | National Pollutant Discharge Elimination System |
| NSC | Smelter, LLC |
| ORP | Oxidation-Reduction Potential |
| PAAOC | Plant Area – Area of Concern |
| PAHs | Polycyclic Aromatic Hydrocarbons |
| PCBs | Polychlorinated Biphenyls |
| PGG | Plateau Geoscience Group, LLC |
| PHS | Priority Habitats and Species |
| PID | Photoionization Detector |
| QAPP | Quality Assurance Project Plan |
| QA/QC | Quality Assurance/Quality Control |
| RYAOC | Rectifier Yard Area of Concern |
| RCRA | Resource Conservation and Recovery Act |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| RPD | Relative Percent Difference |
| RSD | Relative Standard Deviation |
| SCUM II | Sediment Cleanup User's Manual |
| SCO | Sediment Cleanup Objective |
| SE | Scrubber Effluent |
| Site | Former Columbia Gorge Aluminum site |
| SMS | Sediment Management Standards |
| SOPs | Standard Operating Procedures |
| SPL | Spent Pot Liner |
| SWMU | Solid Waste Management Unit |

| | |
|---|---|
| TCE | Trichloroethene |
| Tetra Tech | Tetra Tech, Inc. |
| TEE | Terrestrial Ecological Evaluation |
| TPH | Total Petroleum Hydrocarbons |
| TPH-Dx | Total Petroleum Hydrocarbons – Diesel-extended range |
| TPH-Gx | Total Petroleum Hydrocarbons – Gasoline-extended range |
| TTEC | Total Toxicity Equivalent Concentrations |
| µg/kg | Micrograms per Kilogram |
| µg/L | Micrograms per Liter |
| UA | Unconsolidated Aquifer |
| USACE | U.S. Army Corps of Engineers |
| USCS | Unified Soil Classification System |
| UST | Underground Storage Tank |
| UTL | Upper Tolerance Limit |
| VOA | Volatile Organic Analysis |
| VOC | Volatile Organic Compound |
| WA ELAP | Washington State Environmental Laboratory Accreditation Program |
| WAC | Washington Administrative Code |
| WDFW | Washington Department of Fish and Wildlife |
| WPA | Work Plan Addendum |

# Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs)
## (Agreed Order No. DE 10483)

### Solid Waste Management Units (SWMUs)

NPDES Ponds (SWMU #1)
East Surface Impoundment (ESI) (SWMU #2)
Intermittent Sludge Disposal Ponds (SWMU #3)
West Surface Impoundment (SWMU #4)
Line A Secondary Scrubber Recycle Station (SWMU #5)
Line B, C, D Secondary Scrubber Recycle Stations (SWMU #6)
Decommissioned Air Pollution Control Equipment (SWMU #7)
Tertiary Treatment Plant (SWMU #8)
Paste Plant Recycle Water System (SWMU #9)
North Pot Liner Soaking Station (SWMU #10)
South Pot Liner Soaking Station (SWMU #11)
East SPL Storage Area (SWMU #12)
West SPL Storage Area (SWMU #13)
North SPL Storage Containment Building (SWMU #14)
South SPL Storage Building (SWMU #15)
SPL Handling Containment Building (SWMU #16)
East End Landfill (SWMU #17)
West End Landfill (SWMU #18)
Plant Construction Landfill (SWMU #19)
Drum Storage Area (SWMU #20)
Construction Rubble Storage Area (SWMU #21)
Wood Pallet Storage Area (SWMU #22)
Reduction Cell Skirt Storage Area (SWMU #23)
Carbon Waste Roll-off Area (SWMU #24)
Solid Waste Collection Bin and Dumpsters (SWMU #25)
HEAF Filter Roll-Off Bin (SWMU #26)
Tire and Wheel Storage Area (SWMU #27)
90-Day Drum Storage Area (SWMU #28)
Caustic Spill (SWMU #29)

Paste Plant Spill (SWMU #30)
Smelter Sign Area (SWMU #31)
Stormwater pond and appurtenant facilities (SWMU #32)

## Areas of Concern (AOCs)

Columbia River Sediments
Groundwater in the Uppermost Aquifer
Wetlands
Rectifier Yard
Plant Area

## Section 1
# Introduction

This Work Plan Addendum (WPA) has been prepared to address the requirements of the 2014 Agreed Order No. DE 10483 issued by Washington Department of Ecology (Ecology) and dated May 1, 2014. The Agreed Order directs Lockheed Martin Corporation (Lockheed Martin) and NSC Smelter, LLC (NSC) to complete a Remedial Investigation/Feasibility Study (RI/FS) and draft Cleanup Action Plan for the Former Columbia Gorge Aluminum site (Site) located near Goldendale, Washington.

The Agreed Order required two phases of Remedial Investigation (RI) Work Plan preparation (Phase 1 and Phase 2) that were prepared as two separate volumes. The Final RI Phase 1 Work Plan (Tetra Tech et al. 2015a) summarized available information and data regarding 32 Solid Waste Management Units (SWMUs) and 5 Areas of Concern (AOCs) identified in the Agreed Order, screened each SWMU and AOC to determine if they require further investigation, and identified data gaps and data needs for each SWMU and AOC. The Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b) defined the specific investigation and evaluation activities for each SWMU and AOC that required further investigation to characterize the nature and extent of contamination. Ecology formally approved the Final RI Phase 1 and Phase 2 Work Plans in correspondence dated August 24, 2015 (Ecology 2015b). A supplemental Work Plan for the Plant Area AOC (PGG 2017) and a Bioassay Sampling and Analysis Plan (Tetra Tech 2018a) were also submitted to and approved by Ecology to address data needs identified during the course of the field investigation.

The RI field program was implemented from September 2015 through August 2018. A Draft RI Report was submitted to Ecology on January 24, 2019 (Tetra Tech et al. 2019a). Ecology provided comments, including Yakama Nation Comments, on the Draft RI Report on June 26, 2019 (Ecology and Yakama Nation 2019). The Draft RI Report Comments (Ecology and Yakama Nation 2019) state that additional characterization work was required to adequately define the nature and extent of contamination at the Site, and that the preparation of a WPA would be required to address data gaps identified in the comments submitted on June 26, 2019.

This document serves as the WPA, as required by Ecology under Task 2 of the Scope of Work (Exhibit E) of the Agreed Order (Ecology 2014). The following WPA sections describe the project objectives and data needs, plan organization, and project organization and responsibilities. The Draft WPA was submitted for Ecology and Yakama Nation review on November 18, 2019 (Tetra Tech et al. 2019b). Ecology and Yakama Nation submitted comments on the Draft WPA on March 20, 2020 (Ecology and Yakama Nation 2020a) and comment responses were submitted to Ecology on May 13, 2020 (Tetra Tech et al. 2020). The Final WPA was submitted for Ecology and Yakama Nation review on July 24, 2020 and comments were received on August 26, 2020 (Ecology and Yakama Nation 2020b). The comments and associated responses on the Draft and Final WPA are included as Appendix A-1 and A-2, respectively.

## 1.1 PROJECT OBJECTIVES AND DATA NEEDS

The overall objective of the Agreed Order is to provide a remedial action plan where there has been a release or threatened release of hazardous substances (Ecology 2014). The objective of the RI/FS under the Washington State Model Toxics Control Act (MTCA) is to collect, develop, and evaluate sufficient information and data to select remedial actions consistent with MTCA requirements. The objective of this WPA is to address data gaps and investigation tasks required to adequately define the nature and extent of contamination for completion of the RI work effort and support the evaluation of cleanup alternatives as detailed in the June 26, 2019 comment letter.

On June 26, 2019, Ecology and the Yakama Nation provided review comments for the January 24, 2019 Draft RI Report for the Columbia Gorge Aluminum Smelter Site and the Interim Action Work Plan for East Surface Impoundment (ESI) Fence Line Area (Ecology and Yakama Nation 2019). Ecology comments required preparation and submittal of a WPA to address the following data gaps:

- Additional information is needed in specific areas to understand potential interaction between impacted groundwater at the Site and the Columbia River,
- The extent of soils exceeding applicable screening levels is not fully defined, including in areas not zoned for industrial land use,
- The sources of on-going contaminant loading to the stormwater pond and recontamination of the former National Pollutant Discharge Elimination System (NPDES) ponds are not fully understood,
- Systematic field reconnaissance is needed to confirm that all areas impacted by truck-hauled waste dumping have been identified,

- Soils exceeding screening levels for petroleum hydrocarbons for protection of groundwater were identified in a number of areas that do not appear to have representative/corresponding groundwater data for these pollutants,
- Given current land-use zoning on and adjacent to impacted areas of the Site, it appears that a site-specific terrestrial ecological evaluation (TEE) is required under Washington Administrative Code (WAC) 173-340-7491(2)(a)(i). In addition, an evaluation of screening levels for the protection of human health is needed to ensure that treaty-protected tribal uses do not result in unacceptable risks. Additional characterization data may be necessary to support these elements, and
- Recommendations on additional data needed to support an evaluation of cleanup alternatives should be developed for each Solid Waste Management Unit and Area of Concern. These recommendations should be addressed in the WPA.

On August 6, 2019, Ecology met with Lockheed Martin and NSC representative at the Site to discuss the Draft RI Report comments and relevant topics. Lockheed Martin and NSC provided formal response to Ecology and Yakama comments pertinent to the development of the WPA on August 28, 2019 (Lockheed Martin and NSC 2019). On September 30, 2019, a meeting with Ecology and Yakama was held at Ecology's Headquarters in Lacey, Washington to discuss comments and topics relevant to development of the WPA, including 1) zoning and land use, 2) truck haul waste dumping and site reconnaissance, 3) groundwater to surface water pathway, 4) groundwater characterization, 5) plant area and stormwater conveyance lines, and 6) extent of soil contamination.

Specific data needs addressing primary topics and existing data gaps in support of the WPA are summarized by SWMUs and AOCs in Table 1-1. In addition to SWMUs and AOCs, the data needs for other investigation areas, including the ditch near the West Spent Pot Liner (SPL) Storage Area, the ESI Fence Line Area, and Eastern Area Site Reconnaissance are included in Table 1-1. Investigation work elements and associated Data Quality Objectives (DQOs) are summarized in Section 4 of this plan. Figure 1-1 provides an overview of site features, including many of those referenced in this plan.

## 1.2 PLAN ORGANIZATION

This WPA is supplemental to the Final RI Phase 1 and Phase 2 Work Plans (Tetra Tech et al. 2015a,b) and routinely references these sources as appropriate because the proposed field investigation and laboratory analytical methods and procedures are in large part the same as those previously used in support of the RI work effort to date.

**Table 1-1**
**Work Plan Addendum Data Needs Summary by SWMU and AOC**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 1 of 3)**

| Work Plan Addendum Investigation Area(s) | Ecology and Yakama Nation Draft RI Comment Topics Relating to Work Plan Addendum | Project Team Identified Work Plan Addendum Data Needs |
|---|---|---|
| **Solid Waste Management Units (SWMUs)** | | |
| **SWMU 1**<br>NPDES Ponds | - Extent of soil contamination.<br>- Plant Area and Stormwater Conveyance Lines.<br>- Zoning and Land Use.<br>- Site-Specific and Site-Wide TEE. | • Determine extent of soil contamination in NPDES Ponds A, B, C, and D<br>• Determine if SWMU 17 (East End Landfill) is a potential source of PAH soil contamination.<br>• Chemical characterization of discharge at head of NPDES Pond A (see Plant Area AOC).<br>• Confirm previous results of RI-bypass line investigation.<br>• Site-wide and site-specific TEE with further assessment of TEE screening levels. |
| **SWMU 3**<br>Intermittent Sludge Disposal Ponds | - Zoning and Land Use.<br>- Truck Haul Waste Dumping and Site Reconnaissance.<br>- Extent of soil contamination.<br>- Site-Specific and Site-Wide TEE. | • Evaluation of historical remedial action soil confirmation results to help determine potential of extent of soil contamination<br>• Field reconnaissance to verify absence of additional aluminum smelter-related wastes and stained soils.<br>• Confirmation soil characterization outside of excavation limits to determine extent of contamination<br>• Site-wide and site-specific TEE with further assessment of TEE screening levels |
| **SWMUs 10 and 11**<br>North and South Pot Liner Soaking Stations | - Extent of Soil Contamination.<br>- Soil screening levels for groundwater protection. | • Better characterize vertical and horizontal extent of contamination based on revised soil screening levels for groundwater protection<br>• Verify absence of perched UA zone in this area. |
| **SWMU 31**<br>Smelter Sign Area | - Zoning and Land Use.<br>- Truck Haul Waste Dumping and Site Reconnaissance.<br>- Extent of soil contamination.<br>- Site-Specific and Site-Wide TEE. | • Determine extent of surface soil contamination at both the Smelter Sign and NESI sub-areas.<br>• Field reconnaissance and sampling along transects immediately east of the NESI area to verify no evidence of waste dumping (as consistent with previous site reconnaissance findings) and evaluate potential wind-related impacts.<br>• Site-wide and site-specific TEE with further assessment of TEE screening levels. |
| **SWMU 32**<br>Stormwater Pond and Appurtenant Facilities | - Plant Area and Stormwater Conveyance Lines. | Refer to Plant Area AOC |

**Table 1-1**
**Work Plan Addendum Data Needs Summary by SWMU and AOC**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 2 of 3)**

| Work Plan Addendum Investigation Area(s) | Ecology and Yakama Nation Draft RI Comment Topics Relating to Work Plan Addendum | Project Team Identified Work Plan Addendum Data Needs |
|---|---|---|
| **Areas of Concern (AOCs)** | | |
| **Groundwater in the Uppermost Aquifer (GWAOC)** | - Groundwater to Surface Water Pathway.<br>- Groundwater Characterization. | • Characterize spring water quality (including newly discovered spring in western area, NESI area wetland spring, Wetland D spring, Wetland K spring, and Wetland F spring).<br>• Characterize shallow groundwater chemical concentrations at the Western Intermittent Drainage near the Boat Basin and between Wetland K and the Boat Basin.<br>• Single round of sampling of Unconsolidated Aquifer (UA) and Basalt Aquifer Upper (BAU) zone wells in the Former Plant Area Footprint to assess current conditions and better document TPH distribution in groundwater.<br>• Risk evaluation for fluoride and sulfate groundwater and surface water screening levels protective of ecological receptors.<br>• Groundwater flux and hydrogeologic water balance assessment to evaluate the amount of discharge to the Columbia River.<br>• Additional boring and shallow monitoring wells to address subsurface soil hotspot areas in PAAOC and assess potential shallow groundwater impacts for TPH and other chemicals of potential concern. |
| **Wetlands** | - Zoning and Land Use.<br>- Groundwater to Surface Water Pathway.<br>- Extent of Soil Contamination.<br>- Site-Wide TEE. | • Further characterize extent of soil contamination in Wetlands D and K.<br>• Confirm that MTCA unrestricted land use screening levels are protective of tribal treaty-protected land uses for Wetland K (off property areas zoned as open-space).<br>• Estimation of recharge/discharge for Wetland K.<br>• Characterize site-wide spring water quality (including newly discovered spring in western area, NESI area wetland spring, Wetland D spring, Wetland K spring, and Wetland F spring).<br>• Characterize extent of water quality exceedances within Wetland K.<br>• Determine the presence or absence of shallow perched groundwater at Wetland K and in the Western Intermittent Drainage near the Boat Basin. Characterize shallow groundwater chemical concentrations.<br>• Site-wide and site-specific TEE with further assessment of TEE screening levels. |
| **Plant Area (PAAOC)** | - Groundwater to Surface Water Pathway.<br>- Groundwater Characterization.<br>- Soil Sources of Groundwater Contamination.<br>- Extent of Soil Contamination.<br>- Site-Wide TEE (applies to all soil investigation areas, PAAOC not excluded). | **Extent of Contamination**<br>• Additional test pits, borings, and shallow monitoring wells to address subsurface soil hotspot areas in PAAOC and assess potential shallow groundwater impacts for TPH or other chemicals.<br>• Assess potential impacts to soil and shallow groundwater in newly identified investigation areas.<br>• Further characterize extent of fluoride, sulfate, PAHs, and TPH contamination in soil at select Courtyard Segment hotspot areas.<br>• Site-wide and site-specific TEE with further assessment of TEE screening levels.<br>• Single round of groundwater sampling of existing BAU and UA wells in Former Plant Area Footprint to assess current conditions and better document groundwater TPH concentrations.<br>• Vertical Extent of Contaminated Soil at transformer substations and other operational features in Courtyard Segments.<br>• Characterize vertical and horizontal extent of fluoride and sulfate in the Crucible Cleaning Room Area.<br>• Determine the vertical and horizontal extent of carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and petroleum hydrocarbons in soil at the Soil Boring SB-VS01 location in Courtyard Segment A5.<br>• Evaluate potential impact of contaminated sediment and groundwater in the Coke and Pitch Unloading Sump on shallow groundwater immediately downgradient from the sump. |

**Table 1-1**
**Work Plan Addendum Data Needs Summary by SWMU and AOC**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 3 of 3)**

| Work Plan Addendum Investigation Area(s) | Ecology and Yakama Nation Draft RI Comment Topics Relating to Work Plan Addendum | Project Team Identified Work Plan Addendum Data Needs |
|---|---|---|
| **Areas of Concern (AOCs) (Continued)** | | |
| **Plant Area (PAAOC) (Continued)** | - Plant Area and Stormwater Conveyance Lines. | • Determine vertical and horizontal extent of cPAHs and petroleum hydrocarbons in soil at the Former Above-ground Storage Tank (AST) Near the East SPL Storage Area and the potential impact on underlying shallow groundwater.<br>• Determine the vertical extent of fluoride in soil at the Friction Weld Building and evaluate the potential impact on underlying shallow groundwater.<br>• Determine the vertical and horizontal extent of fluoride and sulfate in soil at the Soil Boring SB-SE08 location in Courtyard Segment A4 and evaluate the potential impact on underlying shallow groundwater.<br>• Determine the horizontal extent of sulfate in soil at the Soil Boring SB-SE18 location in Courtyard Segment C5 and evaluate potential impact on underlying shallow groundwater.<br>• Characterize groundwater occurrence and chemical concentrations in the vicinity of the Soil Boring SE-SB17 investigation area through installation and sampling of new UA zone and BAU zone wells.<br><br>**Stormwater and Other Lines Evaluation**<br>• Determination of source of discharge to NPDES Pond A.<br>• Sampling of discharge pipe at head of NPDES Pond A.<br>• Further characterization of the interconnection of stormwater/groundwater/process water lines under the Plant Area.<br>• Characterize sediment quality in the Industrial Sump that is part of the NPDES-permitted system.<br>• Characterization of contaminant loading from various line types and line segments. Determine relative contribution of contaminated groundwater inflow versus site runoff. |
| **Additional Area of Investigation** | | |
| Ditch near West SPL Storage Area | - Extent of soil contamination.<br>- Site-Wide TEE. | • Determine extent of soil contamination in associated with ditch.<br>• Site-wide and site-specific TEE with further assessment of TEE screening levels. |
| East Surface Impoundment (ESI) Fence Line Area | - Zoning and Land Use.<br>- Truck Haul Waste Dumping and Site Reconnaissance.<br>- Waste-listing determination for existing soil stockpile removal.<br>- Site-Wide TEE. | • Additional site reconnaissance and characterization to verify the lateral and vertical extent of contamination in ESI Fence Line Area.<br>• Ecology concurrence for disposal of existing soil/waste stockpile.<br>• Site-wide and site-specific TEE with further assessment of TEE screening levels. |
| Eastern Area Site Reconnaissance | - Zoning and Land Use.<br>- Truck Haul Waste Dumping and Site Reconnaissance.<br>- Site-Wide TEE. | • Site reconnaissance including inspection and documentation using grid in eastern portion of the Site to verify absence of aluminum smelter-related waste and stained soils.<br>• Verification sampling of surface and subsurface conditions at select locations based on site reconnaissance observations.<br>• Site-wide and site-specific TEE with further assessment of TEE screening levels. |

**Notes:**
AOC = Area of Concern
BMEC = Blue Mountain Environmental Consulting
ESI = East Surface Impoundment
GWAOC = Groundwater Area of Concern
MTCA = Model Toxics Control Act
NESI = North of the East Surface Impoundment
NPDES = National Pollutant Discharge Elimination System
NSC = NSC Smelter LLC
PAAOC = Plant Area – Area of Concern
PAH = Polynuclear Aromatic Hydrocarbon
RI = Remedial Investigation
SPL = Spent Pot Liner
SWMU = Solid Waste Management Unit
TEE = Terrestrial Ecological Evaluation
TPH = Total Petroleum Hydrocarbons


Legend

Wetlands

N
W E
S

0 500 1,000 2,000

Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 1-1
Primary Site and Vicinity Features Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

This plan is organized into eleven primary sections including: 1) Introduction, 2) Site Background, 3) Regulatory Framework, 4) Field Activities Summary, 5) Field Methods and Procedures, 6) Quality Assurance Project Plan, 7) Health and Safety, 8) Cultural Resources, 9) Reporting, 10) Schedule, and 11) References. The site background and regulatory framework sections (Sections 2 and 3) generally focus on new or updated information since the preparation of the RI Work Plans (Tetra Tech et al. 2015a,b) and/or the Draft RI Report (Tetra Tech et al. 2019a). For instance, the zoning and land use section includes supplemental information not included in the Draft RI Report (Tetra Tech et al. 2019a). Similarly, the regulatory framework section specifically addresses recent changes in media-specific cleanup/screening levels with comparison to associated laboratory reporting limits to support assessment of project DQOs.

## 1.3 PROJECT ORGANIZATION AND RESPONSIBILITIES

Ecology is the lead regulatory agency for the work to be conducted under the 2014 Agreed Order (Ecology 2014). NSC, the current property owner, and Lockheed Martin, the previous owner, are both named parties required to undertake actions under the terms and conditions of the Agreed Order. A team of consultants including Tetra Tech, Inc. (Tetra Tech), Blue Mountain Environmental Consultants, Inc. (BMEC), and Plateau Geoscience Group, LLC (PGG) are working for the parties named in the Agreed Order in support of the RI work effort. The Confederated Tribes and Bands of the Yakama Nation are an interested party because the Site is located in a treaty-defined usual and accustomed area.

The organization and responsibilities for completion of the WPA include those previously described in the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b). Mr. Garin Schrieve is the Ecology representative for this project. The Agreed Order specifies designation of project coordinator for each responsible party, which includes Ms. Shanel Aliano on behalf of Lockheed Martin and Mr. Peter Trabusiner on behalf of NSC. Tetra Tech is providing environmental consulting support on behalf of Lockheed Martin and BMEC and PGG on behalf of NSC, and these firms are collectively referred to as “Performing Contractors” in RI Work Plans and this WPA. The new project lead for the Yakama Nation is Mr. Robert (Bob) Dexter.

WPA subcontractor support services will include the analytical laboratory, driller(s), excavation contractor, surveyors, waste services, and private utility locators. These subcontractors will be under the direct supervision of the Lockheed Martin and NSC consultants, and in accordance with subcontract agreements, specifications, and the procedures outlined in the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b).

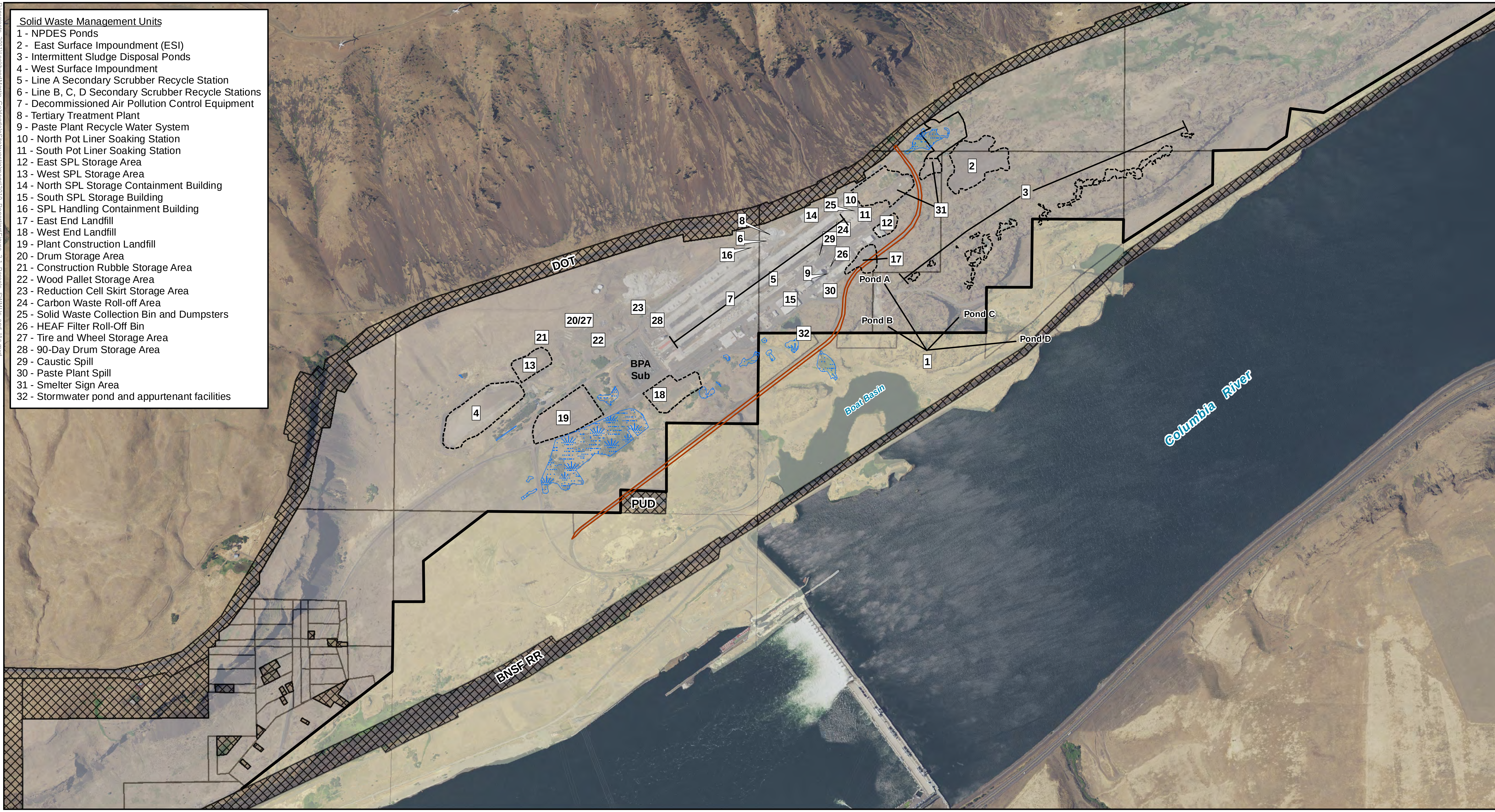
# Section 2
# Site Background

This section briefly summarizes background information relevant to the WPA including supplemental information regarding property ownership, zoning and land use, as well as a brief summary of geology and hydrogeology. For a more detailed summary of site hydrogeology refer to Volume 3 of the Draft RI Report (Tetra Tech et al. 2019a).

## 2.1 PROPERTY OWNERSHIP, ZONING, AND LAND USE

The Site occupies land owned primarily by NSC with areas south of the main plant owned by the U.S. Army Corps of Engineers (USACE). Figure 2-1 shows land ownership in the Site vicinity. As shown in Figure 2-1, a portion of a few SWMU areas are located outside of the NSC-owned property. These SWMU areas include the NPDES Ponds C and D (SWMU 1), as well as a small portion of the Intermittent Sludge Disposal Ponds (SWMU 3). Wetland K, which was investigated during the RI as part of the Wetlands AOC and is included for additional investigation in the WPA (refer to Section 4.8), is located outside of the NSC-owned land on the north side of the Boat Basin (refer to Figure 2-1) on land owned by the USACE.

Figure 2-2 shows the zoning and land use in the Site vicinity. The majority of the Site falls within an area zoned as Industrial Park. The SWMUs and most of the investigation areas were part of past industrial operations. An area zoned as Extensive Agriculture is present in the eastern portion of the Site and includes the North of the East Surface Impoundment (NESI) subarea of the Smelter Sign Area (SWMU 31) and a portion of the closed and capped ESI (SWMU 2), which was closed under RCRA. An area zoned as Open Space is present south of main plant area and includes portions of NPDES Ponds C and D (SWMU 1), the Intermittent Sludge Disposal Ponds (SWMU 3), and Wetland K. The location of the Bonneville Power Administration (BPA) transmission line corridor right-of way is also shown on Figure 2-2 because the BPA right-of-way areas are subject to property access and land use restrictions and are not shown on the Klickitat County Zoning Map.




Legend

- NSC Smelter LLC Parcels
- USACE
- Other Ownership
- Klickitat County Road Right-of-Way (John Day Dam Road)
- Property Boundary
- 1 Solid Waste Management Unit
- SWMU Investigation Areas
- Wetlands

N / W / E / S

0 500 1,000 2,000
Feet

Imagery Source: NAIP 2017

Figure 2-1
Parcel Ownership and
Solid Waste Managment Units
and Investigation Areas

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

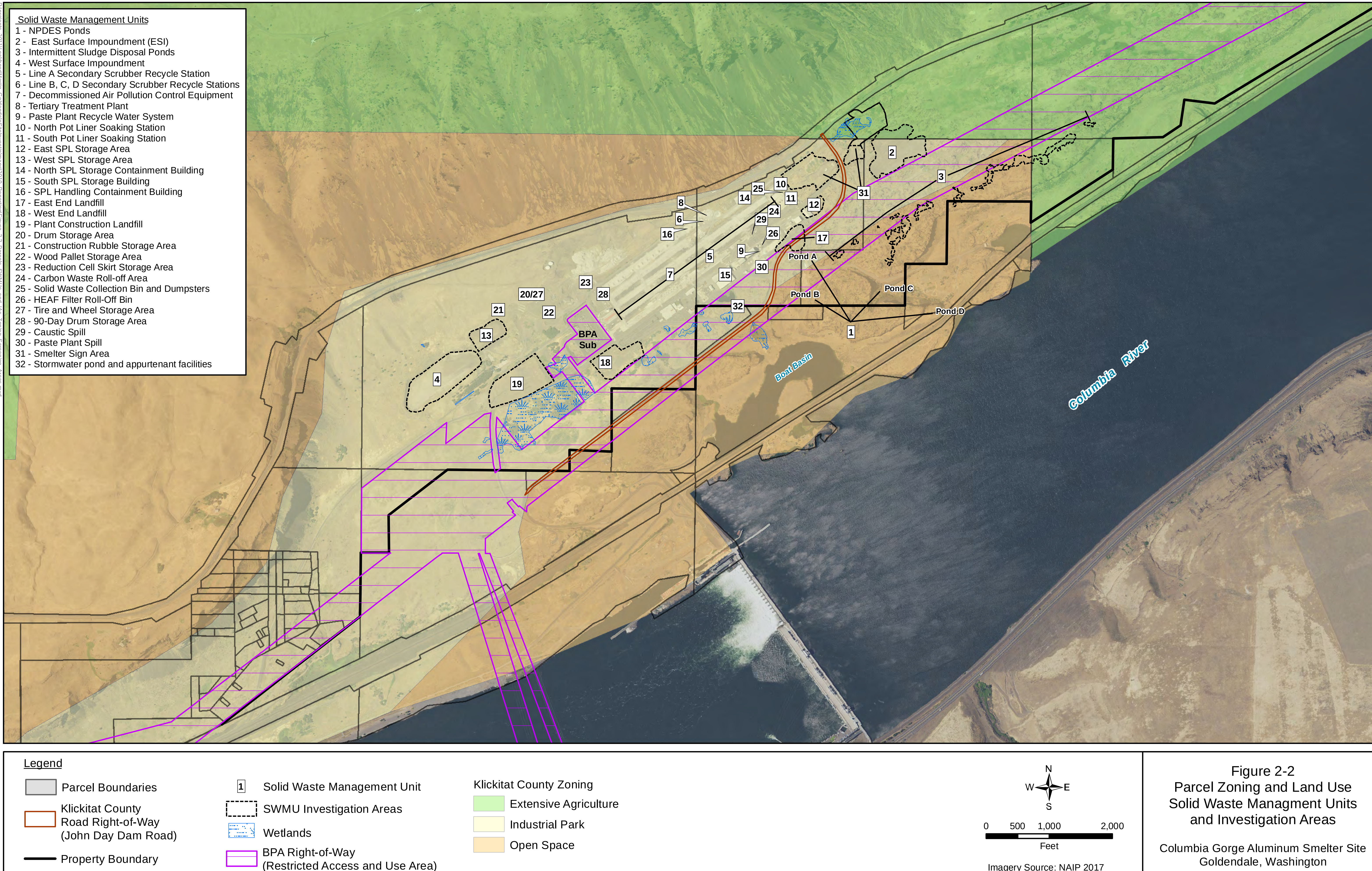



Figure 2-2
Parcel Zoning and Land Use
Solid Waste Managment Units
and Investigation Areas

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Ecology and Yakama Nation Comments (Ecology and Yakama Nation 2019) on the Draft RI Report (Tetra Tech et al. 2019a) state that screening levels should be applied consistent with the property use based on current Klickitat County zoning information. Ecology and the Yakama Nation's position is that soil screening levels appropriate for industrial use can only be used for screening in areas zoned for industrial use and where a restrictive covenant is able to be recorded, and screening levels appropriate for unrestricted land use should be applied for all other areas (i.e., zoned for Open Space and Extensive Agriculture).

The selection of appropriate screening levels in areas of NSC-owned lands where institutional controls can be maintained is still under further evaluation by the responsible parties. However, the data quality objectives developed in support of this WPA provide for assessment of both industrial and unrestricted land uses, as well as tribal treaty-protected uses and associated risk assessment, as appropriate.

At the September 30th, 2019 meeting, Ecology provided supplemental information regarding Priority Habitats and Species (PHS) in the Site vicinity. PHS information is used primarily by cities and counties when implementing and updating land use plans and development regulations under the Growth Management Act and Shoreline Management Act. It is also used by local governments and landowners for wildlife conservation purposes to protect habitat.

Washington Department of Fish and Wildlife maintains a listing https://wdfw.wa.gov/species-habitats/at-risk/phs/list and geographic information system (GIS) application http://apps.wdfw.wa.gov/phsontheweb/ of PHS that are defined as follows:

- Priority Species include State Endangered, Threatened, Sensitive and Candidate Species, vulnerable animal aggregations (e.g., bat colonies), and vulnerable species of recreational, commercial, or tribal importance.

- Priority Habitats represent habitat types or elements with unique or significant value to many species. A Priority Habitat may consist of a unique vegetation type (e.g., shrub-steppe) dominant plant species (e.g., juniper savannah), or a specific habitat feature (e.g., cliffs).

Figure 2-3 shows the PHS areas mapped in the Site vicinity.


Legend
Wetland Area Designation
Spring
Species
Prairie Falcon Breeding

Habitat
Aquatic Habitat
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Talus Slopes
Waterfowl Concentration
Cliffs/Bluffs
Oak Forest
Oak/Pine Mixed Forest

There are 7 records of Golden Eagle Breeding Area within the Township, and 1 record of Little Brown Bat Communal Roost within the Township.

N W E S

0 500 1,000 2,000
Feet

Figure 2-3
Priority Habitat and Species

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Based on the review of the PHS maps and associated database records, the following species records were identified:

- **Golden Eagle Breeding**. The Golden Eagle represents a State Candidate Species with seven records shown in the Township.

- **Prairie Falcon Breeding.** The Prairie Falcon is not included in the Washington State species listings and appear to represent a vulnerable animal aggregation. One record was found that corresponded to the cliff/bluff areas north of site.

- **Little Brown Bat Communal Roost.** The Little Brown Bat is not included in the Washington State species listings and appears to represent a vulnerable animal aggregation. One record was found in the Township.

The following Priority Habitats were identified in the Site vicinity:

- **Boat Basin and Wetland K**. These areas were listed in the map application and associated database based on waterfowl concentrations (i.e., database designation of "regular" concentration).

- **Cliffs and Bluffs.** These features were listed in the map application and associated database as a habitat feature.

- **Oak or Oak-Pine Mixed Forest.** These features were listed in the map application and associated database as terrestrial habitat features.

- **Talus Slopes.** These features were listed in the map application and associated database as a habitat feature.

- **Freshwater Forested/Shrub Wetland.** The wetland area adjacent to the recently discovered spring southwest of the Site near the former Cliffs town site is mapped as a freshwater forested/shrub wetland with aquatic habitat.

- **Freshwater Emergent Wetland.** A small portion of Wetland D (i.e., part of former Duck Pond location) is mapped as a Freshwater Emergent Wetland.

- **NPDES Pond A.** Mapped as an aquatic habitat.

This information will be summarized in the TEE portion of the Draft Final RI Report.

## 2.2 GEOLOGY AND HYDROGEOLOGY

Site geology consists of unconsolidated deposits including colluvium, alluvium, and fill material that are underlain by two to three basalt flows that are part of the Grand Ronde Basalt Formation, Sentinel Springs Member, Basalt of Museum (informally designated sub-member) that represents the topmost stratigraphic portion of the formation. In general, there is a lack of sedimentary interbeds within the basalt flows at the Site. Within the basalt sequence, groundwater predominantly occurs in flow-top breccias and connected fractures. The hydrogeologic conceptual model is presented in detail in Volume 3 of the Draft RI Report, and is briefly summarized in this WPA for convenience.

Conceptually, the aquifer system represents an unconsolidated alluvial/colluvial aquifer underlain by a series of basalt bedrock aquifer zones that represent the more permeable zones within the basalts and typically correspond to flow tops/flow top breccias.

Three suspected strike-slip fault zones were identified during the RI that likely affect groundwater flow at the Site (Figure 2-4). The fault system and site geology are based on initial mapping by Bela (1982). Also, included in Figure 2-4 are monitoring wells completed in the Basalt Aquifer Lower (BAL) zone and other monitoring wells in the vicinity of the faults because of their relevance to the groundwater-to-surface water migration pathway. The strike-slip fault zones occur at the following locations: 1) the western intermittent drainage that extends up the gulley at the western end of the Boat Basin, 2) along the alignment of the stormwater pond/Spring 01/Wetland K, and 3) the eastern end of the Former Plant Area. The fault areas coincide with topographic valley trends and are oriented generally parallel to groundwater flow direction (toward the Columbia River). Within the Basalt Aquifer Upper (BAU) zone, groundwater flow converges on the fault zones. It appears that groundwater migrates along these fault/fracture systems both horizontally and vertically. Based on continuous cores drilled during the RI, evidence of tectonic fracturing was found including shatter breccias, potential slickensides, and gouge zones were noted between about 45 and 160 feet below ground surface (ft bgs) with an estimated 10 to 20 ft of vertical displacement. Conceptually, the thrust fault located north of the Site may limit groundwater migration from the upgradient deeper basalt aquifer system across the fault zone.


**Legend**

- Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

- $BAU_1$ - Shallower Water-bearing Zone
- $BAU_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

- $BAL_1$ - Shallower Water-bearing Zone
- $BAL_2$ - Deeper Water-bearing Zone
- $BAL_3$ - Deepest Water-bearing Zone
- Spring

- 1 SWMU Investigation Areas
- Thrust Fault
- Strike Slip Fault
- Fault Displacement and Location Uncertain

N W E S

0 500 1,000 2,000

Feet

Imagery Source: NAIP 2017

Figure 2-4
Fault Locations and
Selected Monitoring Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

The various aquifer zones present at the Site are described and defined as follows:

- **Unconsolidated Aquifer (UA) Zone.** Based on the occurrence of unconsolidated water-bearing deposits including fill material (absent in some areas).

- **Basalt Aquifer Upper (BAU) Zone**. Two water-bearing zones ($BAU_1$ and $BAU_2$) within the upper basalt aquifer system at an elevation significantly higher than the Columbia River.

- **Basalt Aquifer Lower (BAL) Zone**. Two to three water-bearing zones ($BAL_1$, $BAL_2$, and $BAL_3$) within the lower basalt aquifer system. The $BAL_1$ water bearing zone occurs near the elevation of the Lake Umatilla Pool. The $BAL_2$ water-bearing zone occurs at an elevation about 40 feet (ft) below the Lake Umatilla Pool. The $BAL_3$ water-bearing zone occurs near the elevation of the Columbia River below John Day Dam (about 100 ft lower than the Lake Umatilla Pool).

There are currently 78 groundwater monitoring wells at the Site that were included in the RI field program. Well locations are shown by aquifer zone in Figure 2-5.

A series of four RI cross-sections, water-level elevation maps for each aquifer zone, and selected well and surface water intake pond hydrographs that are relevant to the potential groundwater-to-surface water flow path are included in Appendix B. The cross-section figures have been modified from the RI cross-sections to show the fluoride and sulfate concentrations for wells and springs.

Groundwater flow is conceptualized toward the Columbia River (generally to the southwest-southeast) for all three aquifer zones (refer to Appendix B). There is an east-southeast water-level elevation gradient observed in the BAL zone. A steep water-level elevation gradient is observed in all three aquifer zones between the Former Plant Area and the Columbia River (i.e., UA zone = 0.053 foot/foot near the West Surface Impoundment, BAU zone = 0.202 foot/foot along fault zone at the east end of the former plant, $BAL_1$ zone= 0.060 feet per foot). The $BAL_2$ zone that responds to water-level fluctuation in the Lake Umatilla Pool is characterized by a flatter horizontal gradient of 0.001 foot/foot. The horizontal gradient in the $BAL_3$ zone has not been characterized as only one well has been installed in this zone. Based on review of the water-level elevations for RI-MW20-BAL and gauging data for the John Day Dam Spillway, it appears that water-level elevations in this well are within about one foot of the Columbia River. Note that the river elevation varies significantly on each side of the dam. Further information regarding the horizontal gradient and vertical gradients is summarized in the Draft RI Report (refer to Volume 3, Section 2.3.2, and Volume 4, Appendix D-13, Table D-13-14 for vertical gradients).


Legend

- Production Well
- Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

- $BAU_1$ - Shallower Water-bearing Zone
- $BAU_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

- $BAL_1$ - Shallower Water-bearing Zone
- $BAL_2$ - Deeper Water-bearing Zone
- $BAL_3$ - Deepest Water-bearing Zone

- Spring
- Thrust Fault
- Strike Slip Fault
- Fault Displacement and Location Uncertain

N
W E
S

0 500 1,000 2,000
Feet

Imagery Source: NAIP 2017

Figure 2-5
Monitoring Well Network
by Aquifer Zone

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Downward vertical gradients are present between aquifer zones. The vertical gradient between the BAU and BAL zones is large, which is indicative of a general lack of hydraulic connection between these zones. The UA and BAU zones are interconnected, while the BAL zone has limited connection to the BAU and UA zones with a greater potential for interconnection in areas with faulting or where topographic relief has resulted in a thinner zone of impermeable flow interior between the BAU and BAL aquifer zones. Confined aquifer conditions were generally observed during drilling in the basalt aquifer zones.

The degree of interconnection within a given basalt water-bearing zone flow breccias and associated fracture system is variable across the Site and the range of hydraulic conductivities for basalt water-bearing zones is also variable. The hydraulic conductivity of basalt flow interiors is low and migration of contaminants through flow interiors to the lower BAL zone appears to be limited to areas with faulting or where the thickness of the flow interior has been reduced based on topographic relief.

Figure 2-6 shows relevant site features and associated flow paths. The figure includes the following features:

- Drainage lines and other constructed features (e.g., groundwater collection lines, stormwater pond, NPDES Ponds).
- Springs and wetlands.
- Natural drainage features.
- Selected relevant SWMU investigation areas.
- Stormwater, spring water, and shallow groundwater flow paths shown in blue.
- BAU and BAL Aquifer zone horizontal gradients shown by color-coded arrows. The gradient arrows are based on the first baseline round of groundwater sampling during the RI (Q1) and the RI water-level elevation maps for Q1 that are included in Appendix B of this WPA.

Two man-made features influence groundwater flow and contaminant transport in the plant area, including: 1) the groundwater conveyance lines, and 2) the stormwater pond (Figure 2-6). There is a flat area in the groundwater elevations for the UA and BAU aquifer zones that coincides with the footprint of the Former Plant Area and the French-drain shallow groundwater collection system that routes shallow groundwater to the stormwater pond (refer to Figure 2-6 and Appendix B). The


Spring

Discharge Line

Solid Waste Management Unit

Wetland Area Designation

Stormwater, Intermittent Surface Water and Shallow Groundwater Flow Path

BAU Aquifer Zone Horizontal Gradient

BAL Aquifer Zone Horizontal Gradient

Thrust Fault

Strike Slip Fault

Fault Displacement and Location Uncertain

EELF - East End Landfill
ESI - East Surface Impoundment
NESI - North of East Surface Impoundment
NPDES - National Pollutant Discharge Elimination Sytem
SSA - Smelter Sign Area
WELF - West End Landfill

Imagery Source: NAIP 2007

Figure 2-6
Former Plant Area
Flow Path Features

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSite\Investig\maps\2019_Reporting\Figure_2-6_Flow_Path_Features.mxd

Scrubber Effluent (SE) Lines appear to route shallow groundwater to the head of the former NPDES Pond A (SWMU 1); however, the source of this water is unknown and will be investigated under this WPA. The unlined stormwater pond is interconnected with and appears to locally recharge the BAU aquifer zone based on multiple lines of evidence including the results of the pond-drawdown test, water quality results, and water geochemistry. Water from the stormwater pond appears to represent a significant recharge source for Wetland K and Spring 01.

Groundwater migration to the Columbia River is most likely localized along fracture/fault zones that coincide with topographic lows. Migration of contaminant to the BAL zone, and subsequently to the Columbia River is most likely where: 1) sources of contamination are/were at a lower elevation than a portion of the impermeable flow interior between the BAU and the BAL zones due to topographic relief at the Site (e.g., NPDES ponds), and 2) areas where the basalt bedrock is fractured or faulted to provide a migration pathway to the deeper zones.

In some areas, water discharging from a spring (e.g., Spring 01 and Wetland F spring) or discharge pipe (head of Pond A) flows downstream within a gulley and subsequently seeps back into the ground where it may continue to migrate toward the Columbia River within unconsolidated deposits or fractures. A limited portion of this water may migrate through the basalts in fractured or faulted areas to reach the BAL zone. Evapotranspiration appears to limit the amount of transport of spring and pipe discharge water toward the Columbia River.

Alluvial terraces are present near the Boat Basin along the shoreline of the Columbia River and extending uphill from the mouths of gullies. These sedimentary deposits represent Missoula Flood Deposits, based on the occurrence of granitic clasts and the high abundance of sand. These deposits are commonly 5- to 10-ft thick and up to a maximum of about 20-ft thick and are generally absent from the topographic bench where the main plant is situated. Due to the thin nature of the unconsolidated deposits and based on RI well drilling observations, it does not appear that this perched zone is well developed along the shoreline of the Columbia River. In these areas, infiltrating wetland water may locally infiltrate into the basalt and potentially migrate to the lower BAL-aquifer zone. However, this scenario is unlikely given the thickness of the impermeable basalt flow interior (greater than 50 ft) between the BAU- and the BAL-aquifer zones. Wetland water could also potentially infiltrate at areas where the basalt flow interiors may be more permeable due to faulting.

The $BAL_1$ and $BAL_2$ zones do not appear to have widespread groundwater discharge to the Columbia River based on hydrographs of shoreline monitoring wells versus the Columbia River and the absence of groundwater during drilling of the $BAL_1$ stratigraphic interval at two of three shoreline well locations (refer to Appendix B hydrographs). The hydraulic relationship between the Columbia River and the $BAL_3$ zone was not characterized as only one well (RI-MW20-BAL) has been installed in this zone and a long-term water-level elevation study was not planned in this area of the Site because of the large distance (over 1 mile) from the likely source areas (West Surface Impoundment and West SPL Storage Area) to the Columbia River and the significant depth of the $BAL_3$ zone (about 300 ft bgs in the suspected source area).

From the perspective of potential migration to surface water, fluoride represents the most wide-spread chemical with concentrations exceeding the Maximum Contaminant Level (MCL) of 4 milligrams per Liter (mg/L) across the Site and in all three aquifer zones. Fluoride concentrations are below 4 mg/L MCL in all wells near the Columbia River. Sulfate concentrations exceed the Secondary MCL of 250 mg/L primarily in the eastern and western portion of the Site and in all three aquifer zones. Sulfate concentrations slightly exceed the sulfate screening level of 250 mg/L in a few well locations near the Columbia River. Section 3.4 summarizes the approach for evaluation risk-based screening levels for these chemicals.

# Section 3
# Updated Regulatory Framework

This section is intended to update, and supplement information provided in the Draft RI Report and not as a replacement for Volume I of the Draft RI Report (Tetra Tech et al. 2019a). This section summarizes the following aspects of the regulatory framework that are relevant to preparation of this WPA and completion of the Draft Final RI Report including: 1) changes to screening levels, 2) need for evaluation of screening level protectiveness for treaty-protected tribal uses, 3) TEE, and 4) development of risk-based screening levels for a few selected chemicals in specific media.

## 3.1 SCREENING LEVEL CHANGES SUMMARY

There have been updates to various screening levels during and since preparation of the Draft RI Report in January 2019 (Tetra Tech et al. 2019a). The screening levels potentially applicable for various media are summarized for clarity and for evaluation of laboratory reporting limits. Tables 3-1, 3-2, 3-3, and 3-4 summarize current soil screening levels, groundwater screening levels, surface water screening levels, and sediment screening levels, respectively.

### 3.1.1 Model Toxics Control Act (MTCA)

The Ecology Toxics Cleanup Program Cleanup and Risk Calculation (CLARC) Table was updated in May 2019 (Ecology 2019a) subsequent to the completion and submittal of the Draft RI Report (Tetra Tech et al. 2019a) to Ecology on January 24, 2019. The CLARC update includes incorporation of new cancer and non-cancer toxicity values for benzo(a)pyrene that were published by the U.S. Environmental Protection Agency (EPA) during January 2017 in EPA's Integrated Risk Information System (IRIS) database. The CLARC update also affected how other carcinogenic polycyclic aromatic hydrocarbons (PAHs) are evaluated using the Total Toxicity Equivalent Concentration (TTEC) approach under MTCA. Ecology (2019b) guidance further summarizes these changes to PAH and benzo(a)pyrene MTCA default screening levels. These modified MTCA default values have been adopted for screening purposes in this WPA and will be adopted in the Draft Final RI Report.

## Table 3-1
## Soil Screening Level Summary
## Columbia Gorge Aluminum Smelter Site, Goldendale, Washington
## (Page 1 of 3)

| Chemicals of Potential Concern | MTCA Screening Levels: Method A: Unrestricted Land Use | MTCA Screening Levels: Method A: Industrial | MTCA Screening Levels: Method B | MTCA Screening Levels: Method C | MTCA Screening Levels: Protection of Groundwater (Unsaturated Zone) | Site-Specific TEE [d,e]: Ecological Indicator-Plants | Site-Specific TEE [d,e]: Ecological Indicator-Soil Biota | Site-Specific TEE [d,e]: Ecological Indicator-Wildlife | Range of Background Concentrations | Laboratory Reporting Limit / Method Detection Limit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Aluminum Smelting (mg/kg)** | | | | | | | | | | |
| Cyanide (Total) | NA | NA | 48 | 2,100 | 1.9/40.4 [i] | NE | NE | 5 | NE | 2.0 / 0.51 |
| Fluoride | NA | NA | 4,800 | 210,000 | 615 [j] | NE | NE | NE | 14.11 [h] | 8.0 / 2.41 |
| Sulfate | NA | NA | NE | NE | 2,150 [k] | NE | NE | NE | NE | 20.0 / 7.75 |
| **Polynuclear Aromatic Hydrocarbons (PAHs) (mg/kg)** | | | | | | | | | | |
| Total LMW PAH | NA | NA | NE | NE | NE | NE | 29 | 100 | NE | 0.005 / 0.0005 |
| Acenaphthene | NA | NA | 4,800 | 210,000 | 97.9 | 20 | 29 | 100 | NE | 0.005 / 0.0006 |
| Acenaphthylene | NA | NA | NE | NE | NE | NE | 29 | 100 | NE | 0.005 / 0.0005 |
| Anthracene | NA | NA | NE | NE | 2,270 | NE | 29 | 100 | NE | 0.005 / 0.0006 |
| Benzo(g,h,i)perylene | NA | NA | NE | NE | NE | NE | 18 | 1.1 | NE | 0.005 / 0.0005 |
| Fluoranthene | NA | NA | 3,200 | 140,000 | 631 | NE | 18 | 1.1 | NE | 0.005 / 0.0014 |
| Fluorene | NA | NA | 3,200 | 140,000 | 101 | NE | 30 | 100 | NE | 0.005/ 0.0005 |
| 1-Methylnaphthalene | 5 [a,f] | 5 [a,f] | 34.5 | 4,530 | NL [a,f] | NE | 29 | 100 | NE | 0.005 / 0.00063 |
| 2-Methylnaphthalene | 5 [a,f] | 5 [a,f] | 320 | 14,000 | NL [a,f] | NE | 29 | 100 | NE | 0.005/ 0.000205 |
| Naphthalene | 5 [a,f] | 5 [a,f] | 1,600 | 70,000 | 4.46 | NE | 29 | 100 | NE | 0.005 / 0.00162 |
| Phenanthrene | NA | NA | NE | NE | NE | NE | 29 | 100 | NE | 0.005/ 0.00163 |
| Pyrene | NA | NA | 2,400 | 100,000 | 655 | NE | 18 | 1.1 | NE | 0.005/ 0.00097 |
| **Carcinogenic PAHs (mg/kg)** | | | | | | | | | | |
| Total Toxicity Equivalent Concentration (TTEC) | 0.1 [b,f] | 2 [b,f] | 0.19 [b] | 130 [b] | 3.9/0.19 [b] | NE | NE | NE | NE | 0.005 / 0.00084 |
| Total HMW PAH | NA | NA | NE | NE | NE | NE | 18 | 1.1 | NE | 0.005 / 0.00084 |
| Benzo(a)pyrene | 0.1 [b,f] | 2 [b,f] | NL [b] | NL [b] | NL [b] | NE | 18 | 12 | NE | 0.005 / 0.00084 |
| Benzo(a)anthracene | NL [b] | NL [b] | NL [b] | NL [b] | NL [b] | NE | 18 | 1.1 | NE | 0.005 / 0.00076 |
| Benzo(b)fluoranthene | NL [b] | NL [b] | NL [b] | NL [b] | NL [b] | NE | 18 | 1,1 | NE | 0.005/ 0.00059 |
| Benzo(k)fluoranthene | NL [b] | NL [b] | NL [b] | NL [b] | NL [b] | NE | 18 | 1.1 | NE | 0.005/ 0.00060 |
| Chrysene | NL [b] | NL [b] | NL [b] | NL [b] | NL [b] | NE | 18 | 1.1 | NE | 0.005 /0.0015 |
| Dibenz(a,h)anthracene | NL [b] | NL [b] | NL [b] | NL [b] | NL [b] | NE | 18 | 1,1 | NE | 0.005/ 0.00072 |
| Indeno(1,2,3-cd)pyrene | NL [b] | NL [b] | NL [b] | NL [b] | NL [b] | NE | 18 | 1.1 | NE | 0.005 / 0.00060 |
| **Polychlorinated Biphenyls (PCBs) (mg/kg)** | | | | | | | | | | |
| Total PCBs | 1.0 | 10.0 | 0.5 | 65.6 | NE | 40 | NE | 0.65 | NE | 0.02 / 0.0074 |
| **Aroclors** | | | | | | | | | | |
| 1016 | NA | NA | 14.3 | 245 | NE | NE | NE | NE | NE | 0.02 / 0.0074 |
| 1221 | NA | NA | NE | NE | NE | NE | NE | NE | NE | 0.02 / 0.0042 |
| 1232 | NA | NA | NE | NE | NE | NE | NE | NE | NE | 0.02 / 0.0049 |
| 1242 | NA | NA | NE | NE | NE | NE | NE | NE | NE | 0.02 / 0.0035 |
| 1248 | NA | NA | NE | NE | NE | NE | NE | NE | NE | 0.02 / 0.0029 |
| 1254 | NA | NA | 0.5 | 65.6 | NE | 40 | NE | NE | NE | 0.02 / 0.0037 |
| 1260 | NA | NA | 0.5 | 65.6 | NE | NE | NE | NE | NE | 0.02 / 0.0074 |

**Table 3-1**
**Soil Screening Level Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 2 of 3)**

| Chemicals of Potential Concern | MTCA Screening Levels: Method A – Unrestricted Land Use | Method A – Industrial | Method B | Method C | Protection of Groundwater (Unsaturated Zone) | Ecological Screening Levels [d,e]: Ecological Indicator-Plants | Ecological Indicator-Soil Biota | Ecological Indicator-Wildlife | Range of Background Concentrations | Laboratory Reporting Limit / Method Detection Limit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Metals (mg/kg)** | | | | | | | | | | |
| Aluminum | NA | NA | 80,000 | 3,500,000 | NE | 50 | NE | NE | 12,692 [h] / 28,299 [g] | 15.0 / 3.3 |
| Arsenic | 20 [m] | 20 [m] | 0.667 | 87.5 | 2.9 | 10 | 60 | 132 | 1.9 [h] / 7.61 [g] | 0.5 / 0.1 |
| Cadmium | 2 [f] | 2 [f] | 80 | 3,500 | 0.69 | 4 | 20 | 14 | 0.07 [h] / 0.81 [g] | 0.4 / 0.07 |
| Chromium [l] | 2,000 | 2,000 | 120,000 | 5,250,000 | 480,000 | 42 | 42 | 67 | 12.37 [h] / 31.88 [g] | 0.5 / 0.06 |
| Copper | NA | NA | 3,200 | 140,000 | 280 | 100 | 50 | 217 | 28.4 [g] | 1.0 / 0.22 |
| Lead | 250 | 1,000 | NE | NE | 3,000 | 50 | 500 | 118 | 5.19 [h] / 13.1 [g] | 0.5 / 0.05 |
| Mercury | 2 [f] | 2 [f] | 24 | NE | 2.1 | 0.3 | 0.1 | 5.5 | 0.0015 [h] / 0.04 [g] | 0.03 / 0.009 |
| Nickel [c] | NA | NA | 880 | 38,500 | 130 | 30 | 200 | 980 | 24.54 [g] | 0.5 / 0.19 |
| Selenium | NA | NA | 400 | 17,500 | 5.2 | 1 | 70 | 0.3 | 0.29 [h] | 1.5 / 0.28 |
| Silver | NA | NA | 400 | 17,500 | 14 | 2 | NE | 4 | 0.14 [h] | 0.2 / 0.02 |
| Zinc | NA | NA | 24,000 | 1,050,000 | 6,000 | 86 | 200 | 360 | 80.91 [g] | 5.5 / 1.61 |
| **Total Petroleum Hydrocarbons (TPHs) (mg/kg)** | | | | | | | | | | |
| TPH-Gx (gasoline-extended range) | 100 [n]<br>30 | 100 [n]<br>30 | NE | NE | NA | 120 | 120 | 1,000 | NA | 5.0 / 2.30 |
| TPH-Dx (diesel and heavy-oil ranges) | 2,000 | 2,000 | NE | NE | NA | 1,600 | 260 | 2,000 | NA | 50 / 12.3 |
| **Volatile Organic Compounds (VOCs) (mg/kg)** | | | | | | | | | | |
| ***Fuel-Related*** | | | | | | | | | | |
| Benzene | 0.03 [f] | 0.03 [f] | 18 | 2,400 | 0.0274 | NE | NE | 0.255 | NA | 0.030 / 0.0038 |
| Toluene | 7 [f] | 7 [f] | 6,400 | 280,000 | 4.52 | 200 | NE | 5.45 | NA | 0.15 / 0.0135 |
| Ethyl benzene | 6 [f] | 6 [f] | 8,000 | 350,000 | 6.05 | NE | NE | 5.16 | NA | 0.040/0.0091 |
| Xylenes | 9 [f] | 9 [f] | 16,000 | 700,000 | 14.600 | NE | NE | 10 | NA | 0.2 / 0.0149 |
| ***Solvents*** | | | | | | | | | | |
| Tetrachloroethene (PCE) | 0.05 [f] | 0.05 [f] | 480 | 21,000 | 0.0499 | NE | NE | 9.92 | NA | 0.002/ 0.0004 |
| Trichloroethene (TCE) | 0.03 [f] | 0.03 [f] | 12 | 800 | 0.0252 | NE | NE | 12.4 | NA | 0.002 / 0.0003 |
| 1,1,1-Trichloroethane (1,1,1-TCA) | 2[f] | 2 [f] | 160,000 | 7,000,000 | 1.49 | NE | NE | 29.8 | NA | 0.002 / 0.0003 |
| 1,2,-Dichloroethane (1,2-DCA) | NE | NE | 11 | 1,400 | 0.0231 | NE | NE | 21.2 | NA | 0.001 / 0.0002 |
| cis-1,2-Dichlorothene (cis-1,2-DCE) | NE | NE | 160 | 7,000 | 0.0781 | NE | NE | 30.2 | NA | 0.003 / 0.0006 |
| Vinyl chloride | NE | NE | 0.67 | 88 | 0.00167 | NE | NE | 6.46 | NA | 0.002/ 0.0003 |

**Table 3-1**
**Soil Screening Level Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 3 of 3)**

**Notes:**

Cleanup Level and Risk Calculations Summary Tables accessed online during October 2019 and incorporate May 2019 CLARC Update (Ecology 2019a)

a Method A level includes sum of 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene.
b MTCA cleanup levels for carcinogenic PAHs are based on toxicity equivalency factor summation approach specified in WAC 173-340-708(8) and Table 708-2 of MTCA.
c CLARC value for nickel refinery dusts adopted for human-health screening purposes. Soil screening values for protection of groundwater based on soluble salt-physical properties.
d Ecological indicator soil concentration for plants, soil biota, and wildlife exposure categories (Table 749-3, WAC 173-340-7493, MTCA).
e Additional ecological indicator soil screening values provided by Ecology and based on Ecology Implementation Memorandum # 19 for TPH and EPA ecological soil screening level guidance for low molecular-weight (LMW) and high molecular-weight (HMW) PAHs (EPA 2007). For PAHs, total LMW and HMW PAH concentrations will be used for screening purposes. Individual PAH levels are provided for completeness.
f Method A soil level is designed to be protective of groundwater drinking water use.
g Natural background based on Ecology (1994) soil natural background concentration study. Value represents 90$^{th}$ percentile of eastern Washington data set.
h Site-specific background value from PGG (2013a) site investigation.
i Cyanide soil screening levels for protection of groundwater based on literature distribution coefficient, MTCA Method B groundwater formula value/MCL, and fixed parameter three phase partitioning mode.
j Fluoride soil screening level for protection of groundwater based on MCL and empirical demonstration consistent with WAC 173-340-747.
k Sulfate screening level for protection of groundwater based on literature distribution coefficient, Secondary MCL, and fixed parameter there-phase partitioning model.
l Chromium screening levels are based on chromium (III) as the dominant form.
m Method A Cleanup Level for arsenic based on protection of groundwater adjusted for soil natural background.
n Method A Cleanup Level of 100 mg/kg if benzene is not detected and the sum of BTEX is less than 1 percent). Otherwise, the MTCA Method A Cleanup Level is 30 mg/kg.

mg/kg = Milligrams per kilogram
µg/kg = Micrograms per kilogram
BTEX = Benzene, toluene, ethylbenzene, and total xylenes
CLARC = Cleanup Level and Risk Calculations Summary Tables and guidance accessed online during April 2018.
HMW = High Molecular-Weight
LMW = Low Molecular-Weight
MTCA = Model Toxics Control Act
MCL = Maximum Contaminant Level
NA = Not applicable
NE = Not established in look-up Tables.
NL = Not listed. Screening level for specific chemical is not listed but is accounted for by summation process. Refer to footnotes.
NPDES = National Pollutant Discharge Elimination System
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
TEE = Terrestrial Ecological Evaluation
TPHs = Total Petroleum Hydrocarbons
TPH-Dx = Total Petroleum Hydrocarbons – Diesel-extended range
TPH-Gx = Total Petroleum Hydrocarbons – Gasoline-extended range
VOCs = Volatile Organic Compounds

**Table 3-2**
**Groundwater Screening Level Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 1 of 2)**

| Chemicals of Potential Concern | MTCA Screening Levels | | | Natural Background | WA MCL | Laboratory Reporting Limit / Method Detection Limit |
|---|---|---|---|---|---|---|
| | Method A | Method B | Method C | | | |
| **Aluminum Smelting (mg/L)** | | | | | | |
| Cyanide (Free) | NE | 0.0096 | 0.021 | ND | 0.2 | 0.005 / 0.0015 |
| Fluoride | NE | 0.96 | 2.1 | 0.72 | 4 | 0.20 / 0.030 |
| Sulfate | NE | NE | NE | 32 | 250 (also federal secondary) | 1.20 / 0.260 |
| **Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)** | | | | | | |
| Acenaphthene | NE | 960 | 2,100 | NE | NE | 0.10 / 0.014 |
| Acenaphthylene | NE | NE | NE | NE | NE | 0.05 / 0.009 |
| Anthracene | NE | 4,830 | 10,500 | NE | NE | 0.10 / 0.022 |
| Benzo(g,h,i)perylene | NE | NE | NE | NE | NE | 0.05 / 0.012 |
| Fluoranthene | NE | 640 | 1,400 | NE | NE | 0.20 / 0.050 |
| Fluorene | NE | 640 | 1,400 | NE | NE | 0.10 / 0.017 |
| 1-Methylnaphthalene | 160 [a] | 1.51 | 15.1 | NE | NE | 0.10 / 0.019 |
| 2-Methylnaphthalene | 160 [a] | 32 | 70 | NE | NE | 0.20 / 0.039 |
| Naphthalene | 160 [a] | 160 | 350 | NE | NE | 0.10 / 0.031 |
| Phenanthrene | NE | NE | NE | NE | NE | 0.10 / 0.031 |
| Pyrene | NE | 480 | 1,050 | NE | NE | 0.10 / 0.033 |
| **Carcinogenic PAHs (µg/L)** | | | | | | |
| Total Toxicity Equivalent Concentration (TTEC) | 0.1 | 0.2 [d] | 0.2 [d] | NE | NE | 0.10 / 0.011 |
| Benzo(a)pyrene | 0.1 [b] | NL [b] | NL [b] | NE | 0.2 | 0.10 / 0.011 |
| Benzo(a)anthracene | NL [b] | NL [b] | NL [b] | NE | NE | 0.05 / 0.014 |
| Benzo(b)fluoranthene | NL [b] | NL [b] | NL [b] | NE | NE | 0.05 / 0.011 |
| Benzo(k)fluoranthene | NL [b] | NL [b] | NL [b] | NE | NE | 0.05 / 0.012 |
| Chrysene | NL [b] | NL [b] | NL [b] | NE | NE | 0.10 / 0.016 |
| Dibenz(a,h)anthracene | NL [b] | NL [b] | NL [b] | NE | NE | 0.10 / 0.026 |
| Indeno(1,2,3-cd)pyrene | NL [b] | NL [b] | NL [b] | NE | NE | 0.05 / 0.014 |
| **Polychlorinated Biphenyls (PCBs) (µg/L)** | | | | | | |
| Total PCBs | 0.1 | 0.0438 | 0.438 | ND | 0.5 | 0.1 / 0.621 |
| 1016 | NE | 1.12 | 12.5 | ND | NE | 0.1 / 0.621 |
| 1221 | NE | NE | NE | ND | NE | 0.1 / 0.621 |
| 1232 | NE | NE | NE | ND | NE | 0.1 / 0.621 |
| 1242 | NE | NE | NE | ND | NE | 0.1 / 0.621 |
| 1248 | NE | NE | NE | ND | NE | 0.1 / 0.621 |
| 1254 | NE | 0.0438 | 0.438 | ND | NE | 0.1 / 0.621 |
| 1260 | NE | 0.0438 | 0.438 | ND | NE | 0.1 / 0.621 |
| **Metals (mg/L)** | | | | | | |
| Aluminum | NE | 16 | 35 | 1.14 | NE | 0.1 / 0.0126 |
| Arsenic | 0.005 | 0.0000583 | 0.000583 | 0.0069 | 0.010 | 0.001 / 0.0002 |
| Cadmium | 0.005 | 0.008 | 0.0175 | NE | 0.05 | 0.0004 / 0.0001 |
| Chromium (total) | 0.050 | NE | 52.5(Cr III) | 0.03 | 0.1 | 0.0004 / 0.0002 |
| Copper | NE | 0.64 | 1.4 | NE | 13 | 0.002 / 0.0006 |
| Lead | 0.015 | NE | NE | 0.0004632 | 0.015 | 0.0008 / 0.0002 |
| Mercury | 0.002 | NE | NE | NE | 0.002 | 0.0003 / 0.0002 |
| Nickel [c] | NE | 0.176 | 0.385 | 0.0651 | 0.1 | 0.0003 / 0.0001 |
| Selenium | NE | 0.08 | 0.175 | NE | 0.050 | 0.0008 / 0.0020 |
| Silver | NE | 0.08 | 0.175 | NE | NE | 0.0004 / 0.0005 |
| Zinc | NE | 4.8 | 10.5 | NE | NE | 0.007 / 0.0019 |

**Table 3-2**
**Groundwater Screening Level Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 2 of 2)**

| Chemicals of Potential Concern | MTCA Screening Levels | | | Natural Background | WA MCL | Laboratory Reporting Limit / Method Detection Limit |
|---|---|---|---|---|---|---|
| | Method A | Method B | Method C | | | |
| **Total Petroleum Hydrocarbons (TPH) (mg/L)** | | | | | | |
| TPH-Gx (gasoline-extended range) | 1 (no benzene) 0.80 (benzene present) | NE | NE | NE | NE | 0.250 / 0.10 |
| TPH-Dx (diesel and heavy-oil ranges) | 5 | NE | NE | NE | NE | 0.110 / 0.065 |
| **Volatile Organic Compounds (VOCs) (µg/L)** | | | | | | |
| **Fuel-Related** | | | | | | |
| Benzene | 5 | 0.795 | 70 | NE | 5 | 0.20 / 0.03 |
| Toluene | 1,000 | 640 | 1,400 | NE | 1,000 | 0.20 / 0.05 |
| Ethyl benzene | 700 | 800 | 1,750 | NE | 700 | 0.20 / 0.05 |
| Xylenes | 1,000 | 1,600 | 3,500 | NE | 10,000 | 0.50 / 0.115 |
| **Solvent-Related** | | | | | | |
| Tetrachloroethene (PCE) | 5 | 20.8 | 105 | NE | 5 | 0.50 / 0.084 |
| Trichloroethene (TCE) | 5 | 0.54 | 8.75 | NE | 5 | 0.20 / 0.066 |
| 1,1,1-Trichloroethane (1,1,1-TCA) | 200 | 16,000 | 35,000 | NE | 200 | 0.20 / 0.025 |
| 1,2,-Dichloroethane (1,2-DCA) | 5 | 0.481 | 4.81 | NE | 5 | 0.20 / 0.043 |
| cis-1,2-Dichlorothene (cis-1,2-DCE) | NE | 16 | 35 | NE | 70 | 0.20 / 0.055 |
| Vinyl chloride | 0.2 | 0.029 | 0.29 | NE | 2 | 0.02 / 0.013 |

Notes:
Cleanup Level and Risk Calculations Summary Tables accessed online during October 2019 and incorporate May 2019 CLARC Update (Ecology 2019a).

a Method A level includes sum of 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene.

b MTCA cleanup levels for carcinogenic PAHs are based on toxicity equivalency factor summation approach specified in WAC 173-340-708(8) and Table 708-2 of MTCA.

c CLARC Method B and C values for nickel refinery dusts or nickel soluble salts depending on available values.

d MTCA Method B and C Cleanup Levels for carcinogenic PAHs represent the MCL consistent with Ecology (2019b) May 2019 CLARC modification.

mg/L = Milligrams per Liter
µg/L = Micrograms per Liter
CLARC = Cleanup Level and Risk Calculations Summary Tables accessed online during April 2018.
MCL = Maximum Contaminant Level
MTCA = Model Toxics Control Act
ND = Chemical was not detected
NE = Not established in look-up Tables
NL = Not listed. Screening level for specific chemical is not listed but is accounted for by summation process. Refer to footnotes.
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
TPHs = Total Petroleum Hydrocarbons
TPH-Dx = Total Petroleum Hydrocarbons – Diesel-extended range
TPH-Gx = Total Petroleum Hydrocarbons – Gasoline-extended range
VOCs = Volatile Organic Compounds
WA = Washington
Xylenes = Represents the total of m-, o-, and p-xylene isomers.

**Table 3-3**
**Surface Water Screening Level Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 1 of 3)**

| Chemical | MTCA Human Health | | Human Health – Freshwater | | | Aquatic Life | | Drinking Water WA MCL | Laboratory Reporting Limit/Method Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| | Method B | Method C | WAC 173-201A (Washington State Surface Water Criteria) | 40 CFR 131.45 Water Quality Criteria | Clean Water Act Section 304 National Recommended Water Quality Criteria – Water + Organisms | National Recommended Water Quality Criteria – Freshwater Acute (CMC) | National Recommended Water Quality Criteria – Freshwater Chronic (CCC) | | |
| **Aluminum Smelting (mg/L)** | | | | | | | | | |
| Cyanide (Free) | 1.6 | 4.1 | 0.019 | 0.009 | 0.004 | 0.022 | 0.0052 | 0.2 | 0.005 / 0.0015 |
| Fluoride | NE | NE | NE | NE | NE | NE | NE | 4.0 | 0.20 / 0.030 |
| Sulfate | NE | NE | NE | NE | NE | NE | NE | 250 (Federal Secondary MCL) | 1.20 / 0.260 |
| **Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)** | | | | | | | | | |
| Acenaphthene | 640 | 1,600 | 110 | 30 | 70 | NE | NE | NE | 0.10 / 0.014 |
| Acenaphthylene | NE | NE | NE | NE | NE | NE | NE | NE | 0.05 / 0.009 |
| Anthracene | 26,000 | 65,000 | 3,100 | 100 | 300 | NE | NE | NE | 0.10 / 0.022 |
| Benzo(g,h,i)perylene | NE | NE | NE | NE | NE | NE | NE | NE | 0.05 / 0.012 |
| Fluoranthene | 90 | 230 | 16 | 6 | 20 | NE | NE | NE | 0.20 / 0.050 |
| Fluorene | 3,500 | 8,600 | 420 | 10 | 50 | NE | NE | NE | 0.10 / 0.017 |
| 1-Methylnaphthalene | NE | NE | NE | NE | NE | NE | NE | NE | 0.10 / 0.019 |
| 2-Methylnaphthalene | NE | NE | NE | NE | NE | NE | NE | NE | 0.20 / 0.039 |
| Naphthalene | 4,900 | 12,000 | NE | NE | NE | NE | NE | NE | 0.10 / 0.031 |
| Phenanthrene | NE | NE | NE | NE | NE | NE | NE | NE | 0.10 / 0.031 |
| Pyrene | 2,600 | 6,500 | 310 | 8 | 20 | NE | NE | NE | 0.10 / 0.033 |
| **Carcinogenic PAHs (µg/L)** | | | | | | | | | |
| Total Toxicity Equivalent Concentration (TTEC) | 0.000016 [b] | 0.000016 [b] | NE | NE | NE | NE | NE | NE | 0.10 / 0.011 |
| Benzo(a)pyrene | 0.000016 [b] | 0.000016 [b] | 0.0014 | 0.000016 | 0.00012 | NE | NE | 0.2 | 0.10 / 0.011 |
| Benzo(a)anthracene | NE | NE | 0.014 | 0.00016 | 0.0012 | NE | NE | NE | 0.05 / 0.014 |
| Benzo(b)fluoranthene | NE | NE | 0.014 | 0.00016 | 0.0012 | NE | NE | NE | 0.05 / 0.011 |
| Benzo(k)fluoranthene | NE | NE | 0.014 | 0.0016 | 0.012 | NE | NE | NE | 0.05 / 0.012 |
| Chrysene | NE | NE | 1.4 | 0.016 | 0.12 | NE | NE | NE | 0.10 / 0.016 |
| Dibenz(a,h)anthracene | NE | NE | 0.0014 | 0.000016 | 0.00012 | NE | NE | NE | 0.10 / 0.026 |
| Indeno(1,2,3-cd)pyrene | NE | NE | 0.014 | 0.00016 | 0.0012 | NE | NE | NE | 0.05 / 0.014 |
| **Polychlorinated Biphenyls (PCBs) (µg/L)** | | | | | | | | | |
| Total PCBs | 0.0001 | 0.0026 | 0.00017 | 0.000007 | 0.000064 | 2 | 0.014 | 0.5 | 0.1 / 0.621 |
| **Aroclors (µg/L)** | | | | | | | | | |
| 1016 | 0.0058 | 0.015 | NE | NE | NE | NE | NE | NE | 0.1 / 0.621 |
| 1221 | NE | NE | NE | NE | NE | NE | NE | NE | 0.1 / 0.621 |
| 1232 | NE | NE | NE | NE | NE | NE | NE | NE | 0.1 / 0.621 |
| 1242 | NE | NE | NE | NE | NE | NE | NE | NE | 0.1 / 0.621 |
| 1248 | NE | NE | NE | NE | NE | NE | NE | NE | 0.1 / 0.621 |
| 1254 | 0.0017 | 0.0026 | NE | NE | NE | NE | NE | NE | 0.1 / 0.621 |
| 1260 | NE | NE | NE | NE | NE | NE | NE | NE | 0.1 / 0.621 |

**Table 3-3**
**Surface Water Screening Level Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 2 of 3)**

| Chemical | MTCA Human Health | | Human Health | | | Aquatic Life | | Drinking Water WA MCL | Laboratory Reporting Limit/Method Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Freshwater | | | | | | |
| | Method B | Method C | WAC 173-201A (Washington State Surface Water Criteria) | 40 CFR 131.45 Water Quality Criteria | Clean Water Act Section 304 National Recommended Water Quality Criteria – Water + Organisms | National Recommended Water Quality Criteria – Freshwater Acute (CMC) | National Recommended Water Quality Criteria – Freshwater Chronic (CCC) | | |
| **Metals (mg/L)** | | | | | | | | | |
| Aluminum [a] | NE | NE | NE | NE | NE | NE | NE | NE | 0.1 / 0.0126 |
| Arsenic | 0.000098 | 0.0025 | 0.00001 | 0.000018 | 0.000018 | 0.36 | 0.19 | 0.010 | 0.001 / 0.0002 |
| Cadmium | NE | NE | NE | NE | NE | 0.0037 | 0.001 | 0.05 | 0.0004 / 0.0001 |
| Chromium (III) | 240 | 610 | NE | NE | NE | 0.55 | 0.18 | 0.1 | 0.0004 / 0.0002 |
| Copper [a] | 2.9 | 7.2 | 1.3 | NE | 1.3 | 0.017 | 0.011 | 13 | 0.002 / 0.0006 |
| Lead | NE | NE | NE | NE | NE | 0.065 | 0.0025 | 0.015 | 0.0008 / 0.0002 |
| Mercury | NE | NE | NE | NE | NE | 0.0021 | 0.000012 | 0.002 | 0.0003 / 0.0002 |
| Nickel (soluble salts) | 1.1 | 2.8 | 0.15 | 0.08 | 0.06 | 1.4 | 0.16 | 0.1 | 0.003 / 0.0001 |
| Selenium | 2.7 | 6.8 | 0.12 | 0.06 | 0.17 | 0.02 | 0.005 | 0.050 | 0.008 / 0.0020 |
| Silver | 26 | 65 | NE | NE | NE | 0.0034 | NE | NE | 0.0004 / 0.0005 |
| Zinc | 17 | 41 | 2.3 | 1 | 7.4 | 0.11 | 0.01 | NE | 0.007 / 0.0019 |
| **Total Petroleum Hydrocarbons (TPHs) (mg/L)** | | | | | | | | | |
| TPH-Gx (gasoline-extended range) | NE | NE | NE | NE | NE | NE | NE | NE | 0.250 / 0.10 |
| TPH-Dx (diesel and heavy-oil ranges) | NE | NE | NE | NE | NE | NE | NE | NE | 0.110 / 0.065 |
| **Volatile Organic Compounds (VOCs) (µg/L)** | | | | | | | | | |
| **Fuel-Related** | | | | | | | | | |
| Benzene | 23 | 570 | 0.44 | NE | 0.58 | NE | NE | 5 | 0.20 / 0.03 |
| Toluene | 19,000 | 48,000 | 180 | 72 | 57 | NE | NE | 1,000 | 0.20 / 0.05 |
| Ethyl benzene | 6,900 | 17,000 | 200 | 29 | 68 | NE | NE | 700 | 0.20 / 0.05 |
| Xylenes | NE | NE | NE | NE | NE | NE | NE | 10,000 | 0.50 / 0.115 |
| **Solvent-Related** | | | | | | | | | |
| Tetrachloroethene (PCE) | 100 | 1,300 | 4.9 | 2.4 | 10 | NE | NE | 5 | 0.50 / 0.084 |
| Trichloroethene (TCE) | 13 | 290 | 0.38 | 0.3 | 0.6 | NE | NE | 5 | 0.20 / 0.066 |
| 1,1,1-Trichloroethane (1,1,1-TCA) | 930,000 | 2,300,000 | 47,000 | 20,000 | 10,000 | NE | NE | 200 | 0.20 / 0.025 |
| 1,2-Dichloroethane (1,2-DCA) | 59 | 1,500 | 9.3 | 8.9 | 9.9 | NE | NE | 5 | 0.20 / 0.043 |
| cis-1,2-Dichlorothene (cis-1,2-DCE) | NE | NE | NE | NE | NE | NE | NE | 70 | 0.20 / 0.055 |
| Vinyl chloride | 3.7 | 92 | 0.02 | NE | 0.022 | NE | NE | 2 | 0.02 / 0.013 |

**Table 3-3**
**Surface Water Screening Level Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 3 of 3)**

**Notes:**

Cleanup Level and Risk Calculations Summary Tables accessed online during October 2019 and incorporate May 2019 CLARC Update (Ecology 2019a)

a Hardness and/or pH dependent criteria.

b Ecology has adopted the EPA 40 CFR 131.45 criteria as the MTCA Method B and C Surface Water Cleanup Level (Ecology 2019b).

mg/L = Milligrams per Liter
µg/L = Micrograms per Liter
CCC = Criterion Continuous Concentration
CFR = Code of Federal Regulations
Cleanup Level and Risk Calculations Summary Tables accessed online during August 2019 (May 2019 CLARC Update)
CMC = Criterion Maximum Concentration
MTCA = Model Toxics Control Act
NE = Not established in look-up Tables
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
TPHs = Total Petroleum Hydrocarbons
TPH-Dx = Total Petroleum Hydrocarbons – Diesel-extended range
TPH-Gx = Total Petroleum Hydrocarbons – Gasoline-extended range
VOCs = Volatile Organic Compounds
WAC = Washington Administrative Code

**Table 3-4**
**Sediment Freshwater Screening Level Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**

| Chemical | Washington SMS Freshwater | | Reference Station Concentrations | | Laboratory Reporting Limit / Method Detection Limit |
|---|---|---|---|---|---|
| | Sediment Cleanup Objective | Cleanup Screening Level | Maximum | 90/90 UTL | |
| **Aluminum Smelter (mg/kg)** | | | | | |
| Total Cyanide | NE | NE | ND | NC | 2.0 / 0.51 |
| Fluoride | NE | NE | 7.8 | 7.7 | 8.0 / 2.41 |
| Sulfate | NE | NE | 290 | 278 | 20 / 7.75 |
| **Polycyclic Aromatic Hydrocarbons (PAHs) (µg/kg)** | | | | | |
| 1-Methylnaphthalene | NA | NA | 28 | NC | 5.0 / 0.63 |
| 2-Methylnaphthalene | NA | NA | 30 | NC | 5.0 / 2.05 |
| Acenaphthene | NA | NA | 24 | NC | 5.0 / 0.60 |
| Acenaphthylene | NA | NA | 28 | NC | 5.0 / 0.50 |
| Anthracene | NA | NA | 29 | NC | 5.0 / 0.60 |
| Benz[a]anthracene | NA | NA | 83 | NC | 5.0 / 0.76 |
| Benzo(a)pyrene | NA | NA | 140 | 41 | 5.0 / 0.84 |
| Benzo(b)fluoranthene | NA | NA | 150 | NC | 5.0 / 0.59 |
| Benzo(ghi)perylene | NA | NA | 190 | NC | 5.0 / 0.50 |
| Benzo(k)fluoranthene | NA | NA | 43 | NC | 5.0 / 0.60 |
| Chrysene | NA | NA | 120 | NC | 5.0 / 1.50 |
| Dibenzo(a,h)anthracene | NA | NA | 26 | NC | 5.0 / 0.72 |
| Fluoranthene | NA | NA | 210 | NC | 5.0 / 1.40 |
| Fluorene | NA | NA | 27 | NC | 5.0 / 0.50 |
| Indeno(1,2,3-cd)pyrene | NA | NA | 150 | NC | 5.0 / 0.60 |
| Naphthalene | NA | NA | 100 | NC | 5.0 / 1.62 |
| Phenanthrene | NA | NA | 100 | NC | 5.0 / 1.63 |
| Pyrene | NA | NA | 260 | NC | 5.0 / 0.97 |
| Total cPAH BaPeq (calc) | NA | NA | 185 | 57 | 5.0 / 0.97 |
| Total PAHs | 17,000 | 30,000 | 1,516 | NC | 5.0 / 0.84 |
| **Polychlorinated Biphenyls (PCBs) (mg/kg)** | | | | | |
| Total Aroclors | 0.110 | 2.5 | ND | NC | 0.02 / 0.0074 |
| **Metals (mg/kg)** | | | | | |
| Aluminum | NA | NA | 21,000 | NC | 15.0 / 3.3 |
| Arsenic | 14 | 120 | 20 | 18 | 0.5 / 0.1 |
| Cadmium | 2.1 | 5.4 | 1.5 | 1.3 | 0.4 / 0.07 |
| Chromium | 72 | 88 | 32 | NC | 0.5 / 0.06 |
| Copper | 400 | 1,200 | 54 | NC | 1.0 / 0.22 |
| Lead | 360 | >1,300 | 35.8 | 128 | 0.5 / 0.05 |
| Mercury (inorganic) | 0.66 | 0.8 | 0.18 | 1.06 | 0.03 / 0.009 |
| Nickel | 26 | 110 | 22.7 | 48.6 | 0.5 / 0.19 |
| Selenium | 11 | >20 | NE | NE | 1.5 / 0.28 |
| Silver | 0.57 | 1.7 | NE | NE | 0.2 / 0.02 |
| Zinc | 3,200 | >4,200 | 121 | 459 | 5.5 / 1.61 |
| **Bulk Petroleum Hydrocarbons (mg/kg)** | | | | | |
| TPH-Diesel | 340 | 510 | ND | NC | 50 / 12.3 |
| TPH-Residual | 3,600 | 4,400 | 61 | NC | 50 / 17.5 |

**Notes:**

The list of chemicals is limited to chemicals of potential concern for freshwater sediment. There are no SMS Standards for individual PAHs. Volatile Organic Compounds (VOCs) do not represent chemicals of potential concern for sediments.

mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
BaPeq = Benzo(a)pyrene equivalent
cPAHs = Carcinogenic Polycyclic Aromatic Hydrocarbons
NA = Not Applicable
NC = Not Calculated
ND = Not Detected
NE = Not Established
PAHs = Polycyclic Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
SMS = Washington State Sediment Management Standard
TPH = Total Petroleum Hydrocarbon
UTL = Upper Tolerance Limit

The CLARC update also reflects changes to surface water criteria based on applicable state and federal laws as described below. Tables 3-1 and 3-2 summarize updated and current soil and groundwater screening levels for the project, along with laboratory reporting limits and method detection limits.

### 3.1.2 Water Quality Criteria

Ecology and Yakama Nation comments (Ecology and Yakama Nation 2019) on the Draft RI Report (Tetra Tech et al. 2019a) state that the surface water screening levels should be updated to include recent changes to the State human health water quality criteria promulgated in 2015 and 2016 changes in federal water quality criteria. Several surface water quality criteria have changed during the course of the RI field effort and Draft RI Report (Tetra Tech et al. 2019a) preparation, including updates in EPA's National Water Quality Criteria [304 (a)] in 2015 and 2016, Ecology Water Quality Standards (WAC 173-201A) in 2016, and EPA's 2016 "Revision of Certain Federal Water Quality Criteria Applicable in Washington." Changes of the water quality criteria in Washington are summarized in Ecology (2019a) and EPA (2016).

EPA has recently announced finalization of a rule to repeal the 2015 Clean Water Rule and re-codify the regulatory text defining the waters of the United States that existed prior to 2015. It is unclear how this repeal affects the potential use and application of surface water quality criteria at the Site. Further discussion is warranted regarding selection of appropriate surface water screening levels for use at the Site moving forward. However, the data quality objectives developed in support of this WPA provide for assessment of groundwater to surface water and groundwater screening levels, as appropriate.

Table 3-3 summarizes updated and current surface water screening criteria as summarized in the May 2019 update of CLARC for both human health and ecologic exposures along with project laboratory reporting limits and method detection limits. Based on Ecology (2019b) guidance, Ecology has adopted the EPA 40 CFR 131.45 water quality criteria for benzo(a)pyrene as the MTCA Method B Cleanup Level. Note that some of the surface water screening criteria [e.g., benzo(a)pyrene] are orders of magnitude below the method detection limit and reporting limits.

### 3.1.3 Washington State Sediment Management Standards

In 2013, Ecology finalized updates to the Sediment Management Standards (SMS), Chapter 173-204 WAC. In support of those SMS updates, revisions to the Sediment Cleanup User's Manual (termed SCUM II) were finalized in 2015. Included in SCUM II were Sediment Cleanup Objectives (SCO) and cleanup screening levels for the protection of the benthic community in freshwater and marine sediments. The SCUM II guidance also includes the assessment approach for risks to human health for bioaccumulative chemicals. For the human health assessments, the SCUM II guidance includes two options, a simple streamlined approach using sediment data or a more detailed site-specific approach using site-specific sediment and tissue data. The SCUM II guidance included risk-based calculations for concentrations in sediment, using default assumptions, for human exposure pathways for direct contact included as a resource in the SCUM II guidance. The guidance notes that for the simple streamlined approach, the use of background sediment concentrations instead of site-specific consumption calculated values is appropriate since the risk-based concentrations are frequently below background, resulting in Sediment Cleanup Objectives and Cleanup Screening Level values defaulting to background or practical quantitation limits.

A revision of the SCUM II was made in 2017 (Ecology 2017a) with a draft of a second revision put out for comment in 2019 (Ecology 2019c). The 2019 revision of SCUM II included updates to the default assumptions for the risk-based calculations that resulted in changes to the guidance values for the human health direct exposure pathways included. The 2019 revision for the SCUM II guidance also has added text noting the risk-based concentrations for bio-accumulative chemicals are to be established if complete exposure pathways have been identified in the RI and that if exposure pathways are incomplete, then the benthic criteria should be compared to background concentrations and practical quantitation limits.

Ecology comments on the Draft RI report and the Draft WPA, state that the SMS criteria are potentially applicable for use in areas that are inundated with water for periods of more than 6 consecutive weeks. At this time, the responsible parties do not agree that the SMS criteria are applicable to the stormwater pond and NPDES ponds that represent part of the constructed and permitted NPDES system. Also, only a limited portion of the wetlands at the Site meet this inundation criterion. Also, in general, it should be noted that for the main site chemical of potential concern (COPC) in soil and sediment (e.g., fluoride and PAHs), Sediment Cleanup Objectives and Cleanup Screening Levels are either not established or are typically higher than corresponding soil screening levels for terrestrial ecologic screening, unrestricted land use, or groundwater protection.

Table 3-4 summarizes current freshwater sediment screening criteria. Table 3-4 also includes maximum and 90 Upper Tolerance Limit (UTL) reference station concentrations which have been updated to include carcinogenic PAHs.

## 3.2 TREATY-PROTECTED TRIBAL USES

Ecology and Yakama Nation comments (Ecology and Yakama Nation 2019) on the Draft RI Report (Tetra Tech et al. 2019a) indicated a data need to confirm that MTCA Soil Cleanup Levels for Unrestricted Land Use (MTCA Method A and B) are protective of Treaty-Protected Tribal Uses. It appears likely that MTCA soil cleanup level for unrestricted land use are protective based on their residential exposure assumptions (e.g., exposure frequency, average body weight, soil ingestion rate and risk levels). Based on Yakama Nation comments on the Draft WPA, it appears that "data of sufficient quality to determine protectiveness based on Unrestricted Land Use would likely be sufficient to determine protectiveness relative to Treaty-protected Tribal uses."

## 3.3 TERRESTRIAL ECOLOGICAL EVALUATION

Ecology and Yakama Nation comments (Ecology and Yakama Nation 2019) on the Draft RI Report (Tetra Tech et al. 2019a) requested additional TEE. In the Draft RI Report (Tetra Tech et al. 2019a), SWMUs and AOCs were evaluated individually for either a simplified (most SWMUs) or the site-specific TEE that was conducted for the Wetlands AOC. The simplified TEE evaluation included comparison of soil screening levels for industrial or commercial sites (refer to MTCA Table 749-2) and protection of wildlife (refer to MTCA Table 749-3). In addition, some SWMUs and AOCs were excluded from TEE based on their lack of available habitat [e.g., the Plant Area – Area of Concern (PAAOC)] or on the basis that a remedial action had already been completed (e.g., the West Surface Impoundment).

Supplemental ecological information was provided by Ecology that shows the location of PHS areas in the Site vicinity (refer to Section 2.1 and Figure 2-5). The Draft Final RI Report will incorporate PHS areas summary into the TEE.

Ecology comments (Ecology and Yakama Nation 2019) on the Draft RI Report (Tetra Tech et al. 2019a) state that a site-specific TEE is necessary for the overall site and that MTCA Table 749-3 Indicator Concentrations for three receptor categories (soil, biota, plants) should be used in this screening. Ecology's position is that soils in areas which are both owned by NSC and zoned for industrial use may be screened using only the wildlife values for TEE. All other areas of the Site should be screened using appropriate values for all three eco-risk receptor categories.

In addition to the screening levels included by rule in MTCA Table 749-3, screening levels for additional chemicals have been provided by Ecology. These recommended screening levels are based on best available science. For PAHs, The PAH values in the Ecology-supplied table are based on EPA (2007) guidance "Ecological Soil Screening Levels for PAHs, Interim Final". Table 3-1 summarizes these TEE screening values with associated laboratory reporting limits and method detection limits.

## 3.4 DEVELOPMENT OF RISK-BASED CONCENTRATIONS

In the Draft RI Report (Tetra Tech et al. 2019a), it was noted that risk-based screening levels for two chemicals that are widespread in groundwater (fluoride and sulfate) had not been identified for all media and potential exposure pathways of concern. Chemicals and pathways are described by media in the following sections.

### 3.4.1 Groundwater

For sulfate, the only screening level found is the Secondary MCL of 250 mg/L, which is deemed non-mandatory by EPA, because Secondary MCL are established for "nuisance" chemicals on aesthetic qualities as opposed to human health effects. According to EPA, contaminants are not considered to present a risk to human health at the Secondary MCL. However, Ecology has explained that the Secondary MCL for sulfate represents a likely Applicable or Relevant and Appropriate Requirement for the project. Washington State drinking water regulations (WAC 246-290-310) include a Secondary MCL for sulfate of 250 mg/L and drinking water system purveyors must monitor for and comply with this secondary standard.

A preliminary review of the EPA IRIS, EPA Health Effects Assessment Summary Table (HEAST), and the National Center for Environmental Assessment (NCEA) databases do not show available reference doses for sulfate. Further evaluation of the databases and scientific literature will be performed consistent with MTCA requirements [WAC 173-340-708 (7)] to establish sulfate risk-based concentrations for consideration. The secondary MCL for sulfate of 250 mg/L will also be retained for screening comparisons in the RI/FS.

For fluoride, the Primary MCL of 4.0 mg/L will be adopted for screening purposes consistent with other aluminum smelter cleanups in Washington State. The MTCA Method B groundwater formula value of 0.96 mg/L will also be retained in the RI/FS for screening purposes.

### 3.4.2 Surface Water

Surface water screening levels for fluoride and sulfate protective of human health and ecologic exposures have not been established. The Reynolds Metals Longview site (Anchor QEA 2018) has adopted the primary MCL for fluoride as the Site surface water cleanup level along with a Narrative Standard of no adverse effects on the protection and propagation of fish and aquatic life. A 1.8 mg/L screening level for fluoride in sediment porewater based on the Narrative Standard and reportedly protective of ecological exposures will be used for long-term monitoring at the Reynolds Metals Longview site (Anchor QEA 2018). This 1.8 mg/L fluoride screening level has been preliminarily identified for further evaluation by Ecology and the Yakama Nation. The technical basis and potential application for the 1.8 mg/L screening level will be further assessed. A literature search will be performed to evaluate freshwater screening levels protective of human health and ecological exposures for fluoride and sulfate.

Some of the screening levels for metals (e.g., aluminum and copper) represent hardness and pH dependent criteria. Screening levels for these constituents will be adjusted and/or determined based on site-specific pH and hardness groundwater and spring data as appropriate and will be presented in the Draft Final RI Report.

### 3.4.3 Fluoride Soil Screening Levels for Protection of Groundwater

Ecology commented on the empirical demonstration used to derive soil screening levels for protection of groundwater for fluoride [screening level of 615 milligrams per kilogram (mg/kg) based on 4.0 mg/L MCL]. These comments have been discussed with Ecology and a response to comments was submitted (Lockheed Martin and NSC 2019). The empirical demonstration represents a worst-case scenario in which fluoride-containing wastes are in direct contact with shallow groundwater and is sufficiently conservative to ensure that areas of fluoride-impacted soils that may impact groundwater are appropriately addressed in the Feasibility Study (FS). Accordingly, no further assessment is proposed. In response to Ecology and Yakama Nation comments on the Draft WPA, an additional fluoride soil screening level for groundwater protection of 147.6 mg/kg based on the MTCA Method B groundwater formula value of 0.96 mg/L will be included in the soil screening level comparisons.

### 3.4.4 Soil Screening Levels for Terrestrial Ecological Evaluation

The Ecology-provided TEE soil screening levels will be preliminarily assessed by the project team through a literature review. The problem formulation step, exposure pathways, evaluation of terrestrial ecological receptors of concern, and toxicological assessment as previously summarized for the Wetlands AOC in Volume 3, Section 3.2 of the Draft RI Report will be updated, re-evaluated, and applied on a site-wide basis.

The EPA (2007) guidance regarding PAH screening levels for Terrestrial Ecologic Evaluation indicates that concentrations of low molecular-weight (LMW) PAHs and high molecular-weight (HMW) PAHs should be summed and compared to the lowest of the screening levels for individual PAHs of that category. For LMW PAHs, this value is 100 mg/kg dry weight based on Mammalian Wildlife and for HMW PAHs, the value is 1.1 mg/kg dry weight based on this same receptor category. According to the guidance, a toxicity equivalency approach (as used in MTCA for PAH human health exposures) cannot be used with these screening levels due to data limitations.

A simple summation approach will be used to calculate the total LMW PAH and total HMW PAH concentrations. Table 3-1 has been revised to include the total LMW PAH and total HMW PAH screening levels and explain the calculation approach. The screening levels for individual PAHs will remain in Table 3-1 for completeness, but the total concentrations will be used for screening purposes.

In particular, Ecology soil screening levels for PAHs will be further evaluated. Alternative screening levels found through literature review, or allowable modifications to exposure parameters or other inputs to the wildlife exposure model may be proposed consistent with MTCA (WAC 173-340-7493) requirements and Ecology draft TEE guidance (Ecology 2017b). If needed, any additional fieldwork for TEE beyond the specific scope of this WPA, including additional substantive data analysis, or additional laboratory analysis (e.g., soil bioassays) will be proposed by the responsible parties in a separate WPA for Ecology review and approval before implementation.

# Section 4
# Field Activities Summary

This section summarizes the proposed field program for this WPA. Data needs, work elements, and the analytical program summary for the WPA field program are summarized in Table 4-1.

## 4.1 SITE PREPARATION AND PERMITTING

Project pre-mobilization planning and permitting activities are anticipated and are fully summarized in the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b). Planned site preparation and permitting work includes the following:

- **Review and Potential Updates of the Health and Safety Plan (HASP)**. The HASP will be reviewed and updated as necessary to incorporate WPA activities and project organizational changes.
- **Cultural Resources Field Surveys and Notifications.** Procedures specified in the Cultural Resources Monitoring Protocol included as an Appendix B to the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b) will be followed and is consistent with Washington State Department of Archaeology and Historic preservation guidance (DAHP 2010).
- **Site Access Coordination and Notification.** Performing contractors will provide notification and coordinate with the facility in advance of scheduled field work.
- **Re-establishment of Equipment Laydown, Decontamination, and Investigation-Derived Waste (IDW) Storage Areas.** These areas will be located in the canopy area similar to the previous phase of RI fieldwork.
- **Obtain Ecology Concurrence for Discharge of Water IDW to the Stormwater Pond.** During the RI field program, water IDW was routinely sampled and discharged in batches to the stormwater pond, which is part of the NPDES-permitted stormwater system (Ecology 2015a). Ecology previously had approved this activity (that was conducted as part of the routine storm water discharge program under the current NPDES Permit for the Site) prior to the start of RI field activities. The project team will obtain concurrence again from Ecology prior to field mobilization. In addition, field teams will obtain approval from both NSC and Lockheed Martin, prior to any discharge activities.

**Table 4-1**
**Work Plan Addendum Data Needs, Work Elements, and Analytical Program Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 1 of 9)**

| Work Plan Addendum Investigation Area(s) | Work Plan Addendum Data Needs | Work Elements | Analytical Program |
|---|---|---|---|
| **Solid Waste Management Units (SWMUs)** | | | |
| **SWMU 1**<br>NPDES Ponds | • Determine extent of soil contamination in NPDES Ponds A, B, C, and D.<br>• Determine if SWMU 17 (East End Landfill) is a potential source of PAH soil contamination.<br>• Chemical characterization of discharge at head of NPDES Pond A (see Plant Area AOC).<br>• Confirm previous results of RI-bypass channel investigation.<br>• Characterization of white-gray precipitate in Ponds A and B.<br>• Reconnaissance of unlined ditch between Ponds B and C. | **NPDES Pond A**<br>➢ Collect 9 surface soil samples within pond and outside of channel.<br>➢ Drill 2 hand auger soil borings within channel (collect surface and base of boring samples at each location).<br>➢ Surface soil scrapings of the white-gray precipitate will be collected from one location and analyzed for calcium and sulfur with field acid test for carbonate.<br>**Stormwater Bypass Channel**<br>➢ Drill 1 hand auger soil boring in area of highest concentrations and/or soil thickness (collect surface and base of boring samples).<br>**NPDES Pond B**<br>➢ Collect 5 surface soil samples within pond.<br>➢ Drill 2 hand auger soil borings within channel (collect surface and base of boring samples at each location).<br>➢ Surface soil scrapings of the white-gray precipitate will be collected from one location and analyzed for calcium and sulfur with field acid test for carbonate.<br>**East End Landfill and Adjacent Slopes**<br>➢ Collect 3 surface soil samples from landfill surface.<br>➢ Collect 7 surface soil samples from adjacent slopes.<br>**NPDES Ponds C and D**<br>➢ Collect 6 surface soil samples within the excavated area Pond C and 4 surface soil samples within the excavated area Pond D.<br>**Reconnaissance of Unlined Ditch Between Ponds B and C**<br>➢ Inspect ditch to determine if there's appreciable sediment accumulation and sample if warranted. | Analytical suite for all soil samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Select Metals (SW 6020A)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx)<br>• Calcium and Sulfur (EPA 6010C)<br>• Field acid test for carbonate |
| **SWMU 3**<br>Intermittent Sludge Disposal Ponds | • Evaluation of historical remedial action soil confirmation results to confirm that soils outside of NSC-owned lands were cleaned up to MTCA unrestricted land use standards.<br>• Field reconnaissance of entire remediated area to verify absence of aluminum smelter-related wastes and stained soils.<br>• Confirmation soil characterization outside of NSC-owned lands to verify soil quality meets MTCA unrestricted land use cleanup standards.<br>• Characterization of white-gray precipitate material. | ➢ Review historical documents to establish soil conditions at completion of remedial action.<br>➢ Field reconnaissance of the complete area subject to the past soil removal action. Supplemental soil characterization if evidence of soil/waste contamination is found.<br>➢ Collection of 32 surface soil samples along 8 transects with samples collected 20-ft and 75-ft outside of excavated areas.<br>➢ Surface soil scrapings of the white-gray precipitate will be collected from one location and analyzed for calcium and sulfur with field acid test for carbonate. | Analytical suite for all soil samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Select Metals (SW 6020A)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx)<br>• Calcium and Sulfur (EPA 6010C)<br>• Field acid test for carbonate |

## Table 4-1
## Work Plan Addendum Data Needs, Work Elements, and Analytical Program Summary
## Columbia Gorge Aluminum Smelter Site, Goldendale, Washington
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| Work Plan Addendum Investigation Area(s) | Work Plan Addendum Data Needs | Work Elements | Analytical Program |
|---|---|---|---|
| **Solid Waste Management Units (SWMUs) (Continued)** | | | |
| **SWMUs 10 and 11**<br>North and South Pot Liner Soaking Stations | • Better characterize the vertical and horizontal extent of soil contamination, particularly with consideration of the revised soil screening levels for protection of groundwater for fluoride and PAHs.<br>• Confirm the absence of perched groundwater zone in this area (UA) zone. | ➢ Drill 4 borings to basalt bedrock contact and collect 3 soil samples from each boring at 0.5 ft bgs, 2.0 ft bgs and the base of the boring.<br>➢ If appreciable amounts of groundwater are encountered in these borings, one of the borings will be completed as a shallow UA zone monitoring well. The well will be developed, surveyed, and then sampled once. | Analytical suite for all soil samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |
| **SWMU 31**<br>Smelter Sign Area | • Determine extent of surface soil contamination at both the Smelter Sign and NESI sub-areas.<br>• Field reconnaissance east of the NESI area to verify no evidence of waste dumping (as consistent with previous site reconnaissance findings). | **Smelter Sign Subarea**<br>➢ Collect 29 surface soil sample samples (approximate 75-foot grid spacing).<br>**NESI Subarea**<br>➢ Collect 11 surface soil samples in areas where no wastes were found during the RI.<br>➢ Collect 7 surface soil samples in NESI Wetland area.<br>➢ Collect 13 surface soil samples from three northwest-southwest-oriented transects immediately east of the NESI area (approximate 100-foot spacing). | Analytical suite for all soil samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Select Metals (SW 6020A)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |
| **SWMU 32**<br>Stormwater Pond and Appurtenant Facilities | Refer to Plant Area AOC | | |

**Table 4-1**
**Work Plan Addendum Data Needs, Work Elements, and Analytical Program Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
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| Work Plan Addendum Investigation Area(s) | Work Plan Addendum Data Needs | Work Elements | Analytical Program |
|---|---|---|---|
| **Areas of Concern (AOCs)** | | | |
| **Groundwater in the Uppermost Aquifer (GWAOC)** | • Characterize spring water quality (including newly discovered spring in western area of Site, NESI area wetland spring, Wetland D spring, Wetland K spring, and Wetland F spring).<br>• Characterize shallow groundwater chemical concentrations at the Western Intermittent Drainage near the Boat Basin and between Wetland K and the Boat Basin.<br>• Characterize groundwater concentration in existing wells in the UA and BAU zones in the Former Plant Area Footprint.<br>• Risk evaluation for fluoride and sulfate groundwater screening levels.<br>• Groundwater flux and water-balance evaluation to assess amount of discharge to the Columbia River.<br>• Supplemental TPH groundwater and spring sampling to address elevated petroleum hydrocarbon concentrations in soil as appropriate. | ➢ Collect 1 water sample from each of the five existing wetland springs, including the newly discovered spring in western area, NESI area wetland spring, Wetland D spring, Wetland K spring, and Wetland F spring.<br>➢ Collect single round of groundwater samples from existing UA and BAU zone wells in the Former Plant Area Footprint to determine current conditions and better document TPH groundwater concentrations.<br>➢ Installation and sampling of two temporary hand-driven well points, one at the Western Intermittent Drainage near the Boat Basin and one between Wetland K and the Boat Basin. Collect 1 groundwater sample from each well point (if water is present). Three attempts will be made at sub-locations for each temporary well point stations to successfully complete sampling.<br>➢ Installation and sampling of up to six new temporary monitoring wells and 21 borings in the PAAOC to address subsurface hotspot areas in PAAOC and to assess shallow groundwater impacts for TPH and other chemicals of potential concern. Characterize water-level elevations at new well locations (see PAAOC below).<br>➢ Analysis of stage ratio and time lag for shoreline wells and Columbia River to estimate transmissivity and groundwater flux.<br>➢ Evaluation of hydrogeologic water balance in the vicinity of the stormwater pond and the NPDES ponds.<br>➢ Evaluation of risk-based concentrations for development of fluoride and sulfate screening levels. | Analytical suite for water samples from wetland springs, and hand-driven temporary well points includes:<br>• Total Cyanide (EPA 335.4)<br>• Free Cyanide (EPA 9016)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• PCBs (EPA 8082A)<br>• Select Metals (EPA 200.8)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx)<br><br>Analytical suite for single round of groundwater samples for existing wells in the Former Plant Area Footprint includes:<br>• Total Cyanide (EPA 335.4) and Free Cyanide (EPA 9016) (North and South Pot Liner Soaking Station and East SPL Building area wells only: MW-E7, MW-E8, RI-MW8-BAU, and BAMW-3)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300).<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx)<br>• Gasoline-range hydrocarbons (NWTPH-Gx and BTEX (Former Compressor Building UST and EELF area wells only: RI-GW6, RI-GW8, RI-GW9, MW-E1A, MW-E3, and MW-E4)<br>• VOC (EELF area wells only-MW-E1A, MW-E3 and MW-E4)<br><br>Analytical suite for groundwater samples collected from borings and newly constructed monitoring wells at individual investigation areas such as are included in the PAAOC are summarized in the table subsections for each individual area. |

**Table 4-1**
**Work Plan Addendum Data Needs, Work Elements, and Analytical Program Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
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| Work Plan Addendum Investigation Area(s) | Work Plan Addendum Data Needs | Work Elements | Analytical Program |
|---|---|---|---|
| **Areas of Concern (AOCs) (Continued)** | | | |
| **Wetlands** | • Further characterize extent of soil contamination in Wetlands D and K.<br>• Confirm that MTCA unrestricted land use screening levels are protective of tribal treaty-protected land uses for Wetland K (off property area zoned as open-space).<br>• Estimation of recharge/discharge for Wetland K.<br>• Characterize site-wide spring water quality (including newly discovered spring in western area of Site, NESI area wetland spring, Wetland D spring, Wetland K spring, and Wetland F spring). | **Wetland K**<br>➢ Collect 3 spring water samples (1 from Spring 01 location and 2 from furthest downstream channel locations with flowing water).<br>➢ Install 1 hand-driven well point located between Wetland K and the Boat Basin (as described under the GWAOC) to evaluate potential occurrence of shallow groundwater. Collect 1 groundwater sample (if water present). Three attempts will be made at sub-locations to successfully sample this well point station.<br>➢ Collect up to 10 surface soil samples, including 5 samples from channel areas and 5 samples from non-channel areas.<br>➢ Measure discharge rate in wetland channel segments. Estimate recharge contribution associated with stormwater pond.<br>**Wetland D**<br>➢ Collect 16 soil samples to evaluate extent of soil contamination, particularly in vicinity of the former Duck Pond.<br>➢ Collect 1 spring water sample.<br>➢ Measurement of spring discharge.<br>**Wetland Springs**<br>➢ Collect 1 water sample from each of the five existing wetland springs, including the newly discovered spring in western area, NESI area wetland spring, Wetland D spring, Wetland K spring, and Wetland F spring (as described under the GWAOC).<br>➢ Measurement of spring discharge at all locations. | Analytical suite for all wetland soil/sediment and water samples includes:<br>• Total Cyanide (EPA 9012B / 335.4)<br>• Free Cyanide (EPA 9016) – water samples only<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Select Metals (Soil SW 6020A / Water EPA 200.8)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |

**Table 4-1**
**Work Plan Addendum Data Needs, Work Elements, and Analytical Program Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
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<table>
<tr><th>Work Plan Addendum Investigation Area(s)</th><th>Work Plan Addendum Data Needs</th><th>Work Elements</th><th>Analytical Program</th></tr>
<tr><td colspan="4">Areas of Concern (AOCs) (Continued)</td></tr>
<tr><td rowspan="2">Plant Area (PAAOC)</td><td rowspan="2">Extent of Contamination in Courtyard Segments<br>Areas of identified soil hotspots, and impact on shallow groundwater using a decision-tree approach, as described in Section 4.9.1, to allow field decisions and additional step-out investigation.<br><br>Data needs include:<br>• Additional TPH groundwater sampling to address petroleum hydrocarbon subsurface soil hotspot areas in PAAOC.<br>• Assess impacts to shallow groundwater from Coke and Pitch unloading sump.<br>• Further evaluate the vertical extent of the chemicals of concern (COC) for soil contamination in all Courtyard Segments.<br>• Further characterize the extent of fluoride, sulfate, PAHs, and TPH contamination in soil at identified Courtyard Segments soil hotspots.</td><td>Vertical Extent of Contaminated Soil in All Courtyard Segments<br>➢ Determine vertical extent of soil contamination at transformer substations and other Courtyard operational features.<br>➢ Excavate 46 test pits at locations where vertical extent has not been determined.<br>➢ Collect 42 soil samples at specified depth (Table 4-3).<br>➢ 12 test pits will be excavated for visual identification purposes with no soil samples collected.</td><td>Analytical suite for all soil samples collected at transformer substations includes:<br>• PAHs (EPA 8270D SIM)<br>• PCBs (EPA 8082A)<br>• Select Metals (Soil SW 6020A / Water EPA 200.8)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx)<br>Analytical suite for all soil samples collected at other sample stations includes:<br>• Total Cyanide (EPA 9012B)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Select Metals (SW 6020A)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx), if previously detected at concentrations above screening levels in RI.</td></tr>
<tr><td>Crucible Cleaning Room Area<br>➢ Determine horizontal and vertical extent of fluoride and sulfate contamination in soil and potential impact on shallow groundwater.<br>➢ Initially drill 5 soil borings to bedrock in an area generally bounded by SB-BH03, SB-SE09, and SB-CU01. Collect a minimum of 3 soil samples per borehole.<br>➢ Collect 1 grab groundwater samples per boring with temporary well screen installations.<br>➢ Install 1 temporary groundwater monitoring well completed in shallow groundwater at the SB-CU01 location, develop the well, perform a single round of sampling, and analyze for same constituents as soil.<br>➢ Evaluate expedited soil and groundwater data.<br>➢ If further extent investigation is needed to define horizontal extent, complete up to 3 soil borings beyond edges of initial investigation.<br>➢ If indicated by data evaluation, install 1 additional shallow groundwater monitoring well at best location.</td><td>Analytical suite for all soil and groundwater samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Free Cyanide (EPA 9016) – water samples only<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx)<br>• Soil pH (EPA 9045D) - soil samples only</td></tr>
</table>

**Table 4-1**
**Work Plan Addendum Data Needs, Work Elements, and Analytical Program Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
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| Work Plan Addendum Investigation Area(s) | Work Plan Addendum Data Needs | Work Elements | Analytical Program |
|---|---|---|---|
| **Areas of Concern (AOCs) (Continued)** | | | |
| **Plant Area (PAAOC) (Continued)** | **See above** | **Soil Boring SB-VS01 Area in Courtyard Segment A5**<br>➢ Determine vertical and horizontal extent of cPAH and TPH contamination in soil and impact on shallow groundwater.<br>➢ Perform video survey of SE Line in Courtyard Segment A5, inspect for breaches near boring SB-VS01.<br>➢ Initially drill 1 soil boring to bedrock near SB-VS01 and collect 1 grab groundwater sample using a temporary well screen installation. No soil samples will be collected.<br>➢ Evaluate expedited lab groundwater data.<br>➢ If indicated by data based on the decision-tree approach, drill two additional soil borings, collect minimum 3 soil samples and 1 grab groundwater sample from each boring. | Analytical suite for all soil and groundwater samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Free Cyanide (EPA 9016) – water samples only<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• VOCs (EPA 8260C)<br>• Select Metals (Soil SW 6020A / Water EPA 200.8)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |
| | | **Coke and Pitch Unloading Sump**<br>➢ Determine potential impact of contaminated sump sediment and water on groundwater adjacent to sump.<br>➢ Initially, drill 1 boing to bedrock downgradient adjacent to the Coke and Pitch Unloading Sump and collect a minimum of 3 soil samples from boring above, at and below the sump floor level.<br>➢ Install 1 temporary groundwater monitoring well completed in shallow groundwater, develop the well, perform a single round of sampling.<br>➢ Evaluate expedited soil and groundwater data.<br>➢ If additional extent investigation is needed, complete 1 soil boring downgradient from the sump and collect 1 grab groundwater sample with a well screen installation consistent with the decision-tree approach. | Analytical suite for all soil and groundwater samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Free Cyanide (EPA 9016)- water samples only<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |
| | | **Former AST near East Spent Pot Liner (SPL) Storage Area**<br>➢ Determine the horizontal and vertical extent of carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and TPH in soil and potential impact on shallow groundwater.<br>➢ Initially, drill 3 soil borings to bedrock and collect a minimum of 3 soil samples per boring.<br>➢ Collect grab groundwater samples with temporary well screen installations from 2 of the borings.<br>➢ In 1 boring, install a temporary groundwater monitoring well completed in shallow groundwater, develop the well, perform a single round of sampling, and analyze for same constituents as soil.<br>➢ Evaluate expedited soil and groundwater data.<br>➢ If soil and groundwater data exceed screening levels drill 1 additional boring downgradient and collect 1 grab groundwater sample consistent with decision-tree approach. | Analytical suite for soil and groundwater samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Free Cyanide (EPA 9016) - water samples only<br>• Fluoride (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |

## Table 4-1
## Work Plan Addendum Data Needs, Work Elements, and Analytical Program Summary
## Columbia Gorge Aluminum Smelter Site, Goldendale, Washington
## (Page 7 of 9)

| Work Plan Addendum Investigation Area(s) | Work Plan Addendum Data Needs | Work Elements | Analytical Program |
|---|---|---|---|
| **Areas of Concern (AOCs) (Continued)** | | | |
| **Plant Area (PAAOC) (Continued)** | **See above** | **Friction Weld Building**<br>➢ Determine the vertical extent of fluoride in soil.<br>➢ Drill 1 soil boring and collect up to 4 soil samples.<br>➢ If groundwater is encountered above the soil/bedrock interface, collect 1 grab sample of groundwater using a temporary well screen installation. | Analytical suite for soil and groundwater samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Free Cyanide (EPA 9016) - water samples only<br>• Fluoride (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |
| | | **Soil Boring SB-SE08 in Courtyard Segment A4**<br>➢ Determine the vertical and horizontal extent of fluoride and sulfate in soil and potential impact on shallow groundwater.<br>➢ Initially, drill 2 soil borings and collect up to 4 soil samples.<br>➢ Install 1 temporary groundwater monitoring well completed in shallow groundwater, develop the well, perform a single round of sampling.<br>➢ Collect 1 grab groundwater sample with a well screen installation in one boring.<br>➢ Evaluate expedited soil and groundwater data.<br>➢ If soil and groundwater data exceed screening levels, 1 additional soil boring will be completed with collection of up to 4 samples and 1 groundwater sample from the boring equipped with a temporary well-screen installation. | Analytical suite for soil and groundwater samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Free Cyanide (EPA 9016) - water samples only<br>• Fluoride (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |
| | | **Soil Boring SB-SE18 in Courtyard Segment C5**<br>➢ Determine the horizontal extent of sulfate in soil and potential impact on shallow groundwater.<br>➢ Initially, drill 3 soil borings, collect up to 4 soil samples and 1 grab groundwater samples with well screen installations in each boring.<br>➢ Evaluate expedited soil and groundwater data.<br>➢ If soil and groundwater data exceed screening levels 1 additional soil boring will be completed, collect up to 4 soil samples and 1 grab groundwater sample with a temporary well screen installation. | Analytical suite for all soil and groundwater samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Free Cyanide (EPA 9016)- water samples only<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |
| | | **Soil Boring SB-SE17 Investigation Area near Scrubber Effluent (SE) Line and East End Landfill (SWMU 17)**<br>➢ Characterization of soil chemical concentrations below the waste and above the bedrock contact (unless the waste directly overlies the bedrock).<br>➢ Verification of the presence of a saturated interval above the basalt bedrock contact (UA zone) at this location.<br>➢ Characterization of the occurrence of the BAU aquifer zone in this area.<br>➢ Characterization of the groundwater flow pattern in this are with comparison to approximate SE and other line elevations.<br>➢ Characterization of groundwater chemical concentrations. | Analytical suite for all soil and groundwater samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Free Cyanide (EPA 9016)- water samples only<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx)<br>• Gasoline-range hydrocarbons (NWTPH-Gx)<br>• VOCs (EPA 8260C) |

**Table 4-1**
**Work Plan Addendum Data Needs, Work Elements, and Analytical Program Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 8 of 9)**

| Work Plan Addendum Investigation Area(s) | Work Plan Addendum Data Needs | Work Elements | Analytical Program |
|---|---|---|---|
| **Areas of Concern (AOCs) (Continued)** | | | |
| **Plant Area (PAAOC) (Continued)** | **Stormwater and Other Lines Evaluation**<br>• Determination of source of discharge to NPDES Pond A.<br>• Sample discharge pipe at head of NPDES Pond A.<br>• Further characterize interconnection of stormwater/groundwater/process water lines under the Plant Area.<br>• Characterize sediment quality in the Industrial Sump that is part of the NPDES-permitted system.<br>• Characterization of contaminant loading from various line types and line segments. Determine relative contribution of contaminated groundwater inflow versus site runoff. | **Industrial Sump**<br>➢ Collect 1 solids/sediment sample from base of the Industrial Sump. | Analytical suite for sump process solids/sediment sample includes:<br>• Total Cyanide (EPA 9012B)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• PCBs (EPA 8082A)<br>• VOCs (EPA 8260C)<br>• Select Metals (SW 6020A)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |
| | | **Source of Discharge to Pond A**<br>➢ Use a vacuum truck to remove debris and rock for SE manholes MH14L4 through MH17L4.<br>➢ Conduct video survey of SE Line 4 in Courtyard Segment A4 and Segment A5 and through the Passage No. 3 up to the Crucible Cleaning Room.<br>➢ Two seasonal (Spring and Fall) water samples from the discharge from the SE Line at the head of NPDES Pond A.<br>➢ Seasonal flow rate measurements between MH2L2 and MH2L5 and discharge from the SE Line at the head of NPDES Pond A.<br>➢ Collect two seasonal (Spring and Fall) water samples from MH1L5. | Analytical suite for all line and discharge water samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Free Cyanide (EPA 9016)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• PCBs (EPA 8082A)<br>• VOCs (EPA 8260C)<br>• Select Metals (EPA 200.8)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |

**Table 4-1**
**Work Plan Addendum Data Needs, Work Elements, and Analytical Program Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**
**(Page 9 of 9)**

| Work Plan Addendum Investigation Area(s) | Work Plan Addendum Data Needs | Work Elements | Analytical Program |
|---|---|---|---|
| **Additional Area of Investigation** | | | |
| Ditch near West Spent Pot Liner (SPL) Storage Area | • Determine extent of soil contamination in ditch. | ➢ Collect up to 5 surface soil samples, including 2 within the drainage ditch and 3 in the investigation area at the ditch discharge point. One deeper sample will be collected from the discharge area with a hand auger to assess vertical extent.<br>➢ Removal of the rip-rap armor in the ditch will be attempted using hand tools. If feasible, a soil sample will be collected from below the rip-rap and liner (if present).<br>➢ The discharge pipe will be inspected at the time of soil sampling. If flowing water is found, a grab water sample will be collected. One of the ditch soil samples will be collected from near the discharge pipe outlet. | Analytical suite for all soil samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• PCBs (EPA 8082A)<br>• Select Metals (SW 6020A)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |
| East Surface Impoundment (ESI) Fence Line Area | • Additional site reconnaissance and characterization to verify the lateral and vertical extent of contamination int the ESI Fence Line Area.<br>• Ecology concurrence for disposal of existing soil/waste stockpile. | ➢ Visual inspection of areas within 500 ft of the soil excavation area both inside and outside the ESI Fence Line Area.<br>➢ Excavate up to 4 test pit locations within the fence line and up to 6 test pit locations outside the fence line, including soil sample collection at each station location based on field observations. | Analytical suite for all soil samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Select Metals (SW 6020A)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |
| Eastern Area Site Reconnaissance | • Site reconnaissance including inspection and documentation using grid system in eastern portions of the Site to verify absence of aluminum smelter-related wastes and stained soils.<br>• Verification of subsurface conditions at select locations based on site reconnaissance observations. | ➢ Supplemental soil characterization if evidence of soil/waste contamination is found.<br>➢ Excavate up to 4 test pit locations (up to two soil samples per test pit) to verify surface and subsurface conditions based on reconnaissance findings. | Analytical suite for all soil samples includes:<br>• Total Cyanide (EPA 9012B)<br>• Fluoride (EPA 300)<br>• Sulfate (EPA 300)<br>• PAHs (EPA 8270D SIM)<br>• Select Metals (SW 6020A)<br>• Diesel/Oil-Range Hydrocarbons (NWTPH-Dx) |

**Notes:**
Metals include: Al, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, and Zn.
AOC = Area of Concern
BMEC = Blue Mountain Environmental Consulting
EPA = U.S. Environmental Protection Agency
ESI = East Surface Impoundment
GWAOC = Groundwater Area of Concern
MTCA = Model Toxics Control Act
NESI = North of the East Surface Impoundment
NPDES = National Pollutant Discharge Elimination System
NSC = NSC Smelter LLC
NWTPH-Dx = Total Petroleum Hydrocarbons – Diesel-extended range
PAAOC = Plant Area – Area of Concern
PAH = Polynuclear Aromatic Hydrocarbon
RI = Remedial Investigation
SPL = Spent Pot Liner
SWMU = Solid Waste Management Unit
TPH = Total Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds

- **Utility Notification and Clearance Activities.** The 48-hour underground utility notification number will be contacted prior to any subsurface investigation activities (e.g., drilling and/or excavation) consistent with state law. In addition, for Lockheed Martin-lead sites, a Lockheed Martin Operation Procedure Dig Permit will be completed, submitted to the Lockheed Martin Project Coordinator, and approved by Lockheed Martin prior to the start of subsurface activities. NSC contractors will adhere to NSC review and approval procedures. A private utility contractor will also be contracted to clear the proposed drilling and excavation locations.

  Overhead BPA power lines pass through the southwest, south-central, and eastern portion of the project site that must be considered during field operations. Work authorization must be obtained from BPA if drilling and excavation work is planned in the vicinity of the BPA power-line corridor.

- **BPA Power Transmission Line Right-of-Way Use Authorization.** A permit will be required for the test pit excavation work in the ESI Fence Line Area. Proposed drilling locations do not appear to be within the BPA right-of-way, and site reconnaissance and manual sampling activities do not require a right-of-way use authorization.

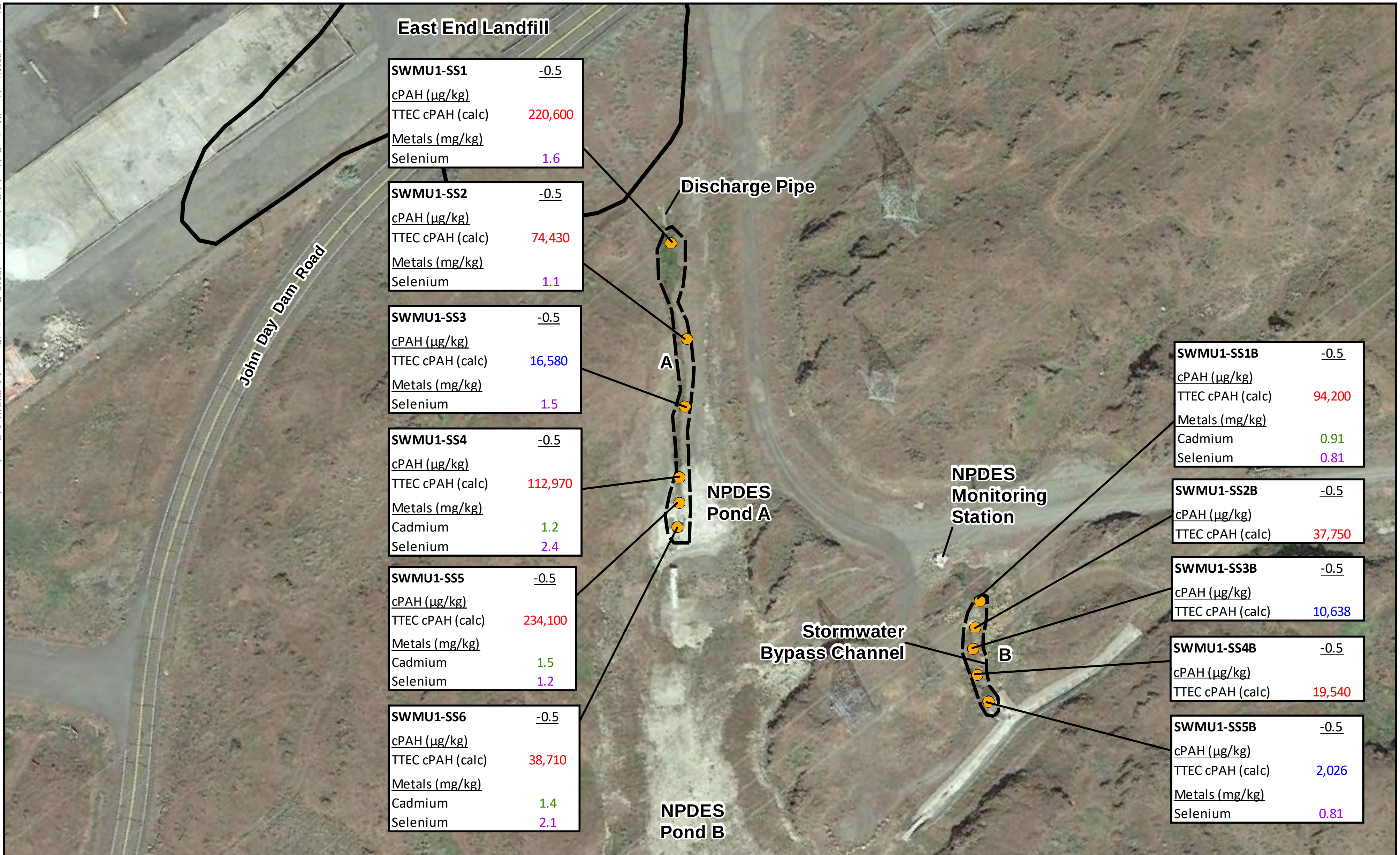
- **Start Cards.** Start cards are required by Ecology for the construction of wells and borings that incept groundwater. The licensed drilling subcontractor will obtain the start cards necessary for this project.

- **Soil IDW Profiling and Authorization for Disposal.** Soil IDW will be sampled and profiled prior to transport and disposal. The field team will obtain approval from both NSC and Lockheed Martin before transport and disposal of soil wastes. Ecology approval is required before transportation and disposal of soils that may be subject to a “contained-in” demonstration (i.e., K088 hazardous waste listing for SPL-contaminated soil). The performing contractors will perform these activities as authorized agents on behalf of the waste generators.

## 4.2 NPDES PONDS (SWMU 1)

NPDES Ponds site features and RI analytical results are shown in Figure 4-1 and the results are presented in detail in Volume 2, Section 1.0 of the Draft RI Report (Tetra Tech et al. 2019a). Analytical results show the presence of carcinogenic PAHs above MTCA Method C soil screening in both NPDES Pond A and the stormwater bypass channel. A soil removal remediation project was completed in 2011 at the NPDES Ponds (ARCADIS 2011); however, based on results of the RI, Ponds A, B, and the Stormwater Bypass channel have become re-contaminated. The source of contamination is unclear but could be related to the ongoing pipe discharge at the head of Pond A or the nearby East End Landfill (EELF).

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\2019_Reporting\Figure_4-1_SWMU_1_Sampling.mxd




Legend

RI Surface Soil Sample Location

Estimated Extent of Soil Contamination above MTCA Screening Levels

red: Exceeds MTCA Method C Soil Screening Level
blue: Exceeds MTCA Method A Industrial Soil Screening Level
green: Exceeds CLARC Soil Screening Level for Protection of Groundwater
purple: Exceeds Terrestrial Ecological Soil Screening Level

MTCA- Model Toxics Control Act
PAH - Polycyclic Aromatic Hydrocarbon
RI - Remedial Investigation
TTEC (calc) - Total Toxicity Equivalent Concentration (calculated)

N W E S

0 50 100 200
Feet
Imagery Souce: NAIP 2017

Figure 4-1
SWMU 1
NPDES Ponds
RI Sample Locations and Soil Screening Level Exceedance Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

### 4.2.1 Investigation Objectives

Investigation objectives include the following:

- Determine the extent of soil contamination in NPDES Ponds A, B, C, and D.
- Determine if the EELF (SWMU 17) is a source of the NPDES Pond A soil contamination.
- Chemical characterization of discharge and flow estimate for discharge pipe at the head of NPDES Pond A (see stormwater and other lines investigation scope, Section 4.9.3).
- Determine composition of white crusty material (potential precipitate – possibly gypsum) that coats the bottom of NPDES Pond A and Pond B. The objective is to determine if this material represents a visual marker of contamination (e.g., fluoride minerals or PAHs). It is assumed that this material represents gypsum or carbonate (e.g., caliche) and does not represent a marker of contamination or fluoride salts.
- Reconnaissance of the Unlined Ditch between Ponds B and C.

### 4.2.2 Investigation Scope

WPA sample station locations are shown in Figure 4-2. In response to Yakama Nation comments on the Draft WPA, the boring depths will be shallow because contaminated soil were already excavated down to bedrock in several areas and the soil thickness is anticipated to be thin (less than 3 feet thick). Most stations represent surface soil samples to be collected from the ground surface to 0.5 feet. It is anticipated that refusal will occur at depths of 1-3 ft bgs at most locations. The intent is to collect samples of visibly impacted soils where encountered.

The scope of work will include collection of collection of soil samples as follows:

- **NPDES Pond A.** Sampling will include collection of nine surface soil samples within the pond and outside of the channel, and sampling of two hand-auger soil borings within the drainage channel, with sample collection at the surface and the base of the boring at each location). A surficial scrape sample of the crust material will also be collected for analysis of calcium and sulfur to assess the presence of gypsum. This material will also be field tested with acid to evaluate the presence of carbonate.
- **Stormwater Bypass Channel**. Sampling of one hand-auger soil boring in area of highest concentrations and/or soil thickness (collection of surface and base of boring samples).
- **NPDES Pond B.** Collection of five surface soil samples within the pond and outside of the channel, and sampling two hand-auger soil borings within the channel (collection of surface and base of boring samples at each location). A surficial scrape sample of the crust material will also be collected for analysis of calcium and sulfur to assess the presence of gypsum. This material will also be field tested with acid to evaluate the presence of carbonate.

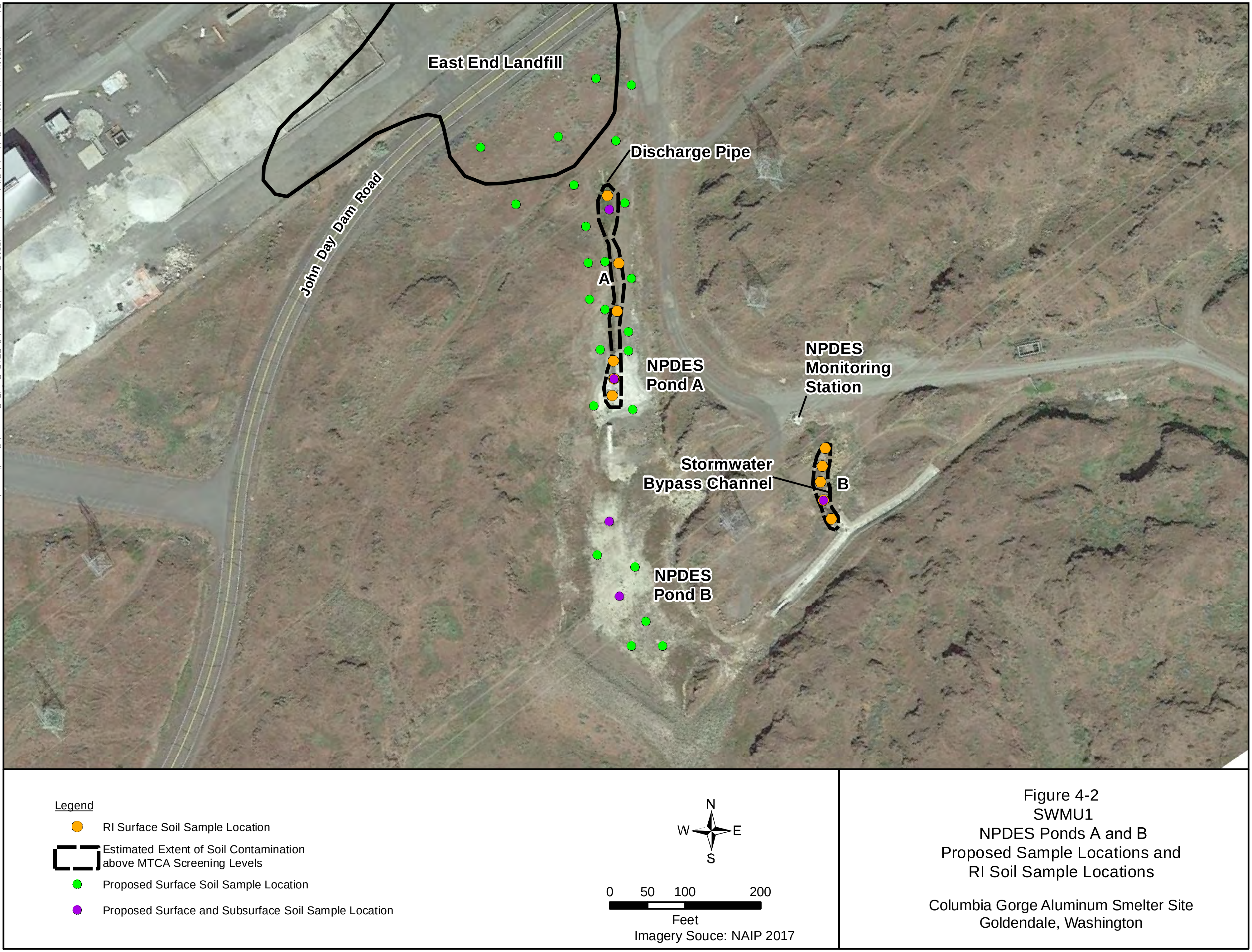



Figure 4-2
SWMU1
NPDES Ponds A and B
Proposed Sample Locations and
RI Soil Sample Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

- **East End Landfill and Adjacent Slopes.** Collection of three samples from landfill footprint surface soils and seven surface soil samples from adjacent slope area.

- **Unlined Channel Site Reconnaissance.** The unlined channel downstream of the stormwater bypass channel between NPDES Ponds B and C will be inspected for sediment deposition. The current conceptual understanding is that little to no sediment will be found in this channel that is largely completed in basalt bedrock. If more than di minimus quantities are found, the areas will be sampled as part of the WPA sampling program.

- **NPDES Ponds C and D.** Based on Ecology comments on the Draft WPA, soil sampling of NPDES Pond C and D has been included for low lying areas within the former excavation (Figure 4-3). Collection of 10 surface soil samples is planned for Ponds C and D (6 samples for Pond C and 4 samples for Pond D).

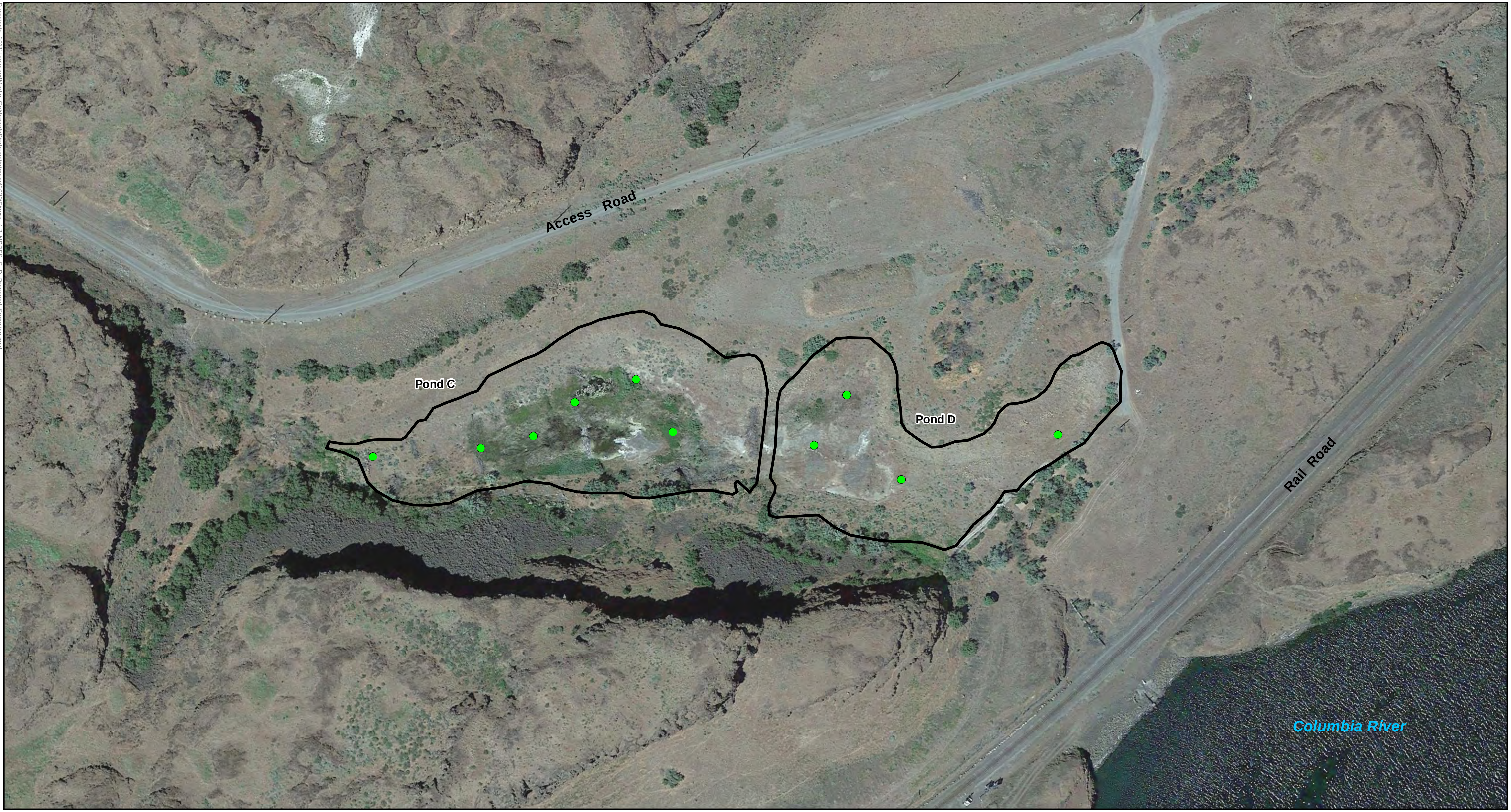
- **Pipe Discharge Measurements and Chemical Sampling.** This work element is summarized in Section 4.9.3 as part of the stormwater and other lines evaluation.

The soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn) and diesel/oil-range petroleum hydrocarbons.

Two tests will be performed to determine the composition of the white-gray crusty material (potential precipitate) that is present in NPDES Pond A and B that is suspected to be gypsum. The material will be tested with dilute hydrochloric acid to determine its reactivity. A positive reaction would indicate the presence of carbonate (e.g., caliche) in the sample. The two surface soil samples collected from Ponds and A and B (one from each of these ponds) to characterize the white-gray crusty material will consist of a scraping of the precipitate layer to determine if it has elevated concentrations of site chemicals of potential concern. In addition, the surface scrapings of the precipitate layer will be analyzed for calcium and sulfur. Gypsum is typically in the range of 19 to 23 percent calcium by weight, 15 to 20 percent sulfur by weight, and 40 to 55 percent sulfate by weight. For reference, these are equivalent to 150,000 – 550,000 mg/kg dry-weight concentrations. Washington state background soil concentrations for calcium range from 0.4 to 5.5 mg/kg.

## 4.3 INTERMITTENT SLUDGE DISPOSAL PONDS (SWMU 3)

No RI data needs were identified, as described in the Final RI Phase 1 and Phase 2 Work Plans (Tetra Tech et al. 2015a,b), and no further investigation was included in the initial RI field program. An independent soil removal cleanup action was performed in this area in 2007 using industrial soil cleanup levels, which assumed to be appropriate for SWMU 3.




Legend

Former Excavation Area

Proposed Surface Soil Sample Location

N
W E
S

0 100 200 400

Feet

Imagery Source: Google Earth 2019

Figure 4-3
SWMU 1
NPDES Ponds C and D
Proposed Sampling Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Comments received (Ecology and Yakama Nation 2019) regarding the Draft RI Report (Tetra Tech et al. 2019a), requested consideration of additional soil screening levels appropriate for unrestricted land use for this area, consistent with the current open space or extensive agriculture zoning and to address treaty-protected tribal uses.

Following closure of the ESI in 1985, additional areas east of the smelter were discovered that had been used for the disposal of sludge from the NPDES ponds. Thirteen small deposits of sludge with no standing water were found. The Intermittent Sludge Disposal Ponds (SWMU 3) was investigated in 2006 (ARCADIS 2007) and an independent soil removal action was completed in 2007 (URS 2008a).

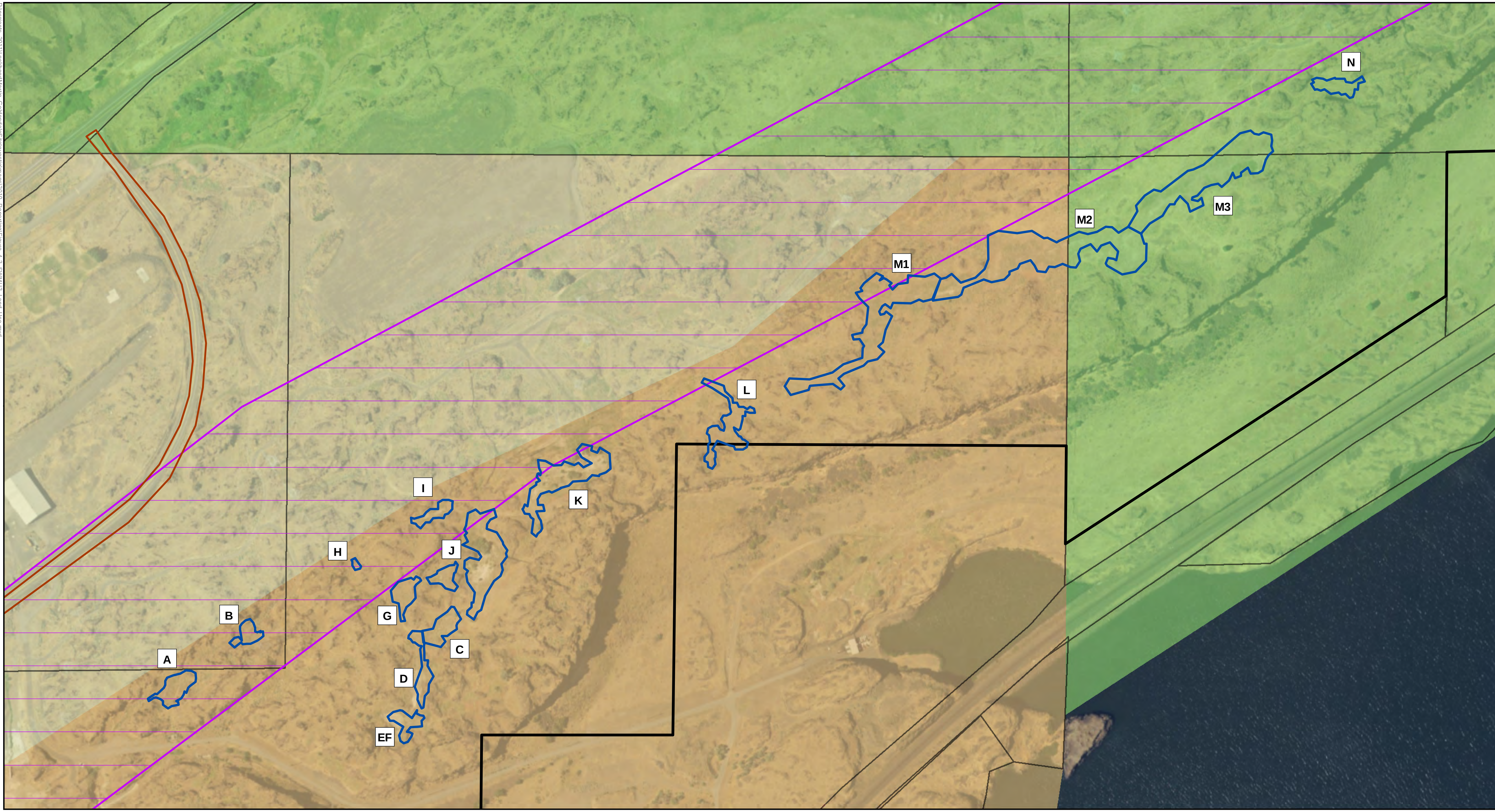
Confirmation samples collected from within the remediated excavations during the 2007 remediation met MTCA Method A Soil Cleanup Levels for Unrestricted Land Use of 0.1 mg/kg for PAHs; however, 28 of 36 lateral extent samples collected from outside of the excavation limits exceeded the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 0.1 mg/kg. However, all of the lateral extent samples, except two, met MTCA Method A Industrial Soil Cleanup Levels of 2.0 mg/kg for PAHs.

Figure 4-4 shows the Intermittent Sludge Disposal Pond (SWMU 3) remediation subareas A through M, the NSC property boundary, the current zoning, and the location of the BPA power line right-of-way. A small portion of Subarea L is not located on NSC property. This area is on land that was formerly leased by the facility from USACE.

### 4.3.1 Investigation Objectives

Objectives for this investigation include the following:

- Further evaluation of historical remedial action soil confirmation results to identify remaining areas with soil contamination above MTCA screening levels for Unrestricted Land Use.
- Field reconnaissance to verify the absence of aluminum smelter-related wastes and stained soils and to approximately locate the 36 lateral extent sample stations (2007 investigation) for placement of the soil sampling transects.
- Perimeter soil sampling to determine the lateral extent of soil contamination outside of excavation areas.




Legend

- Parcel Boundaries
- Klickitat County Road Right-of-Way (John Day Dam Road)
- Property Boundary
- BPA Right-of-Way (Restricted Access and Use Area)
- Remediation Area

Klickitat County Zoning

- Extensive Agriculture
- Industrial Park
- Open Space

N
W E
S

0 125 250 500
Feet

Imagery Source: NAIP 2017

Figure 4-4
SWMU 3
Intermittent Sludge Disposal Ponds
Remediation Areas, Property Boundaries
and Land Use

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

- Determine composition of white-crusty material (potential precipitate – possibly gypsum) noted by the Yakama Nation in WPA comments based on coloration in aerial photographs. The objective is to determine if this material represents a visual marker of contamination (e.g., fluoride minerals or PAHs). It is assumed that this material represents gypsum or carbonate (e.g., caliche) and does not represent a marker of contamination or fluoride salts.

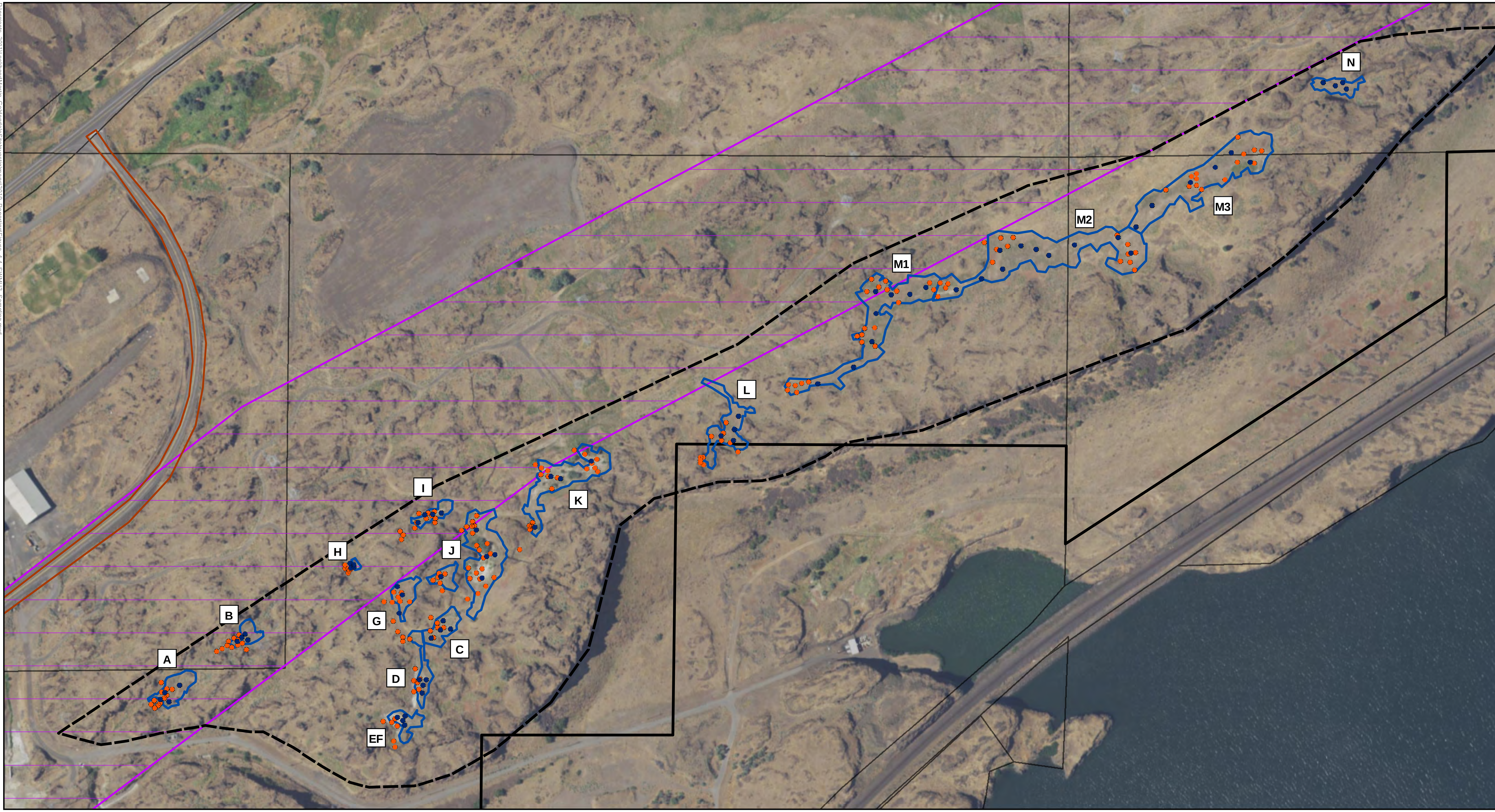
### 4.3.2 Investigation Scope

Remediation areas A through N will be inspected to verify the absence of waste and stained soils and to approximately locate historical lateral extent soil sample stations. Areas between and adjacent to the remediated subareas will also be inspected. Figure 4-5 shows historical sample locations and the area to be addressed by site reconnaissance and inspection. Additional sampling will be performed if new areas of waste or discolored soils are identified and if new identified wetlands are found in this area.

Grab surface soils will be collected at a depth of 0.0 to 0.5 feet from outside the perimeter of the excavation areas at 8 transect locations (refer to Figure 4-6) that extend across the excavation areas. The transect locations were selected based on the historical lateral extent sample results and to provide adequate spatial coverage. The transects also target areas where there appears to be soil present outside of the excavation limits (i.e., excavation edges that appear to be primarily terminated in rock outcrops will not be sampled). The transect locations may be adjusted based on the results of the field reconnaissance. Samples will be collected 20 ft outside and 75 ft outside of each edge of the excavation (i.e., 4 samples per transect with 8 transects representing 32 soil sample stations).

The soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn) and diesel/oil-range petroleum hydrocarbons.

One test will be performed to determine the composition of the white-gray crusty material (potential precipitate) if encountered. The material will be tested with dilute hydrochloric acid to determine its reactivity. A positive reaction would indicate the presence of carbonate (e.g., caliche) in the sample. The sample will consist of a scraping of the precipitate layer to determine if it has elevated concentrations of site chemicals of potential concern. In addition, the surface scrapings of the precipitate layer will be analyzed for calcium and sulfur.




Legend

- Parcel Boundaries
- Klickitat County Road Right-of-Way (John Day Dam Road)
- Property Boundary
- BPA Right-of-Way (Restricted Access and Use Area)
- Remediation Area
- SWMU 3 Reconnaissance Area

Historical Sampling Points

- Arcadis Pre-Excavation Soil Sample Location
- URS Confirmation Soil Sample Location

Source: ARCADIS 2007, URS 2008

N W E S

0 125 250 500

Feet

Imagery Source: NAIP 2017

Figure 4-5
SWMU 3
Intermittent Sludge Disposal Ponds
Reconnaissance Area and
Historical Sample Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington


Legend

Remediation Area

Historical Sampling Points

Arcadis Pre-Excavation Soil Sample Location

URS Confirmation Soil Sample Location

Proposed Surface Soil Sample Location

Proposed Surface Soil Sample Transect

Source: ARCADIS 2007, URS 2008

N W E S

0 125 250 500

Feet

Imagery Source: NAIP 2017

Figure 4-6
SWMU 3
Intermittent Sludge Disposal Ponds
Proposed Soil Sampling Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

The intent of the transect sampling is to verify the extent of soil contamination near the excavation boundaries. The assumption is that the PAH concentrations should decrease moving away from the excavation boundaries if the contamination is directly related to a specific deposit that was not adequately addressed. If there are indications of area-wide contamination or newly discovered areas, supplemental step-out sampling and/or quick-turnaround laboratory results will be implemented using broader step-outs to complete characterization in the SWMU 3 area.

## 4.4 NORTH AND SOUTH POT LINER SOAKING STATIONS (SWMUS 10 AND 11)

The North and South Pot Liner Soaking Stations were identified as separate SWMUs, the North and South Pot Liner Soaking Stations (SWMUs 10 and 11, respectively) have been previously investigated together (URS 2008b) and were accordingly addressed together in the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b). As such, both SWMUs 10 and 11 are combined here for further discussion.

The Pot Liner Soaking Stations operated between 1971 and 1990 and were composed of two concrete basins in which steel Hall Cells (i.e., aluminum smelting pots) were soaked with water (i.e., “quench water”) to remove refractory SPL material. This SPL residue represents a listed hazardous waste (K088) because it can contain cyanide. Due to the potential for leaching cyanide from the pot liners, quench water was treated with hypochlorite to oxidize the cyanide. Excess quench water that overflowed the cathode or leaked through holes in the steel shell was collected and directed back to the recycle sump. No documented historic spills or leaks have been reported for these SWMUs, and in 1990 the concrete basins were removed (URS 2008b).

A soil investigation of SWMUs 10 and 11 was conducted in 2008, and included eight shallow soil test pits, one shallow soil boring, and three deeper soil borings (URS 2008b). Most soil samples were collected at depths of about 1 to 1.5 ft. Soil samples were analyzed for PAHs, total cyanide, fluoride, sulfate, metals, and PCBs. PAHs were detected in 10 soil samples, but only the two samples from an unpaved area south of the Soaking Stations exceeded the associated MTCA Method C soil screening level for carcinogenic polycyclic aromatic hydrocarbons (cPAHs). The area of PAH-impacted soil was estimated at about 14,400 square feet ($ft^2$), with a conservative average depth of about 3 ft bgs, or about 1,600 cubic yards (URS 2008b).

Supplemental data was collected during the RI to further characterize this area. The RI field effort included drilling four soil borings (SB1 though SB4) using sonic drilling techniques that produces a continuous core. The borings were drilled to the basalt bedrock contact or a maximum depth of 10 ft bgs, whichever was shallowest. Three soil samples were collected for chemical analyses from each boring (0 to 0.5 ft bgs), 2 ft bgs, and the base of the boring. The soil samples were analyzed for PAHs, total cyanide, fluoride, sulfate, and metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn). A new well was installed (RI-MW8-BAU) on the south (downgradient) side of SWMUs 10 and 11 to characterize water quality and groundwater flow in this area (refer to Figure 4-7).

### 4.4.1 Investigation Objectives

Investigation objectives for the North and South Pot Liner Soaking Stations (SWMUs 10 and 11) include the following:

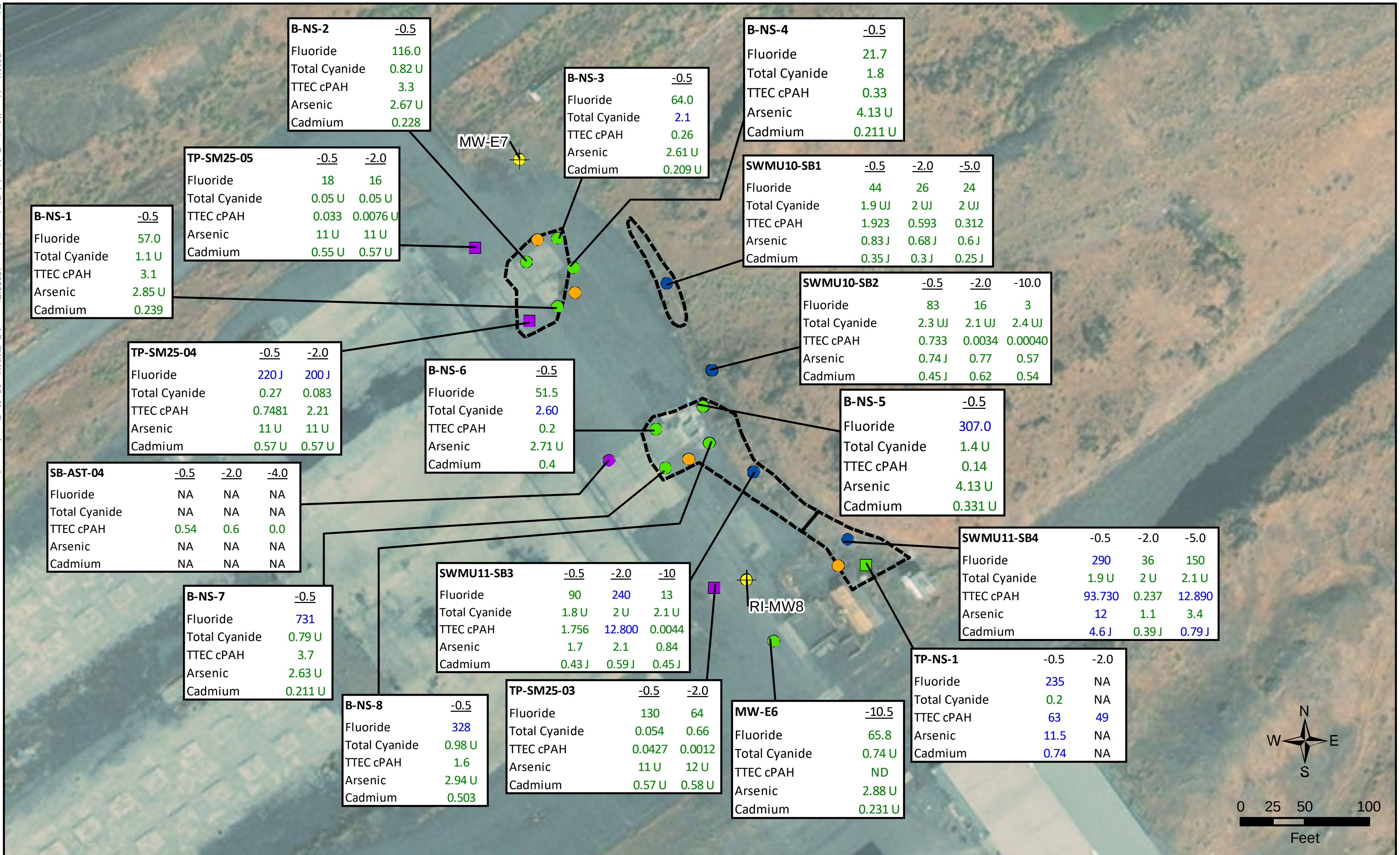
- Better characterize the vertical and horizontal extent of soil contamination, particularly with consideration of the revised soil screening levels for protection of groundwater for fluoride and cPAHs.
- Confirm the absence of a perched groundwater zone (UA zone) in this area.

### 4.4.2 Investigation Scope

The investigation scope includes installation of four borings to the basalt bedrock contact as shown in Figure 4-7. Three soil samples will be collected from each boring (0.5 ft bgs, 2.0 ft bgs, and base of the boring) and analyzed for fluoride, sulfate, total cyanide, PAHs, and TPH-Dx.

If groundwater is encountered in these borings that is judged to be sufficient for routine sampling (i.e., at least 2 feet of water rapidly accumulating in the boring), one of the borings will be completed as a monitoring well, developed, and sampled for these same constituents. Based on past RI investigations in this area, this scenario appears to be unlikely.

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\2020\Figure_4-7_SWMUs_10_11_Sampling.mxd




Monitoring Well
RI Sampling
Soil Boring
2008 URS Sampling
Soil Boring
Test Pit

PAAOC RI Sampling
Soil Boring
Test Pit
Approximate Area above MTCA Screening Levels (soil removal area)
Proposed Soil Boring

blue: Exceeds MTCA Soil Screening Level for Protection of Groundwater
green: Below Soil Screening Level for Protection of Groundwater
NS: Not Sampled

All concentrations in mg/kg
J - Estimated Concentration
MTCA - Model Toxics Control Act
PAH - Polycyclic Aromatic Hydrocarbon
TTEC (calc) - Total Toxicity Equivalent Concentration (calculated)
U - Chemical was not detected. The associated value represents the method detection limit.
UJ - Chemical was not detected. Associated limit is estimated.

Figure 4-7
SWMUs 10 and 11
North and South Pot Liner Soaking Stations
Proposed Sampling Locations and Soil Screening Level for Groundwater Protection
Exceedance Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

## 4.5 SMELTER SIGN AREA (SWMU 31)

The Smelter Sign area consists of two subareas that were investigated as part of the RI, including the Smelter Sign subarea and the NESI subarea (Figure 4-8). Suspected SPL and other smelter-related wastes were found in both subareas. For both subareas, the RI sampling program emphasized subsurface waste and subsurface soil sampling and the Draft RI Report (Tetra Tech et al. 2019a) identified additional characterization of surface soil concentrations as a data need for the FS or design phase of the project.

### 4.5.1 Smelter Sign Subarea

RI analytical results for waste and soil at the Smelter Sign Area are shown in Figures 4-9 and 4-10, respectively. An estimated bulk volume of 334 cubic yards of smelter waste was estimated for the Smelter Sign Area in the Draft RI Report (Tetra Tech et al. 2019a). This estimate did not include potentially contaminated surface soils.

#### *4.5.1.1 Investigation Objectives*

The objective of the field investigation is to characterize the extent of surface soil contamination in the Smelter Sign subarea to better estimate the extent and volume of contaminated surface soil.

#### *4.5.1.2 Investigation Scope*

The investigation scope for the Smelter Sign subarea includes collection of 29 surface soil samples at an approximate 75-foot spacing as shown in Figure 4-11.

The soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn) and diesel/oil-range petroleum hydrocarbons.

### 4.5.2 NESI Subarea

The occurrence of waste, waste chemical results, and soil chemical results are shown in Figures 4-12, 4-13, and 4-14, respectively. An estimated bulk volume of 7,708 cubic yards of smelter-related wastes were estimated for the NESI in the Draft RI Report (Tetra Tech et al. 2019a). The largest amount and thickness of wastes (about 8 ft thick) are found in the central portion of the NESI immediately east of the main wetland area. In this area, the buried wastes are in contact with shallow groundwater.


Legend

Smelter Sign and NESI Area Boundaries

Note: NESI Area (Area North of East Surface Impoundment)

N
W E
S

0 125 250 500
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 4-8
SWMU 31
Smelter Sign and NESI Area
Site Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\Phase2_RI_WP\Figure_5.1.30-1_SWMU31.mxd


Legend
- Smelter Sign Area
- RI Trench Location
- RI Test Pit Location
- RI Soil Sampling Location
- RI Waste Sampling Location

red: Exceeds MTCA Method C Soil Screening Level
blue: Exceeds MTCA Method A Industrial Soil Screening Level
green: Exceeds CLARC Soil Screening Level for Protection of Groundwater

All results in mg/kg unless otherwise indicated
MTCA - Model Toxics Control Act
PAH - Polycyclic Aromatic Hydrocarbon
RI - Remedial Investigation
TTEC (calc) - Total Toxicity Equivalent Concentration (calculated)

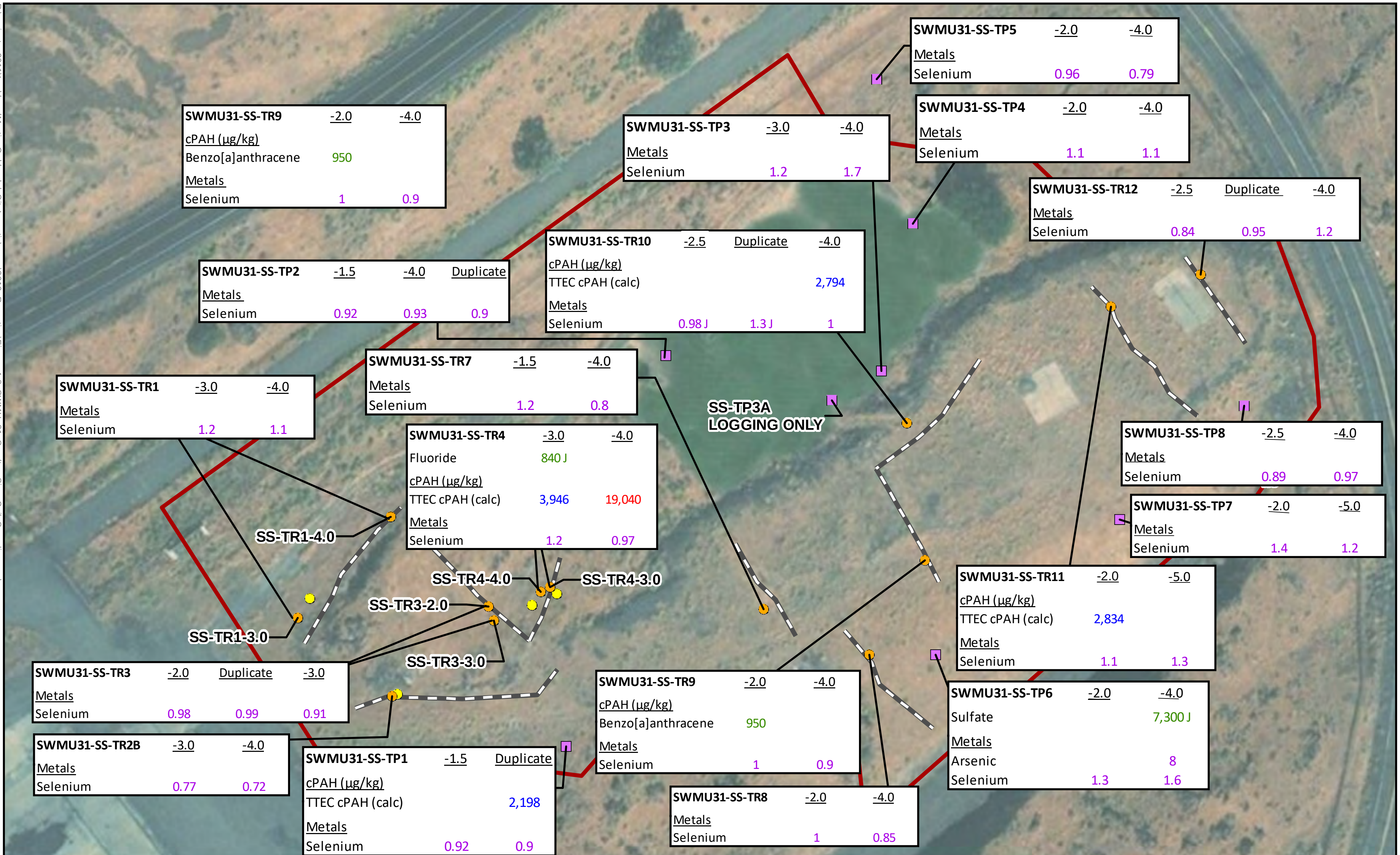
N W E S

0 50 100 200
Feet

Imagery Source: NAIP 2017

Figure 4-9
SWMU 31
Smelter Sign Area
RI Waste Sampling Locations and
Screening Level Exceedance Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Legend
- Smelter Sign Area
- RI Trench Location
- RI Test Pit Location
- RI Soil Sampling Location
- RI Waste Sampling Location

red: Exceeds MTCA Method C Soil Screening Level
blue: Exceeds MTCA Method A Industrial Soil Screening Level
green: Exceeds CLARC Soil Screening Level for Protection of Groundwater
purple: Exceeds Terrestrial Ecological Soil Screening Level

All results in mg/kg unless otherwise indicated
MTCA - Model Toxics Control Act
PAH - Polycyclic Aromatic Hydrocarbon
RI - Remedial Investigation
TTEC (calc) - Total Toxicity Equivalent Concentration (calculated)

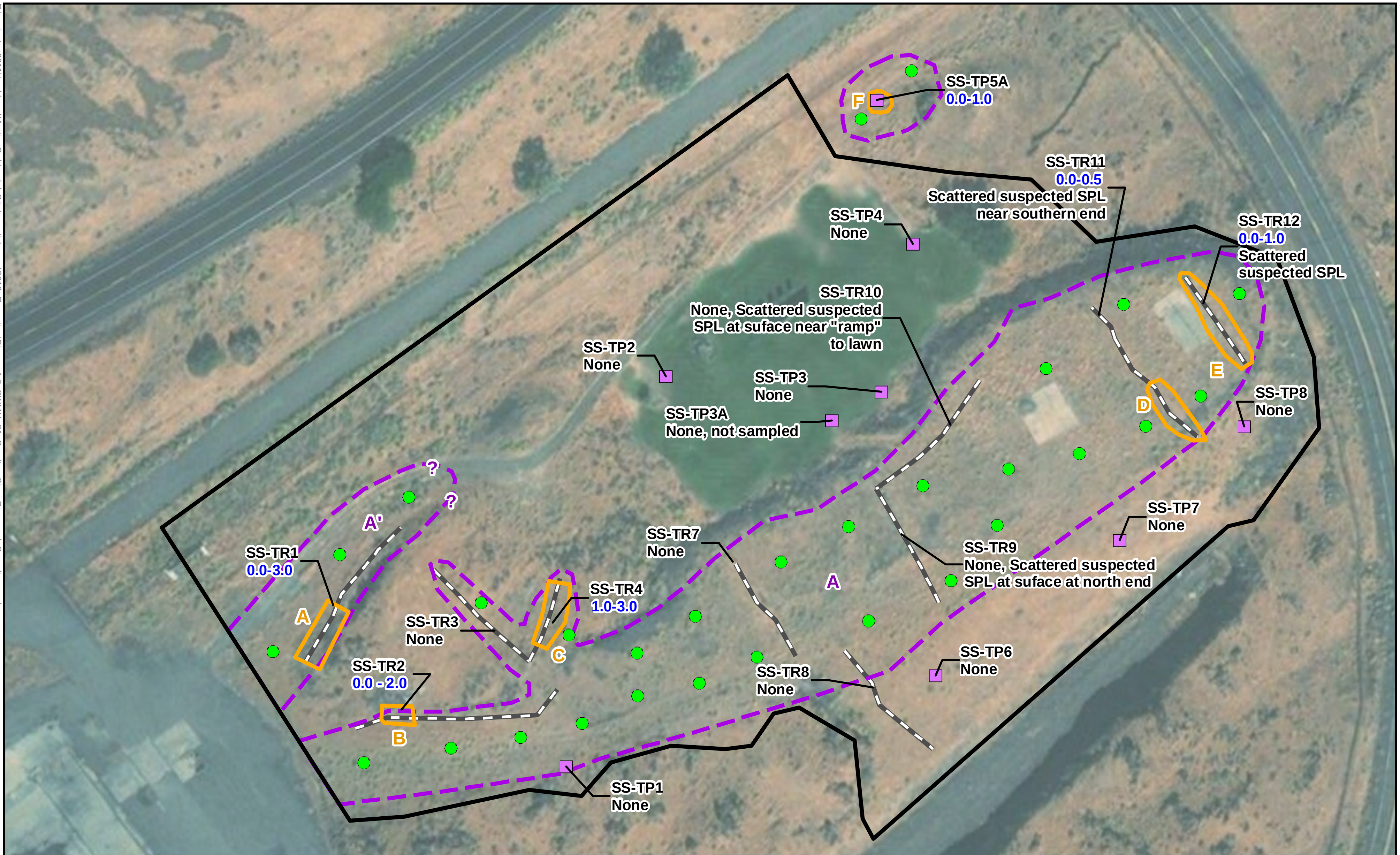
N S W E

0 50 100 200
Feet

Imagery Source: NAIP 2017

Figure 4-10
SWMU 31
Smelter Sign Area
RI Soil Sampling Locations and Exceedance Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Legend

- Smelter Sign Area
- RI Trench Location
- RI Test Pit Location
- A Carbon Waste Area
- A Areas of suspected surface soil with PAH concentrations above MTCA screening levels
- Proposed Surface Soil Sample Location

Carbon waste interval including intermixed suspected spent pot liner (SPL) 2.0-4.0 feet bgs

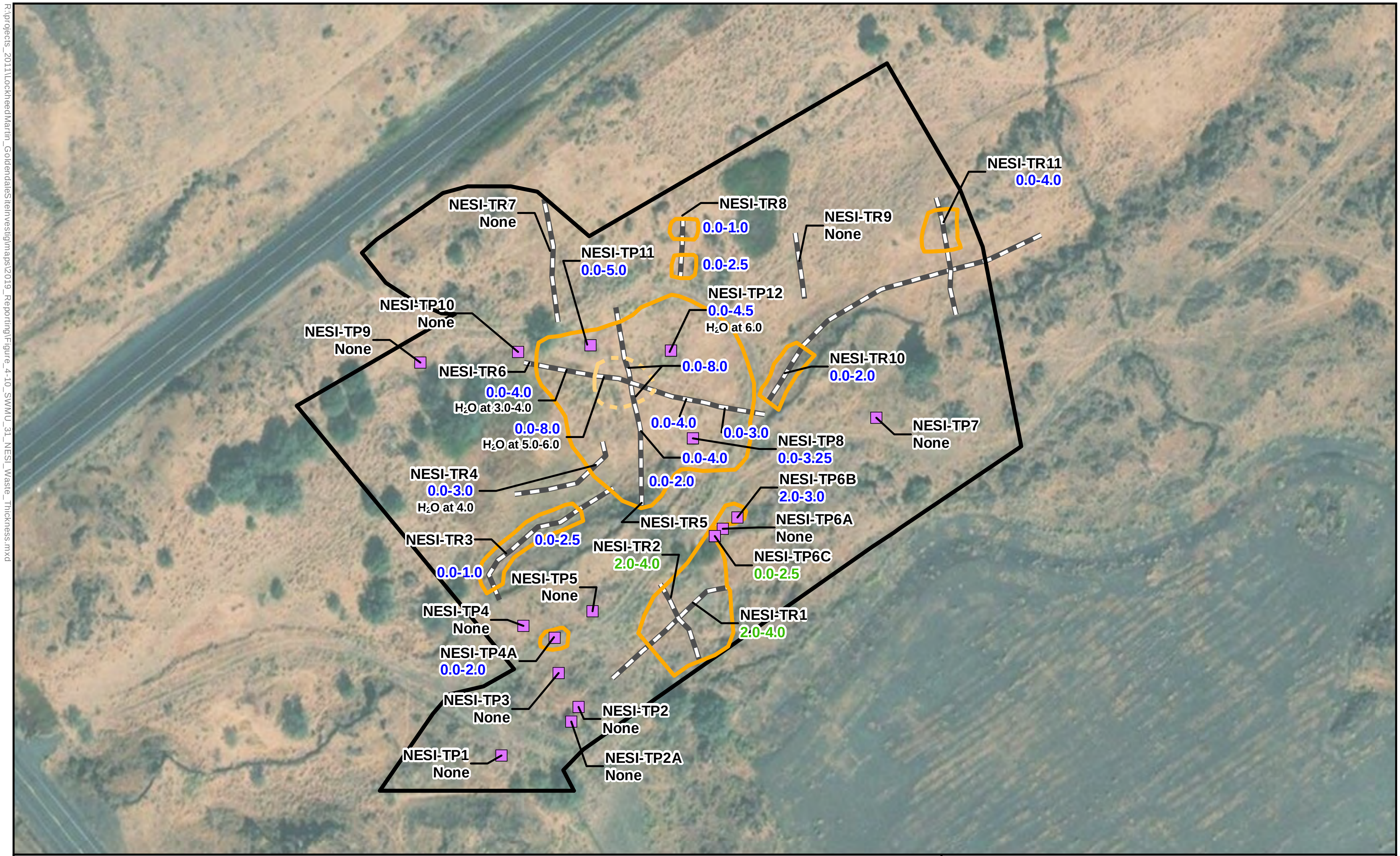
RI - Remedial Investigation

N
W E
S

0 25 50 100
Feet

Figure 4-11
SWMU 31
Smelter Sign Area
Proposed Surface Soil Sample Locations,
RI Trench, Test Pit Locations, and Waste Areas

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Legend

- NESI Area
- RI Trench Location
- RI Test Pit Location
- Waste Area
- 7.5-foot Waste Thickness Contour Interval

Carbon waste interval including intermixed suspected spent pot liner (SPL) 2.0-4.0 feet bgs

Cryolite waste interval 2.0-4.0 feet bgs

RI - Remedial Investigation

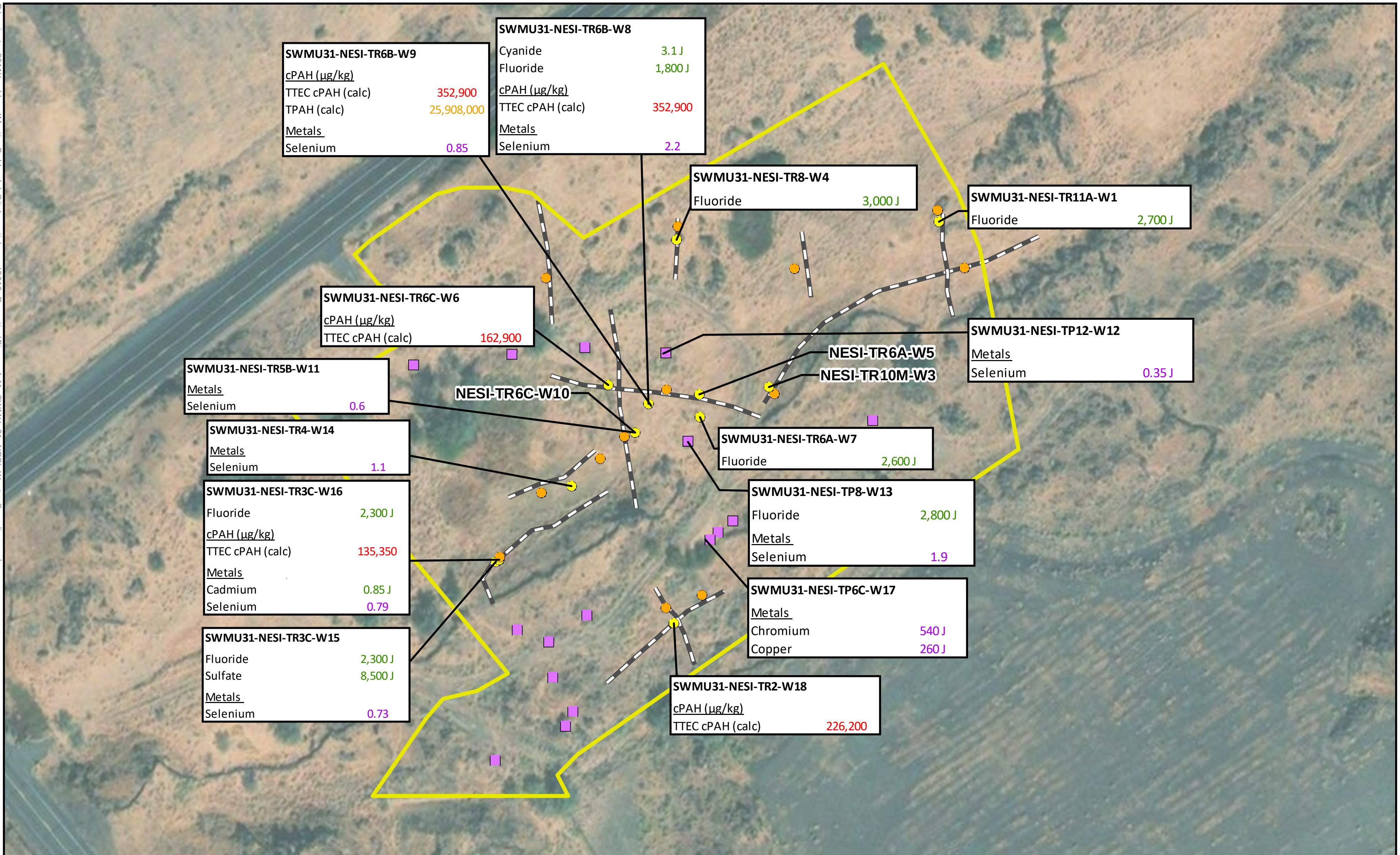
N W E S

0 50 100 200
Feet

Imagery Source: NAIP 2017

Figure 4-12
SWMU 31
NESI Area
RI Waste Thickness and Extent

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Legend
- NESI Area
- RI Trench Location
- RI Test Pit Location
- RI Soil Sampling Location
- RI Waste Sampling Location

orange: Exceeds Washington State Dangerous Waste Regulation
red: Exceeds MTCA Method C Soil Screening Level
green: Exceeds CLARC Soil Screening Level for Protection of Groundwater
purple: Exceeds Terrestrial Ecological Soil Screening Level

All results in mg/kg unless otherwise indicated
MTCA - Model Toxics Control Act
PAH - Polycyclic Aromatic Hydrocarbon
RI - Remedial Investigation
TTEC (calc) - Total Toxicity Equivalent Concentration (calculated)

N W E S

0 50 100 200
Feet

Imagery Source: NAIP 2017

Figure 4-13
SWMU 31
NESI Area
RI Waste Sampling Locations and
Screening Level Exceedance Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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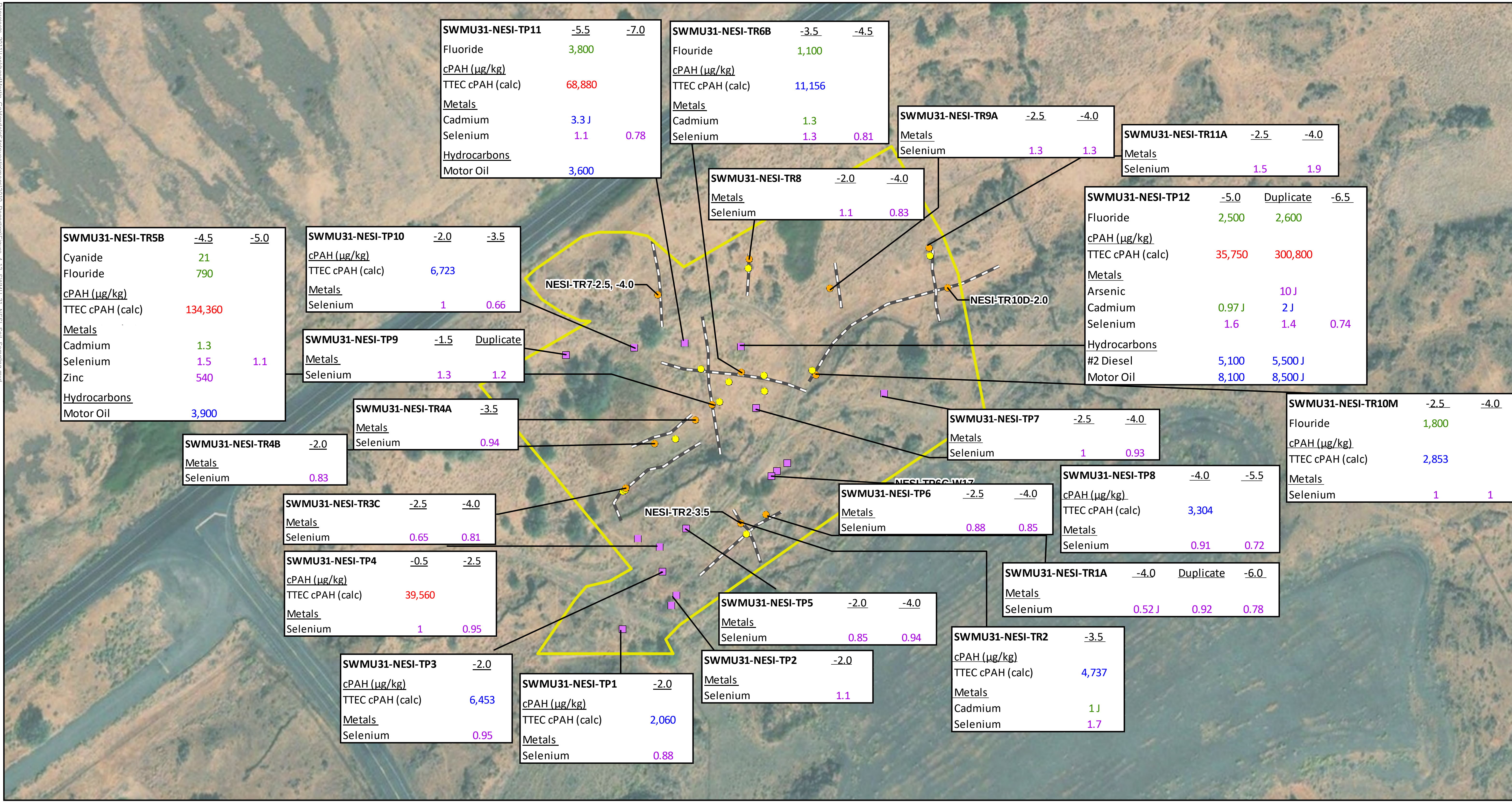


Legend
- NESI Area
- RI Trench Location
- RI Test Pit Location
- RI Soil Sampling Location
- RI Waste Sampling Location

red: Exceeds MTCA Method C Soil Screening Level
blue: Exceeds MTCA Method A Industrial Soil Screening Level
green: Exceeds CLARC Soil Screening Level for Protection of Groundwater
purple: Exceeds Terrestrial Ecological Soil Screening Level

All concentrations in mg/kg
MTCA - Model Toxics Control Act
PAH - Polycyclic Aromatic Hydrocarbon
RI - Remedial Investigation
TTEC (calc) - Total Toxicity Equivalent Concentration (calculated)

N W E S
0 50 100 200
Feet
Imagery Source: NAIP 2017

Figure 4-14
SWMU 31
NESI Area
RI Soil Sampling Locations and Soil Screening Level Exceedance Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

#### *4.5.2.1 Investigation Objectives*

The objective of the NESI field investigation is to characterize the extent of surface soil contamination in the NESI subarea to better estimate the extent and volume of contaminated surface soil for both RI and FS purposes.

Site reconnaissance activities for the larger area east of the NESI will be addressed as an additional investigation area – the eastern area truck-haul waste dumping site reconnaissance (refer to Section 4.6.3 for the Site reconnaissance grid).

#### *4.5.2.2 Investigation Scope*

WPA sample locations are shown on Figure 4-15. The investigation scope for the NESI subarea is includes the following:

- **NESI Wetland**. Seven surface soil samples will be collected from the NESI wetland that was not previously investigated during the RI.
- **Areas Adjacent to Waste Footprint**. Eleven surface soil samples will be collected from areas adjacent to Waste Footprint areas. In the NESI area, most wastes were found at or near the ground surface, and it is assumed that surface soils in all waste areas are contaminated and will need to be addressed during remediation. For this reason, the proposed surface soil sample stations in the NESI area will be collected from outside the Waste Footprint.
- **Eastern Area.** Surface soils will be collected along three transects at a 100-foot spacing to characterize surface soil concentrations immediately east of the NESI area. The transects will be placed in low lying areas, areas of former dirt roads and cattle paths and in the general dominant downwind direction from the NESI Area (i.e., up valley, dominant wind direction is from the southwest to the northeast). A total of 13 surface soil samples will be collected from this area.

The soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn) and diesel/oil-range petroleum hydrocarbons.

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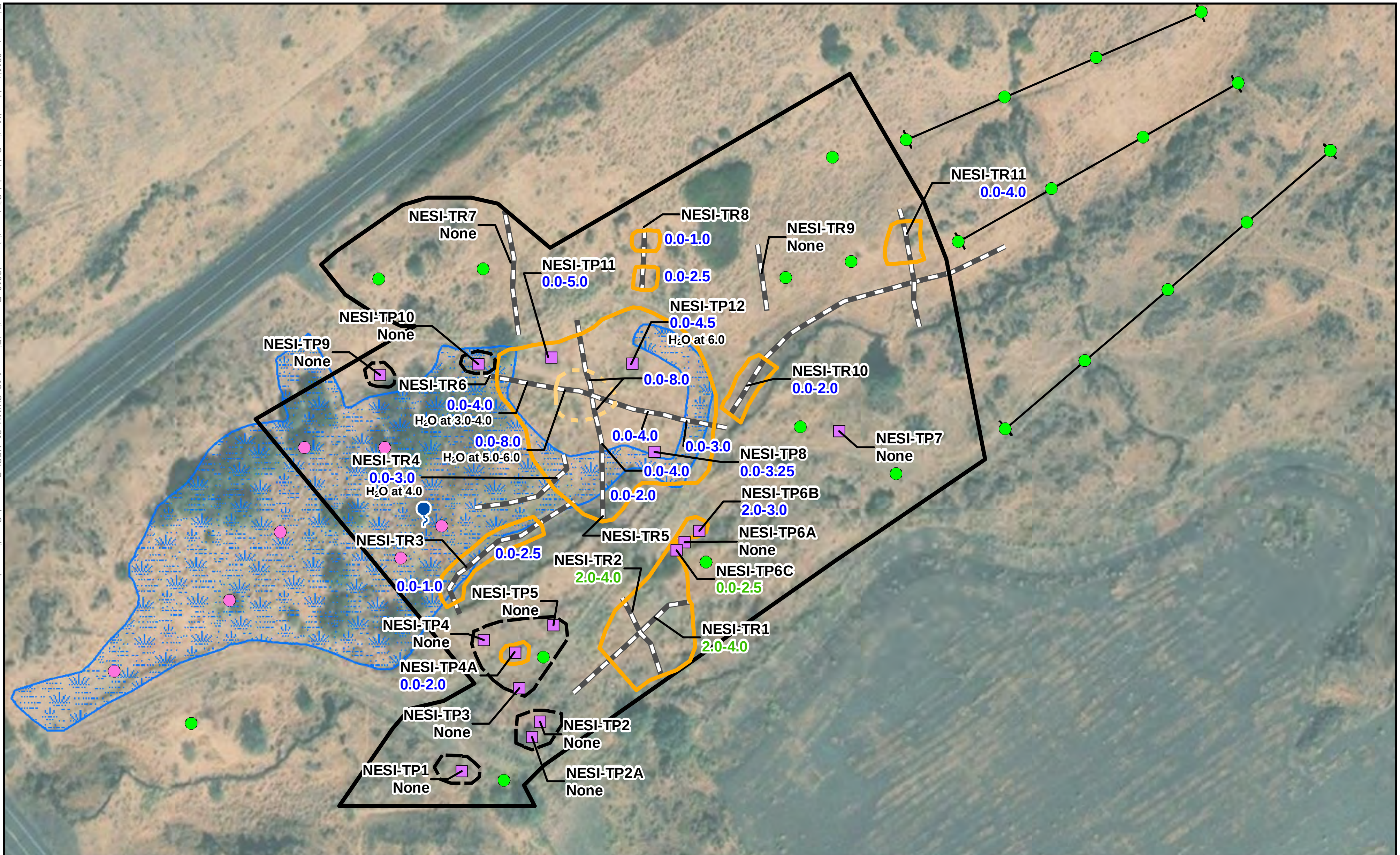



Legend

- NESI Area
- RI Trench Location
- RI Test Pit Location
- Waste Area
- 7.5-foot Waste Thickness Contour Interval
- Estimated Extent of Soil Contamination above MTCA Screening Levels and Outside of Waste Footprint
- Spring
- Wetland Area
- Proposed Surface Soil Sample Location
- Proposed Wetland Soil Sample Location
- Soil Sampling Transect Line (Sampling at 100' Intervals)

N W E S

0 50 100 200
Feet

Carbon waste interval including intermixed suspected spent pot liner (SPL) 2.0-4.0 feet bgs

Cryolite waste interval 2.0-4.0 feet bgs

RI - Remedial Investigation

Figure 4-15
SWMU 31
NESI Area
Proposed Surface Soil Sample Locations, RI Trench, Test Pit, and Waste Distribution

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

## 4.6 ADDITIONAL INVESTIGATION AREAS

Three additional investigation areas have been identified during the remedial investigation including: the ditch near the West SPL Storage Area, the ESI Fence Line Area, and the eastern reconnaissance area.

### 4.6.1 Ditch Near West SPL Storage Area

A single soil sample was collected from the Ditch near the West SPL Storage Area as summarized in Volume 2, Section 33 of the Draft RI Report (Tetra Tech et al. 2019a) and shown in Figure 4-16.

#### *4.6.1.1 Investigation Objectives*

The investigation objectives are to characterize the extent of soil contamination within the ditch and to verify that the pipe that could potentially drain the West SPL Storage area cap does not contain water.

#### *4.6.1.2 Investigation Scope*

Figure 4-16 shows the proposed and RI sampling stations. Five surface soil samples will be collected including two within the drainage ditch and three in the area of the ditch discharge point located to the southwest. One deeper sample will also be collected with a hand-auger from this area or from beneath the armored and lined portion of the ditch based on field observations and subsurface conditions.

Removal of the rip-rap armor in the ditch will be attempted using hand tools. If feasible, a soil sample will be collected from below the rip-rap and liner (if present).

The discharge pipe will be inspected at the time of soil sampling. If flowing water is found, a grab water sample will be collected from the pipe.

The soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, polychlorinated biphenyls (PCBs), metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn) and diesel/oil-range petroleum hydrocarbons. The pipe discharge will be sampled for this same analytical program (with the addition of dissolved metals and free cyanide) if sufficient discharge is present for sampling.


| HA1 | -0.5 | Duplicate |
|---|---|---|
| cPAH (µg/kg) | | |
| TTEC cPAH (calc) | 33,950 | 36,190 |
| Metals (mg/kg) | | |
| Arsenic | 15.0 | 15 J |
| Cadmium | 2.3 J | 2.5 J |

Legend

- RI Surface Soil Sampling Location
- Outfall
- Exposed Liner
- Monitoring Well
- Vault
- Armored Ditch
- Culvert
- Area of Minor Sediment and Vegetation
- Investigation Area
- Proposed Soil Sampling Location

red: Exceeds MTCA Method C Soil Screening Level
blue: Exceeds MTCA Method A Industrial Soil Screening Level
green: Exceeds CLARC Soil Screening Level for Protection of Groundwater
RI - Remedial Investigation

N W E S

0 25 50 100
Feet

Imagery Source: NAIP 2017

Figure 4-16
Additional Investigation Area
Ditch by West SPL Storage Area
Proposed Sample Locations,
RI Sampling Locations and
Soil Screening Level Exceedance Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

### 4.6.2 ESI Fence Line Area

The ESI Fence Line Area was discovered in June 2016 during a routine inspection of the cap. In 2018, shallow soils in the ESI Fence Line Area were sampled, excavated, and removed offsite for disposal as documented in an ESI post-closure monitoring report (Tetra Tech 2018b). The soil removal action was subsequently reported to Ecology as an Interim Action Work Plan (Tetra Tech et al. 2019a). Approximately 435 tons of PAH-contaminated soils were excavated and sent for disposal to the Columbia Ridge Landfill. Approximately 15 cubic yards of stockpiled material was segregated during excavation work, stockpiled and covered inside the ESI fence line. The stockpiled soil is pending Ecology approval for disposal. Soil confirmation samples collected from the base of the excavations are below MTCA industrial soil screening levels and MTCA-derived soil screening levels for protection of groundwater.

Figure 4-17 shows the soil removal area and the confirmation sample locations. Comparison with the recently adopted terrestrial ecological screening levels show that one of five confirmation samples collected from within the excavation (confirmation sample ESI-CONF01) exceed the 1,100 micrograms per kilogram (μg/kg) screening level for total HMW PAHs.

#### *4.6.2.1 Investigation Objectives*

Additional site reconnaissance and characterization will be performed to verify that additional waste areas are not present and to verify the lateral and vertical extent of soil contamination in the ESI Fence Line Area.

#### *4.6.2.2 Investigation Scope*

Figure 4-18 shows the reconnaissance area and sampling stations for ESI Fence Line Area. The investigation includes inspection of areas within 500 ft of the soil excavation area both inside and outside the ESI fence line. This specific area will be informally gridded-out and transects will be walked and inspected by foot along a series of north-south and east-west oriented transects at an approximately 175-foot spacing.

Note that Figures 4-17 and 4-18 include the locations of the North, South, and West Intermittent Ponds. These features represent historical depressions associated with ESI (SWMU 2). These depressions were addressed by the ESI closure around 1987 through excavation and placement of


**Legend**

MW-8 Monitoring Well

MW-10 ESI Monitoring Program Well

Confirmation Sample Location

Fenceline

Approximate Gravel Road Location

ESI Cap Boundary

Excavated Area

Rocky Area

N

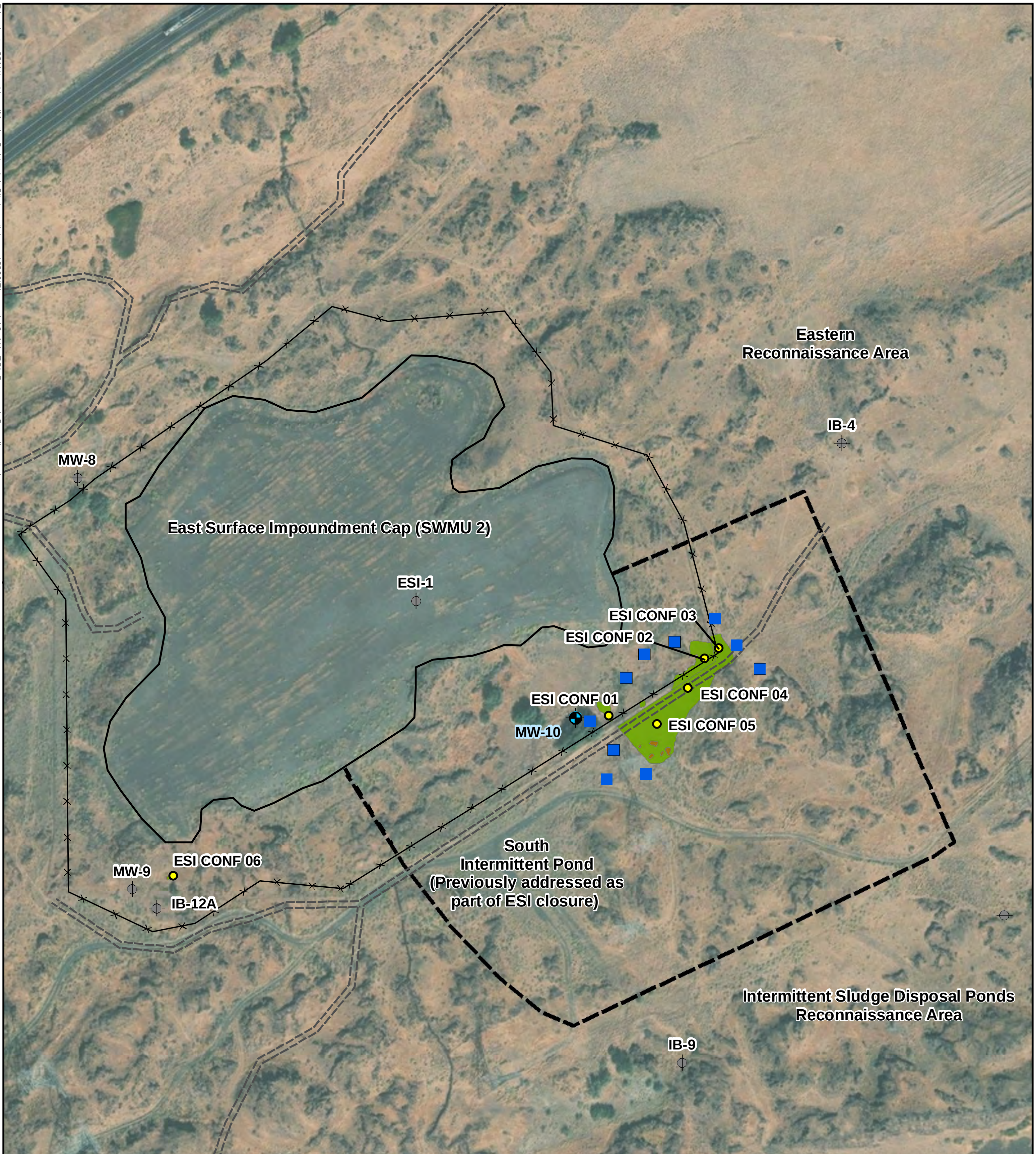
0 50 100 200

Feet

Imagery Source: NAIP 2007

Figure 4-17
Additional Investigation Area
ESI Fenceline Interim Action Work Plan
Soil Excavation and
Confirmation Soil Sample Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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**Legend**

MW-8 Monitoring Well

MW-10 ESI Monitoring Program Well

Confirmation Sample Location

Fenceline

Proposed Test Pit Excavation

Approximate Gravel Road Location

ESI Cap Boundary

Excavated Area

Rocky Area

Site Reconnaissance Area

N

0 50 100 200

Feet

Imagery Source: NAIP 2017

Figure 4-18
Additional Investigation Area
ESI Fenceline Reconnaissance Area
and Proposed Sampling Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

cover material. Investigation of the Intermittent Ponds is not included the scope of activities for the ESI Fence Line Area.

The sampling program includes four test pit locations within the fence line and six test pit locations outside the fence line and includes collection of two soil samples at each station location based on field observations.

The soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn) and diesel/oil-range petroleum hydrocarbons.

#### 4.6.3 Eastern Area Truck Haul Waste Dumping Site Reconnaissance and Sampling

Based on the discovery of waste and contaminated soil in the ESI Fence Line Area, Ecology has requested further documentation that adequate site reconnaissance has been performed to verify that all areas of truck-haul waste dumping have been identified and to address the potential for buried wastes to occur in these areas.

The Final RI Phase 1 Work Plan included compilation and review of historical aerial photographs as well as a comprehensive review and summary of past environmental investigations and other records. A site-wide reconnaissance was previously performed to identify dumping areas in the vicinity of the Smelter Sign and NESI subareas (SWMU 31) (Tetra Tech 2011a,b). In addition, several investigation, remediation, and long-term monitoring projects have been performed in the eastern area of the Site that included site reconnaissance activities:

- Characterization and remediation of the Intermittent Sludge Disposal Ponds (SWMU 3) (ARCADIS 2007; URS 2008a).
- Long-term monitoring and inspection of the ESI cap (SWMU 2) and site characterization and soil removal at the ESI Fence Line Area.
- RI reconnaissance and characterization work including well network verification, groundwater sampling, NESI and Smelter Sign site reconnaissance, and site characterization.

Additional eastern area site-reconnaissance and sampling is included in this WPA to address Ecology comments. Note that site reconnaissance and sampling activities in the Intermittent Sludge Disposal Ponds (SWMU 3), the eastern portion of the NESI subarea (SWMU 31), and ESI Fence

Line Additional Investigation Area are addressed separately from the Eastern Reconnaissance Area in this WPA (refer to Sections 4.3, 4.5.2, and 4.6.2, respectively).

#### *4.6.3.1 Investigation Objectives*

The objectives of the eastern area site reconnaissance include:

- Documentation and verification that additional waste disposal areas are not present based on visual inspection.
- Limited subsurface characterization through test pit excavation to address the potential for buried wastes.
- Limited characterization of chemical concentrations in surface and subsurface soils to verify absence of contamination above soil screening levels.

#### *4.6.3.2 Investigation Scope*

Site reconnaissance will be performed including inspection and documentation in the eastern portion of the Site using a grid system as shown in Figure 4-19. Each grid area will be inspected by walking lines at an approximate 250-foot spacing. The grid corners will be established using a hand-held global positioning system (GPS). Photographs will be taken in each grid area and coordinates of relevant features will be determined, using a hand-held GPS. Areas of historical disturbance and adjacent to vehicle tracks will be visually examined.

Note that Figure 4-19 shows the locations of the North, South, and West Intermittent Ponds. These features represent historical depressions associated with ESI (SWMU 2). These depressions were addressed by the ESI closure around 1987 through excavation and placement of cover material. Investigation of the Intermittent Ponds is not included the scope of activities for the Eastern Area Truck Haul Waste Dumping Site Reconnaissance and Sampling.

Supplemental soil and waste sampling will be performed if evidence of soil/waste contamination is identified. Up to four test pit locations will be excavated to verify subsurface conditions based on reconnaissance findings. If no surface indications of soil contamination or waste are found, the historical borrow pit area south of SR 14, will be assessed through test pit excavations shown in Figure 4-19.


Legend

- Eastern Reconnaissance Area
- Intermittent Sludge Disposal Ponds (SWMU 3) Reconnaissance Area
- ESI Fenceline Reconnaissance Area

EELF: East End Landfill
ESI: East Surface Impoundment
NESI: Area North of East Surface Impoundment
SSA: Smelter Sign Area

N W E S

0 500 1,000
Feet

Figure 4-19
Eastern Reconnaissance Area Grid

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Two soil samples will be collected from each test pit excavation (one surface soil sample and one subsurface soil sample). The depth of the subsurface soil sample will be selected based on field observations. If no indications of contamination are found the subsurface sample will be collected from the base of the excavation. The test pit excavations will be dug to a maximum depth of 7 ft (maximum depth for TEE) or bedrock refusal. The soils samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn) and diesel/oil-range petroleum hydrocarbons.

## 4.7 GROUNDWATER AOC

Ecology comments (Ecology and Yakama Nation 2019) on the Draft RI Report (Tetra Tech et al. 2019a) have indicated the need for additional evaluation of the groundwater-to-surface pathway as well as comments regarding the groundwater characterization needs particularly for petroleum hydrocarbons in various portion of the Former Plant Area Footprint.

### 4.7.1 Spring Sampling

Two springs were sampled during the RI field investigation: the NESI wetland spring and Spring 01 located in Wetland K. The locations of springs and wetland areas are shown in Figure 4-20. Water in wetlands at the Site (Wetlands D, E, F, and K) was previously sampled during 2013 (PGG 2013a,b) and results are presented in the Final RI Phase 1 Work Plan (Tetra Tech et al. 2015a) and Volume 3, Section 3.1 of the Draft RI Report (Tetra Tech et al. 2019a). Of the five springs identified, only the recently discovered spring in the western portion of the Site has not been previously sampled.

Spring and flow channels respond quickly to major precipitation and snow melt events as previously noted in the Draft RI Report (Tetra Tech et al. 2019a) in the area of the NPDES ponds. As documented in the Draft RI Report, wetlands generally have more standing water during the spring season as well as the seasonal high groundwater elevations. Groundwater recharges are the source of water for perennial springs in the vicinity of the Site. Sampling and flow characterization of the springs will be delayed until Winter or Spring in order to obtain the necessary USACE access permits. Both seasons represent higher water periods. If practicable, this work will be completed following a period of rainfall.


Legend

A Wetland Area Designation

Spring Sampling Location

Hand-Driven Well-point Location

N W E S

0 500 1,000 2,000

Feet

Figure 4-20
Wetland Locations, Proposed Spring Sampling Locations and Temporary Well Point Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

#### 4.7.1.1 Investigation Objectives

Springs in the Site vicinity in most cases are associated with wetlands, and in some areas of the Site are associated with faults that appear to represent preferential flow pathways as previously summarized in the Site hydrogeologic conceptual model summary (refer to Section 2.2). Sampling of the springs will address the following objectives:

- Characterization of water contaminant concentration along suspected preferential flow paths.
- Characterization of the lateral extent of groundwater contamination.
- Verification that total petroleum hydrocarbon (TPH) concentrations are below screening levels in springs, wetland areas, and along flow paths. This will be addressed through inclusion of diesel-range and oil-range petroleum hydrocarbons in the analytical program.
- Estimation of spring water discharges.

#### 4.7.1.2 Investigation Scope

Five springs will be sampled including the following as shown on Figure 4-20:

- **Wetland D Spring**. This spring appears to drain from the UA zone. A collection system was installed to supply water to a cattle trough at this location. This work element is also described in the Wetland AOC sampling program (refer to Section 4.8.1).
- **Wetland F Spring**. This spring is assumed to drain from the $BAU_2$ aquifer zone and appears to be perennial. It is present in the vicinity of the mapped fault that extends up the Western Intermittent Drainage from the Boat Basin.
- **Wetland K Spring (Spring 01).** This spring drains from the $BAU_2$ aquifer zone and was sampled concurrently with groundwater during each of the four RI groundwater sampling rounds. This spring and Wetland K are recharged by the stormwater pond based on the findings of the Draft RI Report (Tetra Tech et al. 2019a). As summarized in the Wetland AOC sampling program (refer to Section 4.8.2), Wetland K spring will also be sampled in two additional locations within Wetland K to determine the extent of water chemical exceedances within Wetland K.
- **NESI Wetland Spring.** This seasonal spring is present during winter through spring and appears to be associated with groundwater discharges from the UA zone and/or $BAU_1$ zone.
- **Recently Discovered Spring.** This spring was found in the western portion of the Site during well installation activities at RI-MW20-BAL. This spring appears to drain from the $BAU_1$ zone.

The source of the springs identified in the text is based on hydro-stratigraphy, the occurrence of faults, topography, spring and groundwater water-level elevations, and chemical results as summarized in the Draft RI Report. Groundwater geochemistry data was collected from some of the spring and all well locations during the baseline (Q1) groundwater sampling round. However, a clear geochemical pattern was not discerned for each aquifer zone based on the collected geochemical data. Except for the NESI wetland spring, the springs appear to be perennial. Sampling will be timed as needed to obtain the necessary samples and will likely be performed during the Fall season based on the current project schedule.

Spring samples will be analyzed for total cyanide, free cyanide, fluoride, sulfate, PAHs, total and dissolved metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn) and diesel-range and oil-range petroleum hydrocarbons.

Spring samples will be collected using the field procedures specified in Section 5.4. Field evaluation of spring discharge rates will be performed using the procedures summarized in Section 5.5.

### 4.7.2 Temporary Well Point Installation and Sampling

Hand-driven temporary well points will attempt to be installed at two locations (Figure 4-20): 1) between Wetland K and the Columbia River, and 2) at the mouth of the Western Intermittent Drainage gulley near the Boat Basin.

#### *4.7.2.1 Investigation Objectives*

The objective of the well point sampling is to:

- Evaluate the potential presence of a shallow water-bearing zone (UA) in unconsolidated deposits in two areas where a potential flow pathway to the Columbia River has been identified.
- Characterize water quality concentrations within the surficial deposits (the UA zone) near the Columbia River if water is present.

#### *4.7.2.2 Investigation Scope*

The investigation scope includes installation and one-time sampling of hand-driven well points at two locations shown in Figure 4-20: 1) one location at the mouth of the Western Intermittent Drainage near the western end of the Boat Basin, and 2) one location between Wetland K and Columbia River. Installation and sampling of the temporary well points will be delayed until

Winter or Spring in order to obtain the necessary USACE access permits. Both seasons represent higher water periods with a higher likelihood of finding shallow perched groundwater in the unconsolidated soils.

The RI field reconnaissance suggest that there may not be a sufficient thickness of unconsolidated soils present for a perched water aquifer zone to be present on top of the basalt bedrock. This is particularly suspected for the proposed temporary well-point location between Wetland K and the Columbia River. There may also be difficulties in driving the well point to the bedrock contact given the rocky nature of the unconsolidated deposits at the Site. For these reasons, installation will be attempted at up to three sub-locations with a maximum depth of 10 ft bgs or refusal. Field procedures for the hand-driven well points are summarized in Section 5.3.

The Western Intermittent Drainage drive-point sampling location geology appears to represent a fan deposit area with sediments derived from Missoula Flood deposits and the drainage and fault may serve as a flow pathway. The drive-point sample may provide a good indicator of water quality from upgradient areas that may be discharging to the Boat Basin. Indications of flowing water in this drainage will be noted. A surface water sample will be collected of identified spring discharges.

Samples collected from the hand-driven well points will be analyzed for total cyanide, free cyanide, fluoride, sulfate, PAHs, total and dissolved metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, and Zn), and diesel-range and oil-range petroleum hydrocarbons.

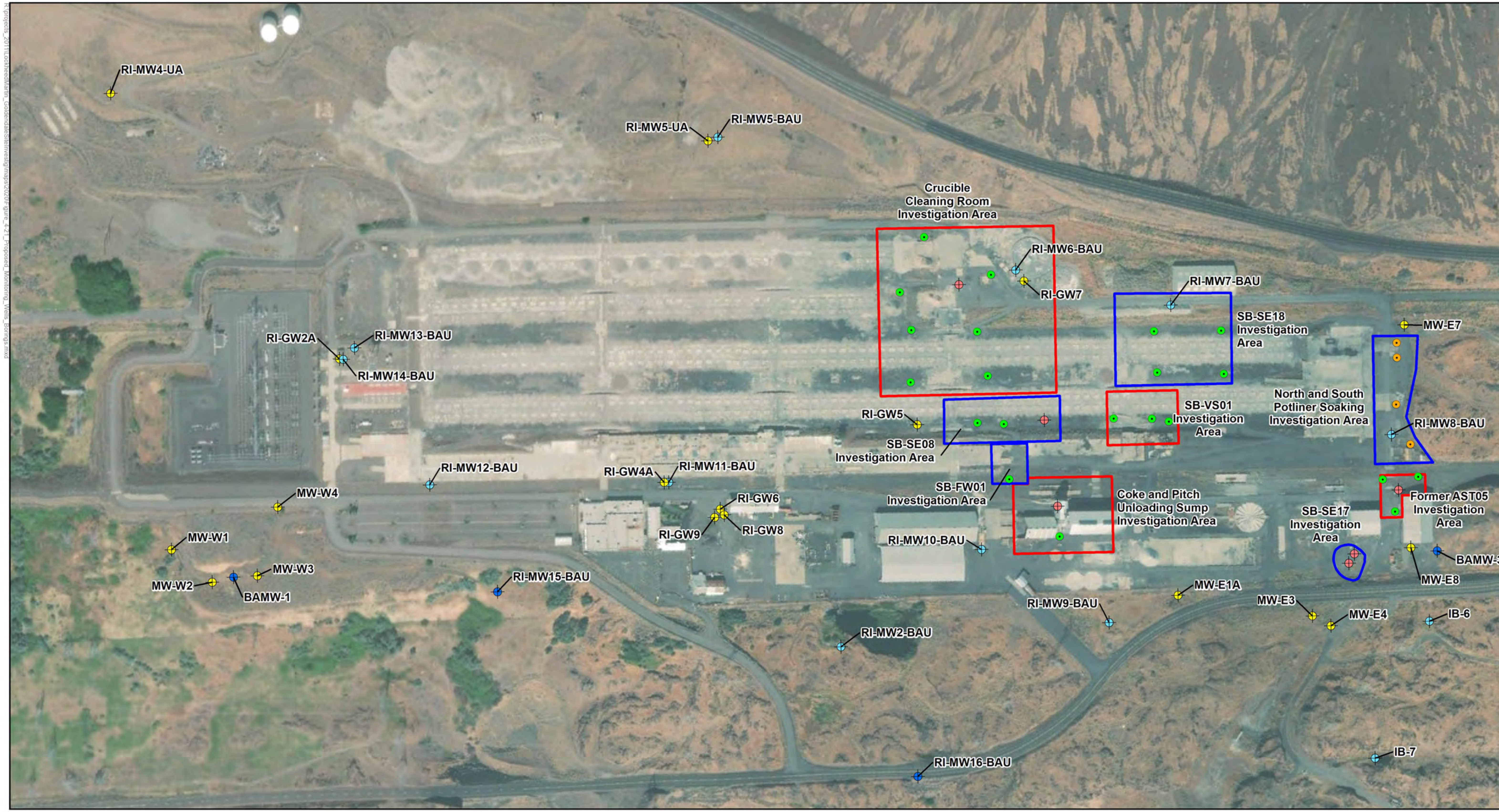
### 4.7.3 Well Installation and Sampling

Shallow wells and borings will be installed as part of the PAAOC investigations. Refer to Section 4.9 for a complete summary of the PAAOC work effort. The groundwater component of the PAAOC investigation is summarized in this section for convenience. Figure 4-21 shows the proposed temporary well and boring groundwater sample locations in the PAAOC.

#### *4.7.3.1 Investigation Objectives*

The objectives of the groundwater characterization work include the following:

- Supplemental characterization of shallow groundwater (UA zone) quality in specific areas with subsurface soil contamination.
- Supplemental characterization of water-level elevations in the UA zone.




Legend

- Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

- $BAU_1$ - Shallower Water-bearing Zone
- $BAU_2$ - Deeper Water-bearing Zone
- Proposed Soil Boring - One shallow well will be installed in this area if appreciable groundwater is found.
- Proposed Boring with Grab Groundwater Sampling
- Proposed Groundwater Well
- WPA Investigation Area
- Additional WPA Investigation Area

0 100 200 400
Feet
Imagery Source: NAIP 2017

Figure 4-21
Former Plant Area
Proposed Shallow Monitoring Wells
and Borings with Groundwater Sampling

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

- Supplemental characterization of UA and BAU groundwater quality and water-level elevations at existing wells in the Former Plant Area Footprint to address Ecology comments on the Draft WPA about the need for additional TPH sampling in this area. Other groundwater chemical of concern (e.g., fluoride and sulfate) will also be included (Figure 4-21). Refer to Table 4-1 for a detailed summary of the analytical program for sampling of existing wells in the Former Plant Area Footprint.
- Supplemental characterization of UA zone and BAU zone groundwater quality and water level elevations in the SB-17 area within the EELF (SWMU 17) Footprint and near the SE Line that trends toward the head of former NPDES Pond A (SWMU 1) (Figure 4-21).

#### *4.7.3.2 Investigation Scope*

Six shallow monitoring wells and 21 borings that incorporate grab groundwater sampling are included in the PAAOC scope of work (Figure 4-21). Well specifications, well development, well surveying, and groundwater sampling procedures are briefly summarized in Section 5.1 and are consistent with the Ecology-approved Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b). The shallow well and groundwater boring sampling program is summarized in more detail in Section 4.7 and 4.9. Procedures for collection of grab groundwater samples from a boring are described in Section 5.2 and are designed to minimize entrainment of sediment and allow collection of a representative groundwater sample. After collection of the grab sample, the boring will be properly plugged and abandoned.

Groundwater samples will be collected from the newly installed wells. Sampling will be conducted following the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b) using low-flow sampling techniques including a flow-through cell to measure water quality parameters, and likely use of a peristaltic pump or low flow submersible pump for BAU zone wells.

The analytical program for groundwater samples collected from the new wells and groundwater grab samples will be routinely analyzed for total cyanide, free cyanide, fluoride, sulfate, PAHs, and diesel-range and oil-range petroleum hydrocarbons. Wells and groundwater borings from a few selected investigation areas will also include gasoline-range petroleum hydrocarbons, volatile organic compounds (VOCs), and select metals analyses as summarized in Table 4-1 for each investigation area.

To resolve the Ecology's outstanding concerns regarding the potential distribution of petroleum hydrocarbons in groundwater, a single round of groundwater sampling for TPH constituents is proposed for shallow wells in the Plant Area Footprint including a total of 30 wells (16 UA zone wells and 14 BAU zone wells). Of these existing wells, 5 of the UA zone wells have typically been dry and therefore sample collection may not be possible. The wells will be sampled for diesel-range and oil-range hydrocarbons, fluoride, and sulfate. A small subset of these wells will also be analyzed for total cyanide, free cyanide, gasoline-range petroleum hydrocarbons, and VOCs as summarized in Table 4-1 under the analytical program for the GWAOC.

### 4.7.4 Groundwater to Surface Water Flux and Water Balance Assessment

The groundwater to surface water migration pathway represents a key RI topic. The proposed spring sampling and temporary well-point sampling are intended to characterize chemical concentrations in spring discharges from the shallow BAU zone and UA zones along potential flow pathways, and to characterize water concentrations in wetland areas. Based on the findings of the Draft RI Report, there is limited interconnection and contaminant migration between the BAL zone and the Columbia River (refer to Section 2.2).

#### *4.7.4.1 Groundwater Flux and Water Balance Assessment Objectives*

The purpose of this data evaluation is to: 1) help estimate the degree of interconnection (flux) between the $BAL_2$ zone and the Columbia River, and 2) develop a rough estimate of the water balance for hydrogeologic system in areas where there is a potential transport pathway to the Columbia River (e.g., Stormwater Pond-Wetland K and NPDES drainage).

#### *4.7.4.2 Groundwater Flux and Water Balance Assessment Scope*

Methods of Ferris (1963) will be used to analyze stage ratios and time lag for shoreline wells and the Columbia River to evaluate transmissivity and groundwater flux. The regulation of a surface water reservoir, such as Lake Umatilla, produces correlative water-level changes in hydraulically-connected wells that are near the reservoir. As the surface water stage rises, the head upon the subaqueous outcrop (defined as the subaqueous area of the aquifer that interacts with the surface water body) of the aquifer increases and thereby either increases the rate of flow into the aquifer or reduces the rate of flow from it. The increase in recharge or reduction in discharge results in a general rise of the water-level in the aquifer. Conversely, a falling surface water stage causes a corresponding decline of the water-level in the aquifer. In this manner, changes in the reservoir stage are propagated inland as a train of sinusoidal waves. The amplitude of the wave decreases, and the lag time increases, with increased distance from the subaqueous aquifer outcrop.

Confined conditions were documented in the RI for the $BAL_2$ aquifer zone along the Columbia River. Ferris (1963) notes that if an aquifer has no subaqueous outcrop, but is confined by an extensive aquiclude, the rise and fall of the surface water stage changes the total weight upon the aquifer. Resulting variations in compressive stress are borne in part by the formation matrix of the aquifer and in part by its confined water. The relative compressibility of the formation materials and the confined water determine the ratio of stress assignment and the net response of the piezometric surface to the surface force. An implication of this finding is that groundwater can respond to changes in surface water stage without having substantive physical interconnection (physical recharge and discharge) with the surface water body. Since the compressibility of basalt bedrock is low, the bulk of the compressive stress would be manifested in the piezometric response of the confined aquifer water.

The average values for time lag and stage ratio will be calculated for RI-MW18-BAL and RI-MW19-BAL and the surface water pond based on the year-long hydrograph study. These well locations and the location of the surface water intake pond are shown in Figure 2-4 of Section 2.2. The stage ratio is defined for a given rising or falling stage as the range in water-level fluctuation in a given observation well to the corresponding range in water-level fluctuation for the surface water intake pond. The data will be reviewed to identify maximums and minimums for the surface water reservoir that can be clearly paired with corresponding maximums and minimums for the select $BAL_2$ aquifer zone wells. These maximum and minimums will then be used to determine the average stage ratio and time lag for each well with respect to the surface water intake pond. An equal number of rising stages and falling stages will be used in the calculation of the average stage ratio. Transmissivity (T) will be independently calculated using the average stage ratio and time lag for each well and using a range of representative storage (S) values. For the purposes of this analysis, the shortest distance from the well to the Columbia River or Surface Water Intake Pond will be assumed to be the distance to the subaqueous outcrop (i.e., the assumption is that the groundwater is hydraulically affected by the changes in river stage at the closest shoreline location).

The data will be compared to the hydraulic conductivity values for specific shoreline wells (wells RI-MW18-BAL and RI-MW19-BAL) based on RI slug test results. Slug tests characterize conditions only over a small radius around the well, while the Ferris (1963) method characterizes average conditions over a large area. If there is limited connection, it would be expected that the hydraulic conductivities for the wells would likely be higher for the slug tests than the range of values calculated based on stage ratio and time lag.

Based on the detailed hydrographs presented in Appendix D-10 of the Draft RI Report (Tetra Tech et al. 2019a), during most of the year-long study, the water-level elevation in Lake Umatilla is higher in elevation than the shoreline wells. Contaminant flux from the groundwater to the Columbia River should not occur under these circumstances. The duration of the water-level elevations reversal will be determined from the year-long hydrograph data for RI-MW18-BAL, RI-MW19-BAL, and the surface water intake pond.

The hydrogeologic water balance will be determined through evaluation and estimation of the following parameters or conditions:

- **Evapotranspiration/Evaporation.** This parameter will be estimated for Wetland K, the Western Intermittent Drainage, and the NPDES Ponds using the EPA HELP model or similar approach.
- **Precipitation Records**. A search will be performed to obtain precipitation data for April 2017 to April 2018 (the period of the RI water-level characterization study) for a station near the Site.
- **Water Discharge into NPDES Pond A Drainage**. This parameter will be estimated based on pipe-flow measurements and past remediation reports.
- **Water Discharge into the Stormwater Pond**. This will be estimated based on pipe-flow measurements, stage data from the RI water-level characterization study, precipitation data, and drainage areas.
- **Water Pumped from the Stormwater Pond.** This parameter will be estimated on an annual basis based on past NPDES discharge reports, pumping duration, and estimated pond pumping rate. The year-long hydrograph data for the pond will also be used to estimate the amount of water pumped from the pond during NPDES discharge events.

- **Water Recharge to the Basalt Aquifer System in the Stormwater Pond Vicinity.** This condition will be estimated from the amount of water entering and pumped out of the pond, and the hydraulic conductivity estimates for the aquifer zones and flow interiors near the Stormwater Pond (including wells RI-MW2-BAU, RI-MW16-BAU, and RI-MW2-BAL core). The response in adjacent wells to stage changes in the stormwater pond will be incorporated into this analysis.

This information and data analysis will be evaluated to define an approximate water balance for groundwater migration toward the Columbia River along these two suspected flow pathways. Chemical concentration data for the shoreline monitoring wells, proposed temporary well points, and proposed spring sampling will also be considered in this evaluation through comparison of results with groundwater and surface water screening levels.

The scope of work for field evaluation of the lines including pipe connection characterization, pipe discharge measurements, and associated chemical sampling is summarized in the stormwater and other lines investigation scope of work in Section 4.9.3.

## 4.8 WETLANDS AOC

Wetland and springs at the Site are shown in Figure 4-20, and Wetlands AOC RI soil sampling results are shown in Figure 4-22.

Ecology and Yakama Nation comments (Ecology and Yakama Nation 2019) on the Draft RI Report (Tetra Tech et al. 2019a) requested additional investigation for specific wetland areas including Wetlands D and K. These comments have also requested consideration of additional screening levels for wetland areas potentially including the Washington State SMS as well as additional TEE screening levels.

Ecology has commented on the Draft WPA regarding a potential distinction between soil and sediment samples in the wetlands for sampling purposes. Most of these wetland areas have been defined primarily based on vegetation and there are only small areas of persistent standing water. There is no distinction between soil and sediment samples from a sampling perspective. Both are proposed to be collected with a hand auger or spoon depending on lithology as was previously done during RI sampling at the Wetlands AOC as documented in the Draft RI Report.


Legend

- RI Surface Soil Sample Location
- Wetland Area Name

blue: Exceeds MTCA Method A Industrial Soil Screening Level
green: Exceeds CLARC Soil Screening Level for Protection of Groundwater
purple: Exceeds Terrestrial Ecological Soil Screening Level

CLARC - Cleanup Levels and Risk Calculation
cPAH - Carcinogenic Polycyclic Aromatic Hydrocarbon
J - Estimated Concentration
MTCA - Model Toxics Control Act
RI - Remedial Investigation
TTEC - Total Toxicity Equivalent Concentration

N
W E
S

0 250 500 1,000
Feet
Imagery Source: NAIP 2017

Figure 4-22
Wetlands AOC
RI Soil Sample Locations and
Screening Level Exceedance Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

### 4.8.1 Wetland D

Wetland D was characterized in the RI through collection of 8 surface soil samples. The highest concentrations of PAHs, arsenic, and sulfate were found in sample WLAOC-SS13 that corresponds to the former location of the Duck Pond (Figure 4-23). As discussed in the Draft RI Report (Tetra Tech et al. 2019a), there appears to be signs of historical soil disturbance/grading observed in the area of the Duck Pond in a 2005 aerial photograph.

#### *4.8.1.1 Investigation Objectives*

Objectives of the Wetland D characterization activities include the following:

- Further investigation of the extent of soil contamination, particularly in the area of the former Duck Pond that corresponds to location of the soil sample with highest PAH and sulfate concentrations.
- Characterize spring water quality at Wetland D.

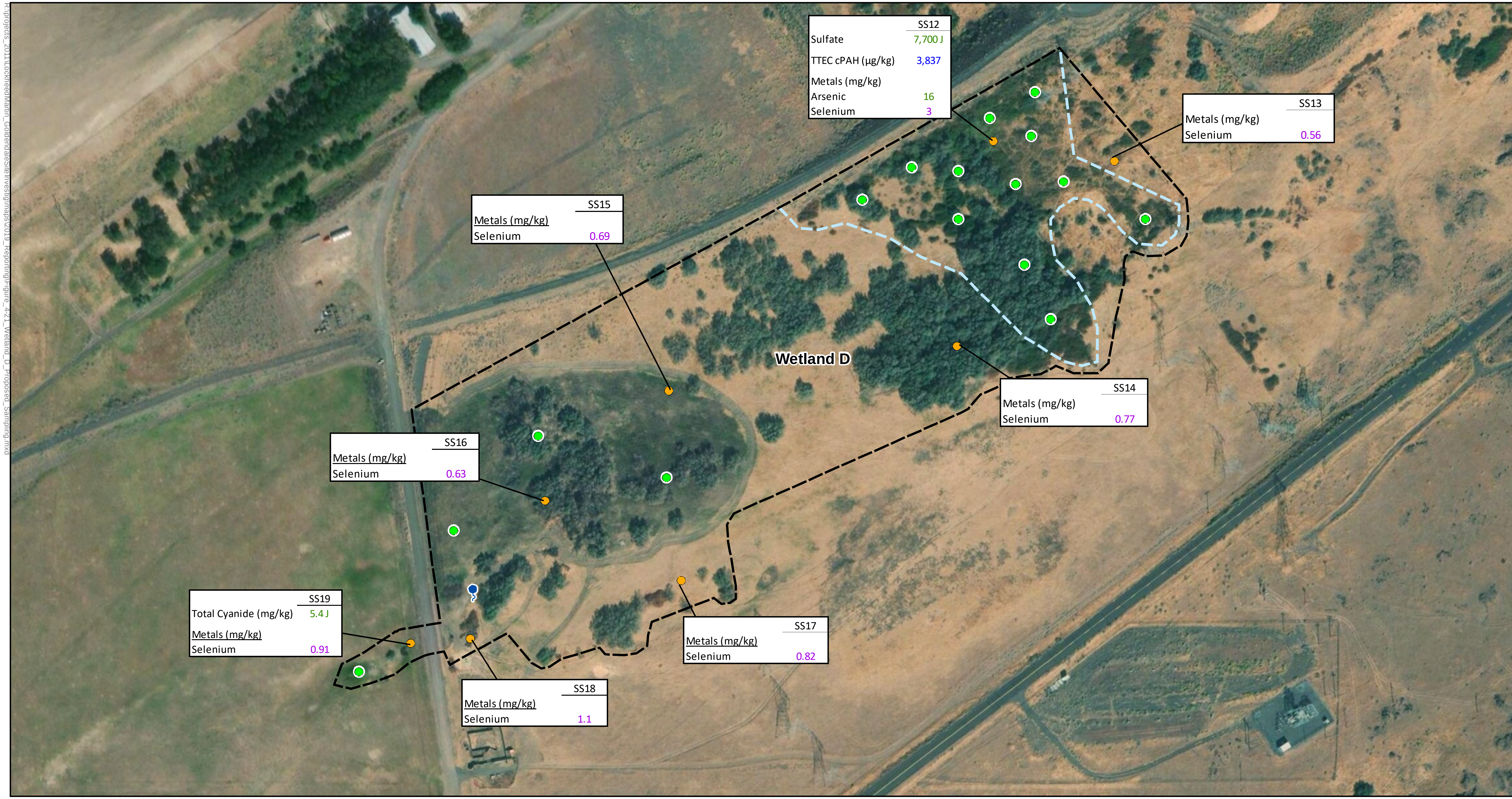
#### *4.8.1.2 Investigation Scope*

The proposed sampling stations are shown in Figure 4-23. The investigation scope for Wetland D includes:

- Collection of 15 surface soil samples to evaluate the extent of soil contamination, particularly in vicinity of the former Duck Pond.
- Collection of one spring sample as described in the Groundwater AOC field investigation (refer to Section 4.7.1.2).
- Estimation of spring discharge.

The analytical program for the Wetland D soil investigation includes total cyanide, fluoride, sulfate, PAHs, total and dissolved metals (Al, As, Cd, Cr, Cu, Hg, Pb, Ni, Se, and Zn), and diesel-range and oil-range petroleum hydrocarbons.

Spring sampling procedures and discharge measurement procedures are specified in Section 5.4 and 5.5, respectively.




Legend
- RI Surface Soil Sample Location
- Proposed Surface Soil Sample Location
- Spring
- Former "Duck Pond" Area
- Wetland D Investigation Area

blue: Exceeds MTCA Method A Industrial Soil Screening Level
green: Exceeds CLARC Soil Screening Level for Protection of Groundwater
purple: Exceeds Terrestrial Ecological Soil Screening Level

CLARC - Cleanup Levels and Risk Calculation
cPAH - Carcinogenic Polycyclic Aromatic Hydrocarbon
J - Estimated Concentration
MTCA - Model Toxics Control Act
RI - Remedial Investigation
TTEC - Total Toxicity Equivalent Concentration

Figure 4-23
Wetlands AOC
Wetland D Proposed Sample Locations
and RI Sample Exceedance Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

### 4.8.2 Wetland K

Wetland K is located outside of the property boundary on USACE-owned property and in an area zoned as Open Space (refer to Figures 2-1 and 2-2). Wetland K was investigated during the RI through collection of two samples in the main drainage channel as well as sampling of the Spring 01 coincident with each groundwater sampling round. The sample results are summarized in Figure 4-24.

#### *4.8.2.1 Investigation Objectives*

Investigation objectives for Wetland K include the following:

- Further investigation of the extent of soil contamination in channel and non-channel areas.
- Characterize spring water contamination. Wetland K spring will be sampled in three locations within Wetland K to determine the extent of water chemical exceedances within Wetland K.
- Characterize amount of spring discharge to help evaluate the hydrogeologic water balance in the stormwater pond and Wetland K vicinity.

#### *4.8.2.2 Investigation Scope*

Previous RI sample stations and newly proposed sample station locations are shown in Figure 4-24.

The scope of the field investigation for Wetland K includes the following:

- Collection of 10 soil samples including 5 samples from channel areas and 5 samples from non-channel areas.
- Collection of three spring water samples with one sample collected from the Spring 01 location and two samples from the furthest downstream channel locations with flowing water (refer to Section 4.7.1 for spring sampling program in other areas).
- Installation and sampling of one temporary hand-driven well point (refer to Section 4.7.2, Groundwater AOC, for discussion of all temporary well-point locations).
- Measure discharge rate in wetland channel segments. Discharge rate will be measured at three stations within each of the two channels in Wetland K.


Legend

- RI Surface Soil Sample Location
- Spring
- Hand-Driven Well-point Location
- Proposed Sediment Sample Location
- Proposed Surface Soil Sample Location
- Proposed Spring Water Sample Location
- Proposed Sediment and Spring Water Sample Location
- Channel Area
- Wetland K Investigation Area

blue: Exceeds MTCA Method A Industrial Soil Screening Level or MTCA Method B Groundwater Screening Level
green: Exceeds CLARC Soil Screening Level for Protection of Groundwater
purple: Exceeds Terrestrial Ecological Soil Screening Level

CLARC - Cleanup Levels and Risk Calculation
cPAH - Carcinogenic Polycyclic Aromatic Hydrocarbon
J - Estimated Concentration
MTCA - Model Toxics Control Act
RI - Remedial Investigation
TTEC - Total Toxicity Equivalent Concentration

N S W E

0 50 100 200
Feet

Figure 4-24
Wetlands AOC
Wetland K Proposed Sample Locations
and RI Sample Exceedance Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

The analytical program for the Wetland K soil investigation includes total cyanide, fluoride, sulfate, PAHs, metals, and diesel-range and oil-range petroleum hydrocarbons. The Wetland K water samples will be analyzed for the same parameters as soils but will also include both total and dissolved metals and free cyanide.

Field procedures for temporary well point installation, spring water sampling, and discharge rate measurements are described in Section 5.3, 5.4, and 5.5, respectively.

## 4.9 PLANT AREA AOC AND LINES EVALUATION

The Plant Area – Area of Concern (PAAOC) consists of approximately 140 acres that include the main production area. The main production area extended northeast from the eastern end of the Rectifier Yard AOC to the John Day Dam Road and northward from the south fenced margin of the plant parking and production area to the access road north of Production Building D (refer to Figure 1-1).

The Draft RI Report presented the results of the investigation outlined in the 2015 RI Work Plan. Ecology comments on the Draft RI Report with respect to the PAAOC included a requirement to further investigate the extent of soil contamination, and to address tasks outlined in the 2015 RI Work Plan that were not completed. The following sections (Section 4.9.2 Extent of Contamination, and Section 4.9.3 Stormwater and Other Lines Evaluation) discuss these two comment categories and present proposed additional investigation.

### 4.9.1 Decision-Tree Field Investigation Approach for PAAOC

The revised investigation will include a decision tree field investigation approach, so next-step decisions can be made in the field during one mobilization. The decision tree (Figure 4-25) incorporates an iterative approach to define the horizontal and vertical extent of contamination in soil and shallow groundwater. This investigation will be conducted with a single mobilization of drilling equipment and will utilize expedited lab turnaround analyses as the basis for field decision-making.

The discussion of scope under each of the following Subsections 4.9.2.2 through 4.9.2.9 describes an initial round of investigation with expedited laboratory analyses turn-around times for targeted chemicals that will support field decisions. One or more rounds of investigation will follow with

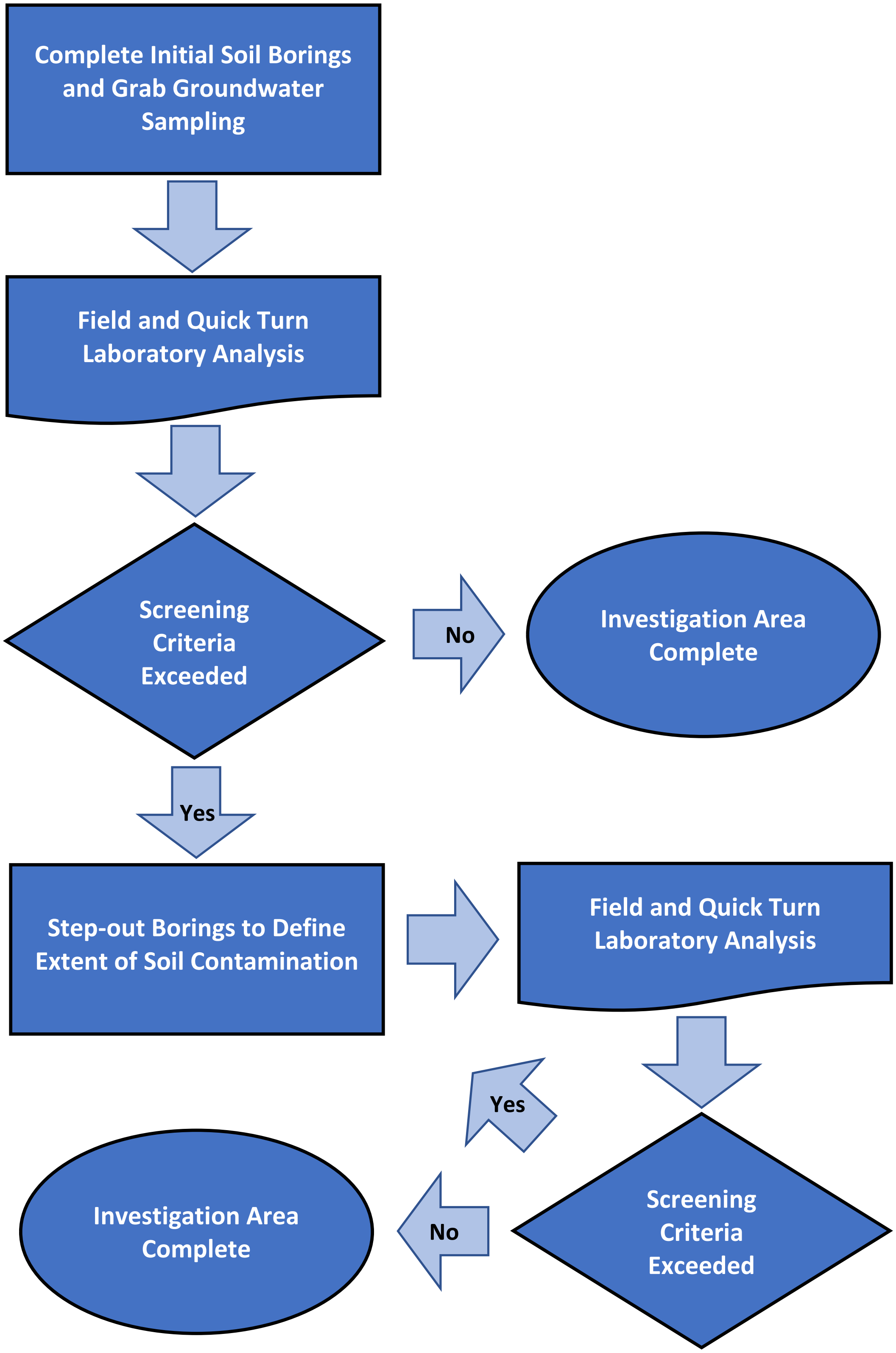



**Figure 4-25**
Decision Tree for Identifying Soil Sources of Contamination to Groundwater in Investigation Areas
Columbia Gorge Aluminum Smelter Site, Goldendale, Washington
TETRA TECH, INC.

borings located based upon expedited data results from the previous round(s) of sampling, until the extent of soil contamination, which is the focus of that investigation area, is determined. Initial boring locations for the investigation areas proposed in Figures 4-28 through 4-34 are within 50 to 100 ft from the focal point for the investigation area (for example, boring SB-SU01 in the Crucible Cleaning Room Area) and will be finalized in the field. Additional step-out boring locations will be determined in the field based on results of expedited laboratory analyses.

The focus of the additional investigation areas is to determine whether those locations may serve as soil sources of contamination to shallow groundwater. The investigations will target sampling of the shallowest groundwater, the UA zone, if it is present. If the UA is not present, the investigation would target sampling of the uppermost BAU zone if it is present within a reasonable depth from the soil/bedrock contact.

### 4.9.2 Extent of Contamination

Ecology comments on the Draft RI and Draft WPA focused on extent of soil contamination in Courtyard soil, petroleum hydrocarbons in soil associated with above- and under-ground storage tanks (AST and UST), and impact of soil contamination on shallow groundwater. Based on these comments, RI results for the Plant Area AOC were assessed to identify specific areas for proposed additional investigation.

In response to Ecology’s comments on the Draft RI Report and the Draft WPA, the Final WPA includes work elements to address additional characterization of soil-to-groundwater impacts. Areas with soils exceeding soil to groundwater screening levels that did not have downgradient shallow groundwater sampling locations have been prioritized for additional deeper soil sampling and/or groundwater sampling.

Additional figures have been prepared to more clearly show the vertical extent of soil contamination and were submitted with the response to Ecology and Yakama Nation comments (refer to Appendix C). The figures show the distribution of chemical concentration in soil for selected key chemicals (fluoride, sulfate, gasoline-range TPH, diesel-range TPH, motor-oil range TPH, and TTEC cPAHs for selected depth ranges of 0-1 ft bgs, 1-2 ft bgs, 2-6 ft bgs, 6-10 ft bgs, and greater than 10-ft bgs). For the two deepest depth ranges (6-10 ft bgs and greater than 10 ft bgs), groundwater results for wells in the Former Plant Area Footprint are included to facilitate comparison.

The figures have been divided into sets for convenience and ease of review as follows:

- Figure Set C1 (Figures C1-1, C1-2, and C1-3) shows soil station location included in the evaluation and the proposed WPA investigation areas. For the selected chemicals (fluoride, sulfate, TPH constituents, and TTEC cPAHs), the complete RI PAAOC soil data set, the Rectifier Yard AOC (RYAOC) data set, as well as SWMUs in the Former Plant Area Footprint have been included.

- Figure Set C2 (Figure C2-1 through C2-5) shows the distribution of fluoride in soil with depth. Fluoride soil results were compared against MTCA derived soil screening levels for groundwater protection of 147.6 mg/kg and 615 mg/kg, respectively that are based on the MTCA Method B groundwater formula value of 0.96 mg/L and the 4.0 mg/L MCL, respectively.

- Figure Set C3 (Figures C3-1 through C3-5) shows the distribution of sulfate in soil with depth. Sulfate soil results were compared against MTCA-derived soil screening level of 2,150 mg/kg that is based on the Secondary MCL of 250 mg/L.

- Figure Set C4 (Figures C4-1 through C4-5) shows the distribution of gasoline-range total petroleum hydrocarbons (TPH-Gx) in soil with depth. TPH-Gx results were compared against the MTCA Method A Soil Unrestricted Land Use Cleanup Level of 0.30 mg/kg that is for sites where benzene is detected. Groundwater concentrations were compared with the MTCA Method A Groundwater Cleanup Level of 0.8 mg/L for sites where benzene is detected.

- Figure Set C5 (Figures C5-1 through C5-5) shows the distribution of diesel-range TPH in soil with depth. Diesel-range TPH soil results were compared against the MTCA Method A Soil Cleanup Level for Unrestricted Land Use that is based on prevention of accumulation of free product on the water table. Groundwater concentrations were compared against the MTCA Method A Groundwater Cleanup Level of 0.5 mg/L.

- Figure Set C6 (Figures C6-1 through C6-5) shows the distribution of motor oil-range TPH in soil with depth. Motor oil-range TPH soil results were compared against the MTCA Method A Soil Cleanup Level for Unrestricted Land Use that is based on prevention of accumulation of free product on the water table. Groundwater concentrations were compared against the MTCA Method A Groundwater Cleanup Level of 0.5 mg/L.

- Figure Set C7 (Figures C7-1 through C 7-5) shows the distribution of TTEC cPAH in soil with depth. TTEC cPAH soil results were compared against MTCA soil screening level for groundwater protection of 3.9 mg/kg that is based on the MTCA Method B Groundwater Cleanup Level of 0.2 micrograms per liter (µg/L), which also represents the MCL.

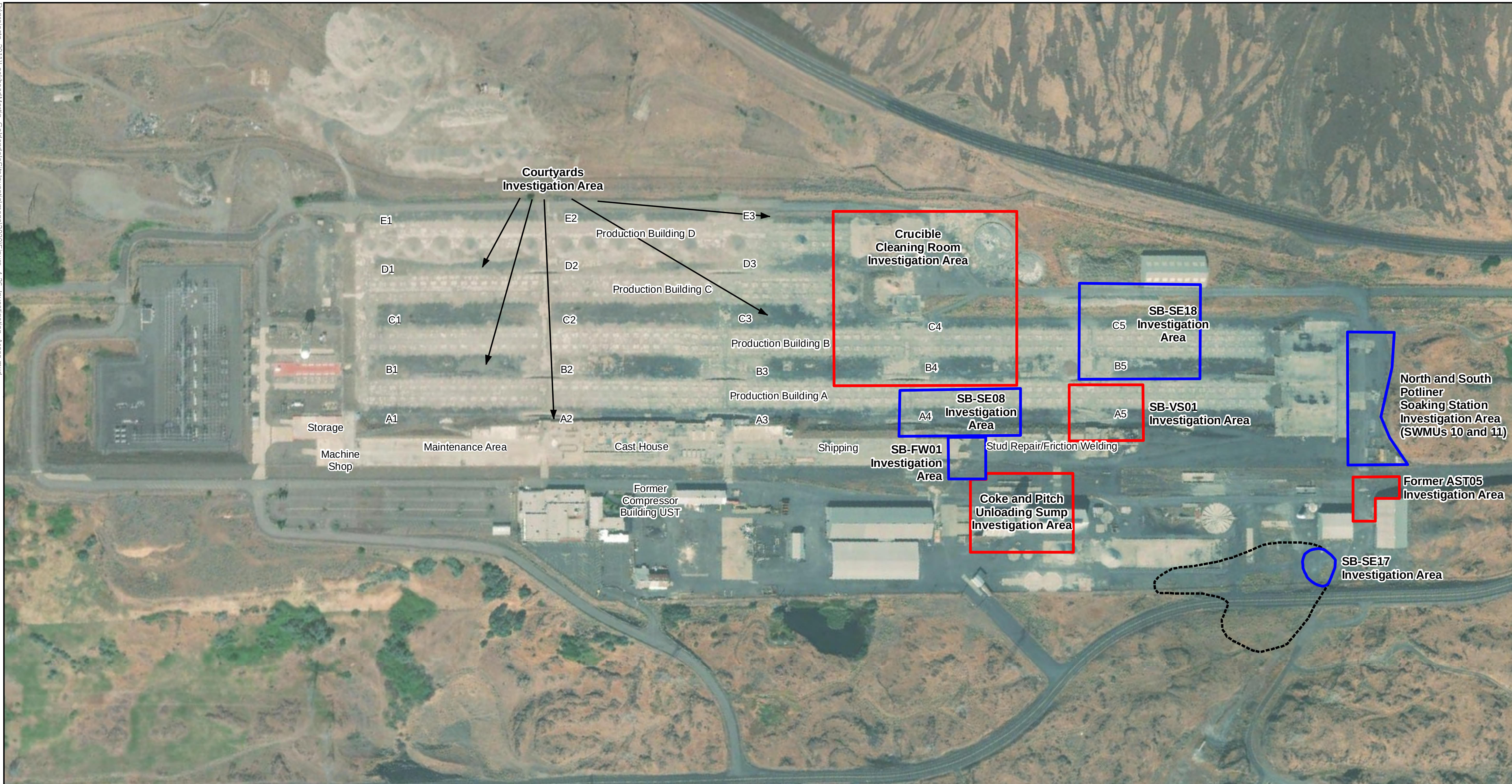
New areas of WPA investigation have been identified since preparation of the Draft WPA and are shown on Figure 4-26 including the following: the SB-FW01 area near the Stud Repair area and rail lines, the North and South Pot Liner Soaking Stations (SWMUs 10 and 11), the SB-SE08 Area, the SB-SE17 area located within the EELF (SWMU 17) Footprint, and the SB-SE18 area.

In addition, to resolve the Ecology's concerns regarding the potential occurrence of petroleum hydrocarbons in groundwater, a single round of groundwater sampling for TPH constituents is proposed for shallow wells in the Plant Area Footprint including a total of 30 wells (16 UA zone wells and 14 BAU zone wells). These wells will also be sampled for fluoride, sulfate, and other chemicals of concern to facilitate comparisons with the newly installed wells, springs, and groundwater boring sample results. Of these wells, five of the UA zone wells have typically been dry and not available for sampling.

The investigation boundary and scope of work for the Crucible Cleaning Room Area has also been expanded (refer to Figure 4-26) to address additional areas with documented and suspected fluoride soil contamination. Some of the other investigation boundaries originally presented within the Draft WPA have also been refined based on the evaluation of the newly prepared soil maps and further consideration of the comments on the Draft WPA provided by Ecology and the Yakama Nation.

The following represent the proposed additional PAAOC investigation areas (Figure 4-26):

- Vertical extent of soil contamination in Courtyard Segments.
- Vertical and horizontal extent of fluoride and sulfate in soil in the Crucible Cleaning Room Area, and potential impact on underlying shallow groundwater.
- Vertical and horizontal extent of petroleum hydrocarbons in soil at SB-VS01 (Courtyard Segment A5), and potential impact on underlying shallow groundwater.
- Potential impact from elevated concentrations of PAH in sediment in the Coke and Pitch Unloading Sump, and potential impact on underlying shallow groundwater.
- Vertical and horizontal extent of PAHs and petroleum hydrocarbons in soil at the former AST05 above-ground storage tank location, and potential impact on underlying shallow groundwater.
- Vertical extent of fluoride in soil near the Friction Weld Building, and potential impact on underlying shallow groundwater.




WPA Investigation Area

Additional WPA Investigation Area

East End Landfill

N
W E
S

0 250 500

Feet

Figure 4-26
Areas Proposed for Additional Investigation
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

- Vertical and horizontal extent of fluoride and sulfate at soil boring SB-SE08 in Courtyard Segment A4, and potential impact on underlying shallow groundwater.
- Horizontal extent of sulfate at soil boring SB-SE18 in Courtyard Segment C4, and potential impact on underlying shallow groundwater.
- Characterization of the occurrence of groundwater and groundwater and soil chemical concentrations in the soil boring SB-SE17 area that is within the footprint of the EELF (SWMU 17).

The objectives and scope of proposed additional investigation for these areas, as well as related groundwater data, are discussed in the following subsections. Investigation of areas where soil borings are proposed will be completed with a single mobilization of drilling equipment and will utilize expedited laboratory turnaround analyses for contaminants that support field decision-making.

Additional figures have also been prepared to show the vertical extent of soil contamination more clearly (refer to Figure package set in Appendix C). The figures show the distribution of chemical concentration in soil for selected key chemicals (fluoride, sulfate, gasoline-range TPH, diesel-range TPH, motor-oil range TPH, and TTEC cPAHs for selected depth ranges 0-1 ft bgs, 1-2 ft bgs, 2-6 ft bgs, 6-10 ft bgs, and greater than 10-ft bgs. For the two deepest depth ranges (6-10 ft bgs and greater than 10 ft bgs), groundwater results for wells in the Former Plant Area Footprint are included to facilitate comparison.

#### *4.9.2.1 Vertical Extent of Contaminated Soil in Courtyard Segments*

The RI work plans (Tetra Tech et al. 2015a,b) specified investigation of soil in Courtyard Segments to evaluate several plant operational features that were previously located in the Courtyards. One line of investigation was to evaluate whether a surface layer of black soil visible in some Courtyard Segments is contaminated, and present on a widespread basis. Assessment of surface soil in Courtyards A and C, including a visible black soil layer, was considered an important factor at the time of RI Work Plan development when the SE Lines would potentially be removed from these Courtyards, and contaminated soil could be visually separated for disposal. The property owner now intends to abandon and leave in place the SE Lines in Courtyards A and C and they will be addressed in the FS.

During the RI, black soil visible at ground surface in Courtyards A through E was mapped (Figure 4-27) and sampled. Analytical results for cPAHs as TTEC, fluoride, sulfate, and metals are


## Legend

**PAAOC-TPB2-BS**

Black Soil Sample Locations

Black Soil Areas

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N W E S

0 215 430 Feet

Figure 4-27
Black Soil Areas and Sample Locations (PAAOC)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

summarized in Table 4-2. The data indicates that the black soil layer contains elevated concentrations of cPAHs, fluoride, and to a lesser extent sulfate, arsenic, cadmium, and nickel, and that where it is present the black soil layer is generally in shallow soil in the Courtyard Segments.

**Table 4-2**
**Plant Area AOC – Black Soil RI Soil Results Summary for Selected COCs**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**

| Sample Name | Sample Date | Mapped at Surface (Y/N) | Sample Type | Units | Analytical Results: TTEC | Fluoride | Sulfate | Arsenic | Cadmium | Nickel |
|---|---|---|---|---|---|---|---|---|---|---|
| TP-BS01-BS | 3/8/2018 | Y | Surface | mg/kg | **97** | **2,500** | 120 U | **34** | **6** | **280** |
| TP-BS02-BS | 3/8/2018 | Y | Surface | mg/kg | **2038** [a] | **1,100** | 36 U | 10 U | **2.8** | 73 |
| TP-BS03-BS | 3/8/2018 | N | Surface | mg/kg | **558** | **3,100** | 1,700 U | **19** | **6.4** | **260** |
| TP-BS04-BS | 3/8/2018 | N | Surface | mg/kg | **274.4** | **2,800** | 94 U | **12** | **3.1** | **310** |
| TP-BS05-BS | 3/7/2018 | Y | Surface | mg/kg | **4.5** | 280 | 20 | 11 U | 0.55 U | 13 |
| TPB2-BS | 3/6/2018 | N | Targeted | mg/kg | **80.3** | **1,800 J** | 11 U | 11 U | **1.7** | **140** |
| TPB11-BS | 3/6/2018 | N | Targeted | mg/kg | **4.8** | 280 | 30 U | 11 U | **0.93** | 54 |
| TPB30-BS | 3/6/2018 | N | Targeted | mg/kg | **702.4** | **630** | 12 U | 11 U | **1.8** | 66 |
| TP-B41-BS | 3/7/2018 | Y | Targeted | mg/kg | **147.02** | 310 | 10 U | 10 U | 0.52 U | 11 |
| **Screening Levels** | **MTCA Method A Industrial** | | | **mg/kg** | 2 | NA | NA | 20 | 2 | NA |
| | **Protection of Groundwater** | | | **mg/kg** | 3.8 | 615 | 2,150 | 2.92 | 0.69 | 130 |
| | **Site Background** | | | **mg/kg** | NE | 14.11 | NE | 7.61 | 0.81 | 24.54 |

**Notes:**
**a** Concentration of all PAHs = 13,390.5 mg/kg exceeds Washington Dangerous Waste concentration (10,000 mg/kg).
Surface = Sample collected from test pit as vertical channel sample from 0 to 12 inches below ground surface
Targeted = Sample collected from test pit as grab sample from observed black soil layer
TTEC = Toxicity Equivalent Concentration
NE = Not Established

RI soil borings and test pits that investigated other features in Courtyard Segments resulted in detection of PAHs, some metals, TPH, fluoride, and sulfate at concentrations that exceeded MTCA Method A Industrial and protection of groundwater screening levels. In most locations, concentrations of these chemicals of concern (COCs) that exceeded screening levels were only detected in shallow soil. For example, PAH soil contamination in Courtyards soil is limited to uppermost 4 ft bgs (refer to Appendix C, Figure Set C7) and is not of major concern for protection of groundwater in the Courtyards. In other locations, the vertical extent of concentrations that exceeded screening levels has not been characterized. Fluoride, sulfate, and TPH concentrations that were detected at depth above screening levels (refer to Appendix C) are proposed for further investigation of vertical extent of contamination and potential impact on underlying groundwater and are discussed in following sections. Widespread groundwater contaminants include fluoride and sulfate; PAHs are generally not detected above groundwater screening levels in the Courtyards.

#### *4.9.2.1.1 Investigation Objectives*

This section addresses vertical extent of soil contamination in Courtyard Segments. The following are investigation objectives for proposed soil sampling in Courtyard Segments:

- Characterize vertical extent of select COCs in soil at transformer substations, and other plant operational features locations, where soil has been previously sampled.
- Confirm whether black soil layer is present at all soil sample locations.
- Provide additional thickness and distribution data for COCs in soil to support development of remedial alternatives.

#### *4.9.2.1.2 Investigation Scope*

Vertical extent of soil contamination is proposed to be investigated at several sample stations in each of the 21 Courtyard Segments (Table 4-3). Results of the RI investigation of soil in Courtyard Segments indicates that contamination is predominantly PAHs and cPAHs that are typically associated with a visible black soil layer. PAH and cPAH contamination, along with other COCs, is also predominantly within the upper 3 feet from ground surface. Therefore, the proposed test pit depth of sampling for vertical extent at 4 ft bgs is expected to characterize shallow soil contamination in the Courtyard Segments.

Table 4-3 summarizes the proposed sample stations, number of test pits to be excavated, and number of samples to be collected. Where the proposed sample station has been previously sampled, the test pit will be excavated to a depth of 4 feet and one soil sample will be collected. Where the proposed sample station has not been previously sampled, a test pit was located to provide further soil data between previous sample stations more than 100 feet apart. At these locations, a test pit will be excavated, and two soil samples will be collected, one of surface soil (0 to 12 inches) and a second sample at 4 feet depth. In these locations, if a visible black soil layer is present, then one targeted sample of the black soil will be collected and a second sample at 4 feet depth. At some proposed sample stations where the PAH concentrations in the previous sample did not exceed screening levels, no additional sampling is proposed, but the exposed soil will be inspected to confirm whether black soil is present. A total of 63 shallow test pits are proposed to be excavated, and a total of 61 soil samples collected including 5 duplicate samples.

**Table 4-3**
**Plant Area AOC – Proposed Courtyard Segment Soil Sampling to Define Vertical Extent of Contamination**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**

| | Proposed Sampling at Transformer Substations | | | | Proposed Sampling at Other Courtyard Stations | | | |
|---|---|---|---|---|---|---|---|---|
| **Courtyard Segment** | **Station Name** | **Test Pits** | **Samples** | **Sample Depth (ft)** | **Station Name** | **Test Pits** | **Samples** | **Sample Depth (ft)** |
| A1 | TP-T8A | 1 | 1 | 4 | SB-MM04 | 1 | 0 | NA |
| | TP-T8B | 1 | 1 | 4 | | | | |
| A2 | TP-T9B | 1 | 1 | 4 | SB-SE03 | 1 | 0 | NA |
| | TP-T9C | 1 | 1 | 4 | BS01-BS | 1 | 1 | 4 |
| A3 | TP-T27A/B/C | 2 | 2 | 4 | SB-SE05 | 1 | 0 | NA |
| | TP-26A/B | 1 | 1 | 4 | | | | |
| | TP-T17A/B | 1 | 1 | 4 | | | | |
| | TP-T10A | 1 | 1 | 4 | | | | |
| A4 | | | | | SB-BC01 | 1 | 0 | NA |
| A5 | | | | | SB-SE014 | 1 | 0 | NA |
| | | | | | SB-SWMU24-03 | 1 | 0 | NA |
| | | | | | BS02-BS | 1 | 1 | 4 |
| | | | | | BS03-BS | 1 | 1 | 4 |
| B1 | TP-T1A/B | 2 | 2 | 4 | TP-B29-SS | 1 | 1 | 4 |
| | | | | | TP-B30BS | 1 | 1 | 4 |
| B2 | | | | | SB-BH04 | 1 | 0 | NA |
| | | | | | TP-B32-SS | 1 | 1 | 4 |
| | | | | | TP-B33-SS | 1 | 1 | 4 |
| B3 | | | | | TP-B34-SS | 1 | 1 | 4 |
| | | | | | TP-B35-SS | 1 | 1 | 4 |
| | | | | | TP-B36-SS | 1 | 1 | 4 |
| B4 | TP-T14A | 1 | 1 | 4 | TP-B37-SS | 1 | 1 | 4 |
| | | | | | TP-B38-SS | 1 | 1 | 4 |
| | | | | | TP-B39-SS | 1 | 1 | 4 |
| | | | | | BS04-BS | 1 | 1 | 4 |
| B5 | TP-T5-01 | 1 | 1 | 5 | SB-BS02 | 1 | 1 | 5 |
| | TP-T5-02 | 1 | 1 | 5 | TP-B41-SS | 1 | 1 | 4 |
| | TP-T5-03 | 1 | 1 | 5 | TP-B43-SS | 1 | 1 | 4 |
| C1 | | | | | SB-CR02 | 1 | 0 | NA |
| | | | | | SB-SE02 | 1 | 0 | NA |
| C2 | | | | | SB-SE04 | 3 | 6 | 0-1, 4 |
| C3 | | | | | SB-AST02 | 1 | 0 | NA |
| C4 | | | | | SB-SE10 | 1 | 0 | NA |
| C5 | | | | | | | | |
| D1 | | | | | TP-B6-SS | 1 | 1 | 4 |
| | | | | | TP-B9-SS | 1 | 1 | 4 |
| D2 | TP-T21B | 1 | 1 | 4 | TP-B10-SS | 1 | 1 | 4 |
| | TP-T22B | 1 | 1 | 4 | TP-B11-BS | 1 | 1 | 4 |
| D3 | | | | | TP-B13-SS | 1 | 0 | NA |
| | | | | | TP-B14-SS | 1 | 1 | 4 |
| E1 | | | | | TP-B1-SS | 2 | 1 | 4 |
| | | | | | TP-B2-SS | 1 | 1 | 4 |
| E2 | | | | | TP-B3-SS | 3 | 5 | 0-1, 4 |
| E3 | | | | | TP-B4-SS | 2 | 3 | 0-1, 4 |
| | | | | | TP-B5-SS | 1 | 1 | 4 |
| **Total** | | 17 | 17 | | | 46 | 39 | |
| **Duplicates** | | | 2 | | | | 3 | |

**Notes:**
Gray highlighted cells indicate no additional sampling is proposed for this Courtyard Segment.
Additional test pits will be excavated near stations SB-SE04, TP-B1-SS, TP-B3-SS, and TP-B4-SS to further evaluate horizontal extent of cPAHs.
NA Not applicable
At locations where no soil sample is proposed to be collected, the purpose of the test pit is for visual confirmation of potential presence of a black soil layer.

Soil samples collected from transformer substations will be analyzed for PAHs, metals, fluoride, sulfate, and TPH. Soil samples collected from other proposed sample stations will be analyzed for PAHs, metals, fluoride, and sulfate, and analyzed for TPH only if soil samples previously collected during the RI detected concentrations of TPH above screening levels.

#### *4.9.2.2 Crucible Cleaning Room Area*

The Crucible Cleaning Room Area was investigated during the RI with soil borings and test pits completed in Courtyard Segments C3 and C4, along the SE Line north of Courtyard Segments C3 and C4, and the Crucible Cleaning Room located at the east end of Production Building C (Figure 4-26). Soil borings and monitoring wells were also installed at SWMU 6 Secondary Scrubber Recycle Station and SWMU 8 Tertiary Treatment Plant, located northeast of the Crucible Cleaning Room. Site COCs that were detected in soil at concentrations that exceeded screening levels include TTEC, fluoride, sulfate, cadmium, nickel, and petroleum hydrocarbons primarily as lube oil. Most of these COCs were detected in soil above about 3 ft bgs; however, both fluoride and sulfate were detected in soil at depth at concentrations that exceed their screening levels.

Fluoride and sulfate are detected in subsurface soil at concentrations that range from elevated concentrations compared to nearby borings to concentrations that exceed protection of groundwater screening levels of 615 mg/kg and 2,150 mg/kg, respectively.

In the Crucible Cleaning Room Area fluoride was detected at the following sample stations:

- SB-BH02 up to 1,700 mg/kg to 2 ft bgs (north of Crucible Cleaning Room foundation).
- SB-BH03 at 1,800 mg/kg at 1 ft bgs (south of Crucible Cleaning Room foundation).
- SWMU08-SB02 at 730 mg/kg at 0.5 ft bgs (north of Crucible Cleaning Room foundation).
- SB-CU01 at 4,600 mg/kg to 700 mg/kg at 23 ft bgs (boring is adjacent to the Crucible Cleaning Room foundation).
- SB-SE09 at 1,200 mg/kg at 3 ft bgs and 390 mg/kg at 5 ft bgs (south of Crucible Cleaning Room foundation).
- SB-COPC02 at elevated concentrations of 240 mg/kg at 1 ft bgs and 66 mg/kg at 3 ft bgs, (south of Crucible Cleaning Room foundation).

Sulfate was detected at the following sample stations.

- SB-BH03 1,800 to 7,100 mg/kg to 8 ft bgs (south of Crucible Cleaning Room foundation).
- SB-CU01 at 22 mg/kg at 0.5 ft bgs to 260 mg/kg at 23 ft bgs (adjacent to the Crucible Cleaning Room foundation).
- SB-SE09 at 75 to 87 mg/kg at 5 ft bgs (south of Crucible Cleaning Room foundation).
- SB-COPC02 at 81 mg/kg at 3 ft bgs and 140 mg/kg at 9 ft bgs (south of Crucible Cleaning Room foundation).
- SWMU08-SB01 at 120 J mg/kg at 0.5 ft bgs, and 830 mg/kg at 11 ft bgs (north of Crucible Cleaning Room foundation, north of large clarifier).
- SWMU06-SB02 at 150 mg/kg at 3.5 ft bgs (east of Crucible Cleaning Room foundation, southeast of large clarifier, and location of well RI-MW6-BAU).

Soil boring SB-CU01 is the location where fluoride has been detected in soil at the highest concentrations and the deepest depth. Soil boring SB-BH03 is the location where sulfate has been detected in soil at the highest concentrations and the deepest depth. At SB-BH02, the vertical extent of fluoride concentration that exceed the screening level have not been defined.

Investigation of shallow groundwater (UA and BAU) has identified a fluoride plume beneath this area (refer to Appendix C, Figures C2-4 and C2-5 for the fluoride distribution in soil at depth as well as the groundwater fluoride distribution), along with elevated concentrations of sulfate that are below the 250 mg/L secondary MCL screening level (refer to Appendix C, Figures C3-4 and C3-5 for the sulfate distribution in soil at depth as well as the groundwater sulfate distribution). Groundwater gradients in the shallow groundwater beneath the general Crucible Cleaning Room Area are interpreted to be southward for both the UA and BAU, but south of Production Building B the gradient in the UA changes slightly with southwestward and southeastward components (refer to Appendix B, Groundwater Elevation Contour Figures from the RI Report, Vol. 3, Figures 2-16 and 2-17). A fluoride plume with concentrations that exceed the 4 mg/L MCL is interpreted in the UA with the northern edge in the vicinity of the east end of Production Building D, Tertiary Treatment Plant, and large clarifier (Appendix C, Figures C2-4 and C2-5).

During 2017 quarterly groundwater sampling fluoride was detected in well RI-GW7 (UA; located south of the large clarifier) at 6.7 J to 17 mg/L, and in well RI-MW-6 (BAU; located west of the large clarifier) at 2.9 to 4.2 mg/L. Sulfate was detected in well RI-GW7 (UA) at 17 to 43 mg/L, and in well RI-MW-6 (BAU) at 93 to 130 mg/L (Appendix C, Figures C3-4 and C3-5). The next closest downgradient well is RI-GW5-UA located approximately 400 feet south of the Crucible Cleaning Room foundation in Courtyard Segment A3. Sulfate was detected at 160 to 190 mg/L at RI-GW5-UA during the 2017 quarterly groundwater monitoring.

The Crucible Cleaning Room Area may be the primary soil source of contamination contributing to the area-wide fluoride plume depicted in Figure C2-4 (Final Work Plan Addendum). An area-wide sulfate plume has not been identified, but this area may also be a soil source of sulfate contamination to shallow groundwater. Soil boring SB-CU01 (highest detection of fluoride in soil at depth) and SB-BH03 (highest detection of sulfate in soil at depth) are located along a corridor from the Tertiary Treatment Plant through Passage No. 3 where Industrial and Monitoring (I&M) lines and Scrubber Effluent (SE) lines (Corridor containing I&M and SE Lines) run between the Tertiary Treatment Plant and Courtyard A (Figure 4-28) where SWMU 5 Line A Secondary Scrubber Recycle Station was previously located (refer to Figure 2-1). Based on discussion with the former plant manager, potential pipe leaks may have occurred in this area and may be the source of fluoride and sulfate contamination in soil. The video survey of the SE lines, discussed in Section 4.9.3.1, will be conducted in this area prior to implementing the soil boring program and will contribute information about the SE lines and potential leaks or breaches in the Crucible Cleaning Room Area. Depths to manholes and horizontal pipelines in this area are available from plant drawings.

It is possible that there are other sources of fluoride and sulfate contamination in soil in this area, including the Tertiary Treatment Plant and recycle and caustic tanks located to the south, SWMU 16 Cathode Dismantling and Recovery Building at the end of Production Building D, Crucible Cleaning Room at the end of Production Building C, and baghouses located adjacent to Production Buildings C and D. Potential pipe or tank leaks would allow fluoride- and sulfate-containing liquids to contact soil at depth. During the RI, boring SB-CU01 was drilled to sample soil below the depth of the nearby SE line horizontal pipe invert. Other potential sources could be sources of fluoride solids deposited at ground surface and mixed into shallow soil by subsequent demolition activities. Occurrence of fluoride in shallow soil from these potential sources would be expected to decrease in concentration with depth. Near potential pipe or tank leaks detection of fluoride and sulfate would be expected to occur throughout the soil column above the water table. At a distance from soil sources of fluoride and sulfate, these constituents would be expected to increase in concentration with depth and/or occur above the water table, and result from interaction between soil and a fluctuating water table within the fluoride area-wide plume.


**Figure 4-28**

Plant Area AOC

Crucible Cleaning Room Area Proposed Boring and Monitoring Well Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

GeoEye, Maxar

#### 4.9.2.2.1 <u>Investigation Objectives</u>

Fluoride and sulfate have been detected in subsurface soil and in shallow groundwater beneath the Crucible Cleaning Room Area suggesting this area is a potential source of fluoride and sulfate contamination for shallow groundwater. Objectives for the proposed additional investigation of fluoride and sulfate in soil and shallow groundwater in the Crucible Cleaning Room Area include the following:

- Determine the vertical and horizontal extent of fluoride and sulfate in subsurface soil.
- Collect grab groundwater samples from the shallowest groundwater.
- Install one or two shallow groundwater monitoring wells and perform one round of groundwater sampling.

#### 4.9.2.2.2 <u>Investigation Scope</u>

Proposed investigation of the Crucible Cleaning Room Area incorporates an iterative approach to define the horizontal and vertical extent of fluoride and sulfate contamination in soil and shallow groundwater. Figure 4-25 shows the decision tree that will guide field decisions on the need for and location of additional step-out borings and well installations.

Initially, nine soil borings (SB-CU02 through SB-CU10) will be drilled to bedrock and through the upper 10 feet of shallow groundwater (Figure 4-28). One boring (SB-CU02) will be completed adjacent to SB-CU01 and a monitoring well will be installed in the boring with one round of groundwater sampling performed. the second through fifth borings (SB-CU03 through SB-CU-6) will be completed near SB-CU01 as shown on Figure 4-28. A sixth boring (SB-CU07) will be completed near SB-BH02 and the seventh through ninth boring s(CU08 through SU-10) will be completed near SB-BH03. In the nine borings, soil samples will be collected at a minimum of 5-foot intervals, and in all borings but SB-CU02 groundwater will be collected from the upper 10 feet of groundwater through temporary well screen installations. Soil samples from the nine borings and grab groundwater samples from eight borings will be submitted for analysis with fluoride and sulfate analyses being performed on an expedited basis.

If expedited soil analytical results indicate that concentrations of fluoride and/or sulfate exceed protection of groundwater screening levels throughout or at multiple depths in the soil column above the water table, that location would be considered within the soil source of contamination and additional step-out borings would be drilled at those locations. If expedited soil analytical results indicate that the vertical extent of detected concentrations of fluoride and sulfate in soil is defined and does not extend to the water table, and/or fluoride and sulfate are detected at concentrations that exceed groundwater protection levels only at depth above the water table, that location would be considered outside of a soil source of contamination to the water table. During each round of step-out borings, soil and groundwater samples would be collected as previously described and submitted for analysis with fluoride and sulfate analyses on an expedited basis. Investigation will continue until the horizontal extent of the soil source (fluoride and/or sulfate throughout or at multiple depths above the water table) has been defined and the investigation will be complete.

Two additional monitoring wells will be installed based on results of soil and groundwater data and one round of sampling will be performed in the wells. Because the Crucible Cleaning Room Area is located inside of an identified area-wide fluoride plume, it will be further addressed in a future groundwater monitoring program as determined in the FS or CAP.

Temporary well screens will be installed in the soil borings to facilitate collection of a grab sample of shallow groundwater. The temporary well screen completions will consist of installation of a well screen and sand pack, followed by gentle purging, then collection of one groundwater sample as described in Section 5.2, after which the boring will be properly plugged and abandoned.

One or two shallow groundwater monitoring wells (UA zone) will be installed based on results of soil and groundwater data, subsurface materials, and depth to groundwater as encountered in the soil borings. After well installation, development, and stabilization, one round of groundwater samples will be collected from the newly installed temporary shallow groundwater monitoring well(s).

Soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, TPH, and soil pH. Groundwater samples will be analyzed for cyanide (free and total), fluoride, sulfate, PAHs, and TPH. Fluoride and sulfate analyses for soil and groundwater will be completed on an expedited turnaround time.

#### *4.9.2.3 Soil Boring SB-VS01 in Courtyard Segment A5*

RI Results for soil boring SB-VS01 in Courtyard Segment A5, south of the east end of Production Building A (Figure 4-26), indicates concentrations of cPAHs as TTEC and petroleum hydrocarbons as lube oil in soil exceed screening levels only at a depth of 11 ft bgs (refer to Appendix C,

Figure Sets C6 and C7). The source of the soil cPAH and petroleum hydrocarbon contamination in SB-VS01 at 11 ft bgs is not clear. Evaluation of nearby soil borings SB-BC01, SB-SH01, SB-SE14, and SB-SWMU24-02 indicates that cPAHs and petroleum hydrocarbons were not detected at concentrations that exceed protection of groundwater screening levels, at depths comparable to samples in boring SB-VS01 and provide a horizontal bounding to the SB-VS01 contamination.

The closest downgradient shallow groundwater monitoring well MW-E1A (UA zone) is located approximately 150 feet to the southeast. cPAHs were not detected above reporting limits in first quarter 2017 groundwater monitoring and not sampled thereafter. There are no nearby downgradient UA or BAU monitoring wells to provide data on presence of petroleum hydrocarbons in shallow groundwater (refer to Appendix C, Figures C4-4, C4-5, C5-4, C5-5, C6-4, C6-5, C7-4 and C7-5 for the distribution of petroleum hydrocarbons and cPAHs in soil and groundwater in the Former Plant Area Footprint).

#### *4.9.2.3.1 Investigation Objectives*

Additional investigation is proposed to evaluate the extent of cPAH and petroleum hydrocarbon contamination in soil and potential impact on shallow groundwater. Objectives for the proposed investigation of cPAH and petroleum hydrocarbon soil contamination are as follows:

- Determine the vertical and horizontal extent of cPAH and petroleum hydrocarbons in soil at the SB-VS01 location.
- Collect grab groundwater samples from the shallowest groundwater (UA or BAU).
- Evaluate potential leakage in the nearby SE Line during video survey of the SE Line in Courtyard Segment A5. The SE Line video survey is described in a later section of this WPA.

#### *4.9.2.3.2 Investigation Scope*

Proposed investigation of the SB-VS01 area incorporates an iterative approach (see Figure 4-25) to define the horizontal and vertical extent of cPAH and petroleum hydrocarbon contamination in soil and the potential impact on shallow groundwater. The decision tree will guide field decisions on the need for and location of additional step-out borings.

Initially, two soil borings will be completed, with one (SB-VS03) near the location of SB-VS01 and the second (SB-VS04) located approximately 50 feet west of SB-VS01 (Figure 4-29) to determine whether the SB-VS01 location is a soil source of contamination to the shallow groundwater. The borings will be drilled through the upper 10 feet of groundwater with a minimum of four soil samples collected including one above or near the water table. Samples of groundwater will be collected from the borings through a temporary well screen installation. Soil and groundwater samples will be submitted for analysis with cPAH and petroleum hydrocarbons on an expedited basis.

If detected concentrations of cPAH and petroleum hydrocarbons in soil exceed protection of groundwater screening levels, then an additional round of step-out borings will be drilled based on results of the expedited soil and groundwater data. The borings would be completed as described above. If detected concentrations of cPAH and petroleum hydrocarbon in soil do not exceed protection of groundwater screening levels, then the investigation will be considered complete.

If detected concentrations of cPAH and petroleum hydrocarbon in groundwater exceed MTCA Method A or B screening levels, then nearby wells will be further addressed in a future groundwater monitoring program as determined in the FS and CAP.

Video survey data collected from the SE Line in Courtyard Segment A5 will also be evaluated. The purpose of this evaluation for the SB-VS01 investigation area is to determine whether the source of the cPAHs and petroleum hydrocarbons detected in SB-VS01 could be associated with the nearby SE Line, if a line breach exists. If a breach is discovered in the SE Line in the vicinity of SB-VS01, further investigation will be made consistent with the decision-tree approach provided that other soil borings in this area have not addressed data needs, and if feasible based on the limited physical space in this are as noted above.

A temporary well screen will be installed in the soil borings to facilitate collection of a grab sample of shallow groundwater. The temporary well screen completion will consist of installation of a well screen and sand pack, followed by gentle purging, then collection of one groundwater sample as described in Section 5.2, after which the boring will be properly plugged and abandoned.

Soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn), TPH, and VOCs. Groundwater samples will be analyzed for cyanide (free and total), fluoride, sulfate, PAHs, metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn), TPH, and VOCs. cPAH and petroleum hydrocarbon analyses for soil and groundwater will be completed on an expedited turnaround time.


**Figure 4-29**

Plant Area AOC

SB-VS01 in Courtyard Segment A5
Proposed Boring Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

GeoEye, Maxar

#### 4.9.2.4 Coke and Pitch Unloading Sump

The Coke and Pitch Unloading Sump is a large subterranean "room" beneath the rail-accessible Coke and Pitch Unloading Area (Figure 4-26). Coke and pitch brought onsite in rail cars were unloaded by gravity from the rail cars into the sump below. The sump is constructed of concrete, with its upper floor at about 21 ft bgs (approximately 468 ft elevation) and near or below the depth of shallow groundwater in the UA measured at approximately 475 ft elevation during winter quarter 2017 in the area of the Coke and Pitch Unloading Sump (refer to Appendix B, RI Report Figure 2-16). Currently, the lower level of the room is flooded, and water is standing above the upper floor at approximately 16 ft bgs. Based on conversations with plant employees (BMEC, personal communication, 2019), historically the sump was pumped to remove excess water. Clearly, the Coke and Pitch Unloading Sump, both the upper and lower floors, are in communication with shallow groundwater.

Evaluation of soil borings SB-CP03, SB-PB02, SB-PB05, and SB-HP02, near the Coke and Pitch Unloading structure and completed during the RI, indicate that PAHs were not detected at concentrations that exceed protection of groundwater screening levels below approximately 3 ft bgs. This depth is approximately 14 feet above the standing water level (2017 groundwater monitoring data) in the Coke and Pitch Unloading Sump. Soil adjacent to the downgradient side of the sump, and above the floor level of the sump, is not expected to contain PAHs at concentrations that exceed protection of groundwater screening levels based on data from nearby soil borings, and other soil borings in the pitch building area.

Sediment and water in the sump were sampled during the RI and results presented in the Draft RI Report. The following are results of the sump sediment sample analysis for contaminants that exceed groundwater protection screening levels:

- PAHs: Fluoranthene 1,200 J mg/kg, Pyrene 1,000 J mg/kg.
- TTEC: 1,612.1 mg/kg, near the 1% Washington Dangerous Waste concentration threshold.
- Metals: Cadmium 8.1 J mg/kg.
- Lube Oil: 58,000 J mg/kg, indicating potential non-aqueous phase liquid may be present.

The following are results of the sump water sample analysis for contaminants that exceed MTCA Method A or B screening levels:

- cPAHs: Several cPAHs were detected at concentrations that exceed their screening levels. benzo(a)anthracene 24 µg/L, benzo(a)pyrene 36 µg/L, benzo(b)fluoranthene 45 µg/L, benzo(k)fluoranthene 15 µg/L, dibenzo(a,h,)anthracene 6.1 µg/L, and indeno(1,2,3-cd)pyrene 28 µg/L.

No downgradient UA/BAU shallow groundwater monitoring wells are located near the Coke and Pitch Unloading Sump.

#### *4.9.2.4.1 Investigation Objectives*

Soil borings in the carbon manufacturing area adjacent to and south of the Coke and Pitch Unloading Sump indicates PAHs are not detected in soil at concentrations that exceed protection of groundwater screening levels generally below approximately 3 ft bgs. Subsurface soil near the Coke and Pitch Unloading Sump is not anticipated to contain contaminants that exceed protection of groundwater screening levels at the corresponding depth of the floor of the sump.

Thus, the objective for the proposed additional investigation of the Coke and Pitch Unloading Sump is to evaluate its potential impact to shallow groundwater immediately downgradient from the sump.

#### *4.9.2.4.2 Investigation Scope*

Proposed investigation of the Coke and Pitch Unloading Sump incorporates an iterative approach (Figure 4-25) to define the potential impact of cPAH and petroleum hydrocarbon contamination in sump sediment on shallow groundwater. The decision tree will guide field decisions on the need for and location of additional step-out borings.

Initially, one soil boring (SB-CP04) will be completed adjacent to and downgradient from the sump (Figure 4-30). The soil boring will be drilled to bedrock and through the upper 10 feet of shallow groundwater. A minimum of three soil samples will be collected from the boring above, at, and below the sump upper floor level (about 21 ft bgs). A monitoring well will be installed in the shallow groundwater (UA) and one round of groundwater sampling will be performed. A grab water sample will also be taken from the Coke and Pitch Unloading Sump at the time the newly installed monitoring well is sampled.


Proposed shallow groundwater monitoring well

Proposed soil boring with grab groundwater sample

RI Soil Borings

Coke & Pitch Unloading Sump Investigation Area

Plant Area Sumps

**Figure 4-30**

Plant Area AOC

Coke and Pitch Unloading Sump Proposed Borings and Well Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

GeoEye, Maxar

Soil and groundwater samples will be analyzed and evaluated on an expedited basis. If concentrations of PAHs and/or petroleum hydrocarbons detected in shallow groundwater adjacent to the coke and pitch unloading sump are at or below MTCA Method A and B screening levels, then the investigation of the Coke and Pitch Unloading Sump impact on shallow groundwater will be complete. If concentrations of PAHs and/or petroleum hydrocarbons detected in shallow groundwater exceed Method A or B screening levels, then a second soil boring will be drilled farther downgradient from the sump.

If a second soil boring is needed, one soil boring (SB-CP05) will be completed farther downgradient from the Coke and Pitch Unloading Sump. Because of space limitations in area downgradient from the sump, the nearest potential location for a second soil boring will be south of the pitch building near soil boring SB-PB04. The second boring will be completed like SB-CP04 except that a grab groundwater sample will be collected from a temporary well screen installation. If concentrations of PAHs and petroleum hydrocarbons detected in shallow groundwater at the downgradient location of the Coke and Pitch Unloading Sump are below MTCA Method A and B screening levels, then the investigation of the coke and pitch unloading sump will be complete. If concentrations of PAHs and/or petroleum hydrocarbons are at or above MTCA Method A and B screening levels, then this area will be addressed in a future groundwater monitoring program.

One groundwater monitoring well will be installed adjacent to the coke and pitch unloading sump on its downgradient side. After well installation, development and stabilization, a single round of groundwater sampling will be performed from the newly installed groundwater monitoring well.

A temporary well screen will be installed in the potential second soil boring to facilitate collection of a grab sample of shallow groundwater. The temporary well screen completion will consist of installation of a well screen and sand pack, followed by gentle purging, then collection of one groundwater sample as described in Section 5.2, after which the boring will be properly plugged and abandoned.

Soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, and TPH. The groundwater and sump water samples will be analyzed for cyanide (total and free), fluoride, sulfate, PAHs, and TPH. cPAH and petroleum hydrocarbon analyses for soil and water would be completed on an expedited turnaround time.

#### 4.9.2.5 Former AST Near the East SPL Storage Area

An above-ground storage tank (AST05) was previously located near the northwest corner of the Bath Storage Building (also historically was SWMU 12, East SPL Storage Area), south of the east end of Production Building A (Figure 4-26). During the RI, AST05 was investigated with one soil boring. cPAHs as TTEC and petroleum hydrocarbons as lube oil were detected at concentrations that exceed MTCA Method A Industrial and protection of groundwater screening levels to the depth of the boring at 4 ft bgs. Evaluation of nearby test pits TP-SWMU25-01 and TP-SWMU25-02 indicate that cPAHs exceed the MTCA Method A Industrial and protection of groundwater screening levels to the west of AST05, but not to the east where surficial soil thins, and petroleum hydrocarbons are below MTCA Method A Industrial screening level to the west and east of AST05. Based on the function of the AST05 feature as an above-ground storage tank, a relatively limited horizontal extent of petroleum hydrocarbon contamination in soil is anticipated. cPAH contamination, however, is found widespread in shallow soil in the south plant area and east of the AST05 location.

One shallow groundwater monitoring well MW-E8 (UA zone) is located downgradient, approximately 160 feet from AST05, and on the south side of the Bath Storage Building. This well was dry during the 2017 quarterly groundwater monitoring program, which is consistent with an increasingly shallow depth to bedrock at and east of the Bath Storage Building. Shallow groundwater (UA zone) is interpreted to be approximately 470 ft elevation in the AST05 area (refer to Appendix B, Figure 2-16).

##### 4.9.2.5.1 Investigation Objective

Additional investigation is proposed at the location of RI soil boring SB-AST05 to determine the vertical and horizontal extent of cPAHs and petroleum hydrocarbons in soil and their impact on shallow groundwater. The following are objectives for the AST05 investigation:

- Determine the horizontal and vertical extent of cPAH and petroleum hydrocarbon associated with above-ground storage tank AST05.
- Collect grab groundwater samples from the shallowest groundwater (UA).
- Install one shallow groundwater monitoring well at the SB-AST05 location.

#### *4.9.2.5.2 Investigation Scope*

Proposed investigation of the SB-AST05 area incorporates an iterative approach (see Figure 4-25) to define the horizontal and vertical extent of cPAH and petroleum hydrocarbon contamination in soil and the potential impact to shallow groundwater. The decision tree (Figure 4-25) will guide field decisions on the need for and location of additional step-out borings.

Initially four soil borings (SB-AST05A, SB-AST05B, AST05C, and AST05D) will be completed as shown on Figure 4-31 to determine whether this area is a soil source of petroleum hydrocarbons to shallow groundwater. One boring (SB-AST05A will be completed near the SB-AST05 location, and three borings (AST05B, AST05C, and AST05D) will be completed to the west, east and north of the SB-AST05 location. The borings will be completed to bedrock and through the upper 10 feet of shallow groundwater and at least four soil samples will be collected from each boring beginning at 0.5 ft bgs. One monitoring well will be installed in the shallow groundwater (UA zone) in SB-AST05A, and a single round of groundwater sampling will be performed. A grab sample of groundwater will be collected from SB-AST05B, SB-AST05C, and SB-AST05D from the upper 10 feet of groundwater through temporary well screen installations.

If concentrations of petroleum hydrocarbons in soil exceed protection of groundwater screening levels, then additional step-out borings will be completed from the location of screening level exceedance following the decision-tree approach. The borings would be completed, and soil and groundwater samples collected as described for borings SB-AST05B through SB-AST05D. If concentrations of petroleum hydrocarbons in soil do not exceed protection of groundwater screening levels in borings SB-AST05B through SB-AST05D, then the investigation of this area will be complete.

If concentrations of petroleum hydrocarbons in groundwater exceed MTCA Method A or B, then this area will be further addressed in a future groundwater monitoring program. Groundwater samples will be collected from nearby existing monitoring wells as part of the WPA fieldwork and will be used to define the lateral extent of groundwater plume in this area. Shallow UA zone groundwater may not be present in this area based on past investigation results.


**Figure 4-31**

Plant Area AOC

Former AST Near East SPL Storage Area
Proposed Borings and Well Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

A temporary well screen will be installed in soil borings SB-AST05B, SB-AST05C, and SB-AST05D, if this boring is completed, to facilitate collection of a grab sample of shallow groundwater. The temporary well screen completions will consist of installation of a well screen and sand pack, followed by gentle purging, then collection of one groundwater sample as described in Section 5.2, after which the boring will be properly plugged and abandoned.

A shallow groundwater (UA or BAU) monitoring well will be installed in soil boring SB-AST05A. After well installation, development, and stabilization, a single round of groundwater sampling would be performed at the newly installed monitoring well in SB-AST05A.

Soil samples will be analyzed for total cyanide, fluoride, PAHs, and TPH. Groundwater samples will be analyzed for cyanide (free and total), fluoride, PAHs, and TPH. Petroleum hydrocarbon analyses for soil and water will be completed on an expedited turnaround time.

#### *4.9.2.6 Friction Weld Building*

The Friction Weld Building is located east of the Cast House and Shipping Building (Figure 4-26) and was investigated during the RI with three soil borings completed along the south side of the building. RI results for the soil borings indicate that concentrations of fluoride in soil boring SB-FW01 exceeds protection of groundwater screening levels to the total boring depth of 10.75 ft. Fluoride detected at a concentration of 160 J mg/kg was below the MCL-based protection of groundwater screening level of 615 mg/kg, but above the MTCA Method B-based screening level of 147.6 mg/kg. Evaluation of nearby soil borings SBFW02, SB-CP01, and SB-CP02 indicates that fluoride was not detected at concentrations that exceed the protection of groundwater screening levels to depths of 6 ft bgs, the maximum depth of these borings.

The closest downgradient shallow groundwater monitoring well is RI-MW10-BAU located east of the South SPL Building (SWMU 15) approximately 250 feet to the southwest. Concentrations of fluoride detected in the well ranged from 1.2 to 1.6 J mg/L during the 2017 quarterly groundwater monitoring program (Appendix C, Figures C2-4 and C2-5). Interpreted groundwater monitoring data shown on Appendix C, Figures C2-4 and C2-5 indicate a shallow groundwater fluoride plume in the BAU encompassing most of the southern portion of the plant area, including the Friction Weld Building, at concentrations that exceed the MTCA Method B screening level of 0.96 mg/L. Concentrations of fluoride in this identified shallow groundwater plume beneath the Plant Footprint at and west of the Friction Weld Building range from 1 to 2.7 mg/L.

#### 4.9.2.6.1 Investigation Objective

Additional investigation is proposed to evaluate the vertical extent of fluoride contamination in soil and potential impact on shallow groundwater. Objectives for the proposed investigation of the friction weld building are as follows:

- Determine the horizontal and vertical extent of fluoride in soil at the SB-FW01 boring location.
- Collect a grab groundwater sample from the shallowest groundwater (UA or BAU).
- Evaluate whether concentrations of fluoride in soil at this location have impacted shallow groundwater above concentrations that may be present in an identified area-wide fluoride plume.

#### 4.9.2.6.2 Investigation Scope

Proposed investigation of the Friction Weld Building area incorporates an iterative approach (Figure 4-32) to define the vertical extent of fluoride contamination in soil and the potential impact on shallow groundwater. The decision tree will guide field decisions on the need for and location of additional step-out borings.

Initially, two soil borings (SB-FW05 and SB-FW06) will be completed at the location of SB-FW01 (Figure 4-32) to determine if this area is a potential source of fluoride contamination to shallow groundwater. One boring (SB-FW05) will be drilled east of SB-FW01, and a second boring (SB)-FW06) will be drilled to the west. The soil borings will be completed to bedrock and through the upper 10 feet of shallow groundwater. A minimum of four soil samples will be collected from each boring including one above or near the water table, if the water table occurs above the soil/bedrock contact. A grab sample of groundwater will be collected from the soil boring through temporary well screen installations.


Proposed soil boring with grab groundwater sample

RI Soil Borings

Friction Weld Building Investigation Area

W N S E

0 20 40 80

Feet

**Figure 4-32**

Plant Area AOC

Friction Weld Building Boring Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

GeoEye, Maxar

If concentrations of fluoride in soil are below the protection of groundwater screening level, then the investigation of this area would be complete. If concentrations of fluoride in soil exceed the protection of groundwater screening level, then additional step-out borings would be completed from the location of screening-level exceedance following the decision-tree approach. If concentrations of fluoride in shallow groundwater exceed MTCA Method A or B, then this area would be further addressed in a future groundwater monitoring program as determined in the FS or CAP.

Temporary well screens will be installed in the soil borings to facilitate collection of grab samples of shallow groundwater. The temporary well screen completion will consist of installation of a well screen and sand pack, followed by gentle purging, then collection of one unfiltered groundwater sample as described in Section 5.2, after which the boring will be properly plugged and abandoned.

Soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, and TPH. The groundwater samples will be analyzed for cyanide (total and free), fluoride, sulfate, PAHs, and TPH. Fluoride analyses for soil and water will be completed on an expedited turnaround time.

#### *4.9.2.7 Soil Boring SB-SE08 in Courtyard Segment A4*

Soil boring SB-SE08 is in Courtyard Segment A4 and was completed during the RI as one of a series of borings to investigate the SE Line at depth beneath Courtyard A (Figure 4-26). RI results for the soil boring indicate that fluoride and sulfate were detected in soil at concentrations that exceeded their protection of groundwater screening levels to the total boring depth of 19 ft bgs.

Fluoride was detected at concentrations that exceeded the Method B-based screening level of 147.6 mg/kg at 11 ft bgs at 270 J mg/kg, and at 19 ft bgs (total boring depth) at 160 mg/kg. Sulfate was detected at concentrations that exceeded the screening level of 2,150 mg/kg at 3 ft bgs at 2,300 JD mg/kg, decreasing to 12 J mg/kg at 19 ft bgs. Evaluation of nearby soil borings SB-PF08, SB-BC01, SB-SE07, and SB-FW01 indicated that fluoride was detected in soil at concentrations that exceed the 147.6 mg/kg screening level, at 3 ft bgs and 280 mg/kg in boring SB-BC01 located to the east, and the same depth at 410 mg/kg in boring SB-SE07 located to the west. Fluoride was detected in boring SB-FW01, located to the southwest, at concentrations that exceed the 147.6 mg/kg protection of groundwater screening level to the bottom of the boring at 10.75 ft bgs. Sulfate was not detected in soil in nearby borings at concentrations that exceed the protection of groundwater screening level but did increase in concentration with depth in borings SB-BC01 and SB-SE07, to the east and west.

The closest shallow groundwater monitoring wells are down gradient well RI-MW10-BAU located east of the South SPL Building (SWMU 15) approximately 400 feet to the southwest, and side gradient well RI-GW5-UA located to the west in Courtyard Segment A3. During the 2017 quarterly groundwater monitoring program (Appendix C, Figures C2-4, C2-5, C3-4, and C3-5) concentrations of sulfate detected in RI-GW5-UA ranged from 160 to 190 mg/L, and in RI-MW10-BAU, ranged from 27 to 32 mg/L. Interpreted groundwater monitoring data (Appendix C, Figures C2-4 and C2-5) indicates a fluoride plume in the UA above the MCL of 4 mg/L and in the BAU above the Method B 0.96 mg/L groundwater screening level in an area that encompasses most of the southern portion of the plant area, including Courtyard Segment A4. Interpreted groundwater monitoring data (Appendix C, Figures C3-4 and C3-5) do not indicate sulfate plumes above the secondary MCL screening level in the UA or BAU.

While a surface source of fluoride and sulfate in soil at depth at the SB-SE08 location is not clear, as discussed in Section 4.9.2.2, the occurrence of concentrations of fluoride and sulfate soil that exceed protection of groundwater screening levels at depth may be a result of interaction between soil and a fluctuating water table within the area-wide fluoride plume.

#### *4.9.2.7.1 Investigation Objective*

Additional investigation is proposed to evaluate the vertical and horizontal extent of fluoride and sulfate contamination in soil and potential impact on shallow groundwater. Objectives for the proposed investigation of fluoride and sulfate soil contamination are as follows:

- Determine the vertical and horizontal extent of fluoride and sulfate in soil at and near the SB-SE08 boring location.
- Collect a grab groundwater sample from the shallowest groundwater (UA or BAU).
- Evaluate whether concentrations of fluoride in soil at this location have impacted shallow groundwater above concentrations present in an identified areawide fluoride plume.
- Evaluate whether concentrations of sulfate in soil at this location have impacted shallow groundwater.

#### *4.9.2.7.2 Investigation Scope*

Proposed investigation of the SB-SE08 area incorporates an iterative approach (Figure 4-25) to define the vertical extent of fluoride and sulfate contamination in soil and the potential impact on shallow groundwater. The decision-tree will guide field decisions regarding the need for and location of additional step-out borings.

Initially, three soil borings (SB-SE08A, SB-SE08B, and SB-SE08C) will be completed in the boring SB-SE08 area to determine if this area may be a soil source of fluoride and sulfate to shallow groundwater (Figure 4-33). Boring B-SE08A will be completed near the SB-SE08 location, borings SB-SE08B and SB-SE08C will be completed to the west and east of SB-SE08. The borings would be drilled to bedrock and through the upper 10 feet of shallow groundwater. A minimum of four soil samples will be collected from each boring. A monitoring well (UA or BAU) will be installed in SB-SE08A, and one round of groundwater sampling will be performed. A grab sample of groundwater will be collected from SB-SE08B and SB-SE08C from the upper 10 feet of groundwater through a temporary well screen installation.

If concentrations of fluoride and sulfate in soil are below the protection of groundwater screening levels, then the investigation of this area would be complete. If concentrations of fluoride and sulfate in soil exceed the protection of groundwater screening level, then additional step-out borings would be completed from the location of screening level exceedance following the decision tree approach, although step-out borings are constrained to the south by a steep slope to near boring SB-FW01 which is the adjacent investigation area. If concentrations of fluoride and sulfate in shallow groundwater exceed MTCA Method A or B or secondary MCL screening levels, then this area would be further addressed in a future groundwater monitoring program as determined in the FS or CAP.

A shallow groundwater (UA or BAU) monitoring well will be installed in soil boring SB-SE08A. After well installation, development, and stabilization, a single round of groundwater sampling will be performed at the newly installed shallow groundwater monitoring well.

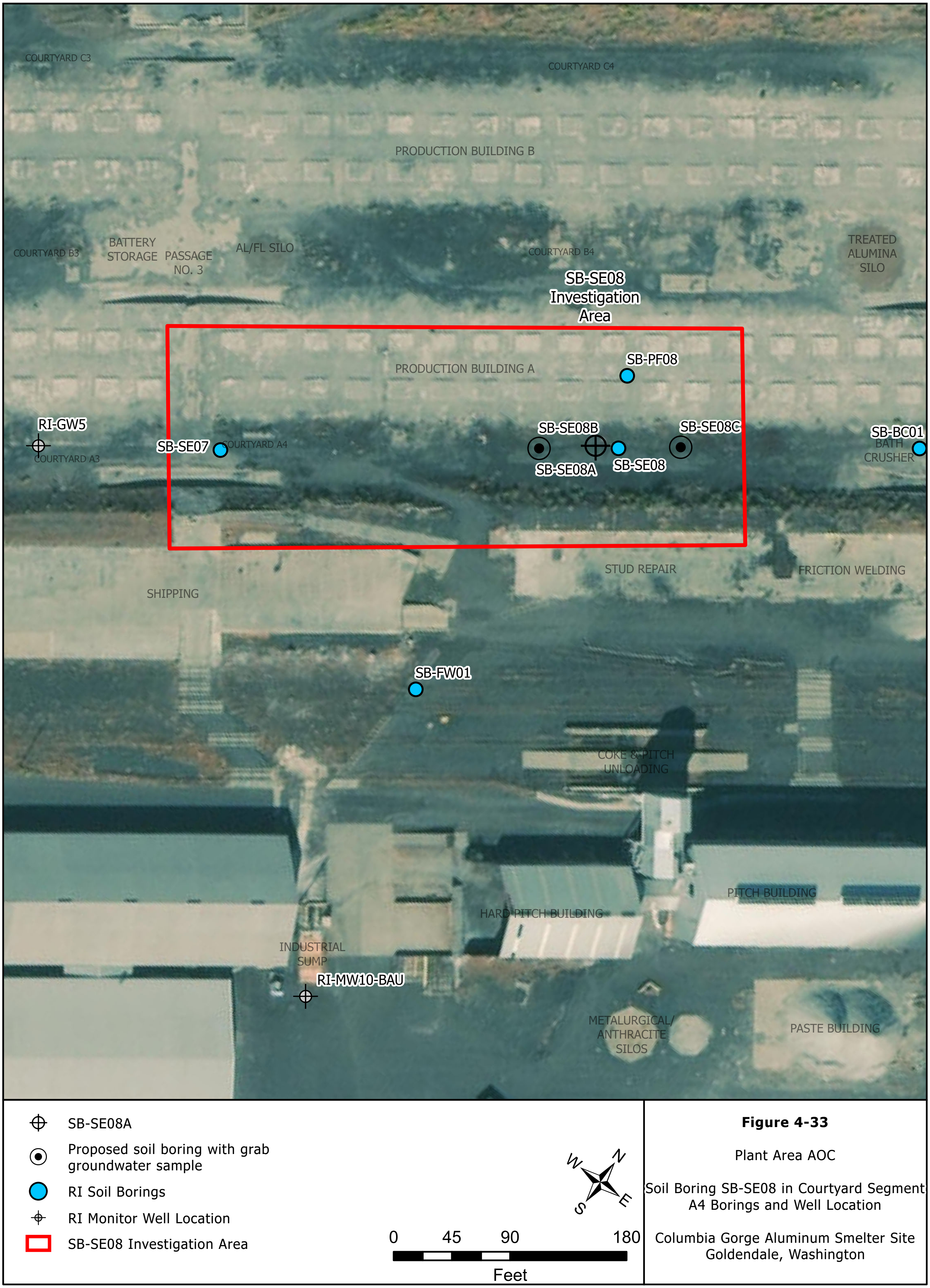



**Figure 4-33**

Plant Area AOC

Soil Boring SB-SE08 in Courtyard Segment A4 Borings and Well Location

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

GeoEye, Maxar

A temporary well screen will be installed in soil boring SB-SE08B, and in SB-SE08C if completed, to facilitate collection of a grab sample of shallow groundwater. The temporary well screen completion will consist of installation of a well screen and sand pack, followed by gentle purging, then collection of one groundwater sample as described in Section 5.2, after which the boring will be properly plugged and abandoned.

Soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, and TPH. Groundwater samples will be analyzed for cyanide (total and free), fluoride, sulfate, PAHs, and TPH. Fluoride and sulfate soil and water analyses will be completed on an expedited turnaround time.

#### *4.9.2.8 Soil Boring SB-SE18 in Courtyard Segment C5*

Soil boring SB-SE18 is in the west end of Courtyard Segment C5 and was completed during the RI as one of a series of borings to investigate the SE Line at depth beneath Courtyard C (Figure 4-26). RI results for the soil boring indicate that sulfate was detected in soil at concentrations that exceeded the protection of groundwater screening level. Sulfate was detected in SB-SE18 in soil at concentrations increasing from 180 mg/kg at 2 ft bgs to 2,200 mg/kg at 9 ft bgs, the total depth of the boring. Evaluation of nearby soil borings SB-SE10, SB-SE15, SB-BH05, and SB-PF06 indicates that sulfate was detected at a concentration that exceeds the protection of groundwater screening level of 2,150 mg/kg in boring SB-PF06 to the southeast at 3,000 mg/kg at 4 ft bgs. Sulfate was also detected in boring SB-SE10 to the west at concentrations below the protection of groundwater screening level but increases from 91 mg/kg at 3 ft bgs to 430 mg/kg, and 260 mg/kg, at 10 and 11.5 ft bgs, respectively.

The closest shallow groundwater monitoring well is RI-MW7-BAU is located less than 100 feet to the north. Concentrations of sulfate detected in the well range from 140 to 220 J mg/L, during the 2017 quarterly groundwater monitoring program (Appendix C, Figures C3-4 and C3-5). Interpreted groundwater monitoring data (Appendix C, Figures C3-4 and C3-5) does not indicate a sulfate plume above the secondary MCL screening level in the BAU. No nearby monitoring well is completed in the UA.

The source of sulfate in soil at depth at the SB-SE18 location is unclear. The vertical concentration profile of sulfate detected in soil, increasing in concentration with depth, is similar in borings SB-SE10 and SB-SE18.

#### *4.9.2.8.1 Investigation Objective*

Sulfate was detected in boring SB-SE18 at a concentration that exceeds the protection of groundwater screening level at the total depth of the boring. Additional investigation is proposed to evaluate the horizontal extent of sulfate contamination in soil, and potential impact to shallow groundwater. Objectives for the proposed investigation of sulfate are as follows:

- Determine the horizontal extent of sulfate contamination in soil near the SB-SE18 location.
- Collect a grab groundwater sample from the shallowest groundwater (UA or BAU).
- Evaluate whether concentrations of sulfate in soil at this location have impacted shallow.

#### *4.9.2.8.2 Investigation Scope*

Proposed investigation of the SB-SE18 area incorporates an iterative approach (Figure 5-25) to define the horizontal extent of sulfate contamination in soil and the potential impact on shallow groundwater. The decision tree will guide field decisions on the need for and location of additional step-out borings.

Initially three soil borings (SB-SE18A, SB-SE18B, and SB-SE18C) will be completed in this area (Figure 4-34). Boring SB-SE18A will be completed near boring SB-SE18, boring SB-SE18B will be completed approximately 200 feet to the east in Courtyard Segment C5, north of soil boring SB-PF06, and boring SB-SE18C will be completed approximately 150 feet to the south in Courtyard B5. All borings will be drilled to bedrock and through the upper 10 feet of shallow groundwater. Up to four soil samples will be collected from each soil boring. A grab sample of groundwater will be collected from the borings from the upper 10 feet of groundwater through temporary well screen installations.

Soil and groundwater samples will be analyzed and evaluated on an expedited basis. If concentrations of sulfate in soil in borings SB-SE18B and SB-SE18C are below the protection of groundwater screening level, then the investigation of the SB-SE18 area will be complete. If concentrations of sulfate in soil in boring SB-SE18B exceeds the protection of groundwater screening level, then one additional soil boring will be completed in Courtyard Segment B5 south


Proposed soil boring with grab groundwater sample
RI Soil Borings
RI Monitor Well Location
SB-SE18 Investigation Area

0 45 90 180
Feet

**Figure 4-34**

Plant Area AOC

Soil Boring SB-SE18 in Courtyard Segment C5 Boring Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

GeoEye, Maxar

of boring SB-PF06. No additional borings will be completed south of SB-SE18C if concentrations of sulfate in soil exceed the protection of groundwater screening level, since the SB-VS01 investigation area is adjacent to the south of SB-SE18C and that investigation includes analysis of sulfate in soil and groundwater.

If concentrations of sulfate detected in soil in borings SB-SE18A and SB-SE18C exceed the protection of groundwater screening level, then this investigation area will be addressed together with the Crucible Cleaning Room Area in a future groundwater monitoring program as determined in the FS or CAP.

Temporary well screens will be installed in the soil borings to facilitate collection of grab samples of shallow groundwater. The temporary well screen completions will consist of installation of a well screen and sand pack, followed by gentle purging, then collection of one groundwater sample as described in Section 5.2, after which the boring will be properly plugged and abandoned.

Soil samples will be analyzed for total cyanide, fluoride, sulfate, PAHs, and TPH. Groundwater samples will be analyzed for cyanide (total and free), fluoride, sulfate, PAHs, and TPH. Sulfate analyses for soil and water will be completed on an expedited turnaround time.

#### *4.9.2.9 Soil Boring SB-SE17*

Boring SB-SE17 is located within the footprint of the East End Landfill (SWMU 17) and near the SE Line and other groundwater line that discharges at the head of NPDES Pond A. During the RI, black silty gravel and gravelly silt (likely smelter wastes) was found between 2.5 and 4.0 ft bgs as well as between 6 and 8 ft bgs. The boring was also found to be damp to wet from 15 to 24 ft bgs with basalt (likely bedrock contact) encountered a 24.0 to 25.0 ft bgs. This indicates that the base of the boring above the bedrock contact is potentially saturated.

Soil analytical data collected for this boring showed significantly elevated concentrations of PAHs, fluoride, and TPH-Dx for samples collected at 3.0 ft bgs and 6.0 ft bgs. Trichloroethene (TCE) was also detected at elevated concentrations (maximum of 0.74 mg/kg) above the MTCA Method A Industrial Soil Cleanup Level of 0.03 mg/kg as well as the MTCA CLARC soil screening level for protection of groundwater of 0.0252 mg/kg.

#### *4.9.2.9.1 Investigation Objectives*

Investigation objectives include the following:

- Characterization of soil chemical concentrations below the waste and above the bedrock contact (unless the waste directly overlies the bedrock).
- Verification of the presence of a saturated interval above the basalt bedrock contact (UA zone) at this location.
- Characterization of the occurrence of the BAU aquifer zone in this area.
- Characterization of the groundwater flow pattern in this area with comparison to the approximate SE and other line elevations.
- Characterization of groundwater chemical concentrations.

#### *4.9.2.9.2 Investigation Scope*

The investigation scope includes installation of two monitoring wells in this area: one completed in the UA zone and one completed in the BAU zone (Figure 4-35). Each well will be surveyed, developed, and sampled for one round of water-level and chemical samples.

Groundwater samples from this well cluster will be sampled for total cyanide, free cyanide, fluoride, sulfate, TPH (gasoline-range, diesel-range, and motor-oil range), VOCs, and PAHs. Soil samples will be collected from beneath the wastes at two depth intervals (1 and 3 feet) depending on the soil thickness and analyzed for the same analytical program. VOCs are included in the analytical program consistent with Ecology's comments on the Draft WPA.

The UA zone well will be installed immediately above or straddling the weathered basalt bedrock contact. Based on the SB-SE17 boring log the shallow zone UA zone (if present) should be found between 15 and about 24 ft bgs; damp to wet soils were found in this interval during drilling of SB-SE17.

The BAU zone well will be completed in the shallowest encountered water-bearing zone that is within the basalts. Based on nearby BAU zone wells, this zone is anticipated to occur at approximately 32 to 52 ft bgs based on well RI-MW10-BAU to as deep as 111 to 131 ft bgs based on well BAMW-3).


Figure 4-35
Soil Boring SB-SE17 Investigation Area
and Proposed Monitoring Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

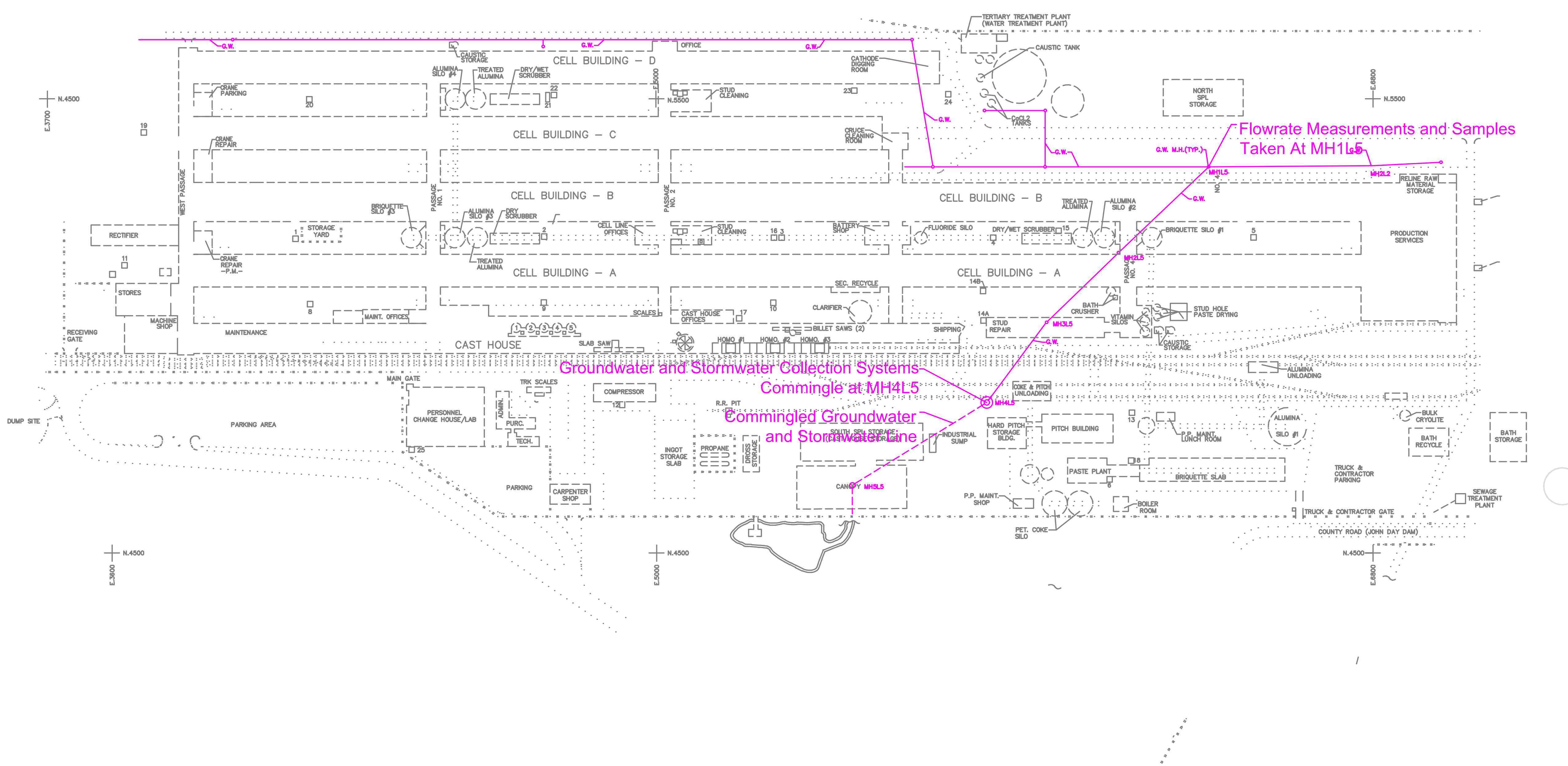
R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\2020\Figure_4-35_SB-SE17.mxd

### 4.9.3 Stormwater and Other Lines Evaluation

The stormwater and groundwater systems consist of vertical catch basins and manholes with connecting horizontal piping. The groundwater collection system in Courtyard Segments C4 and C5 collects shallow groundwater and connects to the stormwater pond, via a northeast-southwest diagonal line that includes manholes MH1L5 through MH5L5 (Figure 4-36). Stormwater located in manhole CB1L14 in Courtyard Segment A4 flows south and co-mingles with groundwater at MH4L5, prior to connecting to the stormwater pond (Figure 4-37). Historically, water from the stormwater pond was co-mingled with industrial process water in the Industrial Sump prior to discharge to the NPDES ponds. Since plant operations ceased in 2003, no industrial process water has been co-mingled with the Industrial Sump. In 2010, a bypass line was constructed to redirect water from the Industrial Sump for discharge at the NPDES permitted discharge point. Currently, water from the stormwater pond is pumped into the Industrial Sump and discharges via the bypass line under a new NPDES permit.

Details of the groundwater system layout and the tie-ins with the stormwater collection system are unclear. The hydraulic evaluation of the impact of the groundwater collection system on the stormwater pond and flow rates from the stormwater, groundwater, and other lines will be quantified, as described in the RI Work Plan, as part of this RI WPA.

In addition to the stormwater and groundwater collection systems, the Site also has other previously used lines including Industrial & Monitoring (I&M), SE, and sanitary sewer system. The disposition of all line systems is summarized on Table 4-4. The I&M lines were visually inspected, and no flow was observed in the lines or discharging at the end of the pipe located in the Industrial Sump or where the pipe daylights approximately 150 feet north of the head of Pond A. Discharge from the I&M lines where the pipe daylights approximately 150 feet north of the head of Pond A has not been observed since at least 2010. The I&M lines connecting to the Industrial Sump will be cleaned and abandoned. It should be noted that a portion of the I&M lines are in Passage No. 3 up to the Tertiary Treatment Plant, and in Courtyards A4 and A5. During video inspection of the SE Lines, breaches near the I&M line in Passage No. 3 or potential connections between the SE and I&M Lines will be investigated.




Source: Goldendale Aluminum Company, Plant Drawing A1/1752, "Underground Storm & Sanitary Sewer Piping W/Chem'l & Oil Str'g Areas"

Legend

Electrical Substations

Ground Water Manhole

0 150 300 600

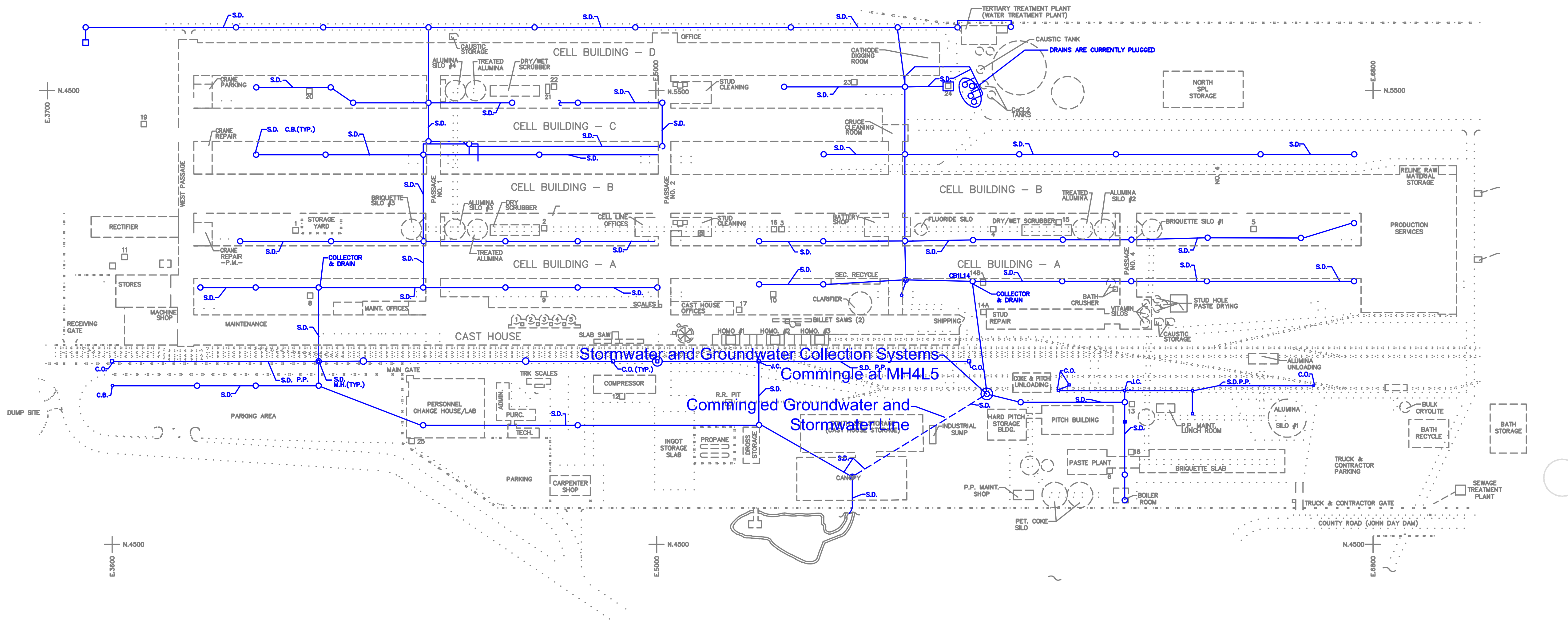
SCALE IN FEET

**Figure 4-36**

Plant Area AOC

Groundwater Collection System Lines

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Source: Goldendale Aluminum Company, Plant Drawing A1/1752, "Underground Storm & Sanitary Sewer Piping W/Chem'l & Oil Str'g Areas"

## Legend

- Electrical Substations
- Storm Drain Catch Basin
- Storm Drain Manhole
- Storm Drain Clean Out

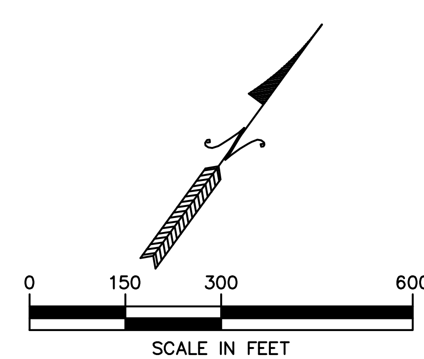



**Figure 4-37**

Plant Area AOC

Stormwater System Lines

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

**Table 4-4**
**Plant Area AOC – Line Groups**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**

| Line Group | Sediment sampled | Water sampled | Connectedness | Feasibility Study Goals |
|---|---|---|---|---|
| Industrial & Monitoring (I &M) | Yes | No water present | Extends from Rectifier Yard to Industrial Sump, also located in Passage No. 3. Investigate breaches or connection to SE Line in Passage No. 3 under WPA. | Clean and abandon the I&M lines. |
| Groundwater | No sediment present | Yes | Collects shallow seepage in Courtyards C4 and C5, then flows southwest through a diagonal line from MH1L5 through MH5L5, and discharges to the stormwater pond. Stormwater co-mingles with groundwater at MH4L5. No additional investigation proposed for WPA. | Retain for future use. Potential reconfiguration in FS. |
| Sanitary Sewer | No | No | Sewer line from administrative building to sewage treatment facility. | No action. Retain sanitary sewer for future use. |
| Scrubber Effluent (SE) | Yes | Yes | Located in Courtyards A, C, Passage No 3, and extends from Courtyard A5 to an open pipe at the head of Pond A. Investigate source of water discharging to Pond A under WPA. | Clean and abandon the SE Lines. |
| Stormwater | Yes | Yes | Present in Courtyards A through E, parking area, and the south part of the PAAOC. Discharges to the stormwater pond. No additional investigation proposed for WPA. | Clean stormwater lines and retain for future use. |

The SE Lines were visually inspected, and water, wood, and sediment were sampled in numerous manholes throughout the system. The SE Lines do not appear to be leaking; however, the source of water flowing in Passage No. 3, the lower reaches in Courtyard Segments A4 and A5, and discharging at the end of the pipe at the head of Pond A, needs to be determined before the lines can be cleaned, and abandoned.

The Sanitary Sewer lines were not inspected during the RI as they were not considered a source of contamination for the Site. The Sanitary Sewer lines will be left in place for future redevelopment of the Site.

The SE, I&M, and groundwater lines are discussed in further detail in the following sections as it pertains to determining the source of flow from the SE pipe at the head of Pond A and measuring the rate of discharge from groundwater collection system into the stormwater pond.

#### 4.9.3.1 Source of Water for Discharge at the Head of NPDES Pond A

Water discharges at the head of Pond A through the outlet of the SE Line and water flows mostly year-round. Based upon RI investigation activities, including system manhole inspections, sampling, and video inspection of horizontal line segments, the source of the water discharging from the SE Line at Pond A is interpreted to be from water entering the SE Lines at a potential connection with another line or breach suspected beneath the Crucible Cleaning Room Area. The Crucible Cleaning Room Area is located north of Passage No. 3 between Courtyards A3 and A4, at the far east end of Production Building C, and to the southwest of the Tertiary Treatment Plant (Figure 4-38).

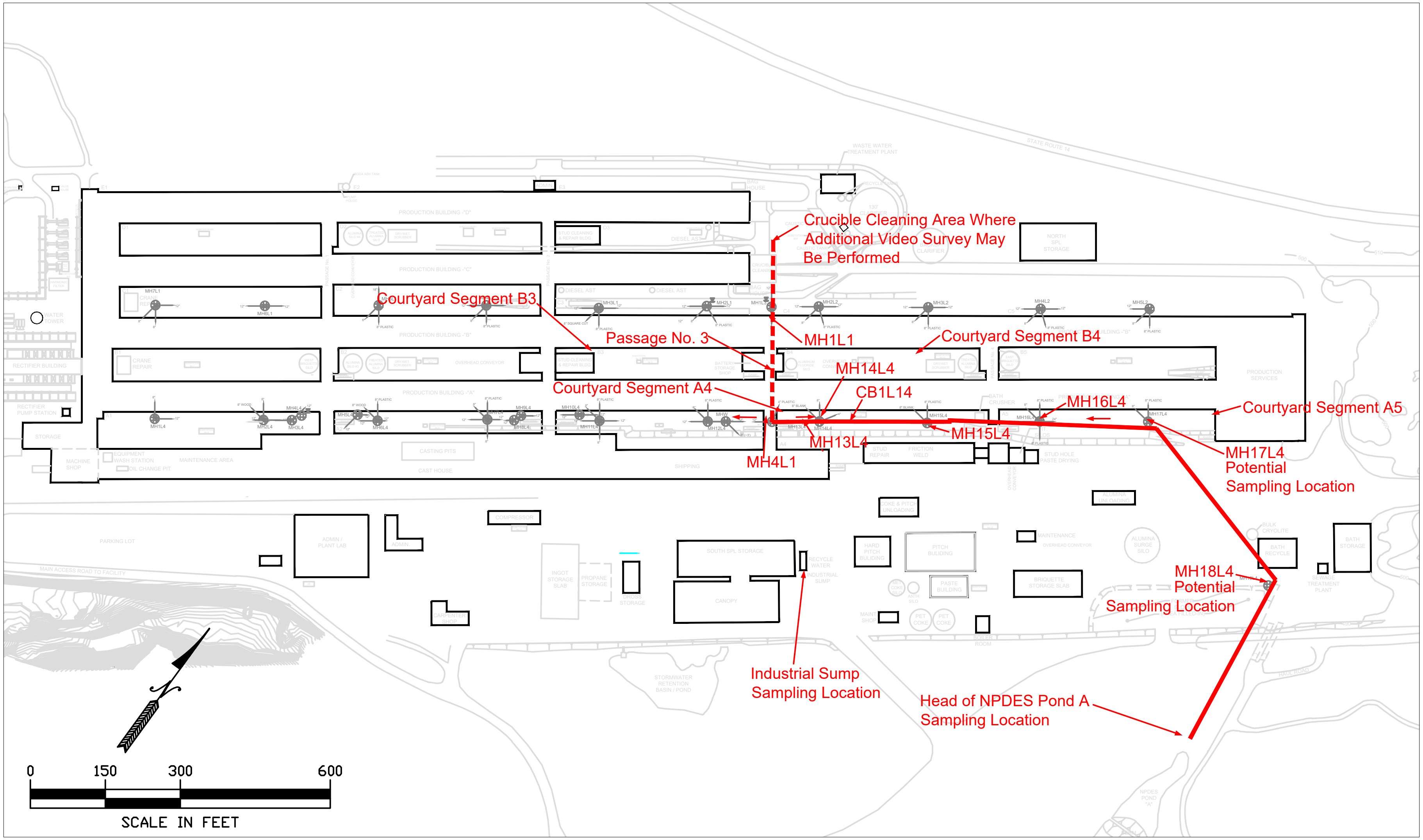
##### 4.9.3.1.1 Investigation Objectives

The water flow rates and seasonal variation of water in lines and discharging to the NPDES Pond A were previously not quantified. A video survey will be conducted after removal of debris from portion of SE Lines located in Courtyard Segments A4, A5, and Passage No. 3, to identify potential connections with other lines and/or water sources.

##### 4.9.3.1.2 Investigation Scope

Debris and miscellaneous materials located in SE Line manholes MH13L4 through MH17L4, located in Courtyards A4 and A5, and manholes in Passage No. 3, will be removed with a vacuum truck. If sediment is present in manhole MH17L4, a sample is proposed to be collected. Previously, MH18L4 was going to be sampled for sediment; however, none was present during the RI field investigation. Additional SE manholes MH1L1 through MH4L1, located in Passage No. 3, will also be opened and inspected to determine if sediment or blockage is present further upstream. This is the section of SE Lines from MH1L1 through MH1L4 is the area of the suspected water source discharging to Pond A.

A video survey will then be performed from SE Line manholes MH13L4 through MH17L4 (Courtyard Segments A4 and A5) and from SE Line manholes MH1L1 to MH1L4 (Passage No. 3). Video surveying of SE Line manholes MH17L4 through MH18L4 will also be performed, along with possible video surveying to the north of MH1L1, beneath the Crucible Cleaning Area, if accessible (Figure 4-33). The video survey will be conducted to identify potential points of entry for water entering the SE Line in these areas.




## Legend

MH2L3 — Manhole with ID Direction and Diameter of Entering Lines Shown (SE Lines)

CB4L11 — Catch Basin with ID Direction and Diameter of Entering Lines Shown (Stormwater Lines)

Lines Inspected Are Color-Coded by Piping System As Follows:
Red = Scrubber Effluent System

Colored arrow indicates direction of video inspection from indicated manholes.
Dashed indicates lines intended but unable to be surveyed.

**Figure 4-38**
Plant Area AOC

Proposed Video Survey and Inspection
of Specific SE Line Segments

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

#### 4.9.3.2 Estimation of Discharge and Line Contributions to Stormwater Pond and NPDES Ponds

An objective of the FS for the Groundwater AOC is to evaluate potential remedial action for water from various sources that may contribute contamination to the uppermost basalt aquifer. One such source is the Groundwater Collection System that collects shallow groundwater from the north central portion of the CGA site and conveys the collected groundwater to the stormwater retention pond, south of the Former Plant Area. RI results indicate that several site COCs are detected in the collected groundwater, with Fluoride exceeding Washington Department of Ecology MTCA Methods A and B screening levels, and the Washington MCL for drinking water.

The Groundwater Collection System consists of east-west horizontal lines located in Courtyard Segments B4, B5, C4, and C5. The east-west groundwater lines connect to groundwater line 5 (a diagonal line) running northeast-southwest and extending from Courtyard C4 at MH1L5 to MH5L5 located under the canopy, immediately northeast of the stormwater pond.

Lines 1 and 2 in Courtyard Segments C4 and C5, and lines 3 and 4 in Courtyard Segments B4 and B5 are 18-inch diameter perforated pipe. The diagonal groundwater line 5 that begins in Courtyard Segment C4 at MH1L5 is 24-inch diameter perforated pipe that runs to MH4L5, where it co-mingles with stormwater from CB1L14 from Courtyard Segment A4. From MH4L5, line 5 discharges to MH5L5 and then to the stormwater retention pond through a 36-inch diameter reinforced concrete pipe.

##### 4.9.3.2.1 Investigation Objectives

Water discharges at the head of Pond A, through the outlet of the SE Line, and flows mostly year-round. Based upon RI investigation activities, including system manhole inspections, sampling, and video inspection of horizontal line segments, the source of the water discharging from the SE Line at Pond A is interpreted to be from water entering the SE Lines at a potential connection with another line or breach suspected beneath the Crucible Cleaning Room Area. The Crucible Cleaning Area is located north of Passage No. 3 between Courtyard Segments A3 and A4, at the far east end of Production Building C, and to the southwest of the Tertiary Treatment Plant. Other conveyance lines (groundwater and stormwater lines) were found to contain flowing water; however, these lines discharge to the stormwater pond and none of these lines had any designed or observed connections to the SE Lines.

#### 4.9.3.2.2 Investigation Scope

Water flow rate measurements will be made for water flowing in the groundwater line from northeast to the southwest through the diagonal portion of groundwater line 5. Determination of the water flow rate in the groundwater line 5 will be made at MH1L5 (Figure 4-39). The depth of water at MH1L5 will be measured and the water flow rates will be calculated using the Manning Equation that describes uniform flow in a pipe or open channel. Two seasonal measurements of the water flow rate will be taken.

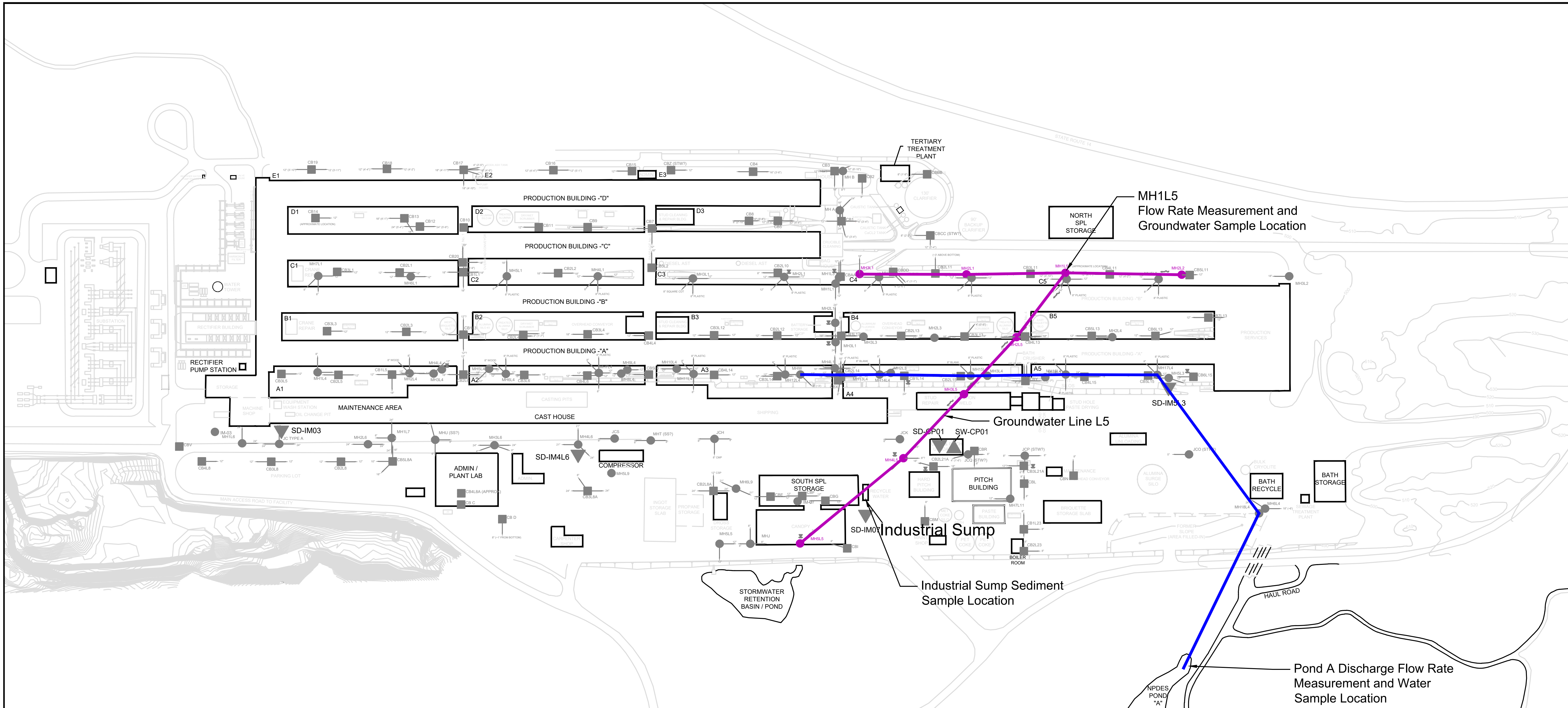
The following table provides known information about manhole MH1L5, the next upstream manhole MH2L2, and the downstream manhole MH2L5. This information will be utilized in the Manning Equation calculation and the flow rate calculated in terms of gallons per minute.

| Parameter | MH2L2 | MH1L5 | MH2L5 |
|---|---|---|---|
| Survey Station, feet | 3 + 40 | 0 + 00 | 2.69.3 + 00 |
| Horizontal Pipe Structure | Perforated | Perforated | Perforated |
| Pipe Diameter, inches | 18 | 24 | 24 |
| Inlet Invert Elevation, feet | 471.3 | 470.5 | 469.5 |
| Invert Depth from Manhole Top, feet | 9.2 | 9.65 | 7.8 |
| Groundwater System data from plant maps A0/0051 and A0/0052 located at CGA facility in map room. | | | |

Flow rate for the water discharging at the head of Pond A will be measured at the SE Line discharge point by measuring the length of time to fill a known volume. A calibrated container will be used to collect water from the discharge and a timer will be used to note the length of time to fill the container. At least three trials will be used to calculate an average flow rate in gallons per minute.

### 4.9.3.3 Chemical Characterization of Line Water and Sump Sediments

Tasks that were not completed during the initial RI field activities will be completed under this WPA. These tasks will include chemical characterization of groundwater collection line and Pond A discharge water, collection of a sediment sample from a SE Line manhole, and collection of a sediment sample from the Industrial Sump.




## Legend

- Manhole with ID Direction and Diameter of Entering Lines Shown (MH2L3)
- Catch Basin with ID Direction and Diameter of Entering Lines Shown (CB4L11)
- Standing Water Observed
- Flowing Water Observed Arrow Indicates Direction

## Features are Color-Coded As Follows:

- Groundwater Collection System Lines and Manholes
- Scrubber Effluent System

The Remaining Systems are Shown in Gray:
Stormwater System
Industrial and Monitoring System
Sanitary Sewer System (Probable)
Previously Unknown Features
Features Shown on Plans, Not Located in Field (Probable Location Shown)

0 150 300 600
SCALE IN FEET

# Figure 4-39

Stormwater Pond and Appurtenant Facilities (SWMU 32)
Proposed Flow Rate Measurements, Groundwater Sample, and Sump Sediment Sample Locations
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

The Industrial Sump is in the south of the Plant Footprint, to the east of the South SPL Building, and is a focal point for collection and discharge of site waters. Historically, the Industrial and Monitoring Lines conveyed process water to the Industrial Sump. Currently, stormwater and collected groundwater are pumped from the stormwater retention pond into the Industrial Sump and then discharged through the 2010 bypass line to discharge to the Columbia River under the current site NPDES Permit. The Industrial Sump has also been used as a backup fire suppression water source.

#### ***4.9.3.3.1 Investigation Objectives***

Water discharging from the SE Line into the head of Pond A was not sampled during RI field activities. Two samples of the discharge water will be collected at two different seasonal times to characterize water discharging at the head of Pond A.

During the RI field activities sampling of sediment in SE Line manhole MH18L4 could not be performed because no sediment was present. The objective for collecting this sample was to characterize sediment in the SE system at the last manhole prior to discharge to Pond A. Another attempt will be made to sample sediment in the SE Line after cleaning debris from the SE Line in Courtyard Segment A5. If sediment is present in SE Line manhole MH17L4, the next manhole upstream from MH18L4, then a sediment sample will be collected to characterize sediment in the SE system prior the discharge point at Pond A.

Previous attempts at collecting sediment from the Industrial Sump have not been successful because of depth of the sump, overhead accessibility, and difficulty of retrieving a sample through a deep-water column. Another sample collection attempt will be made to characterize sediment present in the Industrial Sump.

#### ***4.9.3.3.2 Investigation Scope***

Two water samples and one duplicate sample will be collected at two different seasonal times from the SE Line discharge. Water sampling will follow procedures described in the Final RI Phase 2 Work Plan, Field Sampling Plan, Section 5.3.10.3. The collected water samples will be analyzed for fluoride, sulfate, cyanide (total and free), PAHs, VOCs, metals (Al, As, Cd, Cr, Cu, Hg, Pb, Ni, Se, and Zn), and petroleum hydrocarbons.

One sediment sample will be collected from SE Line manhole MH17L4 if sediment is present, and one sediment sample and one duplicate sample will be collected from the Industrial Sump. Sediment sampling will follow the procedures described in the Final RI Phase 2 Work Plan, Field Sampling Plan, Section 5.3.10.3 (Tetra Tech et al. 2015b). The sediment samples will be analyzed for fluoride, sulfate, total cyanide, PAHs, VOCs, PCBs, metals (Al, As, Cd, Cr, Cu, Hg, Pb, Ni, Se, and Zn), and petroleum hydrocarbons.

Discharge measurements will be collected at the head of former NPDES Pond A during a rainfall event to qualitatively evaluate the amount of stormwater inflow versus shallow groundwater inflow. A rapid response may be related to stormwater inflow/cross-connection and a slower response would tend to indicate a shallow groundwater source. Note that based on current information, there does not appear to be cross-connection between the SE lines and the stormwater lines. Also, there is a suspected older groundwater collection line in this area that may complicate interpretation. The assessment will be performed during a rainfall event in the winter or spring (i.e., a higher-water period) when there is active discharge occurring. The discharge measurements will be made by hand over the course of a few hours immediately following the start of a rainfall event.

# Section 5
# Field Methods and Procedures

This section briefly summarizes field methods and procedures as needed to accomplish the WPA scope of work with an emphasis on those methods and procedures that are being performed as part of this WPA and that are not specifically addressed in the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b). Refer to Section 5.3 of the Ecology-approved Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b) for a comprehensive summary of the field methods and procedures for the project.

## 5.1 MONITORING WELL INSTALLATION, DEVELOPMENT, SURVEYING, AND SAMPLING

Due to anticipated difficult drilling conditions, the PAAOC borings and wells will be installed using sonic or air-rotary drilling techniques. Borings with planned groundwater sampling and wells will target the unconsolidated deposits/basalt bedrock contact as the completion interval. Borings may extend as necessary up to 5 ft into the weathered and fractured basalt as shallow groundwater at the Site can occur in this zone of fractured and weathered flow tops.

The WPA monitoring wells will be constructed similar to the other temporary wells at the Site (wells RI-GW1 through RI-GW9) installed as part of the RI. These wells are considered as “temporary” only in the sense that the Final RI Phase 2 Work Plan included a provision for abandonment of the wells if the initial round of chemical sampling showed that groundwater chemical concentrations were below screening levels. These wells will be constructed in accordance with WAC Chapter 173-160 Minimum Standards for Construction and Maintenance of Wells. The installation of the wells will be overseen by a Washington State-licensed geologist who will be available to provide consultation as needed. Lithologic logs and well construction diagrams will be prepared for each well.

The monitoring wells will be constructed of 2-inch diameter Schedule 40 PVC casing and 10-15 ft in length, machine-slotted (10 slot-size) screens. The borehole annulus will be filled with a 10-20 size silica filter sand pack extending to 3 ft above the screened interval consistent with WAC Chapter 173-160 requirements. A 3/8-inch bentonite chip annular seal shall be installed from the top the sand pack to within a foot of the ground surface. The seal will be installed in segments and hydrated with potable water as appropriate. The wells will be completed with flush-mounted, traffic rated surface completions.

The BAU zone well will be installed using the procedures specified in the Final RI Phase 2 Work Plan. Temporary casing will be used during well drilling and construction for wells where contaminated groundwater could migrate through the borehole into potentially uncontaminated or less contaminated deeper water-bearing zones. Temporary casing will be set and grouted into low permeability layers before drilling into the deeper zone. A 30 percent bentonite grout slurry will be used to grout between the temporary conductor casing and the drill casing. The thickness of the seal and the set-up time for the grout slurry will be dependent on drilling conditions and the type of drill rig used to construct the well.

Monitoring wells completed in the BAU zone shall be constructed using schedule 80 PVC and 10- to 20-foot screen lengths and machine slotted (20 slot) screens. Size 8-12 silica sand pack will be used in the BAU zone wells. A bentonite slurry will be used to construct the annular seal for the BAU zone well due to the anticipated boring depth and the anticipated amount of standing water in the boring.

The wells will be developed using pumping and possibly bailing consistent with the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b). Well development will occur no sooner than 24 hours following well construction. Pumping will be completed with a down-hole impeller type pump and bailing can be performed with a “sand” bailer. All down-hole well development equipment will be decontaminated prior to use. Water field parameters including pH, conductivity, temperature, oxidation-reduction potential (ORP) and turbidity will be periodically measured during well development. Well development will continue until water turbidity is minimized, water quality parameters stabilize, and 3 to 10 borehole volumes of groundwater have been removed.

The newly installed wells will be surveyed by a State of Washington Licensed surveyor. Surveyed well coordinates will include both the ground surface elevation and the water-level measuring point elevation. The horizontal coordinate positions should be provided using the Washington State Plane Coordinate System South Zone Grid, NAD 83. Vertical positions should reference the North

American Vertical Datum of 1988. Survey work can also establish the positions using real-time kinematic GPS equipment and the Oregon Real Time GPS network.

Groundwater sampling and associated water-level elevation measurements will be performed using low-flow sampling techniques as specified in the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b). Given the anticipated depth to water for the proposed shallow wells, a peristaltic pump will be used for sample collection. Deeper wells will be sampled with a submersible low flow pump or a bladder pump equipped with dedicated tubing. Wells will be sampled a minimum of 24 hours following development.

## 5.2 COLLECTION OF GRAB GROUNDWATER SAMPLES FROM BORINGS

The contact between the unconsolidated material and the underlying basalts is targeted for grab groundwater sampling. When the target zone is reached, a two-inch diameter, schedule 40 PVC 5-ft long 10 slot-size well screen and connected blank-pipe section(s) will be placed into the boring. Silica sand pack (10-20 size) will be placed in the boring annulus to extend above the top of the well screen, but a bentonite seal will **not** be placed above the sand pack. The temporary well will be briefly purged to clear it of fine-grained materials introduced during drilling. About one saturated bore-hole volume should be pumped during purging. The temporary well should then be allowed to recover and recharge for short period (e.g., around 15 to 20 minutes) before a grab groundwater sample is collected. A peristaltic pump or disposable bailer will be used to collect the grab sample. Following sample collection, the PVC pipe will be removed from the boring and the boring will be abandoned by filling the borehole using 3/8-inch bentonite chips consistent with WAC Chapter 173-360 requirements.

## 5.3 INSTALLATION AND SAMPLING OF HAND-DRIVEN WELL POINTS

The two proposed hand-driven well points will be installed using an AMS Inc. well point or equivalent sampling device. Conceptually, the device consists of a short stainless-steel screen and drive-point assembly, approximate 3-ft and 5-ft drive rods, a slotted drive head, and hand-driven slide hammer.

Based on the rocky terrain and expected thinness of surficial deposits in this area, shallow refusal is expected at least some locations. For this reason, the temporary well points will attempt to be driven at up to three sub-locations. The temporary well points will be driven to a maximum depth of 10 ft or refusal. A time period of about 20-minutes will be used prior to sampling to ensure adequate time for water recharge into the well points.

Assembly and operation of the drive-point device consists of the following major steps:

- A section of new polyethene tubing is attached to the screen and drive point assembly, the polyethylene tubing is passed through the drive-rod section. The drive-rod section is screwed onto the screen and drive point assembly.
- The polyethylene tubing is then passed through the slotted drive-head and the drive-head is screwed onto the top of the drive-rod section.
- The drive-point assembly is then driven using the slide hammer. Additional sections of drive-rod are added until the target depth is reached.
- After allowing a 20-minute period for water to recharge into the screen, the temporary well point will be checked for water using a peristaltic pump. If water is encountered, the well point will be briefly purged to remove fine-grained materials and/or suspended solids prior to sample collection. If the boring doesn't produce water, the next sub-location will be tested.

The temporary hand-driven well points will be sampled using a peristaltic pump and flow-through cell to measure water quality parameters with a similar set up to groundwater sampling. It is anticipated that the amount of water present in the surficial deposits will be small. For this reason, only a small amount of water will be purged from the well point prior to sampling in an attempt to reduce turbidity. A single round of water quality parameter (pH, conductivity, temperature, dissolved oxygen, ORP, and turbidity) will be measured and recorded. If limited sample volume is anticipated, the glassware for fluoride and sulfate analysis will be collected first followed by the glassware for PAH analyses, and then all other chemical groups.

The well points will be removed following sampling using hand tools. If the boring annulus remains open following removal, the boring will be backfilled with 3/8-inch bentonite chips.

The water quality parameters and field observations must be recorded on the sampling forms. The sample represents a grab sample and purging to obtain stabilization of field parameters is not necessary. New pump tubing will be used at each station. All non-dedicated sampling equipment in contact with soil and groundwater must be decontaminated before use at each station.

## 5.4 SPRING AND SEEP SAMPLING

Springs and seeps will be sampled using a peristaltic pump and flow-through cell to measure water quality parameters with a similar set up to groundwater. Care will be taken not to disturb the water body or sediments prior to or during sampling. The tubing inlet will be positioned to draw from the middle of the water column thickness. A stick or pole will be zip-tied to the tubing and used to carefully position the tubing inlet. The water quality parameters and field observations must be included on the sampling forms. The sample represents a grab sample and a purging to obtain stabilization of field parameters is not necessary. New pump tubing will be used at each station. All non-dedicated sampling equipment will be decontaminated before use at each station.

## 5.5 DISCHARGE MEASUREMENTS

This section summarizes the procedures for discharge measurement for springs as well as pipe discharges.

### 5.5.1 Spring Discharge Measurements

For Wetland K, three flow stations will be established in each of the two drainages to evaluate spring flow. One flow station will be established at Wetland D modified spring, the recently discovered spring, and the Wetland F spring. An attempt will be made to evaluate flow at the NESI wetland; however this seasonal spring appears to only be manifested as standing water within the wetland and flow measurements may not be possible.

Identification of stream flow measurement station locations will include consideration of the following factors: 1) the channel should have as much straight run as possible, 2) the station locations should be in a stable stream bed where the channel cross-section and water velocity are relatively uniform and free of obstructions and turbulence, and 3) stations should provide relatively easy access and allow for accurate relocation.

Methods for measurement include: 1) use of a digital flow meter (current-meter measurements using a low-flow pygmy-type meter), 2) measurement of stream surface velocities over a known distance, and 3) volume measurements, 4) cutthroat flume, and 5) V-notch weir. The anticipated water depth within the channels is likely too shallow (less than 0.5 ft) for use of a digital flow meter, but potential use of this method and other methods identified will be further considered once the stations are established.

The stream surface velocity approach involves placing a buoyant object to float along the stream surface and use of a stopwatch to measure the time for the object to travel through the measured channel section. A minimum of five repetitions will be recorded and the calculated average travel time will then be divided by the length of travel to obtain an average surface velocity. The channel width will be measured and averaged over the length of the stream section. The depth of the water in the channel will be measured across the stream profile and averaged. The average surface velocity multiplied by the average stream depth and width provides an estimate of the channel discharge in cubic feet per second.

If the channel width is narrow (less than about 2 ft) and the flow rate is slow (less than 5 gallons per minute such that the flow can be readily containerized in a 5-gallon bucket), the volume method will be used to estimate the discharge rate. This is simply calculated as the volume of water per unit time.

### 5.5.2 Pipe Discharge Measurements

This section summarizes the procedures for measurements of line discharges.

#### *5.5.2.1 Groundwater Collection Lines*

Water flow rates will be calculated using the Manning Equation that describes uniform flow in a pipe or open channel. Some water may be leaving the horizontal pipe through apparent perforations, but that aspect will not be measured or incorporated into the flow rate estimate.

The parameter that will be measured is the depth of water flowing through manhole MH1L5 (the invert of the inlet and outlet of MH1L5 is level with the floor of the manhole). Other parameters required for the Manning Equation are pipe diameter and pipe invert elevation upstream and downstream from manhole MH1L5. The flow rate will be calculated in gallons per minute.

#### *5.5.2.2 Line Discharge to Pond A*

Flow rate will be measured at the SE Line discharge point by measuring the length of time to fill a known volume. A calibrated container will be used to collect water from the discharge and a timer will be used to note the length of time to fill the container. At least three trials will be used to calculate a flow rate in gallons per minute can then be calculated, and an average value calculated.

## 5.6 EQUIPMENT DECONTAMINATION

Equipment decontamination procedures for drilling equipment and general field sampling and monitoring equipment are provided in the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b). An equipment decontamination area located onsite will be used for drilling and excavation equipment decontamination. A temporary decontamination pad will be constructed at the Site with prior client approval.

All equipment that may directly or indirectly contact samples or directly enters a borehole or well casing shall be decontaminated prior to and after each use including casing, drill rods and bits, sampling devices, and instruments, such as slugs and sounding equipment. The excavator bucket and excavator tracks will be decontaminated using brushes prior to moving between sampling areas. Excavation sequence and excavator positioning will be managed to minimize the potential for physical tracking of contamination.

The drill rig(s) used for this work effort will be equipped with a self-contained decontamination station to provide for day-to-day decontamination requirements. Drilling equipment will be decontaminated before and after use, and between each distinct sampling location (e.g., borehole, well). The following procedure shall be used to decontaminate large pieces of equipment and those portions of the drill rig that may stand directly over a boring or well location, or that come into contact with casing, pipe, or rods:

- Rinse with high-pressure water cleaner.
- Wash external surfaces of the drilling equipment with high-pressure water and laboratory grade detergent (i.e., Alconox™ or Liquinox™), and scrub if necessary, to remove dirt, grime, grease, and oil.
- Wash internal surfaces of casings and drill rods as described above.
- Rinse with high pressure water cleaner.
- Rinse with potable water until all rinsate water appears clear.
- Drain decontamination materials (solids and fluids) to a collection container and dispose in accordance with applicable regulations, following proper chemical characterization and evaluation of disposal options.

Sampling and monitoring equipment that directly contact groundwater (e.g., lifting lines, water-level indicators, and re-usable bailers, down-hole water quality probes) will be decontaminated prior to collection of the sample following the sequential steps below.

- Scrub the equipment with a solution of potable water and Alconox™, Liquinox™, or equivalent laboratory-grade detergent to remove visible soil or other visible potential contaminants.
- Rinse the equipment with copious quantities of potable water until rinsate appears clean.
- Double rinse with distilled or deionized water.
- Dispose of rinse solutions in a designated 55-gallon drum properly marked for its contents.

Purge equipment, including pumps and discharge lines, will be decontaminated by flushing/pumping a Liquinox™ or equivalent solution, potable water, then deionized water through the components. Lifting lines will be washed with a Liquinox™ or equivalent solution and rinsed with potable and distilled water.

## 5.7 INVESTIGATION-DERIVED WASTE (IDW) MANAGEMENT

IDW handling, storage, transportation, and disposal will be performed consistent with the procedures specified in the Final RI Phase 2 Work Plan. An IDW containment and storage area will be established at a secured location onsite. IDW generated from drilling (e.g., cuttings, purge and well development water) and groundwater sampling will be transported from the drilling and sampling locations to the IDW containment and storage area as soon as practical following generation.

All IDW shall be segregated at the Site according to matrix (solid or liquid) and derivation (e.g., soil cuttings, decontamination fluids, purged groundwater, etc.). Each container shall be properly labeled with site identification, sampling point, generation date, matrix, constituents of concern, and other pertinent information for handling.

All IDW will be kept in containers until analytical results are obtained to determine if IDW is hazardous or nonhazardous. Acceptable containers include sealed, DOT-approved plastic or steel 55-gallon drums, water tanks/vessels with lids, and/or roll-off bins with lids. The containers shall be transported in a manner that prevents spillage or particulate loss to the atmosphere.

A brief discussion regarding IDW types is provided below:

- **Soil and Rock Cuttings**. Soil cuttings are generated during the course of coring and drilling boreholes and wells. Cuttings will be containerized and will be labeled to identify the associated boring and/or well location they were generated from. Soil cuttings with obvious indications of contamination (e.g., visible staining) will be containerized separately in an attempt to limit the volume of material that may require special handling and disposal. All containers will be periodically moved to the centralized waste storage area and disposed of after waste characterization has been completed.

- **Trench/Test Pit Soils**. All excavated soils will be stockpiled temporarily on plastic sheeting. Temporarily stockpiled soils/wastes will be covered if left overnight.

  At the completion of trenching and/or test pit installation, all excavations will be backfilled with the excavated materials and compacted and graded using the excavator.

- **Decontamination Fluids**. Equipment decontamination fluids will be placed in labeled 55-gallon drums at the designated IDW storage area. Depending on the volume generated, these fluids will either be bulk sampled for waste characterization and disposal evaluation or characterized for disposal using appropriate environmental sampling data (e.g., groundwater and spring data, and soil data).

- **Well Development and Purged Groundwater Fluids**. Fluids generated from well development and during purging and sampling of monitoring wells will be containerized and transported in 55-gallon drums to the designated IDW storage area. These fluids will be characterized for disposal based on the collected groundwater data from the wells.

- **SE Manhole Materials.** Debris and accumulated sediment in select SE manholes to be cleaned prior to a video survey will be removed using a vacuum truck. Manhole materials will either be properly disposed of directly through the manhole cleanout service, or manhole materials will be placed in the centralized waste storage area and disposed of after characterization has been completed.

## 5.8 IDW TRANSPORT AND DISPOSAL

Waste transport and disposal from the centralized storage area must be approved in advance by both Lockheed Martin and NSC as summarized in Section 4.1. Ecology consultation and approval is necessary for: 1) initial approval for discharge of water IDW to the stormwater pond, and 2) transportation and disposal of soils or wastes that may be contaminated or mixed with suspected SPL, which may require Ecology approval of a “contained-in” demonstration, or handling and disposal of the materials as a Resource Conservation and Recovery Act (RCRA)-listed (K088) hazardous waste. If Ecology approval for discharge of water IDW to the stormwater pond is not obtained, water IDW will be temporarily stored onsite, profiled, and transported to an approved waste disposal facility for proper disposal or treatment.

Waste characterization will consist of collecting and analyzing soil cuttings and wastewater per waste profiling requirements set by an appropriate disposal facility.

Water generated during drilling equipment decontamination, well development, and well purging will be disposed of at the plant stormwater pond if it meets NPDES permit criteria and there is sufficient capacity. The Performing Contractor will be responsible for verifying that project wastewater meets the NPDES permit requirements prior to discharge, and that the facility is provided required documentation for inclusion in their NPDES discharge report(s), as appropriate.

The Performing Contractor will be required to use a Project Coordinator Lead-approved waste disposal facility for any offsite disposal of project IDW. It is the Performing Contractor's responsibility to confirm that the selected waste disposal facilities are currently approved for use by the Project Coordinator Lead(s).

## 5.9 TEST PIT EXCAVATIONS

Test pits will be excavated using a small excavator. All excavated soils will be stockpiled temporarily on plastic sheeting beside the excavation. Temporarily stockpiled soils/wastes will be covered in windy conditions or if left overnight.

The potential generation of dust will be closely monitored during project excavation activities. If necessary, a water truck will be used as needed for dust suppression at the Site. Watering activities associated with the soil excavation activities will be performed based on visible dust or exceedances of the particulate monitoring action levels specified in the health and safety plan. During the dry season, the water truck can also be used to reduce the potential for grass fires in open space areas as appropriate and necessary based on site conditions and health and safety protocols in place at the time of the field activities.

The field crew will be use sequencing and excavator positioning to minimize the potential for tracking of contamination. Suspected highly contaminated areas will be entered, excavated, and sampled last, and to the extent practical, the excavator will be positioned at the edge or outside of obviously contaminated areas. Dry decontamination of the bucket and tracks will be manually performed prior to moving between investigation areas.

Excavations deeper than 4 ft will not be physically entered by sampling personnel. Soil samples collected from a depth of 4 ft or greater will be collected from the excavator bucket teeth.

At the completion of trenching and/or test pit installation, all excavations will be backfilled with the excavated materials and compacted and graded using the excavator.

## 5.10 WASTE RECOGNITION, CATEGORIZATION, AND LOGGING PROTOCOLS

A waste recognition and categorization approach has been developed as part of the Final RI Phase 2 Work Plan and those protocols will be followed under the WPA if wastes are encountered. Specifically, a technical memorandum regarding definition and recognition of SPL wastes is included as Appendix D and will be used to help confirm the presence and/or absence of SPL (K088) wastes, as well as to provide basis for roughly estimating the quantity of SPL waste. All field staff performing sampling at these SWMUs will have participated in SPL recognition training before the start of field activities.

The lithology of each test pit will be continuously logged consistent with the Unified Soil Classification System (USCS) as described in ASTM Method 2488 Visual-Manual Procedure. The presence and depth of potentially impacted soils from field observations and field screening will be recorded. Field observations regarding the physical characteristics of the waste will be recorded including the following as appropriate: color, odor, texture, density, evidence of crystallization/salt-like encrustations, labeling on metal and other debris, grain-size, hardness, evidence of sheen, and field screening results for the health and safety program [e.g., Photoionization Detector (PID) readings for volatile vapors, particulate air readings for dust, and iBRID™ meter readings for aluminum reduction-related constituents such as hydrogen cyanide gas]. The presence or absence of water in all excavations will also be recorded including the depth of any water encountered.

Digital photographs of the types and quantities of solid waste encountered within each trench or test pit will be obtained. For each test pit and/or trench, a log showing the materials and categories of wastes encountered will be prepared. The Performing Contractor will use the following categories of waste on the field forms:

- **Suspected SPL (K088) wastes** will be identified through the use of the recognition memorandum and field-training. The materials may be identified from other carbon wastes by its blue-gray color, recrystallization, presence of salt-like encrustations, and co-occurrence with brick. SPL waste can superficially resemble weathered basalt but may be distinguished by its lower hardness and dull sound when struck by a hammer.

- **Anode carbon wastes.** These wastes are commonly cobble- or boulder-sized blocks of carbon that may show evidence of drilling. Anode wastes will be profiled if they are encountered in association with suspected SPL wastes.

- **Coke and pitch carbon wastes**. Briquettes and other source materials used in construction of the pots and anodes can contain elevated PAH concentrations and will be profiled if they are encountered in significant quantities.

- **Bricks.** The presence and color of brick will be noted as well as its association with carbon materials. Both fire (red) and insulating (yellow or white) brick were reportedly used in facility operations. According to facility personnel, red brick is more likely associated with pot liner wastes. White brick was reportedly associated with cast house operations.

- **Cryolite and alumina wastes**. These fine-grained white or gray materials represent bath materials and ore-derived materials placed in the pots. These wastes commonly contain fluoride in addition to alumina. Fluoride can represent a chemical-of-potential-concern for groundwater.

- **Metal debris.** Miscellaneous metal debris (e.g., piping, crusted drums, metal sheeting) that may have been disposed with other wastes.

- **Electrical equipment such as transformers or capacitors.** Discovery of potential transformers or capacitors will be reported as soon as practical to Lockheed Martin and CDM. Based on review of previous environmental reports, it does not appear likely that transformers or capacitors will be encountered. Handling and characterization of such wastes is beyond the current scope of this plan.

- **Potential asbestos-containing materials** including such items as roofing materials, insulation, and siding will be noted in the trench and test pit excavation logs.

- **Scrubber sludges and bag house dust.** Based on process knowledge, these materials are not expected at the Smelter Sign Area but may be recognized in the field by their fine-grained nature and steel-gray to dark-brown/black color.

- **Undifferentiated or mixed carbon wastes**. It is anticipated that the origin of some carbon wastes will unable to be identified with confidence in the field or that other carbon materials (e.g., anode wastes) will be mixed with SPLs. Chemical sampling will be conducted of wastes in this category. If wastes in this category cannot be reliably segregated and screened from SPL materials, they will be treated as SPL wastes for remediation purposes. Sampling of mixed carbon wastes is one of the main waste types targeted by the proposed sampling program.

- **Fill.** The presence of soil (silt, clay, sand, and gravel) and bedrock (basalt cobble and boulder) fill materials will be noted where encountered and distinguished from waste materials used as fill. Soil fill material is suspected beneath the lawn and on the south-facing slope above the railway spur. Basalt cobble fill is suspected in the bench area.

For each excavation and subarea of the Site, the rough volume of the identified waste categories will be estimated in the field to support the rough order-of-magnitude estimation of the waste categories (e.g., RCRA-listed wastes, Washington State Dangerous and Extremely Dangerous Wastes, and non-hazardous wastes). These quantities will be needed for future evaluations of remedial alternatives and associated costs.

## 5.11 LINES AND SUMP WATER AND SEDIMENT SAMPLING

Catch basin and sump sediment samples will be obtained using a long handle dipper to reach the bottom of the basin or sump. The dipper bowl will be dragged on the bottom of the basin to capture the settled and representative sediment material. The sample will be obtained directly from the dipper bowl upon removal of the basin or sump. The process will be repeated as necessary to fill all sample bottles.

Groundwater collection manhole water samples will be obtained using a long-handled dipper to reach the bottom of the manhole. The dipper bowl will be submerged in water to collect the sample. The sample containers will be filled directly from the dipper bowl upon removal from the manhole. The process will be repeated as necessary to fill all sample bottles.

Samples will be collected using new and disposable equipment. Upon completion of the sampling event, the sampling equipment will be disposed following IDW handling procedures.

## 5.12 WATER SAMPLING FROM DISCHARGE PIPING

Water discharges from existing piping will be sampled directly into appropriately labeled and pre-preserved (as appropriate) sample containers. Where the discharge flow rate is too high to control flow into small and preserved sample containers, a secondary new and disposable container will be used to collect water then fill sample containers. Sampling of water discharging from piping will use the following procedures:

- Label the appropriate sample containers with all necessary information.
- Collect water samples in order of volatilization (i.e., VOCs first). Samples for VOC analysis (if any) will be filled directly into pre-labeled, pre-preserved Volatile Organic Analysis (VOA) sample containers, with care taken to minimize turbulence. The VOA containers will be filled completely to eliminate any headspace, and the seal/lid will be secured.
- Dissolved metals (if any) will be filtered in the field using a 0.45-micron disposable, in-line filter. Care will be taken not to overfill pre-preserved sample containers as to help maintain proper pH control.
- Upon collection, immediately place the properly labeled sample containers in a cooler with ice and maintain at a temperature of $0^o$ to $6^o$ C for the duration of sampling and transportation to the laboratory.
- Record all sample collection information (e.g., location, date and time sampled, and preservative(s), if any, in the field logbook and/or on appropriate field forms.
- Follow sample custody and handling procedures.

# Section 6
# Quality Assurance Project Plan

A detailed Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) for the Columbia Gorge Aluminum Smelter Site RI/FS were prepared and included in the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b). The QAPP was prepared to comply with the Guidance for Quality Assurance Plans (EPA 2002), herein referred to as EPA QA/G-5, Ecology's Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Ecology 2004), and Sediment Sampling Analysis Plan Appendix (Ecology 2008). As such, this document is referenced as relevant to this WPA.

In support of the WPA, this section specifically addresses: 1) Quality Assurance Objectives, 2) Field Sample Quality Assurance Program, 3) Laboratory Operation, Management, and Quality Assurance Program, 4) Corrective Action and No-Conformance Reporting, and 5) Data Reduction, Validation, and Reporting.

A brief summary of site background and regulatory framework information is provided in Sections 2 and 3, respectively. A comprehensive description of the Columbia Gorge Aluminum Smelter Site is provided in the RI Work Plans (Tetra Tech et al. 2015a,b) and in the Draft RI Report (Tetra Tech et al. 2019a). WPA field investigation activities, including associated data needs, work elements, and investigation objectives are summarized in Section 4 of this plan.

## 6.1 ANALYTICAL PROGRAM SUMMARY

Target analytes for laboratory sample analysis in support of the WPA investigation effort are presented in Table 6-1. Table 6-1 includes identification of chemical-specific laboratory techniques, as well as associated laboratory analytical preparation methods and analysis for specific environmental sample media (i.e., soils, freshwater sediments, groundwater and surface water). The list of target analytes has been established based on previous data collected from the Site, as well as understanding of past facility operations, activities, and/or known or suspected spills and releases as summarized in the Final RI Phase 1 Work Plan (Tetra Tech et al. 2015a). Quality assurance objectives, including chemical-specific DQOs are discussed in the following section.

**Table 6-1**
**Work Plan Addendum Laboratory Analytical Program Summary**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**

| Chemical | Laboratory Analytical Technique | Laboratory Analytical Method / Preparation Method | | |
|---|---|---|---|---|
| | | Soil | Freshwater Sediment | Groundwater and Fresh Surface Water |
| **Cyanide** | | | | |
| Total Cyanide | Colorimetric | EPA 9012A / 9013 | EPA 9012A / 9013 | EPA 335.4 / Distill-CN |
| Free Cyanide | Colorimetric | NA | NA | EPA 9016 / 9016 |
| **Fluoride** | | | | |
| Fluoride | IC | EPA 300.0 / DI-Leach | EPA 300.0 / DI-Leach | EPA 300.0 / 1312 |
| **Sulfate** | | | | |
| Sulfate | IC | EPA 300.0 / DI-Leach | EPA 300.0 / DI-Leach | EPA 300.0 / 1312 |
| **Metals (Total and Dissolved)** | | | | |
| Aluminum | ICP-MS | SW 6020A / 3050B | SW 6020A / 3050B | EPA 200.8 / 200.8-P |
| Arsenic | ICP-MS | SW 6020A / 3050B | SW 6020A / 3050B | EPA 200.8 / 200.8-P |
| Cadmium | ICP-MS | SW 6020A / 3050B | SW 6020A / 3050B | EPA 200.8 / 200.8-P |
| Chromium | ICP-MS | SW 6020A / 3050B | SW 6020A / 3050B | EPA 200.8 / 200.8-P |
| Copper | ICP-MS | SW 6020A / 3050B | SW 6020A / 3050B | EPA 200.8 / 200.8-P |
| Lead | ICP-MS | SW 6020A / 3050B | SW 6020A / 3050B | EPA 200.8 / 200.8-P |
| Mercury | CVAA | SW 7471B / 3050B | SW 7471B / 3050B | EPA 245.1 / 245.1 |
| Selenium | ICP-MS | SW 6020A / 3050B | SW 6020A / 3050B | EPA 200.8 / 200.8-P |
| Zinc | ICP-MS | SW 6020A / 3050B | SW 6020A / 3050B | EPA 200.8 / 200.8-P |
| **Volatile Organic Compounds (VOCs)** | | | | |
| VOCs | GC/MS | EPA 8260C / 5035A | NA | EPA 8260C |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | | | | |
| cPAH/HPAH/LPAH | GC/MS | EPA 8270D SIM / 3546 | EPA 8270D SIM | EPA 8270D SIM |
| **Polychlorinated Biphenyls (PCBs)** | | | | |
| PCBs -Aroclors | GC/ECD | EPA 8082A / 3665A | EPA 8082A | EPA 8082A |
| **Total Petroleum Hydrocarbons (TPHs)** | | | | |
| Gasoline Range | GC/FID,PID | NWTPH-Gx / 5035A | NWTPH-Gx / 5035A | NWTPH-Gx / 5030B |
| Diesel/Oil Range | GC/FID,PID | NWTPH-Dx / 3546 | NWTPH-Dx / 3546 | NWTPH-Dx / 3510C |
| **Other Parameters** | | | | |
| Calcium | ICP | SW6010C/3050B | NA | NA |
| Sulfur | | | | |

**Notes:**

CVAA = Cold Vapor Atomic Absorption
ECD = Electron Capture Detector
EPA = U.S. Environmental Protection Agency
FID = Flame Ionization Detector
GC = Gas Chromatography
IC = Ion Chromatography
ICP = Inductively Coupled Plasma
LPAH = Low Molecular-Weight Polycyclic Aromatic Hydrocarbons
MS = Mass Spectrometry
NA = Not applicable
PAHs = Polycyclic Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
PID = Photoionization Detector
TPHs = Total Petroleum Hydrocarbons
NWTPH-Dx = Northwest Total Petroleum Hydrocarbons – Diesel-extended range
NWTPH-Gx = Northwest Total Petroleum Hydrocarbons – Gasoline-extended range
VOCs = Volatile Organic Compounds

## 6.2 QUALITY ASSURANCE OBJECTIVES

The primary objective of the plan is to produce data that are accurate, reliable, reproducible and representative of site conditions. DQOs represent qualitative and quantitative statements developed by data users to specify requirements for data quality from field and laboratory data collection activities to support specific decision and regulatory actions. Field-related DQOs for SWMUs and AOCs are included in Section 4 of this plan. DQOs also establish numeric limits of accuracy precisions, quantitation, and completeness for the data to allow the data user to determine whether data collected are of sufficient quality and quantity for use in their intended application. The purpose of DQOs is to guide decisions and processes for the collection, analysis, and evaluation of data to satisfy overall project objectives.

### 6.2.1 Data Quality Objectives (DQOs)

The usability of the data collected during an investigation depends on its quality. A number of factors relate to the quality of data, and sample collection methods are as important to consider as methods used for sample analysis. Following standard operating procedures (SOPs) for both sample collection and analysis reduces sampling and analytical error. Complete chain-of-custody documentation and adherence to required sample preservation techniques, holding times and proper shipment methods ensure sample integrity. Obtaining valid and comparable data also requires adequate quality assurance/quality control (QA/QC) procedures and documentation, as well as established detection and control limits.

Quantitation limits are based on the extent to which the field equipment, laboratory equipment, or analytical process can provide accurate measurements of consistent quality for specific constituents in field samples. The quantitation limit for a given analysis will vary depending on instrument sensitivity and matrix effects.

Analytical data will be obtained using published, standard methods by a Washington State-certified laboratory. Analytical DQOs are achieved through evaluation of analytical methods used, project specific reporting limits, and laboratory QC, which are detailed in the following sections of this QAPP.

The components associated with measurement of data quality are described in EPA QA/G-5. Performance and acceptance criteria are often expressed in terms of data quality indicators, such as accuracy, precision, representativeness, comparability, and completeness. A set of default QC limits, including analytical method detection and reporting limits, as well as the associated precision, accuracy, and completeness criteria for the WPA work effort are summarized in Table 6-2 for aqueous analyses and Table 6-3 for soil/sediments.

Chemical-specific laboratory reporting limits and method detection limits have been included for comparative review in each of the media-specific screening level summary tables provided in Section 3, Regulatory Framework. These limits are based on current method detection limit-studies provided by Test America, a Washington State-certified laboratory previously used in support of earlier RI field investigation work. Based on the final selection of a qualified fixed-based analytical laboratory, these limits and criteria may vary slightly; however, any revisions will be based upon the DQO process and inputs from the project coordinator(s) and project team. The justification for changes in QC Level will be detailed in a QAPP addendum, otherwise the default QC criteria will apply accordingly.

The QC limits developed for this WPA are intended to support the assessment of both industrial and unrestricted land uses, as well as tribal treaty-protected uses and associated risk assessment as appropriate. For instance, the selection of EPA Method 8270D SIM for analysis of PAHs and use of EPA Method SW 6020A / EPA 200.8 for total and dissolved metals in soil and water provides for significantly lower reporting limits and method detection limits for comparative review against media-specific risk-based screening levels. A description of data quality indicators used in support of the WPA work effort, including accuracy, precision, representativeness, comparability, and completeness is provided in the following sections.

### 6.2.2 Accuracy

Accuracy reflects the degree to which the measured value represents the actual or “true” accepted value for a given parameter among individual measurements of the same property under prescribed similar conditions. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into a Laboratory Control Sample (LcS) and Matrix Spike (MS) against a control limit. Surrogate compound recoveries are also used to assess accuracy and method performance.

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the

**Table 6-2**
**Work Plan Addendum Analytical Data Quality Objectives for Groundwater / Surface Water Samples**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**

| Chemical | Analytical Method | Matrix | Units | Laboratory Reporting Limit | Accuracy (Percent Recovery) | | Precision (Relative Percent Difference) | Completeness (Percent) | MTCA Method B Screening Levels [a] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Matrix Spike/ Matrix Spike Duplicate | Laboratory Control | Field and Lab Duplicates | | |
| Total Cyanide | EPA 335.4 | Water | mg/L | 0.05 | 90-110 | 90-110 | 20 | 90 | 0.2 |
| Free Cyanide | EPA 9016 | Water | mg/L | 0.005 | 80-120 | 80-120 | 20 | 90 | 0.0096 |
| Fluoride | EPA 300.0 | Water | mg/L | 0.2 | 90-110 | 90-110 | 20 | 90 | 0.64 |
| Sulfate | EPA 300.0 | Water | mg/L | 1.2 | 90-110 | 90-110 | 20 | 90 | 250 |
| Metals [b] | EPA 200.8 | Water | mg/L | 0.0004-0.1 | 70-130 | 85-115 | 20 | 90 | 0.00005-16 |
| Volatile Organic Compounds (VOCs) [b] | EPA 8260C | Water | µg/L | 0.02-0.5 | 50-130 | 50-130 | 30 | 90 | 0.5-16,000 |
| Polycyclic Aromatic Hydrocarbons (PAHs) [b] | EPA 8270D SIM | Water | µg/L | 0.05-0.2 | 40-130 | 40-125 | 30 | 90 | 0.012-4,800 |
| Polychlorinated Biphenyls (PCBs) [b] | EPA 8082A | Water | µg/L | 0.005-0.01 | 50-140 | 50-120 | 30 | 90 | 0.04-0.5 |
| Diesel / Oil Range Organics | NWTPH-Dx | Water | mg/L | 0.250/0.10 | 50-120 | 50-120 | 30 | 90 | 500 |

a Screening levels are based on Model Toxics Control Act (MTCA) Method B Groundwater Cleanup Levels (ranges provided for analytical methods with multiple compounds).
b Laboratory reporting limits accuracy and precision objectives represent range for analytical methods with multiple compounds. Chemical-specific reporting and method detection limits are included for comparative review against media-specific screening levels in Section 3, Regulatory Framework of this plan. These limits are based on current method detection limit studies provided by Test America of Tacoma, WA, a Washington State-certified laboratory.

mg/L = Milligrams per Liter
µg/L = Micrograms per Liter
EPA = U.S. Environmental Protection Agency
NWTPH-Dx = Northwest Total Petroleum Hydrocarbons – Diesel-extended range
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
VOCs = Volatile Organic Compounds

**Table 6-3**
**Work Plan Addendum Analytical Data Quality Objectives for Soil / Sediment Samples**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**

| Chemical | Analytical Method | Matrix | Units | Laboratory Reporting Limit | Accuracy (Percent Recovery) | | Precision (Relative Percent Difference) | Completeness (Percent) | Screening Levels [a] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Matrix Spike/ Matrix Spike Duplicate | Laboratory Control | Field and Lab Duplicates | | |
| Total Cyanide | EPA 9012A | Soil/Sediment | mg/kg | 2.0 | 80-120 | 80-120 | 20 | 90 | 40-48 |
| Fluoride | EPA 300.0 | Soil/Sediment | mg/kg | 2.0 | 90-110 | 90-110 | 20 | 90 | 4,800 |
| Sulfate | EPA 300.0 | Soil/Sediment | mg/kg | 2.0 | 90-110 | 90-110 | 20 | 90 | NE |
| Metals [b] | SW 6020A | Soil/Sediment | mg/kg | 0.05-2.0 | 80-120 | 80-120 | 20 | 90 | 0.66-130 |
| Volatile Organic Compounds (VOCs) [b] | EPA 8260C | Soil | µg/kg | 1.0-30 | 30-150 | 30-150 | 30 | 90 | 6 |
| Polycyclic Aromatic Hydrocarbons (PAHs) [b] | EPA 8270D SIM | Soil/Sediment | µg/kg | 5.0 | 60-130 | 60-130 | 30 | 90 | 190-4,800,000 |
| Polychlorinated Biphenyls (PCBs) [b] | EPA 8082A | Soil/Sediment | mg/kg | 0.02 | 40-140 | 40-140 | 30 | 90 | 0.5-14.3 |
| Diesel / Oil Range Organics | NWTPH-Dx | Soil/Sediment | mg/kg | 50 | 70-130 | 70-130 | 30 | 90 | 340-2,000 |
| **Other Parameters** | | | | | | | | | |
| Calcium | SW6010C | Soil/Sediment | mg/kg | 50.0 | 43-165 | 82-114 | 20 | 90 | NA |
| Sulfur | | | | 15.0 | 80-120 | 80-120 | 20 | 90 | NA |

a Screening levels are based on Model Toxics Control Act (MTCA) Method B Soil Cleanup Levels as well as the Washington State SMS screening levels, WAC 173-204 (ranges provided for analytical methods with multiple compounds).

b Laboratory reporting limits accuracy and precision objectives represent range for analytical methods with multiple compounds. Chemical-specific reporting and method detection limits are included for comparative review against media-specific screening levels in Section 3, Regulatory Framework of this plan. These limits are based on current method detection limit studies provided by Test America of Tacoma, WA, a Washington State-certified laboratory.

mg/kg = Milligrams per kilogram
µg/kg = Micrograms per kilogram
EPA = U.S. Environmental Protection Agency
NA = Not applicable
NE = Not Established
NWTPH-Dx = Northwest Total Petroleum Hydrocarbons – Diesel-extended range
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
VOCs = Volatile Organic Compounds

true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LcS to a control limit. Table 6-4 provides statistical calculations and formulas used to assess accuracy and precision control. For semi-volatile organic compounds (e.g., PAHs), surrogate recoveries are also used.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. Accuracy values should be compared to the approved control limits (see Tables 6-1 and 6-2) for specified analytes to assess accuracy and method performance.

### 6.2.3 Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Analytical precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. Laboratories use the LcS to determine the precision of the analytical method. If the recoveries of analytes in the LcS are within established control limits, then precision is within limits. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, rather the comparison is between the sample and samples analyzed in previous batches.

Total precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and MSD samples shall be analyzed to assess field and analytical precision. The precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results. For replicate analyses, the relative standard deviation (RSD) is determined. The formulas for calculating RPD and RSD are given in Table 6-4.

Field duplicate/replicate, laboratory duplicate, and MSD samples will be used to assess field and analytical precision, and the precision measurement will be determined using the RPD between the duplicate sample results.

**Table 6-4**
**Statistical Calculations**

| Statistic | Symbol | Formula | Definition | Uses |
|---|---|---|---|---|
| Mean | $\bar{X}$ | $\dfrac{\left(\sum_{i=1}^{n} x_i\right)}{n}$ | Measure of central tendency | Used to determine average value of measurements |
| Standard Deviation | S | $\left(\dfrac{\Sigma(x_i-\bar{x})^2}{(n-1)}\right)^{½}$ | Measure of relative scatter of the data | Used in calculating variation of measurements |
| Relative Standard Deviation | RSD | $(S/\bar{X})$ x 100 | Relative standard deviation, adjusts for magnitude of observations | Used to assess precision for replicate results |
| Percent Difference | Percent D | $\dfrac{x_1 - x_2}{x_1}$ x 100 | Measure of the difference of two observations | Used to assess accuracy |
| Relative Percent Difference | RPD | $\left(\dfrac{(X_1 - X_2)}{(X_1 + X_2)/2}\right)$ x 100 | Measure of variability that adjusts for the magnitude of observations | Used to assess total and analytical precision of duplicate measurements |
| Percent Recovery (LCS) | Percent R | $\left(\dfrac{X_{meas}}{X_{true}}\right)$ x 100 | Recovery of spiked compound in clean matrix | Used to assess accuracy in LCS samples |
| Percent Recovery (MS) | Percent R | $\dfrac{\left(\text{value of spiked sample} - \text{value of unspiked sample}\right)}{\text{Value of added spike}}$ x 100 | Recovery of spiked compound in sample matrix | Used to assess matrix effects and total precision in MS samples |
| Correlation Coefficient | R | (COD) ½ | | Evaluation of "goodness of fit" of a regression line |
| Coefficient of Determination | COD | | Indication of error associated with regression curves | Evaluation of "goodness of fit" of a polynomial equation |

### 6.2.4 Representativeness

Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter mostly concerned with the proper design of the sampling program. Sample data collected in support of this WPA will be evaluated independently and incorporated into the larger RI data set for consideration of representativeness.

Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, and sampling locations. Decisions regarding sample/well/boring locations and numbers are documented in Section 4 of this plan. Representativeness may be evaluated using either statistical or qualitative methods as appropriate to the project. Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives.

### 6.2.5 Data Comparability

Comparability is the confidence with which one data set can be compared to another. Sample data should be compared with other measurements for similar samples and sample conditions. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices sampled, and the range of field conditions encountered, are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis (as covered in Sections 4, 5, and 6 of this Plan, respectively), reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats.

Complete field documentation using standardized data collection forms shall support the assessment of comparability. Examples of standard calculations used to evaluate data sets are presented in Table 6-4. Comparability should take into consideration varying field conditions (seasonal changes), data produced under different DQOs, different equipment and/or procedures used by the Performing Contractor or its subcontractors, and potential involvement of multiple laboratories during the life of a project.

### 6.2.6 Completeness

The completeness of the data will be evaluated based upon the percentage of data judged to be valid relative to the total tests requested. The completeness goal is to generate enough valid data to meet project needs. For completeness requirements, valid data are defined as usable data that meet the objectives of the specific project [i.e., all results not qualified with a rejected (“R”) flag]. The requirement for completeness for analytical samples collected in support of the RI work effort is 90 percent.

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that is expected to be obtained under correct, normal conditions. The following formula is used to determine Percent Completeness (%C):

$$\%C = \frac{v}{T} x 100$$

where:

v = the number of planned measurements judged valid

T = the total number of measurements

Completeness is calculated for the aggregation of usable data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of usable results determines the completeness of the data set. The laboratory is not required to calculate completeness. The Performing Contractor shall review the validated data for usability for the project and calculate completeness based on the usable data. It is the responsibility of the Performing Contractor to review the appropriateness of the flags based on the DQOs and guidelines presented in the QAPP. Quality assurance objectives for completeness will be defined by the DQOs for the project and revised, if necessary, in project-specific QAPP addenda.

## 6.3 FIELD SAMPLING QUALITY ASSURANCE PROGRAM

The WPA field sampling QA/QC program, including sample handling, sample custody, field sample QC requirements, field measurements, and record-keeping and data management is discussed in the following section.

### 6.3.1 Sample Handling and Custody

Sample handling and custody requirements and procedures, including use of proper sample containers and preservation, sample identification and labeling, sample chain-of-custody (CoC), and sampling packaging and shipping are discussed in the following sections.

#### 6.3.1.1 Sample Container, Volumes, Preservation, and Holding Time Requirements

Table 6-5 provides a general summary of sample volumes, container types, preservation methods and analytical holding times for the specified analytical methods. These will be confirmed by the subcontracted laboratory before the start of field activities.

Sample containers are purchased pre-cleaned and treated according to EPA specifications for the appropriate laboratory methods. Containers are stored in clean areas to prevent exposure to contaminants. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol.

Preservation of samples is required so that samples retain their integrity. The most common preservation techniques include pH adjustment and temperature control. Pre-cleaned containers for groundwater samples, containing the appropriate preservatives as specified in Table 6-5, will be provided by the laboratory. Field personnel collecting environmental samples will use EPA-recommended containers and adhere to EPA-recommended preservation techniques for the parameters of concern. The minimum sample volumes required for each type of analysis are also specified and must be met (refer to Table 6-5).

If the Performing Contractor deviates from sample type, the new method shall be approved in advance via a request for a variance. The Performing Contractor will request a variance from the project coordinator(s). Once this variance has been approved in writing, the departure from the conventional sampling and analysis requirements will be included in a project-specific QAPP addendum.

#### 6.3.1.2 Sample Identification and Labeling

A sample identification number that uniquely identifies each sample will be assigned at the time of sample collection. The sample identification scheme developed in the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b) will be similar for work completed in support of the WPA.

Sample identification numbers will be designated by either four-part or five-part codes depending on their location and sample types. The first part of the code includes site designation of the SWMU

**Table 6-5**
**Sample Container, Preservative, and Holding Times**

| Chemical | Sample Matrix | Analytical Method | Container | Recommended Volume | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Total Cyanide | Water | EPA 335.4 | Plastic (HDPE) | 1,000 mL | NaOH to pH >12: Store cool at <6º C > 0º C | 14 days |
| | Soil/Sediment | EPA 9012A | Glass | 4 oz. | Store cool at <6º C > 0º C | 14 days |
| Free Cyanide | Water | EPA 9016 | Plastic (HDPE) | 1,000 mL | NaOH to pH >12: Store cool at <6º C > 0º C | 14 days |
| Fluoride | Water | EPA 300.0 | Plastic (HDPE) | 250 mL | Store cool at <6º C > 0º C | 28 days |
| | Soil/Sediment | EPA 300.0 | Glass | 8 oz. | Store cool at <6º C > 0º C | 28 days |
| Sulfate | Water | EPA 300.0 | Plastic (HDPE) | 250 mL | Store cool at <6º C > 0º C | 28 days |
| | Soil/Sediment | EPA 300.0 | Glass | 8 oz. | Store cool at <6º C > 0º C | 28 days |
| Metals (Total / Field-Filtered Dissolved) | Water | EPA 200.7/200.8 | Plastic (HDPE) | 500 mL | $HNO_3$ to pH < 2: Store cool at <6º C > 0º C | 180 days |
| | Soil/Sediment | SW 6000/7000 series | Glass | 8-oz. | Store cool at <6º C > 0º C | 180 days |
| Volatile Organic Compounds (VOCs) | Water | EPA 8260 C | Glass | 3x40 mL VOA | HCL to pH <2: Store cool at <6º C > 0º C | 14 days |
| | Soil/Sediment | EPA 8260 C | Glass | 4 oz. | Store cool at <6º C > 0º C | 14 days |
| Polycyclic Aromatic Hydrocarbons (PAHs) | Water | EPA 8270D SIM | Glass (Amber) | 1,000 mL | Store cool at <6º C > 0º C | 14 days |
| | Soil/Sediment | EPA 8270D SIM | Glass | 8 oz. | Store cool at <6º C > 0º C | 14 days |
| Polychlorinated Biphenyls (PCBs) | Water | EPA 8082A | Glass (Amber) | 1,000 mL | Store cool at <6º C > 0º C | 14 days |
| | Soil/Sediment | EPA 8082A | Glass | 8 oz. | Store cool at <6º C > 0º C | 14 days |
| Diesel and Oil Range Hydrocarbons | Water | NWTPH-Dx | Glass (Amber) | 500 mL | Store cool at <6º C > 0º C | 14 days |
| | Soil/Sediment | NWTPH-Dx | Glass | 4 oz. | Store cool at <6º C > 0º C | 14 days |

**Notes:**

For samples requiring matrix spike/matrix spike duplicate (MS/MSD), collect triple the recommended volume.

HCL = Hydrogen Chloride
HDPE = High-Density Polyethylene
$HNO_3$ = Nitric Acid
NaOH = Sodium Hydroxide
NWTPH-Dx = Northwest Total Petroleum Hydrocarbons – Diesel-extended range
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
VOA = Volatile Organic Analysis
VOCs = Volatile Organic Compounds

or AOC. SWMU-specific samples will be given the unique SWMU identification number (e.g., SWMU01 = NPDES Ponds). For AOCs, an abbreviation will be used as follows:

- Wetlands AOC = WLAOC.
- Rectifier Yard AOC = RYAOC.
- Groundwater in the Uppermost Aquifer AOC = GWAOC (Note: groundwater samples will be identified using existing and newly installed well nomenclature – see below).
- Columbia River Sediment AOC = CRSAOC.
- Plant Area AOC = PAAOC.

The second part of the code includes the WPA designation used to uniquely identify samples collected as part of this work effort from other RI samples. The designation WPA will be used for this study.

The third part of the code will identify the investigation area within a larger area and will be used primarily in the PAAOC (e.g., Crucible Cleaning Room [CCR]), Wetlands (e.g., Wetlands D and K [WTLD and WTLK]), and SWMU 31 (Smelter Sign Area [SSA] and North of the East Surface Impoundment [NESI] area).

The fourth part of the code includes media-specific sample type and sample sequence as follows:

- Surface Soil Sample = SS (SS01 or SS-01).
- Soil Boring Sample = SB (SB01 or SB-01).
- Test Pit Soil Sample = TP (TP01 or TP-01).
- Sediment Sample = SED (SED01 or SED-01).
- Stormwater Sample = ST (ST01 or ST-01).
- Surface Water Sample = SW (SW01 or SW-01).

Groundwater samples collected from wells will be identified with a two-part code using the existing well identification number (e.g., MW-8A). For newly installed wells, identification will include a unique designation (e.g., WPA-GW10). The sampling round number will also be included in the groundwater sample name. For example, WPA-GW10-5 would represent a sample collected during the fifth round of the sample from the start of the RI from Well WPA-GW10.

An example of a four-part sample identification for a Wetlands AOC sediment sample is presented below:

WLAOC-WPA-WTLK-SS01

where:

| | |
|---|---|
| WLAOC: | Denotes the site designation |
| WPA: | Uniquely identifies the investigation phase |
| WTLK: | Uniquely identifies the investigation area |
| SS01: | Identifies the soil sample station location |

The final part of the code will include additional sample specific information as necessary to distinguish multiple samples collected from a single sample station location. For instance, more than one soil sample might be collected from a single soil boring or test pit location. An example of a four-part sample identification for a soil boring is presented below:

SWMU31-WPA-SB01-5.0

where:

| | |
|---|---|
| SWMU31: | Denotes the site designation |
| WPA: | Uniquely identifies the investigation phase |
| SB01: | Uniquely identifies the sample station location |
| 5.0 | Denotes the sample depth (i.e., the base of the sample) in feet below ground surface |

Note that for groundwater samples the unique well designation number will be used as follows:

- **Newly installed temporary wells**: To distinguish the new temporary monitoring wells installed and sampled in support of the WPA work effort the following two-part designation will be used similar to the existing temporary wells currently present at the Site (e.g., RI-GW10) with the exception that WPA should be substituted for RI. Existing temporary wells include RI-GW1 through 9, so the newly installed well sequence should start with WPA-GW10. For any new BAU and BAL zone wells, the aquifer zone designation should be added to the name to distinguish it from the UA zone wells (e.g., WPA-GW11-BAU). The wells should be numbered in the sequence that they are drilled starting with WPA-GW10.

- **Hand-driven temporary wells points:** The two proposed well points will be designated with a three-part sample designation that includes the station location, the sample media, and the depth of the well point (e.g., WP01-GW-5.0).

- **Grab groundwater samples from borings**: Grab groundwater samples collected from borings will be identified using a six-part sample designation that includes the SWMU or AOC, the study designation, the soil boring number, the media sampled, and the depth of groundwater sample collection:

PAAOC-WPA-CCR-SB01-GW-5.0

where:

| | |
|---|---|
| PAAOC: | Denotes the site designation |
| WPA: | Uniquely identifies the investigation phase |
| CCR | Uniquely identifies the investigation area (e.g., Crucible Cleaning Room) |
| SB01: | Uniquely identifies the sample station location |
| GW: | Uniquely identifies the sampled media. |
| 5.0 | Denotes the sample depth in feet below ground surface |

For water and soil/sediment samples, varying container types and sizes with generally one to three containers for each analysis are required. A single sample identification number will apply to all containers of the same sample.

When field duplicate samples are collected, the duplicate samples will be designated using unique sample numbers. Sample numbers used for blind duplicate samples will be unique and will be distinguishable from primary sample numbers.

If the sample is a field matrix spike/matrix spike duplicate (MS/MSD) sample, the sample identification is the same and extra volume collected as required. Indicate “MS/MSD” in the comments section of the CoC.

For field blanks, letters are used to denote the type of blank, followed by a sequential number and date, which, at the conclusion of work, indicates the total number of the blank type collected for each day of sampling.

**Sample Labeling**

All samples shall be uniquely identified, labeled, and documented in the field at the time of collection. Where necessary, the label will be protected from water with clean label-protection tape. At a minimum, each label will contain the following information: unique sample location identifier, name of collector, date and time of collection, place of collection, and preservative, if any.

A sample identification label will be affixed to each sample container. In addition, each sample number, date, and time the sample was obtained will be recorded in the field notebook or appropriate data sheet. Other information to be entered on the label shall include the date and time of sample collection, initials of the sampler, sample identification, the analysis to be performed on the sample, and preservatives used, if any.

#### *6.3.1.3 Chain-of-Custody Protocol*

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Documentation of the custody and condition of the samples is maintained in field and laboratory records.

Sample custody is maintained by a CoC record form, and the Performing Contractor shall maintain CoC records for all field and field QC samples. The custody record must be completed at the sampling site by the individual designated by the project manager or data management coordinator as responsible for sample shipment. A sample is considered to be under custody if:

- It is in the possession of the responsible person.
- It is in the view of the responsible person.
- It is locked or sealed by the responsible person, to prevent tampering.
- It is in a designated secure area.

The following minimum information concerning the sample shall be documented on the CoC form:

- Unique sample identification.
- Date and time of sample collection.
- Sample matrix type.
- Type of container.
- Designation of MS/MSD (if applicable).
- Preservative type (if used).
- Analyses required.
- Signature of collector(s).
- Number of containers.
- The name of the laboratory that the samples are sent to.
- Serial numbers of custody seals and transportation cases (if used).
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories.
- Bill of lading or transporter tracking number (if applicable).

A CoC record is required for each shipping container. The original form will be sent with the container to the testing laboratory. A copy should be promptly returned to the Performing Contractor by laboratory personnel upon receipt of the samples and completion of the form. Copies are retained by the Performing Contractor for the field and office files, and a copy is retained by the testing laboratory.

Field personnel collecting the samples are responsible for the care and custody of the samples until they are properly transferred. All samples will be accompanied by CoC forms. When transferring samples, the individual relinquishing and receiving the samples will sign, date, and note the time on the form, along with the reasons for transference. The person receiving samples will also sign, date, and provide the time of receipt. If a courier is used, the samples are relinquished to the individual delivering the samples, and that person will relinquish the samples to the laboratory when samples are delivered. Unless samples are specified to be held, all samples should be received by the laboratory within 48 hours of the sample collection period or within the specified holding times for the analyses requested.

The individual shipping the containers will record the specific shipping data (e.g., airway bill number) on the original and duplicate records. If sent by mail, the package will be sent by registered mail with a return receipt requested. If sent by common courier, a bill-of-lading will be used. Freight bills, postal service receipts, and bills-of-lading will be retained as part of the permanent project file.

#### *6.3.1.4 Sample Packaging and Shipping*

Environmental project samples will be placed into the appropriate containers prepared for the specified analysis (refer to Table 6-5). After filling to the top without allowing overflow, the containers will be tightly capped with the provided lids. The containers will then be labeled, wrapped with bubble wrap shipping material, and stored on ice in a thermally insulated shipping container until delivered to the analytical laboratory. Each sample within a shipping container will be listed on a CoC record for that container. The samples will be packaged and transported in a manner that maintains proper sample custody, temperatures, and integrity.

The following procedures will be applied for packaging:

- All sample bottles will be wrapped in bubble pack material to minimize the potential for contamination and breakage during shipment.
- When a 6°C requirement for preserving the sample is indicated, the samples shall be packed in ice or chemical refrigerant to keep them cool during storage and transportation. If ice is used, the ice shall be double-bagged. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. If provided by the laboratory, a temperature blank shall be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory. Alternatively, the laboratory may use an infrared thermometer to measure the temperature of the cooler on receipt.
- Empty space in the cooler will be filled with inert packing material (i.e., bubble-wrap). Under no circumstances will locally obtained material (sawdust, sand, etc.) be used for packing. Newspaper material will not be used.
- The CoC record will be placed in a plastic bag and taped to the inside of the cooler lid.

- All shipping containers will be sealed for shipment to the laboratory. Packing tape will be wrapped around the package at least twice.

- Laboratory-provided custody seals will be attached to each cooler being shipped to the laboratory and affixed in such a manner that the seals will be broken if the cooler is opened. The custody seals will be signed and dated.

### 6.3.2 Field Sample QC Program

Multiple field sampling parameters will be collected during the WPA field investigation. Field QC controls will include measurement of these parameters on duplicate samples and, where possible, comparison against historical readings from the same location. Sample representativeness is a function of the sampling design and procedures and the subsequent sample handling procedures designed to maintain the integrity of collected samples. Representativeness will be ensured by using the appropriate sampling and sample handling techniques as presented in this plan.

Field QC samples will be collected and analyzed in order to assess the consistency and performance of the sampling plan, and for assessment of overall laboratory and field sampling precision. The DQOs established in support of this work effort are outlined in Section 6.2. Field QC, for environmental samples collected for laboratory analysis, will include field duplicate samples, equipment blanks, MS/MSD samples, and trip blank samples as appropriate.

A description of the type of field QC samples anticipated in support of this work effort is provided below:

- **Equipment Blank**. The purpose of the equipment blank is to assess the effectiveness of equipment decontamination procedures. Equipment blanks may be collected from groundwater sampling equipment used in more than one well (e.g., pumps, bailers, and other equipment used in the field). Equipment blanks will not be collected from dedicated sampling pumps. In each case, the blank shall be collected by pouring analyte-free, reagent grade deionized water into or through the equipment, and then transferring the water into sample containers. The Equipment blanks are analyzed for the same analytes as all associated environmental samples. The frequency of all equipment blank collections shall be every day that reusable, down-hole sampling equipment is used. The intent is that over time, rinsate blanks will be collected from each type of non-dedicated sampling equipment.

- **Field Duplicate**. A field duplicate sample is defined as a second sample of the same matrix collected independently, at the same location as the original sample during a single act of sampling. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. Groundwater duplicate samples should be collected as “blind” duplicates, where the sample containers are assigned a unique identification number such that they cannot be identified as duplicate samples by laboratory personnel performing the analysis.

The field duplicate data are used to assess the precision of the overall sample collection and analysis process. Field duplicate samples will be collected at a frequency of one for every ten field samples (10 percent). The sample and the duplicate will be analyzed for the same parameters.

- **Matrix Spike/Matrix Spike Duplicate**. MS/MSDs are defined as one water sample collected at a single sampling location during a single act of sampling, with triplicate sampling volumes. The MS/MSD samples provide the laboratory with additional sample material for the purpose of performing QC analyses. MS/MSD water samples will be collected at a frequency of one for every twenty field samples (5 percent). The sample and the MS/MSD will be analyzed for the same parameters.

- **Trip Blank**. Trip blanks consist of a series of cleaned sample containers filled with analyte-free water and pre-certified by analysis at the laboratory as clean. Trip blanks will be analyzed for VOCs and therefore will only accompany routine samples to be analyzed for VOCs. There will be no holding time limitations for trip blanks in the field. However, it is a general guideline that sample coolers with trip blanks and unfilled sample containers should not be stored at a particular site longer than five working days. Once the trip blank samples are submitted for analysis, they are subject to the same holding times as environmental samples.

### 6.3.3 Field Measurements

Field measurements to be collected in support of the WPA investigation includes periodic ambient air monitoring for personnel health and safety, water-level measurements within existing and newly constructed monitoring wells, and water quality parameter measurements during groundwater sample collection.

Table 6-6 provides a summary of anticipated field measurement parameters, including instrumentation and instrument calibration requirements.

During groundwater sampling, water quality field parameters including temperature, specific conductivity, pH, DO, turbidity, and ORP will be routinely measured using a multi-parameter water quality meter (e.g., YSI 556™ or equivalent). Water-levels and total well depths will also be routinely measured at individual well locations using an electronic water-level indicator outfitted with a calibrated tape to collect measurements to hundredths of a foot increment. General calibration and maintenance considerations for use of field instrumentation are described below.

**Table 6-6**
**Field Measurement and Instrument Calibration**

| Field Parameter | Field Instrument | Calibration |
|---|---|---|
| **Water Quality Parameters** | | |
| pH (pH units) | Multi-parameter water quality meter (e.g., YSI 556™ or equivalent) with flow through sample cell | Calibrate instrument to manufacturer specifications on a minimum daily basis prior to beginning of sample collection (recalibrate as necessary). |
| Specific Conductance (µS/cm or equivalent) | | |
| Temperature (° Fahrenheit or ° Celsius) | | |
| Dissolved Oxygen (mg/L) | | |
| Oxidation/Reduction Potential (ORP Units) | | |
| **Air Quality Parameters** | | |
| Volatile Organic Vapors (ppm) | Photoionization Detector (PID) | Calibrate instrument to manufacturer specifications on a minimum daily basis prior to beginning of sample collection (recalibrate as necessary). |
| Airborne Dust ($mg/m^3$) | Miniram™ (or equivalent) dust monitor | Instrument supplied calibrated by manufacturer. |
| **Groundwater Level and Total Well Depth** | | |
| Water-Level and Total Well Depth (feet in hundredths) | Electronic Water-Level Indicator (with tape calibrated to within 0.01 ft) and length of 200 ft or greater | Instrument supplied with manufactured calibrated tape. |

ft = feet
mg/L = milligrams per Liter
$mg/m^3$ = milligrams per cubic meter
µS/cm = micro Siemens per centimeter
ppm = parts per million

### *6.3.3.1 Equipment Calibration*

General requirements for equipment calibration and quality control are: 1) following the manufacturer’s calibration procedures and frequency for the field tests calibration, 2) using certified standards for calibration materials, 3) the quality control materials and frequency for the field tests, 4) the quality control limits and acceptance criteria for the quality control materials, 5) the acceptance criteria for calibration procedures, 6) the corrective actions for out-of-control events for both calibration and quality control samples, 7) the actions required by field personnel in the event that control parameters exceed the acceptance criteria, and 8) documentation of exceedance of criteria and subsequent corrective actions.

In order to meet project DQOs, proper calibration procedures for field and laboratory instrumentation will be followed. All instruments and equipment used during data and sample collection activities will be maintained, calibrated, and operated according to the manufacturers’ instructions to ensure that the equipment is functioning within established tolerances and as required by the project. Conventional field instruments should be calibrated daily, using standards that bracket the range of probable values, and checked prior to each use. Equipment will be calibrated and maintained in good condition prior to and during use.

Proper maintenance, calibration, and operation of each field instrument will be the responsibility of the field personnel and the instrument technicians assigned to the project. Field equipment will be calibrated prior to use in the field as appropriate. A record of field calibration or calibration checks of analytical instruments will be maintained in a calibration logbook by field personnel. All instruments are to be stored, transported, and handled with care to preserve equipment accuracy. Damaged instruments will be taken out of service immediately and not used again until a qualified technician repairs and recalibrates the instruments.

Copies of the instrument manuals and other equipment calibration records will be maintained by the Performing Contractor. These records will be subject to QC audit. Any notes on unusual results, changing of standards, battery charging, and operation and maintenance of the field equipment will be included in the calibration logbook.

### 6.3.4 Recordkeeping and Data Management

The following section describes field recordkeeping and data management, including use of field logbooks, data sheets and field forms, and photographs.

#### *6.3.4.1 Field Logbooks*

The Performing Contractor shall maintain field records sufficient to recreate all sampling and measurement activities and to meet all electronic data deliverable (EDD) loading requirements. The requirements listed in this section apply to all measuring and sampling activities. Requirements specific to individual activities are listed in the section that addresses each activity. These records shall be archived in an easily accessible form and made available to the client upon request.

All information pertinent to a field survey and/or sampling will be recorded in project field logbooks and/or on appropriate data sheets. The field logbook may also be a bound book with fixed pages that cannot be removed or may consist of daily field activity forms. Entries will be made in waterproof ink. Entries will be described at an appropriate level of detail so that the situation can be reconstructed without relying on memory. Information to be recorded in field logbooks for all field activities may include, but is not limited to:

- Project name and number.
- Location.
- Date and time.
- Weather conditions.
- Personnel protection levels.
- Identity of people performing field activities.
- Personnel or visitors on the Site.
- General work activity.
- Field activity subject.
- Unusual events or other items pertinent to the history of the investigation.
- Subcontractor progress or problems.
- Communications with the client or others.
- Sampling locations.
- Field measurements.
- Calibration of field equipment and record of calibration standards (e.g., pH standards) expiration dates.
- For field measurement records: (1) the numerical value and units of each measurement and (2) the identity of and calibration results for each field instrument.
- Other field-specific activities not recorded on data sheets.

Each data sheet or the end of each entry in the logbook will be signed or initialed and dated by the person making the entries. All original data recorded in field logbooks, on sample tags, or in custody records, as well as other data sheet entries, will be written with waterproof ink. If an error (e.g., incorrect data or sample depth) is made on the document, corrections will be made simply by crossing a single line through the error (in such a manner that the original entry can still be read) and entering the corrected information. All corrections will be initialed and dated.

#### 6.3.4.2 Data Sheets and Field Forms

Data sheets and/or field forms will be used to document specific field procedures and daily activities. Project-specific data sheets and field forms developed by the Performing Contractor for use on this project will require review and pre-approval by the project coordinator lead(s) prior to conducting associated field activities. Field logbooks or daily field activity forms will be used to document such activities as site reconnaissance. Boring log and monitoring well construction log forms will be used to log soil conditions and drill cuttings during the drilling and construction of wells. Monitoring well development and purging information will be recorded on well development field data sheets and groundwater sampling field data sheets. Water-level measurements will be recorded on a water-level measurement or groundwater sample field data sheet. A CoC record will be used to document transfer of custody procedures. Completed data sheets will be maintained in project files by the Performing Contractor.

#### 6.3.4.3 Photographs

Photographs will be taken of the sampling area, as appropriate, to show the surrounding area, drilling and sampling equipment, and sample activities. The picture number (and roll number, if film is used) will be logged in the appropriate logbook section or on a photograph record form to identify which sampling area is depicted in the photograph. Each sequence of photographs will be identified by taking a photograph of an information sign on the first frame. The information presented below will be written on each sign to identify the pictures contained in the sequence:

- Project.
- Location.
- Photograph number.
- Date.
- Photographer's name.
- Work activity.

## 6.4 LABORATORY OPERATIONS, MANAGEMENT, AND QA PROGRAM

The analytical laboratory selected to perform the analysis under this WPA must meet the State of Washington lab accreditation requirement(s) set forth in the WAC 173-50, including accreditation through the Washington State Environmental Laboratory Accreditation Program (WA ELAP).

The WPA-required sample analyses and associated laboratory analytical program requirements are the same as those specified and discussed in Section 6 of the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b), including laboratory analytical methods and procedures, internal quality control checks, performance and system audits, preventative maintenance and audits and reports. As such, this information referenced above has not been repeated here for brevity. However, these referenced sections will be incorporated either by attachment to this WPA or provided under separate cover for use by the selected analytical laboratory.

Laboratory and field-related corrective actions and data reduction, validation and reporting are discussed as appropriate in the following sections.

## 6.5 CORRECTIVE ACTION AND NON-CONFORMANCE REPORTING

During field and laboratory operations, all activities must be carried out according to the approved WPA and supporting documents as referenced in this plan. The following sections discuss requirements for field and laboratory corrective actions and non-conformance reporting, as appropriate.

### 6.5.1 Field Program Corrective Action

The designated project manager and sampling team members will be responsible to ensure that all procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. If a problem arises, prompt corrective action must be taken. Engineering and scientific calculations will be checked and corrected as required by technical personnel, and as a rule will not require QC reporting.

Any time an error, deficiency or deviation from specified criteria occurs in the field, it is defined as an out-of-control or non-conformance event. A non-conformance may exist if there is a deviation from or a non-compliance with contract specifications or approved procedures. Non-conformance also includes major errors in documented analysis, data, or results, and deficiencies in documentation of any other aspect of the project that may affect the quality of the results. Some examples of non-conformance events that may occur in the field include:

- Field equipment calibration criteria are not met.
- Equipment falls into a monitoring well.
- A sampling location is overlooked and not sampled by the field team.
- Pressure transducer failure during a pump test resulting in lost data.

Field personnel or the subcontractor must take the necessary actions to resolve these events and bring the system back into control. These actions are defined as corrective actions. If deviations from the approved plan occur, the Performing Contractor must repeat the activity according to requirements in the form of a corrective action, and document that the corrective action was effective. Alternatively, if no corrective action is taken, the lack of corrective action must also be documented, and approval must be obtained.

In each of these cases, a decision must be made, communicated to the appropriate individual(s), and documented. The degree of non-conformance, in part, influences the degree to which the communications must proceed up the chain of command, and the nature of the documentation. The degree of non-conformance can be assessed by determining whether the non-conforming event will significantly affect the DQOs associated with the program. In cases where a significant effect to the work scope or project DQOs may occur, and a corrective action is either not planned or is not effective, approval is required along with communications and documentation.

### 6.5.2 Laboratory Program Corrective Action

Problems requiring corrective action in the laboratory shall be documented by the use of a corrective action report. The laboratory QA coordinator or any other laboratory member can initiate the corrective action request in the event QC results exceed acceptability limits, or upon identification of some other laboratory problem.

The type and level of corrective action for laboratory activities will depend on the degree of nonconformity. Corrective action may be initiated and carried out by nonsupervisory staff, but final approval and data review by management is necessary before reporting any information. All potentially affected data must be thoroughly reviewed for acceptance or rejection.

When errors, deficiencies, or out-of-control situations arise, the QA program systematically implements "corrective actions" to resolve the problem and restore proper functioning to the analytical system.

Laboratory personnel are alerted that corrective actions may be necessary if the following are observed with respect to analytical results:

- QC data are outside the acceptable window for precision and accuracy determination.
- QC samples such as the method blank or the LcS contain contamination above previously described acceptable levels.
- Undesirable trends are detected in spike recoveries or in the RPDs between the QC sample and appropriate duplicate sample.
- Unusual changes occur in detection limits.
- Deficiencies are detected by the QA/QC Department during internal or external audits of the laboratory and/or deficiencies are detected from the results of performance evaluation samples submitted by the Performing Contractor.
- Client inquiries are received concerning the quality of laboratory-generated results.

Corrective action procedures can usually be handled by the chemist, who reviews the preparation and extraction procedures for errors and checks the instrument calibration, instrument sensitivity, and ancillary equipment associated with the instrument. If the problem persists or cannot be identified after all possible sources of errors are investigated, the matter is then referred to the supervisor and the laboratory QA manager in the form of a corrective action report. The corrective action report is utilized for documenting the suggested corrective need and the return to control. Additional documentation to support the return to control is located in the associated instrument analysis logbook and the instrument-specific maintenance logbook. Once resolved, the corrective action report is completed describing the corrective action procedure. This report is maintained in a project file. A copy of the completed corrective action report is forwarded to the Performing Contractor's project manager and the data management coordinator.

Recommended holding times for samples are monitored closely. If a sample is analyzed outside a holding time, the corrective action report is used to report any holding time violations. The laboratory QA manager will immediately notify the Performing Contractor's project manager and data management coordinator of the holding time violation by phone, followed up by a hard copy of the completed corrective action report by both facsimile and first-class mail. Samples may be re-collected if holding times are exceeded prior to either extraction or analysis of the environmental sample at no additional cost to the client.

### 6.5.3 Non-Conformance Reporting

Personnel who identify a non-conformance shall immediately report both verbally and in a written report the condition to the Performing Contractor's project manager and/or project QC manager who will review the report. Based on an evaluation of the non-conformance, work on the specific task will stop and corrective actions will be taken. If the non-conformance involves a major deviation from the approved Work Plan which may adversely affect the cost and/or schedule of the work, the client will be notified immediately of the non-conformance. If the non-conformance has adversely affected previously gathered data, the Performing Contractor project manager will also notify the client in writing.

For non-conforming events that may affect project DQOs (i.e., missed critical sampling location), the non-conforming event must be corrected according to project requirements. The project manager will review each event and exercise professional judgment in recommending a course of action. For instance, the most direct corrective action for a missed critical sampling point is to re-sample, in order to satisfy the Work Plan. The proposed course of action (i.e., re-sampling) will be communicated to the project coordinator lead(s) for approval. Documentation of the corrective action must be written and placed in the job file, and may include telephone contact logs, e-mail correspondence, etc. If corrective actions proved ineffective or if no corrective action was taken, the project manager must communicate to the project coordinator lead(s) that the non-conforming event was not corrected and must gain written acknowledgement and acceptance of the non-corrected, out-of conformance event.

## 6.6 DATA REDUCTION, VALIDATION, AND REPORTING

The data reduction, review, reporting, and validation procedures described in this section will ensure that 1) complete documentation is maintained, 2) transcription and data reduction errors are minimized, 3) the data are reviewed and documented, and 4) the reported results are qualified if necessary. Laboratory data reduction and verification procedures are required to ensure the overall objectives of analysis and reporting meet method and project specifications.

Data verification and validation involves the process of generating qualitative and quantitative sample information through observations, field procedures, analytical measurements, and calculations. To help ensure the project DQOs are achieved, the Performing Contractor will monitor all aspects of data gathering as part of the comprehensive RI investigation work effort. The laboratory is required to submit an EDD containing each Sample Delivery Group as a separate computer data file. Each Sample Delivery Group should have data for all environmental results and field QC, as well as all associated lab QC data (e.g., Matrix Spikes, LcS, Method Blanks) for QA/QC review. The laboratory must submit the EDD according to general guidelines established by the Performing Contractor. This data shall be placed in the master project database for subsequent analysis and tabulation.

Data storage and documentation will be maintained using logbooks, data sheets, and computer files that will be kept at the laboratory. All computer-generated raw data are stored on magnetic tape, or other media, and will be maintained along with all paper copies for not less than 5 years.

### 6.6.1 Data Reduction

This section discusses field and laboratory data reduction.

#### *6.6.1.1 Field Data Reduction*

Field measurements and observations will be made and documented during the sampling project. Field data will be recorded on standard forms and in a field notebook to provide a permanent record of field activities.

The Performing Contractor’s project manager and data management coordinator will ensure that all field data forms are evaluated for the factors listed below:

- A check for completeness of field records will ensure that all requirements for field activities have been fulfilled, complete records exist for each activity, and procedures specified in this WPA have been implemented. Field documentation will ensure sample integrity and provide sufficient technical information to recreate each field event.

- Identification of valid samples involves interpretation and evaluation of the field records to detect problems affecting the representativeness of environmental samples. The lithologic and geophysical logs may be consulted to determine stratigraphic variations within the subsurface. Records should note sample properties (e.g., clarity, color, and odor).
- The results of field tests obtained from similar areas will be correlated and the findings documented.
- Anomalous field data will be identified and explained to the extent possible. The significance of anomalous data will be discussed in the technical report.

Data quality checks will be performed during the processing of field data. The purpose of these checks is to identify anomalous data (i.e., data that do not conform to the pattern established by other observations). The principal method of this data assessment will be the performance of routine checks to ensure that data are correctly transcribed, and that identification codes and sampling information matches the corresponding information in the associated field documentation.

#### *6.6.1.2 Laboratory Data Reduction*

Data reduction calculations are part of laboratory SOPs. The first step in laboratory data reduction is data processing. In general, an analyst processes data through:

- Manual calculations of instrument calibration and sample results (typically performed on method-specific bench sheets).
- Manual input of raw data for subsequent computer processing.
- Direct acquisition and processing of raw data by a computer.

Raw data are to be entered in bound laboratory notebooks. The raw data entered will be sufficient to document all factors used to arrive at the reported value for each sample. Regardless of how data processing is done at the laboratory, sufficient documentation is to be presented to allow another analyst to review and check the data.

Laboratory personnel are to conduct a review of both sample and laboratory data. At a minimum, this review will focus on CoC forms, holding times, method calibration limits, method blanks, laboratory-established detection limits, analytical batch control records, including MS/MSD results, corrective actions, formulas used for analyte quantitation, calculations supporting analyte quantitation, and completeness of data.

The check of laboratory data completeness will ensure that: 1) all required samples and analyses have been processed, 2) complete records exist for each analysis and the associated QC samples, and 3) procedures specified in this WPA and referenced supporting documents have been implemented.

### 6.6.2 Data Quality Assessment

The following sections describe laboratory and Performing Contractor data quality review and verification requirements, as well as data validation and reporting.

#### *6.6.2.1 Laboratory*

The laboratory analyst is responsible for the first level of data review. Notes are maintained by the analyst and submitted with each data package. Control charts are generated automatically through an Access program for all methods and analytes. The analyst initiates a discrepancy report, if warranted.

The laboratory supervisor oversees the daily analytical activities of their respective assigned areas. Narrative notes and QC information provided by the analyst are reviewed by the supervisor or peer chemist. All final results are reviewed by a laboratory supervisor.

Initial and continuing calibration curves and any discrepancies are reviewed by the supervisor. The supervisor is responsible for ensuring contractual and technical compliance for samples collected in support of this work effort.

The supervisor reviews and approves the case narrative. The supervisor may be asked to confer with the Performing Contractor's data management coordinator regarding technical issues.

All discrepancies in the initial and calibration verification control criteria are to be reviewed by the laboratory QA manager who is responsible for ensuring contractual and technical compliance for samples received. The laboratory QA manager reviews and approves the case narrative, conducts contractual compliance review of at least 10 percent of the data packages, reviews items in the data package such as calculations, determines if both QC and method criteria have been met, and checks that the proper forms have been used and the control criteria have been adequately described.

The laboratory project manager has final data review and validation responsibilities, including assurance that the final data deliverable is prepared and that permanent data packages are properly maintained. The laboratory supervisor also reviews the data package for completeness and quality and reviews the narrative for accuracy. The laboratory project manager also serves as a liaison between the laboratory and the Performing Contractor, and is responsible for providing the Final data packages, complete with cover letter, to the Performing Contractor.

#### *6.6.2.2 Third-Party Data Validation*

Data validation will be conducted by a qualified third-party data validation subcontractor familiar with the analytes and analytical methods specified for this program. The National Functional Guidelines shall be used as the primary guidance documents for validation purposes. Validation activities will be performed according to the following documents:

- EPA (2017a) Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review.
- EPA (2017b) Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review.

Third-party data validation will include 100 percent of the environmental samples collected for laboratory analysis using the National Functional Guidelines and Stage 2B data validation protocol [Appendix B of the Guidance for Labeling Externally Validated Laboratory Data for Superfund Use (EPA 540-R-08-005)]. EPA Stage 2B data validation will be performed on the summary (i.e., no raw data) packages for analyses of groundwater samples analyzed by EPA and non-EPA methods. The validation of non-Contract Laboratory Program analyses must be performed using the requirements and criteria from the analytical method(s) referenced and WPA. The third-party data reviewer will request any missing information from the laboratory and facsimile a copy of this request to the client’s project manager when missing information is requested. The data reviewer will validate all components of the data package even when an individual QC element has rejected the data. All data will continue through the validation process and be qualified and re-qualified as many times as they fail to meet established criteria. An overall final qualification of results will encompass the impact of individual findings and will be determined using the professional judgment of a senior data reviewer.

Data summary packages provided by the contract laboratory should consist of sample results and QA/QC summaries (equivalent to non-Contract Laboratory Program Forms 1 through XIV for inorganic analyses), and all raw data associated with the sample results and QA/QC summaries.

All data validation procedures will be in accordance with EPA Functional Guidelines requirements (as indicated above) and industry standards. Table 6-7 includes a summary of EPA Level 3 data validation elements for inorganic analysis, including QC review elements, data qualifiers, and data qualifier descriptors.

**Table 6-7**
**Data Validation Elements and Qualification**

| QC Review Elements EPA Stage 2B Validation for Inorganics and Organics | Data Validation Qualifiers | Data Qualifier Descriptors |
|---|---|---|
| • Holding times<br>• Initial calibration<br>• Continuing calibration<br>• Blanks (Laboratory and Field)<br>• Surrogate recovery<br>• MS/MSD recovery<br>• Duplicate sample RPD<br>• LcS recovery<br>• Internal standard performance<br>• ICP interference check<br>• MSA and serial dilution checks<br>• Field duplicate sample analysis RPD<br>• Reporting limits<br>• Overall assessment of data in the sample delivery group | B: The sample result is less than 5 times (10 times for common organic laboratory contaminants) the blank contamination. The result is considered not to have originated from the environmental sample, because cross-contamination is suspected.<br>J: The analyte was positively identified, and the result is usable; however, the analyte concentration is an estimated value.<br>R: The sample result is rejected and not usable for any purpose. The presence or absence of the analyte cannot be verified.<br>U: The analyte was not detected above the method detection limit.<br>UJ: The analyte was not detected above the method detection limit; however, the method detection limit is uncertain and may be elevated above normal levels.<br>Y: Confirmation column results indicate a non-detect for the target analyte. | a: The analyte was found in the method blank.<br>b: The surrogate spike recovery was outside quality control criteria.<br>c: The MS and/or MSD recoveries were outside control limits.<br>d: The LcS recovery was outside control limits.<br>e: A holding time violation occurred.<br>f: The duplicate/replicate sample's RPD was outside the control limit.<br>g: The data met prescribed criteria as detailed in the QAPP.<br>h: The method requires a confirmation result, but none was performed.<br>k: The analyte was found in a field blank.<br>l: The second column confirmation result indicates the analyte was not confirmed.<br>n: The laboratory case narrative indicated a QC problem.<br>p: Professional judgment determined the data should be qualified.<br>q: The analyte detection was below the practical quantitation limits.<br>r: The result is above the instrument's calibration range.<br>t: The temperature was outside acceptance criteria. |

### 6.6.3 Data Reporting

Project data reporting, including hardcopy and electronic data submittals, format conformance, and delivery of final analytical data is discussed in the following sections.

#### *6.6.3.1 Hardcopy Data Submittals*

Hardcopy data reporting package requirements are outlined below. All hard copy submittals will be signed by the Laboratory Director certifying that the data provided therein is correct and is suitable for its intended use. Each data package must stand alone analytically and must not rely on other data packages for QC completeness.

Final hard copy reports from the laboratory will include at least the following elements:

- A copy of the signed CoC form showing the date and time the sample was received.
- A cross-reference of field sample number to laboratory sample number.
- A cross-reference to identify applicable laboratory QC samples with the field samples.
- A cross-reference to identify each batch to the QC samples.
- A glossary to define the symbols and terms used in the laboratory report.
- Sample collection, extraction, and analysis dates.
- Sample receiving temperature.
- A list of detection limits, including reporting limits and method detection limits.
- Instrument identification number for the tests performed.
- Instrument calibration summary data to verify that initial and continuing calibration criteria are in control.
- The analytical results for all detected and non-detected QAPP target analytes.

The definitive data package will include a QA/QC summary report, providing data on method blanks, LcS, MS/MSDs, and any other QA/QC samples relevant to all initial, diluted, or re-analyzed samples. The QA/QC report will also contain a narrative that details all elements relevant to the sample results for both inorganic and organic analyses. The narrative will discuss each element; whether the element was acceptable or not and why; if outside acceptance criteria, the value and the criteria will be noted; corrective action taken; and the effect any problems had on the quality of the data.

#### 6.6.3.2 Electronic Data Submittals

Laboratory services providers will report all data in electronic and hard copy format. The electronic data will be reported as EDDs in a format specified by the Performing Contractor. Hard copy data will be reported in the Data Package format and using summary forms.

A QA/QC summary report, providing data on method blanks, LcS, MS/MSDs, and any other QA/QC samples relevant to all initial, diluted, or re-analyzed samples will be provided. The QA/QC report will also contain a narrative that details all elements relevant to the sample results for both inorganic and organic analyses. The narrative will discuss each element; whether the element was acceptable or not and why; if outside acceptance criteria, the value and the criteria will be noted; corrective action taken; and the effect any problems had on the quality of the data.

The results of all initial, diluted, and re-analyzed sample analyses for will follow the guidelines presented above for the EDDs.

#### 6.6.3.3 Format Conformance with Agencies

In determining EDD format, the Performing Contractor must be aware that EDDs should conform to the formatting requirements of other agencies. The EDD format and content must be sufficient to meet the data delivery requirements to Ecology's Environmental Information Management System (EIMS). The Performing Contractor's Statement of Work will specify the project electronic formatting requirements. Project-specific QAPP addenda will further identify electronic requirements to support regulatory agency databases, as required.

#### 6.6.3.4 Formatting Conformance with Performing Contractor

Data generated during sampling activities will be incorporated into an electronic database. A GIS may be utilized as a tool to aid in the graphical presentation and interpretation of physical and analytical data collected during sampling activities. The Performing Contractor shall provide the laboratory with an SOP for data generation that includes instructions regarding data review for consistency and status, and maintenance of magnetically stored data to ensure integrity. Electronic laboratory data are delivered to the Performing Contractor in EDDs and formats for use with GIS data (as applicable).

Hard copy data reports will be provided to the client in various formats depending on contract and end user requirements.

#### *6.6.3.5 Delivery of Final Analytical Data to Ecology*

Within ninety (90) days following receipt of the final data reports from the laboratories, all verified field data, validated analytical results, QA/QC sample results and associated sample location and project descriptive information shall be submitted to Ecology.

EIMS is the Department of Ecology's main database for environmental monitoring data and contains records on physical, chemical, and biological analyses and measurements. Supplemental information about the data (metadata) is also stored, including information about environmental studies, monitoring, and data quality.

As specified in the Agreed Order (Ecology 2014), new sampling data collected in support of the WPA field effort will be entered into EIMS in accordance with WAC 173-340-840(5) and Ecology's Toxic Cleanup Program Policy 840: Data Submittal Requirements. Only validated data will be entered into the EIMS database.

# Section 7
# Health and Safety

A remedial investigation Health and Safety Plan (HASP) was prepared for the former Columbia Gorge Aluminum Smelter site in Goldendale, Washington, as dated October 2015 (Tetra Tech 2015). The HASP was designed to provide for a safe working environment for on-site field personnel during planned work activities. The goal of this HASP is to prevent and minimize personal injuries; illnesses; and damage to equipment, supplies, and property. The HASP will be reviewed and updated as appropriate prior to the initiation of WPA field activities.

All proposed investigation activities in support of the WPA are covered by the October 2015 HASP, with copies available at the project site. The emergency contact information in Table 11-1 of the HASP will be modified to include changes in key project personnel since the time the plan was originally prepared.

Lockheed Martin and NSC consultants and their subcontractors will check-in at the facility office at the beginning of each day to discuss ongoing site activities. Daily health and safety tail gate meetings will be implemented at the job site during the WPA field work effort. Records regarding health and safety training and health and safety-related field monitoring will be maintained by the field manager or his designee at the job site in accordance with HASP-specification.

Onsite workers must also comply with Lockheed Martin, NSC, as well as corporate guidelines regarding safe work practices during the COVID 19 epidemic. These guidelines and procedures will be clearly identified in the updated HASP.

# Section 8
# Cultural Resources

A Cultural Resources Monitoring Protocol (CRMP) was developed for use in completing the RI field activities and included as Appendix B of the Final RI Phase 2 Work Plan (Tetra Tech et al. 2015b) The CRMP was prepared and will be implemented consistent with Washington State Department of Archaeology and Historic Preservation guidance (DAHP 2010). This protocol will be used to help locate, identify, document, and report potential cultural resource artifacts at the Site, if encountered during the course of the planned WPA field investigation activities.

A copy of the CRMP will be available at the project site during the WPA field work effort. The CRMP reporting contact information will be modified to include changes in key project personnel since the time the plan was originally prepared.

# Section 9
# Reporting

The Agreed Order specifies that implementation of the WPA will begin within thirty (30) days of Ecology approval of the WPA. A Revised Draft RI Report incorporating the findings of the WPA investigation effort will be submitted within sixty (60) days of completing the WPA RI field activities as specified in the Agreed Order. The conclusion of field activities milestone has been defined in this WPA based on receipt of all validated laboratory data and survey reports. A Draft Final RI Report will be submitted within forty-five (45) days of receiving Ecology's written comments on the Revised Draft RI Report, in accordance with Agreed Order specification (Ecology 2014).

The laboratory analytical results associated with the WPA field investigation will undergo third-party data validation as previously discussed in this plan. Within ninety (90) days following receipt of the final validated data reports, all verified field data, validated analytical results, QA/QC sample results and associated sample location and project descriptive information will be submitted electronically to Ecology's EIMS database in accordance with the Agreed Order (Ecology 2014).

A preliminary schedule for completion of the WPA, WPA field investigation work, Revised Draft RI Report, and Draft Final RI Report is provided in Section 10.

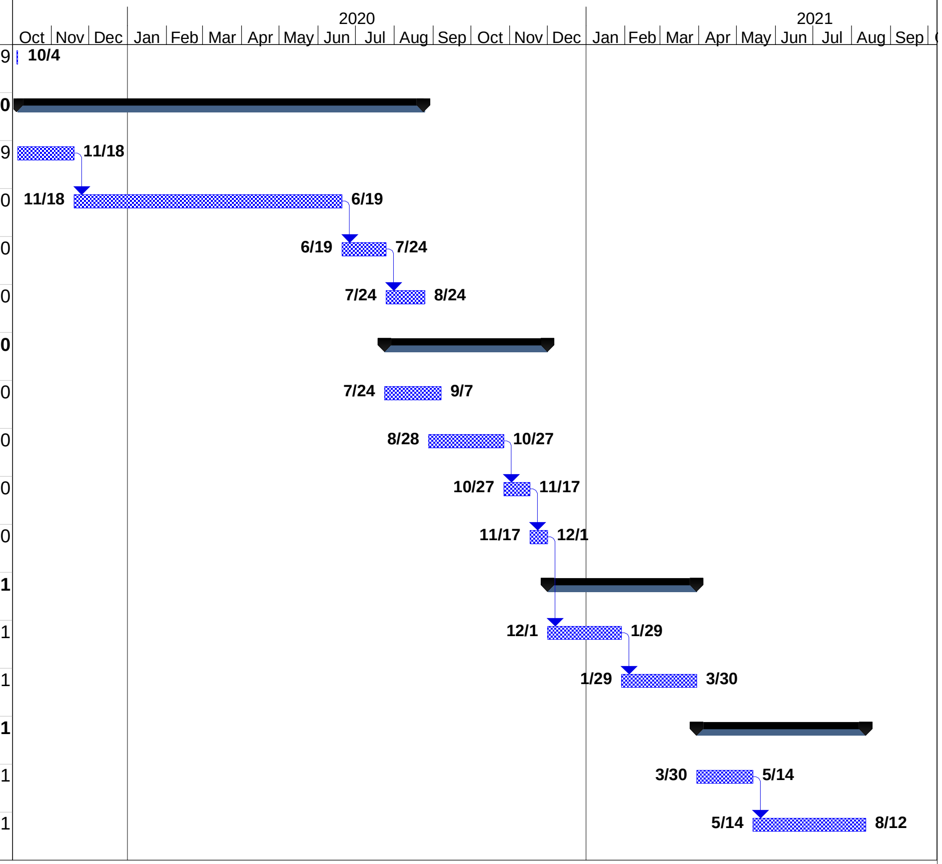
# Section 10
# Schedule

The Final WPA is required for delivery to Ecology on or before July 24, 2020. A preliminary schedule for completion of the WPA, WPA field investigation work, Draft Final RI Report, and Final RI Report is provided as Figure 10-1. The preliminary schedule includes the following milestones:

- Delivery of Draft WPA to Ecology on November 18, 2019.
- Ecology approval of the WPA assumed by August 24, 2020.
- WPA-related permitting and access agreements by September 7, 2020.
- Completion of WPA field investigation activities, including laboratory analysis and data validation by December 1, 2020.
- Submittal of Revised Draft RI Report to Ecology by January 29, 2021.
- Submittal of Draft Final RI Report to Ecology by May 14, 2021.
- Ecology approval of the Final RI Report by August 12, 2021.

## Figure 10-1
## Work Plan Addendum and Final RI Report Schedule
## Columbia Gorge Aluminum Smelter Site
## Goldendale, Washington

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | **Notice to Proceed** | 1 day | Fri 10/4/19 | Fri 10/4/19 |
| 2 | **Prepare Work Plan Addendum** | **325 edays** | **Fri 10/4/19** | **Mon 8/24/20** |
| 3 | -Submit Draft WPA to Ecology | 45 edays | Fri 10/4/19 | Mon 11/18/19 |
| 4 | -Ecology Draft WPA Review and Comment | 214 edays | Mon 11/18/19 | Fri 6/19/20 |
| 5 | -Respond to Comments and Submit Final WPA | 35 edays | Fri 6/19/20 | Fri 7/24/20 |
| 6 | -Ecology Approval of Final WPA | 31 edays | Fri 7/24/20 | Mon 8/24/20 |
| 7 | **Complete WPA Field Investigation** | **130 edays** | **Fri 7/24/20** | **Tue 12/1/20** |
| 8 | -Permit Authroizaton for Work on USACE and/or BPA Property | 45 edays | Fri 7/24/20 | Mon 9/7/20 |
| 9 | -WPA Field Investigation | 60 edays | Fri 8/28/20 | Tue 10/27/20 |
| 10 | -Final Laboratory Analysis | 21 edays | Tue 10/27/20 | Tue 11/17/20 |
| 11 | -Final 3rd Party Data Validation | 14 edays | Tue 11/17/20 | Tue 12/1/20 |
| 12 | **Revised Draft Final RI Report** | **119 edays** | **Tue 12/1/20** | **Tue 3/30/21** |
| 13 | -Submit Revsied Draft Final RI Report to Ecology | 59 edays | Tue 12/1/20 | Fri 1/29/21 |
| 14 | -Ecology Revised Draft Final RI Report Review and Comment | 60 edays | Fri 1/29/21 | Tue 3/30/21 |
| 15 | **Final RI Report** | **135 edays** | **Tue 3/30/21** | **Thu 8/12/21** |
| 16 | -Submit Draft Final RI Report to Ecology | 45 edays | Tue 3/30/21 | Fri 5/14/21 |
| 17 | -Ecology Approval of Final RI Report | 90 edays | Fri 5/14/21 | Thu 8/12/21 |




Project: Goldendale
Date: 10/18/19

Task | Milestone | Summary | External Milestone

## Section 11
# References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# Appendix A-1

# Response to Comments on Draft WPA

**Ecology Comments on the Draft Work Plan Addendum**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**

**General Comments:**

1. **Identification and control of on-going sources of soil-to-groundwater impacts is a priority under the Model Toxics Control Act cleanup process. Ecology is very interested in ensuring we adequately define areas at this site where we have contaminants that exceed screening levels for protection of groundwater that come into contact with shallow groundwater.**

**Response:** The Work Plan Addendum (WPA) includes work elements to address additional characterization of soil-to-groundwater impacts. Areas with soils exceeding soil to groundwater screening levels that did not have downgradient shallow groundwater sampling locations are prioritized for additional deeper soil sampling and/or groundwater sampling.

Additional figures have been prepared to more clearly show the vertical extent of soil contamination (refer to attached Figure package). The figures show the distribution of chemical concentration in soil for selected key chemicals (fluoride, sulfate, gasoline-range total petroleum hydrocarbons (TPH), diesel-range TPH, motor-oil range TPH, and total toxicity equivalent concentration (TTEC) carcinogenic polycyclic aromatic hydrocarbons (cPAHs) for selected depth ranges (0-1 feet below ground surface [ft bgs]), 1-2 ft bgs, 2-6 ft bgs, 6-10 ft bgs, and greater than 10-ft bgs. For the two deepest depth ranges (6-10 ft bgs and greater than 10 ft bgs), groundwater results for wells in the former plant area footprint are included to facilitate comparison.

The figures have been divided into sets for convenience and ease of review as follows:

- Figure Set 1 (Figures 1-1, 1-2, and 1-3) shows soil station location included in the evaluation and the proposed WPA investigation areas. For the selected chemicals (fluoride, sulfate, TPH constituents, and TTEC cPAHs), the complete RI Plant Area Area of Concern (PAAOC) soil data set, the Rectifier Yard AOC (RYAOC) data set, as well as solid waste management units (SWMUs) in the former plant area data footprint have been included.

- Figure Set 2 (Figure 2-1 through 2-5) shows the distribution of fluoride in soil with depth. Fluoride soil results were compared against Model Toxics Control Act (MTCA) derived soil screening levels for groundwater protection of 147.6 milligrams per kilogram (mg/kg) and 615 mg/kg, respectively that are based on the MTCA Method B groundwater formula value of 0.96 milligrams per liter (mg/L) and the 4.0 mg/L Maximum Contaminant Level (MCL), respectively.

- Figure Set 3 (Figures 3-1 through 3-5) shows the distribution of sulfate in soil with depth. Sulfate soil result were compared against MTCA-derived soil screening level of 2,150 mg/kg that is based on the Secondary MCL of 250 mg/L.

- Figure Set 4 (Figures 4-1 through 4-5) shows the distribution of gasoline-range total petroleum hydrocarbons (TPH) in soil with depth. Gasoline-range TPH results were compared against the MTCA Method A Soil Unrestricted Land Use Cleanup Level of 0.30 mg/kg that is for sites where benzene is detected. Groundwater concentrations were compared with the MTCA Method A Groundwater Cleanup Level of 0.8 mg/L for sites where benzene is detected.

- Figure Set 5 (Figures 5-1 through 5-5) shows the distribution of diesel-range TPH in soil with depth. Diesel-range TPH soil results were compared against the MTCA Method A Soil Cleanup Level for Unrestricted Land Use that is based on prevention of accumulation of free product on the water table. Groundwater concentration were compared against the MTCA Method A Groundwater Cleanup Level of 0.5 mg/L.

- Figure Set 6 (Figures 6-1 through 6-5) shows the distribution of motor oil-range TPH in soil with depth. Motor oil-range TPH soil results were compared against the MTCA Method A Soil Cleanup Level for Unrestricted Land Use that is based on prevention of accumulation of free product on the water table. Groundwater concentrations were compared against the MTCA Method A Groundwater Cleanup Level of 0.5 mg/L.

- Figure Set 7 (Figures 7-1 through 7-5) shows the distribution of TTEC cPAH in soil with depth. TTEC cPAH soil results were compared against MTCA soil screening level for groundwater protection of 3.9 mg/kg that is based on the MTCA Method B Groundwater Cleanup Level of 0.2 micrograms per liter (µg/L), which also represents the MCL.

New areas of WPA investigation have been identified and are shown on Figure 1-3 including the following: the SB-FW01 area near the stud repair area and rail lines, the North and South Potliner Soaking Stations area (SWMUs 10 and 11), the SB-SE08 Area, the SB-SE17 area located within the East End Landfill (EELF) (SWMU 17) footprint, and the SB-SE18 area.

In addition, to resolve the Ecology’s outstanding concerns regarding the potential occurrence of petroleum hydrocarbons in groundwater, a single round of groundwater sampling for TPH constituents is proposed for shallow wells in the Plant Area footprint including a total of 30 wells (16 unconsolidated aquifer [UA] zone wells and 14 basalt aquifer upper [BAU] zone wells). These wells will also be sampled for fluoride and sulfate to facilitate comparison with the newly installed wells. Of these wells, 5 of the UA aquifer zone wells have typically been dry and not available for sampling.

The investigation boundary and scope of work for the Crucible Cleaning Room Area has also been expanded (refer to Figure 1-3 of Figure Set) to address additional areas with documented and suspected fluoride soil contamination. Some of the other investigation boundaries originally presented within the Draft WPA have also been refined based on the evaluation of the newly prepared soil maps and further consideration of the comments provided by Ecology and the Yakama Nation.

2. **There are a number of areas where the extent of soil contamination appears to be unbounded vertically. Ecology understands that work is underway to provide additional figures to better illustrate our current understanding in this regard.**

**Response:** As noted in Comment Response #1, additional figures have been prepared to more clearly show the vertical extent of soil contamination. Based on review of these figures, five additional locations have been identified for further investigation: 1) the SB-FW01 area near the stud repair area and rail lines; 2) the North and South Potliner Soaking Stations area (SWMUs 10 and 11); 3) the SB-SE08 Area; 4) the SB-SE17 area located within the East End Landfill (EELF) (SWMU 17) footprint; and 5) the SB-SE18 area. These additional locations are discussed in the Response to Comments #1 and #29.

3. **There are a number of areas in the PAAOC where the horizontal extent of soil contamination appears to be unbounded. If additional delineation of these areas is not proposed in this WPA, ensuring that we adequately define and address the full horizontal extent of impacts will need to be addressed in future phases of the cleanup. Leaving this work until later steps may create uncertainty for redevelopment proposals in the interim.**

**Response:** Additional figures have been prepared to better show the horizontal extent of soil contamination at the Plant Area Area of Concern (PAAOC) footprint and its potential impact to shallow groundwater, and the additional soil and groundwater sampling that has been proposed in the WPA will help address this concern. Additional areas of investigation and more comprehensive Courtyard sampling have been proposed that should adequately define the extent of the horizontal and vertical extent of soil contamination.

The figure sets show that shallow (0-1 ft bgs) soil contamination is widespread and the lateral extent of soil contamination significantly decreases with depth. The shallow soil contamination in the PAAOC has always been planned to be addressed in the Feasibility Study (FS). The emphasis has been on collection of enough data to support adequate volume and cost estimation. For example, Comprehensive Environmental Response Compensation and Liability Act (CERCLA) guidance include a +50 percent and -30 percent accuracy level for estimation. This guidance supports the idea of wider step-outs for characterization as has been adopted in the revised approach for the Intermittent Sludge Disposal Ponds (SWMU 3). Further refinement of the horizontal extent of contamination is planned to be addressed as necessary and appropriate during the remedy design and/or remedy implementation phase of the project potentially as pre-excavation and confirmation sampling.

The revised WPA will include a decision tree, so next-step decisions can be made in the field during one mobilization. The field approach will include use of accelerated turnaround of laboratory results and field screening method in some areas. A general field decision tree is presented in Figure A-1. These additional investigation approaches are described in Comments #22 through #30 below.

4. **While Ecology understands that each party has identified areas where they are taking the lead for the RI, Ecology recommends that the PLPs work to better coordinate their data sharing, management and visualization efforts. Not only will this help make review**

**of submittals much more efficient—it will also help build Ecology's confidence that the work is being coordinated and that the interrelationships between the various study areas (PAAOC soil and groundwater for example) are being considered and adequately addressed.**

**Response**: Comment acknowledged. Additional data sharing and data assessment is ongoing as part of preparation of additional figures for the PAAOC footprint and was used to develop the revised scope of work for the WPA.

5. **It appears that not all figures reflect the updated PAH values. Please ensure that the information presented on figures accurately reflect the applicable screening levels. All figures should note which Method A numbers they are referencing—industrial or unrestricted.**

   **Response:** The additional PAAOC figures have been revised to include the updated soil polycyclic aromatic hydrocarbon (PAH) values for groundwater protection since that is one of the main issues presented in Ecology's comments. The PAH terrestrial ecologic soil screening levels have not been included for this effort because the use of the screening levels will require calculation of total low-molecular weight (LMW) and high molecular-weight (HMW) PAHs for the entire soil data set. Our intention was to include revised screening level exceedance maps in the Revised Draft RI Report, rather than in the WPA. For diesel-range TPH and a few other chemicals, the MTCA Method A industrial and unrestricted land use values represent the same numerical value and are based on groundwater protection. In the Draft RI, MTCA Method A soil screening levels were based on an industrial land use scenario, which includes groundwater protection for specific constituents.

**Specific Comments:**

6. **Section 2.1. Paragraph on top of page 2-4 does not accurately capture Ecology's position. Ecology's position is that in order for industrial land use screening levels to be used, the property must be both zoned for industrial and a restrictive covenant must be able to be recorded. A restrictive covenant may not be possible for areas not owned by NSC.**

   **Response:** The text will be revised to reflect Ecology's position as stated in the comment.

7. **Section 3.1.3. Suggest adding a sentence describing why the SMS is relevant in this WPA in relation to sampling inundated areas of wetlands.**

   **Response:** The text will be revised to describe how the Washington State Sediment Management Standard (SMS) is relevant to sampling inundated wetland areas.

8. **Table 3-2. Arsenic and selenium MCLs are incorrect.**

   **Response**: The Table will be reviewed, and the values corrected accordingly.

9. **Table 3-3. Why no MCLs listed for surface water?**

**Response:** Table 3-3 was substantially revised in the WPA to address prior Ecology and Yakama Nation comments on the Draft RI Report and the inclusion of MCLs was not mentioned in earlier comments regarding the surface water screening levels. MCLs are not specific to surface water and are the same as for groundwater. The Table will be revised to include the MCLs.

10. **Section 3.4.1. The text describes a proposal to develop a risk-based screening level for sulfate. Please note that the MCL will remain an ARAR.**

**Response:** The Secondary MCL for sulfate of 250 mg/L will be retained for use as a screening level in the RI. Risk-based screening levels for sulfate will also be developed for comparison, and recommended cleanup levels will be proposed in the FS.

11. **Section 3.4.4. Please further explain the intent of the language on 3-16 regarding "separate work plan addendum". Do you mean that if you believe that other TEE screening levels are warranted, you may propose additional field work to support site specific screening level development?**

**Response:** If further evaluation and/or literature search suggest additional field data collection is needed to support additional screening-level development, additional field work and chemical analyses (e.g., bioassays) may be proposed in a separate work plan addendum.

12. **Section 4.2.1. NPDES Ponds C&D receive flow from Ponds A&B which appear to have become re-contaminated. Ponds C&D are also located on land either not currently zoned for industrial use or where a restrictive covenant may not be possible and therefore are subject to unrestricted land use assumptions. Given this, additional sampling to determine whether Pond C&D have become re-contaminated above applicable screening levels appears to be warranted.**

**Response**: Agreed. Additional sampling of Ponds C&D will be proposed in the Revised WPA.

13. **Section 4.2.2. Given the results presented in the draft RI, it appears that additional samples of the unlined ditch are warranted downstream of the bypass channel.**

**Response:** This ditch is completed in basalt bedrock and was remediated during the 2010 removal action. Based on site reconnaissance, little to no sediment accumulation has occurred in this area. The WPA will be revised to include reconnaissance of the ditch and sampling of Ponds C/D in response to Ecology comments # 12 and #13.

14. **Section 4.3.1. Section 4.3 states that previous sampling showed 28 of 36 lateral extent samples collected from outside the excavation limits exceeded the MTCA Method A CUL for unrestricted land use. The intent of the sampling effort is not clear given the limited proposed sampling density and previous sampling results. For example, there is**

**one transect of four samples proposed for former Deposit M—a feature nearly 2000' in length.**

**Response:** The lateral extent samples were collected prior to the removal action and used in planning to determine the preliminary extent of contamination above MTCA Method A Industrial Soil Cleanup Levels. It is unclear precisely how the lateral extent samples were positioned with respect to the final excavation boundaries. The intent of the sampling is to verify contaminant concentrations near the excavation boundaries. The assumption is that the PAH concentration should decrease moving away from the edge of excavations if the contamination is directly related to a specific deposit that was not adequately excavated. If there are widespread exceedances, it would suggest potential for area-wide contamination that may necessitate different additional sampling strategies.

To provide better coverage, additional transects are proposed at deposits M1 and M3. The spacing of the outer transect samples will be increased from 50 feet from the edge of the excavation to 75 feet from the edge of a given excavation. In response to a comment by the Yakama Nation (Yakama Nation Comment #14), select samples will be collected from areas identified during the proposed site reconnaissance that appear to show a white-gray tonal signature to determine if areas of potential soil discoloration are related to smelter waste disposal. We note that aerial photos shortly after the excavation activities also show a similar tonal signature and may be areas where bedrock was exposed when waste and sediments were excavated.

If additional areas of potential contamination are discovered during site reconnaissance at this site, they will be reported and added to the sampling program.

15. **Section 4.3.2. What is max depth of grab surface samples?**

**Response:** The depth of grab surface samples is 0 to 0.5 feet.

16. **Section 4.5.2. What confirmatory sampling data do we have from removal of wastes from the former North, West and South Intermittent Ponds?**

**Response:** The North, West and South Intermittent Ponds were remediated as part of the Ecology-approved Resource Conservation and Recovery Act (RCRA) closure of the East Surface Impoundment (ESI) in 1987. Based on post-closure plan documentation, soils from these low-lying areas were excavated and placed in the area now under the ESI cap and the areas were backfilled. The post-closure plan did not identify presence of waste disposal activities in the three pond areas. During operation of the ESI, water accumulated in the three ponds with subsequent evaporation leaving some precipitates. The accumulated materials were excavated over two seasons and these materials were placed in the ESI. Soil confirmation samples in these areas have not been identified to date; however as previously stated these areas were remediated and part of the Ecology-approved closure of the ESI.

17. **Section 4.5.2. Text says that confirmation samples from the unauthorized interim action are below MTCA industrial/groundwater protection screening levels. What about the other applicable screening levels for this area?**

**Response**: MTCA industrial/groundwater protection screening levels were used in screening of this area as was routinely done during preparation of the Draft RI Report. This approach is justified as much of the excavation area was within the fence-line for the ESI, a closed RCRA SWMU that is part of the plant industrial footprint and is zoned industrial. Consistent with Ecology comment 6, restrictive covenants will be put in place in all areas where MTCA Method A or C Industrial Cleanup Levels are adopted. The remaining portion of the excavation area outside the fence-line is also zoned industrial and is within the BPA utility corridor and the industrial/groundwater protection screening levels appear appropriate for this area.

Comparison with terrestrial ecological screening levels show that one of five confirmation samples collected from within the excavation (confirmation sample ESI-CONF01) appears to exceed the 1,100 micrograms per kilogram (µg/kg) screening level for HMW PAHs. See response to Yakama Nation Comment #9 for a summary of how terrestrial ecological soil screening levels will be calculated.

18. **Section 4.5.2.2. How will the reconnaissance/inspection of areas within 500' of the soil excavation area be conducted? Transects? Grid?**

**Response:** This specific area will be informally gridded out and transects will be walked and inspected by foot along a series of north-south and east-west oriented transects at an approximately 175-foot spacing.

19. **Figure 4-19. Please explain here or in the appropriate sections how the locations and density of wells/sample points were chosen. Were the existing wells RI-MW8, MW-E1A, MW-E7, RI-GW5 or RI-GW7 considered for sampling for TPH? Why or why not?**

**Response:** During the RI planning process, TPH was included in the analytical program for a subset of wells located in areas with a higher potential for TPH-handling, storage, or releases. Based on historical data collected at the site and process knowledge, total petroleum hydrocarbons are not one of main chemicals of potential concern for groundwater at the site. Figures showing the screening level exceedances of TPH compounds are attached (refer to Figure Sets 4, 5, and 6).

The specific rationale for exclusion for these wells from TPH sampling during the RI is summarized as follows:

1. RI-MW8-BAU is located between the North and South Potliner Soaking Stations (SWMUs 10 and 11) and the East SPL Storage Area (SWMU 12). Sampling of the well was intended to characterize concentrations of spent potliner (SPL)-related chemicals (e.g., fluoride, cyanide, PAHs) in this area in the BAU aquifer zone.

2. MW-E1A is completed in the shallow UA aquifer zone and is located along the southwest margin of the East End Landfill. This well was installed prior to the RI and historically sampled for TPH constituents and none were detected (see TPH groundwater Figure and

Table provided in the February 5, 2020 response to Ecology's January 9, 2020 information request).

3. MW-E7 is in the northeast corner of the plant area. The well was installed pre-RI as an upgradient well for investigation of the North and South Potliner Soaking Station. This well was installed prior to the RI and historically sampled for TPH constituents and none were detected (see groundwater TPH Figure and Table provided in the February 5, 2020 response to Ecology's January 9, 2020 information request).

4. RI-GW5 is a shallow temporary well located at the Line A Secondary Scrubber Recycle Station (SWMU 5) and this well was installed to assess potential groundwater releases from this unit. TPH was not considered to be a groundwater chemical of potential concern (COPC) at this location based on past waste handling practices.

5. RI-GW7 is a shallow temporary well located near the Lines B, C, D Secondary Scrubber Recycle Station (SWMU 6) and the Tertiary Treatment Plant (SWMU 8) and this well was installed to assess potential groundwater releases from this area. TPH was not considered to be a likely groundwater COPC in this area based on past waste handling practices.

To resolve the Ecology's outstanding concerns regarding the potential distribution of petroleum hydrocarbons in groundwater, a single round of groundwater sampling for TPH constituents is proposed for shallow wells in the Plant Area footprint including a total of 30 wells (16 UA zone wells and 14 BAU zone wells). These existing wells will also be sampled for fluoride and sulfate to facilitate comparison with the newly installed wells. Of these existing wells, 5 of the UA aquifer zone wells have typically been dry and will probably not be available for sampling.

**20. Section 4.7. Wetlands I, J, M are not on NSC property and a restrictive covenant is likely not possible. Samples from Wetlands I and J show levels of PAHs above applicable screening criteria for non-industrial exposure scenarios. Each of these wetlands should also be further characterized.**

**Response:** Wetland areas I, J, and M are small (0.072 acres, 0.464 acres, and 0.187 acres, respectively) and characterized by relatively low wetland functions, and therefore a single soil sample was collected from each wetland. For the purposes of the RI and FS, our intent is to assume that the surface soils (surface to 0.5 foot) in wetland areas I and J exceed Ecology's recommended soil screening levels for PAHs over the entire wetland area. No further soil sampling is planned.

**21. Sections 4.7.1. and 4.7.2. Recommend elaborating in section 4.7.1 and 4.7.2 on any distinction between soil and sediment samples. Will there be any difference in how the samples are collected or analyzed? See comment on Section 5.**

**Response:** There is no distinction between soil and sediment samples from a sampling perspective. Both are proposed to be collected with a hand auger or spoon depending on lithology as was previously done during RI sampling at the Wetlands AOC and elsewhere.

22. **Section 4.8. In addition to specific areas discussed elsewhere in the comments on the PAAOC, there appear to be areas not identified for further investigation which indicate impacts above applicable screening levels that Ecology believes warrant additional evaluation.**

a. Groundwater TPH. Provide information to demonstrate how the proposed sampling locations for TPH in shallow groundwater address potential impacts in areas where TPH exceeds screening levels in soil.

**Response**: All areas with TPH contamination at depth have been addressed by the proposed PAAOC WPA investigations, other proposed WPA investigations, and the proposed groundwater sampling effort in the WPA. Additional figures have been prepared to better show the distribution of TPH and other selected groundwater COPC with depth. As noted elsewhere, a round of groundwater sampling for TPH constituents has been included for existing shallow wells (UA aquifer zone and BAU aquifer zone wells) in the former plant area footprint in addition to proposed TPH sampling at newly installed wells and groundwater borings.

b. It appears that contamination at SB-UST04 is not adequately delineated. The adjacent borings do not appear to be deep enough to delineate lateral extent of petroleum impacts.

**Response**: Soil contamination at this location (SB-UST04, which represents the same location as well RI-GW6) is in a petroleum smear zone near the top of water table. Wells RI-GW8 and RI-GW9 were subsequently drilled down gradient of RI-GW6 to the southwest and south to investigate the lateral extent of petroleum contamination in soil and groundwater associated with the former Compressor Building underground storage tank (UST). This site has already been proposed to be carried forward into the FS for evaluation of soil and groundwater remedies. Additional data and monitoring needs will be addressed during the design and remediation phase of the project.

c. Soil screening level exceedances are unbound for depth in several locations. For example, in vicinities of TP-T9B, TP-T9C, TP-T13B, TP-18A, TP-18B, TP-18C. The WPA should describe how vertical delineation of impacts is being addressed and ensure that potential groundwater impacts for all COCs are identified in these areas.

**Response:** A revised and more comprehensive investigation approach for further delineation of vertical extent of soil contamination in the plant courtyards is proposed. Each soil boring and test pit completed in courtyard segments during the RI has been evaluated and where the vertical extent of contamination was not determined, then additional sampling at that location is proposed. The attached Table A-1 specifies where additional sampling is proposed for transformer substations and sampling locations. Based on results of the RI, most soil contamination in the courtyards is associated with a layer of black soil in the upper 2 to 3 feet, therefore 4 feet was a common proposed depth of additional sampling for vertical extent. Other depths are proposed based upon the depth of RI sampling. Areas where soil contamination occurs at depth and represents a potential for impact on shallow groundwater are addressed in other subsections in WPA Section 4.8, and briefly described under following comment responses.

The vertical extent of soil contamination at locations TP-T9B and TP-T9C will be addressed as indicated in Table A-1, discussed above, which includes all undefined vertical extent in soil in courtyard segments. No further investigation is proposed for locations TP-13B, TP-T18A, TP-T18B, and TP-T18C since they are not located in courtyard segments, but in areas of the south plant where vertical extent has been defined and no potential impact to shallow groundwater was identified.

For the TP-13 and TP-T18 areas, the new Figure 7-3 of the attached figure set depicts one location where cPAH concentrations that exceed protection of groundwater screening levels in the depth interval 2 to 6 ft bgs that is associated with the briquette storage slab. Figure 7-4 of the attached figure set identifies cPAH concentrations that exceed protection of groundwater screening levels in the depth interval >6 ft bgs shows no locations that exceed protection of groundwater screening levels. Figure 7-5 of the attached figure set shows borings in the area of TP-T13A/B/C were completed at depths ranging from 11.5 to 16.5 ft bgs, and cPAHs were not detected in shallow groundwater downgradient from this area above the Method B screening level of 2 mg/L

**23. Section 4.8.1.1. Why only two samples per courtyard when 5 test pits are proposed? The proposed test pits are only up to 2 feet in depth. This may not be sufficient to determine depths of impact. The test pits should extend to the depth of visual impact up to some reasonable maximum depth. If visual impacts exist still exist at that maximum depth, a sample from the bottom of the test pit should be collected.**

**Response:** A revised and more comprehensive investigation approach for courtyard soil is proposed and described under the previous comment 22c.

**24. Section 4.8.1.2. Ecology agrees that additional characterization is needed in this area and that the proposed work will provide useful information. However, it is unlikely that three borings each 150+' away from SB-CU01 will be sufficient to understand the source of the contamination at depth. The options to address this could include: 1) plan a greater number of borings initially and hope the information gathered is definitive; 2) gather the information as described with the assumption that another Work Plan Addendum will likely be needed based on the results; or 3) propose an approach in this Work Plan Addendum that includes a decision tree to include supplemental sampling based on results of initial sampling.**

**Response:** A revised investigation approach for the Crucible Cleaning Room area is proposed that incorporates an iterative approach to define the horizontal and vertical extent of fluoride and sulfate contamination in soil and shallow groundwater. Figure A-1 shows a decision tree that will guide the field decisions on the need for additional step-out borings and selection of groundwater sampling requirements and well installations. This investigation will be conducted with a single mobilization of drilling equipment and will utilize expedited lab turnaround analyses and/or field analyses of water and soil extracts with a fluoride ion-selective electrode.

Soil boring SB-CU01 is the location where fluoride has been detected in soil at the highest concentrations and the deepest depth. Soil boring SB-BH03 is the location where sulfate has been detected in soil at the highest concentrations and the deepest depth. The vertical extent of fluoride exceedance of screening level has not been defined at SB-BH02. An initial step would be to complete four soil borings (SB-CU02 through SB-CU05) to the east, west, and south of SB-CU01 and one boring at SB-BH03. These borings will extend into the water table. Soil samples will be collected for fluoride determinations at the locations surrounding SB-CU01 at 5-foot intervals and above the water table. Subsequent grab groundwater samples will be collected from the locations where elevated fluoride concentrations are detected in soil samples near the water table Subsequent steps would evaluate soil and groundwater data, install up to four additional soil borings if needed to define the horizontal extent of soil and shallow groundwater contamination, and then install up to two shallow groundwater monitoring wells based upon the results of soil and groundwater sample data from the soil borings. The revised investigation approach will be described in more detail in the revised WPA.

25. **Figure 4-24 (updated figure received 2/7/20). Clarify whether -the TD noted on figures always means that there was a sample collected at the Total Depth, or just that the boring or test pit was dug to that depth but potentially no sample was collected. Same clarification for figures 4-25 through 4-27.**

**Response:** Typically, samples were collected at or above the final depths. The PAAOC maps show contaminants at depths where they exceed screening levels. Contaminants detected at concentrations below screening levels are not shown on the maps. New maps are attached that also include sample results below screening levels and identify maximum depth of soil sample collection. Clarification will also be provided on the WPA figures as appropriate.

26. **Section 4.8.1.3. Ecology agrees that this needs more investigation. The proposed scope is insufficient to understand the extent or source of the contamination at depth. See the above comment for options. What is the depth of groundwater in this location? If contamination is near or below the depth of groundwater, at least one boring in this area should be completed as a well.**

**Response:** A revised investigation approach for the SB-SV01 area is proposed that incorporates an iterative approach (see Figure A-1) to define the horizontal and vertical extent of cPAH and petroleum hydrocarbon contamination in soil and the potential impact on shallow groundwater. All nearby borings were evaluated and there are no detections of cPAHs or petroleum hydrocarbons that exceed screening levels comparable to the 11-foot depth in SB-VS01 which provides horizontal bounding for these constituents in soil. An initial step would be to complete two soil borings about 75 feet to the west and to the east of SB-VS01, then collect soil samples and a grab sample of shallow groundwater from each of the two soil borings. Subsequent steps would evaluate soil and groundwater data, complete one additional soil boring if needed to define the horizontal extent of groundwater in groundwater. If cPAHs or petroleum hydrocarbons are detected in shallow groundwater at concentrations that exceed screening levels, then nearby wells would be considered for additional groundwater monitoring. The revised investigation approach will be described in detail in the revised WPA.

**27. Section 4.8.1.4. Given that the intent is to determine a potential impact to ground water associated with the Coke and Pitch Unloading Sump, a properly constructed well should be installed. Where is the data for the most recent sample of the water collected in this sump?**

**Response:** A revised investigation approach for the Coke and Pitch Unloading Sump is proposed that incorporates an iterative approach (see Figure A-1) to define the potential impact of cPAH and petroleum hydrocarbons in sump sediment on shallow groundwater. All nearby borings were evaluated to confirm that contamination detected in soil above screening levels is present generally above about 3 ft bgs which is about 14 ft above the standing water in the sump. Therefore, soil contamination in soil adjacent to the sump floor level is not anticipated to exceed protection of groundwater screening levels and the investigation objective is to evaluate potential impact of sediment contamination on shallow groundwater. An initial step would be to complete one soil boring adjacent to and downgradient of the sump, 3 soil samples would be collected above, at, and below the depth of the sump upper floor level and a monitoring well will be installed in the soil boring. Subsequent steps would be to evaluate the soil and groundwater data, and, if needed to define the horizontal extent of contamination in shallow groundwater, complete one additional soil boring south of the Pitch Building to collect a grab groundwater sample. The revised investigation approach will be described in detail in the revised WPA.

In response to Ecology's comment, sediment and water in the sump were sampled during the RI. The following are results of the sediment sample analysis for contaminants that exceed groundwater protection screening levels:

- **PAHs**: Fluoranthene 1,200J mg/kg, Pyrene 1,000J mg/kg.
- **TTEC:** 1,612.1 mg/kg, near the 1% Washington Dangerous Waste concentration threshold.
- **Metals**: Cadmium 8.1J mg/kg.
- **Lube Oil**: 58,000J mg/kg, indicating potential non-aqueous phase liquid may be present.

The following are results of the water sample analysis for contaminants that exceed MTCA Method A or B screening levels:

- **cPAHs:** Several cPAHs were detected at concentrations that exceed their screening levels. Benzo(a)anthracene 24 µg/L, Benzo(a)pyrene 36 µg/L, Benzo(b)fluoranthene 45 µg/L, Benzo(k)fluoranthene 15 µg/L, Dibenzo(a,h)anthracene 6.1 µg/L, and Indeno(1,2,3-cd)pyrene 28 µg/L.

**28. Figure 4-26. Where is the coke and pitch unloading sump within this figure?**

**Response:** The Figure will be updated to more clearly show the location of the unloading sump.

29. **Section 4.8.1.5. Ecology agrees that a well is needed here. The proposed scope is likely insufficient to define the nature and extent of contamination. See previous comments for options to address. Additional investigation is also needed in the vicinity of SB-SE17. Sampling in that area should include VOCs.**

**Response:** The Ecology comment on Section 4.8.1.5 addresses the SB-AST05 area. A revised investigation approach for the SB-AST05 area is proposed that incorporates an iterative approach (see Figure A-1) to define the horizontal and vertical extent of cPAH and petroleum hydrocarbon contamination in soil and potential impact on shallow groundwater. An evaluation of nearby sampling locations does not indicate widespread soil petroleum hydrocarbon contamination -as would be expected with an above-ground storage tank. An initial step would be to complete two soil borings to the northwest and northeast of SB-AST05 and collect a grab shallow groundwater sample from each, and complete one soil boring at the SB-AST05 location and install a shallow groundwater monitoring well. The revised investigation approach will be described in detail in the revised WPA.

Additional investigation areas have been identified through review of the new soil and groundwater data maps and include the following:

- **SB-SE17 Area.** This boring is located within the East End Landfill (EELF) footprint and had soil contamination at depth, in addition to the presence of carbon wastes. Ecology has noted in this comment a need for further investigation in this area. A well pair will be constructed in the UA zone and BAU zone in this area to assess groundwater conditions in the EELF footprint near a potential preferential flow pathway (i.e., the SE line topographically above former National Pollutant Discharge Elimination System [NPDES] Pond A). Groundwater samples from this well cluster will be sampled for total cyanide, fluoride, sulfate, TPH (gasoline-range, diesel-range, and motor-oil range), and PAHs. Soil samples will be collected from beneath the wastes at two depth intervals depending on the soil thickness and analyzed for the same analytical program. Volatile organic compounds (VOCs) will also be included in the analytical program consistent with Ecology's comments.

- **SB-FW01 Area.** Fluoride was detected in soil at concentrations that exceed protection of groundwater screening level to the depth of the boring at 10.75 ft bgs. The well is located within a larger identified fluoride plume in shallow groundwater. One soil boring would be completed near SBFW01, and soil samples will be collected at 5-foot intervals to the top of the water table or the bedrock contact if shallow groundwater is not encountered. A grab groundwater sample will also be collected if shallow groundwater is present. If fluoride concentrations in soil are generally below the protection of groundwater screening level and the grab groundwater sample is within the expected range of shallow groundwater fluoride concentrations in the area, then the investigation will be considered as complete. If the results, show evidence of a fluoride hotspot in this area, the potential need for groundwater monitoring will be assessed.

- **North and South Potliner Soaking Stations (SWMUs 10 and 11).** An unpaved, low-lying area receives runoff from the area of North and South Potliner Soaking Station (SWMUs 10 and 11) and is characterized by elevated concentrations of PAHs at depth.

There are also elevated concentrations of fluoride and total cyanide detected in nearby well RI-MW8-BAU in this area. The historical test pits installed by URS were also shallow (typically sampled at 1.5 feet) and do not adequately bound the vertical extent of fluoride contamination particularly if the recently adopted 147.6 mg/kg soil screening for groundwater protection is considered.

Four borings will be installed in this area to verify the lateral and vertical extent of soil contamination and to verify the absence of shallow groundwater in this area. Soil samples will be collected at 5-foot intervals to the top of the water table or the bedrock contact if shallow groundwater is not present. If shallow groundwater is encountered above the basalt contact, one of the borings will be completed as a monitoring well. The analytical program will include fluoride, sulfate, PAHs, TPH constituents, and total cyanide. If shallow groundwater is not encountered above the bedrock contact, a well will not be completed in this area and the borings will be abandoned.

- **SB-SE08 Area.** Fluoride and sulfate were detected in soil boring SB-SE08 located in courtyard segment A4 at concentrations that exceed protection of groundwater screening levels. SB-SE08 is located within a larger identified fluoride plume in shallow groundwater. Two soil borings would be completed, one near SB-SE08 and a second about 150 feet west of SB-SE08, based on evaluation of nearby soil borings. One shallow groundwater monitoring well would be installed at the SB-SE08 location, and a grab sample of shallow groundwater would be collected from the second boring. If fluoride and sulfate are detected in soil at concentrations that exceed protection of groundwater screening levels in the second boring, a third boring would be completed to the west of the second boring. If fluoride and sulfate soil concentrations exceed protection of groundwater screening levels in the third boring this area would be considered further in a long-term monitoring program.

- **SB-SE18 Area.** Sulfate was detected in soil in boring SB-SE18 in courtyard segment C5 at a concentration that exceeded the protection of groundwater screening level at the depth of the boring. Sulfate was also detected at concentrations that exceed protection of groundwater screening levels in other nearby borings. Sulfate was detected in shallow groundwater in well RI-MW7-BAU located 100 feet to the north at concentrations of 140 to 220J mg/L. Three soil borings would be completed in this area, one near SB-SE18, a second would be completed about 200 feet to the east (north of a soil boring where sulfate exceeds protection of groundwater screening level), and a third boring would be completed about 150 feet south in courtyard segment B5. Soil samples and grab samples of groundwater would be collected. If sulfate concentrations in soil exceed protection of groundwater screening levels, then a fourth boring would be completed to the southeast of SB-SE18 in courtyard segment B5. No additional investigation would be conducted south of this area as it is adjacent to the SB-VS01 location, but this area may be considered further in a long-term groundwater monitoring plan.

**30. Figure 4-27 (updated figure received 2/7/20). Some color coding still appears to be in error—e.g. fluoride numbers shown in blue on figure 4-27 implying an exceedance of**

**Method A—but there is no Method A number for fluoride. What do asterisks mean on results?**

**Response:** The figure will be reviewed and revised as appropriate.

**31. Section 4.8.2. It is Ecology's assumption that all scrubber effluent lines, stormwater catch basins/lines and other process lines (including SE lines) will be cleaned, grouted and abandoned. If this assumption is incorrect, this Work Plan Addendum must address these features in greater detail and identify which line segments/catch basins require cleanout. Also, if groundwater gradient control lines are to remain, their function as a pathway for contaminated groundwater to the river must be adequately addressed. Please provide a large enough scale diagram of the piping network for the features to be legible. Please label key features referred to in the text such as "passage no. 3".**

**Response:** The attached Table A-2 lists each line group, whether sediment or water was sampled, the connectedness between line groups, and the action for each line group moving forward. The focus of proposed additional investigation of lines under the WPA will be to determine the source of water discharging from the SE line into pond A and will involve a video survey of identified sections of the SE lines. Other tasks will include collecting seasonal water samples from the groundwater collection line and measuring flow rates from the groundwater collection line and SE line to complete sample tasks originally proposed in the RI Work Plan.

A video survey will be conducted after removal of rocks and debris from the portion of SE lines located in Courtyard Segments A4, A5, and passage no. 3. The video survey will be performed from SE Line manholes MH13L4 through MH17L4 (courtyard segments A4 and A5) and from SE Line manholes MH1L1 to MH1L4 (passage no. 3). The video survey will look for breaches in the SE line (especially near SB-VS01 in courtyard A5), to find any potential connections between the SE and I&M lines in passage No. 3, and to determine if there is a groundwater breach north of passage No. 3, beneath the Crucible Cleaning Area.

The figures and text will be revised to clarify the piping network as well as features referred to in the text.

**32. Section 4.8.2.1. Define "SE" on first usage. It's not clear where you are proposing to do the video survey because the figure doesn't include legible labels for the features described in the text.**

**Response:** The acronym "SE "stands for scrubber effluent. The text will be revised to define SE on first usage. The Figure labels and proposed location of the video survey will be clarified on the Figure.

**33. Section 4.8.2.2. Please specify the season/antecedent rainfall conditions will be targeted for these measurements.**

**Response:** Samples of groundwater in the groundwater collection line and the water from the SE line that daylights at Pond A are proposed to be collected during low rainfall (summer/fall) and high rainfall (winter/spring).

**34. Section 4.8.2.3. What are the "Industrial and Monitoring Lines" Are they shown on a figure?**

**Response:** Some of the Industrial and Monitoring (I&M) lines sent process water from the Rectifier Yard and the Cast House production area to the Industrial Sump. A second portion of the I&M lines are in the same vicinity of the SE lines in courtyards A4, A5, and passage no 3. The I&M lines located in the same vicinity as the SE lines sent water from the Columbia River to the recycle tanks located at the Tertiary Treatment Plant. A revised Figure showing the location of the I&M lines will be included. The lines and manholes that will be investigated will be clearly labeled on a figure in the WPA.

**35. Section 5. There is no discussion of wetland sediment sampling in this section. Please clarify if there are any proposed differences between wetland sediment samples and wetland soil samples. Will samples in areas that are inundated be collected in the same way as soil samples? Or do we expect all the sampling areas to be essentially dry at the time of sampling?**

**Response:** Based on past RI experience, most sampling areas are expected to be essentially dry during the WPA field investigation. There is no difference in the proposed method of sample collection between wetland soil samples and sediment. Representative samples were successfully collected with a spoon or hand-auger (depending on lithology) at the Wetlands AOC and elsewhere during past RI sampling efforts.

**36. Section 5.8. Discharge of IDW may be covered under Section S6 of NPDES Permit #WA00054-0 as a Non-routine or Unanticipated Discharge. Note that under S6.A.5, the discharge must meet applicable water quality standards.**

**Response:** During past RI sampling efforts, water investigation-derived wastes (IDW) were sampled, then transferred to the stormwater pond and subsequently discharged via the NPDES-permitted system when the stormwater pond was periodically emptied. The sampling program was designed to address the NPDES permit monitoring requirements and discharge limits for the routine stormwater pond discharge events. Please clarify if additional monitoring parameters are requested or required by Ecology for implementation of the WPA.

**Yakama Nation Comments on the Draft Work Plan Addendum**
**Columbia Gorge Aluminum Smelter Site, Goldendale, Washington**

**Specific Comments:**

**37. Section 1.2 Plan Organization, page 1-4 through 1-6: Table 1-1. The use of Site-Wide and Site-Specific throughout the table regarding the Terrestrial Ecological Evaluation (TEE) is confusing. It's not clear in the work plan how these are defined relative to the MTCA site or why they are used. The MTCA site should have a site-specific TEE unless the whole MTCA site can be excluded or qualifies for a simplified TEE.**

**Response:** A site-specific terrestrial ecological evaluation (TEE) will be performed as requested based on recent conversations with Ecology. The Table will be revised to indicate a site-specific TEE will be performed.

**38. Section 2.2 Geology and Hydrogeology, page 2-7 through 2-13:**

a. Fault traces and springs should be added to figures showing hydrologic features like Figure 2-5, Monitoring Well Network and Figure 2-6 Former Plant Area Flow Path Features. Spring and all well locations should be added to the Figure 2-4, Fault Locations and Select Monitoring Wells.

**Response:** The fault traces and nearby wells are included on Figure 2-4, all well locations are shown on Figure 2-5, and the springs are shown of Figure 2-6. Selected information was intentionally included on each figure to enhance readability. Limited edits will be made to existing figures to include fault traces and springs.

b. In Section 2.2 Geology and Hydrogeology, in the paragraph starting with "Groundwater flow...", please indicate what well data (and dates) were used to calculate vertical and horizontal gradients across the site as referenced in the work plan. Please indicate what areas of the site and units (UA, BAU1, BAU2, BAL1, BAL2, BAL3) these gradients apply or identify if wells from multiple units (subunits) are used in gradient calculations. Please identify the gradient of the BAL3 zone and specify if this zone has any known hydrologic connections.

**Response:** This information is all summarized in the Draft RI Report and associated appendices (refer to Volume 3, Section 2.3.2, and Volume 4, Appendix D-13, Table D-13-14 for vertical gradients). The intent of this section was to provide a general hydrogeologic conceptual summary for the WPA. Citations to the specific sections in the RI supporting the summary in the revised WPA will be included.

The horizontal gradient in the BAL3 zone has not been characterized as only one well has been installed in this zone. Based on review of the water-level elevations for RI-MW20-BAL and gauging data for the John Day Dam Spillway, it appears that water-level elevations in this well are within about one foot of the River. Note that the river elevation varies significantly on each side of the dam.

c. Figure 2-6, Former Plant Area Flow Path Features shows BAL horizontal groundwater gradients (indicated by green arrows) from the west end to beyond the east end of the plant. These horizontal groundwater gradients appear to trend east; however, the potentiometric surface maps for the BAL show horizontal gradients to the southeast, toward the river. Why is there such a large difference in the modeled direction of horizontal groundwater gradient? Please indicate the date of data used on the figures. How was the horizontal groundwater gradient in the BAL determined west of the Boat Basin (which wells were used)? There only appears to be a single BAL west of the plant and boat basin and no groundwater potentiometric surface map information is available in this area.

**Response**: Note that the map orientation in Figure 2-6 is different from the other maps in the WPA as well as the Draft RI Report and this may be part of the cause of the apparent difference. The map orientation was shifted to be able to show the relevant map area and associated features. The map north arrow on Figure 2-6 was also shifted slightly too far to the east and will be corrected. Based on review of these figures, the Basalt Aquifer Lower (BAL)-zone flow gradient is to the east-southeast on both Figure 2-6 as well as on Draft RI Report Figure 2-18 that shows the water-level elevation contours for the BAL zone.

The horizontal groundwater gradient was not modeled, but was based on contouring of the first (baseline) round of groundwater elevation results collected in winter 2017 that was the same data used to prepare the water-level elevation contour maps (Figures 2-16, 2-17, and 2-18) presented in the Draft RI Report.

For the BAL zone, the groundwater gradient direction arrows shown in Figure 2-6 were interpreted directly from Figure 2-18 of the Draft RI report. The gradient arrows were placed in areas where there was water-level elevation data. The westernmost BAL zone arrow on Figure 2-6 is shown near RI-MW17-BAL. It is based on water-level elevation contouring between wells RI-MW17-BAL, BAMW-4, and IB-8, cross-section interpretations, and the long-term water-level elevation hydrograph study.

d. In Section 2.2 Geology and Hydrogeology (pg. 2-13), in the third paragraph, the second to last sentence identifies that infiltrating wetland water may locally infiltrate into the basalt and potentially migrate to the lower BAL-aquifer zone. In the statement made in the last sentence, please also identify the potential for wetland water to potentially infiltrate at areas where the basalt flow interiors may be more permeable due to faulting.

**Response:** The text will be revised as requested. Wetland water could potentially infiltrate at areas where the basalt flow interiors may be more permeable due to faulting. These pathways have been targeted by the temporary well point installations described in the WPA.

e. In Section 2.2 Geology and Hydrogeology (pg. 2-13), discusses the BAL1 and BAL2 zone with respect to discharge to the Columbia River. Please also describe the discharge behavior of the BAL3 zone.

**Response:** The hydraulic relationship between the Columbia River and the BAL3 zone was not characterized as only one well has been installed in this zone and a long-term water-level elevation study was not planned in this area of the site because of the large distance (over one mile) from the likely source areas (WSI and West SPL Storage Area) to the Columbia River and the significant depth of the BAL 3 zone (about 300 ft bgs in the suspected source area).

As a point of clarification, RI-MW20-BAL originally was planned to target the BAU zone in this area, and the purpose of the well was to delineate the downgradient extent of contamination in the BAU zone. No water was found at the elevation of the BAU zone at this location because of the presence of large thickness of impermeable flow interior and the initial boring was abandoned. Ecology subsequently requested installation of a deeper well at this location. Of site groundwater chemicals of concern, sulfate has been detected at concentrations that slightly exceed the Secondary MCL of 250 mg/L in this well. Based on these factors, hydraulic characterization of the Columbia River and BAL3 zone does not appear warranted.

**39. Section 3.1.1 Model Toxics Control Act, page 3-1: While the updated CLARC table values have been included in the tables, the associated figures, including Figures 4-26 and 4-27, still reflect older screening values for some COCs, including the cPAH TTEC values for protection of groundwater. These values should be updated.**

**Response:** Additional figures of the Plant area footprint are being prepared that will include updated screening levels. The main effort of re-screening the draft RI data and producing revised chemical concentration maps is planned to be performed during preparation of the Revised RI Report once the WPA data has been collected.

**40. Table 3-1, Soil Screening Level Summary, page 3-2: In the "Fluoride Notes" section of the updated CLARC tables (May 2019), the following note is included:**

*"Different agencies, including Ecology, have used several CAS numbers to identify fluoride. The CLARC Tables will now use a single name ("fluoride") and a single CAS number (16984-48-8) to evaluate fluoride contamination in water, soil, and air. ChemIDplus lists this CAS number as "Fluoride," "F-," or "inorganic salts of hydrofluoric acid, HF, in which the fluorine atom is in the -1 oxidation state."*

*The following CAS numbers are assumed to be equivalent for the purpose of screening water, soil, and air for fluoride (unless analyzing specifically for fluorine gas, CAS 7782-41-4):*

- *7664-39-3, listed in ChemIDplus as hydrofluoric acid or hydrogen fluoride. This is the CAS number associated with the California EPA Reference Exposure Levels for hydrogen fluoride. Cal EPA also has a listing for "Fluorides (other than Hydrogen Fluoride)" without a CAS number. CLARC does not include the Cal EPA oral REL because the oral* *reference dose for soluble fluoride that is listed in IRIS is used instead. The Cal EPA inhalation REL for "Fluorides (other than Hydrogen Fluoride)" is listed in CLARC and has been associated with CAS 16984-48-8.*

- *7681-49-4, listed in ChemIDplus as sodium fluoride. This is the CAS number associated the U.S. EPA Maximum Contaminant Level for fluoride.*

- *7782-41-4, listed in ChemIDplus as fluorine gas. This is the CAS number associated the listing in the U.S. EPA IRIS database (listed as Fluorine; soluble fluoride). Note that the IRIS reference dose is based on studies of fluoride in drinking water and not fluorine gas."*

As noted in the CLARC table, fluorine (CAS number 7782-41-4) is assumed to be equivalent to fluoride for the purpose of screening water, soil, and air. An ecological indicator soil concentration is included in MTCA Table 749-3 for fluorine for the protection of plants. This value (200 mg/kg) should be included for fluoride in the "Site-Specific TEE" column of Table 3-1 for "Ecological Indicator – Plants".

**Response**: Comment acknowledged. The Table was updated using a list of terrestrial ecological evaluation (TEE) screening values provided by Ecology and fluoride was not included in that list. The MTCA Cleanup Level and Risk Calculation (CLARC) revision also does not address terrestrial ecologic soil screening values for fluoride. Tables 740-2 and 740-3 of MTCA do not indicate substituting the fluorine terrestrial ecological soil screening level for fluoride. From the notes in the comments above, it also appears that the EPA Integrated Risk Information System (IRIS) reference dose mentioned above for fluorine is based on studies of fluoride in drinking water (no mention is made in the above notes regarding soil exposure or ecological receptors).

**41. Table 3-1, Soil Screening Level Summary, page 3-2:**

a. For carcinogenic PAHs, the TTEC concentrations listed under the column "Protection of Groundwater (Unsaturated Zone)" should be "3,900/190", and not "3,900/0.19".

**Response:** The Table will be reviewed and corrected accordingly.

b. General comment – MTCA soil cleanup levels are typically presented in milligrams/kilogram (mg/kg). It would be less confusing to present all values in Table 3-1 in the same units (mg/kg).

**Response:** Table 3-1 will be modified as suggested. As a point of clarification, the laboratory results have been reported in a combination of both units of measure with two separate laboratories used on the project. The screening level summary tables were previously converted in the Draft RI Report to facilitate direct comparison with most of the laboratory results. Data summary tables in the RI text will continue to incorporate screening levels with converted units because conversion of the results for the complete data summary tables in the report text would constitute a relatively large level of effort and be prone to unit conversion errors.

42. **Table 3-2, Groundwater Screening Level Summary, page 3-5:**

a. The MTCA Method C value is 2.1 mg/L, and not 2,100 mg/L as presented in Table 3-2. Please correct this.

**Response:** The text will be reviewed and corrected as appropriate.

b. General Comment – Per MTCA [WAC 173-340-720 (4)(b)(ii)] groundwater cleanup levels must be at least as stringent as surface water criteria "unless it can be demonstrated that the hazardous substances are not likely to reach surface water." This would include discharge to the Columbia River as well as to springs and wetlands.

**Response:** Comment noted. Evaluation of the groundwater-to-surface water transport pathway for the Columbia River is ongoing. Chemical data for groundwater springs in wetland areas will be compared against both groundwater and surface water screening levels.

43. **Section 3.2 Treaty-Protected Tribal Uses, page 3-13:**

a. Rather than stating "It appears likely that MTCA soil cleanup levels for unrestricted land use are protective based on their residential exposure assumptions" we would suggest changing this to "Data of sufficient quality to determine protectiveness based on Unrestricted Land Use would likely be sufficient to determine protectiveness relative to Treaty-protected Tribal uses", or similar language. While the statement in the Work Plan may be true, the primary concern is that data to be collected are of sufficient quality to determine protectiveness based on potential Tribal exposures.

**Response:** The sentence will be corrected as recommended.

b. Additionally, the sentence "This is a conservative representation of exposure potential for Treaty Protected Tribal Uses, since these uses tend to be more transitory" is not necessary and should be deleted. While Tribal uses may be transitory, other exposure assumptions, including the soil ingestion rate or dermal exposure, may be underestimated in the standard Method B equations.

**Response:** The text will be deleted as requested. Tribal estimates of exposure assumptions and a specific rationale as to why these would be different from MTCA Method B assumptions are requested.

44. **Section 3.3 Terrestrial Ecological Evaluation, page 3-13: Please see the comment on Table 3-1 above regarding use of the ecological indicator concentration for fluorine.**

**Response:** See response to Comment #4.

45. **Section 3.3 Terrestrial Ecological Evaluation, page 3-14: For the PAH values in Table 3-1 based on EPA guidance ("Ecological Soil Screening Levels for PAHs, Interim Final"), please clarify if the Low Molecular Weight (LMW) and High Molecular Weight**

**(HMW) values from the guidance are to be applied to individual PAHs or to summed totals of LMW or HMW chemicals.**

**Response**: The EPA guidance indicates that concentrations of LMW PAHs and HMW PAHs should be summed and compared to the lowest of the screening levels for individual PAHs of that category. For LMW PAHs, this value is 100 mg/kg dry weight based on Mammalian Wildlife and for HMW PAHs, the value is 1.1 mg/kg dry weight based on this same receptor category. According to the guidance, a toxicity equivalency approach (as used in MTCA for PAH human health exposures) cannot be used with these screening levels due to data limitations.

A simple summation approach will be used to calculate the total LMW PAH and total HMW PAH concentration. Table 3-1 will be revised to include the total LMW PAH and total HMW PAH screening levels and explain the calculation approach. The screening levels for individual PAHs will remain in Table 3-1 for completeness, but the total concentrations will be used for the screening.

**46. Section 3.4.1 Groundwater, page 3-14:**

a. Please explain why the primary MCL (4.0 mg/L) has been adopted for screening purposes rather than the MTCA Method B groundwater cleanup level (0.96 mg/L).

**Response**: Both screening levels will be retained in the RI and a cleanup level recommended in the FS.

b. Method B groundwater cleanup levels must be at least as stringent as concentrations protective of human health calculated using the Method B equations "for hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws". [WAC 173-340-720(4)(b)(iii)].

**Response:** Comment noted.

c. We are assuming that the calculated Method B value for fluoride is not being used because there is a value (the MCL) that has been "established under applicable state and federal laws". However, the phrase "sufficiently protective" also needs to be considered. Section 705 of MTCA (Use of Method B) states that "Where a cleanup level is based on an applicable state or federal law, and the level of risk upon which the applicable state and federal law is based exceeds an excess cancer risk of one in one hundred thousand (1 x 10-5) or a hazard index of one (1), the cleanup level must be adjusted downward so that the total excess cancer risk and hazard index at the site does not exceed the limits established in subsection (4) of this section [WAC 173-340-705(5)]. The Method B groundwater value for fluoride, calculated based on drinking water exposure and using a hazard quotient of 1, is 0.96 mg/L. Since this value is based on a HQ of 1, the cleanup level should be adjusted downward so as not to exceed this value.

**Response:** Comment noted. The technical basis for the 0.96 mg/L CLARC value will be further evaluated by the project team as we are unaware of other smelter sites or other cleanup sites in Washington that have been required to use groundwater cleanup levels lower than the 4.0 mg/L MCL based on drinking water use. The 0.96 mg/L MTCA Method B formula value will continue to be used for screening in the RI and FS report. It is premature to conclude that 0.96 mg/L will ultimately represent the groundwater cleanup level at the site. The groundwater cleanup levels, remediation levels (as appropriate), and the groundwater point of compliance will be evaluated and proposed in the FS.

d. This section states that "Ecology has explained that the Secondary MCL for sulfate represents a likely Applicable or Relevant and Appropriate Requirement for the project." More generally, if secondary MCLs are considered to be ARARs, the secondary MCL for fluoride (2.0 mg/L) should also be included in the groundwater screening level summary table (Table 3-2).

**Response:** The primary MCL (4.0 mg/L) and the MTCA Method B formula value (0.96 mg/L) for fluoride will continue to be used as screening values. In general, secondary MCLs will only be used for screening in cases (e.g., sulfate), where primary MCLs and MTCA formula values are lacking. It's unclear why secondary MCLs generally and necessarily represent an Applicable or Relevant and Appropriate Requirement (ARAR) for a cleanup project, since they do not represent risk-based concentrations and were not intended by EPA as enforceable criteria. The specific basis for the Secondary MCL for fluoride of 2.0 mg/L is based on a potential for cosmetic effects on tooth color, not a health-based impact.

**47. Section 3.4.2 Surface Water, page 3-15: In performing the proposed literature search "to evaluate freshwater screening levels protective of human health and ecological exposures for fluoride and sulfate", a tribal exposure scenario should be considered.**

**Response:** The proposed literature search will be conducted to provide a range of values to considered in addition to the MCLs. Please provide further information on the exposure assumptions and scope of a tribal exposure scenario within the context of fluoride and sulfate freshwater screening levels.

**48. Section 3.4.3 Fluoride Soil Screening Levels for the Protection of Groundwater, page 3-15: Unless there is sufficient justification to use the fluoride MCL (4.0 mg/L) rather than the Method B value, the soil screening level should be based on protection of groundwater using the Method B groundwater value of 0.96 mg/L.**

**Response:** From a practical standpoint, soil remediation efforts for fluoride will likely target hotspot soil/waste source areas where groundwater concentrations are above the MCL and soil/waste concentrations are also elevated. The soil screening level based on 0.96 mg/L is 147.6 mg/kg; the soil screening level based on the MCL is 615 mg/kg. Both values will be used as screening levels in the Revised Draft RI report.

**49. Section 4.2.2 Investigation Scope, page 4-9:**

a. In Section 4.2.2 Investigation Scope, for soil sample collection, the target depth of the borings should be stated. Also, it is unclear why sample collection is limited to only the surface and base of the boring. Provision should be made for the collection of material anywhere in the boring that shows evidence of impacts.

**Response:** In the case of the NPDES Ponds, the boring depths will be shallow because contaminated soil were already excavated down to bedrock in several areas and the soil thickness is anticipated to be thin (less than 3 feet thick). Most stations represent surface soil samples to be collected from the ground surface to 0.5 feet. It is anticipated that refusal will occur at depths of 1-3 ft bgs at most locations. The intent is to collect samples of visibly impacted soils where encountered.

b. Similarly, in lieu of a randomized grid sampling location plan, the areas should be examined for signs of contamination and those areas referentially targeted. Please also collect additional samples along the apparent flow path toward the Columbia River. If necessary, these samples could be archived pending analyses of the samples already planned. The archived samples would be analyzed if the other sample did not delineate the full extent of transport.

**Response:** The sampling stations do not represent a randomized grid. The stations more closely represent a systematic grid over the likely area of impacts. Sampling of Ponds C/D will be included in the sampling program based on Ecology (Ecology comments #12 and #13) and Yakama Nation comments.

**50. Section 4.3 Intermittent Sludge Disposal Ponds (SWMU 31): The images on current Google Maps of the SWMU 31 area, indicated more soil impacts, i.e., light/white soils, associated with the relic ponds than seems to be apparent on the figures in the SA. The sampling locations should be at least refined in the field based on soil characteristics and may need to be increased to capture possible contamination. The planned new wetland delineation should help address this issue.**

**Response:** Note that the coloration on the aerial photographs can be misleading as some of the high-voltage-line towers appear as gray-white areas projected onto the ground. This area was previously remediated. Site reconnaissance has been proposed as a work element to address potential additional indications of contamination and these will be used to modify the sampling plan as appropriate. Two additional sampling transects have been proposed to address Ecology comment #14.

As there are not wetlands in this area, it's unclear how wetlands delineation will address this comment.

**51. Section 4.4 Smelter Sign Area (SWMU 31), page 4-16: On Figures 4-7, 4-8, 4-9, elevated site COCs and proposed investigation work are shown outside of the boundary of the Smelter Sign Area (SWMU 31). Do impacts to the soil at this location indicate that this**

**area should be associated with the Smelter Sign Area SWMU? If so, please adjust the boundary of the SWMU to incorporate these impacts.**

**Response:** Some of the proposed investigation work is outside of the known or suspected area of SWMU 31. The SWMU boundary will be adjusted as appropriate based on the WPA results.

52. **Section 4.4.2 NESI Subarea, page 4-21: In Figure 4-10 and Figure 4-13, the boundary in the legend for the NESI Area is yellow, but within the image it is black.**

**Response:** The figures will be reviewed for consistency and corrected as appropriate.

53. **Section 4.6.1.2 Investigation Scope (Spring Sampling), page 4-36: In Section 4.6.1.2, identifies the spring and the aquifer source. Please provide what tools have been used to link the spring to a given aquifer unit. Has the hydrochemistry of the springs been evaluated to confirm the groundwater aquifer source? Several of the springs are identified as perennial or seasonal. Please identify when these springs will be sampled to ensure that they will flowing.**

**Response:** Geochemistry data was collected from the spring and well locations during the baseline groundwater sampling round. A clear geochemical pattern was not discerned for each aquifer zone based on the collected geochemical data.

The source of the springs was based on hydro-stratigraphy, the occurrence of faults, topography, spring and groundwater water-level elevations, and chemical results.

Except for the North of the East Surface Impoundment (NESI) wetland spring, the springs appear to be perennial. Sampling will be timed as needed to obtain the necessary samples.

54. **Section 4.6.2 Temporary Well Point Installation, page 4-36: This investigation is important in determining the possible existence of a direct link from the wetland to the river. Sampling should be done when water is most likely to be present; careful reconnaissance should be made to look for signs of water and appropriate substrate; and multiple attempt should be made to find water if initial attempts fail. In addition, more locations would be appropriate along the gully if water is found near the wetland to trace the flow.**

**Response:** As explained in the WPA in Section 5.3, up to three attempts will be made to sample each temporary well point. This work ideally would be done during seasons with the most precipitation in the Spring (March-mid May), late Fall (mid-late November), or Winter (December-February).

If temporary well points prove to be unfeasible due to refusal, the potential need for use of more robust drilling equipment (e.g., limited-access track rig) in the area of the Boat Basin will be further evaluated by the project team. Note that use of drill rigs would likely require a lengthy permitting process with U.S. Army Corps of Engineers (USACE) and is not be feasible near Wetland K due to physical access limitations.

**55. Section 4.6.3.2 Investigation Scope (Well Installation and Sampling), page 4-38: In Section 4.6.3.2 Investigation Scope, the first sentence in this section indicates that up to three shallow monitoring wells and three borings including grab groundwater sampling are included in the PAAOC scope of work (Figure 4-19). Why does this sentence indicate that the number of shallow monitoring wells could be 3 wells or less? Why isn't the quantity specific? What criteria would be used to decrease the number of monitoring wells to less than three? Please include this information. What governed the placement of these borings and temporary wells? Please include this information on the figure and within the text.**

**Response:** The phrase "up to" will be deleted and the text will clarify if some of the wells will only be installed based on encountered conditions. The proposed number of wells will be modified based on the revised WPA scope of work. The intent of the section was merely to briefly summarize the well installation and sampling scope of work that is discussed in more detail elsewhere.

**56. Section 4.6.4.2 Groundwater Flux and Water Balance Assessment Scope, page 4-40: In Section 4.6.4.2, in addition to shoreline wells, wells within or adjacent to fault planes should be considered as these areas may have higher fluxes and greater connectivity than shoreline wells with little to no communication with the river due to the structure of basalt flows within the aquifer unit. Please add well RI-MW17-BAL to the evaluation.**

**Response:** Well RI MW-17-BAL is already demonstrated to not be in hydraulic connection with the Columbia River based on the findings of the long-term groundwater elevation study and was therefore excluded from the groundwater flux evaluation. No lag or dampening pattern could be identified when the hydrographs of the well and the Columbia River were compared as is presented in the Draft RI Report.

**57. Section 4.7, Wetland AOC, page 4-43: For sampling of the springs for water quality and the other hydrologic measurements, please specify when the sampling will occur, preferably during the wet season. In addition, there currently seems to be no information regarding how the springs and flow channels respond to large precipitation events. Please discuss how important intermittent storm water runoff and shallow groundwater recharge may impact transport of COCs. If no data exist, please add a storm event investigation/sampling plan.**

**Response:** Spring and flow channels respond quickly to major precipitation events as has been noted in the Draft RI Report for the area of the NPDES ponds after a snow-melt event. As documented in the RI, wetlands generally have more standing water during the spring and the seasonal high groundwater elevations also occur in the spring. Groundwater recharges and is the source of water for perennial springs in the site vicinity. Spring discharge measurements would ideally occur in the spring, though late fall or winter may also suffice.

The proposed pipe-flow discharge measurements, and chemical sampling will occur in spring and summer to evaluate seasonality. The water balance/budget will also include consideration of seasonality.

The purpose and objectives for a storm-event investigation and sampling event are unclear and should be further discussed.

58. **Section 4.7.1.2. Wetland D. Investigative Scope, page 4-43: The text states that the wetland spring sampling is discussed in Section 4.6.2, but the referenced section discussed well point installation. Section 4.6.1.2 mentions the spring but does not discuss sampling.**

**Response:** The internal text references will be reviewed and corrected accordingly.

59. **Appendix A Hydrogeologic Supporting Figures: In Appendix A, Figures 2-9, 2-10, 2-12, and 2-14, show fluoride and sulfate concentrations at some of the wells. Please show fluoride and sulfate results at all applicable locations on the cross-section. Please add vertical groundwater surfaces for each aquifer or sub-aquifer unit on these cross-sections.**

**Response:** Fluoride and sulfate results will be added for all the well locations. The water-level elevations for the various wells and aquifer zones are already shown on these figures.

# ATTACHMENTS

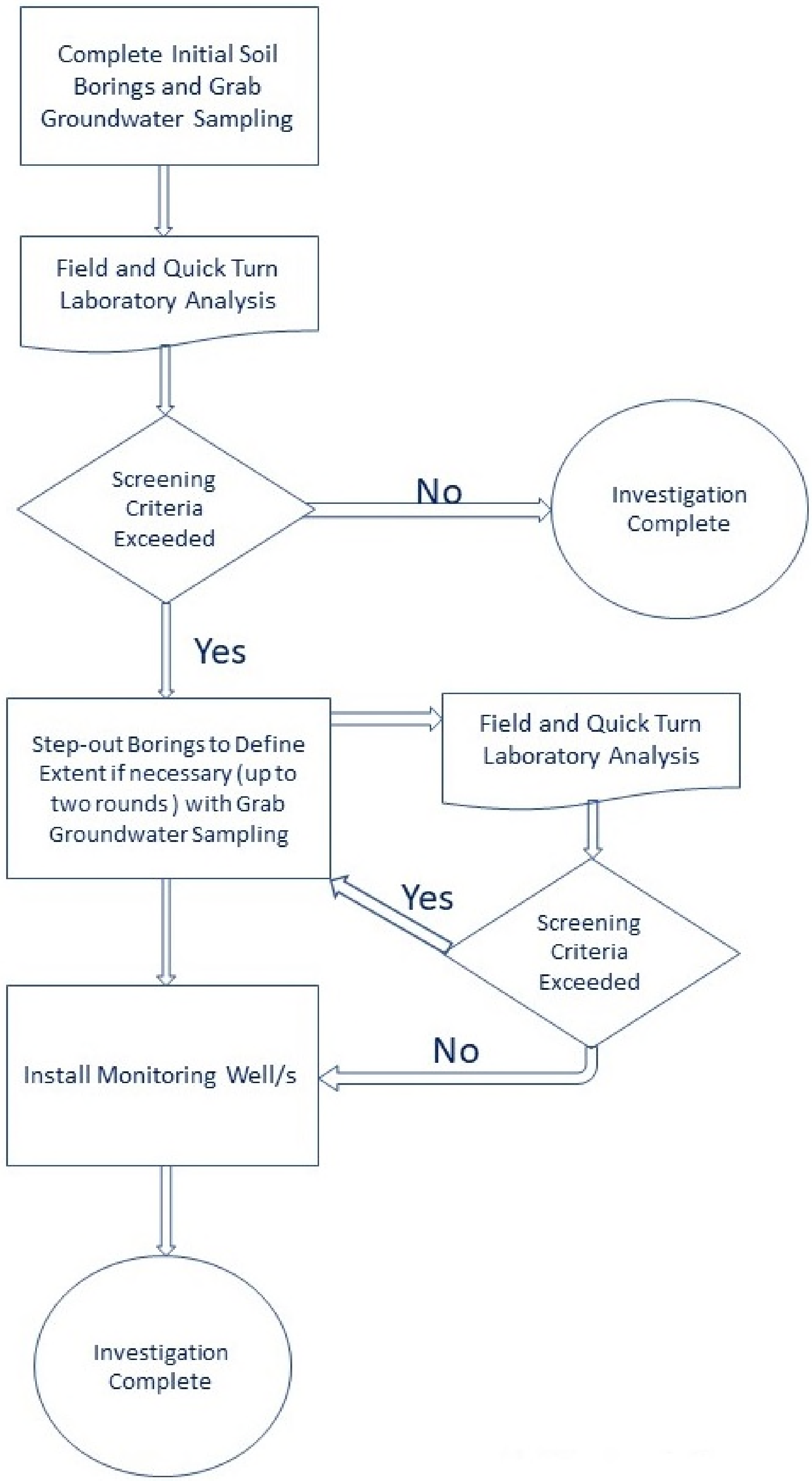



**Figure A-1**
Decision Tree for Soil Investigation Areas (PAAOC)
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Table A-1
Proposed Courtyard Segment Soil Sampling to Define Vertical Extent of Contamination (PAAOC)
Columbia Gorge Aluminum Smelter Site, Goldentale, Washington

| Courtyard Segment | Proposed Sampling at Transformer Substations | | | | Proposed Sampling at Other Courtyard Stations | | | |
|---|---|---|---|---|---|---|---|---|
| | Station Name | Test Pits | Samples | Sample Depth (ft) | Station Name | Test Pits | Samples | Sample Depth (ft) |
| A1 | TP-T8A | 1 | 1 | 4 | SB-MM04 | 1 | 0 | NA |
| | TP-T8B | 1 | 1 | 4 | | | | |
| A2 | TP-T9B | 1 | 1 | 4 | SB-SE03 | 1 | 0 | NA |
| | TP-T9C | 1 | 1 | 4 | BS01-BS | 1 | 1 | 4 |
| A3 | TP-T27A/B/C | 2 | 2 | 4 | SB-SE05 | 1 | 0 | NA |
| | TP-26A/B | 1 | 1 | 4 | | | | |
| | TP-T17A/B | 1 | 1 | 4 | | | | |
| | TP-T10A | 1 | 1 | 4 | | | | |
| A4 | | | | | SB-BC01 | 1 | 0 | NA |
| A5 | | | | | SB-SE014 | 1 | 0 | NA |
| | | | | | SB-SWMU24-03 | 1 | 0 | NA |
| | | | | | BS02-BS | 1 | 1 | 4 |
| | | | | | BS03-BS | 1 | 1 | 4 |
| B1 | TP-T1A/B | 2 | 2 | 4 | TP-B29-SS | 1 | 1 | 4 |
| | | | | | TP-B30BS | 1 | 1 | 4 |
| B2 | | | | | SB-BH04 | 1 | 0 | NA |
| | | | | | TP-B32-SS | 1 | 1 | 4 |
| | | | | | TP-B33-SS | 1 | 1 | 4 |
| B3 | | | | | TP-B34-SS | 1 | 1 | 4 |
| | | | | | TP-B35-SS | 1 | 1 | 4 |
| | | | | | TP-B36-SS | 1 | 1 | 4 |
| B4 | TP-T14A | 1 | 1 | 4 | TP-B37-SS | 1 | 1 | 4 |
| | | | | | TP-B38-SS | 1 | 1 | 4 |
| | | | | | TP-B39-SS | 1 | 1 | 4 |
| | | | | | BS04-BS | 1 | 1 | 4 |
| B5 | TP-T5-01 | 1 | 1 | 5 | SB-BS02 | 1 | 1 | 5 |
| | TP-T5-02 | 1 | 1 | 5 | TP-B41-SS | 1 | 1 | 4 |
| | TP-T5-03 | 1 | 1 | 5 | TP-B43-SS | 1 | 1 | 4 |
| C1 | | | | | SB-CR02 | 1 | 0 | NA |
| | | | | | SB-SE02 | 1 | 0 | NA |
| C2 | | | | | SB-SE04 | 3 | 6 | 0-1, 4 |
| C3 | | | | | SB-AST02 | 1 | 0 | NA |
| C4 | | | | | SB-SE10 | 1 | 0 | NA |
| C5 | | | | | | | | |
| D1 | | | | | TP-B6-SS | 1 | 1 | 4 |
| | | | | | TP-B9-SS | 1 | 1 | 4 |
| D2 | TP-T21B | 1 | 1 | 4 | TP-B10-SS | 1 | 1 | 4 |
| | TP-T22B | 1 | 1 | 4 | TP-B11-BS | 1 | 1 | 4 |
| D3 | | | | | TP-B13-SS | 1 | 0 | NA |
| | | | | | TP-B14-SS | 1 | 1 | 4 |
| E1 | | | | | TP-B1-SS | 2 | 1 | 4 |
| | | | | | TP-B2-SS | 1 | 1 | 4 |
| E2 | | | | | TP-B3-SS | 3 | 5 | 0-1, 4 |
| E3 | | | | | TP-B4-SS | 2 | 3 | 0-1, 4 |
| | | | | | TP-B5-SS | 1 | 1 | 4 |
| Total | | 17 | 17 | | | 46 | 39 | |
| Duplicates | | | 2 | | | | 3 | |

Notes:
Gray highlighted cells indicate no additional sampling is proposed for this courtyard segment.
Additional test pits will be excavated near stations SB-SE04, TP-B1-SS, TP-B3-SS, and TP-B4-SS to further evaluate horizontal extent of cPAHs.
NA Not applicable
At locations where no soil sample is proposed to be collected, the purpose of the test pit is for visual confirmation of potential presence of a black soil layer.

Table A-2
Summary of Status and Proposed Further Investigation of Lines Groups (PAAOC)
Columbia Gorge Aluminum Smelter Site, Goldendale, Washington

| Line Group | Sediment Sampled | Water Sampled | Connectedness | Feasibility Study Goals |
|---|---|---|---|---|
| Industrial & Monitoring (I &M) | Yes | No water present | Extends from Rectifier Yard to Industrial Sump, also located in passage No. 3. Investigate breaches or connection to SE line in passage No. 3 under WPA. | Clean and abandon the I&M lines. |
| Groundwater | No sediment present | Yes | Collects shallow seepage in courtyards C4 and C5, then flows southwest through a diagonal line from MH1L5 through MH5L5, and discharges to the stormwater pond. Stormwater co-mingles with groundwater at MH4L5. Measure water flow rate discharge from groundwater line under WPA. | Retain for future use. Potential reconfiguration in FS. |
| Sanitary Sewer | No | No | Sewer line from administrative building to sewage treatment facility. | No action. Retain sanitary sewer for future use. |
| Scrubber Effluent (SE) | Yes | Yes | Located in Courtyards A, C, passage No 3, and extends from Courtyard A5 to an open pipe at the head of Pond A. Investigate source of water discharging to Pond A, and measure rate of flow discharging from line at Pond A under WPA. | Clean and abandon the SE lines. |
| Stormwater | Yes | Yes | Present in courtyards A through E, parking area, and the south part of the PAAOC. Discharges to the stormwater pond. No additional investigation proposed for WPA. | Clean stormwater lines and retain for future use. |

Note
A new figure will be added to the Work Plan Addendum to show all lines. Figure 32-6 (RI Report, Vol. 2) shows the location of the Stormwater, Groundwater Collection, Industrial & Monitoring, and SE lines.

# Appendix A-2

# Response to Comments on the Final WPA

**Ecology and Yakama Nation Comments**

**Work Plan Addendum Submitted July 24, 2020**

**Columbia Gorge Aluminum Smelter Site**

**Ecology Comments**

**General Comments:**

Ecology appreciates the work done to respond to comments and revise the Work Plan Addendum (WPA) for the Columbia Gorge Aluminum Site. For the most part, the revised WPA appears to have adequately addressed Ecology's comments. There are a few remaining issues, mainly related to the work proposed for a few of the investigation areas in the Plant Area Area of Concern (PAAOC).

The WPA describes a "decision tree" approach to completing the investigation in the specific areas of the PAAOC. Typically, when investigating the extent of an area known to be impacted, borings would start within the area of known impact and step outward until the extent of impact is defined. The specific number of borings would not be limited but rather would be driven by decisions made in the field to ensure that the nature and extent of contamination was fully defined in as efficient a manner as possible given the site constraints.

In this revised WPA, the number of borings proposed is very limited and the logic for placement of the proposed step out borings is not always clear since they are not necessarily "following" observed contamination. Given that, it is not assured that the work will fully define the nature and extent of contamination. Ecology will review the information gathered as part of the WPA when it is submitted with the revised RI report and determine if additional information is needed to define the nature and extent of contamination. Given that the added cost in time and money for additional WPA iterations is almost certainly higher than the investigation cost saved by limiting the number of samples/borings in each iteration, Ecology recommends providing enough resources/scope for the field program to ensure it gets the job done. Please note that a prerequisite for considering any prospective purchaser consent decree involving the PAAOC is that we have adequately defined the nature and extent of contamination.

Response: Work conducted for the additional investigation areas will follow the decision tree approach to determine whether that area is a source of contamination for shallow groundwater. Figure 4-25 (attached), shows the revised decision tree to provide clarification of the approach. The investigation will implement needed step-outs to determine extent, based on the data collected. Initial step-out borings shown on the investigation area figures (4-28 through 4-34) are approximate locations that will be finalized in the field, and additional step-out boring locations will be determined in the field based on rapid turnaround laboratory analysis results.

**Specific Comments:**

Table 3-2. Selenium MCL incorrectly listed here and in Table 3-3 as 50 mg/l. Please correct.

Response: The selenium MCL will be correctly listed in the Final WPA.

Section 4.9.1. See general comment on decision tree approach to the PAAOC.

Response: The decision tree approach may require one or more rounds of step-out investigation. The text in the second paragraph under Section 4.9.1 will be modified as follows:

"The discussion of scope under each of the following subsections 4.9.2.2 through 4.9.2.9 describes an initial round of investigation with expedited laboratory analyses turn around times for targeted chemicals that will support field decisions. One or more rounds of investigation will follow with borings located based upon expedited data results from the previous round(s) of sampling, until the extent of soil contamination, which is the focus of that investigation area, is determined. Initial boring locations for the investigation areas proposed in figures 4-28 through 4-34 are within 50 to 100 ft from the focal point for the investigation area (for example, boring SB-SU01 in the Crucible Cleaning Room Area) and will be finalized in the field. Additional step-out boring locations will be determined in the field based on results of expedited laboratory analyses."

In Section 4.9.1, insert the following paragraph at the end of the section:
"The focus of the additional investigation areas is to determine whether those locations may serve as soil sources of contamination to shallow groundwater. The investigations would target sampling of the shallowest groundwater, the UA zone, if it is present. If the UA is not present, the investigation would target sampling of the uppermost BAU zone if it is present within a reasonable depth from the soil/bedrock contact."

Section 4.9.2.1.2. Second paragraph is repeated.

Response: The repeated paragraph will be deleted.

Section 4.9.2.2.2.

I need some help understanding the logic for boring placement/triggering here. Shown step out locations for SB-07 through 09 are triggered by SL exceedances in CU02. If CU02 shows impacts, wouldn't it be appropriate to do additional borings in that vicinity vs. triggering the added locations noted (approx. 200' to the N and 600' to S). Seems like SB-07 through 09 are needed regardless. Also, three step-out borings may not be enough to get the job done. See general comment.

Response: The following paragraph will be inserted at the end of Section 4.9.2.2 This paragraph describes the overall concept for occurrence of contamination based on soil and groundwater data collected during the RI where the Crucible Cleaning Room Area may be a primary soil source of contamination to shallow groundwater for fluoride, and an area-wide fluoride plume, and possibly sulfate.

"The Crucible Cleaning Room Area may be the primary soil source of contamination contributing to the area-wide Fluoride plume depicted in Figure C2-4 (Final Work Plan Addendum). An area-wide sulfate plume has not been identified but this area may also be a soil source of sulfate contamination to shallow groundwater. Soil boring SB-CU01 (highest detection of fluoride in soil at depth) and SB-BH03 (highest detection of sulfate in soil at depth) are located along a corridor from the Tertiary Treatment Plant through Passage No. 3 where Industrial and Monitoring (I&M) lines and Scrubber Effluent (SE) lines (Corridor containing I&M and SE Lines) run between the Tertiary Treatment Plant and Courtyard A (Figure 4-28) where SWMU 5 Line A Secondary Scrubber Recycle Station was previously located (Figure 2-1). Based on discussion with the former plant manager, potential pipe leaks may have occurred in this area and may be the source of fluoride and sulfate contamination in soil. The video survey of the SE lines, discussed in Section 4.9.3.1, will be conducted in this area prior to implementing the soil boring program and will contribute information about the SE lines and potential leaks or breaches in the Crucible Cleaning Room Area. Depths to manholes and horizontal pipelines in this area are available from plant drawings.

It is possible that there are other sources of fluoride and sulfate contamination in soil in this area, including the Tertiary Treatment Plant and recycle and caustic tanks located to the south, SWMU 16 Cathode Dismantling and Recovery Building at the end of Production Building D, Crucible Cleaning Room at the end of Production Building C, and baghouses located adjacent to Production buildings C and D. Potential pipe or tank leaks would allow fluoride and sulfate containing liquids to contact soil at depth. During the RI, boring SB-CU01 was drilled to sample soil below the depth of the nearby SE line horizontal pipe invert. Other potential sources could be sources of fluoride solids deposited at ground surface and mixed into shallow soil by subsequent demolition activities. Occurrence of fluoride in shallow soil from these potential sources would be expected to decrease in concentration with depth. Near potential pipe or tank leaks detection of fluoride and sulfate would be expected to occur throughout the soil column above the water table. At a distance from soil sources of fluoride and sulfate, these constituents would be expected to increase in concentration with depth and/or occur above the water table, and result from interaction between soil and a fluctuating water table within the fluoride area-wide plume."

In Section 4.9.2.2.2, paragraphs 2 through 5 will be modified as follows and become paragraphs 2 through 4:

"Initially, nine soil borings (SB-CU02 through SB-CU10) will be drilled to bedrock and through the upper 10 feet of shallow groundwater (Figure 4-28). One boring (SB-CU02) will be completed adjacent to SB-CU01 and a monitoring well will be installed in the boring with one round of groundwater sampling performed. Second through fifth borings (SB-CU03 through SB-CU-6) will be completed near SB-CU01 as shown on Figure 4-28. A sixth boring (SB-CU07) will be completed near SB-BH02 and a seventh through ninth boring (CU08 through SU-10) will be completed near SB-BH03. In the nine borings soil samples will be collected at a minimum of 5-foot intervals, and in all boring but SB-CU02 groundwater will be collected from the upper 10 feet of groundwater through temporary well screen installations. Soil samples from the nine borings and grab groundwater samples from eight borings will be submitted for analysis with fluoride and sulfate analyses on an expedited basis.

If expedited soil analytical results indicate that concentrations of fluoride and/or sulfate exceed protection of groundwater screening levels throughout or at multiple depths in the soil column above the water table, that location would be considered within the soil source of contamination and additional step-out borings would be drilled at those locations. If expedited soil analytical results indicate that the vertical extent of detected concentrations of fluoride and sulfate in soil is defined and does not extend to the water table, and/or fluoride and sulfate are detected at concentrations that exceed groundwater protection levels only at depth above the water table, that location would be considered outside of a soil source of contamination to the water table. During each round of step-out borings, soil and groundwater samples would be collected as previously described and submitted for analysis with fluoride and sulfate analyses on an expedited basis. Investigation will continue until the horizontal extent of the soil source (fluoride and/or sulfate throughout or at multiple depths above the water table) has been defined and the investigation will be complete.

Two additional monitoring wells will be installed based on results of soil and groundwater data and one round of sampling will be performed in the wells. Because the Crucible Cleaning Room Area is located inside of an identified area-wide fluoride plume, it will be further addressed in a future groundwater monitoring program as determined in the FS or CAP."

Vertical extent of impact does not appear to have been identified at BH02. Yet SB-CU07 would only be drilled if exceedances of SLs are found elsewhere. How would extent of contamination BH02 ever be addressed if SB-CU07 is not triggered?

Response: Soil boring CU07 will be completed near BH02 in the initial round of investigation.

Section 4.9.2.3.2.

Initial investigation scope proposed here appears to be reduced from that described in the response to comments.

Why no soil samples proposed in SB-VS03? This would be a missed opportunity to verify the result from SB-VS01. Additional borings are only contingent upon groundwater results tripping SLs—how/when would the nature and extent of soil contamination at depth in SB-VS01 be delineated? See general comment.

Response: Six soil samples will be collected in SB-VS03.

In Section 4.9.2.3.2, paragraphs 2 through 4 will be modified as follows:

"Initially, two soil borings will be completed, with one (SB-VS03) near the location of SB-VS01 and the second (SB-VS04) located approximately 50 feet west of SB-VS01 to determine whether the SB-VS01 location is a soil source of contamination to the shallow groundwater. The borings will be drilled through the upper 10 feet of groundwater with a minimum of four soil samples collected including one above or near the water table. Samples of groundwater will be collected from the borings through a temporary well screen installation. Soil and groundwater samples will be submitted for analysis with cPAH and petroleum hydrocarbons on an expedited basis.

If detected concentrations of cPAH and petroleum hydrocarbons in soil exceed protection of groundwater screening levels, then an additional round of step-out borings will be drilled based on results of the expedited soil and groundwater data. The borings would be completed as described above. If detected concentrations of cPAH and petroleum hydrocarbon in soil do not exceed protection of groundwater screening levels, then the investigation will be considered complete.

If detected concentrations of cPAH and petroleum hydrocarbon in groundwater exceed MTCA Method

A or B screening levels, then nearby wells will be further addressed in a future groundwater monitoring program as determined in the FS and CAP."

In areas where we are drilling below the depth of groundwater and investigating potential for petroleum hydrocarbons, a soil sample should be collected at the groundwater table.

Response: One soil sample will be collected near or at the groundwater table if it occurs above the soil/bedrock contact.

Follow-up investigation is a great idea if a breach in a Scrubber Effluent line is identified from video inspection. Please describe generally what that might look like.

Response: If a breach is identified during the SE lines video survey, and it is not in the location of SB-VS01, we would follow up with a boring and collection of soil and groundwater samples at the observed breach location.

Section 4.9.2.5.2.

Soil samples should be collected at the water table.

Response: One soil sample will be collected in each boring above or near the water table.

Figures references in the first paragraph are incorrect.

Response: Both references should be to Figure 4-25 (decision tree).

In Section 4.9.5.2 first paragraph the text will be modified as follows:
"Proposed investigation of the SB-AST05 area incorporates an iterative approach (see Figure 4-25) to define the horizontal and vertical extent of cPAH and petroleum hydrocarbon contamination in soil and the potential impact to shallow groundwater. The decision tree (Figure 4-25) will guide field decisions on the need for and location of additional step-out borings."

Four samples in *each* boring?

Response: Four soil samples are proposed to be collected in each boring.
In Section 4.9.2.5.2 the fourth sentence of the second paragraph will be modified as follows:
"Initially four soil borings (SB-AST05A, SB-AST05B, AST05C, and AST05D) will be completed as shown on Figure 4-31 to determine whether this area is a soil source of petroleum hydrocarbons to shallow groundwater. One boring (SB-AST05A will be completed near the SB-AST05 location, and three borings (AST05B, AST05C, and AST05D) will be completed to the west, east and north of the SB-AST05 location. The borings will be completed to bedrock and through the upper 10 feet of shallow groundwater and at least four soil samples will be collected from each boring beginning at 0.5 ft bgs. One monitoring well will be installed in the shallow groundwater (UA zone) in SB-AST05A, and a single round of groundwater sampling will be performed. A grab sample of groundwater will be collected from SB-AST05B, SB-AST05C, and SB-AST05D from the upper 10 feet of groundwater through temporary well screen installations."

Text states, "If concentrations of petroleum hydrocarbons in soil ***and*** [emphasis added] shallow groundwater exceed MTCA Method A Industrial (soil) and MTCA Methods A and B (groundwater) screening levels than (*sic*) one additional soil boring (SB-AST05D) will be completed." The "and" here should be an "or". Also, what if the extent is unknown in the other direction—will boring(s) be placed there instead? If not, how would we define the extent? Typically step outs are to follow and bound the observed impacts. See general comment.

Response: In Section 4.2.2.5.2 the third and fourth paragraphs will be modified as follows: "If concentrations of petroleum hydrocarbons in soil exceed protection of groundwater screening levels then additional step-out borings will be completed from the location of screening level exceedance following the decision-tree approach. The borings would be completed, and soil and groundwater samples collected as described for borings SB-AST05B through SB-AST05D. If concentrations of petroleum hydrocarbons in soil do not exceed protection of groundwater screening levels in borings SB-AST05B through SB-AST05D, then the investigation of this area will be complete.

If concentrations of petroleum hydrocarbons in groundwater exceed MTCA Method A or B, then this area will be further addressed in a future groundwater monitoring program. Groundwater samples will be collected from nearby existing monitoring wells as part of the WPA fieldwork and will be used to define the lateral extent of groundwater plume in this area. Shallow UA zone groundwater may not be present in this area based on past investigation results."

Section 4.9.2.6. In some places this area is referred to as the Friction Weld Building. It is shown as SB-FW01 Investigation Area on Figure 4-26. Please use consistent naming throughout when referring to investigation areas.

Response: Figures 4-21 and 4-26 will revise the name of this investigation area to "The Friction Weld Building Investigation Area". The revised figures are attached to these comments.

Section 4.9.2.6.1

The objective listed only notes defining the vertical extent of contamination. How will horizontal extent be defined?

An objective for Ecology for this area is to determine if soils in the vicinity are likely to be contributing to the observed area wide groundwater plume.

Response: In Section 4.9.2.6.1 the first bullet will be revised as follows: "Determine the horizontal and vertical extent of fluoride in soil at the SB-FW01 location."

Section 4.9.2.6.2

Why are samples beginning at 6'?

Response: In Section 4.9.2.6.2, the second and third paragraphs will be modified as follows: "Initially, two soil borings (SB-FW05 and SB-FW06) will be completed at the location of SB-FW01 (Figure 4-32) to determine if this area is a potential source of fluoride contamination to shallow groundwater. One boring (SB-FW05) will be drilled east of SB-FW01, and a second boring (SB)-FW06) will be drilled to the west. The soil borings will be completed to bedrock and through the upper 10 feet of shallow groundwater. A minimum of four soil samples will be collected from each boring including one above or near the water table, if the water table occurs above the soil/bedrock contact. A grab sample of groundwater will be collected from the soil boring through temporary well screen installations.

If concentrations of fluoride in soil are below the protection of groundwater screening level, then the investigation of this area would be complete. If concentrations of fluoride in soil exceed the protection of groundwater screening level, then additional step-out borings would be completed from the location of screening level exceedance following the decision tree approach. If concentrations of fluoride in shallow groundwater exceed MTCA Method A or B, then this area would be further addressed in a future groundwater monitoring program as determined in the FS or CAP."

In Section 4.9.2.6.2, the first sentence in the fourth paragraph will be modified as follows: "Temporary wells screens will be installed in the soil borings to facilitate collection of grab samples of shallow groundwater."

How is this an iterative approach? Either way you're only proposing to install one boring. See general comment.

Response: See response to the above comment.

Section 4.9.2.7

Please correct the second sentence of third paragraph. What was between 16J to 17 mg/l? Where? Assuming F, and assuming RI-GW5-UA.

Response: In Section 4.9.2.7, the second sentence of the third paragraph will be modified as follows: "During the 2017 quarterly groundwater monitoring program (Appendix C, Figures C2-4, C2-5, C3-4, and C3-5) concentrations of Fluoride detected in RI-GW5-UA ranged from 160 to 190 mg/L, and in RI-MW10-BAU, ranged from 27 to 32 mg/L."

Last paragraph notes, "While the source of fluoride and sulfate in soil at depth at the SB-SE08 location is not clear, the occurrence of fluoride and sulfate in SB-SE08 may be from a similar source as at SB-FW01 based on their proximity, similar vertical concentration profile of fluoride and sulfate detected in soil, and no clear source for either location." This is an important point since these areas are coincident with the center of the fluoride plume. Seems like these two investigation areas are really investigating the same issue.

Response: In Section 4.9.2.7, the fourth paragraph will be modified as follows:
"While a surface source of fluoride and sulfate in soil at depth at the SB-SE08 location is not clear, as discussed in Section 4.9.2.2 the occurrence of concentrations of fluoride and sulfate in soil that exceed protection of groundwater screening levels at depth may be a result of interaction between soil and a fluctuating water table within the area-wide fluoride plume."

Section 4.9.2.7.1. An objective for Ecology for this area is to determine if soils in the vicinity are likely to be contributing to the observed area wide groundwater plume.

Response: Understood.

Section 4.9.2.7.2

Why are all borings in the same direction? Is there a need for a boring in the direction of SB-FW01?

Response: Physical impediments limit placing borings to the south of SB-FW01. There is a buried high voltage line located immediately south throughout courtyards A1 through A5, and the ground surface slopes steeply upward to the south from the location of SB-SE08B nearly to SB-FW01, which is the adjacent additional investigation area.

In Section 4.9.7.2, the second through fourth paragraphs will be modified to become the second and third paragraphs as follows:

"Initially, three soil borings (SB-SE08A, SB-SE08B, and SB-SE08C) will be completed in the boring SB-SE08 area to determine if this area may be a soil source of fluoride and sulfate to shallow groundwater (Figure 4-33). Boring B-SE08A will be completed near the SB-SE08 location, borings SB-SE08B and SB-SE08C will be completed to the west and east of SB-SE08. The borings would be drilled to bedrock and through the upper 10 feet of shallow groundwater. A minimum of four soil samples will be collected from each boring. A monitoring well (UA or BAU) will be installed in SB-SE08A, and one round of groundwater sampling will be performed. A grab sample of groundwater will be collected from SB-SE08B and SB-SE08C from the upper 10 feet of groundwater through a temporary well screen installation.

If concentrations of fluoride and sulfate in soil are below the protection of groundwater screening levels, then the investigation of this area would be complete. If concentrations of fluoride and sulfate in soil exceed the protection of groundwater screening level, then additional step-out borings would be completed from the location of screening level exceedance following the decision tree approach, although step-out borings are constrained to the south by a steep slope to near boring SB-FW01 which is the adjacent investigation area. If concentrations of fluoride and sulfate in shallow groundwater exceed MTCA Method A or B or secondary MCL screening levels, then this area would be further addressed in a future groundwater monitoring program as determined in the FS or CAP."

Please explain the logic behind using "similar concentrations to those detected in boring SB-SE08" as a decision trigger and how it will result adequate definition of nature and extent of contamination.

Response: As discussed in Section 4.9.2.2 (revised text shown in comment above) detected concentrations of fluoride and sulfate in soil that exceed protection of groundwater screening levels throughout the soil column above the water table may indicate the area could be a soil source of contamination to shallow groundwater. However, if concentrations of fluoride and sulfate increase with depth, that may be a result of interaction between soil and a fluctuating water table within the area-wide fluoride plume and not represent a soil source of contamination.

Section 4.9.3.1.2. Manhole MH1L4 is referred to but not labeled on figure. Please label.

Response: In Section 4.9.3.1.2, Figure 4-38 has manholes correctly labeled and the fourth sentence in the first paragraph will be modified as follows:
"Additional SE manholes MH1L1 through MH4L1, located in Passage No. 3, will also be opened and inspected to determine if sediment or blockage is present further upstream."

Section 4.9.3.2. Lines 1 through 5 are referred to but not labeled on figure. Please label.

Response: The Figures will be updated and labeled for inclusion in the final WPA.

Section 4.9.3.2.2. What antecedent rainfall conditions will be targeted? Watching how this discharge responds to rain events will help determine inflow vs infiltration. A rapid flow response at the outlet following a rain event would point to a stormwater cross connection vs an attenuated response which would indicate a shallow groundwater source. This type of evaluation should be considered.

Response: The objective was to measure the rate of groundwater flow, in the groundwater collection line, at more than one seasonal time to obtain a minimum/maximum groundwater flow rate.

Information has already been collected during the RI that suggests that the stormwater system responds quickly to precipitation events. There is data and visual inspections that shows there is a physical interconnection and co-mingling between the stormwater line and groundwater line at MH4L5. Data also indicates the SE Line system in passage no. 3 and up near the crucible cleaning area may have breach. The lines near the crucible cleaning area are the main investigation of the video survey. There is always flow in some portions of the piping system regardless of season or precipitation, which suggests year-round contribution of shallow groundwater. The idea of the sampling was to roughly bracket the flow rate in the piping that leads to the stormwater pond and NPDES pond.

Section 4.9.3.3.1. Text says, "up to two seasonal samples of the discharge water will be collected". What will determine whether one or two samples will be collected? Text in next section says one sample. Will seasonal variability be evaluated? What antecedent rainfall conditions will be targeted?

Response: In Section 4.9.3.3.1, the second sentence in the first paragraph will be modified as follows: "Two samples of the discharge water will be collected at two different seasonal times to characterize water discharging at the head of Pond A."

Note that data collected from the springs and shallow wells do not show seasonal variations in contaminant concentrations. The objective was simply to document the flow in the pipe system during different seasons and to collect samples at that time to confirm there are not significant changes in chemical concentrations.

**Yakama Nation Comments**

Overall, the plan provides better clarity on the approaches to defining the groundwater pathways and the risk of contaminant transport. We do have a few concerns and comments, however.

The major concern is that, while groundwater occurrence and movement is probably the biggest concern being investigated, the proposed sampling period is in the fall, which the workplan acknowledges in Section 4.7.1., is not the best time for finding groundwater. The plan should include additional sampling over different seasons, particularly during expect higher water periods. It would also be helpful to monitor storm responses at the site.

The groundwater data collected from wells at the site do not show that groundwater is only seasonally present at most locations. Most wells at the site either persistently contain water or are consistently dry, regardless of the season.

The sentence explaining the rationale for spring sampling in the Fall (Section 4.7.1, page 4-43) will be deleted.

The text will be revised to state that "installation of the hand-driven well points as well as sampling and flow characterization of the springs will be delayed until Winter or Spring in order to obtain the necessary USACE access permits. Both seasons represent higher water periods."

Other more specific concerns include:

Section 4.7.2.2. We appreciate the additional well points along the flow path to the Columbia River, but as noted above, the sampling should be done at the most appropriate season, and best over at least two seasons.

As noted above the well points will be sampled in the Winter or Spring, depending on when access agreements are obtained.

Section 4.7.4.2 Water Balance. A water balance could be very helpful in understanding the potential movement of contaminated ground water. However, it is difficult to see how this balance can be developed without substantial seasonal data. In addition, the balance does not consider groundwater flow that may be occurring from upgradient of the site.

The water balance was intended to evaluate groundwater migration toward the Columbia River along two specific suspected flow paths toward the Columbia River (the stormwater pond and the NPDES Pond A Drainage) and not on a site-wide basis. Detailed seasonal assessments and site-wide modeling do not appear warranted because it does not appear that groundwater is migrating to the Columbia River except perhaps in the localized areas identified in the Draft RI and WPA.

Section 4.9.2.1.2. Test pits. It's not clear why the pits are limited to depths of 4ft. The pits should extend to the greater of 4 ft. or 1 ft. below the depth of visible contamination, if present. In addition, soil samples should be collected from all layers where o visible contamination is noted. If necessary, some of those samples could be archived.

Response: Based on the RI data collected to this point (Figures C7-1 and C7-2) and included in the WPA, we believe that as a general case contaminates in soil in the courtyard segments occur primarily between depths of 0 and 3 ft bgs. This includes visible black soil containing elevated metals, fluoride, and TTEC. The WPA test pit program proposes test pits at every previously sampled location where vertical extent of contamination was not defined. Most test pits will go to 4 ft bgs, a few will go to 5 ft bgs. If visible contamination is observed, we will deepen the investigation below the visible soil layer before collecting a soil sample. Other isolated areas with deeper soil contamination in courtyard segments are being investigated separately in additional investigation areas.

Page 4-68—4-69 An editorial comment. There are duplicate paragraphs beginning with "Table 4-3…"

Response: The duplicate paragraph will be removed.

Table 4-3. An editorial comment. The total number of samples in the table does not match the text (61 in table, 59 in text).

Response: In Section 4.9.1.2, the last sentence of the second paragraph will be modified as follows: "A total of 63 shallow test pits are proposed to be excavated, and a total of 61 soil samples collected including 5 duplicate samples."

Section 4.9.3.3.1. The test in this section states that wo seasonal samples of water from pipe will be collected, which is preferred, but Section 4.9.3.3.2. states that only one sample will be collected.

Response: In Section 4.9.3.3.2, the first sentence of the first paragraph will be modified as follows: "Two water samples and one duplicate sample will be collected at two different seasonal times from the SE Line discharge."

See previous responses regarding seasonality and objectives for the sampling.

Section 5.1 work. The plan proposes abandoning the "temporary wells" after only the one round of sampling. Why not retain those wells for potential future sampling? This reuse might support seasonal sampling as suggested previously.

Response: The only installations that will be abandoned after sampling will be the temporary well screen installations which are not wells and must be removed within 72 hours. The single purpose of these well screen installations is to facilitate collection of grab groundwater samples that are filtered.

# Appendix B

# Hydrogeologic Supporting Figures


Legend

Production Well

Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

BAU$_1$ - Shallower Water-bearing Zone

BAU$_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

BAL$_1$ - Shallower Water-bearing Zone

BAL$_2$ - Deeper Water-bearing Zone

BAL$_3$ - Deepest Water-bearing Zone

A A' Cross-Section

Spring

N W E S

0 500 1,000 2,000

Feet

1:15,000 1 inch = 1,250 feet

Imagery Source: NAIP 2017

Figure 2-8
Lines of Cross-Section

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

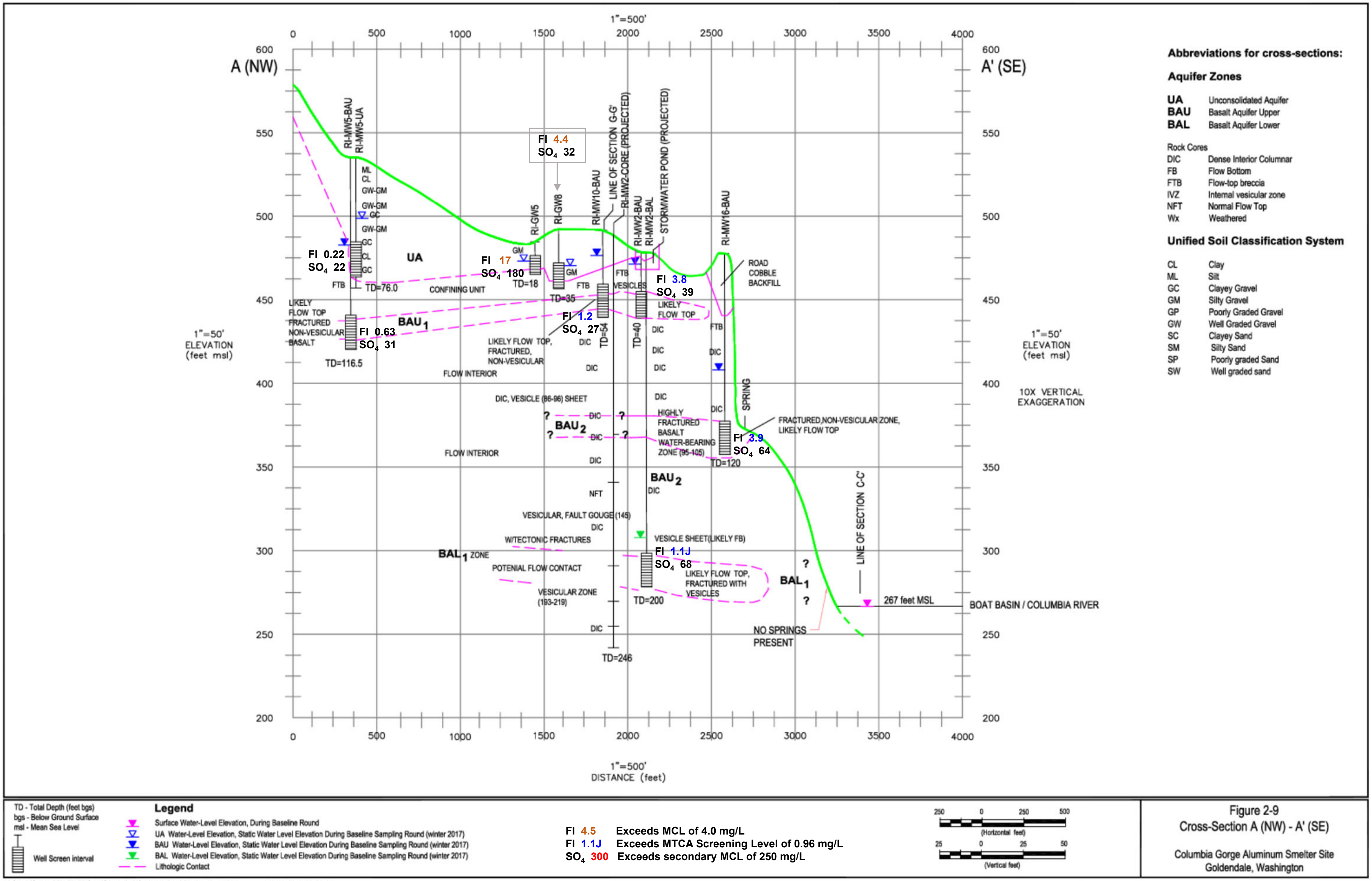
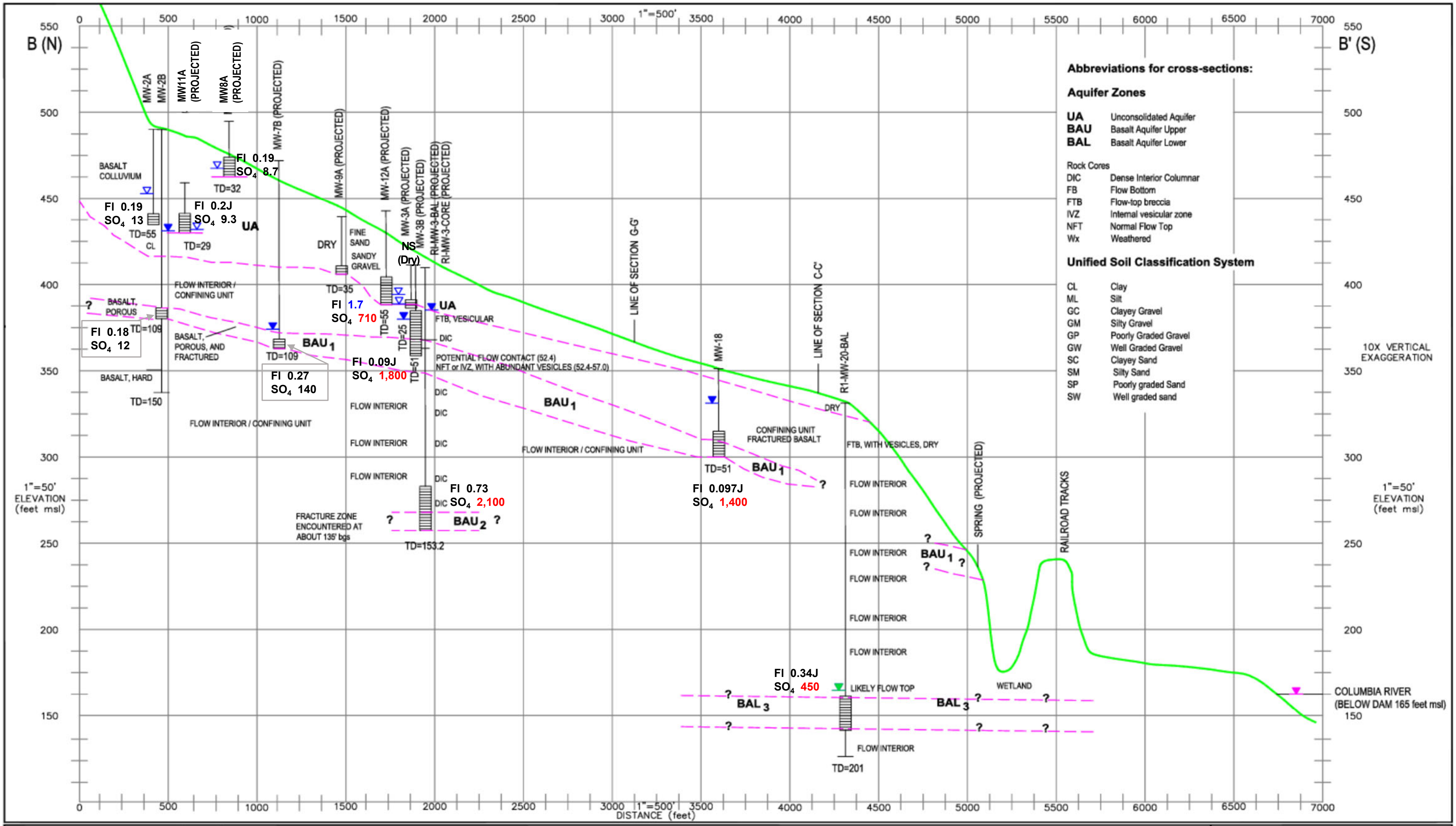



Figure 2-9
Cross-Section A (NW) - A' (SE)
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




TD - Total Depth (feet bgs)
bgs - Below Ground Surface
msl - Mean Sea Level

Well Screen interval

**Legend**

- Surface Water-Level Elevation, During Baseline Round
- UA Water-Level Elevation, Static Water Level Elevation During Baseline Sampling Round (winter 2017)
- BAU Water-Level Elevation, Static Water Level Elevation During Baseline Sampling Round (winter 2017)
- BAL Water-Level Elevation, Static Water Level Elevation During Baseline Sampling Round (winter 2017)
- Lithologic Contact

| | |
|---|---|
| Fl 4.4 | Exceeds MCL of 4.0 mg/L |
| Fl 1.1J | Exceeds MTCA Screening Level of 0.96 mg/L |
| $SO_4$ 300 | Exceeds secondary MCL of 250 mg/L |
| NS | Not Sampled |

25 0 25 50 (Horizontal feet)
250 0 250 500 (Vertical feet)

Figure 2-10
Cross-Section B (N) - B'(S)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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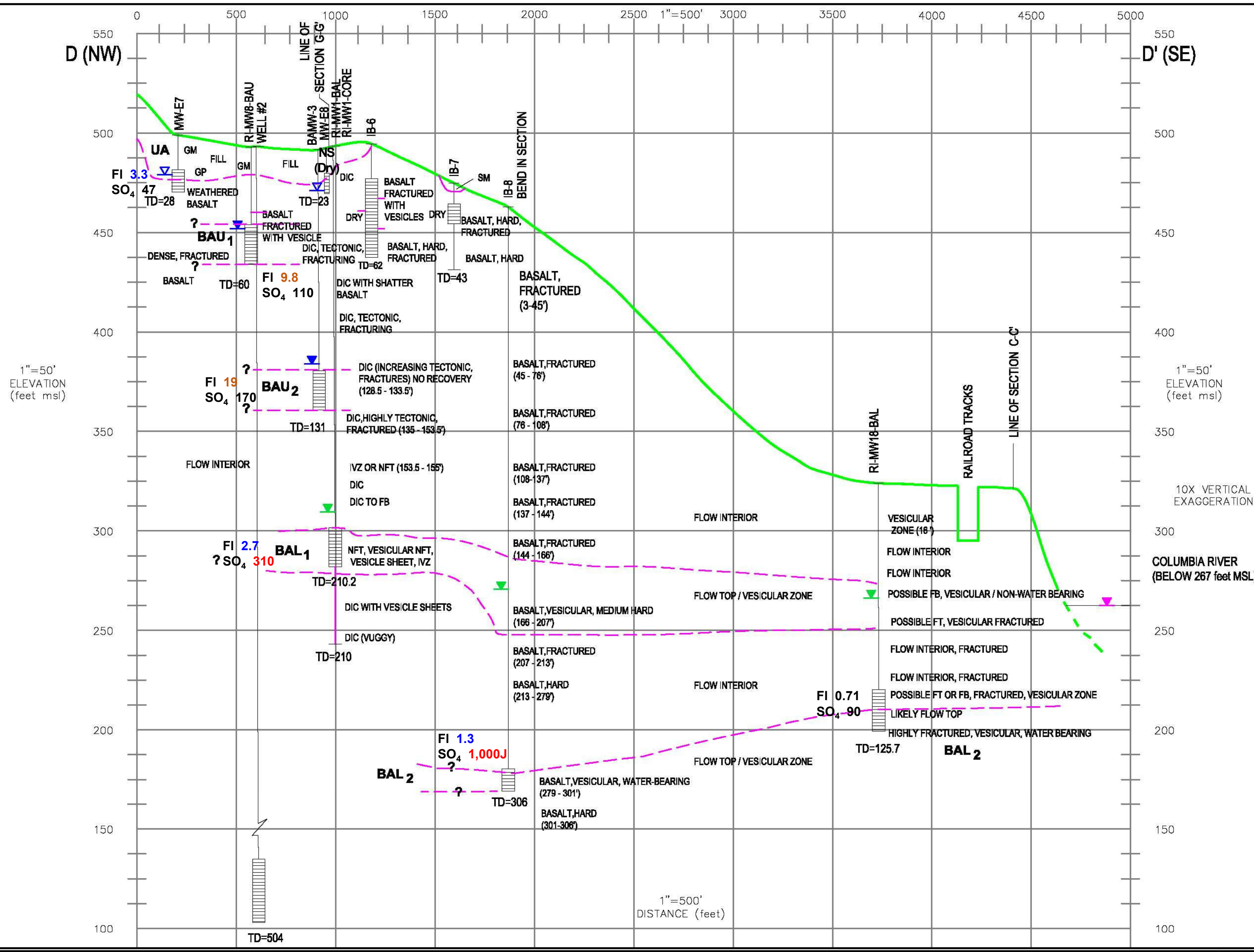


**Abbreviations for cross-sections:**

**Aquifer Zones**

**UA** Unconsolidated Aquifer
**BAU** Basalt Aquifer Upper
**BAL** Basalt Aquifer Lower

Rock Cores

DIC Dense Interior Columnar
FB Flow Bottom
FTB Flow-top breccia
IVZ Internal vesicular zone
NFT Normal Flow Top
Wx Weathered

**Unified Soil Classification System**

CL Clay
ML Silt
GC Clayey Gravel
GM Silty Gravel
GP Poorly Graded Gravel
GW Well Graded Gravel
SC Clayey Sand
SM Silty Sand
SP Poorly graded Sand
SW Well graded sand

TD - Total Depth (feet bgs)
bgs - Below Ground Surface
msl - Mean Sea Level
Well Screen interval

**Legend**

Surface Water-Level Elevation, During Baseline Round
UA Water-Level Elevation, Static Water Level Elevation During Baseline Sampling Round (winter 2017)
BAU Water-Level Elevation, Static Water Level Elevation During Baseline Sampling Round (winter 2017)
BAL Water-Level Elevation, Static Water Level Elevation During Baseline Sampling Round (winter 2017)
Lithologic Contact

FI 4.2 Exceeds MCL of 4.0 mg/L
FI 1.1J Exceeds MTCA Screening Level of 0.96 mg/L
$SO_4$ 300 Exceeds secondary MCL of 250 mg/L
NS Not Sampled

250 0 250 500 (Horizontal feet)
25 0 25 50 (Vertical feet)

Figure 2-12
Cross-Section D (NW) - D'(SE)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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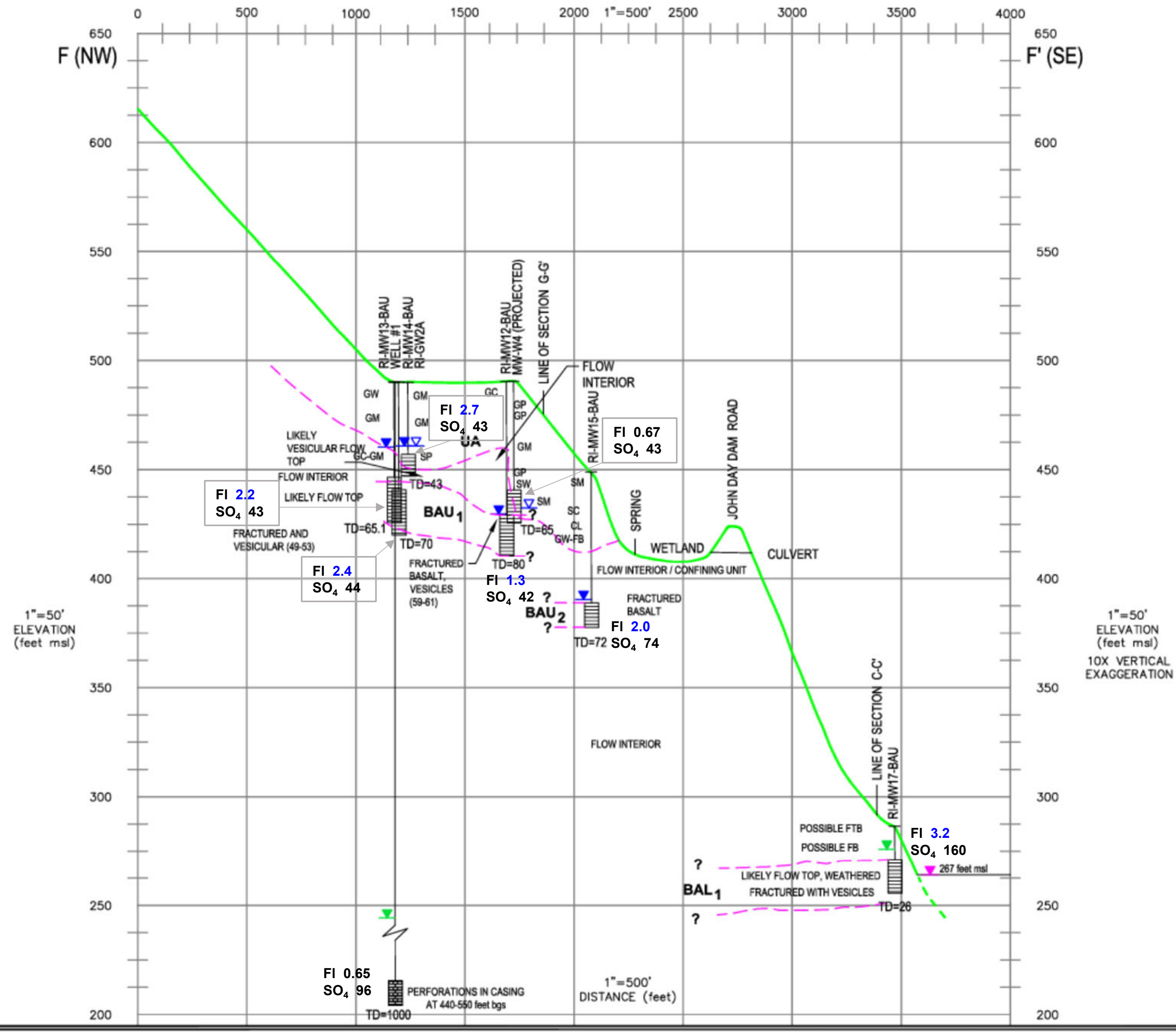


**Abbreviations for cross-sections:**

**Aquifer Zones**

| | |
|---|---|
| **UA** | Unconsolidated Aquifer |
| **BAU** | Basalt Aquifer Upper |
| **BAL** | Basalt Aquifer Lower |

Rock Cores

| | |
|---|---|
| DIC | Dense Interior Columnar |
| FB | Flow Bottom |
| FTB | Flow-top breccia |
| IVZ | Internal vesicular zone |
| NFT | Normal Flow Top |
| Wx | Weathered |

**Unified Soil Classification System**

| | |
|---|---|
| CL | Clay |
| ML | Silt |
| GC | Clayey Gravel |
| GM | Silty Gravel |
| GP | Poorly Graded Gravel |
| GW | Well Graded Gravel |
| SC | Clayey Sand |
| SM | Silty Sand |
| SP | Poorly graded Sand |
| SW | Well graded sand |

TD - Total Depth (feet bgs)
bgs - Below Ground Surface
msl - Mean Sea Level

Well Screen interval

**Legend**

- Surface Water-Level Elevation, During Baseline Round
- UA Water-Level Elevation, Static Water Level Elevation During Baseline Sampling Round (winter 2017)
- BAU Water-Level Elevation, Static Water Level Elevation During Baseline Sampling Round (winter 2017)
- BAL Water-Level Elevation, Static Water Level Elevation During Baseline Sampling Round (winter 2017)
- Lithologic Contact

FI 1.1J Exceeds MTCA Screening Level of 0.96 mg/L
$SO_4$ 300 Exceeds secondary MCL of 250 mg/L

25 0 25 50 (Horizontal feet)
250 0 250 500 (Vertical feet)

Figure 2-14
Cross-Section F (NW) - F'(SE)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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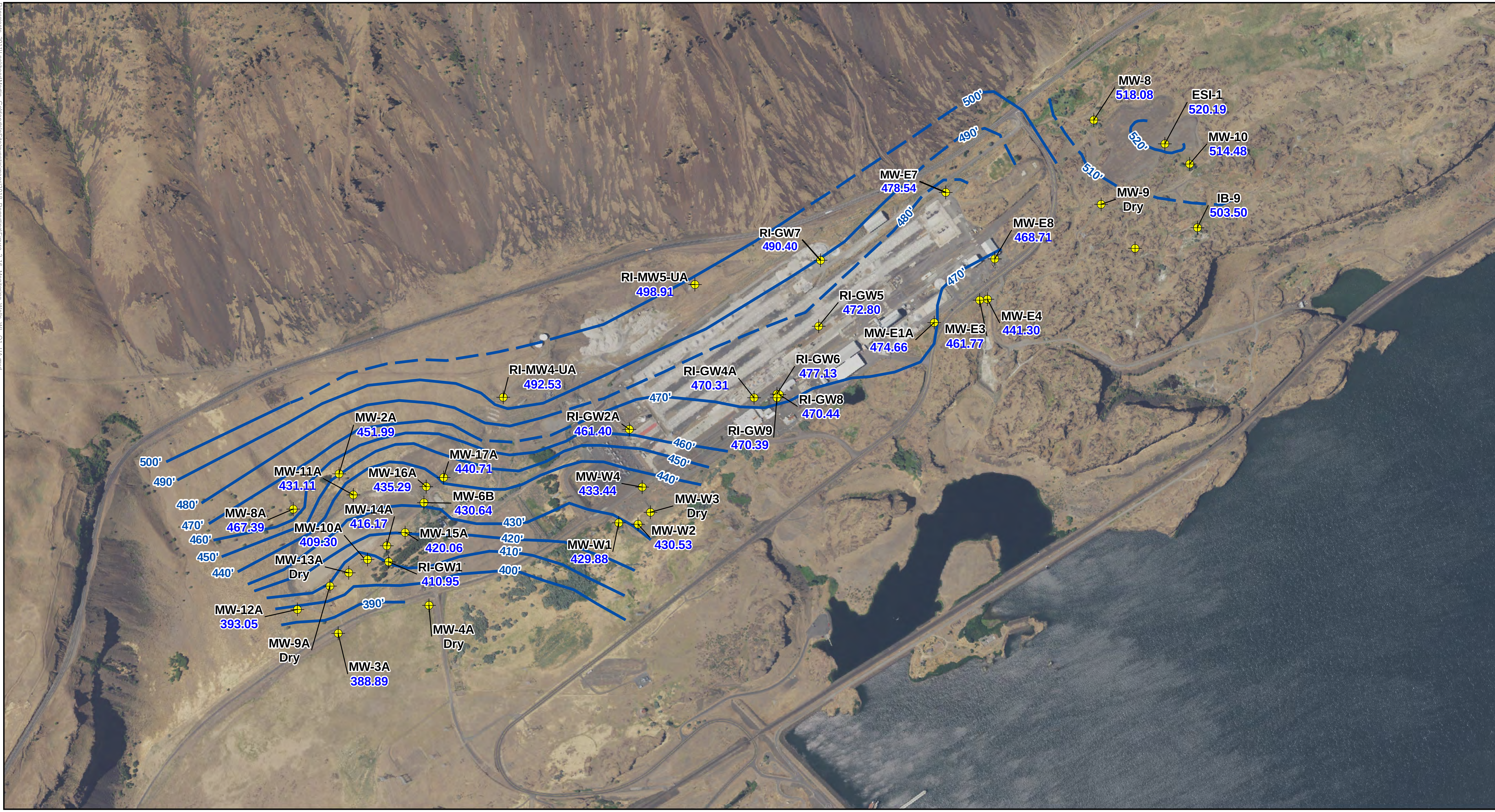



Legend

- Unconsolidated Aquifer (UA) Well
- 388.89 Round 1 (Winter 2017) Static Water Level Elevation
- 300' 10' Water-Level Elevation Contour

N
W E
S

0 500 1,000 2,000
Feet

Imagery Source: NAIP 2017

Figure 2-16
Water-Level Elevations
Unconsolidated Aquifer Wells (UA)
Quarter 1 (Winter 2017)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington


Legend

Uppermost Basalt Aquifer Well (BAU)

$BAU_1$ - Shallower Water-bearing Zone

$BAU_2$ - Deeper Water-bearing Zone

331.21 Round 1 (Winter 2017) Water-Level Elevation

515' 30' Water-Level Elevation Contour

Spring

N W E S

0 500 1,000 2,000 Feet

Imagery Source: NAIP 2017

Figure 2-17
Water-Level Elevations
Uppermost Basalt Aquifer Wells (BAU)
Quarter 1 (Winter 2017)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington


Legend

Lower Basalt Aquifer Well (BAL)

- $BAL_1$ - Shallower Water-bearing Zone
- $BAL_2$ - Deeper Water-bearing Zone
- $BAL_3$ - Deepest Water-bearing Zone

165.77 Round 1 (Winter 2017) Water-Level Elevation

275' 10' Water-Level Elevation Contour $BAL_1$

265' 10' Water-Level Elevation Contour $BAL_2$

N W E S

0 500 1,000 2,000

Feet

Imagery Source: NAIP 2017

Figure 2-18
Water-Level Elevations
Lower Basalt Aquifer (BAL) Wells
Quarter 1 (Winter 2017)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

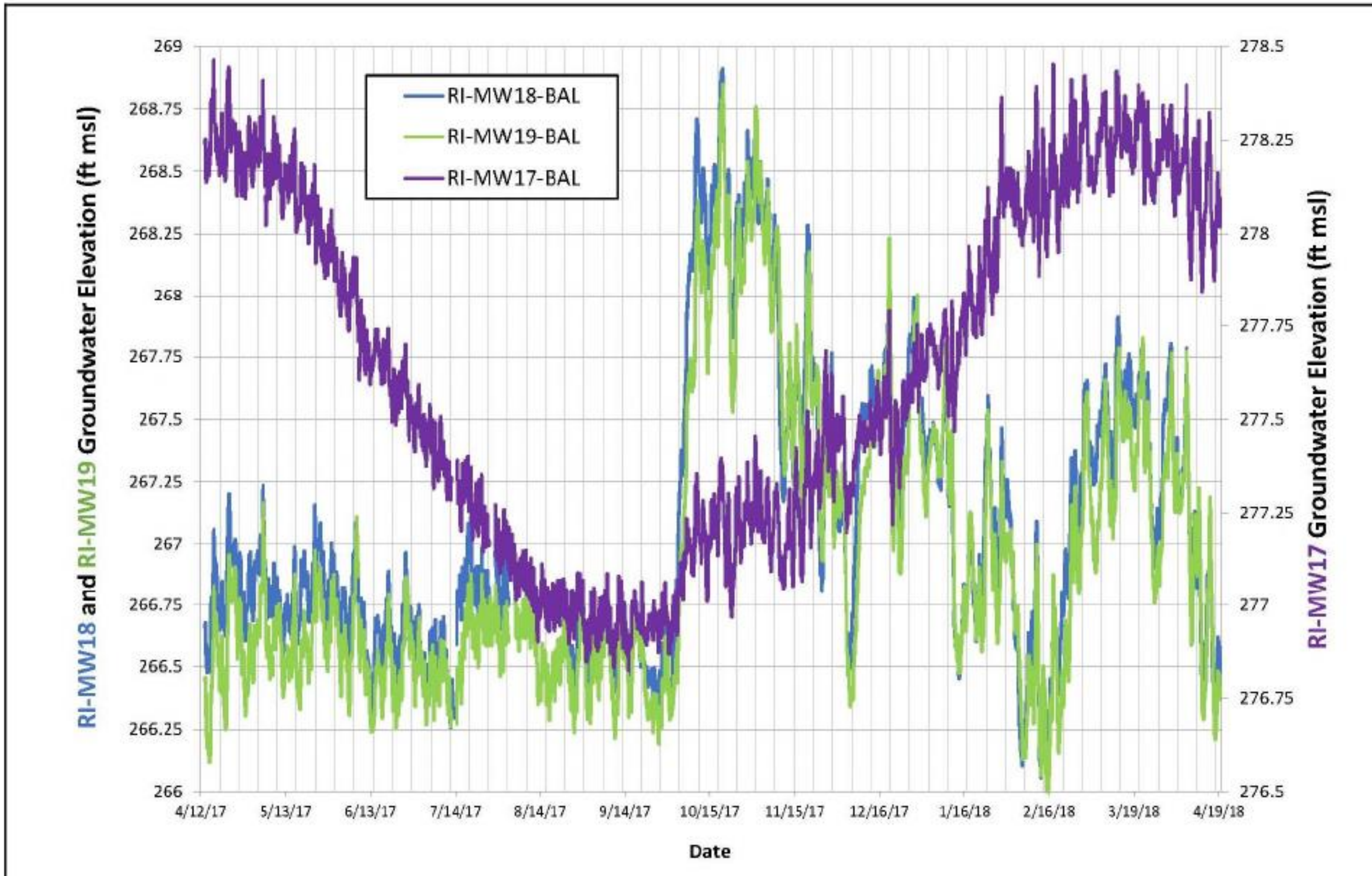
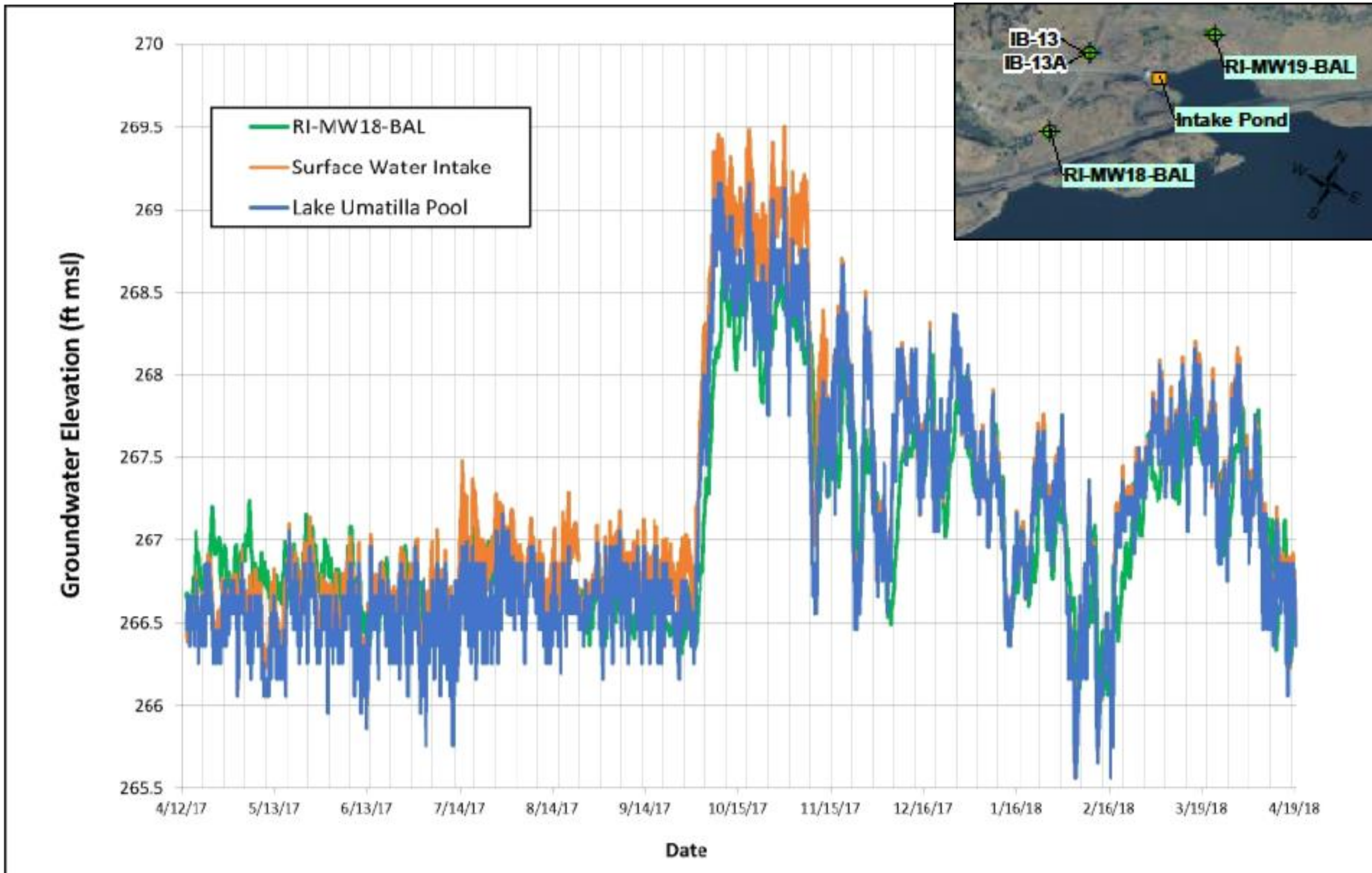




**Figure 2-22**

BAL Aquifer Zone Water-Level Elevations near the Columbia River

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



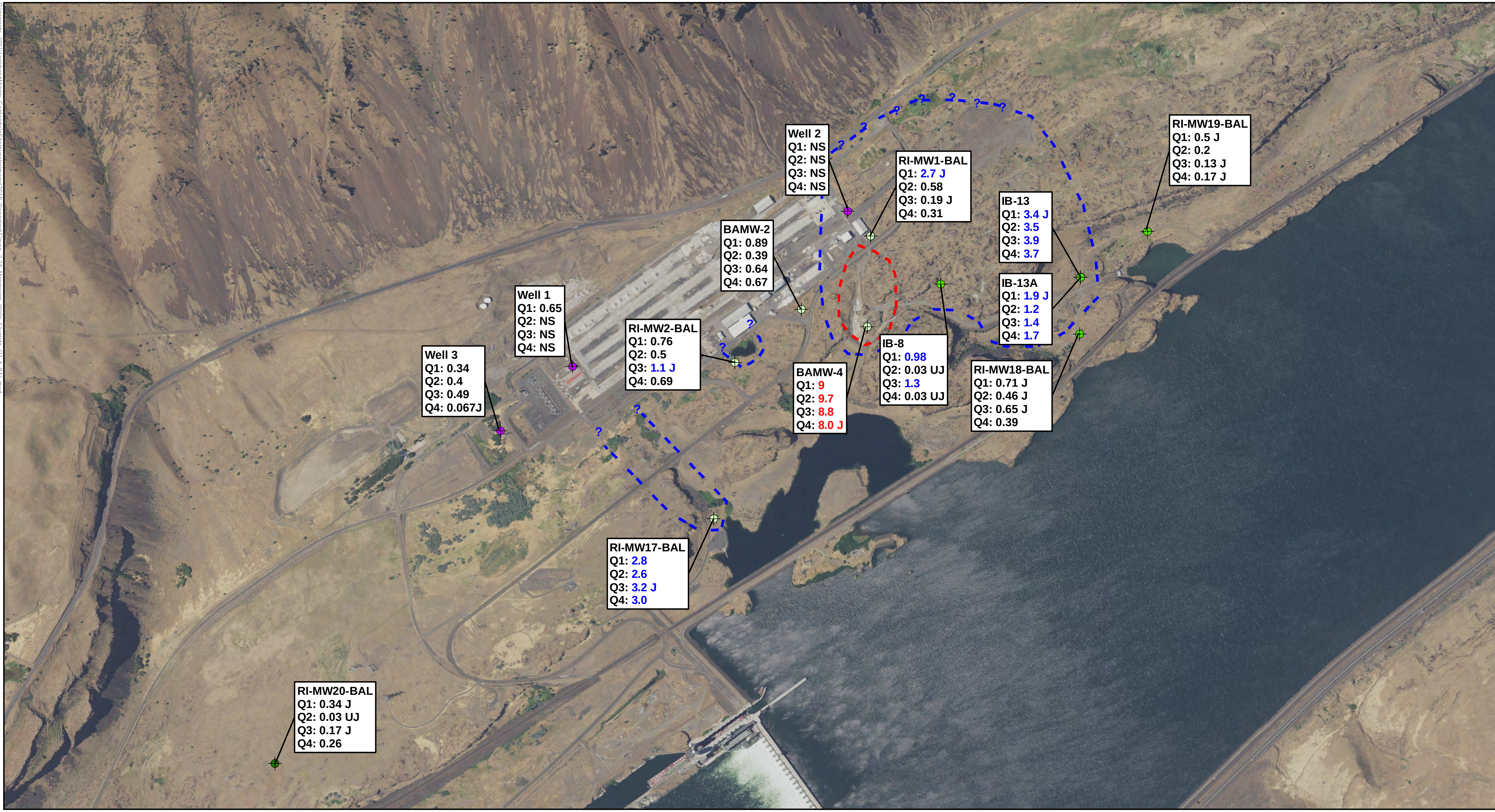

**Legend**

ft msl = Feet mean sea level
BAL = Basalt Aquifer Lower

**Figure 2-23**

BAL Aquifer Zone Water-Level Elevations and Nearby Surface Water Water-Level Elevations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Legend

Lower Basalt Aquifer Well (BAL)

- $BAL_1$ - Shallower Water-bearing Zone
- $BAL_2$ - Deeper Water-bearing Zone
- $BAL_3$ - Deepest Water-bearing Zone

RI-MW20-BAL 0.34 J — Well Identification, Concentration

Production Well

Screening Levels

- 4 mg/L MCL
- 0.96 mg/L MTCA Method B

MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
Concentrations in milligrams per liter (mg/L)
NS: Not Sampled

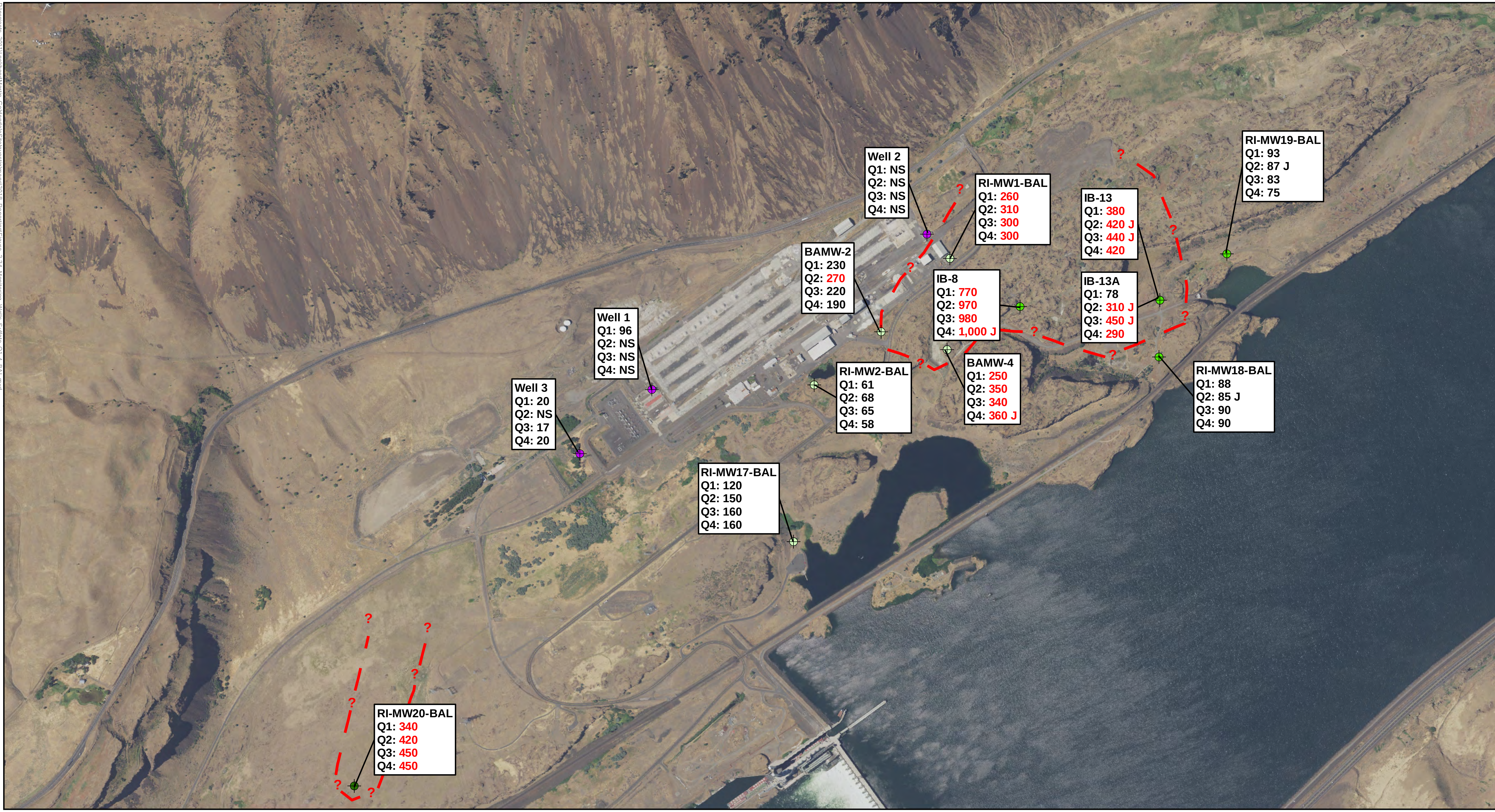
J: Estimated Concentration
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

N W E S

0 500 1,000 2,000
Feet
Imagery Source: NAIP 2017

Figure 2-28
Concentrations for Fluoride In Lower Basalt Aquifer (BAL) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Legend

Lower Basalt Aquifer Well (BAL)

- $BAL_1$ - Shallower Water-bearing Zone
- $BAL_2$ - Deeper Water-bearing Zone
- $BAL_3$ - Deepest Water-bearing Zone

RI-MW20-BAL 340 — Well Identification, Concentration

Production Well

Screening Levels
250 mg/L Secondary MCL

MCL: Maximum Contaminants Level
J: Estimated Concentration
Concentrations in milligrams per liter (mg/L)

NS: Not Sampled
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

N W E S

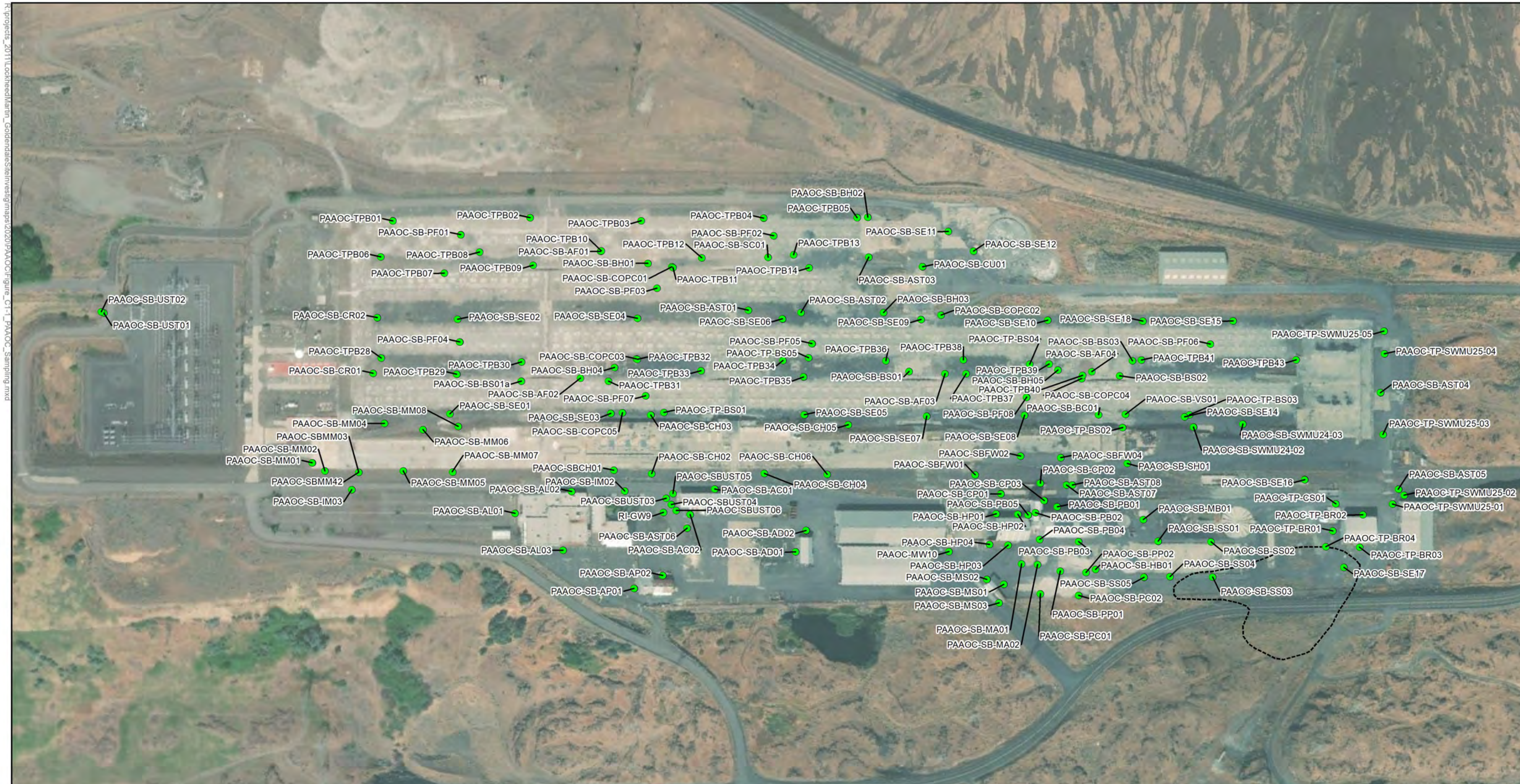
0 500 1,000 2,000
Feet
Imagery Source: NAIP 2017

Figure 2-34
Concentrations for Sulfate In
Lower Basalt Aquifer (BAL) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

# Appendix C

# Figure Package for Plant Area Footprint




Legend

Sample Location

East End Landfill

W N S E

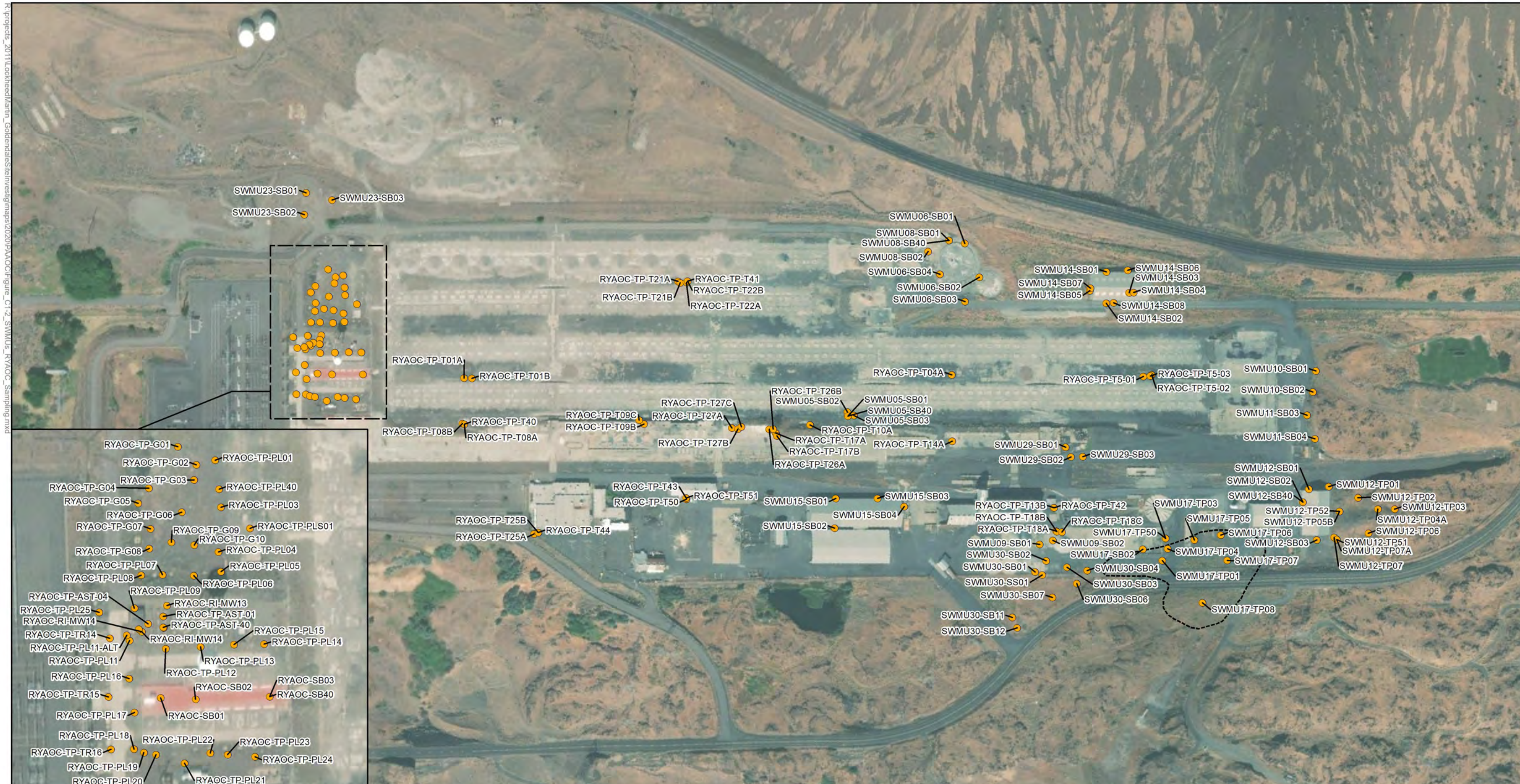
0 250 500

Feet

Figure C1-1
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps2020\PAAOC\Figure_C1-1_PAAOC_Sampling.mxd



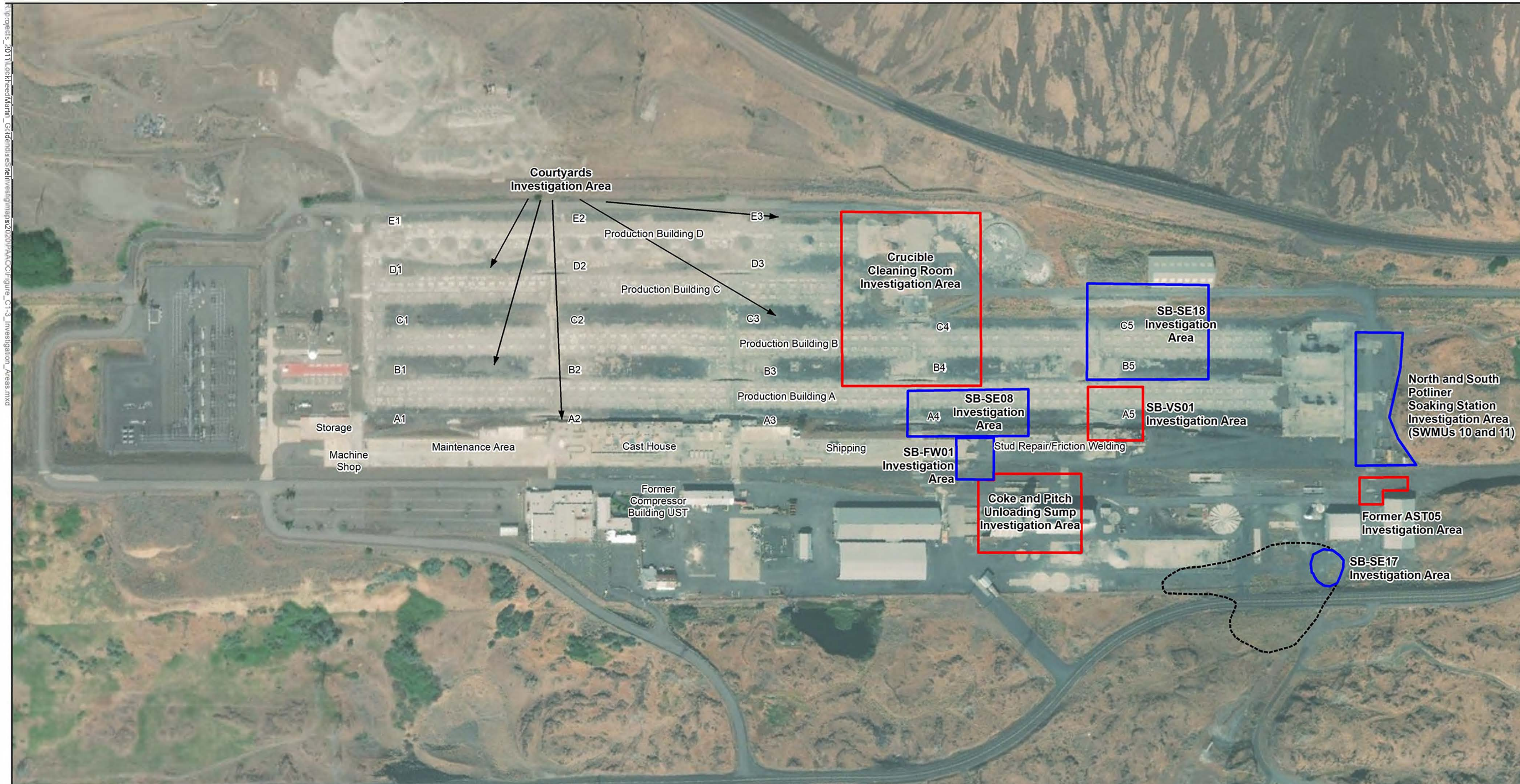

**Legend**

- Sample Location
- East End Landfill


0 250 500
Feet

Figure C1-2
Rectifier Yard AOC
and SWMU Sample Locations,
Plant Area Footprint

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




WPA Investigation Area

Additional WPA Investigation Area

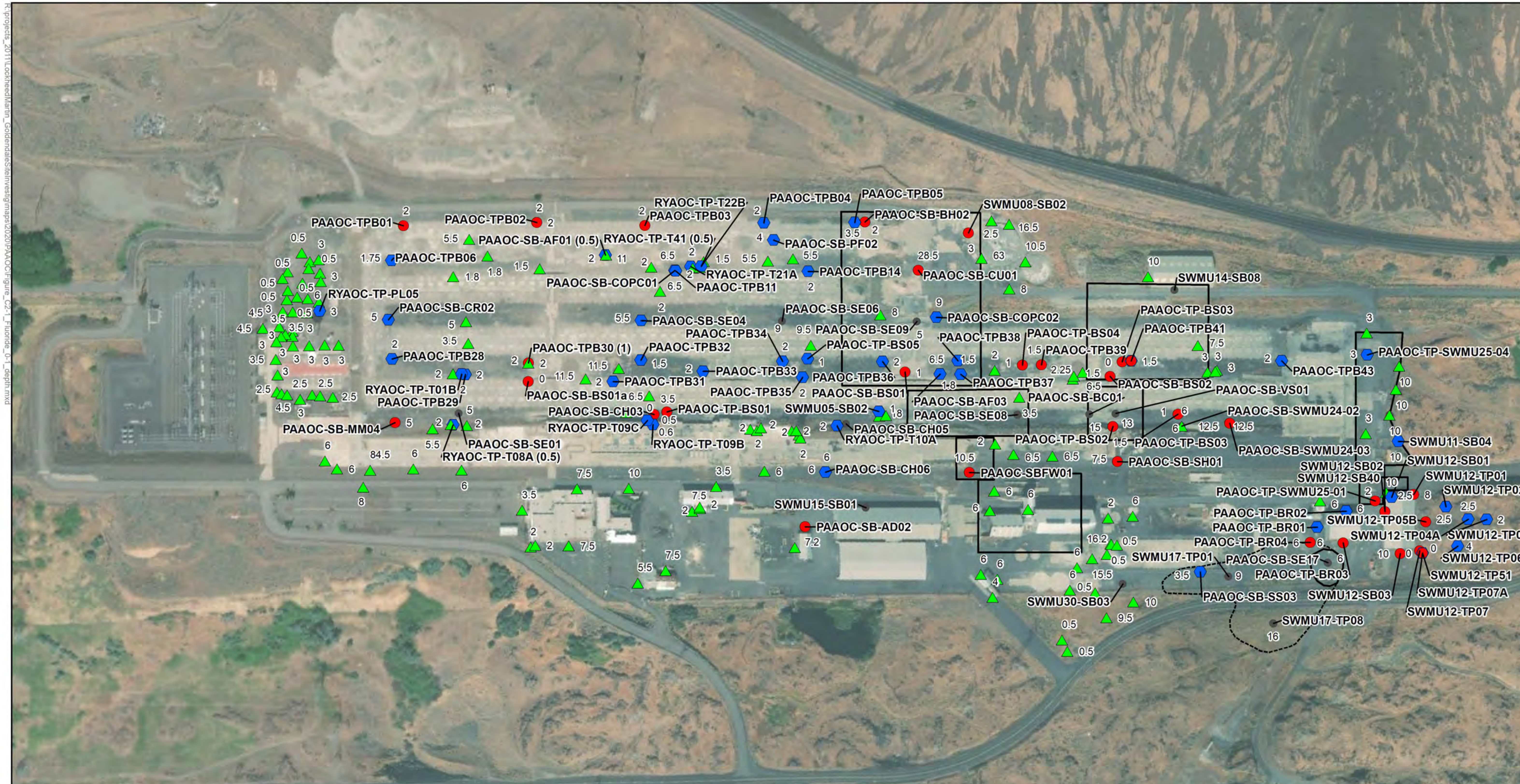
East End Landfill

N E S W

0 250 500
Feet

Figure C1-3
Areas Proposed for Additional Investigation
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

- ▲ Soil concentration is lower than the MTCA Soil Screening Level for Groundwater Protection of 147.6 mg/kg that is based on MTCA Method B Groundwater Screening Level of 0.96 mg/L.
- ⬢ Soil concentration exceeds the MTCA Soil Screening Level for Groundwater Protection of 147.6 mg/kg.
- ● Soil concentration exceeds the MTCA Soil Screening Level for Groundwater Protection of 615 mg/kg that is based on the MCL of 4.0 mg/L.

15 — Total Boring/Test Pit Depth

Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)

SWMU08-SB01

- ● Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

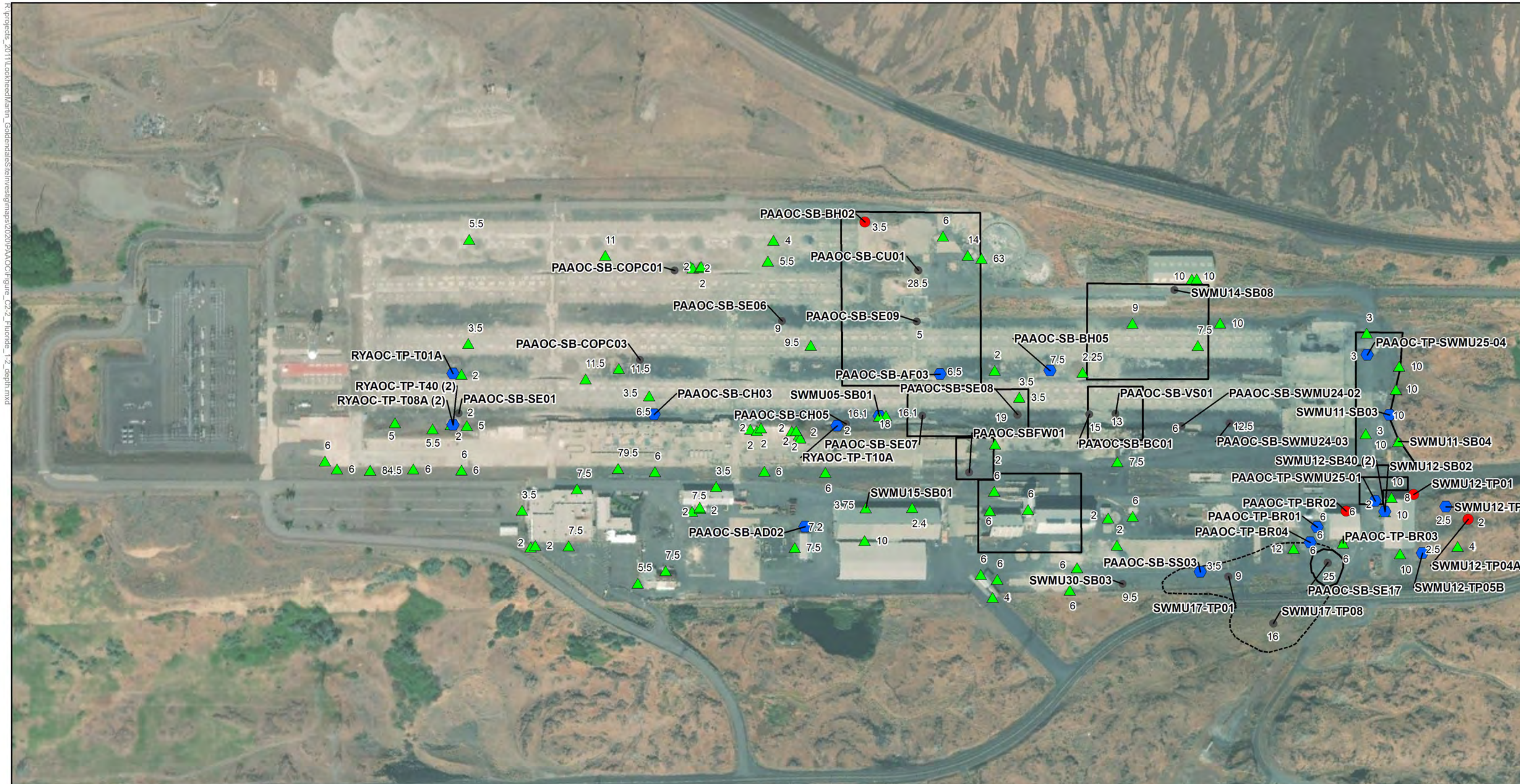
N E S W

0 250 500

Feet

Figure C2-1
Fluoride Concentrations at 0-1 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

- ▲ Soil concentration is lower than the MTCA Soil Screening Level for Groundwater Protection of 147.6 mg/kg that is based on MTCA Method B Groundwater Screening Level of 0.96 mg/L.
- ⬢ Soil concentration exceeds the MTCA Soil Screening Level for Groundwater Protection of 147.6 mg/kg.
- ● Soil concentration exceeds the MTCA Soil Screening Level for Groundwater Protection of 615 mg/kg that is based on the MCL of 4.0 mg/L.

15 — Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

- ● Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

0 250 500
Feet

Figure C2-2
Fluoride Concentrations at 1-2 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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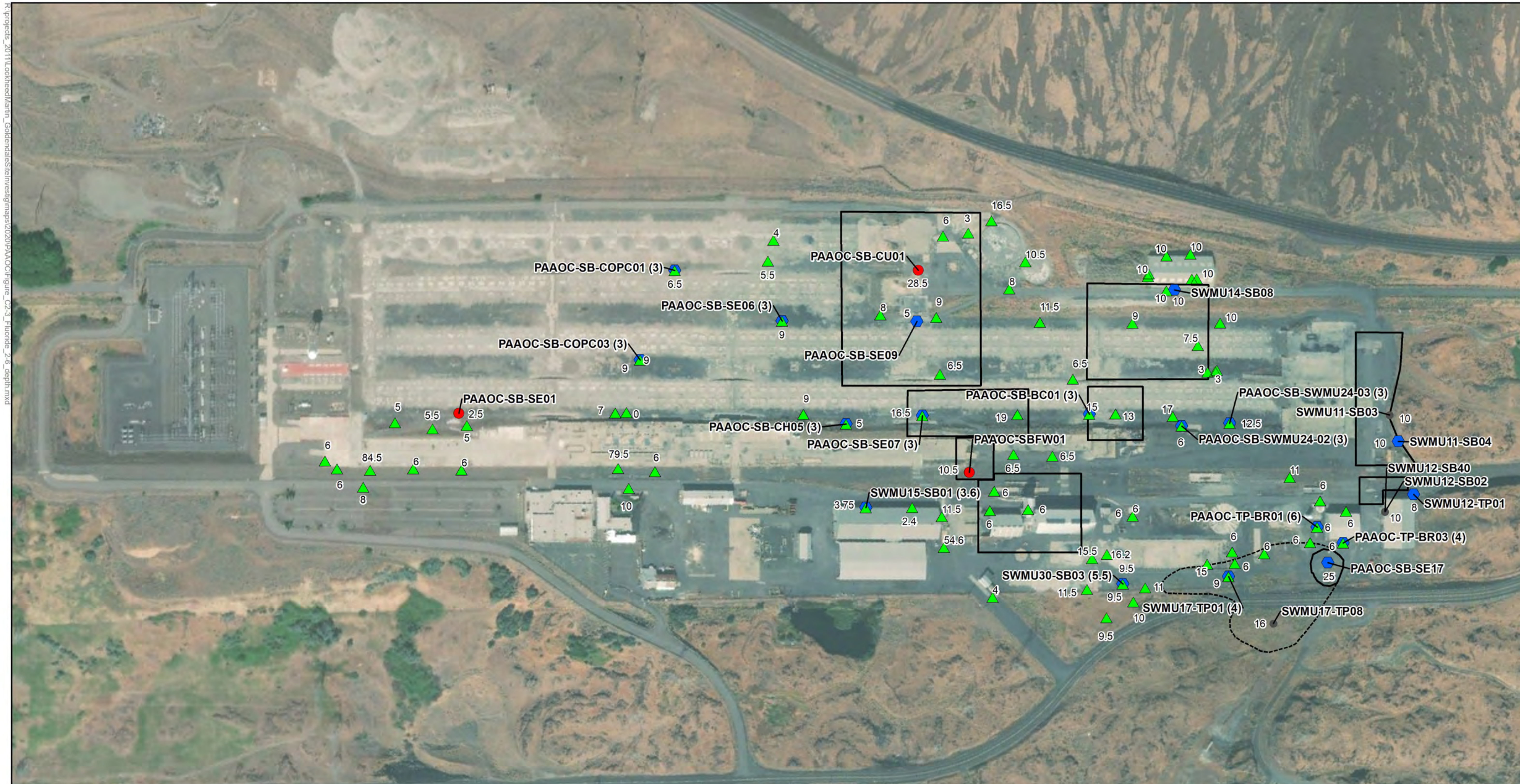



Soil Screening Level

- Soil concentration is lower than the MTCA Soil Screening Level for Groundwater Protection of 147.6 mg/kg that is based on MTCA Method B Groundwater Screening Level of 0.96 mg/L.
- Soil concentration exceeds the MTCA Soil Screening Level for Groundwater Protection of 147.6 mg/kg.
- Soil concentration exceeds the MTCA Soil Screening Level for Groundwater Protection of 615 mg/kg that is based on the MCL of 4.0 mg/L.

15 — Total Boring/Test Pit Depth

Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)

SWMU08-SB01

- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

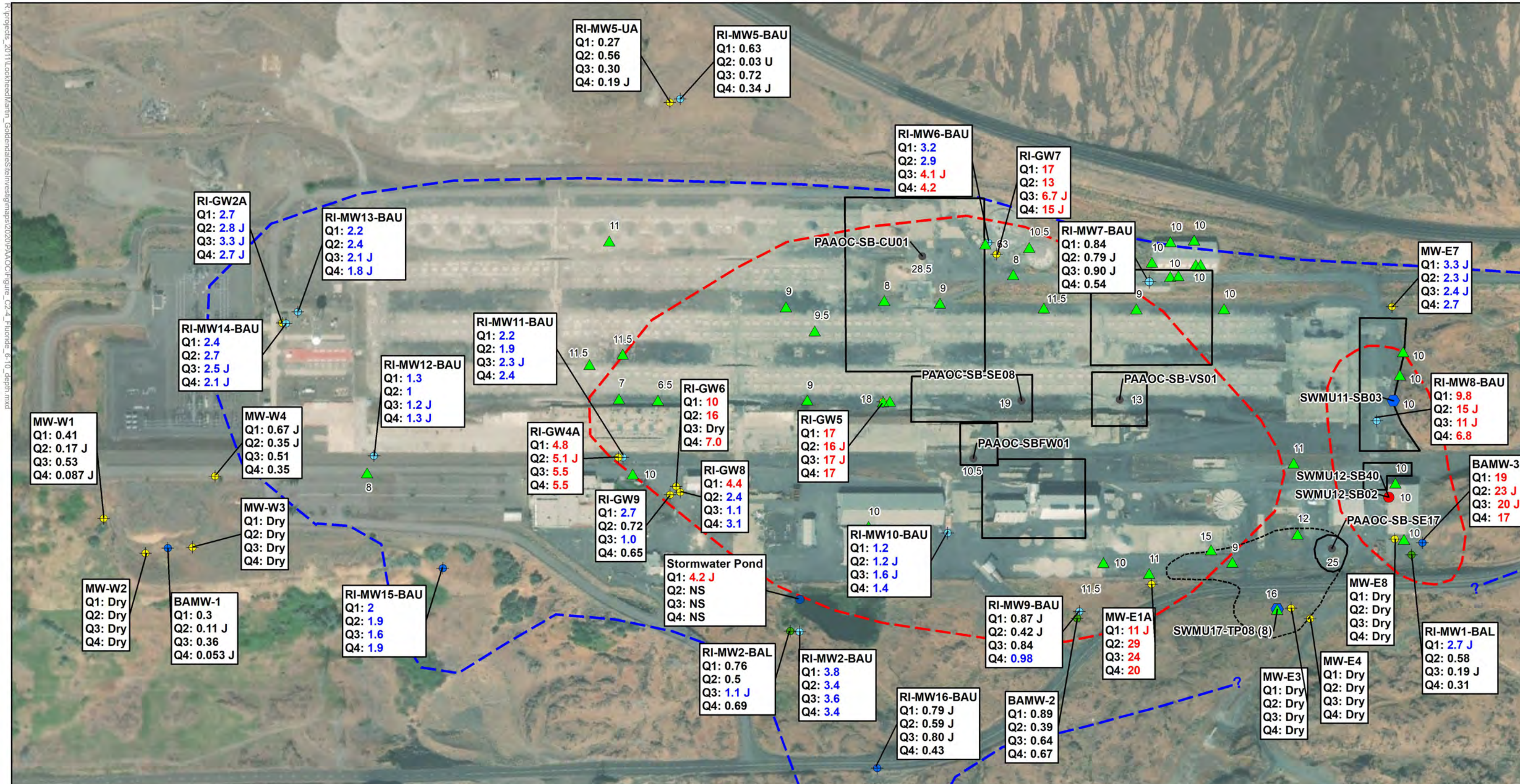
W N S E

0 250 500

Feet

Figure C2-3
Fluoride Concentrations at 2-6 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

- Soil concentration is lower than the MTCA Soil Screening Level for Groundwater Protection of 147.6 mg/kg that is based on MTCA Method B Groundwater Screening Level of 0.96 mg/L.
- Soil concentration exceeds the MTCA Soil Screening Level for Groundwater Protection of 147.6 mg/kg.
- Soil concentration exceeds the MTCA Soil Screening Level for Groundwater Protection of 615 mg/kg that is based on the MCL of 4.0 mg/L.

15 — Total Boring/Test Pit Depth
Location Exceeds Screening Level
SWMU08-SB01 (Depth that was Exceeded if Multiple Samples)

Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

- $BAU_1$ - Shallower Water-bearing Zone
- $BAU_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

- $BAL_1$ - Shallower Water-bearing Zone

Fluoride Maximum Extent Groundwater Concentration Contour (Combined UA and BAU Aquifer Zones)

- 4 mg/L MCL
- 0.96 mg/L MTCA Method B

East End Landfill

Investigation Area

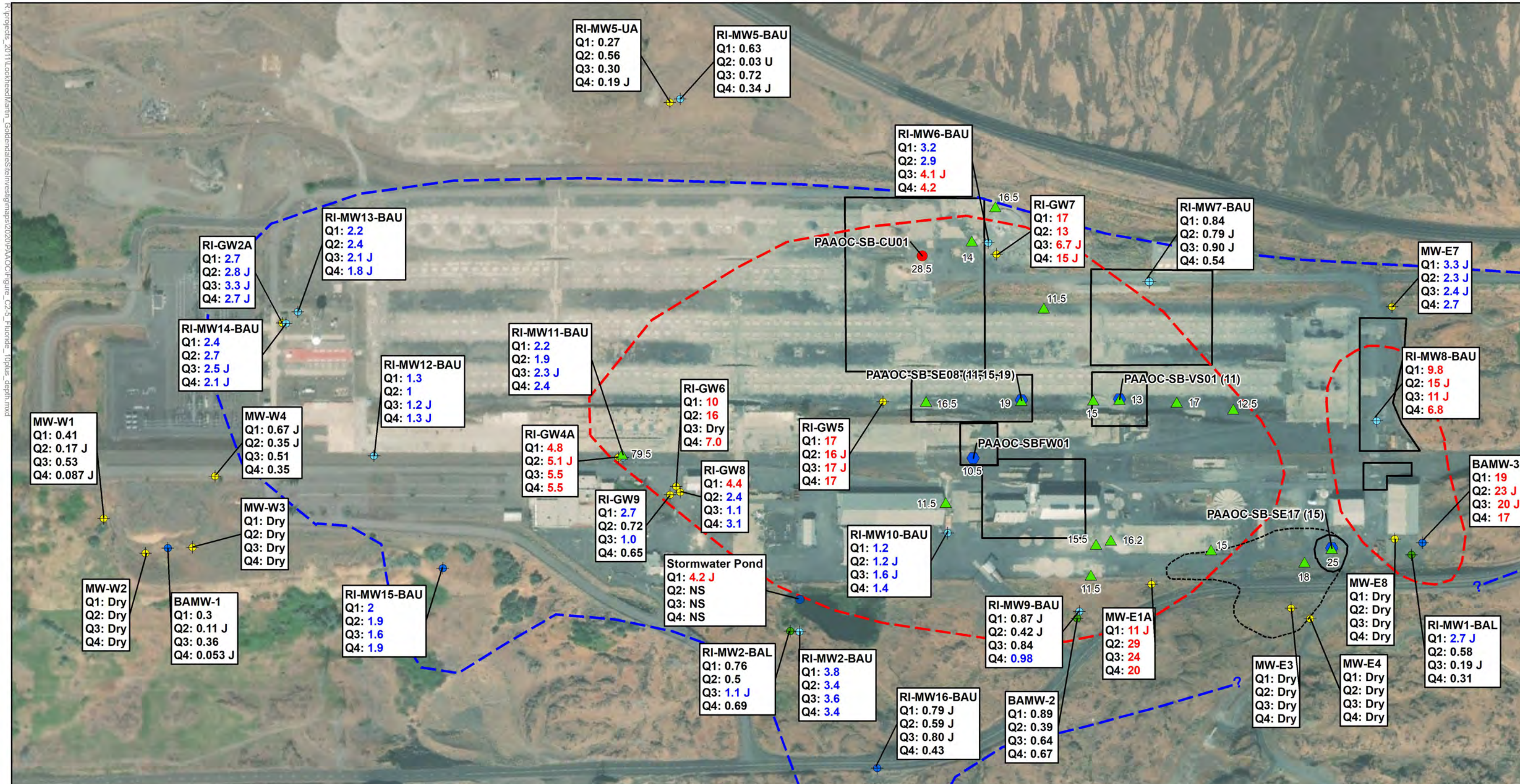
J: Estimated Concentration
MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NS: Not Sampled
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

N / E / S / W

0 250 500
Feet

Figure C2-4
Fluoride Concentrations at 6-10 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

- Soil concentration is lower than the MTCA Soil Screening Level for Groundwater Protection of 147.6 mg/kg that is based on MTCA Method B Groundwater Screening Level of 0.96 mg/L.
- Soil concentration exceeds the MTCA Soil Screening Level for Groundwater Protection of 147.6 mg/kg.
- Soil concentration exceeds the MTCA Soil Screening Level for Groundwater Protection of 615 mg/kg that is based on the MCL of 4.0 mg/L.

15 — Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

- BAU₁ - Shallower Water-bearing Zone
- BAU₂ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

- BAL₁ - Shallower Water-bearing Zone

Fluoride Maximum Extent Groundwater Concentration Contour (Combined UA and BAU Aquifer Zones)

- 4 mg/L MCL
- 0.96 mg/L MTCA Method B
- East End Landfill
- Investigation Area

J: Estimated Concentration
MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NS: Not Sampled
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

N E S W

0 250 500
Feet

Figure C2-5
Fluoride Concentrations at Depth > 10 Feet
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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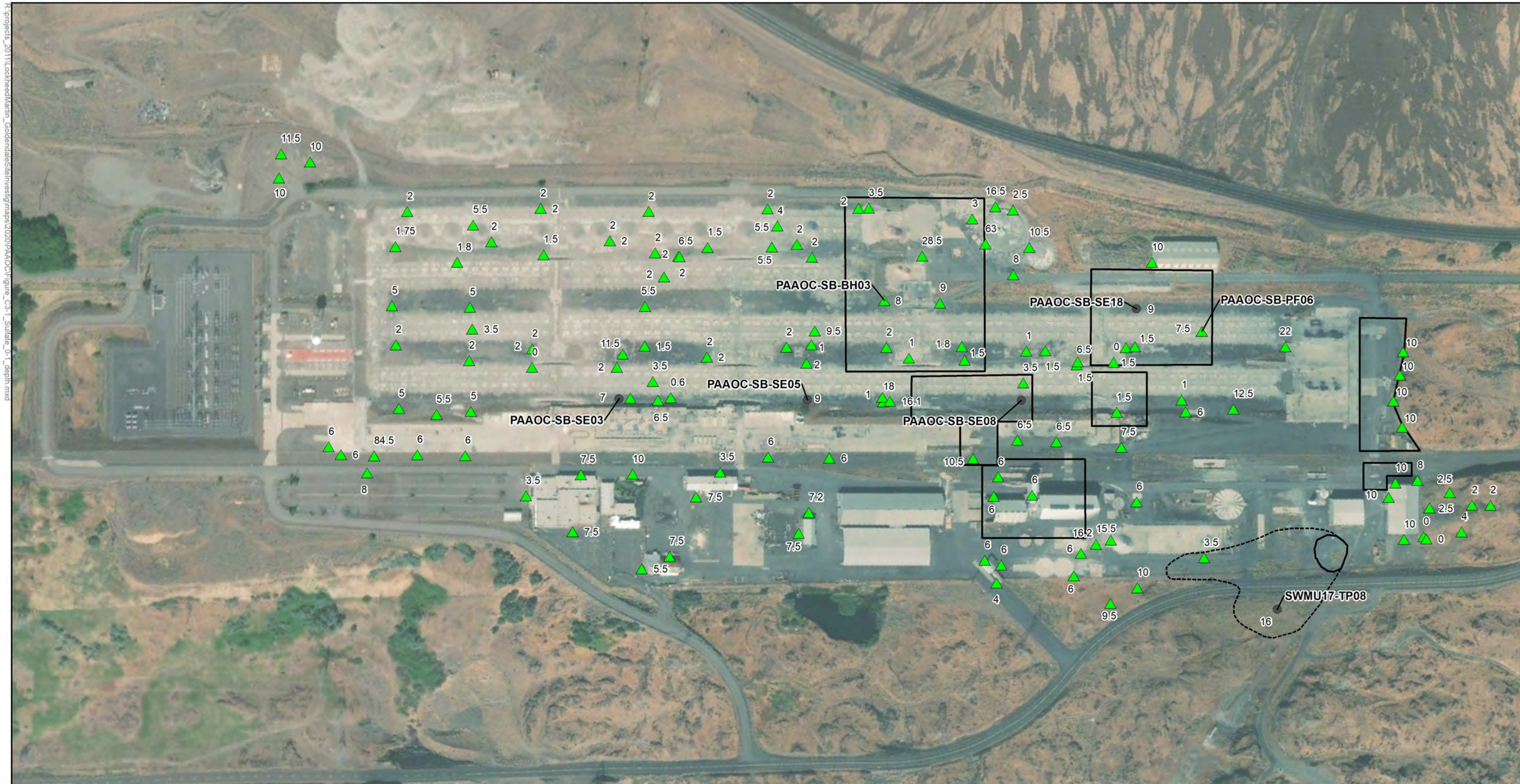


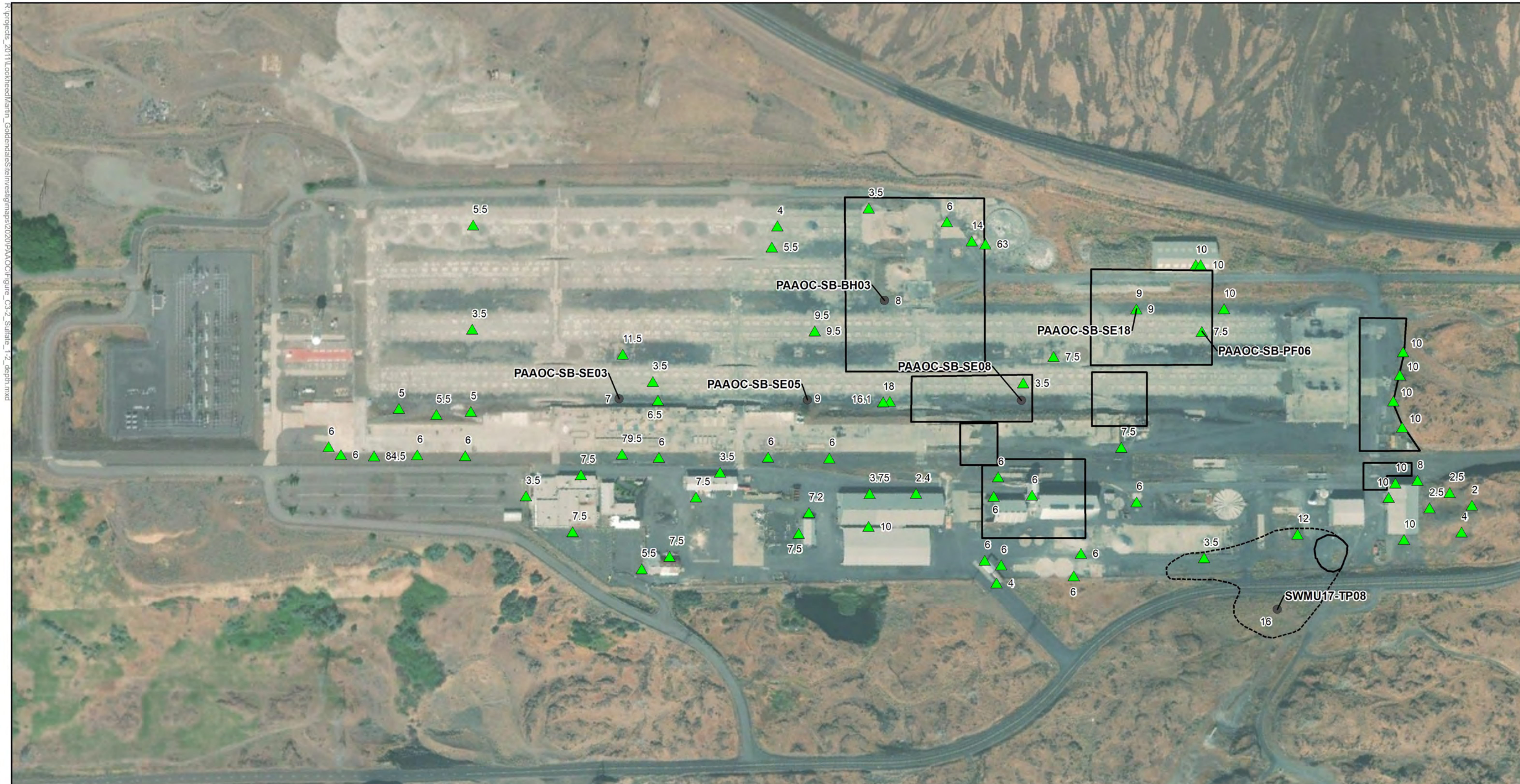

Soil Screening Level

- Soil concentration is below the MTCA soil screening level for groundwater protection of 2,150 mg/kg
- Soil concentration exceeds the MTCA soil screening level for groundwater protection of 2,150 mg/kg
- 15 — Total Boring/Test Pit Depth; Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples) — SWMU08-SB01
- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

0 250 500
Feet

Figure C3-1
Sulfate Concentrations
at 0-1 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

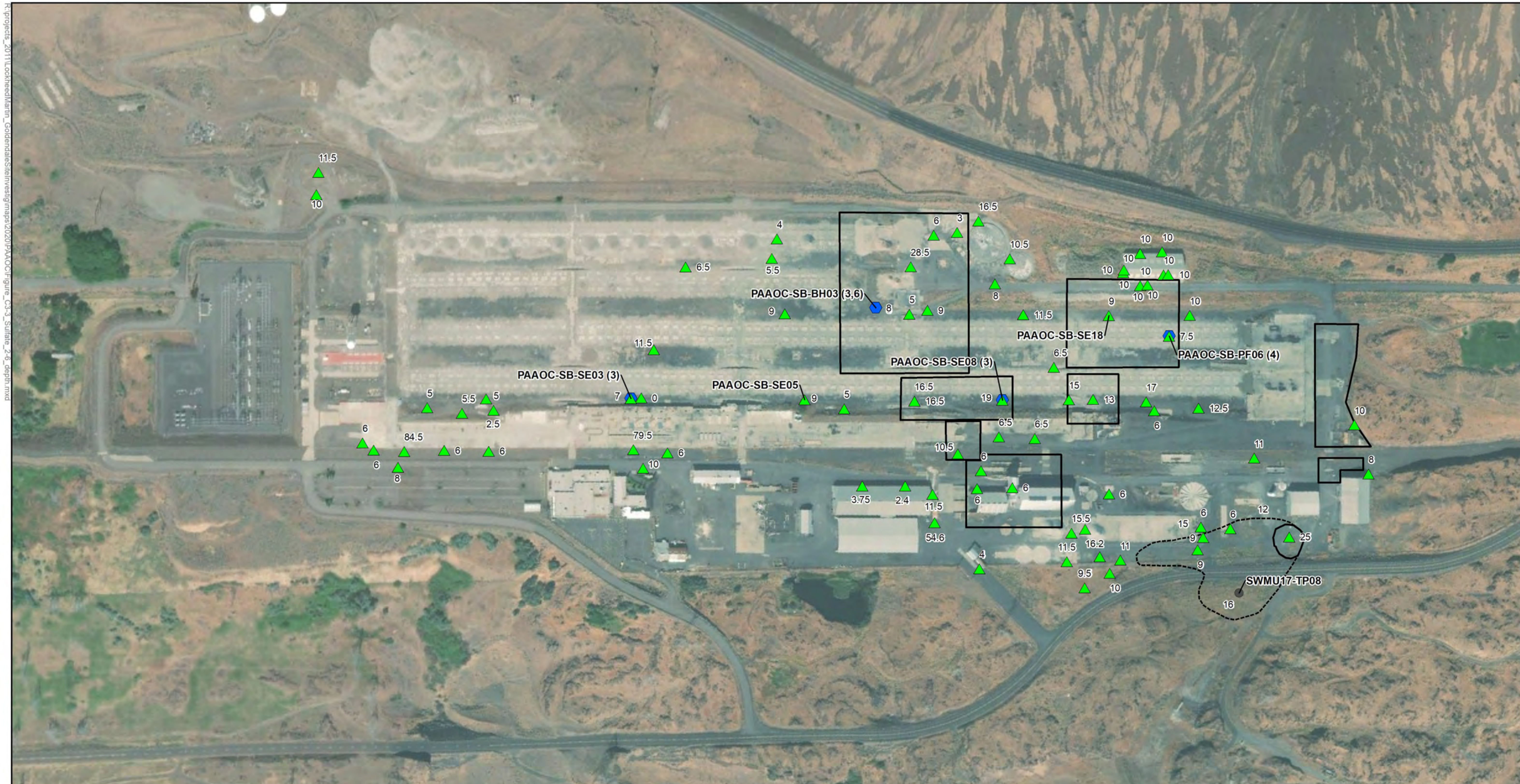
- ▲ Soil concentration is below the MTCA soil screening level for groundwater protection of 2,150 mg/kg
- ⬢ Soil concentration exceeds the MTCA soil screening level for groundwater protection of 2,150 mg/kg
- 15 — Total Boring/Test Pit Depth; Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples) — SWMU08-SB01
- ● Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

N E S W

0 250 500
Feet

# Figure C3-2
## Sulfate Concentrations at 1-2 Foot Depth Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

- Soil concentration is below the MTCA soil screening level for groundwater protection of 2,150 mg/kg
- Soil concentration exceeds the MTCA soil screening level for groundwater protection of 2,150 mg/kg
- 15 — Total Boring/Test Pit Depth
- Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
- SWMU08-SB01
- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

0 250 500
Feet

Figure C3-3
Sulfate Concentrations
at 2-6 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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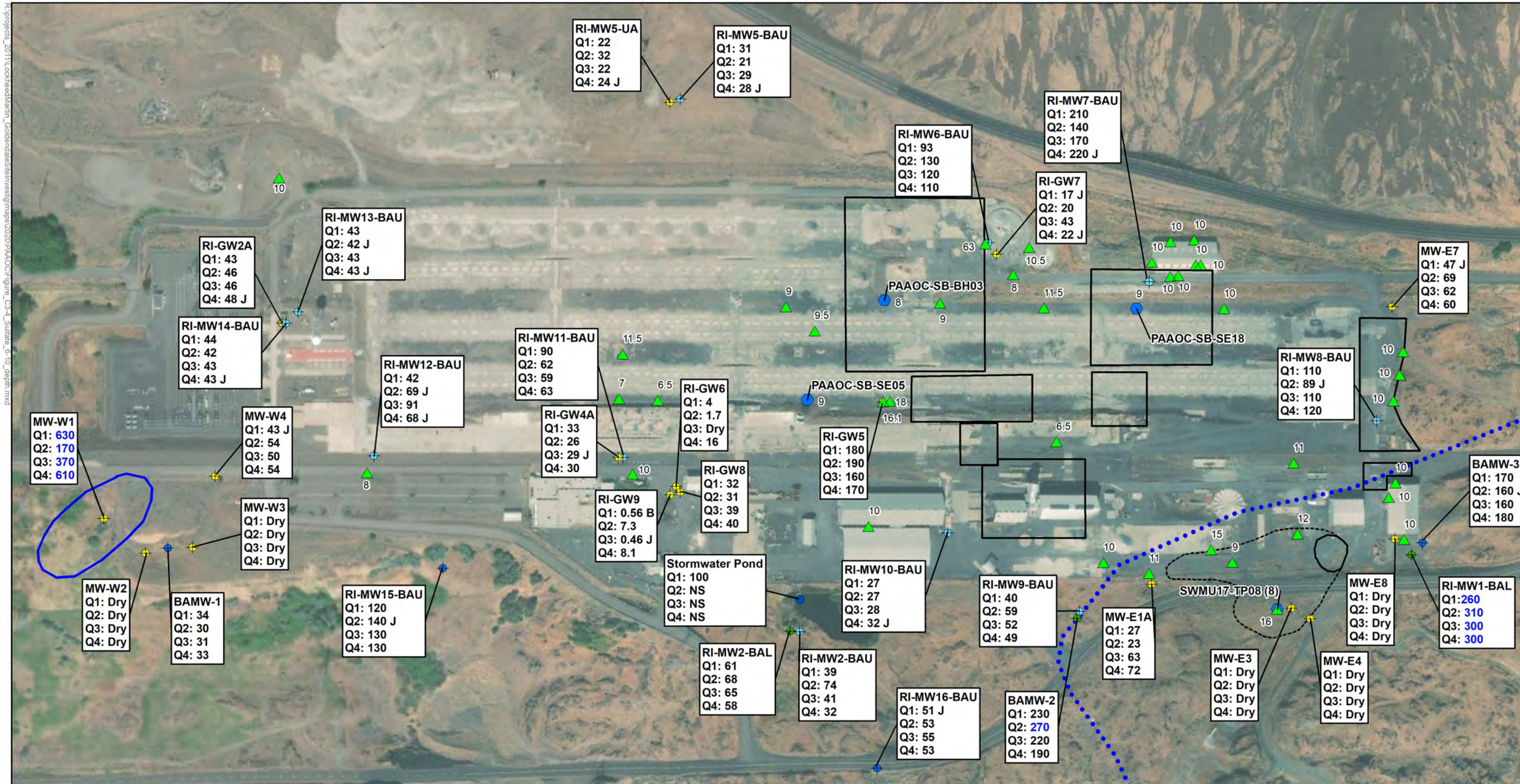



Soil Screening Level

- Soil concentration is below the MTCA soil screening level for groundwater protection of 2,150 mg/kg
- Soil concentration exceeds the MTCA soil screening level for groundwater protection of 2,150 mg/kg

15 — Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

- $BAU_1$ - Shallower Water-bearing Zone
- $BAU_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

- $BAL_1$ - Shallower Water-bearing Zone

250 mg/L Secondary MCL Screening Level

- UA Aquifer Zone Concentration Contour
- BAL Aquifer Zone Concentration Contour
- East End Landfill
- Investigation Area

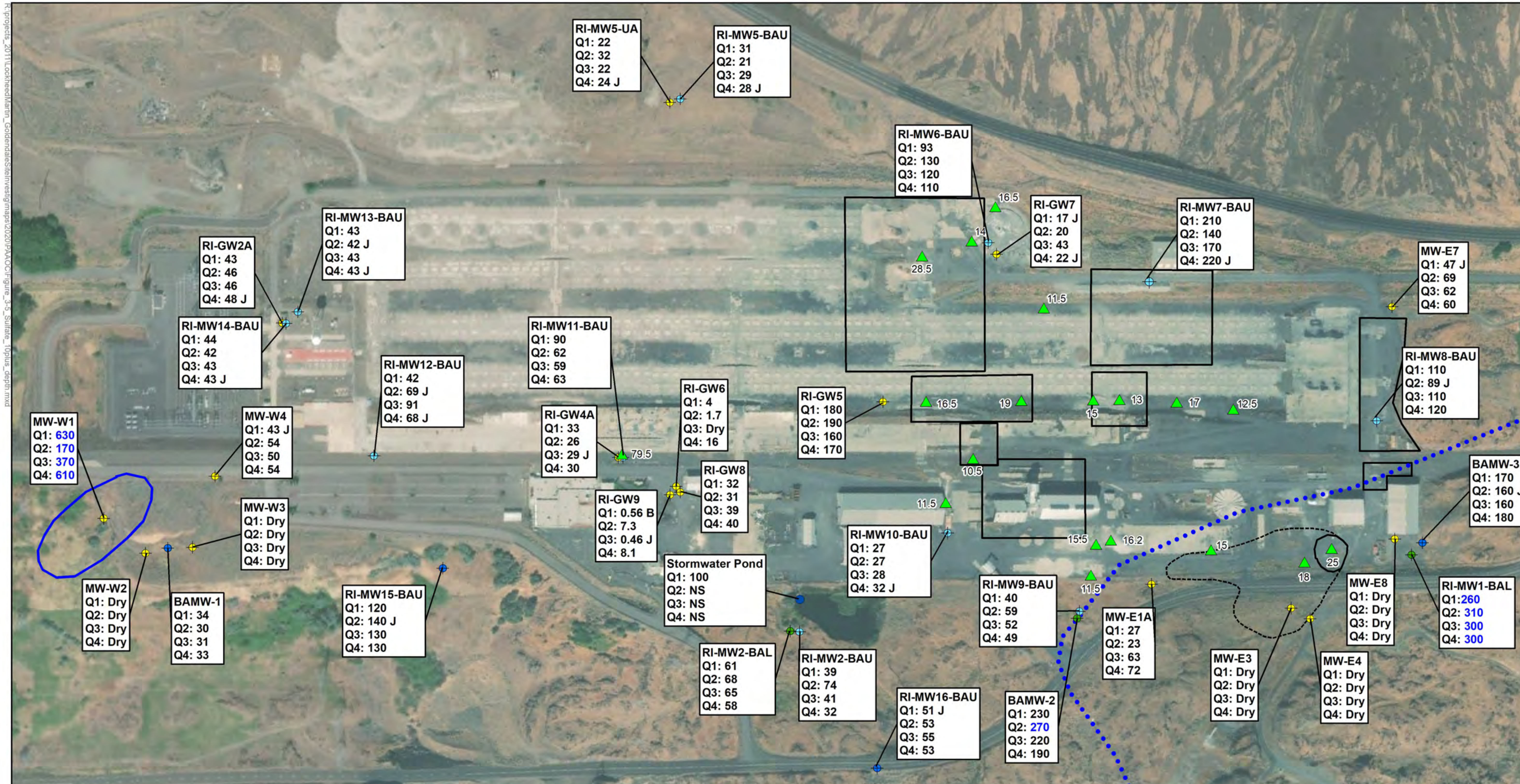
J: Estimated Concentration
MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NS: Not Sampled
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

0 250 500
Feet

Figure C3-4
Sulfate Concentrations at 6-10 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\2020\PAAOC\Figure_C3-4_Sulfate_6-10_depth.mxd




Soil Screening Level

- Soil concentration is below the MTCA soil screening level for groundwater protection of 2,150 mg/kg
- Soil concentration exceeds the MTCA soil screening level for groundwater protection of 2,150 mg/kg

15 — Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

- $BAU_1$ - Shallower Water-bearing Zone
- $BAU_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

- $BAL_1$ - Shallower Water-bearing Zone

250 mg/L Secondary MCL Screening Level

- UA Aquifer Zone Concentration Contour
- BAL Aquifer Zone Concentration Contour
- East End Landfill
- Investigation Area

J: Estimated Concentration
MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NS: Not Sampled
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

W N S E

0 250 500
Feet

Figure C3-5
Sulfate Concentrations
at Depth > 10 Feet
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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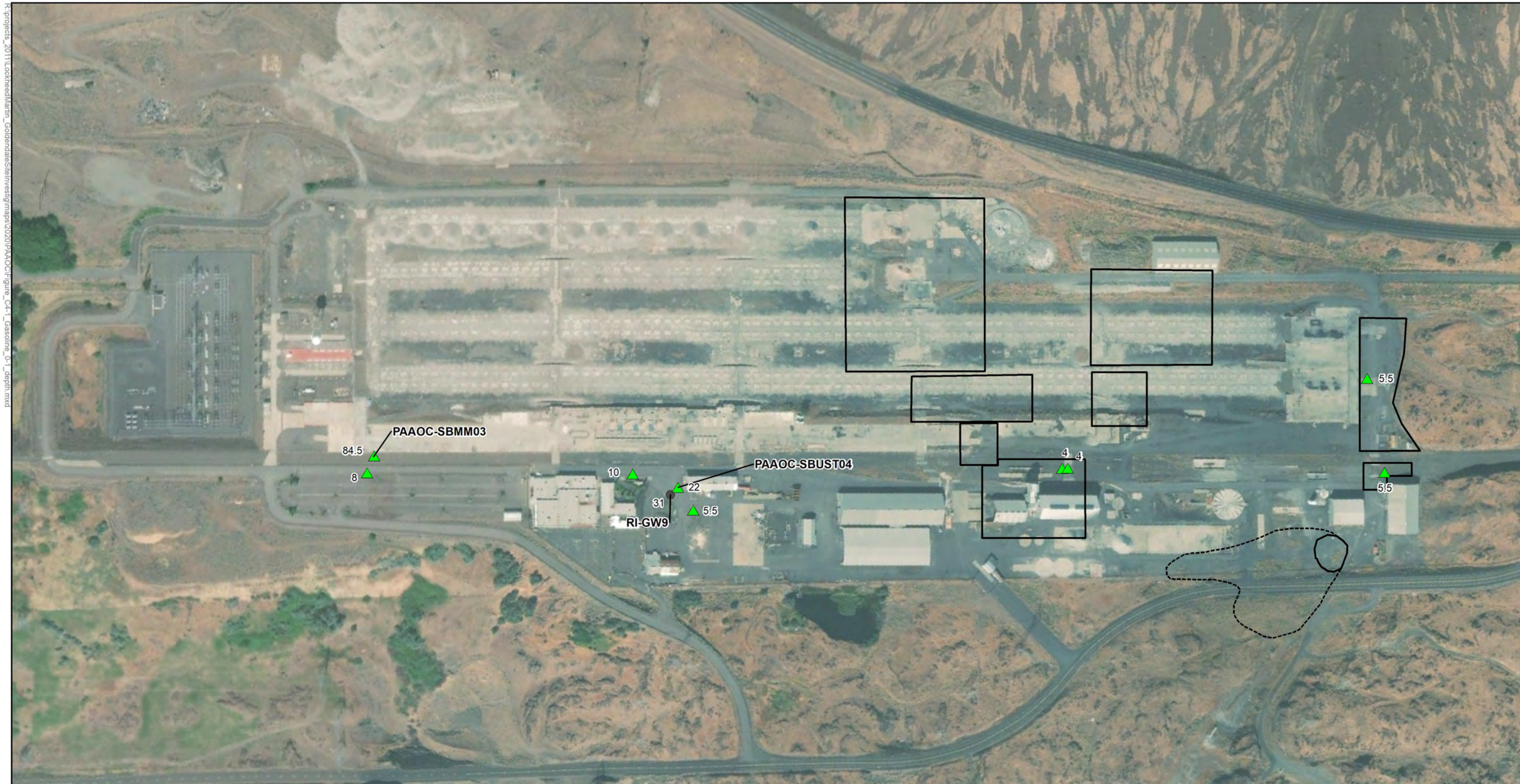


Soil Screening Level

Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 30 mg/kg for sites with benzene detected

Concentration is above the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 30 mg/kg

15 Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

East End Landfill

Investigation Area

W N S E

0 250 500
Feet

Figure C4-1
Gasoline Concentrations
at 0-1 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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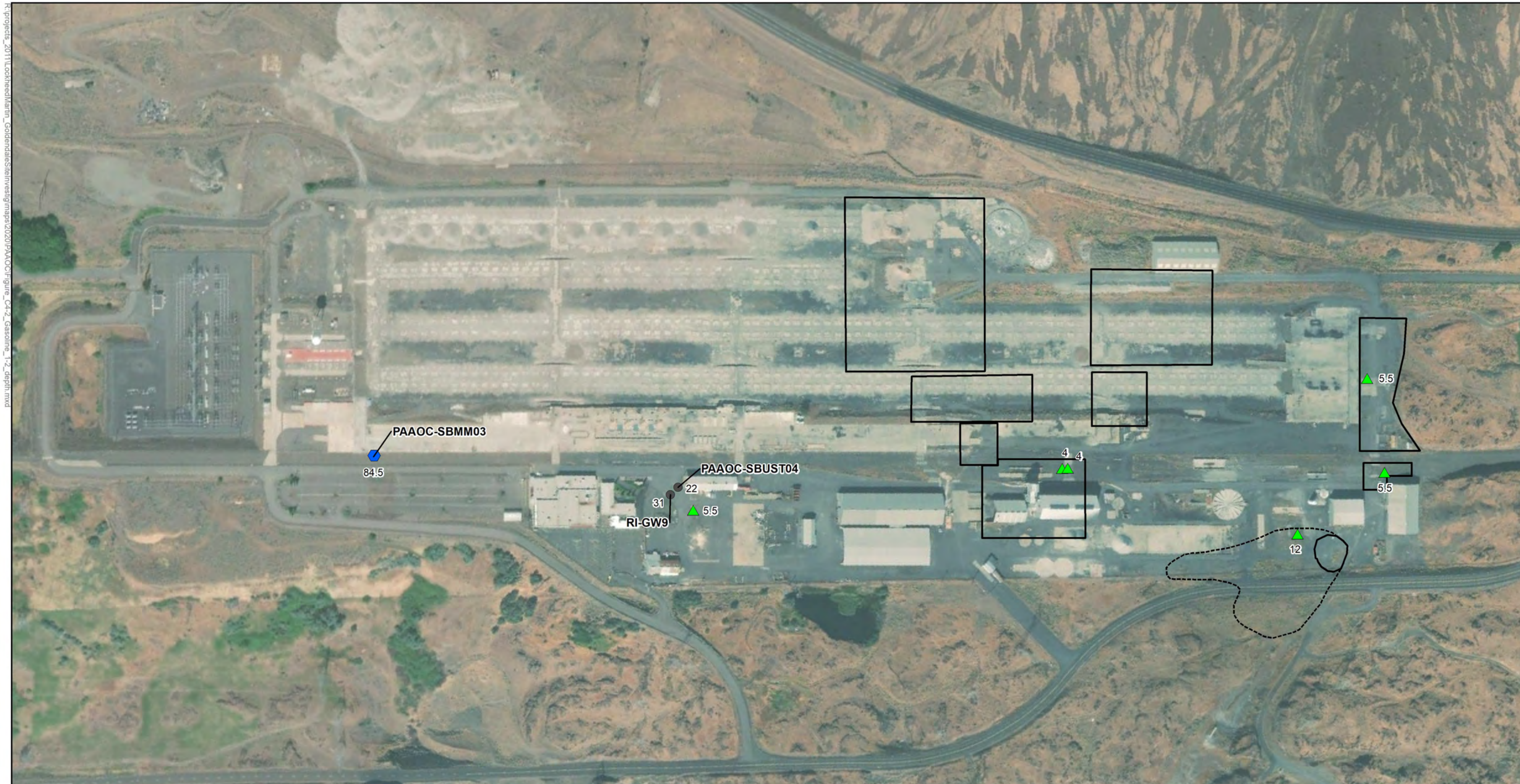



Soil Screening Level

- ▲ Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 30 mg/kg for sites with benzene detected
- ⬢ Concentration is above the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 30 mg/kg

15 — Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

- ● Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

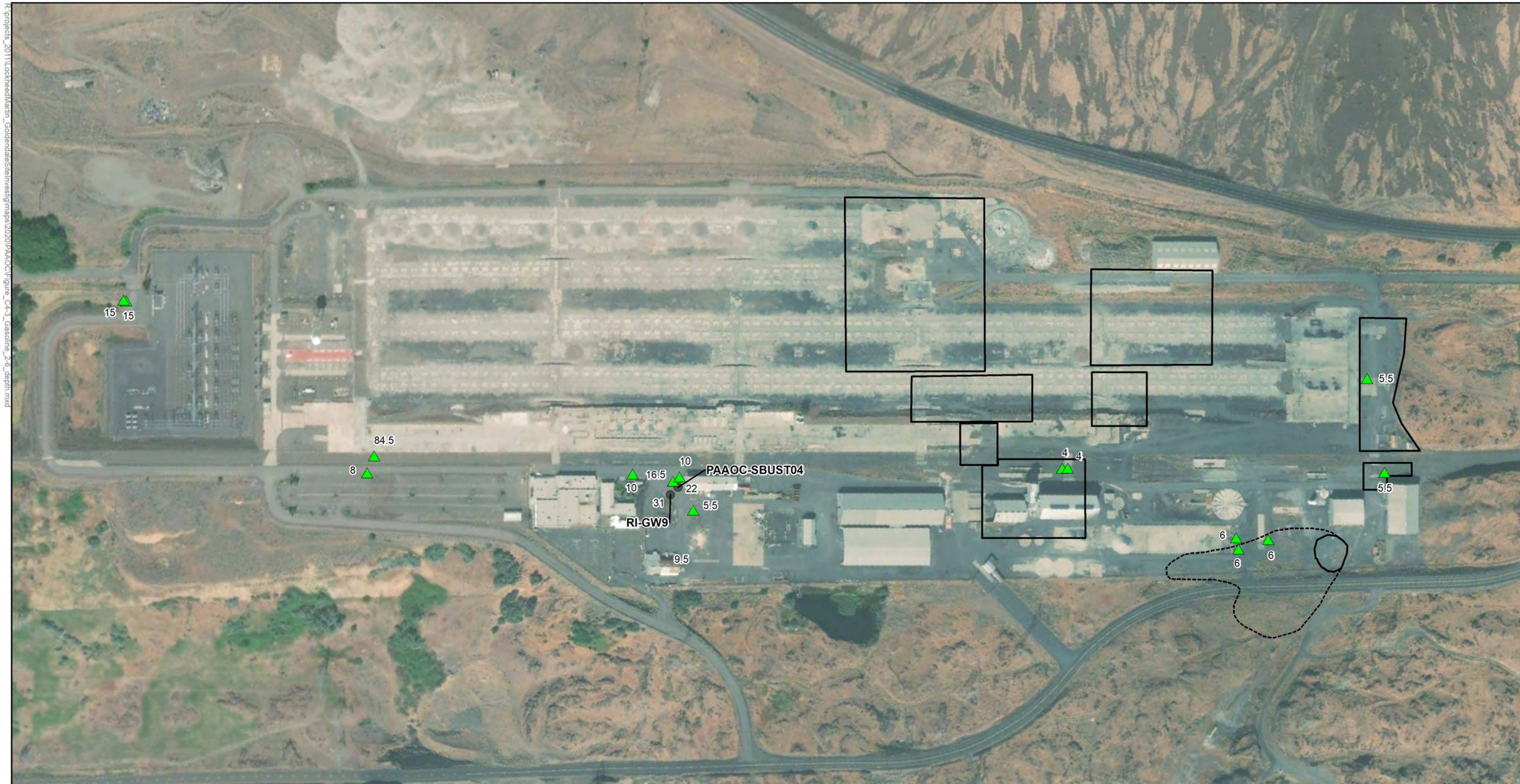
W N E S

0 250 500
Feet

# Figure C4-2
## Gasoline Concentrations at 1-2 Foot Depth Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\2020\PAAOC\Figure_C4-2_Gasoline_1-2_depth.mxd




Soil Screening Level

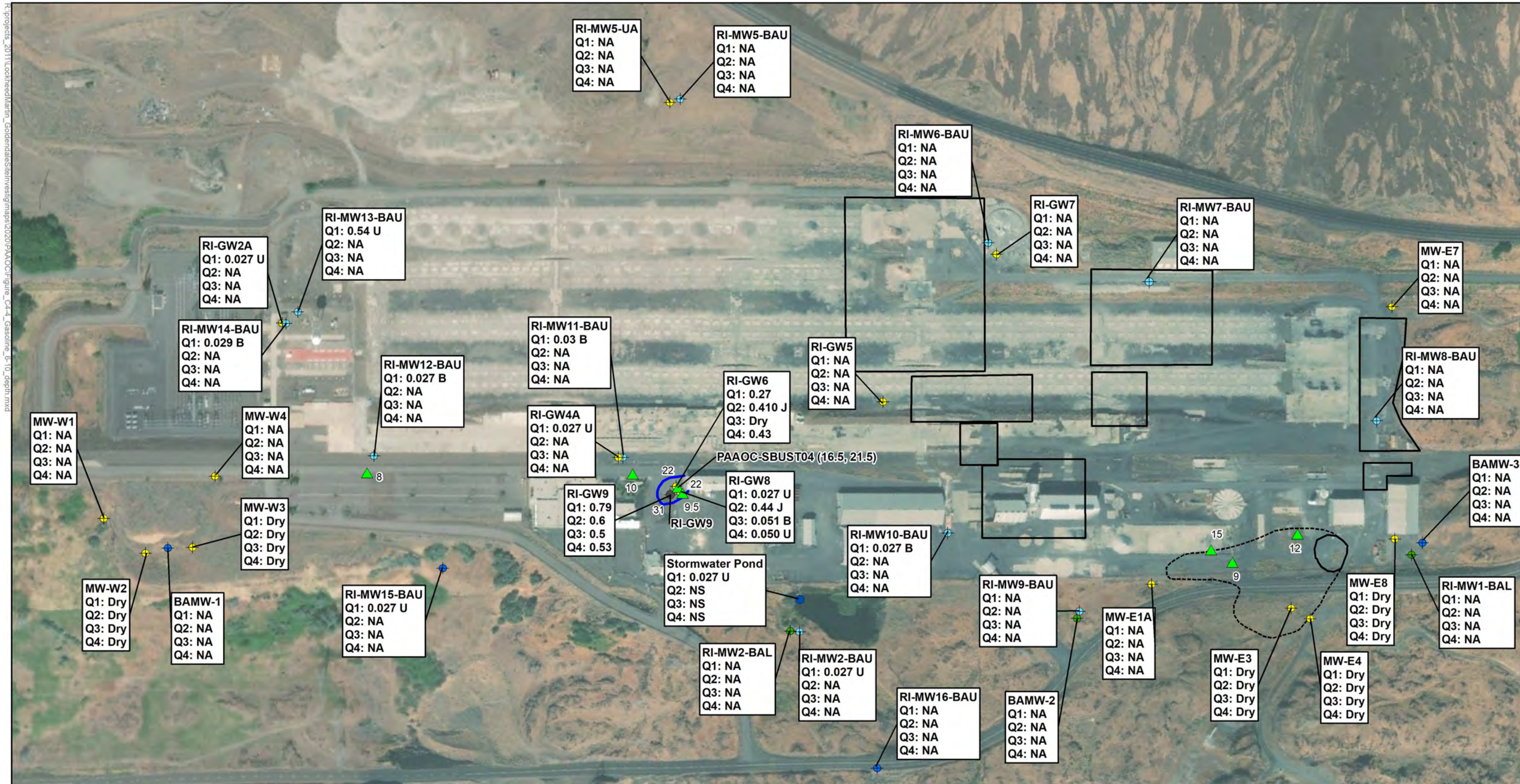
- Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 30 mg/kg for sites with benzene detected
- Concentration is above the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 30 mg/kg
- 15 — Total Boring/Test Pit Depth; Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples) — SWMU08-SB01
- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

0 250 500
Feet

Figure C4-3
Gasoline Concentrations
at 2-6 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\2020\PAAOC\Figure_C4-3_Gasoline_2-6_depth.mxd




Soil Screening Level

Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 30 mg/kg for sites with benzene detected

Concentration is above the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 30 mg/kg

15 Total Boring/Test Pit Depth
Location Exceeds Screening Level
SWMU08-SB01 (Depth that was Exceeded if Multiple Samples)

Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

$BAU_1$ - Shallower Water-bearing Zone

$BAU_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

$BAL_1$ - Shallower Water-bearing Zone

Groundwater Screening Level

Lateral extent of diesel- range TPH in the UA Zone Groundwater above Screening Levels

**0.02** Concentration does not exceed the 0.8 mg/L MTCA Method A Cleanup Level

East End Landfill

Investigation Area

B: Chemical was found in blank and sample
J: Estimated Concentration
MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NA: Not Analyzed
NS: Not Sampled
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

W N E S

0 250 500
Feet

Figure C4-4
Gasoline Concentrations at 6-10 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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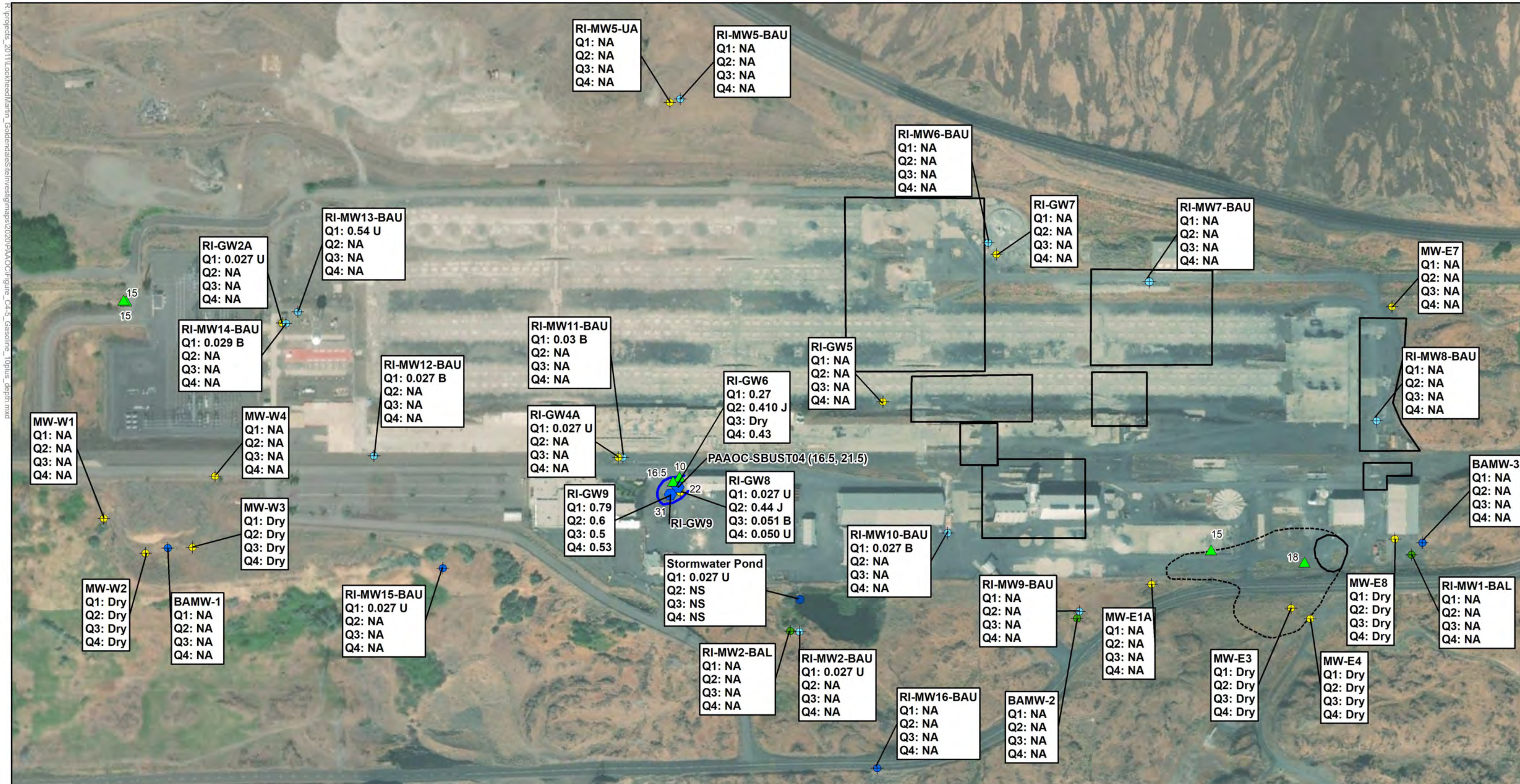



**Soil Screening Level**

- Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 30 mg/kg for sites with benzene detected
- Concentration is above the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 30 mg/kg

15 — Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

- $BAU_1$ - Shallower Water-bearing Zone
- $BAU_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

- $BAL_1$ - Shallower Water-bearing Zone

**Groundwater Screening Level**

- Lateral extent of diesel- range TPH in the UA Zone Groundwater above Screening Levels
- **0.02** Concentration does not exceed the 0.8 mg/L MTCA Method A Cleanup Level
- East End Landfill
- Investigation Area

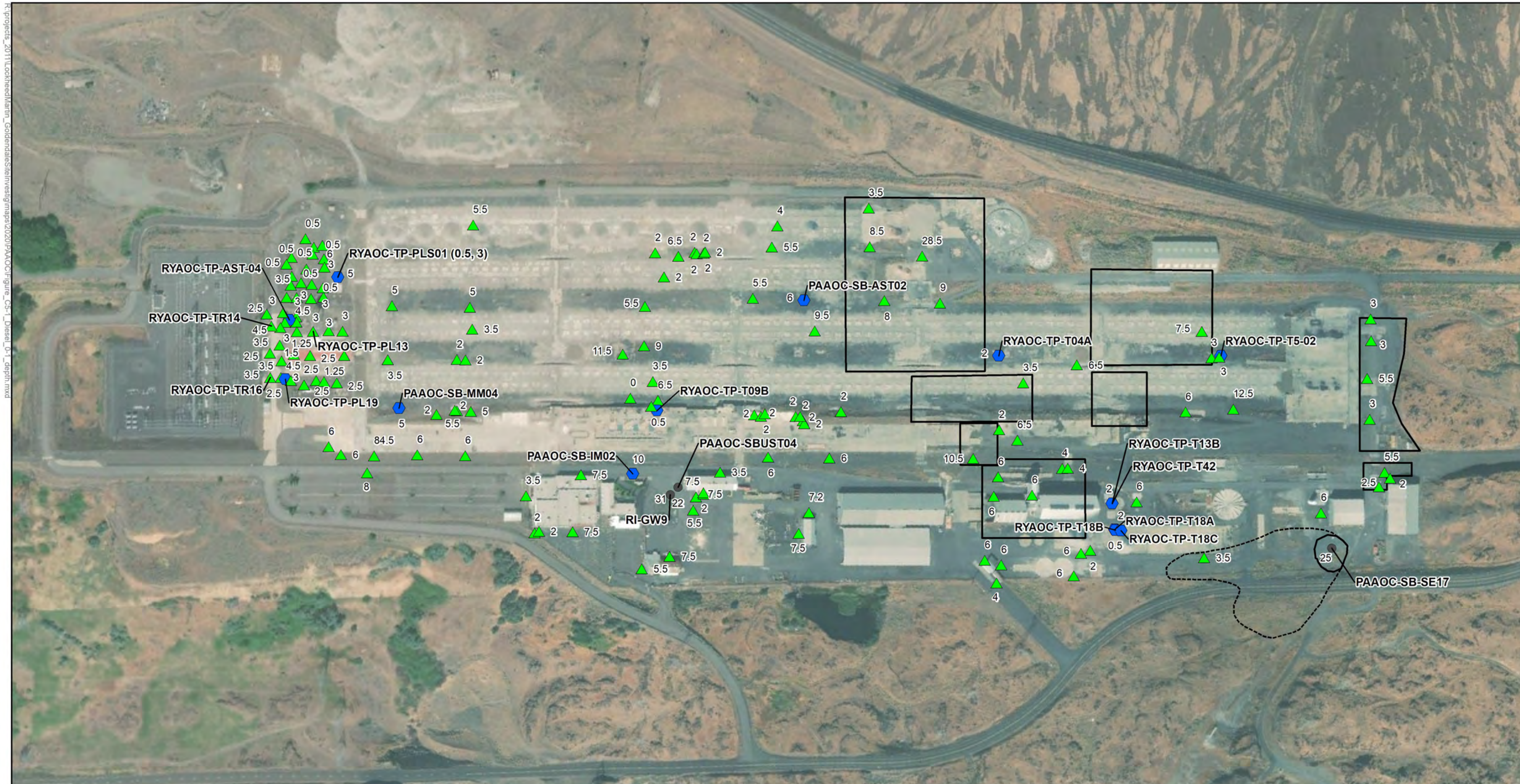
B: Chemical was found in blank and sample
J: Estimated Concentration
MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NA: Not Analyzed
NS: Not Sampled
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

W N S E

0 250 500
Feet

# Figure C4-5
## Gasoline Concentrations at Depth > 10 Feet Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

- Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg that is based on prevention of accumulation of free product on the water table (groundwater protection)
- Concentration exceeds the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg
- 15 — Total Boring/Test Pit Depth; Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples) — SWMU08-SB01
- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

0 250 500
Feet

Figure C5-1
Diesel Concentrations
at 0-1 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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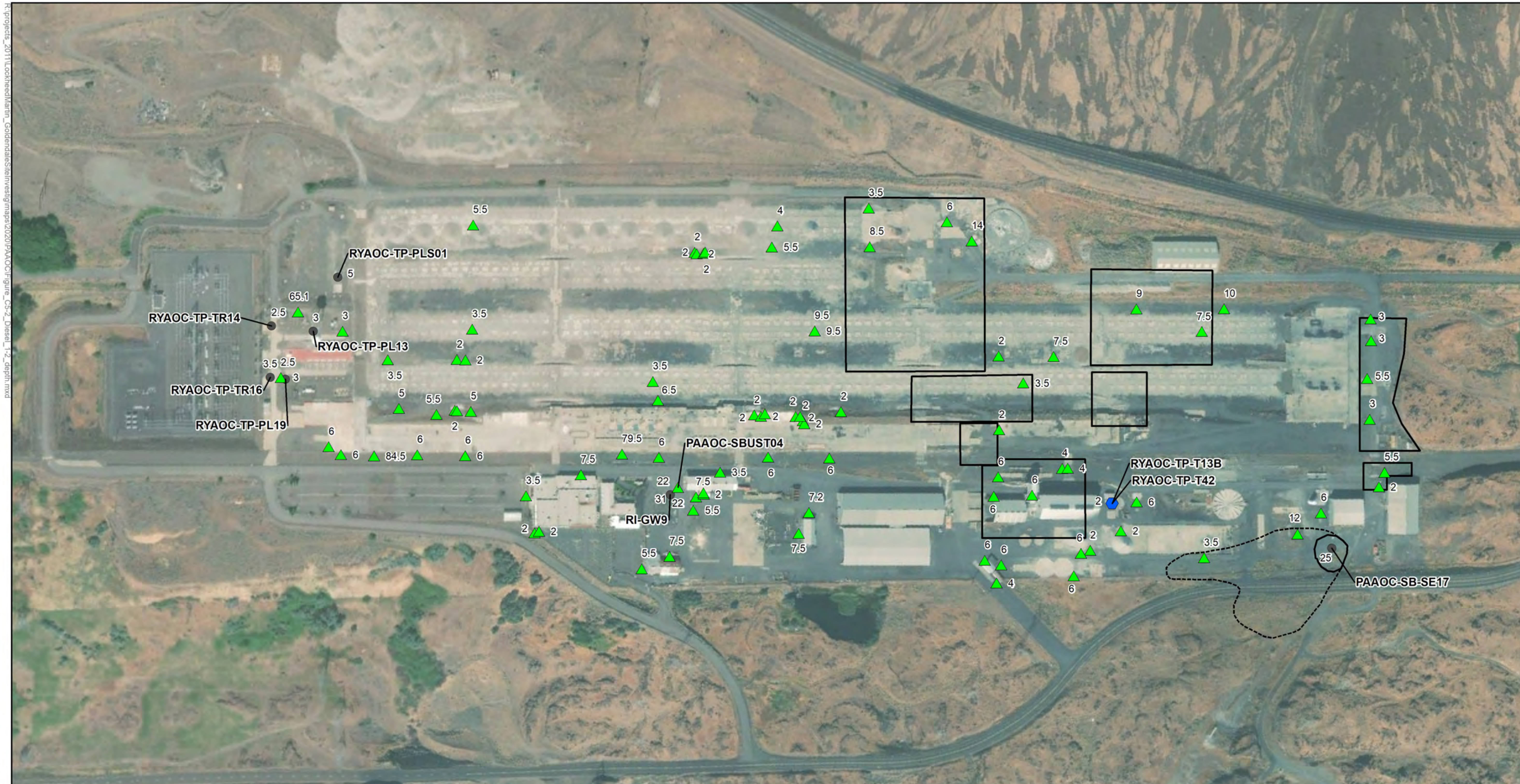


Soil Screening Level

- Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg that is based on prevention of accumulation of free product on the water table (groundwater protection)
- Concentration exceeds the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg
- 15 — Total Boring/Test Pit Depth; Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples); SWMU08-SB01
- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

N, E, S, W

0 250 500
Feet

Figure C5-2
Diesel Concentrations
at 1-2 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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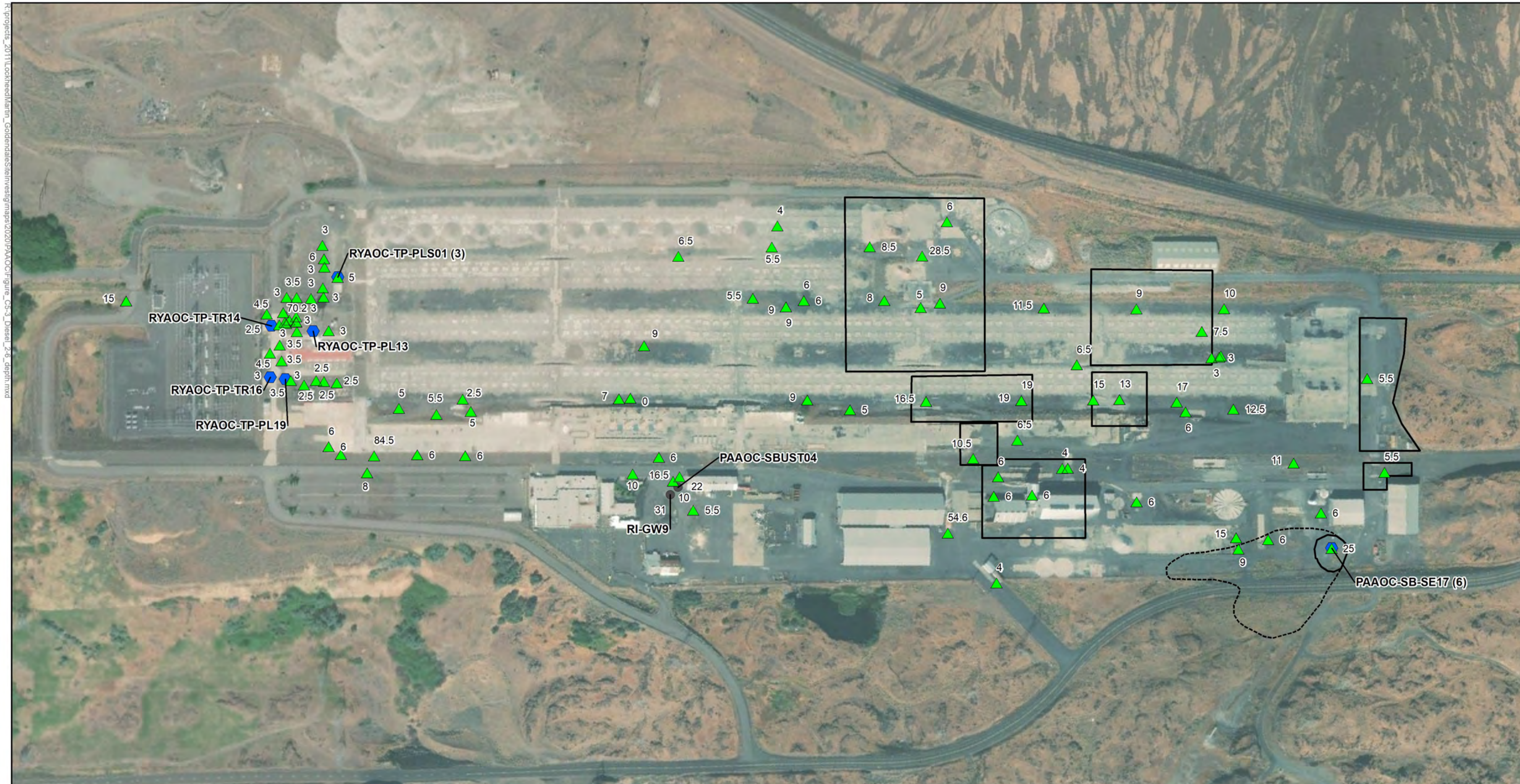



Soil Screening Level

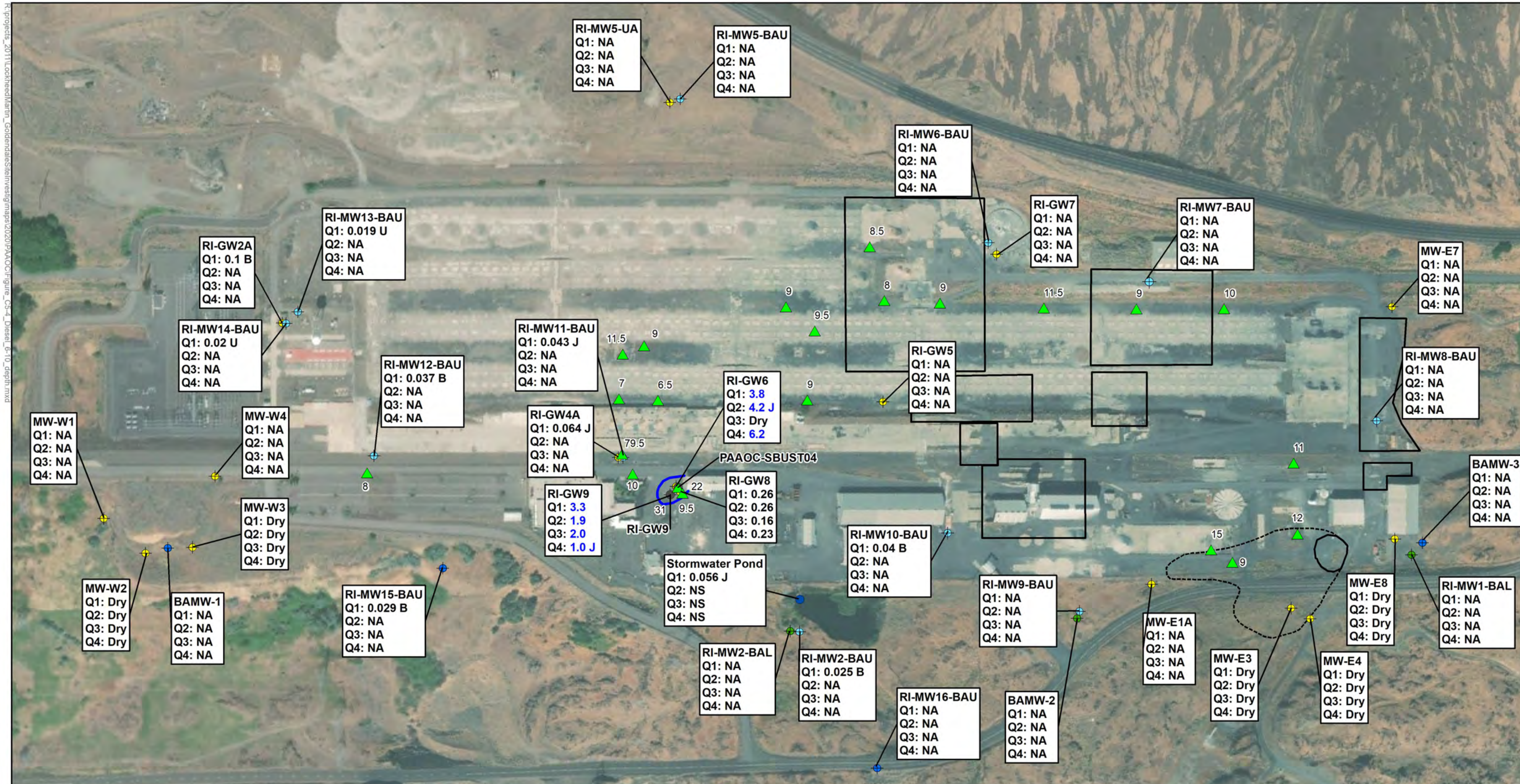
- Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg that is based on prevention of accumulation of free product on the water table (groundwater protection)
- Concentration exceeds the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg
- 15 — Total Boring/Test Pit Depth
- Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
- SWMU08-SB01
- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

N E S W

0 250 500
Feet

## Figure C5-3
## Diesel Concentrations at 2-6 Foot Depth Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg that is based on prevention of accumulation of free product on the water table (groundwater protection)

Concentration exceeds the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg

15 Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

BAU1 - Shallower Water-bearing Zone

BAU2 - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

BAL1 - Shallower Water-bearing Zone

Screening Level Concentration Contours

0.5 mg/L MTCA Method A Groundwater Cleanup Level UA Aquifer Zone

East End Landfill

Investigation Area

B: Chemical was found in blank and sample
J: Estimated Concentration
MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NA: Not Analyzed
NS: Not Sampled
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

W N E S

0 250 500
Feet

Figure C5-4
Diesel Concentrations at 6-10 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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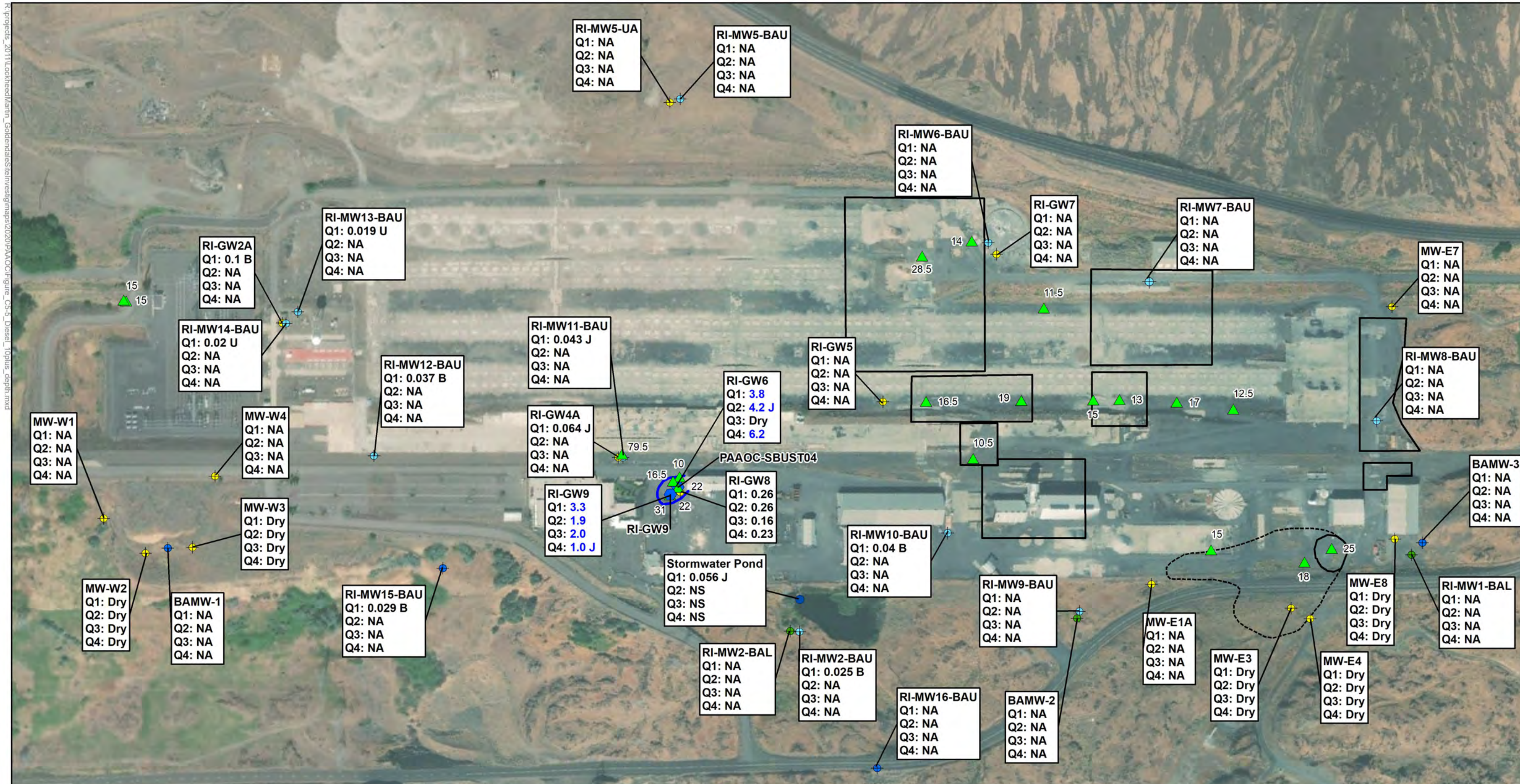



Soil Screening Level

Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg that is based on prevention of accumulation of free product on the water table (groundwater protection)

Concentration exceeds the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg

15 Total Boring/Test Pit Depth

Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)

SWMU08-SB01

Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

$BAU_1$ - Shallower Water-bearing Zone

$BAU_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

$BAL_1$ - Shallower Water-bearing Zone

Screening Level Concentration Contours

0.5 mg/L MTCA Method A Groundwater Cleanup Level UA Aquifer Zone

East End Landfill

Investigation Area

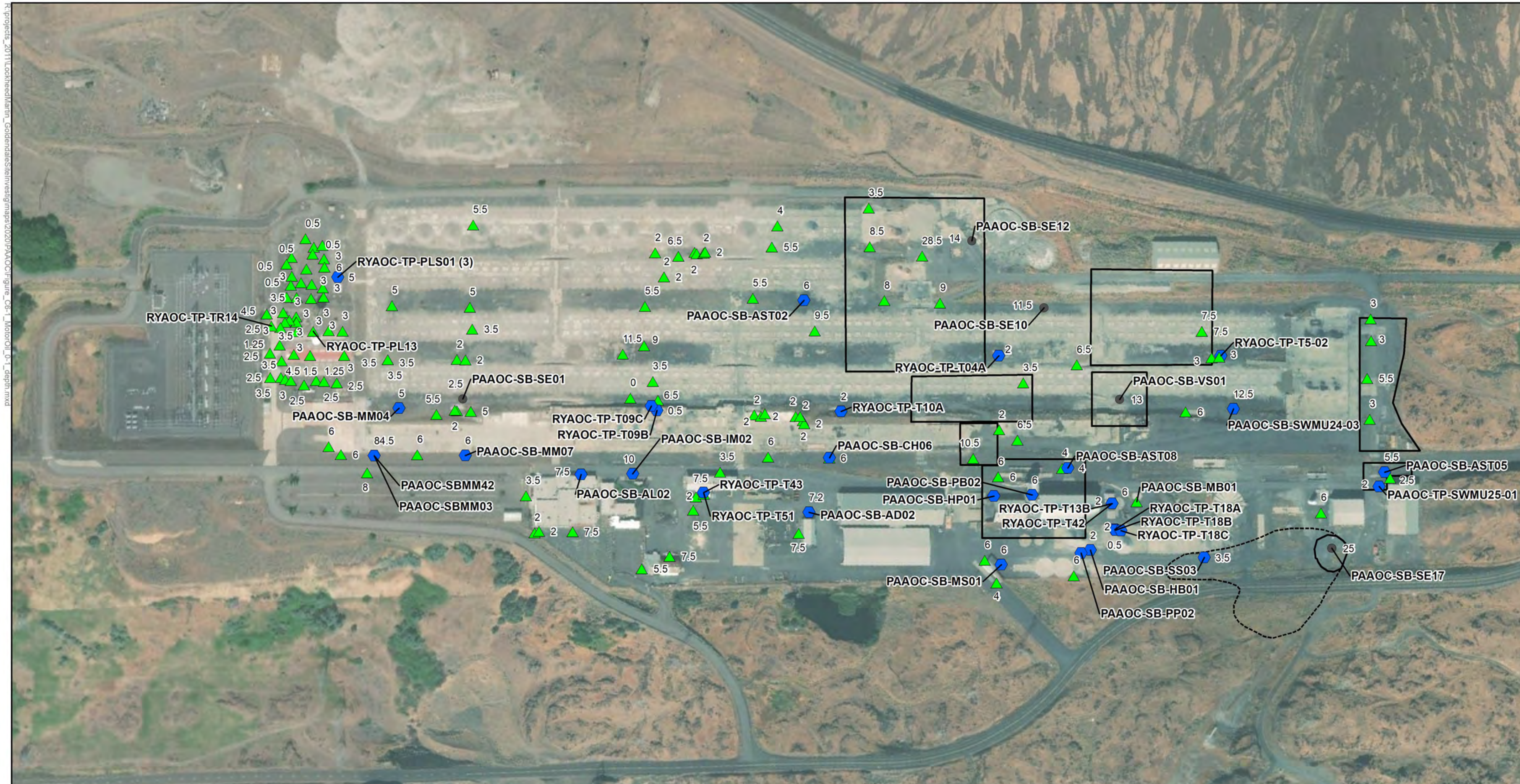
B: Chemical was found in blank and sample
J: Estimated Concentration
MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NA: Not Analyzed
NS: Not Sampled
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

W N S E

0 250 500
Feet

# Figure C5-5
# Diesel Concentrations at Depth > 10 Feet Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg that is based on prevention of accumulation of free product on the water table (groundwater protection)

Concentration exceeds the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg

15 — Total Boring/Test Pit Depth

Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)

SWMU08-SB01

Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

East End Landfill

Investigation Area

W N S E

0 250 500

Feet

Figure C6-1
Motor Oil Concentrations
at 0-1 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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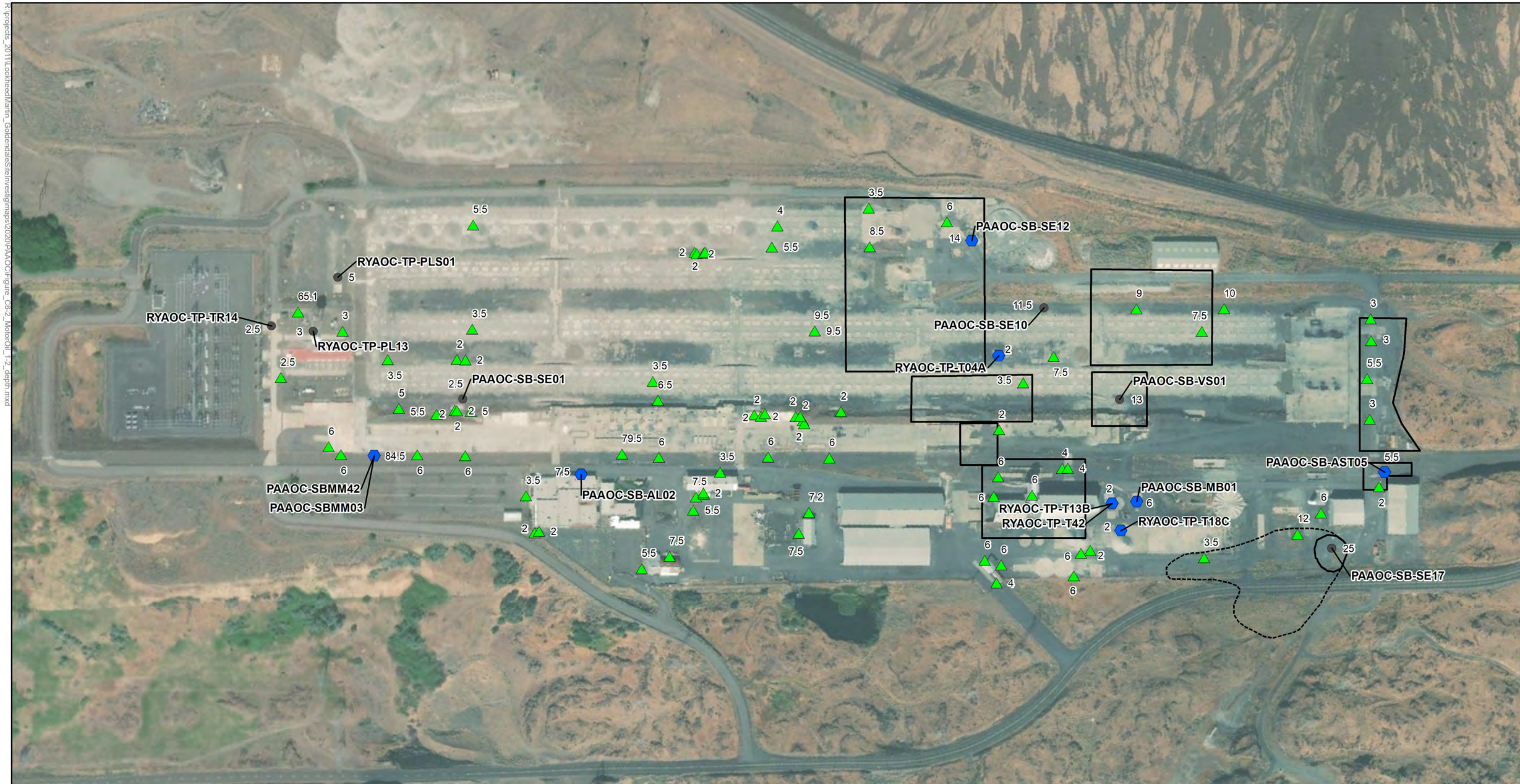



Soil Screening Level

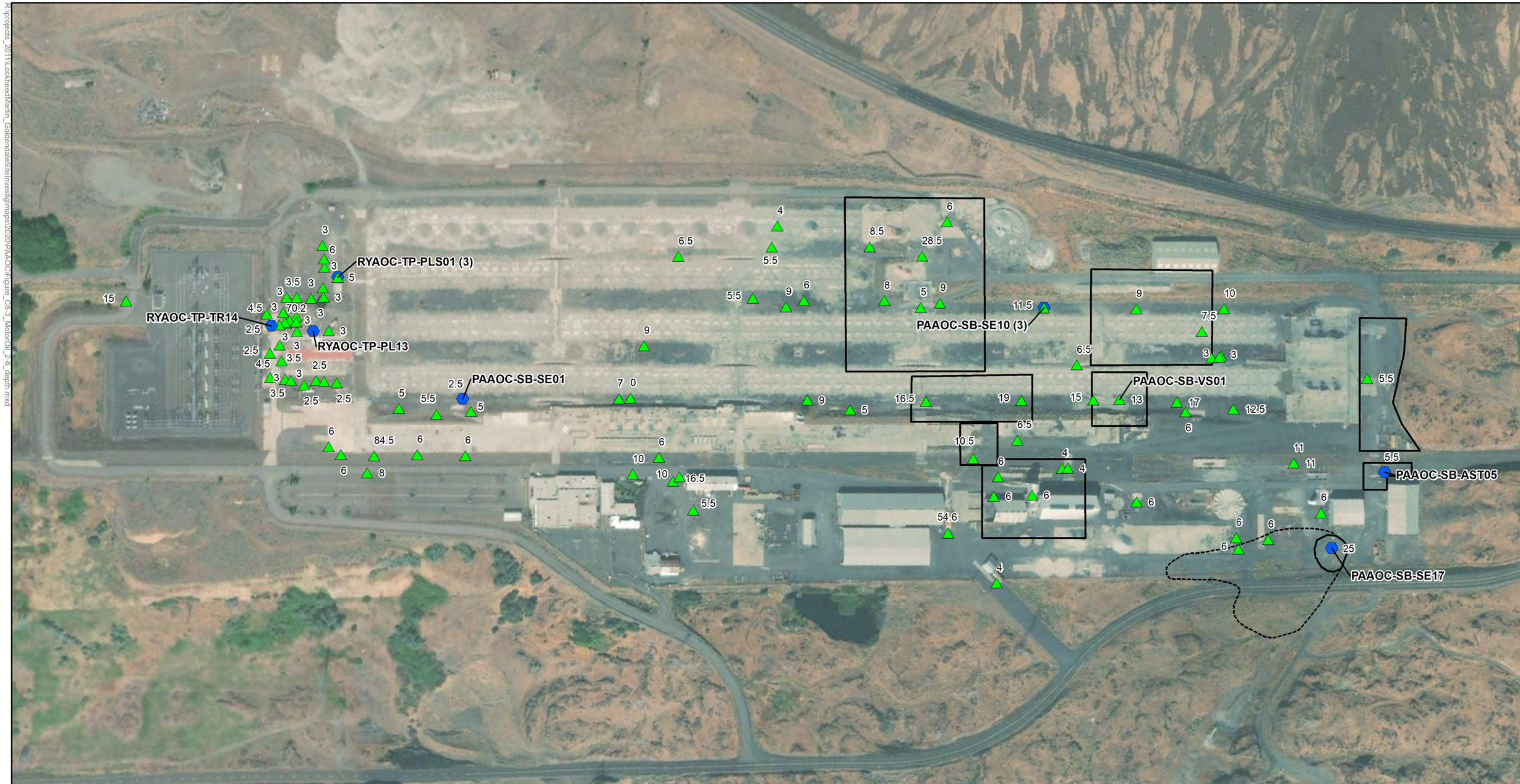
- ▲ Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg that is based on prevention of accumulation of free product on the water table (groundwater protection)
- ⬢ Concentration exceeds the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg
- 15 — Total Boring/Test Pit Depth; Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples); SWMU08-SB01
- ● Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

0 250 500
Feet

Figure C6-2
Motor Oil Concentrations
at 1-2 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\2020\PAAOC\Figure_C6-2_MotorOil_1-2_depth.mxd




Soil Screening Level

- ▲ Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg that is based on prevention of accumulation of free product on the water table (groundwater protection)
- ⬢ Concentration exceeds the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg
- 15 —— Total Boring/Test Pit Depth; Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples); SWMU08-SB01
- ● Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

0 250 500
Feet

Figure C6-3
Motor Oil Concentrations
at 2-6 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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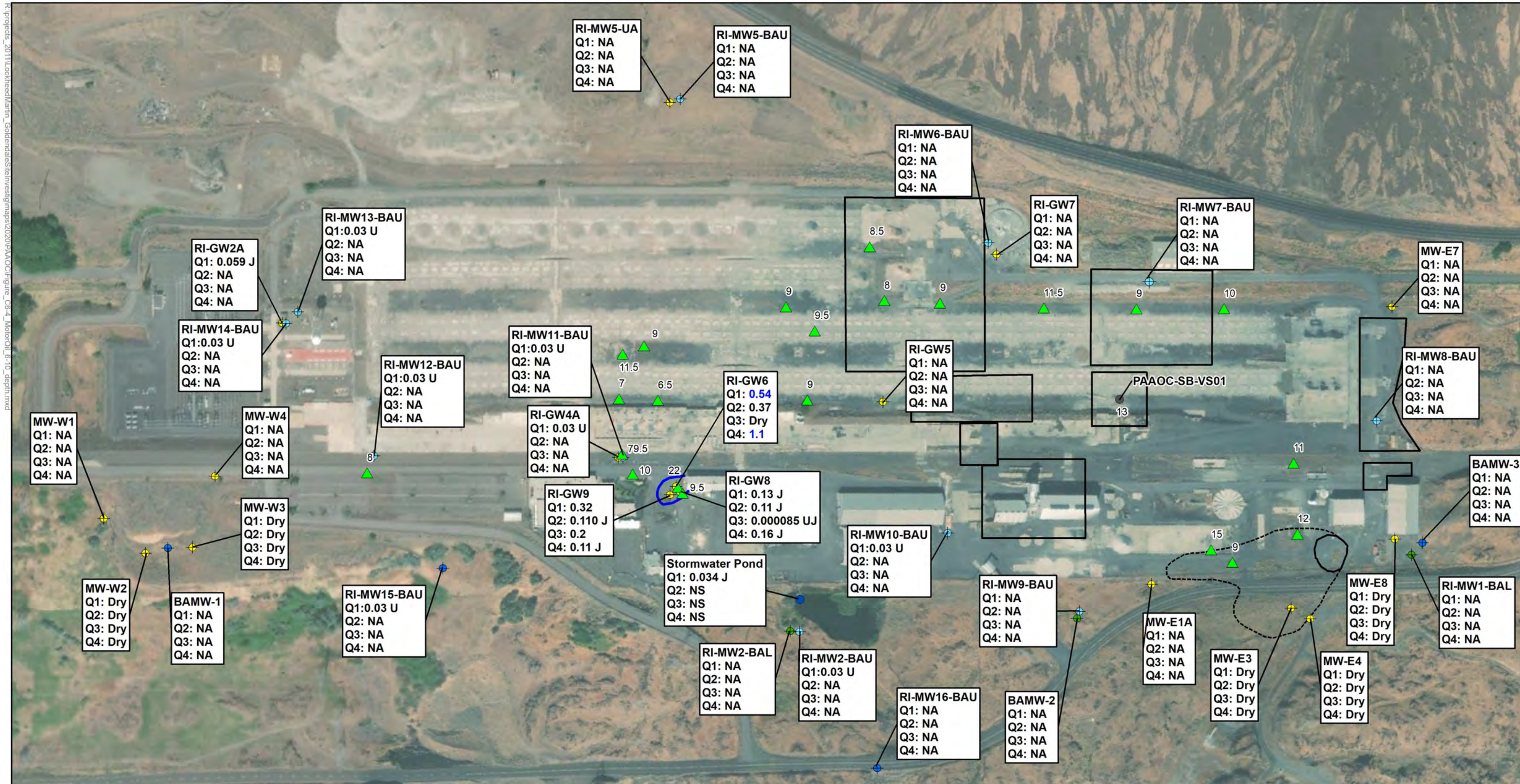



Soil Screening Level

Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg that is based on prevention of accumulation of free product on the water table (groundwater protection)

Concentration exceeds the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg

15 Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

- $BAU_1$ - Shallower Water-bearing Zone
- $BAU_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

- $BAL_1$ - Shallower Water-bearing Zone

Screening Level Concentration Contours

0.5 mg/L MTCA Method A Groundwater Cleanup Level UA Aquifer Zone

East End Landfill

Investigation Area

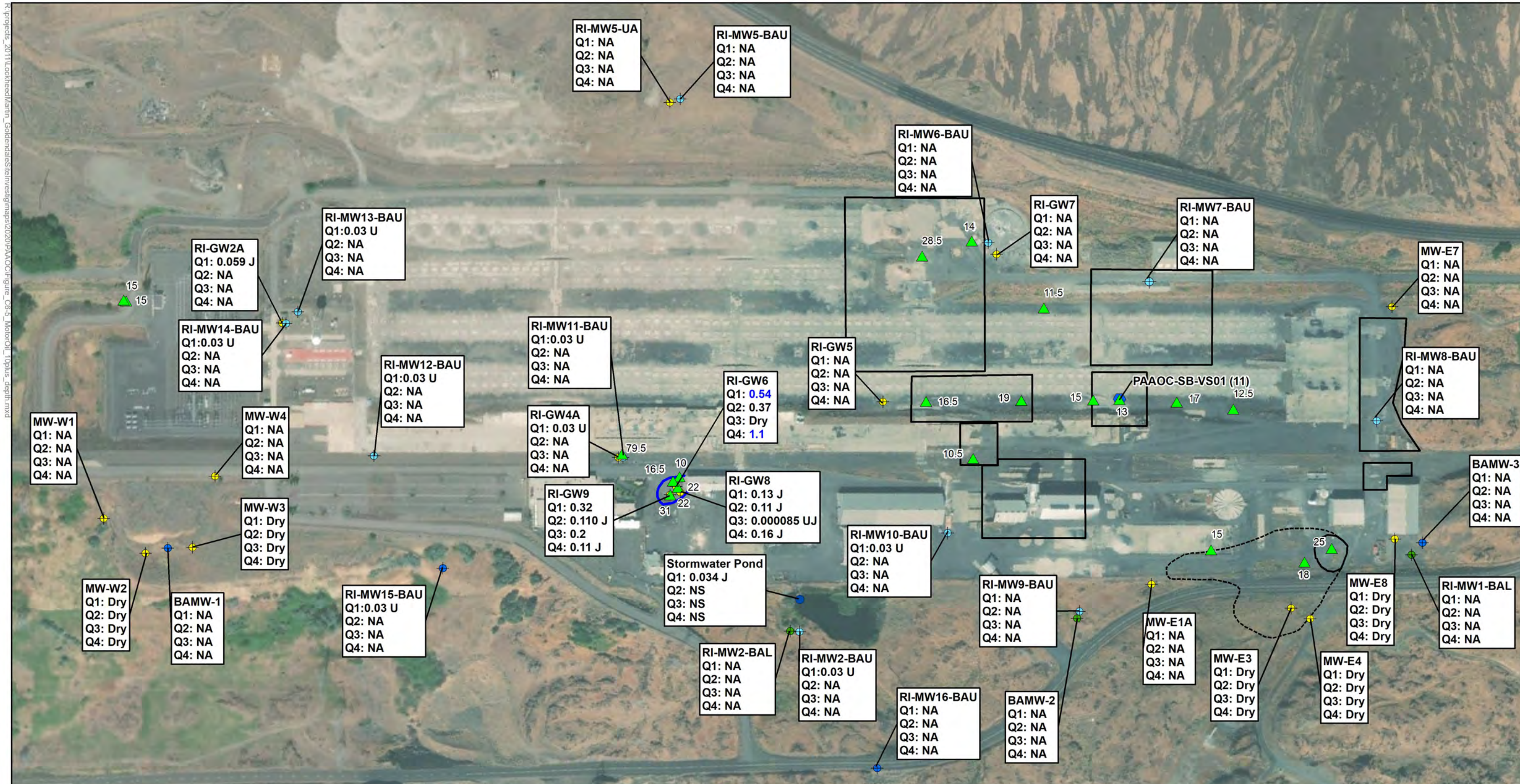
B: Chemical was found in blank and sample
J: Estimated Concentration
MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NA: Not Analyzed
NS: Not Sampled
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

W N S E

0 250 500
Feet

Figure C6-4
Motor Oil Concentrations at 6-10 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

Concentration is below the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg that is based on prevention of accumulation of free product on the water table (groundwater protection)

Concentration exceeds the MTCA Method A Soil Cleanup Level for Unrestricted Land Use of 2,000 mg/kg

15 Total Boring/Test Pit Depth

Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)

SWMU08-SB01

Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

$BAU_1$ - Shallower Water-bearing Zone

$BAU_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

$BAL_1$ - Shallower Water-bearing Zone

Screening Level Concentration Contours

0.5 mg/L MTCA Method A Groundwater Cleanup Level UA Aquifer Zone

East End Landfill

Investigation Area

B: Chemical was found in blank and sample
J: Estimated Concentration
MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act
NA: Not Analyzed
NS: Not Sampled
U: Chemical was not detected. The associated value represents the method detection limit.
UJ: Chemical was not detected. Associated limit is estimated.
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

0 250 500
Feet

Figure C6-5
Motor Oil Concentrations at Depth > 10 Feet
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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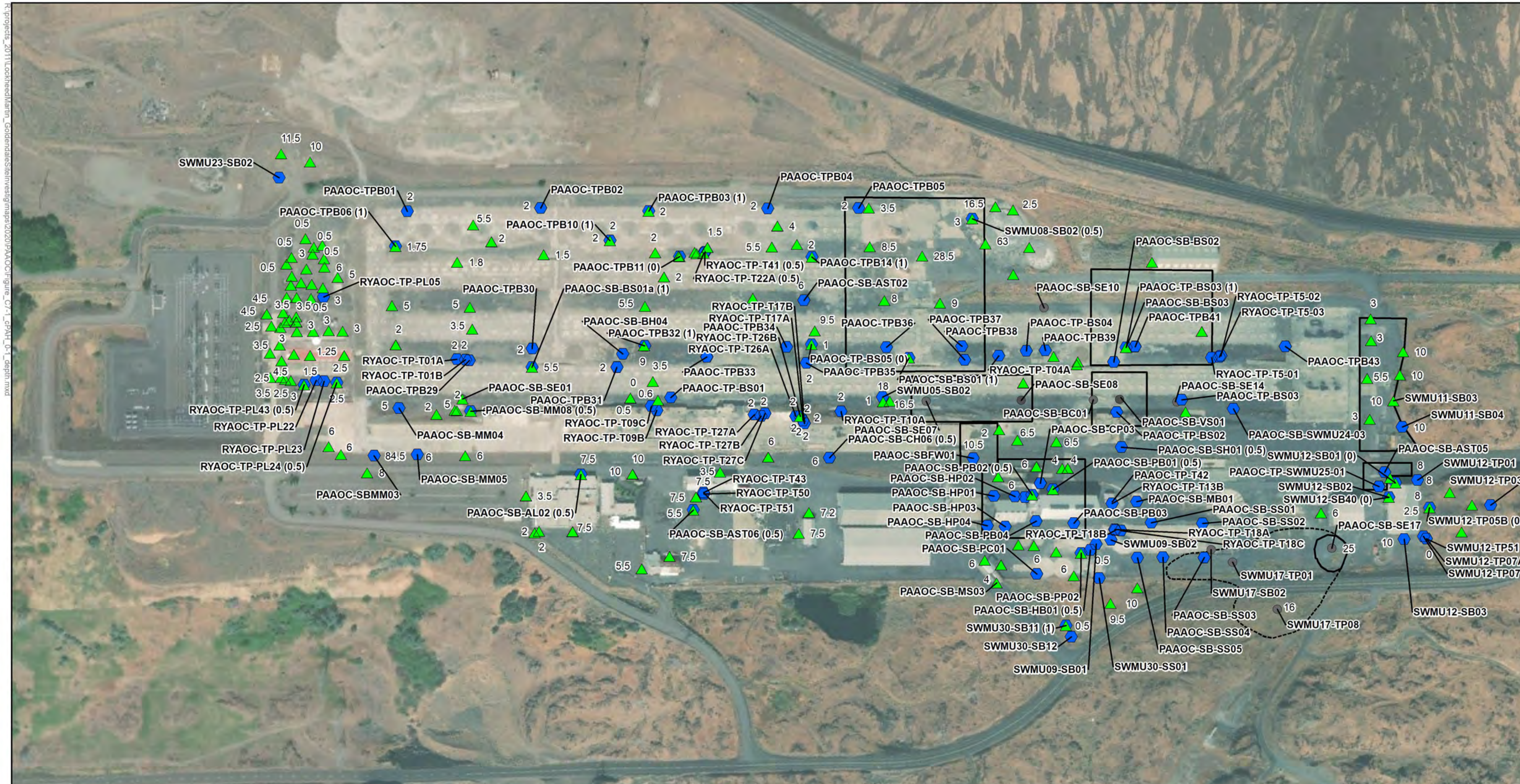



Soil Screening Level

- Concentration is below MTCA Soil Screening Level for Groundwater Protection of 3.9 mg/kg.
- Concentration exceeds MTCA Soil Screening Level for Groundwater Protection of 3.9 mg/kg.

15 — Total Boring/Test Pit Depth

Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)

SWMU08-SB01

- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

East End Landfill

Investigation Area

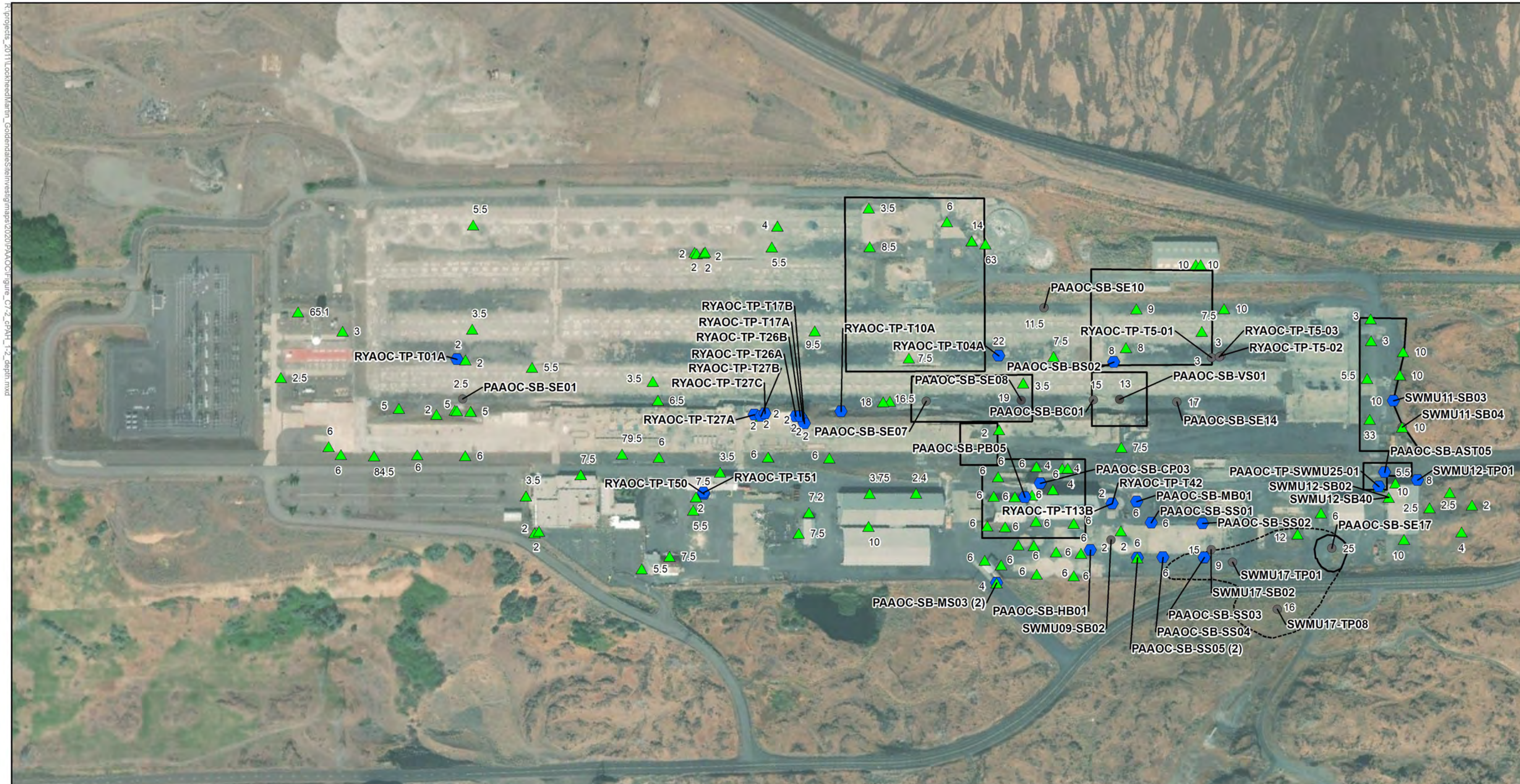
W N E S

0 250 500

Feet

Figure C7-1
cPAH Concentrations
at 0-1 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



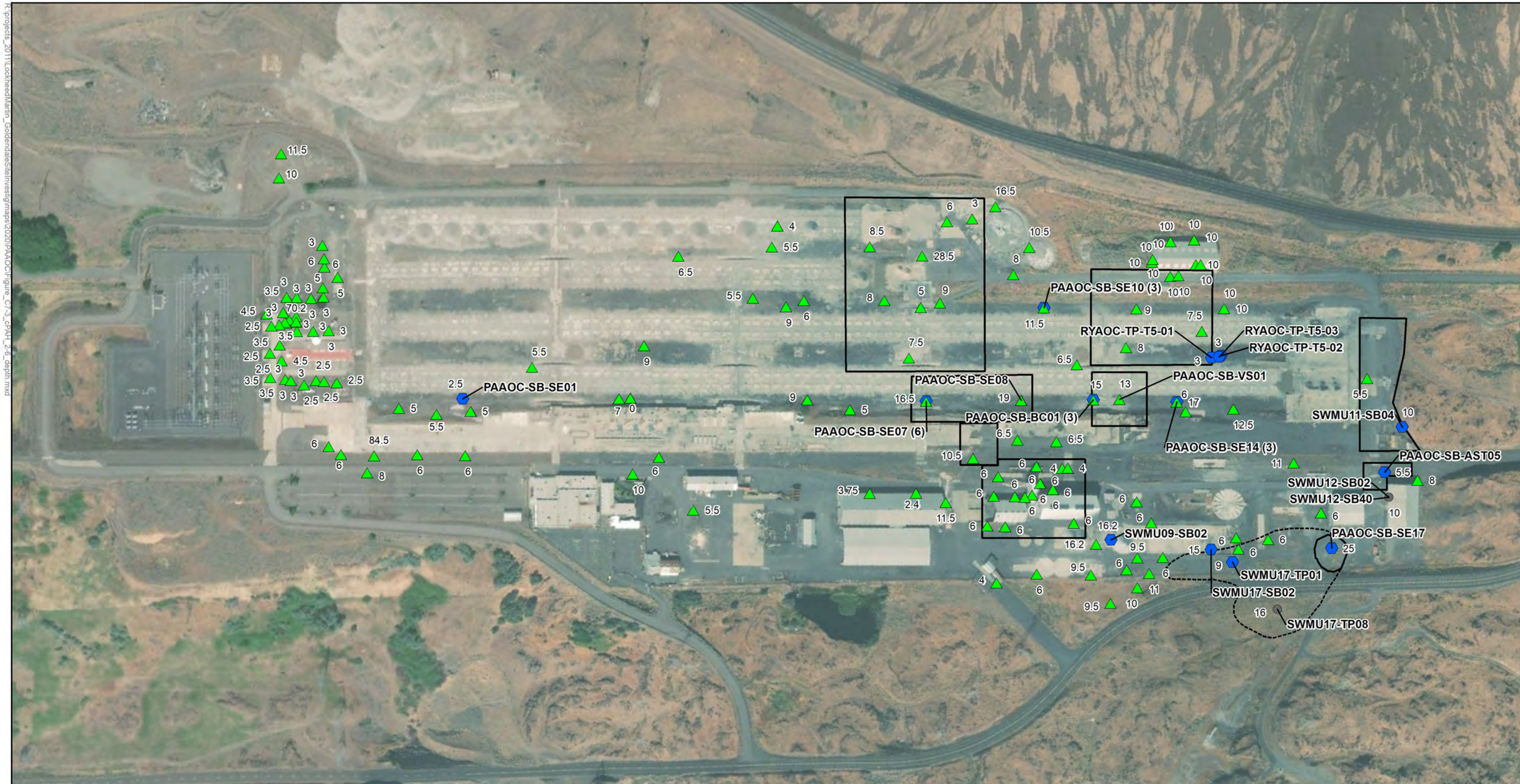

Soil Screening Level

- ▲ Concentration is below MTCA Soil Screening Level for Groundwater Protection of 3.9 mg/kg.
- ⬢ Concentration exceeds MTCA Soil Screening Level for Groundwater Protection of 3.9 mg/kg.
- 15 — Total Boring/Test Pit Depth
- SWMU08-SB01 — Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
- ● Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.
- East End Landfill
- Investigation Area

0 250 500
Feet

Figure C7-2
cPAH Concentrations
at 1-2 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

- Concentration is below MTCA Soil Screening Level for Groundwater Protection of 3.9 mg/kg.
- Concentration exceeds MTCA Soil Screening Level for Groundwater Protection of 3.9 mg/kg.

15 — Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

- Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

East End Landfill

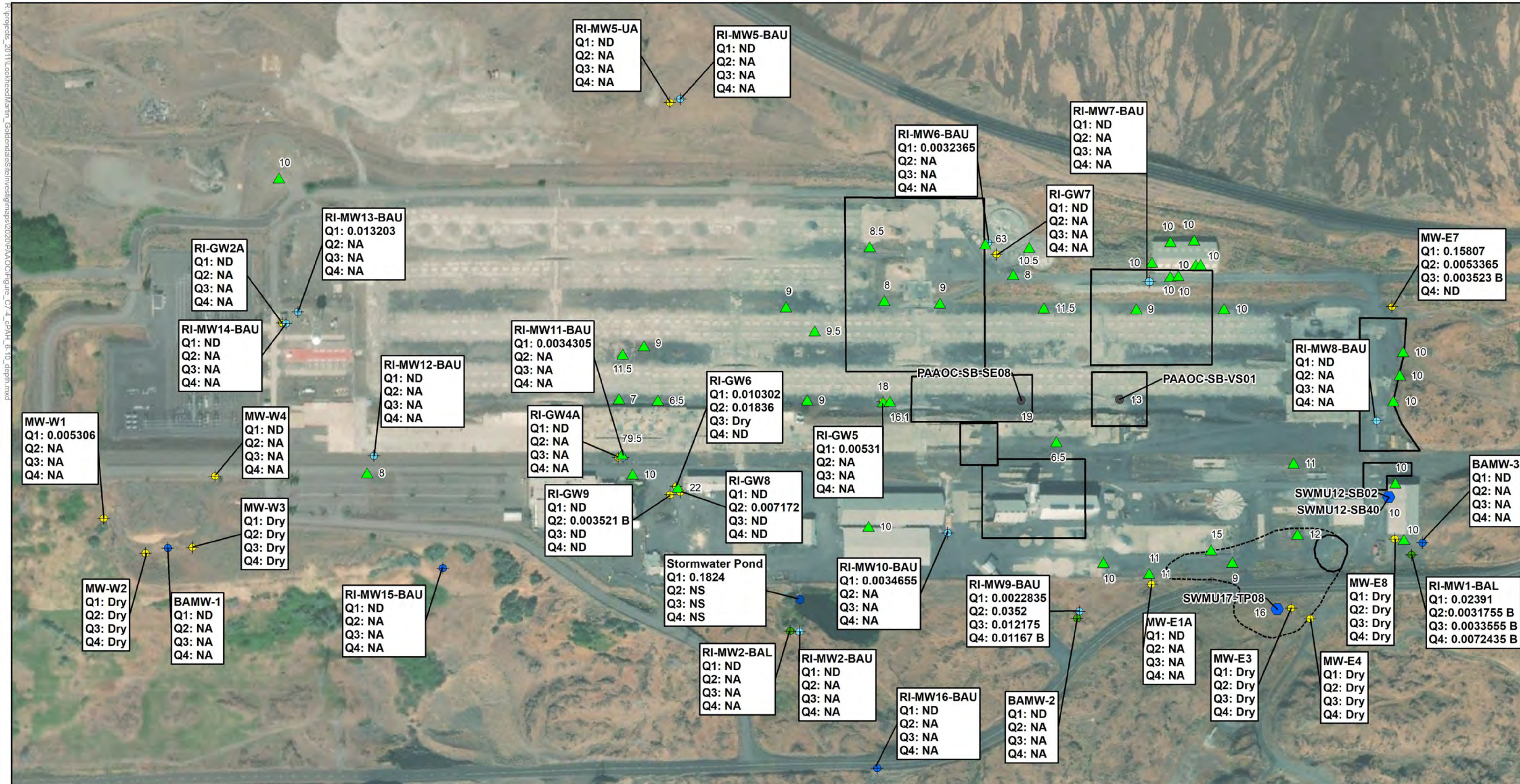
Investigation Area

W N S E

0 250 500
Feet

# Figure C7-3
## cPAH Concentrations at 2-6 Foot Depth Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington




Soil Screening Level

Concentration is below MTCA Soil Screening Level for Groundwater Protection of 3.9 mg/kg.

Concentration exceeds MTCA Soil Screening Level for Groundwater Protection of 3.9 mg/kg.

15 — Total Boring/Test Pit Depth
Location Exceeds Screening Level (Depth that was Exceeded if Multiple Samples)
SWMU08-SB01

Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

BAU$_1$ - Shallower Water-bearing Zone

BAU$_2$ - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

BAL$_1$ - Shallower Water-bearing Zone

Groundwater Screening Level

**0.3** Exceeds 0.2 ug/L MTCA Method B Groundwater Cleanup Level and MCL

**0.1** Below 0.2 ug/L MTCA Method B Groundwater Cleanup Level and MCL

East End Landfill

Investigation Area

B: Chemical was found in blank and sample
MTCA: Model Toxics Control Act
NA: Not Analyzed
ND: Not Detected
NS: Not Sampled
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

W N E S

0 250 500
Feet

Figure C7-4
cPAH Concentrations
at 6-10 Foot Depth
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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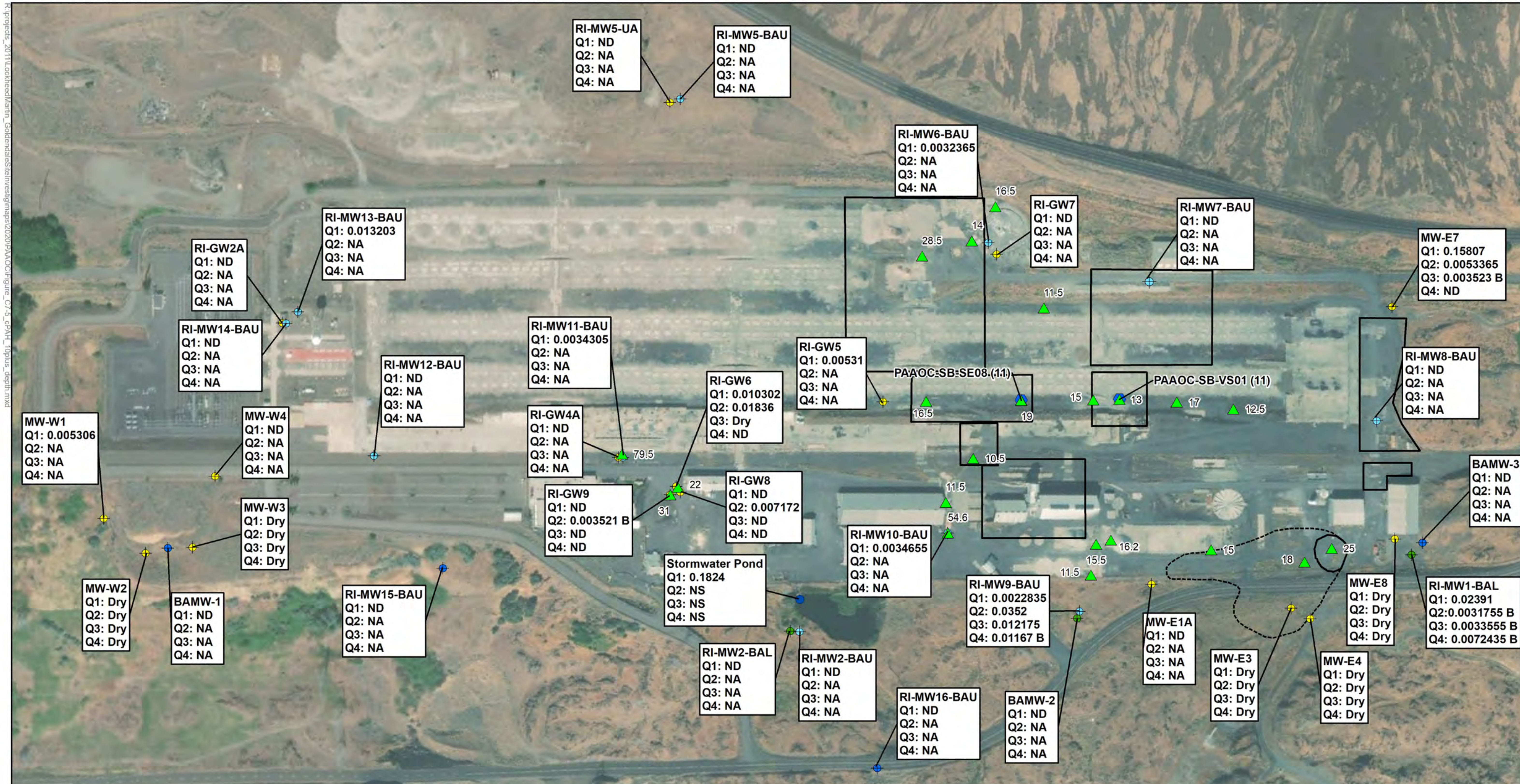


Soil Screening Level

Concentration is below MTCA Soil Screening Level for Groundwater Protection of 3.9 mg/kg.

Concentration exceeds MTCA Soil Screening Level for Groundwater Protection of 3.9 mg/kg.

15 Total Boring/Test Pit Depth
Location Exceeds Screening Level
SWMU08-SB01 (Depth that was Exceeded if Multiple Samples)

Boring present in depth interval, but a sample was not collected/analyzed for the selected chemical.

Unconsolidated Aquifer Well (UA)

Uppermost Basalt Aquifer Well (BAU)

BAU1 - Shallower Water-bearing Zone

BAU2 - Deeper Water-bearing Zone

Lower Basalt Aquifer Well (BAL)

BAL1 - Shallower Water-bearing Zone

Groundwater Screening Level

0.3 Exceeds 0.2 ug/L MTCA Method B Groundwater Cleanup Level and MCL

0.1 Below 0.2 ug/L MTCA Method B Groundwater Cleanup Level and MCL

East End Landfill

Investigation Area

B: Chemical was found in blank and sample
MTCA: Model Toxics Control Act
NA: Not Analyzed
ND: Not Detected
NS: Not Sampled
Q1: Quarter 1 (Winter 2017)
Q2: Quarter 2 (Spring 2017)
Q3: Quarter 3 (Summer 2017)
Q4: Quarter 4 (Fall 2017)

W N S E

0 250 500
Feet

Figure C7-5
cPAH Concentrations
at Depth > 10 Feet
Plant Area AOC Sample Stations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

# Appendix D

# SPL Recognition Memo

# DEFINITION AND RECOGNITION OF SPENT POTLINER
## LMC - Goldendale, WA Site

Molten aluminum is produced in electrolytic reduction cells or "pots" which contain an anode and cathode (**Figure 1**). Although pot configuration varies among smelters, the illustration in **Figure 1** for Northwest Aluminum (The Dalles, OR) is consistent with what was used at Columbia Aluminum (Goldendale, WA). At full capacity, up to 500 pots, approximately 15′ x 30′ each, could have been in service at the Goldendale operation. At full operating capacity the Goldendale plant produced 185,000 short tons primary aluminum metal annually and generated between 4,000 and 10,000 tons per year of "spent potliner".[1]

Excerpt from 1992 RCRA Part B Permit Application[2]:

> "Spent Potliner (SPL) is produced during the demolition of the cathode portion of the cell. The cathode forms the bottom of the cell and consists of a steel outer shell lined with a layer of refractory brick insulation followed by a layer of carbon block. The cathode is formed in a bowl shape to contain molten bath and metal while acting as the cathode in the reduction cell. During the life of a reduction cell, typically 6.5 years, the lining is slowly eroded by the physical and chemical action of the molten metal and bath. Eventually, the lining becomes too thin to perform satisfactorily and the cathode must be removed and rebuilt. When a cathode is removed from a cell, it is cooled, the carbon and refractory liner is broken with jackhammers and removed from the steel shell with a backhoe. The broken carbon block is termed SPL and is a listed hazardous waste (K088). Although the refractory is technically not a listed hazardous waste, it is difficult to completely separate the carbon from the refractory brick, so Columbia Aluminum manages both materials as hazardous waste."

SPL can be visually recognized in the field by experienced personnel with "generator knowledge" of the specific operations. The materials shown in **Figure 2** were tentatively identified as SPL by Wayne Wooster, a former environmental staff person at Goldendale from 1993 to 2005, and a former Washington state regulator for other

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[1] Correspondence and meetings with Wayne Wooster, July-October 2010.

[2] Columbia Aluminum Corporation RCRA Part B Permit Application, prepared by ENSR and submitted to Washington Department of Ecology, April 19, 1992

aluminum sites. Additional identification of SPL was done in conjunction with Galen May, also a long term employee at the aluminum plant. After years of use at high temperature within the aluminum pot, the spent carbon is a dull black, massive material. It may or may not have small voids and/or salt deposits on exterior surfaces. SPL can be distinguished from the basalt rocks at the Goldendale site by use of a pick-hammer (**Figure 3**). When stuck with a hammer, basalt has a sharp, ringing tone, whereas carbon from SPL has a dull thud. In addition, carbon from SPL more readily breaks when struck with a hammer than basalt. SPL that is fused with refractory brick material (e.g., **Figure 4**) is relatively easy to recognize in the field. Carbon from SPL that is not fused with refractory material is more difficult to recognize in the field, and should not be confused with other carbon wastes generated by the aluminum process[3]. SPL superficially resembles basalt, a locally abundant natural material. Figures 4 through 10 show examples of SPL identified in the field.

Characteristics of SPL that are not typically found in the non-hazardous carbon wastes, that area occasionally to commonly observed in SPL include:

- Carbon material in contact with red fire brick (**Figures 3 and 5**)
- Carbon material with crystalline structures visible (**Figures 6, 8a/b, and 9**)
- Color in the blue – gray tonal range (**Figures 6 and 10**)
- Moderate to extensive white to gray-white salt efflorescence on surface, in contrast to the anode wastes, which have limited to no salts visible (**Figures 4,5,6,7 and 10**)

If visual indicators are not clear, it may be possible to distinguish SPL from other forms of carbon waste generated at Goldendale based on chemical composition. **Table 1** illustrates the reported composition of SPL at Goldendale in contrast to industry ranges. These composition ranges may also be helpful in assessing SPL residuals remaining in soil after cleanup. The most diagnostic characteristic of SPL, as opposed to other carbon containing materials is the presence of high sodium content. According to Galen May,

[3] Carbon waste from anode production, possibly in an irregular "briquette" form, can also be observed at the site, in addition to coal tar pitch and miscellaneous carbon powders and granules. The pitch and briquette materials generally have a glossy appearance distinctly different than SPL. The anode materials are very similar to SPL carbon, but have either little or no salt deposits and do not exhibit recrystalizaiton or blue-gray colors. Carbon rod remnants, occasionally present in anote waste, is never found in SPL carbon.

the diffusion of sodium into the pot liner was one of the principal reasons for pot failure.

It is worthy to note that cyanide composition in Goldendale SPL is reportedly much lower than the industry norm. EPA's basis for hazardous waste listing of SPL is cyanide, and the risk of cyanide mobilization to groundwater. The relatively low (reported) cyanide content of SPL at Goldendale, and the relatively dry conditions (10 inches annual average rainfall[4]) may factor into the remaining remediation strategy.

[4] Long-term precipitation records at the John Day Dam on Columbia River; http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?wajohn

**Table 1**
**Spent Potliner Composition**
***(Compilation of Tables 3-1 and 3-2 from 1992 RCRA Permit Application)***

| *Parameters* | *Industry Reported Ranges (%)* [1] | *Columbia Aluminum* [2] *@ Goldendale* |
|---|---|---|
| Fluoride | 7.5 - 22 | 24 |
| Aluminum – Total | 7- 22.2 | 16 |
| Sodium | 8.6 – 22 | 15 |
| Carbon – Total | 13 – 69 | 13 |
| Alumina | 9.2 – 26 | NR |
| CN | 0.04 – 0.6 | 0.009 |
| $SiO_2$ (as Si) | 0.7 – 10.9 | 20 |
| $Fe_2O_3$ (as Fe) | 0.3 – 2.8 | 1 |
| Ca | 0.5 – 6.4 | 4.5 |
| $SO_4$ | 0.1 – 0.6 | NR |
| S | 0.1 – 0.18 | NR |
| Mg | 0.01 – 0.17 | NR |
| Li | 0.46 – 0.57 | NR |
| P | 0.005 – 0.03 | NR |
| Mn | 0.02 | NR |

*1 - Source: Spent Potlining Workshop, the Aluminum Association, Inc., December 3 and 4, 1981; Table 3-1 in 1992 RCRA Permit Application.*

*2 - Source: Martin Marietta Laboratories, October 20, 1978. Table 3-2 in 1992 RCRA Permit Application*

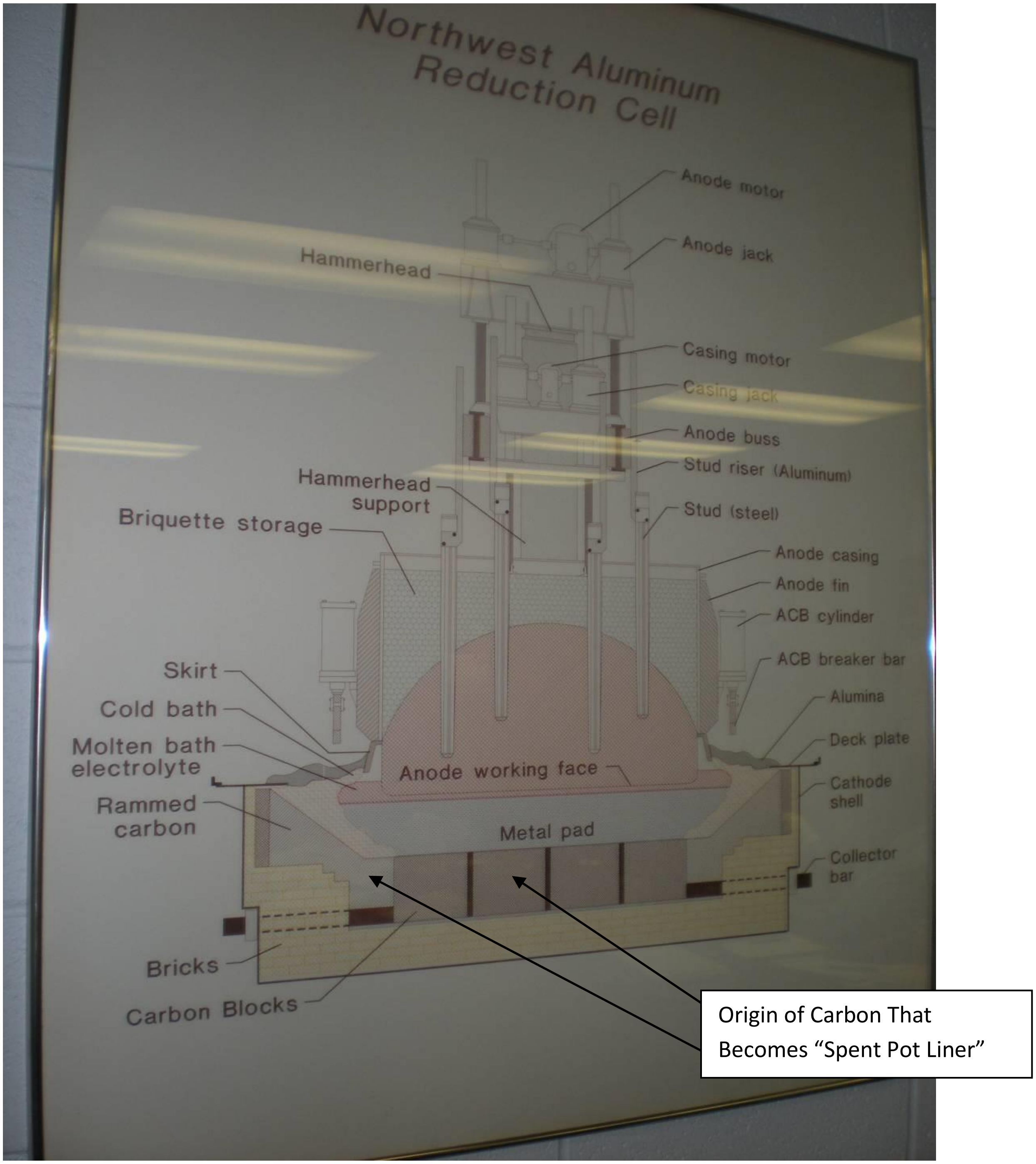


Figure 1 – Diagram of Reduction Cell Used at Northwest Aluminum (The Dalles, OR) and Columbia Aluminum (Goldendale, WA)

Figure 2 – Tentatively Identified Spent Potliner Examples Discovered at “Smelter Sign Area” – July 2010.

[material Identification confirmed by Wayne Wooster, former EHS staff at Goldendale]

Figure 3 – Bill Bath Using Hammer Test on Tentatively Identified Spent Potliner at Goldendale – July 2010.

(Note: salts impregnated into carbon potliner material; aluminum sheet to left;

Figure 4 – SPL in interstices of fire brick, shows white salt deposits

Figure 5 – SPL showing characteristic extensive white salt deposits

Figure 6 – SPL showing white salt deposits, gray-blue cast and recrystalization

Figure 7 – Large intact piece of SPL showing characteristic white salt deposits

Figure 8 a and b – Characteristic recrystalization in SPL

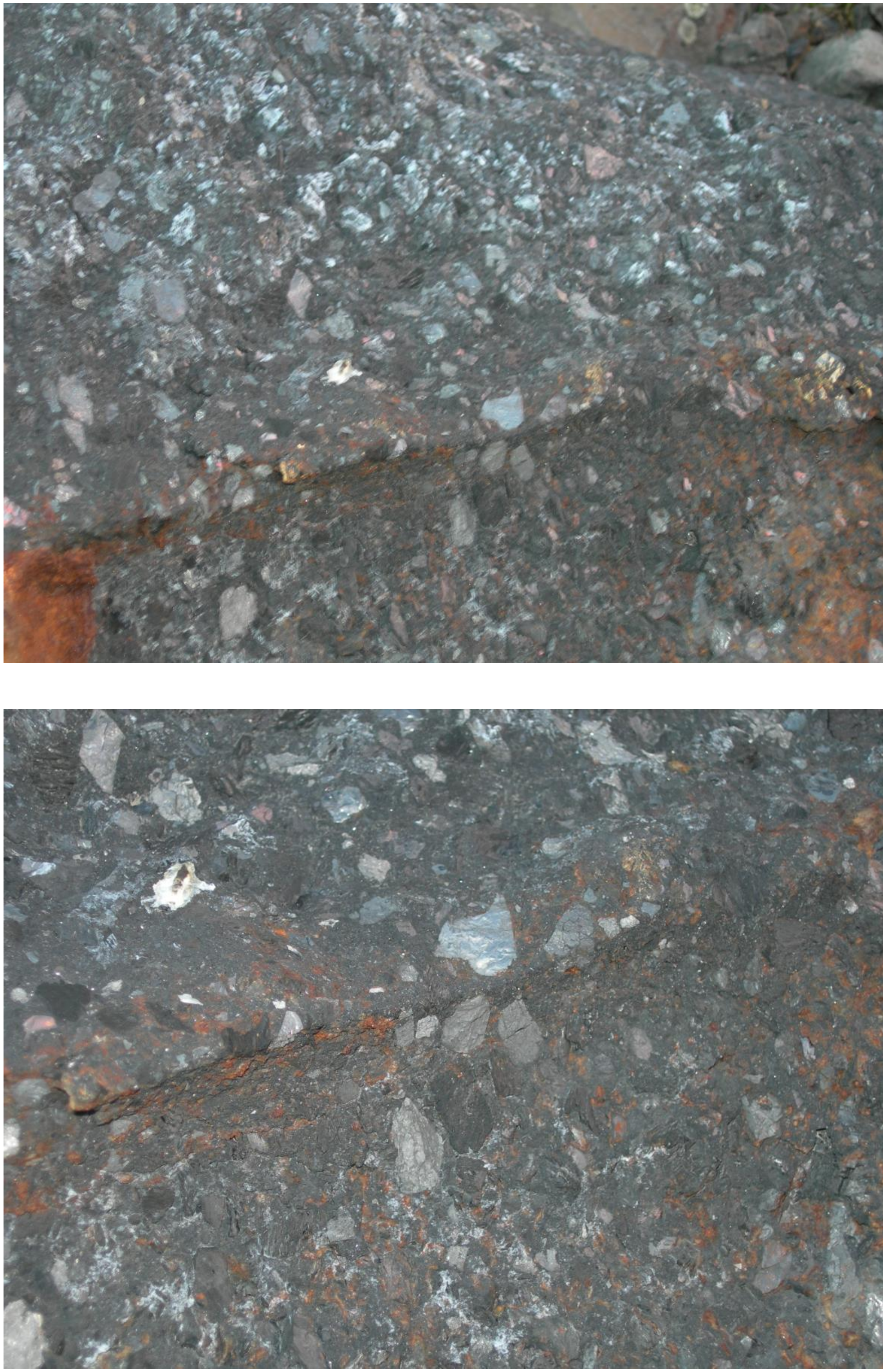

Figure 9 – SPL with recrystalization and vugs

Figure 10 – SPL showing blue gray color and salt deposits